Developing Scientific Literacy

Using News Media in the Classroom

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Open University Press

Open University Press
McGraw-Hill Education
McGraw-Hill House
Shoppenhangers Road
Maidenhead, Berkshire
England SL6 2QL

email: enquiries@openup.co.uk
world wide web: www.openup.co.uk

and Two Penn Plaza, New York, NY 1012–2289
USA

First published 2007

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A catalogue record of this book is available from the British Library

ISBN 13: 978 0 335 21795 3 (pb) 978 0 335 21796 0 (hb)
ISBN 10: 0 335 21795 8 (pb) 0 335 21796 6 (hb)

Library of Congress Cataloging-in-Publication Data
CIP data has been applied for

Typeset by BookEns Ltd, Royston, Herts.
Printed and bound in Poland by OZGraf S.A.
www.polskabook.pl

The McGraw-Hill Companies

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Acknowledgements

This book is based predominantly on work carried out within the Newsroom Project, a major research and development initiative generously funded by the Wellcome Trust. We wish to record our gratitude to the Trust for granting us the opportunity to pursue what has proved to be a very timely study.

During the project, we interviewed or corresponded with over 40 experts on 'science in the media' and we wish to express our sincere thanks to them for their diligent attention to our questions and for the detail, depth and thoughtfulness of their responses. We owe much, too, to the teachers of science and of English who participated in the project. Not only did they take time out of school to attend a series of workshops but they also accepted the challenge of working together to develop approaches and activities supporting the use of science-related news items to promote scientific literacy in their own classrooms. On occasion they even allowed us in to observe these in action!

This book highlights the contribution that newspapers and the reporting of science-based news can make to the development of scientific literacy. We recognise the contribution that science-based news reports have made to our thinking and understanding over the years. In particular we would acknowledge the writers, journalists and news organisations whose work has been included, by way of example, in this publication: Lyndsay Moss and other contributors to the *Belfast Telegraph*, Nigel Blundel and Emma Bamford/*Daily Express*, Tim Utton/*Daily Mail*, Lorna Duckworth /*Independent*, Paul Sutherland/News International syndication, and Matt/*Telegraph*.

Permission to copy a number of graphics and cartoons has also been granted. Parliamentary material is reproduced with the permission of the Controller of HMSO on behalf of Parliament. The 'Frankenstein Foods' graphic and the GM food cartoon are reproduced with permission of the Daily Mail. Guardian Unlimited Newstalk, illustrating web-based talk boards, is reproduced with permission of Guardian Newspapers. Excerpts from 'Corrections and Clarifications' and 'More Corrections and

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We are also very grateful to Frank Burnet, Ben Johnson, Mary Kelly and Darla Shaw for permission to use ideas and material they devised.

1 Scientific literacy and science in the news

Introduction

The school's youth wing had been transformed for the event. The arrangement of seats around tables suggested that group work was on the agenda. Posters and press cuttings adorned the walls. Most intriguing, though, was the roped-off region at the front of the hall. The sign said 'Newsroom'. There were a number of desks, each with a computer, a telephone and a pile of paper. A large clock dominated the corner. A science teacher was bounding in and out of the makeshift office, practising his lines. Not that they were hard to remember. 'Hold the front page,' he was shouting, 'Hold the front page.'

The young people entered the room. There were about 60 in all, comprising two classes of 14-year-olds. They looked about quizzically. The venue was novel; its layout captivating. More striking, however, was the evidence that their science teachers and English teachers were working together here. Clearly, today was going to be different. Everyone was set to explore 'science in the news'.

'Scientific literacy'

The literature on 'scientific literacy' is vast. Indeed Laugksch's (2000: 73) description of it as 'substantial and diverse' seems an understatement and 'voluminous and expanding' (Layton et al. 1994: ii) appears better to fit the bill. In an effort to impose some order on this scholarship, a number of reviewers have attempted to identify common themes in the writing. This has thrown up some interesting issues, not least Paisley's (1998: 71) rather roguish observation, 'the words "scientific literacy" in an article title almost always means a scolding for one or more of the principal (players)'.

We are not, however, about to lecture anyone. Neither is it our aim to provide a synopsis of the literature on scientific literacy. Others have done

so and comprehensively (see Bybee 1997; DeBoer 2000; Jenkins 1994a; Laugksch 2000). Instead, we intend to distinguish those issues that command a degree of consensus and that relate most closely to the theme of this book – developing scientific literacy using the news.

The traditional role of school science has been primarily prevocational or pre-professional, that is, the identification and preparation of those with special aptitude and ability in the subject for future science-related courses and careers. In many countries, however, there is an increasing emphasis, at least at the level of proposal or policy (Fensham 1997), on the need to advance the scientific literacy of all students. In the United Kingdom, this is the first recommendation of the influential publication *Beyond 2000: Science Education for the Future* (Millar and Osborne 1998: 4):

> The science curriculum from 5 to 16 should be seen primarily as a course to enhance general 'scientific literacy'.

It is reiterated in a report of the House of Lords, Select Committee on Science and Technology (2000: 9):

> Science in schools must … equip *all* students for what has been called 'scientific literacy' or 'science for citizenship'.

And it informs the changes, introduced in 2006, in the English National Curriculum and its associated assessment arrangements for 14–16-year-olds (Burden 2005a).

The argument proceeds, persuasively, as follows. We live in a world increasingly influenced (for better and for worse) by science and technology. For the individual, decisions have to be made in relation to a range of issues that have a heightening scientific dimension, for example, healthcare, personal safety, lifestyle, consumer choice etc. All are better placed to address these concerns, it is contended, if they have some, strategic, understanding of the science pertaining to them. Furthermore if, in a democracy, the individual as citizen is to influence decision making in respect of science-related matters in the public sphere such as energy production, waste disposal, the genetic modification of food, the use of early embryos in medical research and so on, then, again, some awareness of the science involved seems indicated.

This line of reasoning is reflected in the definitions of scientific literacy offered in key curricular documents such as the US National Science Education Standards (NRC 1996: 24):

> Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

The mention of the role of science in cultural affairs is significant. It resonates with, for example, Shen's (1975: 49) suggested three categories of scientific literacy, 'practical', 'civic' and 'cultural', the last being 'motivated by a desire to know something about science as a major human achievement'. Although Shen conceived this in rather elitist terms, the theme does recur in a more populist form in some later discussions of scientific literacy. Rennie and Stocklmayer (2003: 766), in the context of community learning, are happy to refer to the 'uncomplicated enjoyment of scientific knowledge for its own sake'. We believe such perspectives, quite properly, serve to broaden otherwise narrowly instrumental views of scientific literacy.

Whether presented as dimensions, domains, elements or components, there is a broad consensus in the literature that scientific literacy comprises or calls for some understanding of:

- scientific terminology and concepts
- scientific enquiry and practice
- the interactions of science, technology and society.

It is acknowledged, too, that these are not distinct domains but interrelated and interdependent. Thereafter views diverge as writers wrestle with the task of specifying more precisely what 'understandings', in the context of formal education, would serve well in the uncertain circumstances of the future.

In respect of '*terminology and concepts*', some suggest long lists of 'essential items' (Hurd 1998), others a limited number of 'core ideas' (see, for example, Millar 1997). Some stress, as grounds for content choice, the significance of the subject matter in terms of disciplinary science; some, its significance in terms of personal and social meaning for the majority of learners. Just how wide ranging and robust the debate can be is well illustrated in publications such as *Science and the Citizen* (Cross and Fensham 2000). It needs to be said, however, that the importance of science content knowledge for decision making on socio-scientific issues is itself disputed (see Kolstø 2001). What we do know, drawn principally from the rich seam of research and scholarship developing around the distinguished work of Layton and his colleagues (1993), is that individuals do not, in any straightforward sense, simply appropriate scientific knowledge and apply it in the solution of their science-related problems. Typically, for science to become instrumental in respect of practical action it must be 'restructur(ed), rework(ed) and transform(ed) … into forms which serve the purpose in hand'. Furthermore, far from occupying a central position in decision making, 'the processes of integrating it with personal judgements and values and with situation-specific knowledge frequently relocates science as a peripheral player' (Jenkins 1997: 147). We need to be just a little cautious,

then, when we talk of citizens as 'consumers of science' lest our metaphor leads us to overlook the complexities of the issues involved.

In respect of '*inquiry and practice*' and '*the interactions of science, technology and society*', a degree of overlap is evident in the literature with reference to these domains and we will consider them together.

In the context of formal education, there is a broad consensus that some understanding of the epistemology and the sociology (both internal and external) of science is beneficial in preparing young people to address the socio-scientific issues they encounter outside of and beyond schooling (Ryder 2001a). More specifically, it is suggested that students should be introduced to, for example, the nature and status of science knowledge, how these knowledge claims are developed and validated, the features of 'science-in-the-making', how communities of scientists function and the contexts in which they practise, the power and limitations of science, its commercialisation and industrialisation, the impact of science on society, judging evidence and judging experts and so on (see Fensham 2000; Jenkins 1999; Kolstø 2001; Millar 1997; Norris et al. 2003; Ryder 2001a; Shapin 1992). It is stressed that students should be aware that 'science is a very human activity' (Lemke 1990: 134) with all that this implies and that 'science as an enterprise has individual, social and institutional dimensions' (AAAS 1990: 8) with all that that implies. Crucially, and contrary to the impressions imparted by conventional science courses, as Millar (1997: 100) indicates:

> It is first essential that students come to appreciate the sheer difficulty of obtaining valid and reliable data about the natural world.

A developing strand in the science education literature is that which explores the link between literacy in its fundamental sense and current conceptualisations of scientific literacy (Norris and Phillips 2003; Osborne 2002; Yore et al. 2004). In fact, there are surprisingly few references to the former in writings on the latter. Yet, as Norris and Phillips (2003: 226) contend so compellingly, reading and writing (and indeed oral disputation) do not stand solely in a functional relationship with science, acting simply as tools for its transmission and storage. 'Rather,' they argue 'the relationship is a constitutive one … Remove a constituent, and the whole goes with it'. The case is well made by these writers for raising the profile of 'literacy' in discussions of 'scientific literacy'.

Not least because each new socio-scientific concern we encounter will have its unique scientific determinants, the development of scientific literacy cannot end with the end of formal education. Scientific literacy is a lifelong pursuit. Consequently, a number of writers emphasise the need for sharpening, during schooling, those skills associated with independent information seeking, synthesis and evaluation (Zimmerman et al. 2001).

It is important to note, not least because it is pertinent to the theme of this book, that there are those who hold a more radical view of 'scientific literacy' than the discussion thus far appears to imply. Cross and Price (1992: 135), for example, advocate 'orienting science teaching toward an emphasis on social responsibility' and 'conceptualising scientific literacy in a way which would emphasise active participation in preventing and solving … problems' (Cross et al. 1996: 137). Hodson (1999: 789) contends that the aim of education for scientific literacy is 'to produce activists', that is 'people who will fight for what is right, good, and just; people who will work to refashion society along more socially-just lines; people who will work vigorously in the best interests of the biosphere'. Roth (2003: 10) calls for 'an articulation of a scientific literacy that is deeper and more critical than that espoused in current science education initiatives'. He points out that scientific literacy is typically portrayed as a property of the individual and proposes, rather, that it should be seen as a characteristic of collective practice. Judging that we learn to participate by participating, he works with teachers to create opportunities for students to engage in authentic community activities (Roth and Barton 2004).

The views just discussed do not go unchallenged. They are questioned on practical, professional and more broadly philosophical grounds. Jenkins (1996: 66) cautions that we should guard against 'burden(ing) science education with responsibilities it cannot hope to meet'. A number of writers remind us that not all science teachers are comfortable moving beyond their traditional territory (Fensham 1997; Ratcliffe and Grace 2003; White 2003). Donnelly (2002) reminds us that current developments stand oppositionally to the subject's ontological characteristics. As summary, Jenkins' (2003) elegantly provocative paper is well worth reading.

'Scientific literacy' and science in the news

A striking feature of the literature on scientific literacy is its intense focus on science in the media, particularly science in the news. In truth, it is difficult to find a paper on the subject that does not at some point mention media. Sometimes, indeed, an individual's ability to deal with science in the news is seen as the defining characteristic of scientific literacy. Thus Hazen and Trefil (1992: xii) cheerfully announce:

> If you can understand the news of the day as it relates to science, if you can take articles with headlines about genetic engineering and the ozone hole and put them in a meaningful context – in short, if you can treat news about science in the same way that you treat everything else that comes over your horizon, then, as far as we are concerned you are scientifically literate.

More commonly an ability to engage critically with science in the news is seen as one among many manifestations of scientific literacy, as one among many requirements of scientific literacy and/or as one among many resources for scientific literacy.

The rationale presented revolves around two important and interrelated issues. For the vast majority of adults, the media constitute their main source of information about science and, significantly, about science-related matters that are impacting society (Rennie and Stocklmayer 2003). Hence science reportage on television and radio, newspapers and the internet are seen as resources for scientific literacy, raising issues and providing information. Additionally, what is shown, spoken or written may (often it is asserted *will*) influence the opinions and actions of individuals and communities in respect of these socio-scientific issues. An individual may start taking dietary supplements based on a television news item. A community may press for one form of waste management over another based on what its citizens have read in their newspapers. Hence the ability to engage critically with science in the media is seen as a requirement of scientific literacy and the demonstration of that ability is seen as a manifestation of scientific literacy. As Zimmerman et al. (1999: 1) write:

> Clearly the ability to read and critically evaluate media is an important skill for citizens in a democracy.

There is a small set of writers who also point out, and we believe importantly, that science stories in the news can (in our words) be captivating, amusing or even enthralling and can fire our interest and imagination whether or not we are specialists in the subject.

It follows almost unquestionably from these arguments that an education designed to enhance scientific literacy should intersect in some way with science in the media, either through providing learning experiences to promote an aptitude and ability to engage critically with such material or at the very least by expecting this aptitude and ability to flow (somehow) from that education. Unsurprisingly, then, this is a theme in curricular statements in a number of countries. In the United States, the National Science Education Standards (NRC 1996: 22) specify:

> Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions.

In the United Kingdom, the report *Beyond 2000: Science Education for the Future* (Millar and Osborne 1998: 12) proposes the curriculum should:

> […] help young people … be able to understand, and respond critically to, media reports of issues with a science component.

The Twenty first Century Science project (Burden 2005b; Millar 2006), which grew from the recommendations of this report, lists on its website five skills that describe the scientifically literate person, including the ability to:

- read and understand the essential points of media reports about matters that involve science
- reflect critically on the information included in, and (often more important) omitted from, such reports.

In Northern Ireland, the proposed new science curriculum for students aged 11–14 (CCEA 2003: Science Section) contains the recommendation that young people should:

- investigate how the media help inform the public about science and science-related issues
- explore some of the strengths and limitations of these sources of information.

Significantly, the testing programme of the OECD's Performance Indicators of Student Achievement (PISA) project aims to assess how well science education in its member countries is 'equipping students to discern, understand and critique the reporting of science in newspaper and the internet' (Fensham 2000: 75).

What has science in the news to offer teachers and learners?

The scene is now set to explore more specifically what science in the news has to offer teachers and learners in formal education settings. In the interests of readability this will be explored under six headings, however these interrelate so strongly that it is difficult to consider them distinct. Studying science in the news, we suggest, has the potential to:

- illustrate the 'relevance' of science
- foster students' engagement with science
- support learning in science

- support learning through science
- encourage lifelong learning
- promote scientific literacy.

Illustrating the 'relevance' of science

Science in the news is by no means the only mechanism for illustrating the relevance of science in everyday life, but it is arguably one of the more powerful. The very act of bringing, for example, a newspaper into a science lesson begins to build a bridge between the classroom and the wider world. It serves, in the words of Lietaer (1999: 57) to make 'the school walls (more) permeable'. Moreover, because science news stories are pervasive in the media, once young people become alert to their existence, the fact they encounter them day after day helps to reinforce their perception of the importance of the subject in society.

A number of other characteristics make news stories a valuable resource for highlighting the relevance of science. Almost by definition, they are up to date, dealing with current developments in the subject and contemporary issues in the community. Indeed, this intrinsic topicality has prompted some Newspapers in Education (NiE) proponents in the USA to describe newspapers as 'living textbooks'. Furthermore, regional and neighbourhood news outlets have a strong 'local' perspective which can lend them a particular relevance for the reader.

These ideas are exemplified by the comment of a chemistry teacher involved in a survey that we conducted of newspaper use in secondary science programmes in Northern Ireland (Jarman and McClune 2002):

> *I want to stress that science is not something that just happens in Room B2 or just happens in their textbook. It's happening out there and it's happening out there all the time.*

Importantly, we have also evidence, albeit from a very small-scale study (McClune and Jarman 2000), that students *do* draw these lessons from looking at science in the news:

> *It's a bit more interesting and practical than reading a textbook. It will apply more to real life than other stuff. It's more relevant.*

> *The lesson helped me to understand that what we learn in biology is actually happening in the world.*

We contend, then, that as teachers we can capitalise on the news to help young people come to recognise that science is, in a sense, all around them.

Fostering students' engagement with science

Closely associated with students' perception of the 'relevance' of science is their engagement with science. Science news text is written for free-choice, non-specialist audiences. The items and articles have to attract and hold the attention of their viewers, listeners or readers. As a consequence, as we shall see later, they focus on 'human interest' themes and angles. They convey something of the excitement of science at the frontiers of knowledge. They are often written and illustrated in an arresting and accessible style. Taken together, this can make the stories particularly appealing to young people, catching their interest and imagination and prompting discussion and debate. As one young teacher recalls, describing the first time she used science-based news articles in class:

> *The surprised expression on some pupils' faces is a memory that will remain with me for a long time to come. The barrage of questions afterwards and the discussion that took place were like nothing I have ever seen or heard.*

An experienced teacher reported, in respect of a group of rather reticent students (Jarman and McClune 2005b):

> *You see their faces light up. And then the discussion starts. It's like a snowball rolling downhill. It just grows and grows. Indeed it's hard to curb at times … There's a certain amount of pride. They feel they have accomplished something by talking to you, by being able to talk knowledgeably about something in the news.*

Brookes (2004) contends that public service broadcasting sustains social capital through its provision of shared experiences. In the instance we have just seen, there is a sense in which the news item is contributing to social capital within the classroom but also, perhaps, beyond, if it forms a basis for future conversation with friends and family.

News stories also provide a useful springboard from which students can explore those issues which research shows they consider should be accorded a place, or a more prominent place, in their science education. When given a voice, young people in the UK indicate they would value more opportunity to study current developments and contemporary debates in science (Osborne and Collins 2001). These are exactly the themes that form the essence of news. Furthermore, almost effortlessly, they can provide occasion for discussion and space for students to express their personal points of view (Osborne and Collins 2001; Solomon and Thomas 1999). It is not surprising, then, that in the few recorded studies of the use of news resources in the science classroom, teachers report a positive

response from the majority of their students (Jarman and McClune 2002, 2005a; Kachan et al. 2006; McClune and Jarman 2001).

Supporting learning in science

News text can be used to support learning in science. In respect of *terminology and concepts*, Hutton (1996: 50), following his review of print media over a period of time, concluded that 'for all areas of the (English National) Curriculum there can be found articles relating, strongly in many instances, to the stipulated subject content'. News, then, offers a resource for introducing topics, for creating a 'need to know', for consolidating learning, for inviting the application of knowledge in new contexts, and for assessing students' understanding (Wellington 1991, 1993).

Less well recognised is the potential of news to support learning about scientific *enquiry and practice*. We refer here, not so much to the evaluation of evidence in support of conclusions but to the science as a social endeavour. Of this, Jenkins (1999: 707) suggests that reading Richard Feynman might yield a better understanding than the 'formal, algorithmic and ritualistic accounts of "scientific method" which flow from the "highly contrived, expensive and time-consuming laboratory activities" associated with, for example, the National Curriculum in England'. We would make a similar case – perhaps even more energetically – for the use of news text. Consider, for example, the insights offered by newspaper articles with headlines such as:

Fish oil may not be so healthy after all

Lancet was wrong to publish MMR paper, says editor

PC brigade ditched my study on gender divide

Embryo cloning cheat resigns in disgrace

Although some science reportage describes science-related phenomena and events, developments and achievements in terms of their intrinsic interest, the preponderance deals with the *interactions of science, technology and society*. News is thus an excellent context for illustrating the impact of science on society, for examining its strengths and its limitations in the solution of human problems and for exploring the interplay of interests and values, rights and responsibilities among those involved.

Supporting learning through science

Fourth, news can be used to support learning through science. There is a widening range of cross-curricular themes and abilities that, increasingly, subject teachers are being encouraged, expected or statutorily required to address. Many can be advanced, among other approaches, through the use of news media. In the UK, for example, government has instituted a series of initiatives stressing the responsibility of all teachers to promote *literacy*. Here, 'promoting literacy' tends to be construed in terms of exploiting science as a context for developing, broadly, students' skills of 'reading, writing, speaking and listening'. (In passing, the distinction should be drawn between this and Norris and Phillip's (2003) concept of 'fundamental literacy', which, we take it, refers more specifically to the discourse practices of scientific communities.) With regard to reading, seen as meriting more attention than presently accorded (Jones 2000; Wellington and Osborne 2001), teachers are encouraged to extend students' experience beyond the textbook and to introduce them to a range of science writing. Norris and Phillips (1994: 951) bluntly state:

> If students experience only one type of text, it is perhaps unreasonable to expect them to become scientifically literate.

With reason, Wellington and Osborne's (2001) very helpful book *Language and Literacy in Science Education* devotes a section to newspapers in its chapter 'learning from reading'. News text provides many opportunities for young people to develop their abilities 'to sift, sort and interrogate information and … to assess its importance and significance', which as Newton et al. (1999: 572) indicate is 'becom(ing) an evermore important skill'.

Similarly, science is seen as a context for *citizenship education*. Since science-related issues impact so prodigiously on contemporary life, it has been argued that science teachers have an important contribution to make in this regard (Campbell 2002; Crick 2001; Ratcliffe and Grace 2003). Indeed, as Jenkins (2004: 165) indicates: 'It is claimed that some knowledge of science is a *sine qua non* of effective citizenship in the modern world.' For those wishing to pursue this objective, news reports represent a very valuable resource (Jarman and McClune 2003; Ratcliffe and Grace 2003) and also for *personal, social and health education* and for *education for sustainable development*.

Encouraging lifelong learning

The focus of the National Curriculum for science in England, it is stated, is 'to give teachers discretion to find the best ways to inspire in their pupils a joy and commitment to learning that will last a lifetime' (DfEE/QCA 1999a: 3).

Not all, of course, would agree that in its present form it fulfils this ambition! Nevertheless, we believe the encouragement of lifelong learning is a worthy aim for science education and we believe it can be cultivated, among other approaches, through the use of news media.

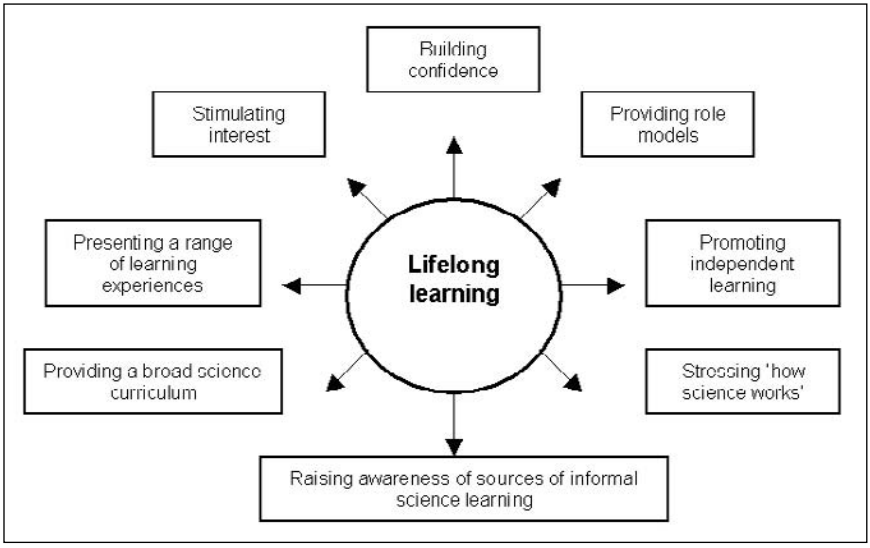

Figure 1.1 School practices that may encourage and equip young people for lifelong learning in science

Figure 1.1 represents an attempt to identify school practices that may encourage and equip young people for lifelong learning in science (from Jarman et al. 1997).

Clearly, students should be apprised of the possibilities for and potentialities of such learning. Specifically, they should be alerted to the large number of channels, including news media, through which it might be achieved, and to the strengths and weakness of each. They should also be made aware that many people, though not scientists, nonetheless find it interesting to follow developments in science or find it expedient to probe science as one potential source of information (among others perhaps more pertinent) which may assist in decision making in respect of personal or social dilemmas. The moves to increase public participation in socio-scientific debate in recent years, through, for example, 'consensus conferences' could be discussed. As Ryder (2001b: 4) contends:

> It is important that school science promotes a positive attitude towards engaging with science by giving students a sense that science is a subject that they are capable of interacting with as adults.

Additionally, news can contribute further to the features indicated. Judiciously selected items can illustrate the excitement of science, so promoting interest. They can illustrate the accessibility of science, so promoting confidence. The latter, perhaps, calls for explanation. Since news is self-evidently in the public domain, then *science* in the news is also in the public domain. It is not solely the preserve of professionals. As students study news material, they may develop confidence in their ability and in their authority to engage with the science they encounter in daily life. Moreover, a scattering of news stories are exemplary, expressly recounting how individuals, groups or whole communities have taken the initiative in this regard as they grappled with problems having a science dimension.

News resources address a wide range of themes, including topical socio-scientific issues likely to be of concern to young people. Their use in the classroom can be associated with a wide range of teaching approaches, including those linked with independent learning. Importantly, as teachers are seen to explore science in the news, they serve as role models of lifelong learners to their students. All told, we support Solomon and Thomas' (1999: 70) contention that, through the use of television, radio, newspapers and the internet, and their coverage of contemporary issues 'we could tempt students into a life-long interest in science' and prepare them for 'learning more about science whenever, throughout life, the occasion demanded'.

Promoting scientific literacy

Finally, science in the news offers a context for promoting scientific literacy. In fact, this is not an additional point at all, but a coming together of previous statements. It will not have escaped your notice (as either Watson or Crick might have said) that, taken together, the five propositions just examined encompass the themes described earlier as prevalent in the literature relating to scientific literacy.

We would argue, then, that 'science in the news' serves as a resource for advancing scientific literacy as much as scientific literacy serves as a resource for addressing 'science in the news'. This is illustrated, albeit rather simplistically, in Figure 1.2.

The Newsroom Project

Much of what is written in this book is informed by the Newsroom Project, a major research and development programme conducted within the School of Education, Queen's University Belfast. This was a cross-professional and cross-curricular venture. Interviews were conducted with over 40 'science in the

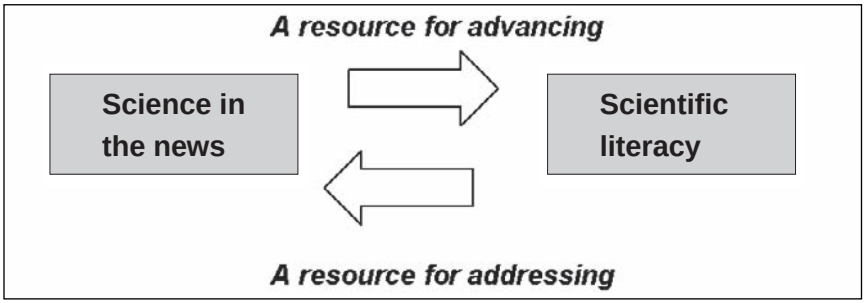

Figure 1.2 Relationship between science in the news and scientific literacy

media experts' drawn from the US, UK and Ireland (science journalists, science communication scholars, media scholars, science educators and media educators). With one group, we explored the knowledge, skills and attitudes that they considered to be a good basis for responding to science-related news text. With the second group, the focus was science-related news images – a theme explored elsewhere (Jarman et al. 2005).

A group of science and English teachers, drawn from schools in Northern Ireland, addressed the same issue. They then reviewed the proposals to decide which were likely to be realisable with students of secondary school age. Subsequently we worked with these teachers to devise activities through which these might be achieved in the classroom.

And finally ...

This chapter has explored how scientific literacy and science in the news interrelate. It has also considered what science in the news has to offer teachers and learners in formal education settings. In so doing, it has highlighted a 'present' and 'future' dimension to such use. In school, news items represent a lively and timely resource capable of catching the interest of students and developing their knowledge and skill. As young people move on from formal education, however, the media become their major source of information about science and, significantly, about science-related issues that are impacting society. One way we can help prepare students for their future, then, is to encourage and equip them to engage critically with science in the news while they are at school. This is especially important in the light of research, detailed in Chapter 5, which reveals that, presently, young people do not always display the interpretative and evaluative skills supportive of critical engagement with science news reports.

The aim of this book is to provide guidance, grounded in research, for teachers, whatever their subject background, who wish to develop among

young people an aptitude and ability to access and appraise science in the news. The early chapters examine the presentation of science in the media. This is an important starting point. Some awareness of the issues involved is essential if we are to deal effectively with these matters in the classroom. Subsequent chapters explore how news can be exploited to teach about key aspects of science, its content, its methods of enquiry and its role in the modern world. The book concludes with a discussion of how teachers of science and of other subjects can work collaboratively to help young people engage, perceptively, with that rich resource that is 'science in the news'.

2 What is news? What is science news?

Introduction

In their book, *Science in Public*, Gregory and Miller (1998: 106) write:

> […] understanding science-in-the-media has something to do with understanding media science, but mostly it is about understanding media.

Our own experience would substantiate this claim. Over the past few years, as our media awareness has grown, so too has our interest in and, we believe, insight into the science that it portrays. This chapter, then, and the two that follow focus on how news organisations report on the world of science and how we 'read' their accounts.

The literature relating to science and the media is large and disparate, expanding and maturing (van den Brul 1995). Indeed, the field of study has recently been described (Hargreaves and Ferguson 2000: 1) as 'old enough to have attracted its first historian'. An exhaustive review of this literature, however, is beyond the scope of this book. Likewise, it is not our intention to present a thorough-going critique of the theoretical debates surrounding the production and reception of news or its role in society. Rather, our aim is to provide an overview of some key ideas so as to offer a framework for those teachers, from whatever discipline, who wish to encourage and empower their students to engage, critically, with science in the news.

What is news?

News is an immensely important media form. We can watch it 24/7 on our televisions; we can listen to it in our cars; we can read it over coffee in Starbucks; we can download it from the internet; we can receive it on our mobile phones and as podcasts on our iPods. But what *is* 'news'?

This apparently simple question proves surprisingly difficult to answer. Aphorisms abound. Thus: 'When a dog bites a man, that's not news. But if a man bites a dog, that is news.' The rash of Rottweiler stories, however, would suggest otherwise. By the same token, 'the first rough draft of history' hardly helps us. Then there is the adage attributed, depending on which side of the Atlantic you live, to Lord Northcliffe, the British press baron, or to William Randolph Hearst, the US press baron, 'News is something someone somewhere wants to suppress.' Along similar lines is the pronouncement (stripped sadly of its original Irish accentuation): 'The business of a newspaper is to comfort the afflicted and afflict the comfortable.' These two maxims raise as many questions as they answer, not least the extent to which news media can afflict the comfortable when it is the comfortable that own them. They do, nonetheless, resonate with Max Hastings's (2002: 2) tongue-in-cheek comment in his account of his time as editor of the *Daily Telegraph*: 'I had been taught to believe that the first duty of a journalist is to cause trouble.'

Perhaps, however, the most useful starting point for understanding news is an observation by Arthur MacEwen, first editor of the *San Francisco Examiner*, cited in Boorstin (1961: 8) and in many collections of quotations thereafter:

> News is whatever a good editor chooses to print.

Although it may not immediately appear so, this statement encapsulates a fundamental tenet of media literacy, namely, news is not inherent in an event, rather what counts as news is a process of selection (Thoman and Jolls 2003). As Branston and Stafford (2003: 136) put it: 'News does not exist free-floating waiting to be discovered in the world outside the newsroom.' Similarly, Philo (1983: 135) writes:

> News on television and in the press is not self-defining. News is not 'found' or even gathered so much as made. It is a creation of a journalistic process, an artefact, a commodity even.

Countless millions of events occur each day. None is news unless and until a journalist acting as editor chooses to make it so. Some incidents will almost achieve that status, only to be supplanted at the very last moment by another story. The former may have been important, they may have been interesting, but they are not news. In contrast, on a slow news day items may surface which would not otherwise have done so.

This perspective places journalists and their institutions – not the events or the people portrayed – at the centre of the news-making process (Bromley 1994).

News values

That events are not intrinsically newsworthy but only become so when nominated for inclusion in news broadcast, webcast or paper obviously raises questions about the nature of the decision-making process involved. Media scholars characterise news practitioners as selecting events for reporting according to a complex set of criteria referred to as *news values*.

'Newsworthiness is fascinating and mysterious in equal parts' observes McGregor (2002: 1) and, unsurprisingly, there is a substantial research literature concerned with these criteria. Central to this is the work of Galtung and Ruge (1965, 1973) who, on the basis of a study of international issues in the Scandinavian press, identified 12 factors that appeared to shape the choice of news stories. They argued that these factors are cumulative, the more criteria an event satisfies, the more likely it is to be reported. They are also interrelated. Thus, for example, 'negativity' encapsulates the notion that 'bad news is good news' for a journalist while 'threshold' implies that an event has to achieve a certain magnitude before it is considered worthy of attention. Hence, the more people die in an accident, the more probable that it will be reported. Likewise, the threshold for bad news is lower than for good news. Newsworthy events themselves must 'jostle for inclusion' in the limited number of slots available in broadcast or print (Hartley 1982: 75).

Galtung and Ruge's work has stood the test of time, with current formulations of 'news values' differing primarily in terminology rather than intent. Some variant of the list below will be presented in most media studies texts. Figure 2.1 offers a 'student-friendly' summary.

Timeliness/immediacy

There is a 'nowness' about news. Recent happenings are considered more newsworthy than are those in the past. Furthermore, those that match the production cycles of the relevant media organisation are favoured. Consequently, since most news outlets operate on a daily or more frequent news cycle, specific events are more likely to be reported than gradually unfolding processes.

Relevance/impact

Events perceived to relate to or impact on the everyday lives of the audience are considered more newsworthy than those that do not. The stories may be of interest alone or they may also be of importance that is of concern or consequence. The greater the impact (the bigger the event, the more people involved) the more likely an occurrence is to be reported.

News values
Timeliness Has the story just happened? Is it of interest right now?
Relevance Does it relate to your life, your family or your community?
Impact Does the story affect a large number of people? Are the consequences serious?
Proximity Did the story take place nearby or does the story relate to local interests or concerns?
Prominence Does the story deal with well-known or powerful people or countries?
Clarity Is the meaning clear; do you think that most people will be able to understand the story?
Personalisation Is it a human interest story about an individual person (or animal!)?
Conflict/controversy Is this an issue about which people strongly disagree?
Emotion Does the story produce strong emotions such as fear or suspense?
Uniqueness/unexpectedness Is the story about something unusual, unexpected or odd? Is the story about something wonderful or awesome?
Co-option Is there a relationship with other news stories?

Figure 2.1 A student-friendly description of conventional news values

Proximity/meaningfulness

Closely related to relevance is the notion of 'proximity' referring both to geographical proximity and cultural proximity. For a given audience, events that occur near at hand are considered more meaningful and hence newsworthy than are those that occur at a distance. Similarly, events happening in a culture similar to that of the readers tend to be selected while those in cultures very different tend to be disregarded. This gives rise to what

Manning (2001: 61) describes as 'a curious moral calculus' (otherwise known as *McLurg's Law*) whereby a few deaths in countries of the north outweigh multitudes in countries of the south.

Prominence

Stories concerned with so-called 'elite nations' (global powers) and 'elite persons' (the powerful, the rich, the famous) are considered to have greater news value than those that do not.

Clarity/unambiguity

Stories that are easily explained are more likely to make the news than those that are not. By the same token, events whose implications are clear and relatively unambiguous may take precedence over those that are more complex.

Personalisation

Stories that centre around a particular person or that can be portrayed as doing so have greater news potential than those that cannot. Thus, in relation to 'hard news', political debate is often presented as a clash between individuals rather than between ideas and ideologies. In relation to 'soft news' so-called 'human interest' stories predominate. *Narrativisation* is also important. It is not without reason that news items are called 'stories' right from their inception. Journalists almost instinctively shape occurrences into narrative form.

Conflict/controversy

Charge and countercharge, controversy and conflict increase the newsworthiness of a story, not least because disagreement and debate add drama to an account. However, this news value goes deeper than simply style. Democracy, at least in its ideal conception, is premised on the possibility of public discussion of government policy and corporate practice and news broadcasts, newspapers and increasingly news websites and blogs are seen as having an important role in this process. In addition to the tensions associated with conflict and controversy, stories which are capable of evoking strong *emotions* such as fear and suspense are likely to make the news.

Uniqueness/unexpectedness

If an event or a situation is unique, unusual, unexpected or downright odd it enhances its chances of being considered newsworthy. Closely related to

this news value is fascination. A phenomenon, event or process may be reported if it has the potential to promote among viewers, listeners or readers, a response of awe or wonderment.

Items may be included in the news if they have already commanded media attention (*continuity*), if they relate to other news stories (*co-option*) or if they serve to balance other news stories giving a variety of coverage.

These, then, are illustrative of the criteria by which news workers determine whether a particular story will be selected, in other words, will count as 'news'. However media scholars point out that practitioners employ these essentially tacitly, all but unconsciously. Journalists are supposed to have an instinctive knowledge of what is newsworthy; they are meant to have 'news sense', a 'nose for news'.

News values as constructions

For any particular day, scrutiny of a range of news products reveals considerable similarity in the stories selected. This implies a similarity in the operation of news values across otherwise diverse media organisations. Furthermore, comparative research suggests that many of these news values, although culturally influenced, are common across newsrooms in the west (Manning 2001).

There are, however, differences in emphasis in different news products. The medium shapes the message. Television news, for example, covers fewer stories than newspapers. Proportionately, it includes more serious or 'hard news' (politics, business, foreign affairs as well as domestic concerns) than 'soft news' (human interest, entertainment). The stories themselves are shorter. Images are given pre-eminence so that 'visualness' becomes a news value in its own right. Anderson (1997) contends that as a result television is more event oriented than the press. Radio news demonstrates many of the characteristics of television news, although, of course, visual imagery is not an issue. In relation to print media, the so-called 'broadsheets', 'mid-markets' and 'tabloids' in the UK (see endnote) display some differences in news values. While all publish serious news items, the tabloids feature more 'personalisation' both in the selection and framing of their stories. They favour human interest articles and angles and often lead with celebrities' love lives!

News values vary with the changing social scene. Given what has been called the 'iconic turn', visualness' is increasingly becoming as much an imperative for newspapers as television. Some media commentators submit that intense market pressures within the news industry are driving all journalism, whatever its outlet, in the direction of increased 'personalisation' and 'human interest' reporting. This tendency, sometimes referred to as 'tabloidisation', may be construed as undesirable 'dumbing down' or

even as 'dangerous' (Fowler 1991: 16) as it is thought to displace serious discussion of underlying issues. Others, however, disagree. They argue that growing human interest reporting is not necessarily occurring at the expense of serious news stories, that greater personalisation may result in more effective communication to a wider audience and that these modes of presentation represent a democratisation of news formats (Allan 1999; Connell 1998; Macdonald 2003; Manning 2001).

News values are neither natural nor neutral. There is no intrinsic reason why David Beckham's sore foot should be any more salient in news terms than your sore head. There is no intrinsic reason why 10 deaths in a fire in one's own country should take precedence over 100 deaths in a famine further afield. For all their apparent 'common sensicality', news values are, in fact, professionally and socially/culturally derived and framed. They are constructions. Furthermore, as Anderson (1997) indicates, they operate at every level within the news production process, not simply at the point of selection of an event but also in the shaping of the text through which that event will be portrayed.

If news values are, essentially, constructions, the news stories flowing from the operation of these news values are also constructions. The media do not simply mirror reality. Chandler (1994) surprises us, perhaps, when he asserts 'news programmes … appear to be the most real and least mediated programmes on TV' yet they are 'as much of a construction as drama'. Nonetheless it *is* the case that all news journalism, whether television or tabloid, the *New Statesman* or the *New Scientist*, involves the process of, quite literally, 'making' news.

What is science news?

Imagine you are the science editor of a national newspaper faced with the potential stories shown in Figure 2.2. Which ones might you consider, on your *first trawl*, for submission to the duty news editor?

We may be wrong, but we imagine you will have chosen numbers 3, 5, 8, 11, 14, 15, and possibly 6 and 16. Now consider the grounds on which you made your choice. It is almost certain that you were employing the news values discussed in the preceding sections. This illustrates a very important point. *Science journalism is first and foremost journalism*. As Tim Radford, former science editor of the *Guardian*, contends:

> There is no such thing as science journalism, there is only journalism. When you write a science piece, the priorities are the same as they are for any other story. (quoted in Farmelo 1997: 182)

Similarly Hansen (1994: 111) concludes from his study of British science correspondents:

> The overriding key to understanding the work of (science journalists) is to recognise that they are, in their practices and professional beliefs, journalists first and specialists second.

Since science journalism is essentially journalism it follows that conventional news values apply. Stories are rarely selected on the basis of their importance in relation to criteria of science, but rather on the basis of their accordance with criteria of newsworthiness. Particularly influential in the selection of science stories are those news values that are strongly associated with 'human interest' (Hansen 1994), most notably relevance/impact qualified, though, by proximity/meaningfulness.

The very 'timeliness' of news has consequences for the nature of the science it covers. Almost axiomatically, much science-in-the-media is science-in-the-making. This stands in contrast to 'core science' (Millar 1997) that comprises much of the school curriculum and so the essence of most people's perception of the subject. 'Core science' is supported by a strong evidence base and has attained the status of agreed or 'certain' knowledge. 'Cutting-edge science', contrariwise, has a weak evidence base; it is tentative and often contested, it is 'uncertain' and provisional. Hence you often hear people complaining that, in relation to, for example, health and diet, scientists in the news are telling us one thing one minute and something completely different the next! Timeliness, too, inclines the media to highlight the latest study rather than to look across all studies (Baggini 2002).

The application of the criteria of 'relevance' excludes, whether we like it or not, a great deal of science. It also privileges certain fields over others. There is, for example, a prevalence of biology-related topics in the news. Content analysis studies have shown that medical and environmental themes are the most common in print media (Hansen 1994; Wellington 1991) and experience would suggest also in broadcast media. Physics-related and chemistry-related stories do appear, however (Glaser and Carson 2005; Hutton 1996; Pellechia 1997; Wellington 1991), and it is only since the mid-1970s that the physical sciences have lost their lead to the biomedical sciences (Gregory and Miller, 1998).

What counts as science in the news covers a much wider range of content than the traditional disciplines of biology, chemistry and physics (Zimmerman et al. 2001). In addition to astronomy and geology, there will be material from archaeology and anthropology, from meteorology and medicine, from psychology and sociology. Little respect is shown for established subject boundaries and seldom is a distinction drawn between science and technology.

1. Scientists discover how the efficiency of rainbow trout (*Oncorhynchus mykiss*) ventricular muscle changes with heart rate
2. Scientists claim the 'dark energy' theory of the universe is wrong
3. Scientists now think some planets in the galaxy may have a layer of diamonds under their surface
4. A 5kg meteorite has landed in northwest Cambodia starting fires across a number of rice fields
5. Eating fast food more than twice a week has strong links to diabetes, a US study shows
6. China to implant ID chips in pandas to help their conservation
7. The Tulotoma snail (*Tulotoma magnifica*) has been declared an endangered species
8. Scientists call for a cod-fishing ban in the Irish Sea. Fish shop owners protest
9. When intense laser pulses interact with a plasma, the oscillation velocity of its electrons approaches the speed of light, and the physics of the interaction becomes relativistic. A new, exciting range of physical phenomena can be studied under these conditions, which are of particular interest in view of important applications as igniters for inertial confinement fusion
10. Australia to ban fishing from a third Barrier Reef
11. Chlorine in swimming pools may be linked to childhood asthma
12. Russian spacecraft docks with international space station
13. Two new 1D copper(II) coordination polymers have been synthesised containing fumarate(-2) and chelating N, N' donor as ligands. Their crystal structures and magnetic properties have been determined
14. The scientist who cloned Dolly the sheep has been given permission to clone human embryos for medical research
15. A clever border collie that can fetch at least 200 objects by name may be living proof that dogs truly understand human language, scientists have reported
16. Concentrations of greenhouse gases such as methane and carbon dioxide are the highest experienced in the last 440,000 years

Figure 2.2 Potential science-related news stories

A particular aspect of relevance is 'co-option', where a general news story throws up a science angle. Thus, tragically, after the 2004 Indian Ocean earthquake and tsunami we all know more about marine geology than we did before the disaster.

As indicated, the greater the 'impact' or potential 'impact' of a science-related occurrence (the more significant its effect, the more people involved) then the more likely it is to attract media attention. Cancer is newsworthy because it is serious; the common cold because it is ubiquitous. The ultimate 'impact' story, a close approach by a sizeable asteroid, is certain to hit the headlines.

Importantly, for a science story to qualify as newsworthy, the ordinary viewer, listener or reader has to be able to understand it. To satisfy the news values associated with 'clarity/unambiguity', the report must be capable of being presented in an accessible, comprehensible manner. Journalists often have to work hard to make complex science simple, but not simplistic (Bennett 1999; Hansen 1994). If the story can be 'personalised' this helps the process. If 'conflict/controversy' are involved, so much the better. (Hansen 1994; Miller 1999; Neidhardt 1993) Small wonder, then, that items relating to genetic modification, cloning and the new reproductive technologies are common in the media.

Finally, journalists look for fascination value, that is for items that meet criteria associated with 'uniqueness/unexpectedness'. Indeed, Rensberger (1997: 11) writes: 'This is the special commodity that science stories, more than any other kind, have to offer.' Much science reporting falls into this category, within which two distinct strands can be identified. First, there are 'awe and wonder' stories, for example, those relating to the very big, the very small and the generally ingenious. As a consequence, astronomy is well represented in the news (Watson 2000) and accounts of intricate microsurgery are commonplace. Second there are 'weird and wacky' stories, often filling the 'and finally' slot on television news or appearing deep within the pages of the newspaper. So we have the formula for the perfect putt, the perfect cup of tea, the perfect joke and the most depressing day of the year (24 January). Science, if you will, as light relief.

As before, the more of these criteria a story meets, the more chance it has of 'making the news' and, as Gregory and Miller (1998: 114) remind us 'a science story packed full of news values can land on the front page'. Indeed, it is not uncommon for all UK national news broadcasts and newspapers on a particular day, to lead with science: neither is it unusual for an individual news outlet to lead with science a couple of times in a particular week. Overall, the coverage of science is 'very substantial indeed' (Hargreaves and Ferguson 2000: 33). As Miller (1999: 206) writes: 'Science and scientists are increasingly visible in the media.'

'Science in the news' and scientific literacy

Although scientists (as observed by, among others, Allan 2002; Gregory and Miller 1998: Hargreaves and Ferguson 2000; Miller 1999) and science teachers (Jarman and McClune 2002; Levinson and Turner 2001) tend to be rather critical of science in the media there is, in fact, much to commend in much that is written. It is significant that the House of Lords, Select Committee on Science and Technology (2000: 56) reported:

> We conclude that science journalism is currently flourishing in the United Kingdom.

This judgement flowed from a consideration of both broadcast and print news media. It is reiterated by many who work in the field of science communication. Farmelo (1997), for example, uses phrases like 'doing a first-rate job' when referring to the science output of the BBC. Walton (2002: 45) writing about television programmes more generally comments:

> The fact that [they] contain accurate representation of scientific ideas is a testimony … to the sincerity of the programme makers. They stand as a useful reminder that the popularisation of science does not inevitably lead to its debasement.

As will be discussed in Chapter 3, this is not to say that there are not examples of mistakes and misconceptions, of undue superficiality and sensationalism, of a lack of balance and a lack of probity in the reporting of science. But having over the last few years followed science in the news very closely, we would happily agree with the positive view these writers present. 'Science in the news', then, as a context for science communication attracts the approbation (in, of course, a general sense) of many who specialise in its study and are competent to judge its merit.

In Chapter 1, it was suggested that 'science in the news' serves as a resource for advancing 'scientific literacy'. We are now in a position to explore this further.

Introductory media studies texts often list the purpose of news journalism as follows:

- to inform
- to interpret
- to persuade
- to entertain
- and, of course, to be economically viable or to generate profit.

Just as we were writing this chapter, Sir Trevor McDonald, one of the UK's most popular television news presenters, retired. On his last day with ITN he was interviewed on the BBC evening bulletin. Introduced as 'still believing passionately that news matters', Sir Trevor responded:

> *I think news is still desperately important to inform people in a well balanced, fair and accurate way. I think it is also important because we do have to hold governments to account. And I think we also get the chance when we do the news to speak for those who cannot speak for themselves.*

There are at least two ideas here. First, a key purpose of news institutions is *to provide information*. In as much as they provide science-related information across a broad front then they have the potential to contribute to 'scientific literacy', at least in accordance with most conceptualisations of the term.

Second, on occasion at least, the purpose of the information is to protect the public interest and guard the common good. The media have traditionally as Bromley points out (1994: 9) 'claimed and been accorded a part in the public debate essential for democracy'. Keeble (2001: 147) writes:

> The journalist occupies a pivotal position between those who make and implement important decisions and those who are forced to comply with those decisions.

This applies as much to science-related issues as it does to politics, the economy or foreign affairs. As the argument goes, any democratic system depends on individuals – as citizens – being well informed about a wide range of issues. The media serve this ideal through the provision, and also the interpretation, of salient information. This view, essentially that portrayed in liberal pluralist theory, is summarised by Allan (1999: 50):

> The news media, according to the liberal pluralists, must carry out the crucial work of contributing to the system of checks and balances popularly held to be representative of democratic structures and processes. More specifically, by fostering a public engagement with the issues of the day, they are regarded as helping to underwrite a consensual process … of surveillance whereby the activities of the state and corporate sectors are made more responsive to the dictates of public opinion.

In passing, in addition to the imparting of information, this also implies, where necessary, an exposing of information or 'investigative journalism'. Interestingly, in relation to science reporting by science

correspondents, the literature suggests some reluctance on their part to take issue with, much less hold to account, the people and process about which they write (see Dornan 1999; Gregory and Miller 1998; Hargreaves and Ferguson 2000; Nelkin 1995). Hargreaves and Ferguson (2000: 12), citing Nelkin (1995), report:

> Unlike, say, the arts, or politics, there is little well-informed analysis or criticism of science. 'Many journalists are in effect retailing science and technology more than investigating them, identifying with their sources rather than challenging them.'

That said, Gregory and Miller (1998) point to some very telling examples of investigative journalism on television documentaries. Besides, as will be seen in Chapter 3, the coverage of science-related issues by generalists is undoubtedly less dutiful.

The science discussed in the news, then, feeds information into the public sphere where it can contribute to debate and decision making in relation to pressing socio-scientific issues. The media thus provide a space where negotiation processes between science and society can be initiated (Felt 1993) This resonates powerfully with radical conceptualisations of scientific literacy.

It should be noted, however, that the role of the news media can be theorised very differently from that portrayed earlier and opposition to the liberal pluralist position has been advanced from a number of different perspectives. Thus, for example, it is argued that the opinions of the powerful receive structural preference in the media and hence they become the 'primary definers' of media coverage. Furthermore, the increasing concentration of media ownership in fewer and fewer hands reduces, potentially, the platforms available for the presentation of alternative viewpoints. Political economists argue that increasing concentration and conglomeration have resulted in a contraction of the media's public sphere role. A fuller discussion of these issues can be found in the general media studies literature, for example Allan (1999) and Devereux (2003).

Newspapers are not simply vehicles for the provision and interpretation of information. They often attempt to '*persuade*' that is, they present news 'in a way that intends to guide the ideological stance of the reader' (Reah 2002: 50). Again, this applies to science-related issues as much as others. It is, of course, most apparent when the press run 'campaigns' on particular issues such as GM crops or MMR vaccination (Figure 2.3). This may seem less of an issue in relation to television and radio news which, in the UK, are under a statutory duty to provide 'balanced' reporting. However, as will be discussed in Chapter 3, it should be remembered that *all* media messages have embedded values.

Figure 2.3 Newspapers – broadsheets, mid-market and tabloids – run 'campaigns'

The purpose of many science-related news items is, in the broadest sense, to '*entertain*'. This embraces much more than the 'weird and wacky' stories referred to previously. Some people, while not practising scientists, nonetheless take pleasure in finding out about the world around them. They watch, listen or read for enlightenment, for enrichment – and for enjoyment. 'Science in the news' fulfils a latent desire within many of us quite simply to learn more. Through the quality of its writing and, yes, through its quirky storylines, it fuels (that is maintains and stimulates) those attitudes considered fundamental to and indicative of scientific literacy.

We believe, then, that 'science in the news' has the potential to contribute to 'scientific literacy'. But is this its aim?

It will be noted that, thus far, no mention whatsoever has been made of 'education'. This is both intentional and important. It is generally agreed that the role of science in the news is not, in the first instance, to educate. As Gregory and Miller (1998: 109) remark:

> Like most journalists, science reporters do not see it as their responsibility to educate the public.

Similarly, the House of Lords, Select Committee on Science and Technology (2000) notes:

> Science journalists are first and foremost journalists, not educators.

Hansen (1994: 127), reporting on his study of practice among British science correspondents, writes:

> Fundamental to both popular and quality press journalists is a clear notion that the primary task of newspaper science coverage is neither to educate the public nor to make the public scientifically literate, but a rather more modest goal of supplying interesting, informative and entertaining coverage.

Hargreaves and Ferguson (2000) dissent from this view. As part of a study of science, society and the media, they invited science journalists to complete a questionnaire. One item asked them to indicate their 'key objectives' among a number of possibilities. The aim 'to educate and inform the public' was rated highest. However, the writers acknowledge that the questionnaire (unlike the rest of the study) was rather unsophisticated and no more so, perhaps, than in relation to this question. Respondents who wished to draw a distinction between 'educating' and 'informing' were unable to do so. The inclusion of science correspondents working in television may also have had some bearing on the outcome. The mission statement of the BBC states that the Corporation 'exists to enrich people's lives with great programmes and services that inform, educate and entertain' and this Reithian culture may well influence the perspectives of its news teams.

And finally ...

We have explored a number of important ideas in this chapter. We have noted that an understanding of science in the news requires some understanding of science, but also of how media operate. We have seen that news is a process of selection and construction based on certain criteria of newsworthiness called news values. We have recognised that science-related stories are prevalent in news and that their selection and construction are governed by the same criteria that apply to other news stories.

Typically, the standard of science journalism is high and well worth our attention. It serves a number of purposes including some important to us both as an individual and, it is asserted, as a citizen within a democracy. Hence science in the news is of key significance in respect of scientific literacy. It is not, however, its aim to promote scientific literacy. This is an important matter. We should not hold news products to account for purposes they do not profess. Neither should our expectations exceed what they can reasonably deliver.

From a teaching perspective, we would want to bring 'science in the news' to our students' attention as an interesting, informative – at times

even exciting – context for learning about science and about its impact in society. We would want to alert them to the fact that some science-related news stories address issues of considerable importance. However, our students also need to know that news stories arise through a process of selection and construction. They are produced for a variety of purposes but not expressely to educate. This has implications for how we should respond to such media reports.

Endnote

In relation to newspapers, the terms 'broadsheet', 'mid-market' and 'tabloid' will be used throughout the book. Given the move to compact or Berliner formats among former broadsheet papers, we accept this terminology is not wholly satisfactory, however, it seems less value laden than referring to 'quality' and 'popular' papers. In the UK, *The Times* and the *Guardian* are examples of 'broadsheets', the *Daily Mail* and *Express* are 'mid-markets' and *The Sun* and *Daily Mirror* are 'tabloids'.

3 News production, science news production

Introduction

This will be a long chapter! It is difficult to condense into two dozen pages the characteristics of news production across the range of news outlets which we access daily. However we hope that it will provide a 'rough guide' to support those who wish to encourage and equip their students to engage critically with science in the news.

We will consider:

- The journalists who construct 'science in the news'
- The constraints under which they work
- The codes and conventions of news reporting
- The sources journalists use
- Language and values in news.

Journalists who construct 'science in the news'

Science in the news is 'constructed' by journalists. At first glance, this may not inspire confidence. In 2003 YouGov conducted a UK-wide poll for the *Daily Telegraph* in which participants were invited to indicate how much they trusted particular groups to tell the truth. Family doctors came first, with a 'net trust' score of 86%; schoolteachers came a close second with a score of 79%. Last on the list were journalists on the 'redtop' tabloids (e.g. *The Sun*, the *Mirror*) with a 'net trust' score of *minus* 69%!

It should be noted, however, that respondents drew clear distinctions between different media outlets. Television news journalists attracted a 'net trust' score of plus 65%; journalists on broadsheet papers, 31%; journalists on local newspapers, 22% and journalists on mid-market papers, –26%. Furthermore, even the much mistrusted tabloid writers were only just bettered by estate agents, car dealers, politicians and 'the people who run large companies'.

There are two types of journalist who cover science news – specialists and generalists – and most commentators will differentiate, to at least some degree, between them. National news organisations often employ specialist science 'correspondents' whose sole or major responsibility is reporting within their area. Despite their specialism, these writers do not necessarily have an educational background in their subject. Among the science correspondents Hargreaves and Ferguson (2000) surveyed (see Chapter 2), 16% did not hold a formal qualification in science and, furthermore, 68% deemed such a qualification unimportant to the conduct of their work. This may reflect the traditions of the news industry, where journalists frequently move from one beat to another – albeit science specialists are more likely than others to retain their portfolio. The belief may also represent a restatement of the now familiar theme 'science journalism is first and foremost journalism'. On a purely practical level, an in-depth knowledge of physics may be of only limited value when writing about biology.

There are, however, some distinct characteristics of the 'culture of science journalism'. As Gregory and Miller (1998: 108) indicate, science correspondents tend to know each other, meeting regularly at academic and press conferences. As mentioned in Chapter 2, it is sometimes argued that they assume an advocacy role in relation to the dominant scientific view and in relation to science more generally. It is to this group, specifically, that the House of Lords, Select Committee on Science and Technology (2000: 56) refers when it reports that 'science journalism is currently flourishing in the UK'.

Science journalists write the science-rich stories that appear in news broadcasts and on the inside pages of newspapers. That said, it should be remembered that it is not the science journalist, but the news editor, who decides what ultimately is aired or printed.

However, many science-related news items are written not by specialists, but by generalists. There are a number of circumstances in which this may occur: when the story becomes politicised; when it is destined for the front page/pages of a newspaper; when a paper is campaigning on the issue; when a news outlet has no designated science journalist etc.

It is interesting, in this connection, that the House of Lords, Select Committee on Science and Technology (2000: 54, 56), followed its positive appraisal of the state of science journalism with the claim:

> There are however problems with the handling of the science angles of news stories by journalists who are not specialist scientific correspondents […]
> What may have started as a science story, presented with care by a specialist science writer, may become a news story, subject to a very different set of values and criteria.

The latter statement should be viewed with a degree of caution. At the very least, it disregards the importance of conventional news values in the framing of all science news stories, however authored. Nonetheless, Hargreaves and Ferguson (2000: 47, 53), in the context of that aspect of their survey that focused on the UK media coverage of the GM food debate, assert:

> It is very clear from the unfolding of the GM food affair that many science journalists felt themselves to be marginalised or even ignored within their own news organisations as the story became the subject of campaigns driven directly by senior executives, using general reporters, political reporters and environmental reporters as much as science reporters.

Of the science journalists they surveyed, 29% considered that the coverage was 'broadly fair and accurate' but 52% thought it 'consistently unfair and sensational'. Their observations ranged from:

> For once the public decided it would not buy what Big Business decided was good for it. That's a scare? Sounds like democracy to me

to

> Science is the first casualty when there is an emotive story to be had.

Hargreaves and Ferguson wonder, moreover, whether GM foods may be something of a special case, 'produc(ing) reactions which are … out of line with the opinion-givers underlying position' (ibid: 54). Hence these responses alone may not be grounds for deprecating non-specialist reportage.

Whether or not the writing of science stories by non-specialist journalists constitute a 'problem', it is sound practice to listen or look out for the designation of the correspondent, given in handover or byline.

Constraints that apply in news production

Journalists work under many constraints and these mould much that is distinctive about news reporting, whether in broadcast or print. Together, they interact to influence the presentation of science-related issues.

Journalists have at their disposal only limited airtime or column space. Consequently, there is little opportunity to explore the particulars and

subtleties of what are often very complex affairs. This favours an economy of words and the omission of detail, including, sometimes, important reservations and restrictions. The absence of these qualifications may make the information appear more certain than it actually is. That space is at a premium may also result in reference being made to only a limited number of sources, which may influence the way opposing views are represented and weighted.

Journalists work to tight deadlines. News production is a hectic business. Whether for television, radio, papers or websites, news stories are put together in haste to meet daily or even, in the case of rolling news outlets, hourly, production schedules. That time is at a premium may mean that wide-ranging research, including consultation across a spectrum of sources, is not always possible. It is significant that, speaking at the Science Media Centre in London, Simon Pearson, Night Editor of *The Times* stated bluntly:

> *Do you want it good or do you want it now? There is only one answer.*

In similar vein, Alan Rusbridger, editor of the *Guardian* writes: 'It would be difficult to devise a process more inclined to throw up errors than the production of a newspaper' (Rusbridger 2000). Small wonder, then, that mistakes are made (see Figure 3.1).

Journalists, whether specialists or generalists, are almost always working in fields which are unfamiliar. With reason, Allan (2002: 76) suggests:

> [O]f the various beats newspaper reporters regularly cover, the science beat is one of the most challenging.

In many other specialisms, reporters need only master a relatively modest body of knowledge and cultivate a relatively small number of sources. For science, correspondents have to:

> […] come quickly up-to-speed on a host of emerging events or issues as they surface from one day to the next.

A constraint (Devereux 2003) that influences mightily what science is reported and how it is framed is perceived audience response. The media operate in the marketplace and it is all important that they attract an audience. A science correspondent interviewed in the course of our Newsroom Project opened the conversation with the rather startling comment:

> *My job is to be right, but even more it is to be read.*

The *Guardian* corrections and clarifications
Ian Mayes

The *Guardian* publishes a daily correction and clarifications column. Ian Mayes, the readers' editor, has compiled some of his more memorable, with commentary, into a number of books. The following are a sample of science-related revisions:

> The chimpanzees on the front of *Science* … were orang-utans.
>
> A reference to the '122-mile journey' of the Mars Climate Orbiter, from Earth to Mars … should have read 122 million miles.
>
> In an article on page 2 of the science section … we said: 'Out of more than 4,000 types of amphibians we have reproductive information in a handful of species. The variation is enormous: blind snakes … sea snakes … crocodiles.' None of these is an amphibian. They are all reptiles. London Zoo says so.
>
> Readers will have noticed that the leech shown with a posterior sucker at each of its ends in the *Guardian* house advertisement running recently … has, after numerous complaints been, so to speak, rectified. It appeared yesterday with a posterior sucker at one end and an anterior sucker at the other.
>
> The dolphins did not talk … in spite of the impression given by our caption, which said that bottlenose dolphins were 'in urgent need of conversation measures'. It is conservation that is needed.
>
> The great crested newt shown on the front of the society section … was, as sober inspection confirms, upside down.

Figure 3.1 Corrections and clarifications

As Neidhardt (1993: 342) indicates 'it is a rational strategy for all (in the media) to select topics, to construct issues and to stage messages in such a way that their own output wins attention'. This, he concludes, is the decisive precondition for any other intentions the media might have. Indeed, to court viewers and listeners, readers and surfers, news organisations are becoming more and more sensitive to the public mood and increasingly sophisticated market research is being used to gauge the public taste (Bromley 1994; Hargreaves and Ferguson 2000).

The media, then, are in intense competition – Keeble (2001) uses the term *hypercompetition* – for attention. This is true of public service television and radio where audience share is a key accountability consideration. It is even more true for commercial television, newspapers and news websites where audience share is, in effect, profit. Interestingly, this profit rarely derives directly from the audience (through, for example, a cover price) but

from the advertisers that the audience attracts. Indeed it is not unreasonable (Devereux 2003) to describe news programmes and newspapers as devices for delivering key demographic groups to advertisers! Be that as it may, it is important, particularly in the context of science-related reporting, to recognise that the corporations and businesses that advertise in news outlets are an interest group in the process.

Ownership, whether minor proprietor, major 'baron' or massive conglomerate, may constrain, either directly or indirectly through self-censorship, the content presented and standpoint adopted on issues. Finally, regulation is a further restriction. In the UK, all broadcasting is regulated by government and all journalism, whether broadcast or print, is subject to extensive legislation such as the Official Secrets Act and laws, for example, of libel and contempt.

The impact of these constraints, particularly competition, concentration and conglomeration, is the subject of debate within the academic community. As noted in Chapter 2, some contend that, as a result, journalists are becoming less analytical and investigative and that they are under increasing pressure to conform to the dominant news agenda rather than present alternative stories or voices.

Codes and conventions

The reporting of news, including science news, follows certain codes and conventions. These have evolved over time and are shaped substantially by the professional and organisational culture, context and constraints within which journalists work. Some knowledge of these codes and conventions and understanding of their implications for the representation of science offer 'some insight into the science behind the headlines' (Gregory and Miller 1998: 131).

If science reporting is to be successful it must entice viewers and listeners, readers and surfers. It must also cater for a wide range of individuals with a wide range of needs. And it must deliver its message fast. Items in a news broadcast last only a few minutes; articles in a newspaper occupy only a few columns. How, then, do journalists address the substantial challenge of reporting science in a way that is *attractive* and *accessible* to their audience?

Attracting attention

As discussed in Chapter 2, 'news values' govern the selection of science-related stories. They also influence the framing of each story, that is 'the process through which complex issues are reduced to journalistically manageable dimensions in the construction of a news story, resulting in the

selective presentation of some sub-themes and not others' (Priest 1999: 241). In respect of science, those associated with 'human interest' predominate. As Keeble (2001: 125) points out 'the human interest consensus is rooted in the journalists' culture'. As a consequence story angles and sub-themes will be chosen for their perceived relevance to the audience. The report, if possible, will be personalised and presented in narrative form. Conflict and controversy, if attendant, will be highlighted; emotion evoked.

That science reporting is so characterised is not, to parallel an argument developed by Gregory and Miller (1998: 117), evidence of self-indulgence, shoddiness or even mischief making on the part of journalists. It stems, as they state, from 'the rhetorical conventions of popularisation – conventions that apply to all journalism whether about science or not'. It is predicated, as Peters (1999: 266) indicates, on reporters 'crucial professional duty' to attract the attention of an audience. These characteristics do, however, establish science writing in a news context as *intrinsically* different from science writing in, say, an academic context. The former is not, for example, some diluted – or, for that matter, adulterated – form of the latter. It is a distinct genre, with all that implies.

A number of implications flow from these distinctions. First and foremost, we should recognise that 'science in the news' has significant strengths but also limitations as a source of information. Second, we should recognise that science writing in the context of news should not be judged by the same criteria used to judge science writing in academic contexts.

There is a tendency, however, for those with a science background to do just that. The media, for instance, are often charged with *superficial* or *sensationalist* coverage. Part of the problem, Peters (1999: 257) suggests 'may be rooted in different concepts of message quality embedded in the journalistic and scientific cultures'. This reinforces Allan's (2002: 69) important contention that to engage critically with science in the news requires an acknowledgement of 'the uneasy tensions which exist between discourses of science and those of journalism'.

Charges of 'superficiality'

In relation to 'superficiality', Salisbury (1997: 222) observes that, for scientists, 'the devil is definitely in the details, while journalists are interested primarily in the big picture'. Gregory and Miller (1998: 39) quote a science reporter from the then *New York Herald Tribune* urging physicists to understand that:

> A news account, by its very nature, is a compromise between the facts and the general impression. Beyond a certain point, what it gains in precision it loses in communication … the precision of the

> layman [sic] is an accuracy of impression rather than an accuracy of specific fact.

Detail and depth of treatment are simply not the intent of science-related news reporting.

This last quotation raises the issue of 'accuracy'. Peters' (1999) reports findings from a survey of German news writers and scientists that indicated that for the journalists, technical accuracy was not among the most important criteria for media coverage, while for scientists it was. Dornan (1999) and Gregory and Miller (1998) note that the academic literature contains a number of studies that highlight inaccuracies in reporting. The former however point out that these researchers tend to focus solely on 'science-in-the media', rather than weighing its accuracy of coverage against 'anything-else-in-the-media'. The latter describes one study (albeit conducted in 1974) which drew such a comparison and found a higher error rate for science reporting. However, Dornan (ibid: 185) is at pains to point out that there is a significant slide:

> … from the premise that journalism should be required to get the scientific details right to the assertion that these details themselves dictate the form and tone that coverage should adopt.

Charges of 'sensationalism'

In relation to 'sensationalism', the media are accused variously of:

- overstating certainty
- overstating applications and implications
- overstating controversy
- overstating risk.

As discussed, restrictions of space and time may result in the omission of qualifications making the story appear more certain than it is. Additionally, certainty tends to be more newsworthy than uncertainty and this encourages the downplaying of provisos. Furthermore, as Fuller (1998) notes, scientists themselves may be motivated to claim more for their work than is warranted.

To enhance relevance, news reports often emphasise the potential applications and implications of scientific developments. Not only does this add further to their apparent certainty (Gregory and Miller 1998), but such speculation may also promote unrealistic expectations (the *miracle cure*) or exaggerated fear (the *killer chemical*). Sometimes, too, the work is heralded as a major advance or a 'breakthrough' rather than a building on previous research. It should be noted, however, that it is not only the news

media that are considered culpable in this regard. Nelkin (1995) is among a number of writers who refer to science's tendency to make extravagant claims for itself.

The treatment of controversy also, on occasion, prompts charges of media sensationalism. Science, particularly as it impacts on society, is often contentious. This may arise from the uncertainty associated with the science itself. Alternately or additionally, it may arise from the moral and ethical issues associated with the application of science in daily life.

From a journalist's perspective controversy is welcome, indeed it may be actively sought as it makes for lively news copy. Disputation is, essentially, 'a journalistic device' (Hargreaves and Ferguson, 2000). However, journalists also have particular conventions for dealing with contending opinion. For most, an important issue is the need to present a 'balanced' picture in which different sides of the argument are represented. In practice, of course, this notion of 'balance' is problematic in relation to science and particularly so in relation to unorthodox science. In the interests of 'balanced reporting' opposing opinions may be given equal weight, although one may represent the majority view of the scientific community and the other a minority or even solitary view.

The reporting of risk will be discussed in Chapter 4.

In reality, sensationalism is a tricky subject to pronounce on. Dornan (1999: 186) describes the notion as 'obstinately difficult to engage in a rigorous fashion':

> At what point does the journalistic labour of the science writer cease to be beneficial (by cultivating lay interest) and begin to detract from the overall goal (by obscuring scientific fact)? On what grounds can sensationalism be proved?

Studies that have actually explored sensationalism in relation to science reporting have been few and, he goes on to claim, of limited worth.

Facilitating access

News is designed to be assimilated quickly and, over the years, further codes and conventions have developed to aid this process. Some of these are general, applying across all media channels. Others are medium specific. As already indicated news is helpfully regarded as a 'genre'. Genre texts are more readily accessed and assimilated by audiences expressly because they contain a repertoire of familiar elements (Lewis 2003).

Television news

Television news broadcasts have codes and conventions, most of which we take for granted. In the UK, they are presented as short bulletins or longer news programmes. They employ in-studio presenters who are accorded a privileged status in the production and delivery of the news product and, thereby, assume an aura of considerable authority. Indeed, with developing technology the role of the presenter is, if anything, extending. Instant satellite communication allows them to conduct live interviews with correspondents across the world. Lewis (2003: 27) lists a number of ways in which the authority of the presenter is accentuated; formal codes of dress, straight-on camera angles, the use of the autocue facilitating fluent delivery etc. Different channels, however, construct their own brand identity and some variation is seen.

News broadcasts follow a relatively established format. First, the 'main points' are presented. These serve the dual purpose of attracting attention to the stories that will be covered and offering a 'digest' of these stories for viewers whose time is limited. They are followed by an amplification of each point comprising commentary, in-studio reports and interviews and on-location reports and interviews. The 'running order' reflects the importance granted each item as judged by the editorial team. A feature of television is the image – video footage, photographs, animations, graphics and even stills on the backdrop behind the presenter. These assist the viewers' engagement with the news story, albeit in rather complex ways. In a short news bulletin, the main points are often restated before signing off. In longer news programmes, the bulletin will be followed by in-depth treatment of a limited number of stories comprising more detailed information and analysis. A summary of the main points may follow and, finally, there is an 'And finally'!

Digital broadcasting affords, potentially, an increasingly less linear approach with no formal beginning and end where viewers are able to determine which stories, and in which order, they wish to explore. Thus the viewer assumes, to a degree, an editorial function choosing to select or 'spike' (exclude) particular items.

Radio news

Radio news broadcasts in the UK tend to have a structure broadly similar to television news broadcasts. Although no longer a visible 'presence', the presenters remain very prominent. In relation to science, the absence of a visual channel of communication precludes the use of animation or graphics to support the explanation of processes or phenomena. Soundscapes may be used to create ambience or atmosphere, but even this is problematic. The 'sounds of science' are not always easy to portray!

Online news

Online news products are offered by broadcast news companies, news agencies and newspapers. Being primarily text based, the web pages share many of the codes and conventions of print media. However, there are important differences. They are updated regularly. The technology affords the opportunity of presenting information across a number of platforms and many stories will be accompanied by video and audio clips (Figure 3.2). These provide a richer news experience and also allow the user to access and assimilate information very quickly. Increasingly online news outlets are offering clients news alerts or regular headlines not only on their personal computers but on their mobile phones etc. Podcasts are becoming common. Further, the electronic news environment allows the public very readily to send material into the organisation contributing to 'citizen journalism' (see Chapter 4).

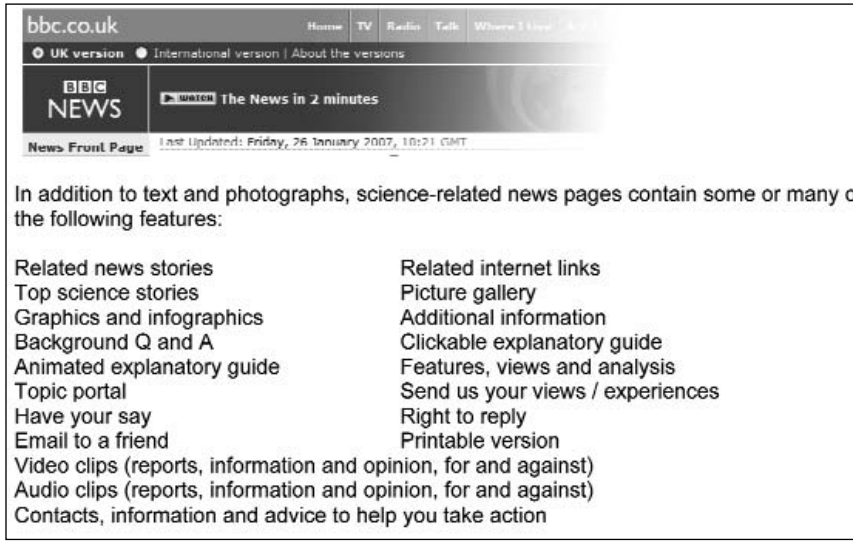

Figure 3.2 An online science-related news story typically contains many features

Newspapers

Newspapers cater for a wide range of readers, with a wide range of needs. Some people peruse the paper from cover to cover; the majority, however, hop quickly from article to article or head straight for a particular section. Both broadsheets and tabloids are designed to facilitate skipping, skimming and selective reading. The headline is the most obvious device to this end.

The function of the headline is to alert us to the content of the story and to attract us to stop and read. They may also be written to influence the opinion of the reader. It is important to note that headlines are composed not by the journalist who created the story, but by a subeditor. Thus, although a science-related story in the *Independent* was written by the science correspondent, its title 'Scientists make a monkey out of cells', was almost certainly not. Sometimes, as here, the subeditor employs word play and other linguistic devices to produce arresting or memorable headlines – alliteration, rhyme, ambiguity, homophones, puns etc. Combining the last two, for example, we have 'Caws for concern' opening a story about the antics of urban crows. Headlines are also a constant source of solecisms – as when it is heralded:

Scientists to kill ducks to see why they're dying

Different newspapers use different styles of headline and these can be recognisable even out of context. Figure 3.3 offers you the opportunity to try your skill at matching headlines to UK newspaper titles. The answers are given in the endnote.

Match the following headlines to their newspapers

Belfast Telegraph *Daily Express* *Daily Telegraph* *Guardian* *The Sun*

1 Super pill for over-55s could cut coronaries and strokes

2 Single pill could cut down heart problems

3 Once-a-day-pill 'cuts heart attacks by 80%'

4 Miracle pill adds 10 years to your life

5 Take a pill and live 12 years longer

Figure 3.3 Match the headline to the newspaper title

Because they are not written by the author of the article and/or because the wordcount is so restricted, headlines can be misleading. As Hargreaves and Ferguson (2000: 4) indicate 'the communication of uncertainty doesn't sit easily with three-word, 72-point headlines'. Sometimes, in science-related stories, the title infers a certainty that is not supported in the text. Thus, for example, The *Independent*, on 28 December 2005, leads with front-page headline 'Revealed: the pill that prevents cancer' while the article opens with 'A daily dose of vitamin D could cut the risk of cancers of the breast, colon and ovary by up to a half.'

Unlike much of the writing with which we are familiar, news stories present the most important and newsworthy information in the first (lead) paragraph or two. The intention is to impart information as quickly as possible and also to 'hook' readers, attracting them further into the story. This is sometimes termed the 'inverted pyramid' model. Often, in this style of writing, the answers to the 5W+H questions (who, what, when, where, why and how) can be found in the opening paragraph(s) (Figure 3.4).

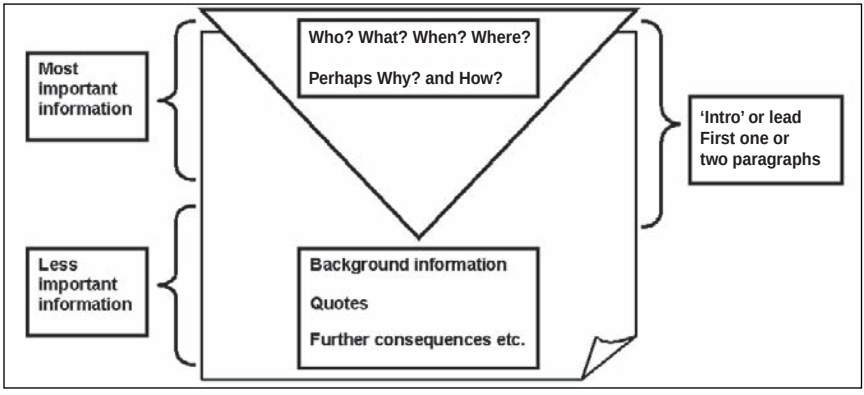

Figure 3.4 'Inverted pyramid'-style of reporting

Although the 5W+H formula does not always apply in science-related news stories, they do nevertheless begin with the most important information. Following the intro or lead paragraph(s), the next few paragraphs (sometimes called 'elaboration') give additional or background information including statements from 'sources'. These 'quotes' are presented, ostensibly, as word-for-word records of what the individual said. They provide immediacy, colour and authenticity to the account and, of course, contribute to the 'personalisation' of the story. Statements from sources are arranged in order of the importance of the informants, as judged by the journalists. The final paragraphs of the story may have further information and/or speculation about future consequences (sometimes called 'projection'). Conventionally, 'hard news stories' focus on 'factual' material, with analysis, commentary and opinion being reserved for feature articles and editorial sections. This is less so in soft news stories.

Interestingly, one advantage of this 'inverted' style of writing is that the final paragraphs of the article contain the least pertinent (and most disposable) information. They can readily be removed should the subeditor need to shorten the article to make space for another news story.

In addition to news stories, newspapers contain components such as feature articles, editorials and commentary that may also deal with science-related themes. Feature articles are not generally 'breaking news'

but they do cover issues that are timely. They are longer, dealing with a particular topic in depth. They do not follow the inverted pyramid-style of writing. They may be more colourful in their use of language. They may be more prolific in their use of opinion. They may be more probing in their use of argument.

Editorials (the 'voice' of the newspaper) and commentary pages offer overt opinion on important and often controversial issues of the moment and science-related matters may be discussed in these sections. The former sets out the newspaper's position on a particular issue or event, the latter may be written by guest writers. Most newspapers also publish letters to the editor. These give readers and representatives of groups with an interest in a current issue the opportunity to share their viewpoints.

Sources journalists use

At the heart of journalism lies the 'source'. Sources serve a number of functions; they provide key information, they afford credibility, they act as advocates for a point of view, they offer balancing comment, they judge the significance of an event or the merit of an idea etc. Conventionally, journalists use sources to distance themselves from the issues being reported creating a semblance of objectivity and neutrality (Keeble 2001).

In respect of science, the elite science and medical journals (for example, *Nature*, *Science*, the *BMJ*, *The Lancet*, the *New England Journal of Medicine* etc.) are a foremost source of stories (although see Hansen 1994). The fact that the research is peer reviewed offers the media a warrant of reliability (Hagendijk and Meeus 1993; Hansen 1994). Thus Simon Pearson, *The Times*, has stated that where his newspaper is concerned, 'the peer review system is our security blanket'. When it goes wrong – as in the case of Hwang Woo-suk's stem cell lines – the story makes even better news!

Major scientific and medical conferences are also a source of stories. The research reported here is generally not peer reviewed.

Scientists often appear in news programmes and papers of their own volition. Indeed, they compete for media space (Allan 2002; Miller 1999; van den Brul 1995). A high profile is to their advantage, attracting attention, acclamation and, possibly, advancement. This is not a new phenomenon. Gregory and Miller (1998) recount how Robert Millikan's colleagues devised a unit of publicity called the 'kan' – with 1,000 millikans in every kan!

In addition, universities and research institutions (governmental, independent and industry based) have press officers who organise press conferences, press releases and web alerts and generally manage the media profile of their organisation. Both the journalists and the scientists (and their employers) benefit from this. The former, relatively effortlessly, gain

material for news reports. The latter, importantly, gain publicity. Interest groups, advocacy groups, pressure groups and campaigning groups have increasingly sophisticated procedures for interacting with the media. Anderson (1997) presents a very interesting picture of their contribution to the environmental news agenda.

News agencies (for example, Reuters and Associated Press) and science-specific news services are a further 'source'. News agencies are organisations that sell stories to the news media. They have their own reporters and photographers who produce both raw and ready-made material that broadcasters and the press can edit and or reproduce. It is interesting to consult the science/technology pages on Reuters News website and note just how many stories listed there appear, sometimes almost word for word, in newspapers. Indeed, the reach of the news agencies raises questions for media scholars about diversity of supply and their representativeness (Boyd-Barrett and Rantanen 1998). In addition to general news agencies, there are also science-specific news services such as AlphaGalileo (Europe) and EurekAlert (USA).

Journalists may also consult directly the scientists involved in a particular news story and also a range of contacts or informants that they have built up over time. The Science Media Centre based at the Royal Institution was set up in 2002 to enhance this process. It aims, when a major news story breaks, to offer news desks a list of scientists available to comment on that topic, a summary of the science involved and sources of further information. For their part, editors are reported to value scientists as sources, deeming them authoritative even beyond their specialism. As Gregory and Miller (1998: 113) put it: 'All a journalist needs to say is "According to Dr X. of the University of Whatever …" and the story is reliable.'

It is sometimes argued that journalists are too selective of sources and too close to those they use – a symbiotic relationship, driven by reciprocity of interest. Herman and Chomsky (1988) argue (see Chapter 2) that the powerful, being in a structural position to 'know', receive preferential access to and approach from news professionals. This privileges their worldview and may render invisible important alternative accounts. As indicated earlier, this may be particularly so for science correspondents where some consider that the close relationship between the two constituencies leads to a favourable even deferential coverage of mainstream science. Indeed, Gregory and Miller (1998: 109) refer to the 'scientist–press officer–journalist club'. Thus, rather than misrepresenting science, some critiques suggests that 'the press is in fact complicit in the advancement and protection of the interests of the scientific estate' (Dornan 1999: 194).

The language of news, or 'boffins beware'

The language of news is not, as Keeble (2001: 81) points out, a 'natural' form of writing or talking, but 'a particular discourse with its own rhythms, tones, words and phrases'. Typically, it is concise. Ideas are introduced succinctly; phrases compress complex meaning into a few words. It is immediate. The extensive use of the present tense creates a sense of urgency; the extensive use of the active voice, a sense of drama (Lewis 2003). Both contribute to the clarity and accessibility of the text, whether heard or read. In print media, the language, particularly in longer articles, is often colourful and, in the case of science items, richly metaphorical. It is also adventurous. Keeble (2001) points out that many hundreds of new words are recorded and invented every year in newspapers.

Values are thoroughly implicated in language usage. As Reah (2002: 55) indicates:

> The transmission of a message through language almost of necessity encodes values into the message. Language gathers its own emotional and cultural 'loading'. What this loading is will depend on the nature of the culture or sub-culture in which the language exists.

Individual word choice can engender ideological slant, in the broadest sense of the term. In the UK, arguably the most famous (or infamous, depending on your perspective) example in recent science-related reporting is 'Frankenfood' and the hybrid word family (Frankenfish, Frankenscience etc.) that derives therefrom. The metaphor packs a particularly powerful punch. Just as loaded is the choice of the word 'mutant' in an oft quoted headline 'Mutant crops could kill you' from the *Express* on 18 February, 1999. Think, too, of the rhetorical force of the phrase 'Playing God'.

Emotive words such as Frankenfood are clearly being called on to persuade, and most people will readily recognise them as having this purpose. Reah, however (2002: 54), makes a very important point when she argues:

> Language can be a powerful tool. It is, perhaps, at its most powerful when its role in presenting the world to an audience is not explicit; in other words, it is easy to resist a particular viewpoint or ideology when you know it is being presented to you, but not so easy to resist when the viewpoint or ideology is concealed.

Compare, for example, the subtle difference in message flowing from the use of the attribution verbs 'said' and 'claimed'. Thus 'Ruth Jarman said …' is essentially neutral, but 'Billy McClune claimed …' is not. It suggests,

somehow, that his statement cannot be substantiated – that it is in doubt. Consider, also, the difference between:

> Scientists *point out* that the effects are not yet fully known

> Scientists *admit* that the effects are not yet fully known.

The former suggests that the researchers are on the offensive, the latter, that they are on the defensive.

In addition to word choice, the larger units of language can also shape media messages. Thus syntax, the positioning of words in a sentence and their relationship to each other, contributes to meaning making. Consider:

> In a blow to the GM lobby, scientists have predicted that a single year of the test crops will yield thousands of hybrids

> Scientists have predicted that a single year of the test crops will yield thousands of hybrids, a blow to the GM lobby

Lexical and syntactic choices (and also in audio and or visual channels, phonological and graphical choices) merge with the stylistic and rhetorical properties of news text to shape the potential messages that it can convey. Fowler (1991: 42), however, reminds us that this does not imply that journalists are consciously and constantly seeking to wrap 'facts' in value-laden language. Rather, as indicated previously: 'The practices of news selection and presentation are habitual and conventional as much as they are deliberate and controlled.'

Values and viewpoints

In the latter half of the nineteenth century the norms of news reporting moved away from radical partisanship to become more closely aligned with notions of 'objectivity'. This is seen in the codes and conventions that characterise 'hard news' reporting: a focus on the 5Ws+H of an event, the corroboration of the 'facts' by at least two independent sources, the reporting of such verified 'facts' without adjoining commentary. As Bromley (1994: 101) notes, 'objectivity was both an expression of journalistic ideal and a journalistic method'.

In the UK, television and radio are legally required to present news 'with due impartiality'. Indeed, according to Lewis (2003), early television news announcers were not shown on screen to avoid bias being revealed in a smile or the raising of an eyebrow!

The print media are not regulated in this way, although they are subject to a range of other legal restraints. Newspapers have ideological, including political, agendas, but interestingly these are not always as sharply or predictably defined as in previous times. Opinion, then, is freely offered; commentary forcefully made. In respect of hard news, such elaboration and evaluation tends to occur in the editorial sections of the paper, although the boundary between 'fact' and opinion is blurring.

News, however, can never be objective or neutral or perfectly balanced. All media messages have, unavoidably, embedded values and points of view. Like the notion of news as a construction, this also is a key tenet of media literacy.

As we have seen, the criteria for selecting stories (news values) are socially and culturally determined and hence essentially ideological. Once a potential story has been chosen, this decision-making process continues. Which 'facts' will be included; which omitted? Which sources will be used; which ignored? There are multiple positions from which any story can be told. Which angle will be presented; which disregarded? The framing of the story will be influenced by the values of the news organisation and its editorial stance. Similarly, it will be influenced by the journalists responsible for the news item. All will bring their values and their viewpoints to their reporting. It could not be otherwise. None of us interprets our world from a position of neutrality. We all bring to bear on the process of meaning making the sum of our life experiences and the perspectives that flow from them.

As the story is moulded into news output, decisions are made about language and image. Language, as we have seen, is value laden. Images are value laden. Decisions about running order on television and radio or about positioning in paper or website are value laden. Even the expression and intonation of the newsreader can convey partiality. Lewis (2003: 57), for example, claims that Peter Sissons, a BBC TV news presenter 'made it clear that the claim by the Raelian cult to have produced the world's first cloned baby was derisory' through the emphasis he placed on the words 'cult' and 'claimed'.

Objectivity, argue Bromley (1994) and Palmer (1998) is better seen, not as the presentation of dispassionate truth in the form of accurate unadorned 'fact' but as a journalistic routine that seeks to give voice to different sides of a story. *The* Impartial Observer *is not. Neither could it be.*

It is sometimes said that a particular science-related news item or article is biased. It should be clear from the earlier discussion that such a proposal is problematic. It implies that somehow you could have 'unbiased' reporting. This is simply not possible. Indeed Fowler (1991) advocates that we avoid using the term 'bias' except in those circumstances where there is an intent to deceive, that is, the deliberate and systematic distortion of a story.

Audience research has shown that people regard television as less biased than the press (Fowler 1991). Certainly it is more regulated, but again our discussion so far would caution us against assuming that broadcast news is therefore value free. Similarly, we should be careful about suggesting that science-related reporting in the broadsheets is impartial, but science-related reporting in the tabloids is not. The former is no more value free than the latter, although, of course different newspapers may have different values and present different viewpoints. Indeed, both science journalists and science communication scholars point to some fine science writing in some sections of the tabloid press (Hutton 1996; Zimmerman et al. 2001).

Many media institutions are controlled by multinational capital (Curran 1998). This also has ideological implications. It raises a number of prospects, for example, a predisposition toward consumerism and capitalism (Curran 1998; Devereux 2003) and a reluctance to report or editorialise in a manner hostile to the conglomerate's commercial interests (Devereux 2003; Reah 2002). Thus, in the commercial news environment, it is suggested that advertisers may exert pressure to have certain stories highlighted or spiked (Curran 1998; Keeble 2001). Hence the old adage:

> Freedom of the press in Britain is freedom to print such of the proprietor's prejudices as the advertisers won't object to.

Ownership of news media rests in fewer and fewer hands and this may amplify the potential for proprietorial influence. Curran (1998), citing Rupert Murdoch of News Corporation as an example, writes of a 'more interventionist generation of publishers'. Others, however, suggest that, given the complexities of the corporate world, the power of the proprietor is sometimes exaggerated (Bromley 1994; Keeble 2001). Clearly the effects of ownership and control are difficult to demarcate. Furthermore, the professional culture of journalists, and their codes of conduct, could be seen as a countervailing influence. As Curran (1998) observes this culture has:

> […] a normative element rooted in beliefs about how journalists should serve society. It is this public interest component, transcending newspaper organisations which provide a potential counter balance to press control.

Certainly, there are 'interests' within the media. It is important to remember, however, that there are also 'interests' within science and particularly so as the amount of commercially sponsored science research increases (Jenkins 1997; Miller 1999). One of the strongest statements in this regard was written by John Sulston of the Human Genome Project (Sulston and Ferry 2003: 9):

> Insidiously, over the past few decades, the prevailing ethos in the world of science has shifted. What was once a collective enterprise, in which discoverers were acknowledged but their results freely shared, is now frequently constrained by the demands of commercial competition. Motivated by financial gain, hamstrung by sponsorship deals, or simply out of self-defence, many researchers trade their discoveries with the rest of the community only under the protection of patent law or commercial secrecy.

Values, viewpoints and science reporting

As we have seen, in most of its routine reporting, news coverage tends to be supportive of the scientific endeavour. It celebrates its achievements and the perceived benefits that flow therefrom. This view in itself is value laden.

An increasing amount of science-related news coverage focuses on social concerns or controversies that have a scientific dimension. In such circumstance, the news organisation may, quite overtly, take a stance on the issue. This viewpoint may be supportive of prevailing perspectives within mainstream science or oppositional. Since frequently the concerns or controversies become politicised, the viewpoint may be supportive of government policy or oppositional. Furthermore, the news organisation may also actively seek to influence its audience's views in relation to the issue. That is, it may 'campaign'.

As Keeble (2001) points out 'campaigns' form an important ingredient of many newspapers' activities. Among recent examples, the most high profile have probably related to the measles-mumps-rubella (MMR) vaccine and GM foods. Some absorbing accounts of the media treatment of these issues exist in the literature. In respect of the GM debate, the relevant chapters in Allan (2002), Durant and Lindsey (2000a) and Hargreaves and Ferguson (2000) make interesting, instructive and, at times, provocative reading.

It is worth noting, that, even in the heat of a campaign, journalistic conventions still apply, including the predisposition to quote contending opinion (Curran 1998; Hargreaves and Ferguson 2000: 43, 44). The latter, for example, point out that even the *Daily Mai*l, undoubtedly a paper 'on the warpath', provided readers with 'some plurality of information and opinion'.

Interestingly, the explicit positioning of a paper for or against an issue makes easier a critical evaluation of its reporting. Where the process is less obvious, the identification of values and viewpoints is rendered much more problematic. It is very difficult, particularly on the basis of one information source, to draw definite conclusions about the degree of partiality. More

generally, the decoding of ideological slant is typically a demanding and indeterminate task. With reason, Devereux (2003: 96) describes this as 'one of the most challenging areas of mass media analysis and debate'.

And finally ...

A lot of ground has been covered in this chapter. We have observed that some science-related news stories are written by specialists and some by generalists. We have noted that journalists work under constraints of time and space and this influences substantially the presentation of science-related issues as does the need to attract an audience. They follow certain codes and conventions. All media messages are inherently value laden. We have every right to expect fair and accurate journalism, however, we should recognise that news reporting is a distinct genre of science writing and it should not be judged by the same criteria used to judge science writing in academic contexts.

From a teaching perspective, we would want to bring to our students' attention the range of media sources reporting science in the news and the strengths and limitations of each. So as to aid their engagement with science in the news, we would want them to understand, at an appropriate level, the constraints under which journalists work and, as relevant, some of the codes and conventions of journalism. Above all, young people need to know that all media messages have embedded values and viewpoints. They should understand, however, that this applies as much to their science textbook as it does to the *Daily Mail*.

Endnote
Answers to 'match the headlines'.
1 *Daily Telegraph* **2** *Belfast Telegraph* **3** *Guardian* **4** *Daily Express* **5** *The Sun*

4 News reception, science news reception

Introduction

To be sure, in the UK more people watch the soap opera 'Coronation Street' than watch the news. Nonetheless, news attracts substantial audiences. On an 'average' sort of day in January 2006 it was estimated that just over 5 million people viewed the BBC evening news and just short of 5 million the ITN evening news. The *Daily Telegraph* (the top-selling 'broadsheet') had a circulation of over 900,000 and a readership of almost 2.2 million. The *Daily Mail* (the top selling 'middle market' paper) had a circulation of almost 2.4 million and a readership of almost 5.7 million. *The Sun* (the top-selling 'tabloid') had a circulation of 3.3 million and a readership of almost 8.3 million. Guardian online has an overall average daily traffic of 4.3 million, rising to 4.9 million on weekdays. That said, news audiences are declining and are lower than might be expected (and, perhaps hoped for) among the young.

This chapter looks in more detail at news reception. We will consider:

- the complexity of news reception
- whether we remember what we see, hear or read
- whether we are affected by what we see, hear or read
- current models of news reception in relation to socio-scientific issues
- how we may enhance our interpretative repertoires.

News reception: a complex process

We thought long and hard about presenting Chapter 3 as 'production' and Chapter 4 as 'reception' of news. It has the advantage, we hope, of making our discussion of 'science in the news' more readable. By the same token, it

could be considered to reinforce a commonly held, but deeply flawed, account of science communication (Figure 4.1). In this model, 'science declares, the media mediates, the public receives' (Hargreaves and Ferguson 2000: 40). Or, too often, this is portrayed as 'science declares, the media distorts, the public is duped'.

Figure 4.1 Transmission model of news reception

This crude transmission or 'canonical' model (Bucchi 1998) is linear and unidirectional and, as Dornan (1999) points out, essentially hierarchical. The roles of the scientists, journalists and 'the public' are fixed and discrete. The role ascribed to the public is passive; the audience simply absorbs information, ideas and ideology. Additionally, there is no provision for information or influence passing up the supposed 'communication chain'. The flow is fundamentally one way from scientists to audience via the media. The journalists concerned convey the message with either high (desirable) or low (undesirable) fidelity to the original.

Media scholars, and increasingly science communication scholars, have little time for such a transmission model, dismissing it as simplistic and misleading. With reason Devereux (2003: 138) writes:

> In discussing media audiences, and more particularly, the processes involved in the reception of mass media texts, we must recognise from the very outset the level of complexity involved.

Indeed, in the literature on media reception, the words complex and complexity crop up again and again and again.

The transmission model attributes little power to the audience of a media message, seeing members as merely passive receivers. This 'pessimistic conception', as Fowler (1991: 43) characterises it, can be challenged on a number of grounds, not least, he argues 'for the reason that it seems to prohibit on principle the possibility of critical readers understanding and taking issue with the implicit values of a (news) text'.

Current theories of audience assert that the viewer, listener, reader or surfer, far from being a passive receiver of news text, must be recognised as an active player in the process of meaning making. In essence, meaning is creatively constructed in the interaction between the individual and the text. Thus, not only is news production a process of construction, but news *reception* is also a process of construction. Furthermore, each of us brings our

own knowledge and experiences, opinions and beliefs to bear on this interaction. Just as, in science education, we have come to understand that what an individual learns from a science lesson is influenced by the ideas she or he already holds, so what an individual takes from a news text is influenced by the ideas she or he already holds.

For a science-related news story, the outcome of the process of meaning making will reflect not only the receiver's understanding of science and of media, but also, more generally his or her values and viewpoints (Norris and Phillips 1994). Different people, therefore, will 'read' the same media message in different ways.

This is not to propose (as might postmodernism) that news texts are entirely 'open' or indeterminate, amenable to any and every interpretation. The framing of the story by the journalists will suggest certain 'preferred' readings generating the news item's 'intended meaning'. Devereux (2003: 84) quotes research conducted by Deacon et al.:

> [T]here are dangers in overstating the interpretative freedom of the audience
> … The details (of our study) reveal a marked consistency between intended meaning at the point of production and audience understanding and interpretation of the text.

We must recognise, nonetheless, that there may be varying degrees of divergence between the 'intended meaning' of the news script and the meaning created by an individual interpreting that script.

Beyond interpretation, audience members possess considerable agency at the level of evaluation when encountering media texts. As the researchers cited by Devereux continue:

> This is not to say that audience members passively deferred to the text – on the contrary, we found substantial evidence of independent thought and scepticism.

Hall (1977) argues that, depending on their frames of reference, individuals may respond to a news script in one of three ways. They may accept the 'preferred reading' of the text, either because, on active reflection, it aligns with their own worldview or because their familiarity with the discursive norms of the particular news source render that reading 'natural' (Fowler 1991). More typically, they may take a 'negotiated' stance, accepting some aspects of the media message but adapting or rejecting others. Finally, they may take an 'oppositional' stance, recognising but rejecting outright the 'preferred reading' and 'intended meaning' of the message. Experience and research evidence shows that individuals can and do resist

or reject media messages (Macdonald 2003). Devereux (2003: 152) reminds us, though, that 'observing people … read against the grain of (a) media product does not mean the media lack power'. Indeed, they may simply be responding to the influence of other media messages!

One further possibility, which Hall identified later, is an 'aberrant position' where the individual fails to understand the preferred reading as, for example, may arise in respect of a science-related article where the journalist has assumed too much by way of a common stock of knowledge.

Do we remember what we see, hear or read?

Most of the media messages we receive, we forget (Gregory and Miller 1998; Titterington and Drummer 1999) and of those we remember, we recall little of their detail (Keeble 2001). Overall, we tend, in our routine encounters with news texts, not to afford them very close attention. After all, we watch news broadcasts while eating our evening meal, we listen to news bulletins while driving to the supermarket, we read the newspaper in our favourite coffee shop and we click through our homepage – a news aggregation site – on our way to booking a holiday.

Sometimes, however, we *do* remember and (as we shall see) occasionally, we react. It is in these circumstances that we need critical acumen.

Television is the main source of news for the majority of people in the UK (Lewis 2003; Ross and Nightingale 2003). From a research perspective, however, television viewing is harder to study than newspaper reading and we know less about science communication through broadcast media than through print media (Hargreaves and Ferguson 2000). Television is a visual medium that might be thought to promote engagement and understanding. However, the opportunity for a comprehensive treatment of issues is limited (the front page of a broadsheet is said to contain more words than a news bulletin) and we tend to watch television while doing other things.

Conventional wisdom has it that newspapers are a superior source of in-depth information and, in relation to political reportage, research has shown they are more strongly associated with the retention of knowledge since the reader is, of necessity, quite focused on the text (Ross and Nightingale 2003). There is some evidence, too, that this applies to science-related reporting (Titterington and Drummer 1999). Ross and Nightingale (2003) point out, however, that the television versus newspaper debate is largely academic since most people use a mix of sources to meet their information needs; neither, in our fast changing media landscape, do they limit themselves to traditional outlets.

Are we affected by what we see, hear or read?

We are now moving on to the Big Question in media studies: 'What is the effect of media on our perceptions, our opinions and our behaviour?'

There is an enormous literature on 'media effects'. Despite decades of study, however, there is little consensus among researchers as to the nature and extent of the influence of the media on audience perception, opinion or behaviour (Anderson 1997; Devereux 2003; Gregory and Miller 1998; Keeble 2001; Ross and Nightingale 2003). As McQuail (1991: 251) observes:

> The entire study of mass communication is based on the premise that there are effects from the media, yet it seems to be the issue on which there is least certainty and least agreement.

We should not be particularly surprised that this is so. The challenges associated with media effects research are immense. It is difficult, 'if not impossible' (Anderson 1997: 23) to separate the influence of television, radio, newspaper or whatever from other major social influences such as the family, peers, religion and education. The media are not monolithic and research suggests different channels may have different impact. How are 'effects' to be defined: short term or long term, temporary or permanent, as a change in perception or a change in behaviour, as a reinforcement of existing opinion (as appears to be the predominant outcome of political journalism) or as a transformation of opinion? Above all, since different people 'read' the same message in different ways, 'media effect' will depend as much on who is doing the viewing, listening, reading or surfing as on the content itself.

It is important to remember, then, that more modest claims are now made for the influence of the media than might have been made in the past. That said, Ross and Nightingale also acknowledge (2003: 78) that there is little doubt in the literature that the media do play some role in contributing to the social, economic and cultural landscape in which we live. They point out that 'most media scholars would cede some effect to mass media', the argument being 'less about if and more about how much'. Furthermore, given the contingent nature of audience reception, the degree of influence will differ for different individuals, depending on his or her background and beliefs (Miller 1999).

In the realm, specifically, of science-related news reporting, it is recognised that media influence may be greater than, for example it is in relation to political reporting.

There is evidence that it can prompt changes in behaviour. Adverse publicity about the combined measles–mumps–rubella (MMR) vaccine resulted in a drop in the numbers of children being brought forward for

vaccination. Reports that farmed salmon have higher levels of toxins than those from the wild resulted in a drop in sales of the product, a drop that was subsequently reversed by an award-winning TV advertising campaign by Scottish Quality Salmon. As Gregory and Miller (1998: 127) quip:

> Media coverage of suspect foods keeps people away from those counters at the supermarket; doctors are inundated with people who think they have a rare disease every time a cluster of cases is reported.

It is likely that we all can think of occasions when we have done something or ceased to do something because of a science-related item we have seen on television, heard on the radio, read on the internet or in the press. By the same token, there are also occasions when we have not responded at all.

Anderson (1997: 24) contends that 'one of the most striking ways in which the news media exert an individual and collective influence is through "agenda setting"'. Hence the often quoted statement, here in the form offered by Gregory and Miller (1998: 130):

> While the media may not necessarily tell people what to think, they do tell them what to think about.

Anderson (1997) is at pains to point out, however, that there is not a simple causal relationship between media agendas and public agendas. She thus supports those who suggest conceptualising the effect as a more nuanced 'agenda building' rather than 'agenda setting'.

While the television, radio, newspapers and news websites flag issues, they are also said to frame issues, that is, they suggest or invite certain interpretations in relation to those issues. Priest (1994) has conducted a very interesting series of studies in this connection, focusing on biotechnology reporting in the US press. She found that, at least at that time, journalists relied heavily on industrial and university sources and that the resultant coverage of the topic emphasised economic and other potential benefits of the new developments. Media coverage, then, was weighted towards a narrow range of issues. In addition, active genetic manipulation is a relatively new area of research and hence, it could be argued, the 'public' might be expected to have a narrow base of pre-existing knowledge and opinion.

It was hypothesised that if media framing existed anywhere, it ought to exist for a newly emerging, highly technical issue such as biotechnology. In fact, what was found was that the range of 'public' concerns about biotechnology was broader than the range of concerns reflected in news

coverage. Framing effects were observed, but were not as strong as had been predicted. However, Priest stresses that this should not be taken as evidence that framing is not a useful concept for understanding how science is communicated. She concludes:

> Important framing effects here, like other media effects, are likely to be subtle and long term; individuals' cognitive schemas are likely to be built up over time using information communicated in media frames. In other words, in the long run, the media are likely to be a critically important source of the general background understandings and expectations that readers bring to the interpretation of a new scientific development.

Thinking about 'risk' in the news

There are few 'effects-associated' issues that are discussed as much and understood as little as the effects flowing from the reporting of risk in the news media.

Risk, or more specifically in this context, how we perceive it, is a signally complex matter. Experience (and research) shows that there are both analytical and affective dimensions to our judgments. A number of factors affect our perception of risk – its scale, of course, and its nature, but also whether we have chosen the experience or had it imposed, whether we have some control over the process or have none, whether the risk is familiar or unfamiliar, whether it is natural or man made, whether we have faith in our informant or have not … and so on. Moreover, the risk–benefit trade-off is an important factor. Hence mobile phones seem here to stay, regardless of what reported research is said to say.

As Gregory and Miller (1998: 67) point out:

> The acceptability of risk is not connected in any straightforward way to the degree of risk.

We need to recognise then, in any consideration of risk, that to view its evaluation from simply a 'scientific-technical' (Peters 1999: 256) or 'rationalist' (Hornig 1993: 96) perspective presents a rather inadequate picture. As Hornig (1993: 98) points out we work with an 'expanded vocabulary of risk' that 'takes into account a broader and in a sense more sophisticated range of factors than do rationalist measures of risk'. These include, for example, compatibility with ethical principles, proposed regulatory procedures etc.

What is the role of the news media in communicating information, in influencing personal perception and in shaping the public debate in respect

of risk-related matters? It is generally acknowledged that news outlets are largely responsible for informing us about risk (Gregory and Miller 1998: 193). Thereafter, there is less we can say for sure. This statement, in itself, is important. It is, for example, simplistic, and thus unhelpful, to dismiss the media (or sections thereof) as merely scaremongers, fomenting fear for profit. If we wish to critically engage with the coverage of a risk-related issue in the news, we need to take a different approach.

First, we should appreciate (and we use the verb both in the sense of understanding and of valuing) that the news media have a vital role in alerting people to risk, in holding to account institutions and individuals who through omission or commission increase risk and in the provision of a public space for debating the acceptability of specific risks.

Second, as we watch, listen to or read about risk-related stories, we need to mobilise our knowledge of media to help us respond, critically, to the message. We should remember, for example, that:

- the operation of news values may predispose the media to cover disproportionately dramatic and exceptional risks, at the expense of ordinary and ongoing risks; they will also govern how the report is framed, illustrated and headlined
- time and space are at a premium, consequently the background and contextualisation necessary to address the complexities of risk issues will be restricted and may be inadequate
- all media messages have embedded values and viewpoints and, additionally, newspapers may campaign on risk issues.

Third, we need to mobilise our knowledge of science to help us respond, critically, to the message. We should remember, for example, that science-in-the-making is incomplete, uncertain and often in contention, but also as Thomas (1997: 164) stresses:

> Science is often not capable of providing clear answers to the cut and dried questions asked by public and politicians alike, for example, the magnitude of any risk to health. … Whether an agreed level of risk is socially acceptable requires deep thinking in areas beyond the realm of science.

Finally, we need to mobilise our knowledge of risk to help us respond, critically, to the message. We should remember, for example, that:

- risk evaluation requires information about the likelihood of an event as well as its potential effect, but also as Hornig (1993) stresses more beside

- risk evaluation involves quantification and 'the media tend not to deal particularly easily with numerical information' (Gregory and Miller 1998: 186); nor well, when we consider headlines trumpeting huge percentage rises for a small increase in instances of a small number of cases
- risk is often politicised. Its reporting, then, will be a value-laden representation of the ideological contests being waged over the characterisation of the risk issue (Allan 2002). Furthermore, the media may be actively obstructed in their attempt to obtain appropriate information by the institutions relevant to the case (Anderson 1997).

As indicated, risk is a complex issue and it is not possible to do it justice within the scope of this chapter. Appendix 1 lists a number of books that deal with this topic in more depth. A consideration of risk has recently been introduced into UK science curricula. Hopefully, this will stimulate the publication of appropriate professional and curricular support materials to assist teachers as they tackle these unfamiliar and difficult ideas.

Current models of news reception in relation to socio-scientific issues

This chapter opened with a consideration of a 'transmission' model of news reception: simple (indeed simplistic), unidirectional and static. It is clear from the subsequent discussion that this is grossly inadequate to the task of describing the dynamics of science-related reportage in the media, particularly in relation to controversial and highly politicised issues.

Although we remain (or so it seems to us) some way from representations that account satisfactorily for all that is known about science communication through the media, increasingly, and quite properly, the models currently being proposed are becoming more sophisticated.

To illustrate this we will discuss the model drawn up by Durant and Lindsey (2000a) describing the relationship between 'the public' and the media in the context of the GM food debate (Figure 4.2).

This model has many features that distinguish it from a 'transmission' view of science in the media. Most obviously, it is no longer a communicative chain, but a communicative circuit. It portrays the involvement of a greater number of actors and constituencies, each influencing and being influenced by the other. It is interactive, multidirectional and dynamic.

The model recognises, for example, that the audience affects the product. News editors broadcast and print not simply what they want to broadcast and print, but what they judge their audience wants them to

broadcast and print. Thus the media is seen as seeking to raise issues that 'resonate' with 'the public'. Where there is little or no resonance, media coverage may remain low key or a media campaign may be discontinued. Where an issue really resonates with 'the public', Durant and Lindsey (2000a: 6) propose:

> [M]edia coverage may escalate rapidly and media influence may be considerable. In this context, resonance may be thought of as a 'feed forward' mechanism between the media and public opinion, influencing both the overall level and tone of media coverage and the nature and strength of public opinion.

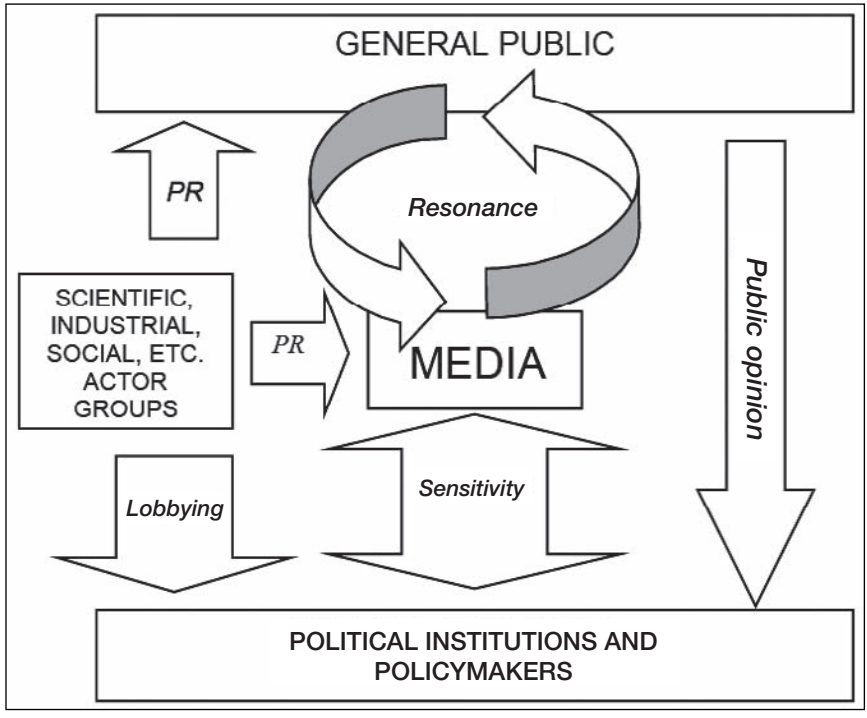

Figure 4.2 Durant and Lindsey's (2000a) model showing the relationship between the public and media

According to this model, we cannot properly understand the behaviour of the 'media' in isolation. All actors and constituencies need to be examined in the context of their interaction if we are to begin to understand the ways in which issues rise and fall on the public agenda. As indicated in the preceding section, 'trust' is an important aspect of risk perception. The BSE

crisis in the UK pre-dated the GM food debate. The official enquiry reported 'confidence in government pronouncements about risk was a further casualty of BSE' (Phillips 2000). Public trust in the government, its officials and its scientists had plummeted. Durant and Lindsay conclude 'the shape and course of the debate were the result of (a) constellation of factors', including the erosion of public confidence, the establishment of a powerful anti-GM coalition, the existence of prominent figures opposed to GM crops and, yes, intense competition in the press (Durant and Lindsey 2000b: 83). The tinder was dry; little was needed to set it alight. The spark, or trigger event, was a letter to the *Guardian* from about 20 scientists supporting Pusztai's critical claims (Durant and Lindsey 2000b).

Significantly Hargreaves, normally rather given to chiding scientists and science communicators for their philosophical and sociological naivete, speaks favourably of this model while suggesting that it still 'stops short of acknowledging in any serious way the true reflexivity of all these communication pathways' (Hargreaves and Ferguson 2000: 11). Against this background, they assert (ibid: 3):

> [T]o suggest as politicians and scientists often have during the GM food controversy, that the public is a malleable victim of distorting media is at best an oversimplification and at worst an outright deception.

Future models will have to take more account of the 'new media'. These have taken audience agency into a new realm with the boundaries between news producers and news consumers becoming increasingly blurred. Those with digital access have now the capacity through websites and news blogs to produce their own news texts ('citizen journalism') in the context of mainstream media sites or alternative media sites. In the last, in particular, stories may be told that would otherwise not have been told, angles presented that would otherwise not have been presented. At a lower level, it is common for online news sites to invite and publish readers' comments on news items, including science-related news items (Figure 4.3).

It remains to be seen how developments such as convergence between print, audio and visual media, 24/7 rolling news on television and 'citizen journalism' will impact on news production and reception in the long term. Of the last, Gillmor (2004) writes:

> Grassroots journalists are dismantling Big Media's monopoly on the news, transforming it from a lecture to a conversation. Not content to accept the news as reported, these readers-turned-reporters are publishing in real time to a world-wide audience.

Figure 4.3 Online science-related news stories frequently invite readers' comments

Enhancing our interpretative repertoires

As Fowler (1991) points out, acknowledging the agency of the audience in responding to media text opens up the possibility that we, as individuals, can develop our own criticality, a foundation for developing criticality among our students.

How, then, can we enhance our interpretative repertoires in respect of science-related news items? First, of course, we have to be attentive to science in the news. Over the last few years we have found this a very fulfilling experience.

Thereafter, it is helpful to have a mental checklist for interrogating news text. Informed by our reading of the literature (see Chapter 5; also Osborne 2000; Ratcliffe 2002) and our research within the Newsroom Project, we have compiled a list of guiding questions that can assist the critical reading of news stories, both those that present reports of scientific studies and those that present reports on socio-scientific issues (Appendices 2 and 3).

These questions, once internalised, can enhance our interpretative and analytical repertoires in relation to the coverage of science-related stories in the news. It must be stressed, however, that there are no cast-iron criteria for judging the trustworthiness of a news text. No more, however, are there cast-iron criteria for judging the trustworthiness of an expert.

Individuals, nevertheless, can be active and reflexive in their reception of news texts. As Macdonald (2003: 25) states, 'while we are subject to (news) discourse, we are not its victims'. It is this knowledge that has provided both rationale and stimulus for this book. It holds the prospect that we can work with young people to encourage them to engage with science in the news and to empower them to do so with a critical eye.

And finally ...

This and the previous two chapters have presented a brief overview of 'science in the news'. It should be stressed, however, that this in no way represents a definitive description of what is a very complex and nuanced field of scholarship. We hope, however, that it has provided some insights into features of an important genre – science news reporting.

The news media have the capacity to reach large numbers of people in a wide range of settings. They inform us about developments in science and how these may impact our daily lives. They offer interpretations of that science and of its applications and implications in and for society. Sometimes they attempt to persuade in relation to socio-scientific issues. Most often they simply aim to entertain us with interesting or intriguing stories. In all of this, they probably shape to a degree our perceptions, possibly our opinions and, perhaps, on occasion our behaviour. News reception, however, is complex and different people experience the same message differently.

From a teaching perspective, the key media-related ideas presented in the three chapters could be summarised as follows:

- Science-related stories are prevalent in the news. Often they are interesting and informative. Some address issues of considerable importance.
- Science news stories arise from a process of selection and 'construction'. They are produced for a variety of purposes but not expressly to educate.
- Science news stories follow the codes and conventions of journalism many of which spring from the constraints under which journalists work. All media messages have embedded values and points of view.
- All sources of science information have strengths and limitations. Significant science news stories call for a critical, reflective response.

5 What research tells us about news and science education

Introduction

Surprisingly, perhaps, this is largely uncharted water. Although (as we have seen in Chapter 1) science in the news and scientific literacy have long been linked in the literature and (as we shall see in this chapter) many science teachers make use of the news as an instructional resource, until recently there has been remarkably little research that could usefully inform their practice.

In the UK, the work of Wellington (1991, 1993) blazed a trail. His study of the reporting of science-related news and its potential to support teaching and learning in science revealed a substantial overlap between the topics covered in newspapers and those covered in the curriculum, an observation corroborated by others (see the interesting paper by Hutton 1996). Wellington indicated that science in the news provides an opportunity for teachers to integrate school science with science in the world beyond the classroom. From this starting point, he suggested possible avenues that teachers might explore in relation to the use of news resources and approaches they might adopt. His papers are well worth reading, as is his co-authored text on the broader theme of *Language and Literacy in Science Education* (Wellington and Osborne 2001).

In this chapter, we will review the relatively few studies that address science in the news and secondary science education. Almost exclusively, this research has centred on newspapers. The studies fall into two categories: those that focus on teachers and their use of science-related news reports and those that focus on young people and their perceptions and interpretation of science-related news reports.

In respect of teachers using news reports, we will highlight issues that relate to curriculum provision and to classroom practice. In respect of young people responding to news reports, we will highlight findings that provide insights which could inform teaching and learning about science in the news.

News in the science curriculum

If science teachers are, in the words of *Beyond 2000: Science Education for the Future* (Millar and Osborne 1998: 12), actively and effectively preparing young people to 'understand, and respond critically to, media reports of issues with a science component' then certain preconditions must, it could be argued, be in evidence. At school level, this objective should be explicit in the general statement of aims and the specific statement of content or intent of the courses on offer. All teachers should have this as an anticipated learning outcome for all their students. They should have in place a systematic programme for developing relevant knowledge and skill throughout the period of compulsory schooling.

The most extensive survey of secondary science teachers' practice in relation to the use of newspapers as a target and resource for teaching and learning was conducted in Northern Ireland (Jarman and McClune 2002). It involved 50 heads of science departments, representing a 20% sample of schools.

The heads of science were asked if issues relating to science in the media were included in their statements of aims and/or schemes of work. Only one in the first instance and two in the second instance indicated that this was so and then implicitly rather than explicitly.

To explore the extent to which newspaper science, while not accorded formal status within statements of policy and practice, was nonetheless considered, the heads of science were asked if the issue was ever discussed within their departments. Fewer than 30% reported that they could recall such conversations. Furthermore, the discussions were casual. There were no examples of the issue as an agenda item in departmental meetings. There were only a few examples of the intentional sharing of ideas. It was concluded that, at least in the context of the survey, if individuals use newspapers in their teaching, they act on their own initiative and not as a result of a school policy or programme designed to encourage young people to engage with science in the news and to empower them to do so critically.

Lack of policy or programme, however, does not imply lack of practice. The survey showed that a surprisingly large percentage of respondents (92%) had used newspapers at some time and in some way to support their work in the classroom. Of these, 78% had used them as a teaching resource (most often in respect of topics relating to environment, human biology/health, genetics and astronomy) and 14% had used them for display purposes only. Focusing on the former, a number of different patterns of use were identified.

Some teachers (34% of the sample) used newspapers *systematically*, year on year. This category was further subdivided into *proactive systematic users* (22%) and *reactive systematic users* (12%). The former actively sought out

newspaper articles to employ in their teaching; the latter 'came across' articles, but subsequently assimilated them into their programme. More than half of those who had used newspapers (44% of the total sample) did so *incidentally*, that is they 'came across' and capitalised on an article related to a topic they had taught, were teaching or were about to teach. However, no attempt was made subsequently to incorporate the media approach into their programme. The picture that is painted, then, is mostly of unplanned use of science in the news.

In a key question, teachers were asked to indicate their intentions in using print media. By far the most common purpose in using newspapers in the classroom was to highlight the links between school science and science in everyday life. They were considered to promote students' perception of the 'relevance' of the subject and so to stimulate their interest. Frequently, too, newspapers, particularly their colour supplements, were used as a source of photographs and graphics to enhance wall and corridor displays.

Newspapers were also acknowledged by departmental heads to be a source of information for themselves, keeping them up to date with developments in science and also, interestingly, providing them with anecdotes to add colour and, on occasion, spice, to their teaching. Only two other aims were mentioned by more than 10% of those surveyed. Some saw print media as reinforcing work covered in science class. The regional and community press were seen as resources that allowed teachers to set topics in local contexts so increasing their interest and impact.

It is contended, however, that one of the most important findings of this study related not to those intentions the science teachers referred to, but to those intentions, typically, they did not refer to. In particular, only two heads of department, both 'proactive systematic users', alluded to the use of newspapers to develop students' ability to critically examine and evaluate science reports in the media. No one referred directly to news as a source of lifelong learning in science.

This study shows that in Northern Ireland at least, it cannot be assumed that, when teachers use newspapers in the science classroom, their purpose is to promote a critical awareness of science in the media or to develop the ideals of lifelong learning. Neither, it is suggested, can it be assumed that if newspapers are being used for other purposes will these particular learning outcomes necessarily result (McClune and Jarman 2000).

During the survey, participants were invited to discuss what they saw as the drawbacks of incorporating newswork into their courses. The most frequently cited disadvantage related to the 'inaccurate' or 'misleading' science that media reports were thought to contain. A close second were concerns relating to examinations. Many mentioned either that content-heavy examination specifications left little time for such work or that it was of little value as it did not feature in the examination specifications.

Assessment is an influential factor in shaping practice. Where there is no substantial link between science in the media and assessment schemes, teachers and students may consider a study of news reports to be an unnecessary diversion (McClune and Jarman 2001, Ratcliffe and Grace 2003). Indeed, in our study, a head of department had stopped using newspapers when the text-based question was dropped from the exam paper. There is evidence to indicate that students too are anxious about examinations. As one teacher noted when referring to her students' response to news-based work in a GCSE biology lesson (McClune and Jarman 2000):

> *The class is very focused on examination syllabus and they felt that they did not have time for this 'irrelevant work'.*

In a preliminary report of our study (Jarman and McClune 1999) we noted that it would be instructive to conduct a similar survey in a context where 'science and society' issues had a higher profile either in a statutory curriculum or in schemes of assessment. A group of Canadian researchers took up our challenge, conducting a survey in Alberta, where the 'science technology society' (STS) theme is strongly emphasised in the provincial curriculum (Kachan et al. 2006). In their fascinating study, which broadened our work by looking at a range of media, they interviewed 10 teachers who taught a general science course and 14 who taught a biology course popular among those preparing for post-secondary education. The examination associated with the biology course included questions based on news texts. They found that *all* those surveyed used media reports in their teaching, sourcing them from newspapers (71% of the sample), magazines (58%), the internet (42%), television (33%) and radio (17%). As in our study, a very high percentage (70%) used the reports to demonstrate the relevance of science in society. Significantly, 50% of those responsible for the biology course, but none of those for the general science course, used news items to teach students how to critically evaluate media reports.

News in the science classroom

Developing the line of argument introduced in the previous section, if science teachers are actively and effectively preparing young people to 'understand, and respond critically to, media reports of issues with a science component' then further preconditions must be in evidence. At classroom level, all students should have the opportunity to explore science in the news across a range of media and to do so through approaches that actively involve them so as to promote learning. Teachers, as individuals or as interdisciplinary teams, should have the knowledge and skill to direct such work confidently and competently.

Although we encountered one teacher who encouraged the reading of short science-related articles among children with special needs, in our survey newspapers were used predominantly with older and more able students. Indeed one interviewee responded:

> *It is only with the Sixth Form (17–18-year-olds). I wouldn't dream of doing newspaper work elsewhere in school.*

In schools where this is the practice, the majority of young people are not granted the opportunity to study science in the news.

Among those who used newspapers in their science teaching, just over half used 'tabloids' and about 85% used 'broadsheets'. Science teachers in general tended to be suspicious of science reporting in the 'tabloids' and those who taught only more able students relied solely on the latter. However, those who taught across the ability range used both types of paper, considering that the reading level of articles in tabloid and 'mid-market' papers was more appropriately matched to the needs of their 'less able' students. If young people are to be encouraged and equipped to engage critically with science in the news, we would argue that there is merit in their exploring a range of media types.

Interviewees were invited to describe how they used news items in the classroom. Most simply read an article to or with their students and then engaged them in a short question/answer session or whole-class discussion. Beyond this, the most common approach was to refer students to newspapers as a source of information for project work. Also common was the preparation of comprehension exercises, where written questions were devised to accompany the newspaper text or image. In the examples seen in the survey, typically these questions were science related rather than science-in-the-media related. Only a few teachers focused quite specifically on the 'newspaperliness' of the resource. Only a few engaged their students actively in more participatory learning experiences. Some designed interesting and imaginative activities based around news items, but these teachers were in the minority.

Research that explores students' experiences of learning from science-related news is limited. Those studies that do, generally provide us with the teacher's perspective on the students' experience (one exception is Halkia and Mantzouridis 2005). Typically, it is reported, as in our survey, that young people respond well to newspaper-based activities finding them stimulating and enjoyable, often exceeding the expectations of teachers and learner alike (see Halkia and Mantzouridis 2005; Kachen et al. 2006; Ratcliffe and Grace 2003). A number of reasons are proposed; students are captivated by the 'real-world' quality of newspapers and by their 'adult' feel, their use represents a different approach from that more normally asso-

ciated with science lessons, often the articles are interesting or intriguing. However, it is noteworthy that a few believe news-based activities to be 'too much like English' This is a revealing comment that reminds us of the tendency of students to place boundaries on knowledge gained from different subject areas (McClune and Jarman 2000).

In our survey, participants were presented with a list of possible newspaper-related aims for science education and invited to indicate how important they considered each to be. Teachers were strongly in favour of 'relating science to everyday life' and this was consistent with their reported practice. Interestingly, however, they were almost equally supportive of the aim of helping children to 'critically evaluate science in the media' but their endorsement of this aim was not reflected in their practice. A considerable gap, then, was evident between attitude and action.

This disconnect is not difficult to explain. Most science teachers feel comfortable addressing issues of relevance. Their training and experience have highlighted the value of placing science in contexts that help students to appreciate its applications. It is self-evident how, at least in an unsophisticated way, news resources can be used for this purpose. In our survey, however, a very high percentage of respondents (84%) reported that they were, to some degree, lacking in confidence or competence to use news resources to promote students' criticality. Teachers reported that they were unfamiliar with suitable strategies and felt insecure with the ill-defined and uncertain outcomes likely to emerge from open-ended discussions. They rightly pointed out that many of the approaches commonly found in English class are not part of their repertoire neither do they feature strongly in their professional training, initial or ongoing:

> *It's hard because there are no right answers. It's hard for us and it's hard for the children.*
>
> *I don't think we are equipped to do that. I'm sure I'm not.*
>
> *It's not the sort of thing I've been brought up to do over the last 25 years. It's a classroom management issue – relinquishing control.*
>
> *I don't know how to encourage them to debate; I feel I am beating my head against a wall.*

Just how challenging change in this direction is is evidenced in the very candid case study of an initiative to introduce media-related activities into a school's GCSE programme described in Ratcliffe and Grace (2003). Here, even though the intended emphasis was on scientific enquiry and the evaluation of evidence, there was a tendency for the teachers involved to revert back to using news items as means to more simple ends.

In our survey, even that minority of teachers who considered that they could address the issue of critical engagement equated 'criticality' rather unproblematically with identifying 'biases' and 'mistakes'. More broadly, there was evidence among respondents of a rather restricted understanding of the nature of the media and, consequently, of the characteristics of science-in-the-media.

All this suggests that there might well be merit in cross-curricular cooperation. Through peer tutoring, support could be provided for science teachers enabling them to learn from the experience and expertise residing in other disciplines. Through coordinated programmes or co-teaching, specialists could play to their strengths. In addition the resulting consistency and continuity in teaching between different subject areas is likely to benefit students' learning (Norris and Phillips 1994). In our survey, evidence of cross-curricular cooperation or coordination was all but absent (see Figure 5.1).

Young people reading science-related news reports

Newspapers are commonplace things. That we are familiar with them is part of their appeal as a learning resource. Newspaper articles are often well written in an engaging style and at a language level appropriate to a wide audience with a range of reading abilities. However, reading science is more complex than we might assume. As Phillips and Norris (1999: 318; Norris and Phillips 1987: 282) warn us 'science text does not wear its meaning on the surface' and reading involves more than 'decoding written symbols into sounds or of concatenating the meanings of individual words'.

So while most teachers report that, before using a news item, they review it in relation to their students' reading level (specifically considering its length and its vocabulary), there are other important issues to be addressed if we are to help them engage, critically, with news. There is a limited amount of research that provides insights into how young people read science-related news reports and that can inform our priorities and practice in this regard. Knowing how students, untutored, typically respond to news text should help us design appropriate teaching programmes.

This work will be reviewed under five subheadings:

- interpreting expressed degrees of certainty
- interpreting the scientific status and role of statements
- adopting a critical stance in relation to text
- questioning news texts
- choosing among news texts.

- Studies show that a high proportion of teachers have used, at some time and in some way, newspapers to support their teaching
- Some teachers use newspapers in a systematic way, but many could be described as incidental users
- Teachers who use news resources typically do so on their own initiative and not as a result of policies or programmes designed to encourage and equip *all* students to engage critically with science in the news. Often it is only older, more able students who are given the opportunity to engage with science-related news items
- Newspapers generate interest among students and have a positive impact on the mood in the classroom
- A wide variety of topics are addressed by teachers through science reported in the news. Few, however, use such reports to teach about scientific enquiry
- Many teachers who use newspapers do so to illustrate the links between school science and the world beyond the classroom and to consolidate learning of school science topics
- Many teachers recognise the value of promoting among students the ability and aptitude to engage critically with science in the news, but few address these aims directly in their teaching
- Teachers express confidence in their ability to use newspapers to help students see the relevance of science in daily life, but few express their confidence in promoting among students skills of critical evaluation in relation to science in the news
- Typically, a narrow range of teaching strategies, primarily comprehension tasks and information searching, tend to dominate in science news work
- The study of science in the news is, essentially, an interdisciplinary issue, however cross-curricular collaboration is rare. Such collaboration may enhance an understanding among all teachers of important issues relating to the science–media–reader interface
- There is evidence to suggest that, in the absence of explicit reference to news-based science in the curriculum and or assessment schemes, the status of news-related science teaching may remain low

Figure 5.1 Summary of key issues relating to teachers' use of news reports

Interpreting expressed degrees of certainty

The work of Norris and Phillips (1994) and Norris et al. (2003) provides us with pertinent information in relation to young people's interpretation of the degree of certainty expressed in science writing.

In their initial study, 91 senior high school science students were invited to read five 'popular' (including newspaper) science articles. Before reading each text, they were asked a question designed to gain some

understanding of their background knowledge of, and beliefs about, the topic reported. After reading the text, they were asked to make decisions about a number of sentences based on statements in the report. These sentences were devised to explore the students' interpretation of three aspects of the account. First among these was the degree of reported or asserted certainty of particular statements.

It was found that the young people tended to overestimate the degree of certainty expressed in the articles. In the words of the researchers (Norris and Phillips 1994: 959) they demonstrated 'a bias toward truth ascription' by attributing to statements in the text a higher degree of certainty than was expressed by the authors. Interestingly, the writers implicate students' school experience in promoting this response. They contend that, given our curriculum, resources and assessment procedures – fact focused as they are – it is not surprising that students have acquired the view that science discourse ascribes only truth to statements.

Norris et al. (2003) subsequently extended this work, conducting a study of over 300 university students using a broadly similar research methodology but revised and refined survey instruments. They found the same result. The university students also demonstrated a 'certainty bias' in their responses to questions regarding the truth status of textual statements.

We have, in a sense, a double-whammy here. As noted in Chapters 2 and 3, there is a tendency for journalists, in the interests of newsworthiness and concision, to underplay the uncertainty that often accompanies scientists' reports of their work. Now we see there is a tendency for young people, while not dupes, nonetheless to display a 'certainty bias' in responding to news text!

Interpreting scientific status and role of statements

In the two studies just described, Norris and Phillips (1994) and Norris et al. (2003) also investigated the high school and university students' interpretation of the scientific status of pertinent statements in news reports and of the role of key statements in the chain of scientific reasoning. These related to the metalanguage of science and to the structure of its arguments, both crucial to the understanding of scientific discourse.

In respect of 'status', the researchers explored high school students' ability to recognise statements of causal claims, observation, 'what ought to be done' and methodology. They found that, while the great majority could recognise statements of observation and methodology, only about two-thirds recognised those indicating 'what ought to be done' and less than one-half recognised those indicating causal claims.

Among the university students, they found that the great majority could recognise statements of observation. Surprisingly, however, fewer

recognised statements of methodology than did high school students. Only about half recognised statements that described what prompted scientists to conduct their studies and only about one-third recognised causal and correlational statements.

In respect of the 'role' of statements within the chain of scientific reasoning, for high school students the researchers found just over half could recognise statements of conclusion drawn on the basis of reasons, less than half could recognise statements of evidence for other statements and less than one-tenth could recognise statements of justification for 'what ought to be done'.

Among the university students, Norris et al. (2003) found about 60% correctly identified evidence and prediction statements, but only about one-third could recognise statements of phenomenon and explanation.

Young people, then, were not notably adept at recognising the status and role of statements in scientific reports and had particular difficulty with those that were related to and dependent on other statements. There was also evidence that the university students in the study appeared overconfident in their ability to read the news articles, rating them easier than the results just seen would suggest. Significantly, scientific background was not strongly predictive of successful performance, forcing the researchers to conclude (2003: 139): 'Science education seemed to have very little to do with these important tasks associated with life-long learning of science and democratic citizenship.'

Adopting a critical stance in relation to text

Results from the initial study just described were further analysed to investigate how the high school students positioned themselves, more generally, in relation to the news texts. Three possible stances were identified (Phillips and Norris 1999: 317) Readers could:

- adopt a *critical stance* by engaging in interactive negotiation between the text and their background beliefs in an attempt to reach an interpretation that, as consistently and completely as possible, takes into account the text information and their background beliefs
- adopt a *dominant stance* toward the text by allowing their background beliefs to overwhelm the text information and thereby forcing an interpretation that cannot consistently and completely account for the text
- adopt a *deferential stance* toward the text by allowing the text to overwhelm their background beliefs and by reaching interpretations that are contradicted by their own beliefs.

Although one might hope that young people would adopt a 'critical stance' toward news text, the researchers presented evidence that the great majority deferred to the reports; at most one-fifth adopted a dominant stance and only a minority of students adopted critical positions toward the articles they read. The most influential factor in the students' response was what the reports said, not whether and why the reports should be believed.

Questioning news texts

'A hallmark of scientific literacy' argue Korpan et al. (1997: 518) 'is the ability to make effective requests for information or to ask good questions about scientific research'.

Acting on this premise, they examined the requests for information made by 60 university students as they evaluated four fictitious scientific news briefs, modelled on those that appear in the print media. The participants were asked:

> *Suppose that this conclusion is very important to you and that you must determine whether it is true. What additional pieces of information, if any, would you like to have about the researchers' report to decide whether the conclusion made is correct?*

Their responses were categorised according to the taxonomy shown in Figure 5.2.

Social context	Questions about prestige and bias related to who did the research or funded it and where it was conducted or published
Theory	Questions about why the reported effects might have occurred, including questions about the properties of the putative causal agent and underlying mechanisms
Methods	Questions about how the research was conducted
Data/statistics	Questions about what was observed in the reported study or about the statistical tests used
Related research	Questions about whether the findings have been replicated or fit other results
Relevance	Questions about importance or applicability of the findings

Figure 5.2 Categorisation of requests for information used in the Korpan et al. (1997) study

The findings showed that students focused most often and most consistently (across the four news briefs) on how the research was conducted ('method'). Rather less frequent, but more consistent than for the remaining categories were requests for information about why the results might have occurred ('theory'). The writers speculate that this concentration on the how and why of the science study may reflect recent emphasis on 'process-oriented' approaches to science education.

Almost all students requested information about 'data', but not as often as 'methods' or as consistently as 'methods' and 'theory'. Disappointing, in the words of the researchers, was the low frequency and the inconsistency of requests for information about the 'social context' of the science study. Less frequent still were requests for information about 'related research'. Again the writers consider that these findings may reflect our current emphasis of instruction where, typically, the social context of science and its consensual processes are underplayed. Rather regretfully, one senses, it is suggested that: 'Students' requests can be telling reflections of what we, as science educators, have taught them or failed to teach them about the nature of science' (Korpan et al. 1997: 529).

One advantage of the use of fictitious news briefs is the ability to write them 'to order' in such a way that text dimensions can be studied. The less plausible the conclusions presented the more questions were asked and particularly so in relation to 'social context'. The greater the relatedness to school science, the more frequent the requests for 'theory'. The more familiar the readers were with the context of the story, the more requests there were for 'data'.

In a follow-up study Korpan et al. (1999) investigated the response of four groups of young people, non-university students, first-year university students and fourth-year students majoring in English and in psychology. Again they found, across all four groups and all four news briefs, questions were focused primarily on 'method' and 'theory'. The psychology majors generated more questions than the other three groups, perhaps, it was suggested, reflecting their extended science education. Both English and psychology majors requested more information about 'social context' than did the other two groups. This was thought to stem from their contact with research communities during their time at university. All groups demonstrated a relatively low level of interest in 'data' and 'related research'. The overall pattern of response, then, was broadly similar to that obtained earlier, prompting the conclusion that there is need for explicit teaching aimed at helping students consider, critically, the broad range of aspects of science relevant to the evaluation of science news reports and especially, as noted in a subsequent paper, (Zimmerman et al. 2001) its social context and consensual processes.

Choosing among news texts

Finally, Halkia and Mantzouridis (2005) have explored students' attitudes toward newspaper science articles and preferences among them. Their sample comprised 351 15–17-year-olds. Each answered a number of background questions in relation to their reading habits. They were then presented with four science-related articles, invited to select one to read and asked to indicate the reasons for their choice. They were also asked what aspect of the article appealed most.

Their findings suggest that most young people do not read newspapers regularly with only 17% in their survey indicating that they did so. Among the very many science areas covered by the press, students preferred those connected with contemporary technological discoveries, cosmology and astronomy.

Participants were offered a choice from articles about:

- the possibility of a catastrophic asteroid–earth collision
- climate change and how it affects Greece
- robots replacing unskilled workers
- string theory in physics.

The students did not choose the story 'written in scientific language' with a lot of diagrams, graphs and conceptual maps, this despite the fact that the article referred to climate change, a phenomenon affecting their lives. The majority selected articles that presented provocative scientific issues and that were strong on narrative. Interestingly, their teachers chose exactly the opposite!

The students were asked to indicate why they chose the article they did. Their responses revealed that they were attracted by the thrill of danger and controversy and by an article's title, subject and/or its accompanying image (those that were evocative, not conceptual maps and abstract graphs). A few chose to read for 'self-education' or because the item related to their ongoing interests.

When invited to indicate what part of the article they liked most, students cited aspects associated with the communication code of newspapers (narrative structure, use of emotional and poetic language, use of analogies and metaphors, personalisation). They were also attracted to evocative images.

Young people reading science-related news reports in instructional settings

As Ratcliffe (1999) points out, these studies were conducted in clinical settings and in the absence of explicit teaching relating to the activity. In contrast, some of her media-based studies have been undertaken in instructional settings which adds an important dimension to their findings.

One study explored 12–14-year-old students' written evaluations of two media reports of science research. Fifty-six children, comprising three classes, participated. All were taught by the same experienced science teacher who introduced and managed the tasks associated with the study as normal classroom activities. The articles were taken from *New Scientist*, a popular weekly science and technology news magazine. They were read with the class and the students then answered a series of questions (Figure 5.3), focusing principally on their understanding of the chain of scientific reasoning, the evaluation of evidence and the interplay of evidence and theory. Their performance was compared with college science students (17-year-olds) and science graduates (trainee teachers) who completed the tasks under clinical conditions.

The vast majority of each of the three groups could distinguish between established facts and areas of uncertainty in the media reports, the former appearing easier to identify than the latter.

Many participants recognised the problems of extrapolating from insufficient evidence. (The hapless Chris may well keep quiet in future, see Figure 5.3.) About 80% of the science graduates demonstrated logical reasoning in explaining their position, pointing out the shortcomings of the research evidence presented. In comparison, only about 40% of school students and college students showed logical, albeit limited, reasoning.

It was considered (Ratcliffe 1999: 1085) that 'only through extensive experience of formal science education do skills of evidence evaluation develop fully'. Nevertheless, they were demonstrated to some degree across all groups. In contrast, then, to the 'depressing picture' that Ratcliffe (1999: 1086, 1097) perceives some other studies to present, she paints a brighter scene pointing out that even the younger students: 'In an instructional situation … can begin to unpick an evidence chain presented through a secondary source.' Consequently, she concludes, they 'exhibit the potential for (these) abilities to be developed through explicit teaching'.

Ratcliffe takes this further in a subsequent case study of a school-based initiative aimed at incorporating media reports into a modular GCSE science course (Ratcliffe and Grace 2003: 98–117). Toward the end of the year-long project, students' answers to a series of questions (Figure 5.3) were analysed by the researcher. Their responses were classified as mature, partial or naive. It was found that few showed 'naive' reasoning with many quite

'mature' (as defined) in their thinking. There was evidence, too, that the reasoning of those initially operating at a low level improved with increased exposure to news reports and structured questions. Students in a 'control class', in a non-project school, did not show as high a level of reasoning as those who had experienced some use of media reports throughout the year. Ratcliffe concludes (Ratcliffe and Grace 2003: 116): 'At one level the student responses are optimistic. A significant proportion of all classes could show mature reasoning but progression and reinforcement may depend on the opportunities given … to develop evaluation skills systematically.'

Questions asked in the 1999 Study

Underline any words or phrases which you do not understand

How interesting do you find this article?
Very interesting, quite interesting, not very interesting, boring

Make a list of questions or comments which come into your mind after reading the report

Write down one or two things in the article which are known for certain

Write down one or two things in the article about which there is some uncertainty

Chris has read this article and says:

This proves that plastic teething rings damage babies' livers
This proves that magnets change the chemistry in a swimming pool

Do you agree or disagree with Chris. Explain why you think this

Questions used in the 2003 Study

What do the researchers claim (i.e. what is the conclusion)?

What evidence is there to support this conclusion?

Is this evidence sufficient to support their claims? Explain your answer.

What further work, if any, would you suggest?

What scientific knowledge have the researchers used in explaining their results and claims?

Figure 5.3 Questions used in the Ratcliffe (1999, 2003) studies

- Young people tend to overestimate the degree of certainty expressed in news texts
- Young people have difficulty recognising the status and role of statements in the chain of scientific reasoning
- Only a minority of young people, in one study, adopted a critical stance to news text in such a way as to reach an interpretation that, consistently, took into account the text information and their background beliefs
- The questions young people asked about news text, when prompted, related primarily to how the research was carried out, the data that were produced and to possible explanations of the results. Questions about the social context of the research and about related research were less frequent
- Young people appeared more confident of their capability for critical evaluation of science in the news than their performance would warrant
- Young people respond positively to the communication code of news stories, to their narrative structure and their use of emotional and poetic language, analogies and metaphors and personalisation
- In instructional settings, students exhibit the potential for their interpretational skills to be developed in relation to news reports of science studies. There is some evidence that as a result of an extended programme of instruction students' reasoning abilities increased

Figure 5.4 Summary of key issues relating to young people's response to news reports

And finally ...

The research described in this chapter adds support to the contention that science reported in the media offers an excellent opportunity for teachers to integrate science in school with science in the wider world. Many teachers use science-related news reports and do so for this purpose. Many also appreciate their value to promote critical evaluation but they are unlikely to address this aim directly in their teaching. Often teachers indicate that they lack confidence and competence in this regard. To date little guidance has been available to suggest what might be an appropriate approach.

Those few studies that focus on students' response to news reports of science indicate that, typically, they react positively to their use in the classroom. However, reading about science in the news is a challenging business. To do so critically, requires particular knowledge and skill. Research shows that young people, while not naive, nonetheless display limitations in their approach to media text. Students are observed to overestimate the degree of certainty expressed in news stories. In addition, they may have

difficulty judging the status and role of important statements in the chain of science reasoning presented. They are apt to pose questions about some aspects of reported scientific research, but overlook others (see Figure 5.4).

The research discussed in this chapter, although narrow in compass, does offer important insights that can inform our planning and presentation of learning experiences to equip young people to engage more effectively with science in the news. It also, in a quotation from Zimmerman et al. (2001: 55), provides a good introduction to the rest of this book:

> In an age where rich sources of information about science are readily available in the popular visual and print media … in such a world, schools must focus on identifying and teaching foundational analytical skills with enduring intellectual value. Curricular reform designed to include a focus on learning to read, comprehend, and critically evaluate materials from the diverse and well developed genres of scientific writing would be of considerable benefit to students who are expected to become effective and scientifically literate citizens.

6 Thinking about aims, articles and activities

Introduction

There is an abundance of science-related news stories on television, on radio, in newspapers and on the internet. Indeed, we are in danger of being spoiled for choice. However, resource material alone neither ensures effective teaching nor promotes effective learning.

A useful parallel is laboratory work in science. Plainly, resources are necessary. However, as teachers, we also accept (even if we don't always act on it) it is important that we are clear about what the students are to do and, crucially, why they are doing it. So with science-related news work. Success depends on us giving careful consideration to our intended learning outcomes and to appropriate learning experiences in addition to selecting suitable news items. Indeed, to keep this in mind we have found the '3As' triangle a useful aide-mémoire (Figure 6.1).

Learning outcomes, activities and resources are closely interlinked. No matter how interesting a news story may be, to justify its use in the classroom it should be linked to intended learning outcomes. No matter how enticing the learning activities suggested by a news story may be, to justify their use in the classroom they should support the achievement of the identified learning outcomes. If we do not have a clear view on what, broadly, is to be accomplished through employing news resources and engaging in news-related tasks, then it is likely that learning will advance little beyond the superficial.

This book has two principal aims. The first, to present an overview of 'science in the news', has been the theme of the first five chapters. The second is to take the notion of 'a critical response to science in the news' and to tease out what it might mean in terms of teaching objectives and learning outcomes for our students. Once these have been identified, relevant teaching approaches and learning activities will be suggested. In this way we hope to support teachers as they tackle this important aspect of the promotion of scientific literacy.

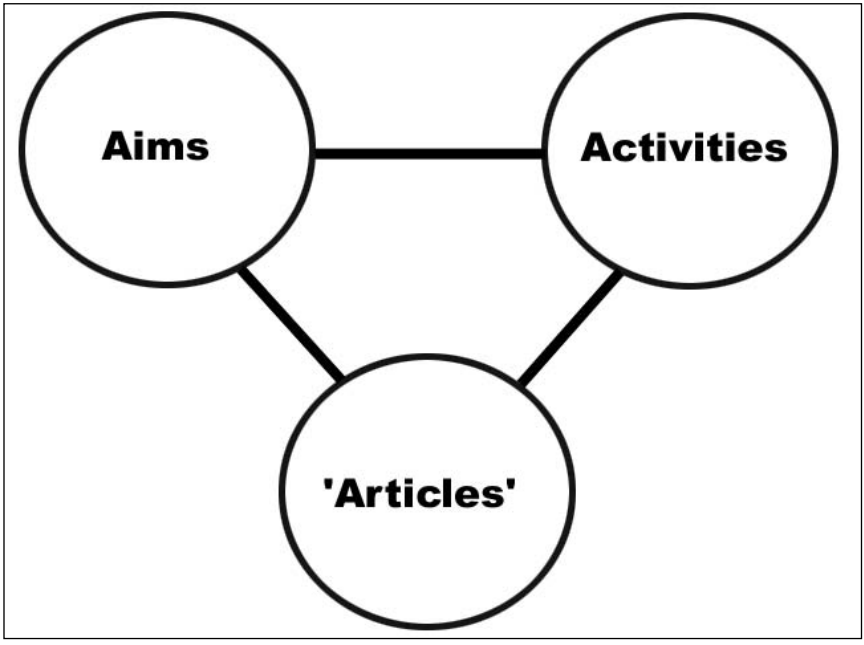

Figure 6.1 The '3As' aide-mémoire for considering use of news items

Selection of 'aims' for science-related news work

Before we embark on a more detailed discussion of learning outcomes, three general points should be made.

Most news items with a science component could be used to promote a range of objectives relating to science, its applications in society and its presentation in the media. It is therefore important to decide beforehand which, among this complex of aims, will be the focus of the lesson. Such separating out of a few potential learning outcomes may seem rather artificial but it avoids activities becoming unfocused or in Davison's (1992: 27) words 'woolly' and 'simply time-consuming'. Neither does it preclude the possibility of other learning occurring.

Second, many teachers share their intended learning outcomes with their students at the beginning of an activity, lesson or topic. This practice is particularly important in relation to science newswork. Not only does it make explicit the focus of the lesson but it offers the opportunity to discuss with students why you are tackling themes not traditionally associated with science. This may avert the resistance sometimes encountered when young people face new ways of working in a particular subject area (Glaser and Carson 2005; Jenkins 1997; McClune and Jarman 2000).

Third, the ideal is that, during a student's time at school or college, opportunities are provided for participation in a programme designed to address, systematically and with suitable reinforcement, the range of desired learning outcomes that would equip the young person to engage critically with science in the news. We will return to this issue later in the book.

In Chapter 1, we offered six interrelated contributions that studying science in the news could make to a student's education in and through science:

- illustrating the 'relevance' of science
- fostering students' engagement with science
- supporting learning in science
- supporting learning through science
- encouraging lifelong learning
- promoting scientific literacy.

We will briefly refer to the first four before a more detailed discussion of the last two.

Relevance

As discussed in Chapter 5, research indicates that the great majority of science teachers who use newspapers in their classrooms do so to demonstrate the relevance of science in daily life. This is an important aim and one well worth pursuing. Not only each science news item but also the sheer quantity of science news items shouts this message loudly. We should most certainly exploit the resource with the specific aim of illustrating the links between science in school and science in the wider world.

Engagement

By taking advantage of the nature of news media we can enliven science teaching by enhancing interest in a topic and, potentially, engagement with the subject. News has a novelty value in the classroom; headlines are arresting, images and graphics are eye catching, items focus on newsworthy and therefore interest-grabbing issues, typically they are presented in an accessible style. Importantly, news reports tell stories. Research shows that students respond positively to news-based activities. With the aim of fostering a more long-term engagement with science in mind, we might point out quite explicitly to students that, just has they have found the science-related news items studied in class interesting and instructive, so they may find other science-related news items interesting and instructive. Who knows, this may act as a springboard to lifelong learning in science.

Learning in and through science

News, whether in broadcast or print media, can be used to support learning in science and through science. In Chapter 7, we will discuss aims associated with the learning of science 'content' and learning about science enquiry. In Chapter 8, we will discuss aims associated with learning about science and society.

Learning outcomes associated with scientific literacy, including lifelong learning

In the literature, the link between scientific literacy, lifelong learning and an aptitude to access and ability to engage critically with science in the news is prominent. Thus, for example, Norris and Phillips (1994: 962), commenting on the failure of participants in their study to interpret key aspects of science-related media reports, conclude:

> Such individuals are unlikely to be able to play the role that is expected of scientifically literate citizens and unlikely to keep abreast of developments in science.

In the context of scientific literacy, then, it is important that we look very specifically at instructional aims that would encourage young people to engage with science in the news and equip them to do so with a degree of criticality. In discussing these we will be drawing heavily on our Newsroom Project described in Chapter 1. In this project, a number of 'science in the media experts' (science journalists, science communication scholars, media scholars, science educators and media educators) and a group of teachers (of science and of English) were asked:

> *What knowledge, skills and habits of mind do you consider would be useful to individuals as they engage with science-related articles in newspapers?*

Their proposals were used to formulate a list of potential 'desirable learning outcomes' describing 'critical engagement'. This was reviewed by the teachers' group to decide which suggestions were likely to be achievable with students of secondary school age. In addition the teachers assigned, tentatively, a level of demand to each proposal. The revised list was restructured to provide a pedagogical model that was considered to be manageable in the school setting (McClune 2006). A modified version of this is presented in this section.

In order for young people to engage with science in the news they must successfully bring together a number of different elements from their previous learning experiences. They need to develop the capability to access and analyse the rreports, that is the combination of knowledge and skills, attitudes and aptitude necessary to weigh science in the news.

Figure 6.2 illustrates the two-dimensional form of the 'operational model'. It comprises four key (but strongly interdependent) elements, 'science knowledge', 'media awareness', 'literacy skills' and 'discerning habits of mind'. 'Critical engagement' lies at the centre of the elements and connected to each of them, denoting that it is achieved by drawing on all four constituent elements.

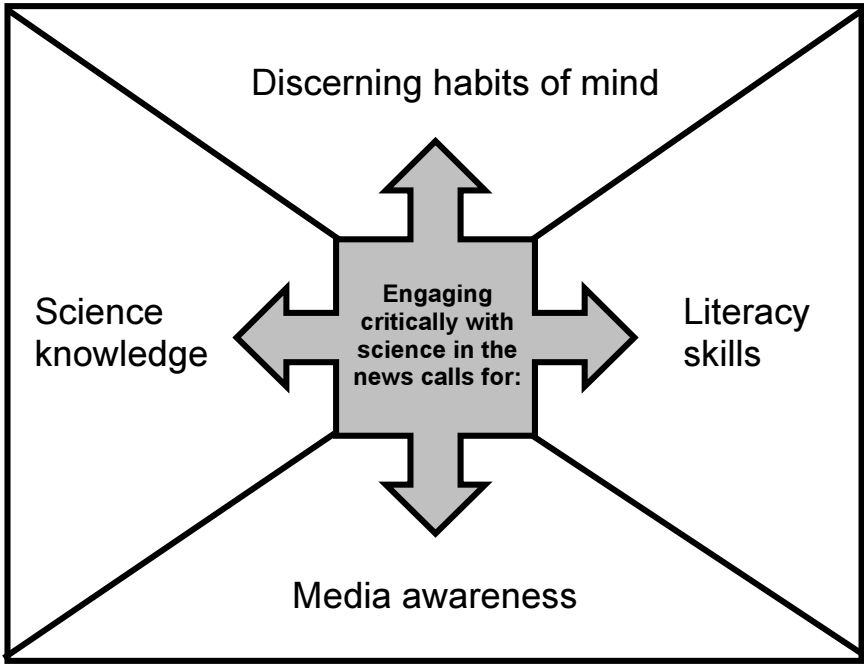

Figure 6.2. The four elements of 'critical engagement'

In order to access a science-based news report some basic *knowledge of science and how it works* is both assumed by the writer and required by the viewer, listener or reader. The subject and extent of this knowledge will depend on the focus of the news item. Thus for example, a news story describing the landing of a space probe on Mars presupposes some knowledge of the solar system and our place within it. However, accessibility is a *sine qua non* of mass media and, typically, the science demand is not high. Furthermore, individuals with different degrees of knowledge are able to

access news reports at different levels. A greater understanding of science may grant more insight, prompt more questioning and occasion more research.

Media awareness refers to a basic appreciation of media production and presentation. This requires insight into the construction of news including the day-to-day practices and pressures of journalism. The media-aware student, for example, will ask questions about the devices used to catch the attention of the audience and shape members' responses. He or she will know that media messages are produced for particular purposes and that all have embedded values and points of view. He or she will query what is omitted from the message that might be important to know.

The *literacy skills* needed to access science in the news include reading and comprehension skills. In addition, it is recognised that students need to deploy higher level skills of inference and interpretation, analysis and synthesis. They need to be apt and able to question. For many teachers the reading level required is a starting point in considering the appropriateness of a newspaper article. However there are other important, literacy-related issues to be addressed if we are to help students take a properly critical stance toward news text.

'*Habits of mind*' describe a range of personal attributes such as curiosity, a pleasure in knowing, a reasonable scepticism, a desire to hear both sides of an argument and even the sheer doggedness required to read a long newspaper article or listen to a long report. In particular, students should be encouraged (as appropriate) to have confidence in their ability to form an independent, but well-judged, opinion. This element is perhaps less tangible than the others. It must be acknowledged that, while we may embrace the spirit of this aspect of 'critical engagement', we have much to learn about how such qualities may best be developed.

In order for the model to be useful in the classroom, each of its elements is further expressed in terms of desirable learning outcomes, see Figure 6.3a–d. Taken together, they form the building blocks of a systematic and progressive programme designed to promote both interest in science in the news and skilfulness in its interpretation and evaluation.

The learning outcomes are 'developmental' in that they represent steps along the path to emergent 'emergent capability'. Teachers in the Newsroom Project allocated each objective to one of three levels; foundation, intermediate or higher level. In most cases, a simple statement exists at one level with more demanding, but closely related statements occurring at higher levels. Thus, within each element, 'strands' can be identified across the levels. For example, in relation to the strand 'science enquiry' at the foundation level students, through conducting simple science investgations, learn about obtaining, presenting and evaluating evidence. At a higher level, they take that learning further, but also explore how science

Science Knowledge Learning Outcomes

FOUNDATION LEVEL

Science content (topic awareness)

1 Students should begin to build up their knowledge of the key ideas and terminology of science

Science Enquiry

2 Students should have a basic understanding of scientific enquiry gained through experience of carrying out simple investigations

Science and society

3 Students should be aware that science is applied in daily life

INTERMEDIATE LEVEL

Science content (topic awareness)

4 Students should have some background knowledge of the science topic to which the news item refers

Science enquiry

5 Students should broaden their understanding to include a basic awareness of how science enquiry proceeds in scientific communities, including the role of peer review in the process and the uncertainty always associated with science-in-the-making

Science and society

6 Students should know that the application of science in society is not always straightforward and may raise ethical and moral questions. The characterisation of 'risk' is particularly difficult

HIGHER LEVEL

Science content (topic awareness)

7 Students should learn to evaluate new information by comparing it to what they already know and to information from other sources

Science enquiry

8 Students should recognise that judging the authority and 'interests' of sources of scientific information is important in evaluating that information

Science and society

9 Students should recognise the power but also the limitations of science in respect of challenging socio-scientific issues such as risk assessment

Figure 6.3a Suggested learning outcomes in relation to science knowledge

knowledge is established within the scientific community through processes such as peer review and publication.

Media Awareness Learning Outcomes

FOUNDATION LEVEL

News presentation and reception

1 Students should be aware that there are many science stories in the news – often they are interesting and sometimes important. These stories can be accessed through a number of media, each having its strengths and limitations

News production

2 Students should recognise that what counts as news is selected by journalists who also select the content and 'angle' of the story

3 Students should have some knowledge of how news stories are put together, including their conventions and the constraints under which journalists work

INTERMEDIATE LEVEL

News presentation and reception

4 Students should recognise that news reporting serves a number of purposes, including profit-making, and be aware of the implications of these

News production

5 Students should be aware that all news messages have embedded values, even those required to be impartial. Newspapers may take positions on issues and students should recognise how they may attempt to influence readers

HIGHER LEVEL

News presentation and peception

6 Students should be aware of the role of news media in a democracy

News production

7 Students should be aware that, in the interests of 'balance', opposing opinions may be reported, although one represents a majority view and the other a minority view

Figure 6.3b Suggested learning outcomes in relation to media awareness

The level achievable within each element of the framework will depend on the age, ability and prior experience of the students. Consideration, then, needs to be given to the selection of appropriate learning goals for individuals and class groups.

Interestingly, we have found it helpful to visualise the framework as not only a two-dimensional but also as a three-dimensional model. Appropriately perhaps, this takes the form of an 'inverted pyramid' (indeed, a more convincing one than that mentioned in Chapter 3) with its four faces representing, in turn, science knowledge, media awareness, literacy skills and discerning habits of mind. This illustrates well how the development from foundation (apex), through intermediate to higher levels of learning within each element extends that element and also the capacity for 'critical engagement' as a whole.

Literacy Skills Learning Outcomes

FOUNDATION LEVEL

Reading and comprehension

1 Students should acquire basic reading and comprehension skills

2 Students should acquire appropriate reading skills for different formats found in news items e.g. images, graphs, tables

INTERMEDIATE LEVEL

Reading and comprehension

3 Students should be able to scan news text to identify important facts and to close read news text to identify qualifying statements and follow an argument

4 Students should recognise the need to consult a range of sources of information when dealing with issues of importance

Language and vocabulary

5 Students should be able to cope with the technical and non-technical vocabulary in a story

6 Students should be able to recognise statements of opinion and persuasion, including the identification of emotive language

HIGHER LEVEL

Reading and comprehension

7 Students should be able to explain, in an informed manner, the grounds on which they agree or disagree with the viewpoints presented in news items

Figure 6.3c Suggested learning outcomes in relation to literacy skills

Selection of 'articles' for science-related news work

News items are not written with the school science curriculum in mind. That said, a great deal of news maps on to school science curricula in relation to biology, certainly, but also to chemistry and physics and, particularly, to scientific enquiry (Hutton 1996; Wellington 1991).

Understandably, for many science teachers the science topic (photosynthesis, plastics, nuclear power, etc.) is the starting point when selecting a news item. If this is the only or even the main criterion employed, however, many potentially useful resources will be overlooked. In order to address the range of learning outcomes already outlined some science-related news items may need to be included which have only tenuous links (or none at all) to traditional school science topics but which could serve as contexts for realising other important objectives in respect of science in the media and scientific literacy. Essentially, news items need to be selected with aims in mind.

Discerning Habits of Mind

FOUNDATION/INTERMEDIATE

Enquiring attitude

1 Students should be enthusiastic and interested in discovering more about science in the news

Critical and reflective attitude

2 Students should recognise that news may alert them to important issues. They should be willing to consult news media, but also to have realistic expectations of them

3 Students should approach the ideas presented in the news with an open mind, and a constructively critical attitude

INTERMEDIATE/HIGHER

Critical and reflective attitude

4 Students should reflect on what a news item means for them as individuals and members of a wider community

5 Students should expect to make judgements on socio-scientific issues. They should have the confidence to seek out scientific information to help them develop informed opinions and make informed decisions relating to such issues

Enquiring attitude

6 Students should recognise that science is an important part of their lives and culture

Figure 6.3d Suggested learning outcomes in relation to 'discerning habits of mind'

It is worth remembering that, aside from news reports in broadcast and print media, there are other news-related resources that can also be used in the classroom. Over the last number of years, for example, we have come across teachers employing the following components of newspapers:

> Advertisements, articles, editorial cartoons, graphics, headlines, job advertisements, letters to the editor, obituaries, photographs, stock market prices, weather forecasts

You might like to identify those few components that are absent from this list and consider whether and how they also could be used in science teaching.

We believe it is important to select news items from a range of news media and, for each medium, from a range of providers. Thus, we consider articles should be drawn from 'broadsheet', 'mid-market' and 'tabloid' newspapers (see also Hutton 1996; Wellington 1991; Zimmerman et al. 2001). We say this for a number of reasons. Compared to the former, in the popular press the stories tend to be shorter, their reading level lower and

their style more engaging. As noted in Chapter 3, contrary to what many people think, experts in the portrayal of science in the media point to some fine reporting in some sections of the tabloid/mid-market press, most notably where the writer is a specialist science, health or environmental journalist. Furthermore, popular newspapers are those most frequently read. To equip young people to engage, critically, with the science they contain is thus an important part of preparing them to cope with the science they will encounter in everyday life.

Finally, in this subsection, a couple of practical points. If possible, select news items that you think the students will relate to. For some, account will need to be taken of the sensitivities associated with some of the issues covered. If using newspapers, you may find it helpful to laminate the clippings – but watch what is on the back! Solicit the help of others in gathering resources. Be warned, however, that the experience of most teachers setting out to collect science-related news reports is that very soon they have more than they can manage. Early in the process, arrange an efficient archival system.

Supporting those with reading difficulties

The demand of the news items you choose will vary depending on the age and ability of the young people for whom they are intended. For some students, however, the language level and length of newspaper articles will pose problems, even when care has been taken to select otherwise suitable material. In such circumstances, it may be necessary to abridge the article or to use extracts rather than the entire text. Associated activities may also need to be differentiated.

Alternatively, the article may be introduced little by little. This is much less threatening for a weaker reader. Indeed, on occasion the use of headlines and/or images may be sufficient while at other times it might be enough simply to give students a flavour of the story. It is important to remember that the use of newspapers does not imply the need to study each and every relevant article in its entirety.

There are a number of other approaches that may increase the accessibility of the article to those with reading difficulties. Key words and phrases can be discussed beforehand and displayed, along with their explanations, around the classroom. This should increase students' familiarity with the important terms. The words could be highlighted on the article beforehand – to do so in colour works well. Alternatively, they could be put into a 'word grid'. The students are asked to locate the word in the grid then match it to a series of potential meanings. This is a 'fun' reading activity and the matching of word to appropriate meaning prepares them in advance and removes the threat of encountering the term for the first time in a lengthy text.

Students can be introduced to the newspaper article through a series of quiz-type questions, literal in nature but encouraging them to focus, individually or in pairs, on the text and actively seek out information. If set up almost like a table quiz, this can be presented in an entertaining way and the award of small prizes can stimulate even the most reluctant reader.

Although this takes time, a potential article can be cut up into sections and students challenged to put it back together in the correct order. This sequencing activity familiarises them with its structure and encourages them to read closely and carefully, looking for clues to link the sections together.

Reading support can also be provided. It might be a good idea for the teacher to read the article aloud with the class. Paired reading is also a possibility. This could involve two students together, a student and teacher, a student and classroom assistant or even a student and an older 'mentor'. A brief explanation of any words and terms that cause difficulty can be given as the reading progresses. The modelling of skilful practice in relation to comprehension strategies for informational texts is also important.

And finally ...

In this chapter, we have stressed the need to consider carefully our intended learning outcomes when using science-related news material in the classroom. We have also offered a framework (albeit provisional) which presents some of those considered to underpin that aspect of scientific literacy concerning the aptitude and ability to engage critically with science in the news. It also provides a guide for the design of a systematic, progressive and, ideally, multidisciplinary approach to the development of students' knowledge and skill in this regard.

It is hoped that this model, or at least the approach it encapsulates, will support those teachers who wish to awaken, among their students, an interest in science in the news and, in Fuenzalida's words (1992: 142), to promote, as necessary, 'a transition from unquestioning reception towards discriminating perception' in relation to science in the news.

We have also discussed the selection of resources to support the achievement of a range of desirable learning outcomes for science news work. With regard to the use of print media in the classroom, a number of suggestions have been made for helping those students with reading difficulties.

You may have noticed, however, that the title of this chapter notwithstanding, little mention has yet been made of 'activities'. These form the subject of the following four chapters that present exemplar lesson outlines and stand alone activities with reference to:

- using news to teach about science 'content' and 'enquiry'
- using news to teach about science and society
- teaching about science in the news
- working together to ensure 'science in the news' a place in the curriculum.

7 Using the news to teach about science 'content' and 'enquiry'

Introduction

The paragraph starts: 'We have in our solar system four "terrestrial" or "rocky" planets – Mercury, Venus, Earth and Mars.' It continues: 'We also have four "Jovian" or "gas giant" planets – Jupiter, Saturn, Uranus and Neptune.' But this is not an extract from a science textbook. It is an article in the *Guardian* newspaper, part of the massive media coverage accompanying the International Astronomical Union's reclassification of Pluto.

Given the science richness of some science-related news stories, they can readily be used to support the learning of science subject matter knowledge or 'content', that is, its key facts, concepts, principles, theories and models. Certain news items can also be used to help students learn about science 'enquiry', that is how science knowledge claims are developed and established.

This chapter considers the use of news for teaching about science 'content' (knowledge in science) and about science 'enquiry' (knowledge about science). It then presents three 'exemplar' lessons, one relating to the former and two to the latter.

Science 'content': teaching approaches and learning experiences

News stories with a science component, whether broadcast or print, can be used for a number of different purposes in relation to the teaching and learning of science subject knowledge. They can stimulate interest and catch students' attention when a topic is being introduced. During the course of teaching a topic, they can have a role in developing students' understanding. As their knowledge of a topic increases, news reports can be a valuable resource for consolidating, extending and assessing students' understanding. Thus new items can act as:

- mind captures/motivators to introduce science lessons or topics
- points of departure for researching science topics
- sources of science information for developing knowledge and understanding
- sources of science information for consolidating and extending knowledge and understanding
- resources for revision activities
- resources for assessment activities.

A number of these approaches will be illustrated in the examples discussed and the exemplar teaching sequences outlined subsequently.

Introducing topics and lessons

News reports are valuable for introducing a new topic or lesson. Their potential lies in the teacher's ability to exploit one of a number of their characteristic features.

First, news belongs to the adult world beyond the classroom. It appeals to students not least because it is perceived to be a little out of place in the science lesson.

Second, news reports are by nature attention seeking. As we have seen in earlier chapters, they employ particular devices designed to get them noticed. Their headlines and images are skilfully presented to maximise impact. They focus on interesting aspects of a subject, use topical references and are written in an engaging style. Although intended to attract the casual viewer, listener or reader, these characteristics can also serve to attract students' attention and to whet their appetite for the science topic they are about to study. Thus a news item 'Nobody under 18 should use a sunbed' could be used to introduce a series of lessons on the electromagnetic spectrum. A news article 'Big breakthrough in fight against blindness' could introduce a series of lessons on the structure and function of the eye, the headline and image stimulating questions such as 'What is the eye like?' 'How does it work?' 'What might cause blindness?' A news web page reporting on the salt content of potato crisps could offer a much more interesting introduction to 'separating salt' than that normally granted first year secondary school children. Such mind captures and motivators capitalise on the news producers' imperative – they must attract and hold an audience.

Third, some news items can provide starting points for other activities. They may suggest questions to be answered, issues to be researched and tasks for students to embark on. Figure 7.1 gives an example of an article that could be used to launch a study of feeding relationships and how predation and competition for resources affect the size of populations. It could also form the point of departure for an information search on ecological

problems resulting from the introduction of non-native species. Using the internet, students could investigate other instances – the introduction of possums to New Zealand being a well-documented example.

Daily Express 28 December 2005

Foreign invaders leave our ladybirds facing extinction

By Emma Bamford

Britain's native ladybirds could be wiped out within three years as a devastating foreign invader seizes their food supply. Experts have worried for some time that the harlequin ladybird, originally from Southeast Asia, could be a threat to Britain's 46 species. Now they are warning that the effects could be worse than thought – and our varieties could become extinct by 2008.

Harlequins are rounder and slightly larger than most British species, measuring 5mm (one-fifth of an inch) to 8mm across. British ladybirds are mainly red, with two, five or seven black spots on their backs. Harlequins have an orange body with up to 22 black spots or a black body with two to four orange spots.

They are a threat because they feed greedily on greenfly, leaving no food for other varieties. And when they run out of greenfly, they feast on other ladybirds.

Harlequins were imported to America in 1988 to curb greenfly. A few years later, France, Holland and Belgium did the same. But entomologists noticed that native varieties were dying out.

A harlequin was first seen in Britain in September last year, at a pub in Sible Hedingham, Essex. It is believed to have reached the UK in a cargo of vegetables or plants.

Harlequins have also been seen as far away as Devon and Derby. There is a huge colony in a Great Yarmouth cemetery. Experts believe there could be millions of them by now, as a single pair can produce 2,000 eggs.

Britain's soft-fruit industry could also be at risk from harlequins: they damage raspberry and strawberry crops by sucking out the juice. In winter, they move into houses and the sticky, dark fluid they secrete destroys soft furnishings.

Dr Mike Majerus of Cambridge University said: 'I don't know of a worse ecological disaster. Harlequins will be all over Britain by the end of 2008 and our native ladybirds will suffer greatly.'

Matt Shardlow, of the Invertebrate Conservation Trust, said: 'The harlequin may sound like a bit of a jester but there's nothing funny about it.'

Figure 7.1 Using a news item as a starting point for research

During a topic or lesson: developing students' learning in science

The value of news items extends beyond their ability to attract attention and generate interest at the start of the lesson. They can be used as the central resource in a science lesson aimed at developing students' knowledge and understanding of a topic.

A single news report or several related reports may be the focus of teaching and learning activities with a view to:

- presenting factual information
- presenting scientific or technical vocabulary
- encouraging students to present what they have been learning in another form
- encouraging students to apply what they have been learning in new situations, so providing further exemplification.

Teachers commonly use 'comprehension'-type tasks in relation to texts and these can help students to learn important science-related information contained in a news story and to observe how this knowledge contributes to their overall understanding of the issues involved. A number of devices such as factual questions, true and false questions, 'find and underline' tasks and summarising or explaining exercises can be used in this regard. As Wellington (1993) suggests, it is sensible to start with simple, closed questions, merely asking for information and then to move on to the more difficult, open-ended questions perhaps asking for an element of discussion and evaluation.

A detailed look at specific words and phrases that are central to the topic can help young people develop their subject specific vocabulary. It will often be the case that the news item (when used for development) will be a little beyond students' current level of knowledge and understanding in respect of the words or phrases used. This provides an opportunity to introduce new terms and their meanings in a context that demonstrates their importance in everyday situations.

Science-rich news reports often contain information about a topic that, if extracted and presented in another form, can provide a good summary of key points. Furthermore, the acts of extracting the information and of re-presenting it are themselves useful learning experiences. Appropriate tasks include inviting students to make a list, table, chart or diagram. Alternatively, information from the text can be used to support drama or role play activities. Exemplar 1 illustrates this approach.

Activities can be devised that give students opportunities to apply what they have been learning in new situations in such a way as to provide further exemplification of the ideas they are studying. These activities also promote the integration of present and previous learning and contribute to

meaning making. Figure 7.2 shows the type of questions that could accompany the news article on non-native species. Exemplar 1 also illustrates the types of exemplification/extension task that could be used to encourage students to apply and communicate their growing science knowledge in new situations.

Factual questions
- In this news report, what British insects are in danger?
- Where are the harlequins from originally?
- How do people think harlequins first came to Britain?

Find and underline tasks
Find and underline the following words and phrases about the feeding habits of harlequins:

'They are a threat because they feed greedily on greenfly …'
'When they run out of greenfly they feast on other ladybirds …'

Use what you have learned so far in this topic and from this report to
- Draw up a food chain for the British ladybird
- Draw up a food chain and food web for the harlequin ladybird

What is your opinion?
A scientist quoted in the article describes the invasion of the harlequins as an 'ecological disaster'.
Why does he call the invasion a 'disaster'?
What do you think?

Figure 7.2 Applying ongoing learning in new situations so providing further exemplification

Toward the end of a topic or lesson: consolidating, extending and assessing students' learning in science

Toward the end of a teaching sequence, news can have a role in helping students consolidate and extend their learning. Appropriate news items can provide a fresh way of looking at a topic and novel contexts for applying newly acquired knowledge and understandings. They can present additional information and ideas and serve as the basis for research. Furthermore, news-based tasks can be used as a context for students to demonstrate their knowledge with a view to identifying gaps in their understanding or weaknesses in their ability to make links between related areas of learning. When used in this rather specific way, news items have potential in respect of assessment for learning.

Additionally news items can be introduced as a revision task at some later time and used to stimulate a review of previous learning. Finally, they

can be used in the summative assessment of learning. Indeed, a number of science courses that emphasise the promotion of scientific literacy include a student's response to authentic or amended news reports as an element in their assessment procedures.

Science 'enquiry': teaching approaches and learning experiences

Many science-based news items are in the form of reports of scientific studies whose results have recently been announced at conferences or in journals. These range from the momentous to the frivolous. Indeed these 'studies have shown' pieces have been characterised by Dux (2006: 1, 4) as:

> […] the scientific equivalent of celebrity gossip: easily digested and just as easily discarded information that may or may not contain nuggets of truth, promising to help us to live longer, healthier lives, or to reveal some hidden truths of our human existence.

On balance, we disagree! We find many of these 'scientific vignettes' interesting and – yes – entertaining. Above all, however, along with other news stories, reports of studies offer an excellent resource for addressing important issues relating to scientific enquiry and to the scientific enterprise more generally. The limitation of the single study should be stressed, though. Good science, typically, takes time.

An important contribution to the debate surrounding scientific literacy has been the work of a number of science educators who have drawn up inventories of 'ideas-about-science' an understanding of which is considered fundamental to an individual's ability to engage with science encountered in daily life (see for example, McComas et al. 1998; Millar 2000; Osborne et al. 2001; Ryder 2001a). In addition, significant issues have been raised by other writers and researchers (see Baggini 2002; Duggan and Gott 2002; Jenkins 1997, 1999, 2000; Kolstø 2001; Norris and Phillips 1994; Phillips and Norris 1999; Ratcliffe 1999) which add weight to and sometimes extend this work.

Among these 'ideas-about-science' are a number that are particularly relevant to an understanding of science in the news and/or that can be illustrated particularly well through use of science in the news. These, listed in Figure 7.3, could provide a framework for formulating intended learning outcomes for news work relating particularly to science enquiry. In so doing, of course, they also relate to scientific literacy and the ability to engage critically with science in the news. They are thus specific illustrations of the more general outcomes set out in Figure 6.3a–d.

- There is no one way to do science. Science uses a range of methods and approaches to the collection of data
- The practice of science involves skilful analysis and interpretation of data derived from such activities. For a particular study, an understanding of the chain of scientific reasoning involved in the analysis and the status of statements within that chain of reasoning is necessary for others engaging with the study. For example, it is important to know that explanations do not simply 'emerge' from data. They are, essentially, conjectures based on prior knowledge, the evidence of the study and, often, the exercise of creative imagination. It is possible for scientists to come to different interpretations of the same data and, therefore, to disagree
- Scientists make assertions with differing degrees of certainty. Typically, a high degree of uncertainty is associated with science-in-the-making. There is a need for vigilance in respect of these expressions of uncertainty and also an awareness of the particular uncertainties involved in risk assessment
- All scientific knowledge claims are, in principle, open to revision in the light of further evidence or argument
- The establishment of reliable scientific knowledge is a critical, consensus-seeking and consensus-building process. Reported findings and explanations must withstand scrutiny by other scientists through peer response at conference presentations and peer review of papers submitted for publication in academic journals. Disputation is intrinsic to this process. Argumentation is not an aberration
- The establishment of reliable scientific knowledge takes time (often a very long time). The outcome of a single experiment is rarely sufficient to establish a knowledge claim. Rather, science is a cumulative process, building on previous work, including, typically, that by other scientists
- Scientific research is carried out in a range of settings (academic, industrial, governmental, military, etc.) and funded from a range of sources. The culture of science is changing and whereas once intellectual property was freely exchanged, with the increase in industry-sponsored research, there is a shift towards confidentiality or other restrictions on publication
- The credibility of the 'source' of information is an important issue to consider when evaluating knowledge claims. Credibility, typically, is related to relevant expertise and experience and to the institution with which the 'source' is associated, its nature and its interests

Figure 7.3 Some 'ideas-about-science' that are particularly relevant to critical engagement with science in the news

Three characteristics of news reports of 'studies' are particularly pertinent to these ideas-about-science. First, some reports of scientific studies

give insights into the design, conduct and interpretation of investigations in a range of contexts, academic, governmental, industrial, etc., which can supplement students' experience of investigative work in school. Second, many studies appearing in the press report the results of cutting-edge science ('science-in-the-making') which is often overlooked in school science. Finally, news reports can be used to illustrate some of the important customs and practices within the scientific community, again seldom discussed in the science classroom. Thus news offers opportunities to extend students' learning in relation to science enquiry and, in so doing, to develop their scientific literacy.

Design, conduct, interpretation and evaluation of scientific studies

News describes science studies of a variety of types conducted in a range of settings. Using checklists such as a simplified version of 'Always ask' (Appendix 2) or the 'Newsbug' audit (Chapter 9) students can interrogate the text, noting the number of questions that cannot be satisfactorily answered. These illustrate areas where reporting is incomplete. This in turn has implications for how an individual should interpret and respond to the news item.

From time to time the reports are in sufficient detail to allow an informed reader to fashion an opinion about the quality of the research, the likely credence of the findings and the applicability of the work. In these cases, students may be in a position to consider the appropriateness of the experimental design and make judgements about the reported conclusions.

Within the Newsroom Project, we would have evidence that even quite young students can produce interesting evaluations of investigations. A group of 14-year-old girls, reviewing a newspaper article reporting that pregnant women who eat fishfingers double their baby's future asthma risk, remained unconvinced of the generalisabilty of its conclusions:

> *The fact that the testing may have only been carried out in America makes us doubtful of the reliability of the results, as the ingredients of fishfingers in America may differ from those used in the UK.*

Norris (1995: 216), however, contends, amplifying the reason in Norris et al. (2003: 141):

> Students need to be taught first that the object of their scepticism should be the believability of experts, not the evidence supporting scientific knowledge claims. They should be taught how to use criteria for judging experts: the role and weight of consensus … prestige in the scientific community … publication and successful competition for research grants; and so on.

> […] It is the theory and method of science that is most technical and inaccessible to critique by non-scientists, in contrast to the social context of research where non-scientists have the most leverage for critique.

This view may be controversial, but there is support for it in the literature (Bingle and Gaskell 1994; Kolstø 2001; Shamos 1995). Indeed, the importance of 'sources' and 'consensus' has emerged from studies of adults' and young people's decision making in relation to socio-scientific issues (Jenkins 1997; Kolstø 2001). Significantly, Kolstø (2001: 899) concludes his interesting study of students judging information with only one suggestion, namely that science teaching for citizenship should include 'training in evaluation of sources of both conclusive and inconclusive science'.

Korpan et al. (1997) strike a middle ground, calling for the promotion of an understanding of the social context of science – including the credibility of experts and sources – and an understanding of good scientific practices.

News reports of science studies can support learning in both these respects. Figure 7.4 shows a newspaper article that could provoke a lively debate on source credibility! News reports of science studies can also sometimes provide a context for evaluating research and, as will be illustrated in Exemplar 3, for identifying the status of statements within the chain of reasoning represented in that research.

The Sun 14 August 2006

PLANET PLUTO'S GETTING BOOT-O

It's too small

By Paul Sutherland, *Sun* Spaceman

Tiny Pluto this week faces losing its status as a planet.

The smallest member of the solar system is in a belt of icy debris. But scientists have recently discovered two other chunks nearby which are LARGER than Pluto.

One, Xena, is 1,400 miles across – 70 miles wider than Pluto. Astronomers must decide whether to call them planets or downgrade Pluto's status. They will make a final decision next week.

Pluto – discovered in 1930 – is the furthest of the nine planets from the Sun. Its orbit lasts 249 years and, despite its size, it has three moons.

TV astronomer Patrick Moore said 'Pluto isn't a planet. It's as simple as that.' Astrologer Mystic Meg is not worried. She said 'Scientists judge everything in terms of size.'

Figure 7.4 A starting point for judging source credibility!

Characteristics of 'science-in-the-making'

As indicated in Chapter 2, 'science-in-the-media' tends to be 'science-in-the-making' (Hutton 1996; Shapin 1992). This contrasts with 'core science', which comprises, materially, the school curriculum (Millar 1997). While the latter has attained the status of agreed knowledge, in the case of the former such consensus has yet to emerge. Hunt (1999: 20) commenting on the tendency for teaching and textbooks to focus only on established certainties writes:

> They do not convey anything of the provisionality and excitement of knowledge at the frontiers of science. School science does not prepare future citizens for debates about controversial issues in fields where the experts disagree and scientists are still struggling to establish the 'truth'.

Even investigative work in schools (it could be argued especially investigative work in schools) presents a picture of scientific enquiry in which experiment leads directly to 'the right answer'. Kolstø (2000: 648) also highlights the danger of leaving students with as he puts it a 'concept of science knowledge (that) is more objective than it ought to be':

> Armed with this epistemology, students are poorly prepared to meet the world 'out there' when the media print stories about scientists who have conflicting viewpoints on various issues.

News items provide a useful way of exposing students to the excitement of cutting-edge science. They also shine a light on science-in-the-making and so serve as a valuable resource for a consideration of its characteristics (Figure 7.5) and, in particular, for raising awareness of its attendant uncertainties and inconclusiveness. The study of such items (or, for ongoing stories a series of such items) may prevent young people expecting clear-cut answers to complex problems or quick answers to emerging problems. They will not be surprised when scientists disagree or when they change their minds. They will be aware of the difficulties in assessing risk and will not be expecting assertions of 100% safety.

Customs and practices within the scientific community

News reports can be used to illustrate some of the key customs and practices of the scientific community (sometimes described as 'insider knowledge' as it is part of the everyday experience of those working in research). Of special importance (Zimmerman et al. 2001: 54) are the:

Science in school	**'Science-in-the-making'**
'Certain'	Tentative
Agreed	Often contested
Evidence base strong	Evidence base weak
Appears to result from single discoveries	Cumulative
Appears to be largely an individual process	Collaborative process
Social context appears largely irrelevant	Social context is relevant
Appears unproblematic in its application	Problematic in its application

Figure 7.5 A comparison of 'school' science and 'science-in-the-making'

> landmark professional activities associated with the evolution of research from tentative findings to widely accepted conclusions in the scientific community. These landmarks include presentations of the results at important conferences and publication in high quality, peer-reviewed journals where tentative findings can be debated, explored, replicated, and either cast aside or accommodated by consensus in the scientific community.

These processes form the cornerstone of scientific practice in relation to the recognition of new knowledge claims yet they are an aspect of scientific enquiry that has received little attention in school curricula (Kolstø 2000). Ryder (2001b) additionally proposes a study of the ways in which commercial and government bodies report science findings.

News reports rarely mention peer review. The names of the academic journals in which the scientific findings are published or the conference at which they were presented are, however, commonly recorded. If an article has been published in a reputable journal it will have been scrutinised by other scientists who are experts in the particular field. It is important that students be made aware of the significance of this. Reports from a conference, by the same token, may be less robust than a journal article. The checking process for a conference is usually less rigorous, although conference presentations are often the precursor to a fully developed journal article. That said, it is important that students are reminded that all scientific knowledge claims are, in principle, open to revision in the light of further evidence or argument. Attention also needs to be drawn to the fact

that individual studies form only a small part of a bigger picture (Baggini 2002).

Other issues merit consideration. Scientific research is expensive and is funded from a variety of sources. Some, at least, will be perceived to have a material interest in the outcomes. For example, pharmaceutical companies often fund medical research. While this does not invalidate the work, it is information that may help the reader make a judgement about the claims being made. The absence of information about funding sources is not necessarily sinister; it may simply be dictated by constraints of time and space. It is nonetheless an issue worth discussing in the context of science in the news.

A number of these ideas will be illustrated in Exemplars 2 and 3. However, we are excited by the use of science news to promote an understanding of how science works and we hope to develop our ideas further over the next few years. We would aim to address all the issues included in Figure 7.4. In addition, we are interested in exploring more widely the social context of science including, perhaps, matters such as vested interest, misconduct and fraud!

Exemplar 1: hot air rises

Our intention for this exemplar teaching sequence, and those that follow, is that they should serve as *templates* showing how a particular type of news story may be employed to serve particular teaching objectives and to achieve particular learning outcomes.

Intended learning outcomes

This teaching sequence, designed for use with 13–14-year-olds, focuses on science 'content'. It exploits a science-related article to invite students to *present what they have been learning in another form* and to *apply what they have been learning in new situations, so providing further exemplification*. The intended learning outcomes relate to energy transfer (convection) and to energy resources (renewable energy sources). It could be a revision context for either one of these themes and a teaching context for the other. In this case the teaching context is renewable energy sources.

Introduction

To engage students, the session could open with a discussion of world records zeroing in on the tallest buildings.

Activity 1

Students are then invited to read the news report (Figure 7.6). A series of true or false questions, based solely on the text, provides a focus for their reading and the class discussion of the answers offers an opportunity to talk about and summarise the story.

Continuing the class discussion, science-related phrases and statements can be selected from the story and students asked to explain what each means. Alternately, they may be asked what science knowledge is needed to understand the story.

Activity 2

Working in small groups, students are invited to describe how the solar tower works, using bullet points to record the key stages in the generation of electricity.

The group is then challenged to sketch on poster paper a diagram showing what members imagine the power plant to be like. Labels should indicate the 'hot air rising', the 'turbines' and the 'solar greenhouse'.

In a report-back session, students review each group's poster.

Activity 3

Finally, students review, through role play, the environmental impact of the project:

> Imagine your group is a firm of environmental consultants. You have been asked to present a report on the power station project. Outline the positive and negative impact the power station could have on the region. You could make your report as a short video or PowerPoint presentation.

BBC Online News 5 January 2003, 03:20 GMT

Australia plans world's tallest tower

An Australian power company is planning to build the world's tallest structure – a solar tower – in the middle of the outback.

The project is part of a global campaign to encourage the use of more renewable energy.

Enviromission says the tower, at a proposed height of 1,000 metres (3,300 ft), will be more than twice the size of the world's current tallest free-standing building, the Canadian National Tower in Toronto.

The one billion Australian dollar (US$0.56 bn) project is being backed by the Australian Government, and is expected to be completed in 2006 in the remote Buronga district in New South Wales.

If successful, the structure could provide enough electricity for 200,000 homes. It will save more than 700,000 tonnes of greenhouse gases which may otherwise have been emitted by coal- or oil-fired power stations.

Enviromission chief executive officer Roger Davey told Reuters news agency: 'Initially people told me "you're a dreamer", there's no way anything that high can be built, there's no way it can work.'

'But now we have got to the point where it's not *if* it can be built, but *when* it can be built.'

Huge monolith

The proposed structure will have a width similar in size to a football field and will stand in the centre of a huge glass roof spanning 7km (4.3 miles).

The sun will heat the air under the glass roof, and as it rises an updraught will be created in the tower, allowing air to be sucked through 32 turbines.

The turbines will then spin, generating power 24 hours a day.

The tower was developed by German structural engineers Schlaich Bergerman, who built a 200-metre-high demonstration power plant in Manzanares, Spain, in 1982.

The tower proposal has received the support of the Australian and New South Wales governments, which have defined it as a project of national significance.

The authorities plan to fit the tower with high-intensity obstacle lights to prevent aircraft from crashing into it.

Figure 7.6 News item describing the solar tower

Exemplar 2: chewing gum

Intended learning outcomes

This teaching sequence, originally used with 13–14-year-olds, focuses on science 'enquiry'. It exploits science-related reports to invite students to consider a research study and comment on its applicability. Importantly, its starting point is a review of the quality of information supplied in two newspaper articles. The intended learning outcomes, then, relate *to evaluation of an investigation and of news sources*.

Introduction

The session opens with a discussion of who chews gum and why people chew gum. A quick class survey could be conducted. It is almost certain that someone will mention 'improving concentration' or 'improving memory'.

Students are then told that scientists have conducted an investigation to study the effect of gum chewing on memory. They are invited to suggest the important information that a journalist should include in a newspaper article that is reporting on the study.

Based on their experience of science investigations in school, we have found that 13–14-year-olds can make quite a good stab at this. They will need some help, though, for example, with 'funding'. However, by asking if the fact that a company that sold chewing gum had sponsored the work would attract their attention, they quickly get the idea.

Activity 1

The students are invited to read the article 'I've got an improved memory, by gum' (Figure 7.7).

Having read the article, students should try to answer as many as possible of the following questions (a short form of 'Always ask'):

1. Who carried out the research?
2. Who funded the investigation?
3. Where was the investigation carried out?
4. How was the investigation carried out? From the information given in the news story could a detailed step-by-step method be written?
5. Where did the scientists report their work?
6. What were the observations or results of the investigation?
7. What conclusions were drawn?

8. Is a possible explanation for the effect included in the report?
9. What do other scientists say about the research?

Daily Mail 14 March 2002

I've got an improved memory, by gum

Chewing gum can improve your memory, scientist have found.

The discovery will come as bad news for pavement cleaners as well as parents, who are irritated by the perpetual motion of their children's jaws. But taking a packet of gum into exams might actually boost a student's performance.

Neuroscientists at the University of Northumbria assessed the effects on memory of various substances – including rosemary, ginseng and aromatherapy oils.

They found that volunteers' ability to remember lists of words improved by more than a third if they were given a stick of gum.

Dr Andrew Scholey told the British Psychological Society's annual conference in Blackpool: 'It was really quite a dramatic effect. It held up over and over again so we are confident it is really helping.'

He is not certain why chewing gum quickens the mind, but said it may raise the heart rate, pumping more blood to the brain.

The team also found that the smell of rosemary jogs the memory. It can help people recall faces and events from years earlier.

The scientists hope to use the information to produce drugs to combat dementia or Alzheimer's.

Figure 7.7 I've got an improved memory, by gum

As a class, students discuss what questions they were able to answer from the article and what additional information they need to help them evaluate the investigation.

Activity 2

The students are then invited to read the article 'Chewing gum can boost brainpower' (Figure 7.8) and to try again to answer the same questions. There may still be some that are not addressed.

In a plenary, it is pointed out that some news reports provide more information than others do. Also we must remember that when reading a newspaper report we are not reading the scientists' own account of their work – but the journalist's report. Missing experimental detail may not mean poor experimental design!

The Independent 14 March 2002

Chewing gum can boost brainpower

By Lorna Duckworth, Social Affairs Correspondent

Chewing gum can greatly improve the performance of the brain, research issued yesterday suggests. People who chew gum scored 40 per cent more in memory tests than those who didn't in a study presented to the British Psychological Society's annual conference in Blackpool.

Dr Andrew Scholey, of the human cognitive neuroscience unit at the University of Northumbria, described the improvement in memory as 'quite dramatic'. Although chewing gum was first marketed in America more than 150 years ago, Dr Scholey's work is the first to look at its impact on mental performance.

Three groups of 25 people took part in the experiment. The first chewed gum throughout, the second had nothing and the third went through the chewing motion with nothing in their mouth.

They then completed computerised tests to measure attention span, response times and long- and short-term memory.

During tests to recall 15 words, the gum-chewers remembered two to three more than the non-chewers. There is no effect on concentration but the heartbeat of the gum-chewers increased by an average of three to four beats a minute compared with only a very slight increase among the fake chewers.

Dr Scholey said chewing gum might improve memory because the heartbeat increased and delivered more oxygen and glucose to the brain. Alternatively, chewing could stimulate insulin production, which affected the part of the brain involved in memory.

Dr Scholey said: 'We found a very clear pattern of improved memory when gum was chewed. We think it is the effect of chewing that causes this rather than anything in the gum itself. There are lots of ways to improve mental function. This may be one of a series of interventions that people may want to try.'

Well-known gum chewers include Sir Alex Ferguson, Robbie Williams and Martine McCutcheon.

Previous work by Dr Scholey has shown that ginseng can enhance the memory and gingko can improve memory and concentration.

Figure 7.8 Chewing gum can boost brainpower

Should an individual or community intend to act on information presented in the news media, the importance is stressed of consulting a number of appropriate sources of information. This is particularly so in relation to matters of health where medical advice should be sought.

Activity 3

Through small group discussion, students are encouraged to respond personally to what they have read, considering the relevance of this research to their own situation:

> *John has made a suggestion to the students' council: 'Teachers should allow chewing in class because scientists say chewing gum helps your memory.'*
>
> *Your group represents the students' council. Do you think there is a case for passing a resolution that chewing gum should be allowed in school?*

The session finishes with a report back from each 'student council'. In our experience, most students come out against the proposal – citing the mess that chewing gum can cause. This reinforces the important point that science knowledge is just one of a number of considerations in decision making.

Exemplar 3: brushing teeth

Intended learning outcomes

This teaching sequence, designed for use with able 15–16-year-olds, focuses on science 'enquiry'. It exploits a science-related article to teach about the characteristics of science-in-the-making and about the social context of science. The intended learning outcomes relate to the *recognition that explanations do not simply emerge from data, to the uncertainties associated with cutting-edge science and to the regulation of scientific research*.

Introduction

Students read 'closely' the article 'Brushing teeth every day can keep the doctor away' (Figure 7.9). After confirming that they understand any new terminology, they answer the following questions individually.

Belfast Telegraph 8 February 2005

Brushing teeth every day can keep the doctor away

By Lyndsay Moss

Brushing your teeth may help to reduce the risk of stroke and heart attack, research suggested today.

A US study found that people with gum disease were more likely to suffer from artherosclerosis – the narrowing of blood vessels that can lead to a stroke or heart attack.

While past research has suggested a link between periodontal disease and vascular disease, researchers said their study was the strongest evidence yet of the relationship.

The team, from Columbia University Medical Centre, concluded that preventing gum disease could significantly improve the chances of avoiding vascular problems in the future.

Researcher Dr Moise Desvarieux said 'This is the most direct evidence yet that gum disease may lead to stroke or cardiovascular disease. And because gum infections are preventable and treatable, taking care of your oral health could well have a significant impact on your cardiovascular health.'

The researchers, writing in the American Heart Association's journal, *Circulation*, measured bacteria levels in the mouths of 657 people with no history of stroke or heart attack.

They also measured the thickness of the participants' carotid arteries – which are measured to identify artherosclerosis.

The team found that people with a higher level of the specific bacteria that cause periodontal disease also had an increased carotid artery thickness.

They were able to show that artherosclerosis was associated with the type of bacteria that cause periodontal disease – and not any other oral bacteria.

Dr Desvarieux said one possible explanation for the link was that the bacteria that cause gum disease may migrate throughout the body via the bloodstream and stimulate the immune system – causing inflammation that results in the clogging of the arteries.

Dr Desvarieux said 'We will continue to study patients to determine if artherosclerosis continues over time.'

Figure 7.9 Brushing teeth every day can keep the doctor away

Activity One

Students complete a 'worksheet' based on tasks (a), (b) and (c):

(a) Identifying the variables that were measured

In this study, which pair of variables did the scientists measure?

Whether a person brushed his/her teeth everyday	_____	How often that person had visited a doctor
Whether a person brushed his/her teeth everyday	_____	Whether that person had suffered a stroke/heart attack
Whether a person had gum disease	_____	The thickness of that person's carotid artery
Whether a person had gum disease	_____	Whether that person had suffered a stroke/heart attack
The bacteria levels in a person's mouth	_____	The thickness of that person's carotid artery
The bacteria levels in a person's mouth	_____	Whether that person had suffered a stroke/heart attack

(b) Studying the study

Complete the following table (Figure 7.10) using sentences/statements from the news article.

Elements of the scientific study	**Sentence/statement from the news article**
Information that probably prompted the study	
Method*	
Findings/results	
Conclusion	
One possible explanation	
Presenting the results/ideas to other scientists for scrutiny	
Follow-up studies	

* the thickness of the carotid artery wall is measured by ultrasound scan

Figure 7.10 Table showing the key elements of the study

(c) Are you certain?

How *certain* are the scientists that high levels of the bacteria that produce gum disease cause people to have artherosclerosis?

Reread the article and circle any 'uncertainty signals' – words, phrases and statements that suggest uncertainly.

In addition to what is written in the news article, can you suggest reasons why the scientists should be cautious about claiming that gum disease causes artherosclerosis?

It is sometimes useful when watching, listening to or reading news reports about science studies to form a mental picture of the certainty/uncertainty of the conclusions drawn. One idea is a mental 'certainty meter' like that shown in Figure 7.11.

Where would you place the needle for the conclusions of this study?

Be prepared to justify your decision!

The answers are reviewed in whole-class discussion. Time should be spent on the third question set exploring the characteristics of science-in-the-making and the time required and difficulties involved in generating reliable scientific knowledge. In this case, for example, it should be explained to students that this single study does not establish a causal link.

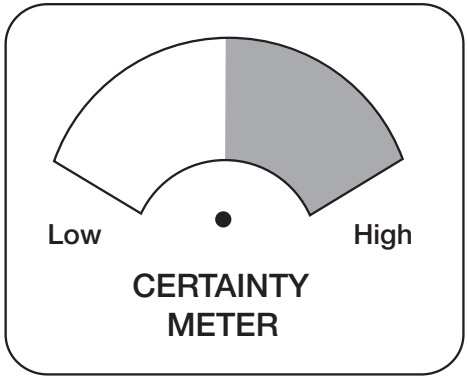

Figure 7.11 A 'certainty meter'

Activity 2

In the final activity students, this time working in groups, consider, through role play, the ethical issues associated with the follow-up study:

> As indicated Dr Desvarieux and his team of scientists are following up the 657 people who participated in the initial study. They plan to invite them back to Columbia University Medical Center and to conduct the same procedure, under the same conditions, every three years over a lengthy time period.
>
> Your group represents the university's research ethics committee. How would you respond to Dr Desvarieux's request for permission to undertake the next phase of this study?

No matter how short the news item is, more information about a study can almost always be obtained on the web. A short search indicates that Dr Desvarieux gave a radio interview about his study in which the issue of ethics was raised. In the debriefing discussion with the students, it may be interesting to inform them of the following exchange:

> **Interviewer** *So is it ethical to follow these people up when there's a suspicion that gum disease is causal in terms of heart disease and you're following up and not doing anything and therefore potentially exposing these people to coronary heart disease when you think they're at increased risk?*
>
> **Dr Desvarieux** *Yes it is. Why? Because it is not established that gum disease causes artherosclerosis. I don't know right now whether there is a relationship.*
>
> **Interviewer** *So do the people who have high levels of bacteria know they've got it in your study?*
>
> **Dr Desvarieux** *Yes, but what we have noticed is that the patients who come in for the follow-up visit three years later, a good number of them have actually improved their oral health. And that's great, but what it means is that we have to follow them up if the relationship is true for a longer period of time for them to get an 'event'.*

The session can be drawn to a close by highlighting, in Millar's (1997) words 'the sheer difficulty of obtaining valid and reliable data about the natural world'.

And finally ...

Through the use of appropriately chosen news items, students' learning in science – in relation to both its 'content' and its 'enquiry' – can be promoted and aspects of their scientific literacy developed. Such items can be drawn from news – broadcasts, papers and websites. In addition there are a number of very useful science news-related websites designed specifically for students and teachers, for example, 'Science UPD8' and 'The Why Files'.

Many will have had experience of using the news to show the relevance of science in everyday life and this is an important intention. There is a case, however, for exploiting news to develop students' ideas about scientific enquiry. Indeed, we believe these could have considerable value as a resource for teaching understandings about science for which, as Millar (2004: 19) suggests 'methods other than practical are likely to be required'.

The next chapter explores the third dimension of 'scientific literacy' mentioned in Chapter 1, namely the interactions of science, technology and society.

8 Using the news to teach about science and society

Introduction

Ask most science teachers why they use the news in their classrooms and they will not reply 'to teach about science content' or 'to teach about science enquiry'. They will say something along the lines of:

> *To show the relevance of the subject.*
> *To show its links with everyday life.*
> *To show the impact of science in society.*

As discussed in Chapter 5, our survey of science teachers in Northern Ireland found that over three-quarters of those who used newspapers in their teaching specified that their intention was to illustrate the relationship between science in the classroom and science in the wider world. Newspapers, they indicated, were an ideal resource for reinforcing this idea:

> *It makes the science real. It contextualises it in everyday life. We keep on telling them science is real – here's the evidence.*

As discussed in Chapter 1, scientific literacy is commonly considered to comprise or call for some understanding of:

- scientific terminology and concepts
- scientific enquiry and practice
- the interactions of science, technology and society.

Bringing together these statements suggests that current practice in relation to science in the news could be said to coincide, in this respect, with the pursuit of scientific literacy. Such a claim, however, would warrant some qualification. An examination of the literature addressing 'science

and society' in the context of science education reveals a range of interrelated ideas and issues judged fundamental to an understanding of the complexities of their interactions. Among these are the following:

- Science finds application in everyday life.
- The application of science may involve scientific ideas from a number of science disciplines.
- The application of science may involve not only scientific ideas but also ideas from other domains.
- In its application, science has power but also limitations.
- The application of science may have personal, social, cultural, ethical, moral, religious, political, legal, economic and/or environmental implications.
- The application of science may be 'messy', often associated with complexity, uncertainty and controversy (in respect of the science itself and/or the issues it raises).
- The application of science may produce positive and negative effects, benefits and burdens, winners and losers.
- The application of science in society is worthy of our interest, attention and, on occasion, action as individuals and as citizens.
- Individuals and groups, whether scientists or non-scientists, can have influence in the public arena in relation to the application of science in society.

See, in this regard, Cross and Price (1999); Jenkins (1994b); Kolstø (2001); Zeidler (2003) and Roth (2003).

In our research, however, we found that the focus of work on science in the news tends to lie more with the first issue (that science is applied) than the succeeding issues (the particularities of such applications) and, where it does deal with these, it does so rather haphazardly. We would argue that there is merit in broadening our aims to address more of the issues just outlined. Indeed, we hope this list provides a helpful framework for formulating intended learning outcomes for the use of news material in the study of, particularly, socio-scientific issues. With this focus, they also relate to scientific literacy and to the ability to engage critically with science in the news. They are thus specific illustrations of the more general outcomes set out in Figure 6.3a–d.

Science-related news items are an immensely rich resource for exemplifying each of these ideas and, additionally, for demonstrating the dynamic interplay of science, technology and society. Furthermore, as Kolstø (2000) points out 'news' may lend the issues under consideration enhanced topicality and this, he argues, may lead to increased student involvement.

As the ideas in our list are addressed, it quickly becomes clear that the application of science in everyday contexts presents us with choices. As an individual, we may ask 'what action should I take, or, indeed, should I take any action at all?' As a citizen, we may ask 'what action should be taken, or indeed, should any action be taken at all?' Hence, a consideration of 'decision making' frequently features in discussions of the interaction of science, technology and society. Thus, before exploring ways in which news may be used to teach about 'science and society' we will look briefly at what some of the relevant literature has to say about decision making in socio-scientific situations. This will lead into a discussion of science education and citizenship. It should be stressed however, that a detailed treatment of each is well beyond the scope of this book. Rather some key points will be raised and some useful references will be suggested.

Decision making in socio-scientific contexts

It is often stated, frequently rather glibly, that the study of science in school will (or at least should) help young people to solve problems and make decisions in respect of the science-related issues they encounter or will encounter in their daily lives. The ability to make informed decisions regarding such issues is seen as a significant component of functional scientific literacy.

Many writers also contend that students, in order to advance their scientific literacy, should engage in contextualised decision making. As Zeidler and Keefer (2003: 11) argue:

> [I]f citizens are expected to make rational, informed decisions about their society (one that is permeated by science and technology) then as students they ought to be provided with the necessary experience in which to practice and apply this kind of decision-making.

News items provide just such context. Almost daily actual situations are reported where individuals or communities are faced with choices in respect of science-related issues. Among these are some with the potential to catch the interest of students and to be presented in a manner that is accessible to them. Such news stories can be used to good effect in the classroom as a resource for decision-making activities.

In so saying, however, we would want to make three key points. First, while these news items are authentic decision-making experiences for those involved, typically they are not for our students. Ratcliffe and Grace (2003: 118) remind us that: 'Decision-making implies commitment to a choice …

from which deliberate action follows.' They draw a distinction between 'informed opinion' and 'informed decision-making' and plainly it is the former that best describes most work of this type undertaken in school. Despite this, they note that 'decision making' is the term most commonly employed in the literature to designate such activities. For this reason they – and we – continue to use the term.

Second, and importantly, it must be recognised that the link between scientific knowledge and decision making in real-world contexts is very complex indeed. It is seldom that choices can be made or action taken solely on the basis of some sort of rational application of scientific principle or procedure. Abd-El-Khalick (2003: 43) leaves us in no doubt about the difficulties:

> [S]ocio-scientific problems are ill-defined, multidisciplinary, heuristic, value-laden … and constrained by missing knowledge. Engaging the problem most likely (will) lead to several alternative 'solutions' each with an incomplete set of burdens and benefits … Given the lack of any algorithms to go about weighing the identified burdens and benefits, a decision regarding socio-scientific issues necessarily involves a judgement call, which could be an agonising undertaking.

We have already noted that science is 'messy' in application, often associated with complexity, uncertainty and controversy. By the same token, it is problematic when called on to serve in support of personal and social decision making. Indeed the words 'mess', 'messy' and 'messiness' occur again and again in the relevant literature (Abd-El-Khalick 2003; Bell 2003; Jenkins 1997; Pedretti 2003; Zeidler and Keefer 2003). To fail to acknowledge this with our students and to convey to them some understanding of why it is so is to do them – and science – a grave disservice.

There is a balance to be struck here. It is undoubtedly the case that science can usefully, indeed, crucially inform our decision making in relation to socio-scientific matters and there are circumstances in which, though we may choose so to do, we ignore its findings at our peril. Nicholls (2004: 130) quotes Carl Sagan:

> Science by itself cannot advocate human action; but it can certainly illuminate the possible consequences of alternative courses of action.

We need to share this with our students while also pointing out that the relevant science knowledge may be incomplete, uncertain and contested. It may need to be 'restructured' (see Jenkins 1994b; Layton et al.

1993) to meet the demands of the situation. Furthermore, knowledge from other domains may be as important or more important and influential in the decision-making process. In particular there may be ethical and moral concerns involved. In relation to socio-scientific issues, there is seldom one right answer or a single, simple solution. There are likely to be 'multiple benefits to weigh against multiple costs' (Bell 2003: 74). As Abd-El-Khalick (2003) testifies, some decisions are agonisingly difficult to take.

Third, Bell (2003: 77) contends that 'without explicit, purposive instruction, the possibility of improving decision making is likely to remain a pipedream'. Therefore he argues for 'explicit instruction on decision making that emphasises roles for moral reasoning and understandings of the nature of science' (2003: 64). Levinson and Turner (2001: 28) affirm:

> As developing citizens young people should develop the analytic skills that will enable them to use ethical reasoning when considering scientific and other controversies. They should be empowered to discuss the issues of the day using their scientific knowledge within an ethical context.

Some writers suggest we should encourage young people to move beyond discussion by creating opportunities for them to participate in or even instigate community action (Cross and Price 1992; Hodson 1999; Pedretti 2003; Roth 2003).

There is a small, albeit expanding, stock of writing and resources that can guide and support teachers wishing to tackle these tasks. Much of this deals, at varying depths, with the treatment of ethical and moral considerations in relation to socio-scientific issues and some specifically address the theme. Some focuses on citizenship education. A list of useful references is contained in Appendix 4. These resources offer, for example, frameworks to aid decision making (Figure 8.1) and advice on important matters such as the role of the teacher in discussion of controversial issues and the need to be sensitive to the backgrounds and beliefs of students. The need remains, however, for further professional support and curricular materials to assist teachers tackle these difficult issues.

Through such instruction we may, in Pedretti's words (2003: 231) 'provide students with critical thinking and doing skills that assist them in understanding and reaching informed decisions while participating as citizens in a democratic society'. Or, at least, we may achieve Millar and Osborne's (1998: 12) more modest goal that young people should:

> Appreciate the underlying rationale for decisions (for example about diet, or medical treatment, or energy use) which they may wish, or be advised, to take in everyday contexts, both now and in later life.

Options
Make a list of all the things you could do/think of relevant to the problem
This statement is phrased appropriately for each different problem

Criteria
How are you going to choose between these options?
Make a list of the *important* things to think about when you look at each option

Information
Do you have useful information about each option?
What do you know about each alternative in relation to your criteria?
What information do you have about the science involved?

Survey
What are the good things about each option?
- Think about your criteria

What are the bad things about each option?
- Think about your criteria

Choice
Which option do you choose?

Review
What do you think of the decision you have made?
How could you improve the way you made the decision?

Figure 8.1 A decision making framework from Ratcliffe (1998: 55)

Science in the news and 'citizenship education'

The word 'citizen' has appeared often in the preceding sections. Indeed, it would be strange if it were otherwise. The very use of the word 'society' implies that we are considering not simply isolated individuals but interacting citizens. As we develop students' understanding and skill in relation to the issues discussed earlier, it can be argued that we are educating them for citizenship. In this sense, then, we are contributing to their 'citizenship education'. Moreover, as we develop students' understanding and skill in this regard *specifically* through the use of news media, we are adding an extra dimension to that citizenship education which would not otherwise be present. This flows from the unique role of the media in filtering and presenting information and in expressing and, perhaps, forming opinion.

In so saying, we recognise the problems associated with specifying the intentions of any programme of citizenship education (whether framed by

indvidual school or central government) not least in addressing how 'good citizenship' is to be interpreted.

For those who are interested in promoting citizenship education (whether within or outwith a statutory programme) science in the news can provide a rich resource for exploring relevant issues and ideas. Many science-related news stories deal with themes that bear significantly on the individual as 'citizen'; as a person with rights and responsibilities, values and viewpoints, interests and intentions residing in a community of others with rights and responsibilities, values and viewpoints, interests and intentions. How these interplay is often of vital importance to a community and to a nation.

Furthermore, the role of media in 'agenda building' and 'gate keeping' in relation to socio-scientific issues needs to be recognised. As discussed in Chapter 4, this is a complex matter and media studies scholars tend to make more modest claims than formerly in this connection. Nonetheless, it is acknowledged that, by their selection of particular items as 'newsworthy', they are able to build the agenda in terms of 'what we will think about' if not 'what we will think'. They focus our attention in some directions and not others. Indeed, as can be seen from the following quotation (*Daily Mail*, 6 February 2002), newspapers may actively seek to influence their readers; they offer advice, they call to action and they wage 'campaigns':

> Two months ago, the Mail detonated the great MMR debate. Since then, writers across the political spectrum have backed our campaign.

'Detonate' is no mild metaphor! It seems reasonable to suggest that if news media can play a part in setting the agenda for us as citizens, then news media should play a part in citizenship education. More specifically, if news media can play a part in setting the 'socio-scientific agenda' for us as citizens then news media should play a part in science–citizenship education.

Finally, science in the news can serve as a context for developing skills undoubtedly important for every citizen – skills of enquiry, skills of communication and skills of participation and responsible action, to adopt the terminology of the National Curriculum (DfEE/QCA 1999a).

Teaching approaches and learning experiences

News stories, whether broadcast or print, can be used in a variety of ways to support teaching about the applications and implications of science in and for society and to illustrate issues and ideas associated with citizenship education. They can serve, for example, as:

- mind captures/motivators to introduce socio-scientific lessons or topics
- sources of science information relating to socio-scientific topics
- sources of social survey information related to socio-scientific issues
- points of departure for researching topical socio-scientific issues
- sources of arguments for and against a particular course of action
- sources of contexts for discussion and debate
- sources of scenarios for role play
- sources of material for assessment activities
- stimulus for school- or community-based action
- channels for reporting to those beyond the school, the need for or outcomes of such action.

A number of these approaches will be illustrated in the three exemplar teaching sequences outlined subsequently. As in the previous chapter, we hope these will be helpful as *templates* showing how a particular type of news story may be employed to achieve particular types of learning outcome.

Before embarking on such work, a few points need to be borne in mind. First, if either teacher or students are new to such activities, there is a case for not being too ambitious. Thus the *Guardian* article 'Stem cell experts seek rabbit–human embryo' may not necessarily the best place to start! Second, during planning it is important to identify (as stressed in our 3As prompt) the desired learning outcomes for the lesson(s), to share these with the students and to monitor their achievement. Third, dealing with these issues demands teaching strategies which involve young people in the clarification, justification and negotiation of ideas, in discussion and debate (see Appendix 5).

Fourth, exploring 'science and society' issues and especially their ethical dimensions places heavy demands on science teachers. Levinson and Turner (2001) in their study of how controversial topics in the biosciences were tackled in schools reported that a majority of teachers of science felt they lacked the skills and confidence to deal effectively with such matters. This highlights the value of cross-curricular collaboration. Teachers from subject areas such as English, the humanities and religious studies have experience and expertise in tackling issues with an ethical dimension. The case for cooperation can be argued from two standpoints. Some (for example, Dawson 2000; Donnelly 2002; Hall 2004) contend that science is not the place for the exploration of ethical issues neither are science teachers the people to lead such an exploration. Others disagree (e.g. Wellington 2004) but nonetheless recognise the benefit in establishing links across the curriculum. As Levinson and Turner (2001: 18) write: 'Great

opportunities lie in the fact that science teachers and humanities teachers are looking at different aspects of the same topic.'

Exemplar 1: air pollution

Intended learning outcomes

This teaching sequence, originally used with 13-year-olds in Northern Ireland, exploits a science-related article in a number of different ways. First, the news story is used to *introduce the topic* of air pollution in a relevant context. Second, the article provides some, but not a large amount of, *science information*. Third, the story provides a backdrop against which a number of *scenarios* can be developed.

Aside from science-related learning outcomes associated with the causes, effects and control of air pollution, the news story provides the opportunity to develop students' understanding of science–society issues and to contribute to their 'citizenship education'. Specifically, they learn that science can illuminate the consequences of alternative courses of action. They are reminded that they, as individuals and groups, can 'make a difference'. They learn that many factors, of which science is only one, influence the lifestyle decisions we make. They explore issues associated with the interplay of rights and responsibilities, values and viewpoints. They 'use their imagination to consider other people's experiences and … express and explain views that are not (necessarily) their own'. As an extension they may even 'develop skills of participation and responsible action' by 'tak(ing) part … in school and community based activities' (DfEE/QCA 1999a: 16).

Introduction

Revising the 'components of air' opens the session. It is then indicated that air also contains other gases and substances which can affect our health and cause other problems. The article 'Belfast gets ultimatum to come clean on pollution' (Figure 8.2) is read with or to the students and they are invited to answer some key questions.

What can you say about air quality in Belfast?
Two substances which cause air pollution are mentioned in this article, what are they?
Where do these substances come from?
Why are they a problem?

It is then stessed that a newspaper will only ever give us limited information about a topic and to find out more about the causes and effects of air pollution we will have to consult other sources.

Belfast Telegraph 19 January 1998

Belfast gets ultimatum to come clean on pollution

Seven years to clear the air

Belfast City Council has been given seven years to improve the quality of its air, currently worse than any other region in the UK.

The rigorous clean-up operation to improve air quality is part of new legislation for all councils across Britain. Belfast is at the bottom of the UK air quality league table because of its high levels of sulphur dioxide and PM 10 particles, from coal and fuel emissions.

Other factors include the city's location in the Lagan basin, poor weather conditions and lack of cleaner fuel options.

Details of a survey into Belfast's air quality problems will be made public for the first time at an energy conference at the Balmoral Conference Centre on Thursday, January 29. The presentation will be given by Heather Armstrong, a senior environmental health officer at Belfast City Council.

According to Heather, a number of health problems can arise from bad air. 'Sulphur dioxide and PM 10 can cause eye irritation, aggravate asthma and other respiratory problems.'

'Air pollution is worse on cold, calm winter days, because the pollution gets trapped under a lid of cold air.'

'People should make sure that they burn only authorised fuels and walk instead of using the car all the time.'

'We can all help reduce the current high levels of air pollution by avoiding making unnecessary short car journeys wherever possible. By walking or making use of public transport instead, we can all do our bit to improve air quality.'

To help promote cleaner air, Belfast City Council has launched a smoke hot line.

'People should ring the number if they want to report a smoky chimney or car exhaust. They should note the car registration number and the address of the house.'

'We will educate and advise people, but if they are persistent offenders, fines may be imposed,' said Heather.

Figure 8.2 News story on pollution from the *Belfast Telegraph*

Activity 1

Students complete a table (Figure 8.3) using reference books, information leaflets, the internet etc.

Air pollutant	**Source (Where does it come from?)**	**Effects (Why are we worried about this substance in the air?)**	**Control and prevention (What can we do to reduce this pollution?)**
Sulphur dioxide			
Particulate matter (PM)			
Nitrogen oxides etc.			

Figure 8.3 Air pollution table to be completed using other information sources to supplement the news article

Activity 2

Students are encouraged to reread the newspaper article and to identify the two main ways to reduce air pollution mentioned in the story.

Working in small groups, they role play or write a short script for the family discussion associated with a relevant 'scenario' such as the following:

Shopping your neighbour

> *The family next door is burning ordinary coal in a smokeless zone. Everyone in the street is complaining about it. Then one night mum reads this article in the* Belfast Telegraph. *'I feel like reporting the O'Connors', she announces. 'I think I will phone this number and tell them what's happening.'*

The debriefing is very important. As a class, students discuss their decision-making process. What influenced their decision? Was it what they knew about air pollution from science? What other factors did they consider? What factor did they consider most important? In our experience, very few student groups choose to 'shop' their neighbour, believing that this would make life difficult. This highlights the fact that science considerations are not always the most prominent in decision making. The interplay of rights and responsibilities, values and viewpoints can be explored.

The complexity of decision making processes in relation to socio-scientific issues is acknowledged.

Activity 3

The final activity focuses on how we can find out the present level of air pollution locally. Students are informed that scientists monitor air quality daily and that the results are made available to the public through the media. They are alerted to the relevant information in newspapers, on weather broadcasts and on websites and are asked to note the air quality over the next (say) six science days and chart the results.

Finally, the series of lessons is concluded by reinforcing the contribution young people can make to the reduction of air pollution and, perhaps, involving them in a relevant school- or community-based activity.

Exemplar 2: the GM debate

Intended learning outcomes

GM food has attracted a great deal of debate in the media and a number of newspapers (both 'broadsheet and tabloid') have actively campaigned on the issue. Levinson and Turner (2001) report the particular misgivings that science teachers have about the coverage of this topic in the press. This series of lessons, designed for 15–16-year-old students, shows how newspapers can nonetheless be exploited as *a point of departure for researching a topical socio-scientific issue*.

Aside from science-related learning outcomes associated with an understanding of the genetic modification of organisms, the news story provides the opportunity to develop students' understanding of science–society issues and to contribute to their 'citizenship education'. Specifically, the application of science in this instance is associated with complexity, uncertainty and controversy. It has implications – economic, environmental, ethical, legal and political etc. It may produce positive but also negative effects, benefits but also harm. Different groups have different 'interests' and this may influence their attitudes and actions. Students learn 'how the public gets information and how opinion is formed and expressed, including through the media' (DfEE/QCA 1999a: 31). They 'research a topical … issue … by analysing information from different sources, including ICT-based sources' (DfEE/QCA 1999a: 15).

Introduction

The session is introduced by a brief description or revision of the genetic modification of organisms.

Activity 1

Working in small groups, students are asked to read the article 'Pollution by GM crops is inevitable say experts' (Figure 8.4) and to answer the questions in Figure 8.5.

Daily Mail 10 October 2003

Pollution by GM crops is inevitable say experts

By Tim Utton, Science Reporter

Scientists warned last night that pollution of Britain's natural plant strains is inevitable once genetically modified crops are planted.

In a blow to the GM lobby, they predicted that a single year of 'Frankenstein' crops will yield tens of thousands of hybrids – when the wild plant and its GM equivalent become mixed. Even wide gaps separating modified varieties from their natural counterparts will not be sufficient because pollen can travel up to two miles said the researchers in the first national study of its kind in the UK.

Campaigners fear such hybrids could turn into superweeds able to resist the strongest herbicides and will dominate the British countryside. Plant genetics experts in Reading University spent three years studying the potential spread of GM traits into the countryside. Writing today in the journal *Science*, they conclude: 'Widespread relatively frequent hybrid formation is inevitable from male/fertile GM rapeseed in the UK.'

It is the latest in a series of setbacks for the government's plans to approve GM crops for cultivation in the UK.

Last month the national 'GM Nation' survey revealed that 93% of people believed not enough is known about the long-term effects of GM food on health, and 86% said they would not eat it.

And last week, leaked results of the government's three-year trials of GM maize, sugar beet and oil seed rape claimed that two of the three types are more harmful to the environment than conventional varieties. In the latest study, plant geneticists used DNA fingerprinting techniques to see how many hybrids – containing genes from both parent plants – had been created when non-GM oil seed rape was planted near to its wild cousin. *cont.*

Dr Mike Wilkinson found that during a single year, 32,000 hybrid plants were created across the UK, and a further 17,000 hybrids were found in a separate 'weed' variant of oil seed rape growing along side the crops. Dr Wilkinson said: 'The concern of many people is that a gene from a genetically modified crop will move into a wild relative, the possession of the gene will give the hybrid plant some sort of advantage, and this will lead to unwanted ecological change.'

Scientists admit the genetic advantages conferred by new GM genes are an unknown quantity and could mean they out-compete natural plants. GM oil seed rape is modified to withstand a powerful herbicide and the fear is that the plant could pass on this resistance to their wild cousins. Patrick Holden, director of the Soil Association, said: 'This study confirms what we have known all along that co-existence is impossible. Neither GM oil seed rape nor any other genetically modified crop should be grown in the UK under any circumstances.'

Figure 8.4 News story on GM crops from the *Daily Mail*

Using *only* the news story, make a list of arguments *against* growing GM crops

Using *only* the news story, make a list of arguments *for* growing GM crops

Do you think the story is 'balanced', that is, do you think the newspaper is trying to show its readers both sides of the argument?

If not, what side of the argument do you think the newspaper might support?

If so, do both sides of the argument appear to be fairly represented? Are positive words and images used to describe one point of view and negative words and images used to describe the other point of view?

Do you think the newspaper is trying to encourage readers to take a particular standpoint, or side, in the argument?

If so, what evidence do you have? Can you find at least three things that might indicate that the newspaper is trying to persuade its readers to take a particular point of view?

Why might an editor decide that the newspaper will take a particular standpoint, or side, in an argument?

Figure 8.5 Questions relating to the news story on GM crops

This activity is drawn to a close by explaining to students that sometimes newspapers undertake 'campaigns' for or against a particular issue. If waging a 'campaign', a news story may reflect predominately or only one side of an argument. It is important for a reader to recognise campaigning journalism.

Activity 2

A newspaper may seek to encourage its readers toward a particular viewpoint through editorial cartoons. These represent, visually, a point of view about a current issue or event. Often, but not always, they employ an element of humour.

A (trustworthy!) student is sent out of the room and those remaining are shown an editorial cartoon such as Figure 8.6. The student is recalled and allowed to look at the image and caption for about 30–40 seconds. He or she is then challenged to draw the image on the board or overhead.

'Tell the manager the truth have you been nibbling any of his genetically modified food before mummy has paid for it?'

Figure 8.6 Editorial cartoon on GM crops from the *Daily Mail*, 9 February 1999

As a class, students discuss the cartoon, using questions such as those shown in Figure 8.7.

This activity is drawn to a close by indicating that the impact of editorial cartoons may be substantial because, typically, they are memorable, they engage our emotions and they almost always convey only one side of an argument. Editorial cartoons express opinion. Just as students need to read news articles critically, they need to 'read' editorial cartoons critically, recognising their rhetorical power.

What science–society issue is this editorial cartoon about?
Which part(s) of the cartoon are remembered most easily? Why is this so?
Do you think the editorial cartoon is in favour of GM food or against GM food?
Why do you think this?
Is the editorial cartoon 'fact' or 'opinion'?
What opinion or viewpoint is the editorial cartoon communicating?
What 'side of the argument' on GM foods, therefore, is presented in this editorial cartoon?
Do you think it would be possible for an editorial cartoon to be 'balanced', in other words, do you think an editorial cartoon could show its readers different sides of an argument?

Figure 8.7 Questions relating to the editorial cartoon on GM crops

Activity 3

Students are reminded that in both article and editorial cartoon, the newspaper provided us with information that supported only or predominately one side of the argument in the GM debate. However, if we are to make up our own minds we need to seek out and consider all sides of the argument. How might we find out the arguments *both* in favour and against growing GM crops and selling GM food?

Working in groups, students explore one or two information sources relating to GM food (interesting examples may be drawn from the scientific societies, environmental pressure groups, the BBC etc.) and compile a list of advantages and disadvantages of growing GM crops for food or other purposes. As a class, they collate the results of their research.

Finally, in whole-class discussion, students evaluate the advantages and disadvantages of the diverse resources they consulted as sources of information.

Activity 4

People who study how the media influence our attitudes and behaviour suggest their effects are difficult to determine and may be less than is sometimes supposed. However, in relation to socio-scientific issues, it is the case that people do sometimes change the way they act as a result of reading a news report or listening to a news broadcast.

Students are challenged to design a brief interview schedule to investigate whether people they know have ever changed what they do on the

basis of having listened to or read a science-related news report, including those on health or environmental issues.

Each student then interviews one person and reports back the next day. (It should be stressed that they only interview individuals they know.) The findings are collated.

Finally, the series of lessons is concluded by reviewing the key role of news media in society as a source of information and reinforcing the need, when making important decisions, to consult a range of information sources and to attempt to evaluate their credibility.

Exemplar 3: fortifying food with folic acid

Intended learning outcomes

This series of lessons, designed for 15–16-year-old students, exploits 'letters to the editor' as *a source of arguments for and against a particular course of action* in relation to a socio-scientific issue. Letters can be a particularly useful resource for teaching and learning about 'science and society'. They tend to be short and well argued. They often come in pairs, one presenting one side and the next the other side of a case.

Aside from science-related learning outcomes associated with vitamins, minerals and deficiency diseases, the letters to the editor provide the opportunity to develop students' understanding of science–society issues and to contribute to their 'citizenship education'. Specifically, they learn that science can illuminate the consequences of alternative courses of action. However, its application in this context is associated with complexity, uncertainty and controversy. It will offer benefits for some, but problems for others. It has ethical implications. In this instance, there are tensions between the rights of the individual and the interests of others. They develop their ability to 'express, justify and defend orally or in writing a personal opinion about (an) issue, problem or event' and to 'express, explain and critically evaluate views that are not (necessarily) their own' (DfEE/QCA 1999a: 15, 16). Students also explore how decisions of this sort are made in their society.

Introduction

The session is opened by a brief revision of vitamins and minerals and their associated deficiency diseases. The students are then introduced to the focus of the news study, folic acid.

Each year a small number of children (about 90 in England, 70 in Scotland and 15 in Northern Ireland) are born with a neural tube defect (NTD) of which spina bifida is the most common. In 1991, scientists

discovered that increasing the amount of folate (a natural B vitamin found in vegetables and wholegrain products) the mother takes prior to conception and for the first 12 weeks of pregnancy can reduce the incidence of NTDs. Consequently women planning a pregnancy are advised to take a folic acid supplement (folic acid is an artificial form of the natural vitamin) and eat food rich in folates prior to conception and during the first 12 weeks of pregnancy. In practice, however, this advice is problematic. About half the pregnancies in the UK are unplanned. Also by the time the mother knows she is pregnant it may be too late for folic acid to be effective. For this reason it has been suggested that folic acid should be added to flour. The addition of nutrients to food in this way is called *fortification*. In this case, we would be *fortifying* flour with folic acid. At present, this is voluntary and few millers do so.

Activity 1

Belfast Telegraph, September 2000

Letters to the editor

Mass dosing with folic acid not necessary

Many people may not be aware of the consultation taking place about adding folic acid to all flour.

The purpose of this fortification is to increase the intake of folic acid (one of the B vitamins) to assist in combating the risk of neural tube defects such as spina bifida. If adopted, this means that all people would be ingesting an increased amount of folic acid, which is the synthetic form of foliate that occurs naturally in green leafy vegetables, whole grains, liver, etc.

No one can predict the effect on health, even in the amount suggested, over a long period. There has been much controversy in the US regarding this fortification. Folic acid and Vitamin B_{12} are closely linked. Just one of the known dangers is that a high intake of folic acid could mask the presence of a Vitamin B_{12} deficiency. That deficiency is associated with pernicious anaemia, particularly in elderly people and it could therefore go undetected. It is known that some drugs and folic acid can be antagonistic (i.e. work against each other). It should be remembered that it took 25 years to discover the possible connection between flour treated with the approved additive agent (to whiten flour) and nervous disorders. *cont.*

The fortification of all flour with folic acid would be for the benefit of pregnant women but in particular those who may have an unplanned pregnancy and who would not have been taking sufficient folic acid before conceiving. However, according to the Association for Spina Bifida and Hydrocephalus even if flour is fortified, 'women should still take daily folic acid diet supplements to raise the folic acid level ... from well before conception.' It would be ethically wrong to inflict a synthetic vitamin on everyone. The right to choose wholesome unfortified food is everyone's prerogative.

Vitamin deficiency in general is the result of a faulty modern diet, processed fast foods and lack of vital fresh fruit and vegetables. Extra folic acid appears to be necessary in pregnancies because of the danger of a baby having spina bifida, even though the cause of this birth defect is not known and in some cases may be genetic.

Why should everyone be medicated in the light of the foregoing? Some cereals and refined flours are already fortified with vitamins, such as folic acid, and these additives could be increased in these products and freedom of choice would be preserved.

Mrs A.

Figure 8.8 Letter against fortification of flour with folic acid

Students are invited to read the letter 'Mass dosing with folic acid not necessary' (Figure 8.8) which appeared in the *Belfast Telegraph* in September 2000, soon after the government issued a consultation document seeking views on the subject.

They are then asked to list the main arguments made in the letter against the universal fortification of flour with folic acid.

Students then read 'Backing bid for flour fortification' (Figure 8.9) which appeared in the *Belfast Telegraph* in response to the first letter.

They are asked to list the main arguments made in the letter in favour of the fortification of flour.

In whole-class discussion, it should be pointed out that many of the statements are statements of consequences, for example, 'this is likely to reduce the incidence of NTDs'. These can be informed by science, albeit sometimes with a degree of uncertainty. Some however are different. For example, one writer states 'the right to choose wholesome, unfortified food is everyone's prerogative', in other words 'everyone has the right to choose unfortified food'. The author considers the denial of this choice to be wrong in itself, independent of consequences. Thus we have arguments on the basis of *principle* (the intrinsic rightness or wrongness of an action) – deontological arguments – and arguments on the basis *consequence* (the outcome of an action) – teleological arguments.

Belfast Telegraph, September 2000

Letters to the editor

Backing bid for flour fortification

It will be up to the Government to decide after the present consultation whether, on balance, the public health interest will be served by the addition of folic acid to all flour in order to reduce the number of spina bifida pregnancies.

The Association for Spina Bifida and Hydrocephalus (ASBAH) strongly believes that it would be in the public health interest to do so. The current strategy of encouraging women to take a daily folic acid supplement before they conceive fails to work for the 50% or so of women who do not plan their families.

Universal fortification will alter that and at a fairly low level proposed by the expert Committee on the Medical Aspects of Food and Nutrition (COMA), which considered arguments to put a range of higher amounts in flour and rejected them.

COMA was clearly of the view that the fortification proposed, 240 mcg of folic acid in every 100 mg of flour, will not impose unacceptably high levels on other groups in the population. Your correspondent (*Writeback*, September 29) quotes ASBAH as saying that even if flour is fortified 'women should still take daily folic acid diet supplements to raise the folic acid level ... from well before conception.' We do, but, more importantly, so did COMA and they played it very safe indeed. If it is introduced, women who become pregnant will still need to reach for the supplement as well so they have best possible protection against spina bifida affecting their unborn children.

The proposed amount will reduce the amount of spina bifida and related defects in pregnancy by 41%. We have heard nothing to suggest that this will hazard the health of mothers, their children or anybody else.

ASBAH wishes the Government to move as quickly as possible to introduce fortification. If they wish, they can preserve freedom of choice by allowing completely unfortified flour to be sold to the public but carrying its own health warning: 'Caution, essential vitamins and minerals normally added to flour have not been added to this flour.'

Regional Manager, Association for Spina Bifida and Hydrocephalus, Belfast

Figure 8.9 Letter in favour of fortification of flour with folic acid

Activity 2

When considering the issue of fortification with folic acid, there are three options:

- Fortification of flour with folic acid remains voluntary.
- Fortification of all flours with folic acid is made compulsory.
- Fortification of some flours with folic acid is made compulsory.

Students are introduced to 'consequence mapping' (Lock and Ratcliffe 1998). Working in small groups, they are given a large sheet of paper, in the centre of which is a 'What if' question and challenged to map out the consequences of that course of action (Figure 8.10).

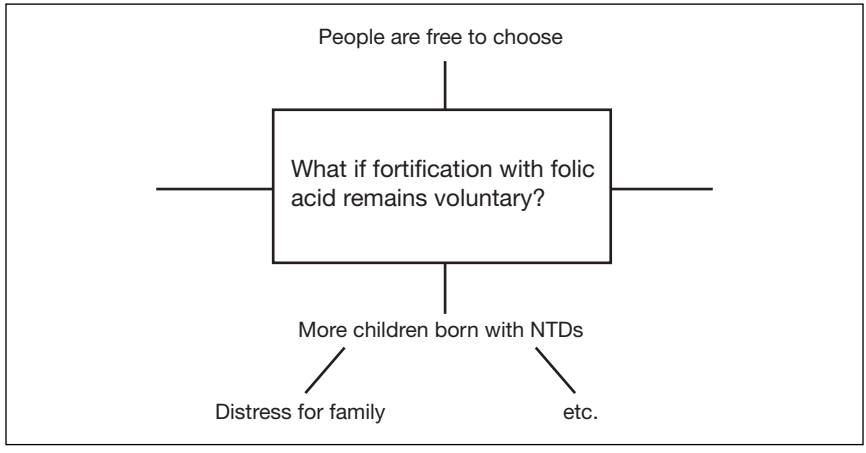

Figure 8.10 First stage of consequence mapping of the voluntary fortification of flour with folic acid

Each group is given out colour markers and a large sheet of paper (a roll of lining paper from a discount hardware store is a useful resource for this activity). Students should use green for what they are sure is a positive consequence of the action, blue for what they think *may* be a positive consequence, black for what they are sure is a negative consequence of the action and red for what they think may be a negative consequence.

They should think of primary and secondary consequences. For example, no reduction in incidence of NTDs may be a primary negative consequence and greater demands on the health service may be a secondary negative consequence of this. An internet search may assist the process.

Following this activity, the class is invited to make a wall display listing the advantages (certain), advantages (possible), disadvantages (certain) and disadvantages (possible) for each of the three courses of action.

After browsing the display, students may be asked whether they think flour should be fortified with folic acid and invited to justify their positions. Alternately, you may consider that the young people still have insufficient evidence on which to base such a decision and so this would be counter-productive. Either way, for those in the UK, it is interesting to indicate (but only at the very end of the activity) that the addition of calcium, iron, vitamin B_1 and vitamin B_3 to all wheat flour except wholemeal and vitamins A and D to margarine is already compulsory!

It is important to stress that science can inform the debate about the fortification of flour with folic acid, for example, in the identification and weighing of risks and benefits. However, science alone cannot resolve the ethical issues so raised.

Activity 3

Whether or not to make it compulsory to fortify all flour with folic acid is a difficult decision. Working in their small groups, students are invited to discuss how they think this decision should be made.

At the time of writing, an account of the decision making to date in the UK is presented on the Department of Health's website, www.dh.gov.uk (search for folic acid).

After describing the process young people should be encouraged to discuss the process, addressing questions such as:

- How does it compare with what they had suggested?
- Overall does it seem reasonable?
- How might it be improved?

Finally, the teaching sequence is concluded by reviewing the relevant characteristics of decision making in relation to socio-scientific issues.

And finally ...

'Scientific progress comes with consequences' (Zeidler and Lewis 2003: 289). Through its application, it presents society with great opportunities to enhance the quality of life. It also presents society with challenges and many of the major ethical dilemmas of our time lie at the interface of science and society. Often, its successes and its failures, its power to excite and its power to perplex, are played out in the news media.

News media therefore provide an excellent resource for demonstrating how science meshes with contemporary society. Also, in as much as they represent the channel through which most adults will acquire their information about science-related issues and on the strength of which they may

make important choices in the personal or social realm, their study may serve as a stimulus for lifelong learning and a preparation for present and future decision making. In these two ways an exploration of science in the news, with a focus on 'science and society', can help encourage young people to form and 'express opinions on issues with a science component that enter the arena of public debate, and perhaps to become actively involved in some of these' (Millar and Osborne 1998: 12). It can, in other words, contribute to the development of students' scientific literacy.

However, alerting young people to the news media as a key information source on socio-scientific issues, though necessary, is an insufficient basis for preparing them to use such sources effectively. This requires instruction on how news is produced and received – the theme of the next chapter.

9 Teaching about science in the news

Introduction

In Chapter 2, we introduced an important idea with a quotation from Gregory and Miller (1998: 106):

> [U]nderstanding science-in-the-media has something to do with understanding media science, but mostly it is about understanding media.

They argue that when we consider 'science-in-the-media', the 'media' aspect of our object of study is as important as the 'science' aspect. It follows that, if we wish to equip our students to engage critically with science in the news, then we have to explore with them how science is presented in the news. This is often overlooked in science education literature. Ryder (2001b: 11) is among the few to draw attention to the fact that:

> The examination of media reports on science-related issues is likely to involve consideration of the aims and activities of the media industry in addition to science content and epistemology of science.

This is quite a challenge for those of us who are science teachers. Typically, we have had little training in this area (Monk and Dillon 2000) or access to appropriate guidance.

Four key 'media awareness' themes relating to science in the news will be explored in this chapter:

Theme 1: Science-related stories are prevalent in the news. Often they are interesting and informative. Some address issues of considerable importance.

Theme 2: Science news stories arise through a process of selection and 'construction'. They are produced for a variety of purposes but not expressly to educate.

Theme 3: Science news stories follow the codes and conventions of journalism many of which spring from the constraints under which journalists work. All media messages have embedded values and points of view.

Theme 4: All sources of science information have strengths and limitations. Significant science news stories call for a critical, reflective response.

Drawing on the Newsroom Project and on other development work we have undertaken, we will break down each into possible student learning outcomes and suggest learning experiences through which these might be achieved. Essentially we are offering a menu with four courses. There is no expectation that every activity will be attempted. Even undertaking one task from each 'course' can contribute to students' understanding of science in the news and to their skill in engaging critically therewith. Account will also need to be taken of the age and ability of students and of the time we are willing or able to devote to this aspect of the science programme.

These learning outcomes also relate to scientific literacy and to the ability to engage critically with science in the news, and so are specific illustrations of the more general outcomes in Figure 6.3a–d.

We recognise, too, that not all science teachers will want to tackle these issues. Indeed, we believe there is a strong case for science teachers working with teachers of English or media studies in pursuance of these aims.

Science-related stories are prevalent in the news

In our research, we have found that young people are often amazed to discover just how much science is mentioned in the media. Thus, an appropriate starting point for teaching about the presentation of science in the news is expressly to draw students' attention to the prevalence of science in the news.

Simply *reading good science journalism to students* on a regular basis can be rewarding. High in human interest and rich in contemporary science, carefully chosen items can convey something of the relevance and excitement of the subject. The sheer quality of some of the writing can fire their interest and imagination. Further, through turning often to newspaper or news site, teachers can serve as role models, demonstrating their ongoing spirit of enquiry and flagging news as an important source of information about developments in science.

An entertaining way to illustrate the same point is to have a science '*scavenger hunt*'. Students work in groups, each of which is given a copy of the same newspaper. They are then challenged to, for example, find 'a

headline naming a gas', 'a story about energy', 'a photograph showing a microscope', 'a letter about biodiversity', 'the phase of the moon today', 'a scientist's birthday' etc. If the paper is too bulky or certain articles considered inappropriate, pages can be removed. Whatever, be prepared for a lively 10 minutes!

There are many other means for conveying the important message that science is prevalent in the news. Students can be invited to keep (say for a week or a month) *a diary or journal* recording instances. Teachers can prepare an *archive* of interesting articles for consultation. More collaboratively and collectively, students and teachers can find and display on a '*bulletin board*' items drawn from news broadcasts, papers and websites. The board can be made 'interactive' by including interesting questions for browsers to answer. It is important, however, that the material is kept current. Yellowing newsprint is particularly unattractive and up-to-date articles make the most impact. By the same token, a '*follow the news*' board can be created where a noteworthy story, likely to run for some time, is followed through. Alternatively, rather than simply displaying current items in classroom or corridor, a '*science in the news learning centre*' can be set up (Shaw, undated). This comprises a corner of the laboratory, attractively arranged, displaying a limited number of stories and two or three 'challenge sheets' presenting a few short questions or tasks that can be completed in minutes. On occasion, the *school librarian* may be willing to set up a 'science in the news' display.

In the Newsroom Project, two activities were developed specifically to demonstrate the prevalence of science news stories. One school set aside a '*newsweek*' in which all major national, regional and local newspapers were scrutinised for science-related items – articles, images, obituaries etc. In advance, students were challenged to guess how many would be found. On completion, the cuttings were counted and displayed.

In all, 207 items had been collected – many more than anyone had predicted! In another project, a number of schools put together a '*science in the news calendar*'. Students were encouraged to watch, listen to and/or read the news and to take note of any science-related stories. In class, they wrote a one-line summary of each story on a Post-it® and stuck it on the poster-sized 'calendar'. Continuing over a month gave a clear indication of how much science makes the news.

An important lesson we learned through these activities, and one seldom alluded to (but see Lucas 1983), is that younger children have some difficulty recognising scientific content in the media. We recommend, therefore, that examples of science-related items should be discussed before students embark on their tasks.

Such activities reinforce students' awareness of the prevalence of science in the news, but it is worth exploiting the wealth of material they generate to explore some of the 'associated ideas' shown in Figure 9.1.

Science-related stories are prevalent in the news

Associated ideas

Science-related news stories are often interesting and important

Much science in the news is well researched and well written

Journalists have to work hard to make complex science simple, but not simplistic

What counts as 'science' is interpreted broadly and is often interdisciplinary. Significantly, it is also often 'science-in-the-making'

Figure 9.1 Ideas associated with Theme 1

The teacher selects a limited number of short items likely to appeal to young people. Students are invited to give each story star ratings based, separately, on their evaluation of its *interest*, *importance* and *accessibility*. In discussion, they defend their decision. Older students can also attempt to classify the stories as biology, chemistry, physics, earth science, astronomy, psychology etc., showing the reach of science reporting and its interdisciplinarity. They can identify 'science-in-the-making'. A more elaborate approach has young people writing their name and a brief relevant comment against one or more headings (appropriate to the age and ability of those involved) on a large poster (Figure 9.2).

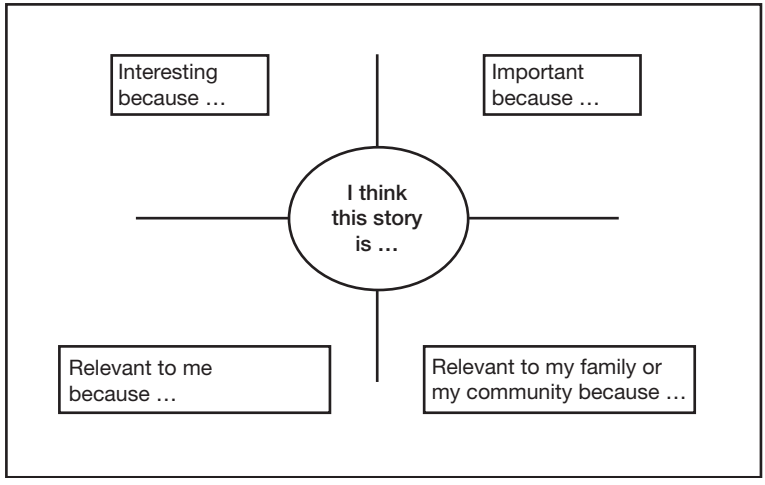

Figure 9.2 Science news – science views.
Idea devsed by Frank Burnet and Ben Johnson, The Science Communication Unit, UWE, and reproduced with permission

Other ideas include students researching the background to a news story and preparing an information leaflet, poster, PowerPoint, 'news broadcast' or short drama to present their work to their peers. In '*Pulitzer Prize by proxy*', older students are given a couple of months during which they seek out science-related reports in the press. From the breadth of their reading, they select the news story or feature article that they found most compelling. They then prepare a defence of their choice, indicating why they considered the item so effective. Both the article and the student's personal response to it are submitted for adjudication by their peers. Those deemed of sufficiently high quality win a Pulitzer Prize – by proxy!

Students get few opportunities to express their opinions about the science they encounter in class and beyond (Osborne and Collins 2001). These activities offer them the chance to do so. Perhaps, too, they may develop the habit of attending to science in the news.

Science news stories arise from a process of selection and 'construction' They are produced for particular purposes

These headline ideas were introduced in Chapters 2 as among the key tenets of media awareness. They focus on agency and intent. How can we introduce these important concepts and associated ideas (Figure 9.3) or, more probably, since they may already have been introduced in English or media studies, consolidate and contextualise them in relation to science in the news? Within the Newsroom Project, a number of activities were devised or adapted from media studies resources.

'*Science editor for a day*' aims to raise students' awareness that what counts as news, including science-related news, is a process of selection. Working in groups, they are given 16 cards each having the outline of a potential science news story (such as those in Figure 2.2). The group, acting as 'science editor' of a newspaper, has to select which six they will pitch to the editor as possible items for inclusion in next day's paper, bearing in mind that a news article must attract, as well as inform, its audience. Based on their selection, students discuss what sort of science-related stories are likely to make the news. In plenary session, the teacher draws these characteristics together and makes the comparison with the 'news values' that influence what we are likely to see, hear or read on the news more generally. It should also be stressed that the criteria for selecting science news are essentially the same as other news. Also the stories that are discarded are not news, so raising the gate-keeping and agenda-setting roles of media.

In '*editor for a day*' science and non-science reports are used. This raises students' awareness that science stories must compete with other stories to

Science news stories arise from a process of selection and 'construction'. They are produced for particular purposes

Associated ideas

Newsworthiness is judged on the basis of, for example, timeliness/immediacy, relevance/impact, proximity/meaningfulness, prominence, clarity/unambiguity, personalisation/narrativisation, uniqueness/unexpectedness, conflict/controversy/emotion, co-option. 'Human interest' is paramount. These criteria are termed 'news values'.

Conventional news values apply as much to science reporting as to other reporting

The purpose of news is to inform, interpret, persuade, entertain and, typically, to generate profit. Even public service broadcasting has to be economically viable. Its purpose is not *expressly* to educate.

News scripts are not science textbooks – they have different intentions, structures and styles of writing

News is only one source of information about science; there are others that should be consulted if and when necessary. Each has its advantages and disadvantages.

Figure 9.3 Ideas associated with Theme 2

make the news. Alternately, in '*news pitch*' each group is given background information about *one* potential item and invited to prepare a case for why that story should get into the next news bulletin or paper. Groups select a representative to pitch their story at the editor's conference. The conference is role played with either the editor choosing or the remainder of the class voting for the story that will appear. This is most interesting when the stories are of broadly similar newsworthiness. The science story, of course, need not win!

For these activities, authentic potential stories can be gathered, in a process similar to that adopted by science journalists themselves, from the websites of news agencies such as Reuters, of journals such as *Nature*, *Science* and the *New Scientist*, and of university press offices and science departments.

'*Spotting news values*' reinforces students' understanding that the selection of stories is made on the basis of certain criteria and, to be considered 'newsworthy', an item should meet one or more of them. The activity can be undertaken in one of two ways. Students, in groups, are assigned a short science-related news story and they discuss why it was considered newsworthy. Each group reports back and the teacher builds up a list of news values based on their summary. Alternatively they can be given out a chart listing the conventional 'news values' (Chapter 2) and they tick those represented in their story. In plenary session, the teacher stresses again that

news values for science stories are similar to news values for other types of stories. Only stories high in human interest are likely to be considered and they will be written so as to accentuate their human interest qualities. In preparation for this activity, science-related news stories should be collected to illustrate as many criteria as possible.

A second key concept in this theme is that media messages are produced for particular purposes. As we saw in Chapter 2, the purpose of news is considered to be to inform, interpret (explain), persuade (influence), entertain and, commonly, to generate profit. It is not necessarily to educate. In this sense, the otherwise appealing phrase 'living textbook' is actually quite misleading. It is important to raise students' awareness of the implications of this for the media as a source of science information.

'*What's the purpose*' activities simply involve students identifying the primary purpose of particular news items among science-related stories illustrative of information, interpretation, persuasion and entertainment. The prevalence of the last purpose is worth a comment.

It is important to instruct young people that, although we can learn science from, say, newspapers, they are not intended to be science textbooks. In an activity we call '*Not a textbook*' students are given one or two short news articles relating to a particular science topic (advances in cardiology, for example) and a few pages from a science textbook relating to the same topic (the structure and function of the heart, say). They list as many differences as they can between the two media. In plenary, they discuss the advantages and disadvantages of news and textbooks as sources of science information. The value of news media in flagging advances in science and, significantly, personal and social issues associated with those advances should be discussed. Textbooks, it should be noted, are also 'media' and hence constructions. They are not ideologically neutral.

Science news stories follow the codes and conventions of journalism
All have embedded values and viewpoints

These headline concepts were introduced in Chapters 3 and 4 along with the associated ideas shown in Figure 9.4. Again many of these, the students will have encountered in English/media studies.

Journalists work under constraints and these mould much that is distinctive about news reporting, whether in broadcast or print. In our experience, even quite young children can come to understand these issues and their implications.

That time is at a premium and thus exhaustive research is not always possible is illustrated in the sketch '*Every minute counts*' (Appendix 6). This

was devised by a science teacher Mary Kelly while participating in our 'Use the News' project and employed to great effect with a class of 13-year-olds. Indeed, the group became so engaged in the lesson that some, of their own accord, extended the set homework to videotape an interview with a 'scientist' and with 'our reporter on the spot'.

Science news stories follow the codes and conventions of journalism. All have embedded values and points of view

Associated ideas

Journalists write within constraints of space, time, expertise and, crucially, audience response

Because time is limited, extensive research is not always possible. Because space is limited, important details such as qualifying statements may be omitted

Science stories are not necessarily written by science journalists

News is a commercial product, driven by the profit motive or at least the need to be economically viable. It is important that it can attract an audience and, often, advertisers

Each news medium has its own characteristics. In newspapers, for example, the most important and newsworthy information is presented at the beginning of the article. This is sometime termed the 'inverted pyramid' model. Often, in this style of writing, the answers to the '5Ws and H' questions can be found in the opening one or two paragraph(s). This applies to a limited extent in science-related stories and less so in longer, feature articles

Journalists write for a target audience, using a particular mode of address based on their sense of the reader. Different newspapers have different perceived or target audiences and hence may have different news values and styles of reporting

Despite claiming to be impartial, news messages will always have embedded values and points of view

Different news organisations may have different values and present different viewpoints

There are 'interests' within the media and also within science

Science as it impacts on society is sometimes accompanied by controversy. This may arise from the uncertainty associated with the science itself or from the moral and ethical issues associated with its application. From a journalist's perspective, controversy is welcome, indeed it may be sought, as it makes for lively newspaper copy

Figure 9.4 Ideas associated with Theme 3

That space is at a premium and consequently important details may be omitted can be illustrated by an activity '*Every word counts*'. Here the teacher reads an account of a scientific study to the students. Sets of cards are distributed, each having specific information relating to the study and a word count. Working in groups, students are challenged to 'write', using the cards, a news report within a certain word limit (say, 250). In plenary session, the teacher discusses which cards – and consequently which information – they omitted. News values again come into play. Scientific detail, sources of funding, previous work, the views of other scientists and, importantly, qualifying statements tend to be dropped. The young people are alerted to the implications of this. What is *not* written may be as important as what is written. This activity works well but takes a lot of preparation. Lengthy accounts of science studies can be found online and used as a basis for the task. Details can be invented too. Our cards say things like 'Professor Smith and Dr Brown are presently having an affair (10 words)'. You may prefer a more sober version.

It is important to teach young people to listen out for the background of the correspondent reporting on a science-related issue on television or radio and to look out for the byline of the correspondent writing on a science-related issue in newspaper or website. This aids evaluation of the expertise of the author.

In an activity called '*Hooked*', students study a number of news items to identify ways in which the journalist attracts the attention of the viewer, listener or reader. They should consider the theme, images, headline and language of the report, noting, for example, those phrases and words which are used to make the story seem important, interesting, humorous etc. In plenary, the teacher discusses the extent to which these techniques might influence the story.

In considering the constraints on production, it is important not to leave students with the impression that news is not a useful starting point for acquiring science information. However, as always we should stress that if, for some reason, they need to find out about a science-related issue, it is prudent to consult a number of apposite sources.

A second thread in this theme relates to the characteristics (conventions) associated with particular news media. '*Finding your way*' familiarises students with the structure of newspaper articles. They read a short science-related news story and answer questions such as 'What is the headline?' 'Who wrote the article?' 'Was she/he a specialist?' 'What is the most important information in the story?' 'Where is it found?' etc. In the report back, these issues are discussed from a science perspective. For example, following up questions relating to quotations, evaluating the credibility of these 'sources' is shown to be part of the process of evaluating the credibility of the story. If future developments (projections) are predicted it is stressed

these are suppositions. An interesting way to reinforce this learning is to cut a short report of a science study into sections (including headline and byline) and present them on cards. Students reorder the cards in the correct sequence. It should be noted that feature articles and editorial pieces have a different structure and style.

A task commonly undertaken in English/media studies is to compare the treatment of a news story in different types of newspaper. Students, working in pairs or in groups, are given a science-related story from, for example, a 'broadsheet', a 'mid-market paper' and a 'tabloid'. They are invited to compare and contrast the coverage each newspaper gives to the story. This task can be structured in a number of ways (see Figure 9.5). In the follow up discussion, it is, we believe, important to avoid the idea that somehow science reportage in the 'broadsheets' is necessarily 'good' and 'unbiased' and that in the tabloids is 'poor' and/or 'biased'. As discussed earlier, science articles in the tabloids can be of high quality.

Aspect	**Paper 1**	**Paper 2**	**Paper 3**
Images: how many are there?			
Images: what size are they?			
Headline: what does it say?			
Headline: what does it look like?			
Text: how long is the article?			
Text: how easy is the article to read?			
Text: how easy is the article to understand?			
Overall, which is the most interesting article?			
Overall, which would be the most helpful if you really needed to find out about this topic?			

cont.

Aspect	**Paper 1**	**Paper 2**	**Paper 3**
Information mentioned			
Name of scientist			
Where the study was conducted			
Where the results were made public etc.			
Comparing Articles		**How are the stories similar**	**How are the stories different**
Headline			
Images			
Text: content/language/style/angle/ balance			

Figure 9.5 Different newspapers have different styles of reporting

A third and significant strand in this section relates to values. Young people need to understand that all media messages have embedded values. A story can be presented in a number of different ways and the '*angle*' chosen will be influenced by the perspectives of journalist, editor and media institution. This can be explored with students by selecting a news story and discussing who might have different views about it and how these might be represented. An account of the injunction granted to Oxford University against certain animal rights groups could be considered. How might this story be treated in the university newsletter, in the animal rights group newsletter, in the local community paper etc.?

Just how subtly positional messages can be conveyed, whether intentionally or unintentionally, is investigated in '*Values and viewpoints*'. The teacher describes the unfolding story of research into the affect of genetically modified corn on monarch butterfly caterpillars (information is available on the internet). Students complete the table in Figure 9.6, deciding which headlines etc. are more likely to appear in a newspaper that has adopted a position generally supportive of GM crops and in a newspaper that generally opposes GM crops.

A potent way for students to learn about news texts is for them to produce news texts (Davison 1992; Watling 2001). As Masterman (1985: 26), an eminent media educator, writes:

> If students are to understand media texts as constructions, then it will obviously be helpful if they have first hand experience of the construction process from the inside.

The production of '*student-authored news texts*' has also the potential, as an example of 'writing for learning', to promote understanding in science.

In a cross-curricular project, Learning Science Making News, we encouraged schools to establish partnerships with local newspapers with the intention that their students research and write science-related articles for publication. A science teacher and an English teacher worked together with a class taught by both. A scientist visited the school and discussed her/his research with the students. A journalist from the local newspaper gave guidance as to how to prepare an interesting news article. The young people then took on the challenge of working together as a news team to find out more about the topic and to present it, through text and image, in a manner likely to attract an audience. This was not an easy undertaking – and there were many problems along the way. However, almost all were rewarded with class 'bylines' and some even with a centre spread. It is, as one student told us, 'writing for real'.

	Generally supports the development of GM crops	**Generally opposes the development of GM crops**
To use the headline 'Monarch butteflies – a near miss'		
To use the headline 'BT corn gets the all clear'		
To report that the US government has conducted an exhaustive study of this issue		
To report that more research is clearly needed to investigate whether the caterpillars feed on anthers		
To report that it was a lucky break not government vigilance that protected the monarch butterfly		

cont.

	Generally supports the development of GM crops	**Generally opposes the development of GM crops**
To report that the GM industry contributed substantial funds to support the conduct of this study		
To report that scientists have challenged the government study		
To describe the monarch butterfly as admired for its vivid colouring and its spectacular 3,000-mile migration		
To include an image of a monarch butterfly		
To include an image of the 5cm-long monarch caterpillar		
To indicate that monarch butterflies are poisonous to predators due to the toxins contained naturally in the milkweed plant		
To report that the Cornell scientists' conclusions have been discredited by government study		

Figure 9.6 Writing from different viewpoints

Significant science news stories call for a critical, reflective response

The issues discussed thus far all contribute to a critical reading of media messages, however, in this section we focus explicitly on the evaluation of science-related news reports (see Figure 9.7).

First impressions are important – and this is a suitable starting point for this section. Through an activity known as '*Rogue headlines*', students are made aware that, in newspapers, the journalist who writes the article rarely writes the headline. These are written by subeditors and are sometimes misleading. In advance, a short science-related story is found that has a deceptive headline. This is surprisingly easy. Many infer, for example, a certainty not supported by the text. The headline is read to the students and they discuss what message it is giving. They then read the article and discuss

what message it is giving. Subsequently, students are challenged to make a collection of misleading science-related headlines.

Beyond the headlines, the need, generally, for vigilance in respect of expressions of uncertainty is important. Young people are not naive, but, as noted in Chapter 5, research has suggested they display a certainty bias that may act against their interpretation of news text.

Significant science news stories call for a critical, reflective response

Associated ideas

Although headlines alert us to interesting and important news stories, they may also mislead

It is important, but not always straightforward, to recognise statements of opinion and persuasion in a science-related news report

Journalists may attempt to persuade their audience through their use of language, content (including quotations from sources) and presentation (including images).

While all media messages have embedded values, on some issues news media may actively campaign or expressly promote one side of an argument

Journalists tend to use a limited range of sources for science information. It is important, but not always easy, to evaluate the credibility of these sources

In the interests of 'balanced reporting', opposing opinions may be presented, although one may represent the majority view of the scientific community and the other a minority view

All sources of science information have strengths and limitations

Often, we attend to the news only casually. On occasion, however, a critical and reflective response is important

Different people experience and respond to the same media message in different ways depending on their opinions, values and worldviews

Figure 9.7 Ideas associated with Theme 4

From English/media studies students will be familiar with distinguishing 'fact' from opinion. In news reports of 'science-in-the-making', however, the factual status of many of the claims is problematic. Consequently we suggest that students are invited to '*spot opinions*' in an article, underlining them in the text. Similarly, in writing having persuasive intent, they can look out for '*leading language*', underlining words and phrases calculated to influence, that is to steer an audience toward a particular viewpoint or course of action. Young people delight in deconstructing headlines such as 'Stop messing with our natural food'. In plenary,

students consider how the report attempts to persuade its audience through language, content and presentation. They discuss whether they agree with the opinions offered and whether the article would prompt them to change their mind about the issue. It is, we accept, a cliché, but young people should be encouraged to look on news as suggesting 'what they should think about' not 'what they should think'. Even then, they should be alert to the media's gate-keeping role.

While all news messages have embedded values, on some issues news media may actively campaign or expressly promote one side of an argument. In '*Waging a campaign*' students read a news story on a controversial theme, for example see Figure 8.4, and answer questions such as those in Figure 8.5.

Campaigns are declared and hence easier to adjudge than less explicit position taking. Nonetheless, it is useful to discuss how we might find out if there are counterarguments. In our experience, young people like to feel they are being given the opportunity to make up their own minds about an issue rather than having a position pressed on them.

Students rarely have the opportunity to assess source credibility in school science (Clark and Slotta 2000). This is unfortunate since, faced with increasingly diverse and unregulated information channels, it is becoming an increasingly important issue. Furthermore, it has been argued that the ability to appraise expertise is very significant in the process of lay evaluation of the credibility of research (Fensham 2000; Jenkins 1999; Kolstø 2001; Korpan et al. 1997; Norris 1995; Norris et al. 2003; Shamos 1995).

Expert credibility, then, is an important issue and one that should be explored with young people. Students read a science-related news story which refers to a number of sources. They look for 'phrases of attribution', identify the sources (names, titles, organisation and quotations) and list them in the order in which they occur in the story. Students then discuss what '*credibility*' they would attach to each source. Which are given priority? Does the order in which they are presented influence how the news story is interpreted? Are there any other sources that should have been included in the news story?

In plenary, the difficulty of evaluating the credibility of a source should be discussed. Unfortunately, there are no easy answers here, no failproof formula by which you can say this person's views are trustworthy while this person's are not. It should also be noted that, in the interests of 'balanced' reporting, opposing opinions may be presented, although one may represent the majority view of the scientific community and the other a minority view.

That all news media have advantages and disadvantages can be explored further through a '*Media SWOT*' activity. As a general exercise, a table listing a range of media sources (including online news sites) with spaces for the perceived strengths and weaknesses of each can be completed

by students. More specifically, a 'day' or a 'story' can be selected and students compare the coverage of science across the target news media or follow the treatment of the story in the target news media. In follow up, they prepare an evaluation of the strengths and weaknesses of each medium in the form of a chart, written report or poster presentation.

As a conclusion to these activities, it is important to stress the need to refer to a number of relevant sources of information if important decisions in relation to a news item are to be taken. In particular, if health-related decisions are to be made, then health-related professionals should be consulted.

Since our overall aim is to encourage young people to engage with science in the media, then we will wish to promote a personal, reflective and enquiring response to science-related news items. We want them to understand that 'the reading is not over when the story is finished' (Fisher 2000: 2). In '*Personal response*' students view, listen to or read an appropriate science news item. They are then encouraged to respond to the story with younger students, perhaps, using prompts chosen from the list shown in Figure 9.8(a) and older students addressing the questions at 9.8(b). In this context, young people may also be encouraged to understand that different people will experience the same media messages in different ways, depending on their opinions, values and worldviews.

(a) Personal response: prompts for younger students

I thought the story was quite interesting because …
I thought the story was quite boring because …

I thought the story was important because …
I though the story was not really important because …

I liked the way the journalist …
I did not like the way the journalist …

It made me think about things I had learned in science for example …

I realised for the first time that …

I was surprised to read that …

I am a bit confused about …

After reading the article, I have changed my mind about …

A question I have for the scientist is …

A question I have for the journalist is …

After reading the article, I think … (based on an idea devised by Darla Shaw, Education Department, Western CT State University and used with permission) *cont.*

(b) Personal response: questions for older students

What are the main ideas presented in this article?

How has this added to my past knowledge about this topic?

What questions would I like to ask the scientists who were mentioned in the story?

What questions would I like to ask the journalist who wrote this story?

Is this an interesting article? If so, why?

Is this an important article? If so, why?

Is this good news, bad news or immaterial for me, my family, my community? Why so?

Overall, what is my personal response to this news story?

Figure 9.8 Responding personally and reflectively to science in the news

Finally we consider how we can extend young people's interpretative and critical repertoires by providing checklists for interrogating news texts. In '*Critical response*', older students may be asked to write, or present orally, a critical evaluation of a news item or article using appropriate checklists similar to those in Appendices 2 and 3. They can be challenged to work with their peers to design an '*Always ask*' (Swanson 2001) poster, leaflet or 'credit card' for other young people to help them critically engage with science news stories.

One of our most popular Newsroom Project activities is '*Newsbug*' designed to encourage critical reading of science-related news stories among younger students. In advance of the activity, a set of 'newsbugs' is made. These can be constructed from painted polystyrene balls. Six small holes are made in the body, but the pipe cleaner legs are not fitted at this stage. Alternately, card models can be made. Students work in groups for this activity. Each group is given a 'science bug' and, separately, its six legs. They are given a news report of a science study and six cards each with a 'key question' (Appendix 7).

Students read the article. Each is assigned one or more of the key questions and asked to evaluate the news story against that question. When everyone in the group has formed a judgement on how well the story measures up against their question, they are ready to try to complete the newsbug! Starting with key question 1, students give the bug a leg *if* it is considered that the answer to that question is *yes*. They then move on to key question 2 etc. For each positive answer, the bug gets a leg. If enough questions can be answered in the positive – the bug, and so the story, can *stand up* as a source of information.

The activity can be done in reverse. The groups start with a complete bug and remove the legs one by one as the article *fails* to answer each questions, eventually getting to the point where the news story *falls down* as a source of information. To be honest, this hugely appeals to children – but it may be sending out the wrong message in regard to the respect due to other animals!

By engaging in these types of activity on a number of occasions, young people may come to internalise the questions – so providing them with a mental checklist to bring to any science-related news report.

And finally ...

We support Solomon's (2001: 95) contention that:

> [S]cientific literacy is asking us to help our pupils get into the habit of following new developments in the press and on television. This ... might be the beginning of a lifelong interest in learning more science and so repay our pupils many times over in years to come.

Consequently, we believe that a reasonable aim for the school science curriculum is to encourage young people to engage with science in the news. Science teachers who espouse this position will wish to introduce their students to the wealth of instructive, interesting and important reports presented through the medium of television, radio, newspapers or the internet.

Many also consider that the curriculum should 'help young people ... be able to ... respond critically to media reports of issues with a science component' (Millar and Osborne 1998: 12). This, we believe, demands some degree of media awareness. Science teachers who espouse this position will wish, either by themselves or with colleagues from other subject areas, to introduce their students to activities designed to develop such awareness and extend evaluative skilfulness. In this chapter, we have offered some suggestions as to how this might be done. In the next, and final, chapter we explore how teachers across the curriculum can work together to build young people's confidence to access and the critical maturity to appraise science-related media reports.

10 Working together to ensure 'science in the news' a place in the curriculum

Introduction

You don't have to know much about tennis to appreciate that there are, essentially, two different games – singles and doubles. At high-profile tournaments we are used to seeing talented individuals competing alone – the singles game. Some of these tennis stars, however, and many others who participate in the sport at a recreational level also choose to play the team game. In doubles, individual ability is still very much in evidence but there is a new dimension to the game. Players' skill sets complement one another; partners offer mutual support, they instruct, they encourage and, yes, from time to time they get in each other's way when they go for the same shot. In one sense, teaching is a lot like tennis. Teachers play both the individual and the team game.

It is, of course, possible for individual teachers to undertake 'science in the news' activities on a personal basis. Indeed this is very much what happens at present (Jarman and McClune 2002). In the survey that we conducted of practice in Northern Ireland many teachers reported that, if they happened on a relevant newspaper article, they would often use it with their students. In addition to this 'incidental' exploitation of the medium, a number used news items as a teaching resource in a more systematic manner. Almost everyone, however, worked alone and on his or her own initiative.

There are some advantages in working independently. First, things get done! In the busy – at times frenetic – pace of school life it is often difficult, even with the best of intentions, to liaise with colleagues and particularly those teaching in another subject area. Time for meetings may be hard to find. Once found, circumstances can intervene to delay progress. Strained relationships can derail the process altogether.

However, there is a serious drawback associated with the teacher working alone. The aptitudes and abilities that we hope to develop through engaging students with science in the news are important for *all* the young people in the school, not just those taught by a particular teacher. Thus we

would advocate that members of the science department work together to introduce, on however small a scale, a systematic programme designed to encourage all students to engage with science in the news and to equip them to do so critically.

Science in the news, however, is pre-eminently a multidisciplinary, and hence in the context of schooling, a cross-curricular concern. The two main themes of this final chapter, then, are planning a programme and collaboration across the curriculum.

A permanent place in the curriculum for science in the news

If our aim is that all young people should be encouraged and equipped to engage, critically, with science in the news, then we must take steps to secure for every student a systematic and progressive programme of learning experiences through which this might be achieved. In other words, news-related work should be incorporated in our schemes and in such a way that children are offered opportunities, at various points throughout compulsory schooling, to acquire the requisite knowledge and skill and to develop the necessary habits of mind. Otherwise, there is the danger that it is seen as a 'bolt-on' and as Osborne (2002: 215) memorably observes, bolt-ons have 'a nasty habit of dropping off'.

We offer the 'operational model' outlined in Chapter 6 as one possible framework for planning provision in this regard. It presents the basic elements of critical response to science in the news – science knowledge, media awareness, literacy skill and discerning habits of mind. In respect of each element it offers (without being unduly prescriptive) suggested key learning outcomes, grouped as strands and arranged in order of level of difficulty. The framework thus supports continuity and progression. Furthermore, it facilitates the development of a shared understanding among those teachers who use it.

The science department will want to address 'scientific knowledge' and to encourage enquiring habits of mind. Science teachers may also be prepared to tackle aspects of 'media awareness' and literacy skill. In relation to 'media awareness', for example, an interesting aim in relation to younger students (say 11–13-year-olds) may be simply to alert them, through an appropriate activity, to the amount of science in the news. They can then build on this experience and address more ambitious learning objectives in subsequent years. With older students it will be appropriate to tackle some higher level issues such as considering the balance of sources used in a news story.

To locate the work within the teaching programme, science schemes could be scanned for 'hot spots'; topics where particular intended learning outcomes could be addressed in an uncontrived manner. Additionally, news resources already held within the department may suggest appropriate contexts. The 3As aide-mémoire reminds us that consideration needs to be given to learning activities, resources and outcomes.

The model, however, also emphasises the interdisciplinary nature of 'criticality' and it can form the basis for a cross-curricular approach.

At the very least, students could be shown the model and advised that both science and English contribute to the development of 'their abilities to access and engage critically with science in the news. The next step may be for teachers of science to find out from teachers of English when and how they approach relevant issues. Moving on again, English teachers could be invited to use some science-related items in their media-related work.

There is value, however, in departments collaborating more closely, assuming and sharing responsibility for particular learning outcomes in such a way that students experience a coherent, consistent and progressive programme of learning experiences. The remainder of this chapter describes such collaborative approaches in more detail, drawing again on the work of the Newsroom Project. It is recognised, however, that there is no one way of doing this and what is appropriate or possible in one school may not be so in another.

Collaboration across the curriculum

When teachers introduce science-related news items into their classrooms they are, inescapably, setting out on a multidisciplinary path. When young people encounter science in the news they are, of necessity, required to draw on knowledge and skill including but also beyond that normally identified with learning in science. As they attend to language, as they distinguish 'fact' from opinion, as they explore points of view, they are using abilities more commonly associated with English and media studies. As they weigh rights and responsibilities and consider ethical and moral dimensions of an issue they are using abilities more commonly associated with the humanities and religious studies. When they are analysing graphics and statistics, they are using abilities more commonly associated with mathematics and so on …

All this suggests a strong case for cross-curricular collaboration.

There are many benefits that, potentially, flow from teachers working together to address science in the news (Kolstø 2000; Levinson and Turner 2001; Norris and Philips 1994) These can be grouped, loosely, as those relat-

ing to the enhancement of curricular quality, professional development and, decisively, student learning.

In terms of curricular quality, collaborative working can provide enhancement through:

- The exploitation of expertise and experience residing in other disciplines.
- The opportunity for teachers to 'play to their strengths', complementing each other's work.
- The making explicit of links between learning in one subject and learning in another.
- The opportunity for reinforcement and consolidation of learning.
- The elimination of undesirable duplication.
- The provision of a more coherent, consistent and progressive programme of learning experiences.

A degree of advantage flows from teachers simply being more knowledgeable about practice in other subject areas. Take, for example, improved progression. Within the Newsroom Project, many science teachers were quite surprised to learn what English teachers expect from their students. Armed with this knowledge, they are better placed to provide news-related work of appropriate challenge.

In terms of professional development, collaborative working can provide enhancement through:

- extension of teachers' relevant knowledge bases
- expansion of teachers' pedagogical repertoire
- refining of teachers' conceptualisation of what it means to engage critically with science in the news
- evolution of a suitable discourse and shared understanding in relation to criticality
- building of confidence and competence.

In terms of student learning, collaborative working can provide enhancement through:

- achievement of a wider range of learning outcomes
- exposure to a wider range of learning experiences
- reinforcement and consolidation of learning in other subject areas
- recognition of links between learning in one subject and that in another
- emphasis on the need to integrate scientific knowledge and skill with that from other domains

- exposure to a consistent, coherent and progressive programme aimed at developing aptitude and ability to engage, critically, with science in the news.

Particularly important here is the need for young people to integrate ideas across domains. There is a tendency for us to think in idea-tight compartments and the transfer of knowledge and skill from one context to another does not occur readily. Cross-curricular collaboration may make some contribution toward countering this disposition. Its absence, in the words of Levinson (House of Commons, Science and Technology Committee 2002: Annex 3, App 9) describing a related situation 'sadly under-prepares our citizens of the future for a world that relies on integrated knowledge'.

However, we would be the first to recognise that purposeful collaboration is not easily established. With a degree of understatement, Medway (1989: 19) observes '(Secondary) schools are not well geared for co-ordinated endeavours across … departments and teachers are socialised into single disciplines.' In Bernsteinian terms they operate a curriculum in which classification is strong, that is, subject contents are well insulated from each other by strong boundaries. Furthermore, science teachers are enculturated into a discipline with vertical structures of knowledge that sits rather uneasily with other relevant disciplines characterised by horizontal structures of knowledge.

That said, cross-curricular collaboration is certainly feasible and there are a number of enabling factors that can operate within a school. Tate (1994) for example cites senior management support, the provision of time and resources, the participation of high-status postholders, the personal qualities of those involved – and the transfer of experience between schools! It is in this spirit that we offer the following accounts of the collaborative work undertaken by schools in the Newsroom Project.

Approaches to collaboration

In the final phase of the Newsroom Project, participating teachers introduced science in the news activities, projects or programmes in their schools. Without any steer from the Newsroom team, they adopted one of four patterns of collaborative working that we have designated:

- a consultative approach
- a cooperative approach
- a coordinated approach
- a coincident approach.

While relatively distinct, these do overlap and schools working primarily in one mode often had elements more typical of another.

These strategies can be viewed as different positions along the spectrum of collaborative working practices. From the teachers' perspective, the consultative approach represents the lowest degree of collaboration (and highest degree of independence) while the coincident approach represents the highest degree of collaboration (and lowest degree of independence). From the students' perspective, the closer the collaboration, the more consistent, coherent and progressive are likely to be their learning experiences.

The Newsroom Project involved nine schools. Of these, three adopted a consultative approach, three adopted a cooperative approach, two adopted a coordinated approach (although one later abandoned this in favour of cooperative working) and one school adopted the fourth and most demanding approach – bringing English and science classes together to participate in an integrated project. Just how stimulating this was is shown in a teacher's account of the experience (Figure 10.1).

The benefits of collaborative working: a teacher's perspective

Working together [with the English department] was beneficial at two levels. It enabled staff to create and strengthen links within their own department as well as between the two departments involved. It also helped to reinforce for pupils the lessons that were learned within English and science

Initially the idea of a joint project was rather frightening as English teachers approached science in the news with fear and trepidation and science teachers in turn approached the necessary English terms, techniques and knowledge with major uncertainty. However, it was discovered that as communication within and between departments grew, so did a greater sense of calm. In fact, we even discovered that we could complement each other as we gleaned the necessary knowledge and helpful hints from each other

As we trialled different ideas in the classroom, we found that energy levels and levels of interest grew. Suddenly English and science became much more relevant and useful. It was discovered that trying out different techniques and ideas specifically related to science in the news was refreshing for both pupils and teachers

Figure 10.1 A teacher's account of the benefits of collaborative working

Consultative approach

This approach is characterised by a willingness to share the expertise that exists among the teachers within a school (McClune and Jarman 2001). It represents a basic level of collaboration with few complications. That said, the conditions necessary for it to flourish are not immaterial and they underpin all aspects of collaborative work. It requires, among participants,

good channels of communication, an openness to new ideas, a desire to explore how teachers of other subjects view topics of shared interest and a willingness to learn from these perspectives. It requires confidence in one's own professional expertise and respect for the professional expertise of others.

In this approach, teachers engage in individually or departmentally designed activities, projects or programmes, but with information and advice, encouragement and support from colleagues in another curricular area. Those involved are stepping outside their normal area of expertise and experience and are availing of the expertise and experience of other members of staff. For example, teachers of science can benefit from an understanding of how pupils have been taught to distinguish between 'fact' and opinion or to identify points of view. By the same token, teachers of English may be planning to use a news item with a science component and would thus profit from an outline of the topic or they may need information about the status of the scientists who are being used as 'sources'. In these situations, timely support or well-directed training sessions from colleagues in other subject areas can help teachers gain new skills and greater self-confidence and so enhance their teaching.

A number of schools within the Newsroom Project adopted this consultative approach. English teachers found science news items an *'untapped resource'* that generated interest among students, and particularly among the boys:

> *I have begun to use science in the news in my classroom and have found that pupils were generally very enthusiastic. I am becoming more adventurous and use my colleagues in the science department to answer questions from the pupils about specific subject knowledge. We (science teacher and English teacher) have been educating each other about the way the separate subjects would approach the articles we have found.*

As mentioned in Chapter 9, a science department had a 'Newsweek' in which for five days the science-related items in a range of newspapers were collected. However, the project did not stop with science. A number of articles were selected which, it was considered, would particularly interest the students. An English teaching perspective allowed 'reading for understanding' activities to address both science and media ideas.

Aside from the benefits just listed, which are common to all collaborative ventures and are present, though perhaps in limited measure, in the consultative approach, this way of working has certain advantages. Specifically, it is not necessarily dependent on a formal programme of meetings, on a specific timetable or on a pre-agreed course of action. Teachers and departments retain independence in relation to classroom

practice. Conversely, teachers are not playing to their strengths and much work would be needed to ensure that students' experiences were consistent, coherent and progressive.

The relatively loose arrangements needed in the consultative approach make this a relatively undemanding introduction to collaborative work in respect of science in the news. It has benefits in its own right and it can serve as a springboard for increased cross-curricular cooperation.

Cooperative approach

When teachers engage in cooperative working, in addition to sharing expertise they work together to collect and develop appropriate resource materials. In the classroom, however, they may continue to operate relatively independently.

The joint identification of potentially useful news items is an important feature of the cooperative approach. As teachers sort through the material to decide what is appropriate, the attendant discussion can be both enlightening and professionally developmental. The blending of perspectives results in the selection of a broader range of items targeting a wider range of learning outcomes than would be the case had teachers from only one subject area been involved. By the same token, any resource material prepared to accompany the news items is more comprehensive in reach and more varied in approach. In addition, participation in these planning activities helps to build up a shared understanding among teachers of the knowledge, skills and habits of mind that would support young people as they engage, critically, with science in the media.

A number of schools in the Newsroom Project adopted the cooperative approach. One very interesting example focused on a high-profile science event, the transit of Venus (2004), and capitalised on its wide reporting in the media. Lessons relating to the topic were conducted in science and in English (albeit for different year groups). At break time on 8 June, a viewing was organised. Commenting on the activity, one participant observed:

> *It worked! The children were really fascinated and were asking questions.*

It seems the occasion also managed to attract the interest of teachers from beyond the English and science department! The work of a second Newsroom school is described in Figure 10.2.

In summary, aside from the benefits listed as common to all cross-curricular collaboration, and present in some measure in the cooperative approach, it has certain specific advantages. In particular, the task of gathering news items and developing support material is shared. Our experience

suggests that this results in a larger and more diverse bank of resources aimed at a achieving a wider and more diverse set of learning outcomes.

There is, of course, a price to pay. Teachers who are working cooperatively are committed to meeting and working together. The time so required can limit progress. It can be frustrating if not all partners appear equally committed to the task. Furthermore, the relatively unregulated approach results in a variable student experience and consistency, coherence and progression may be difficult to secure.

The science department in one school introduced a two-week 'science in the news' project for all Year 10 (14-year-old) students. The lessons took place during normal class time and were the responsibility of the class teacher. A rotating modular scheme was in operation, so resource material was needed for biology, chemistry and physics

A science teacher working closely with an English teacher carried out the preliminary work. The interdisciplinary partners sorted through a newspaper collection compiled by the school librarian and managed by the English department. They selected appropriate items and discussed the issues they raised and their potential use in the classroom. A core team of three science teachers then developed subject-specific resources and exemplar materials. These included general background information relating to science in the media highlighting for example, the structure of newspaper articles, the strengths and limitations of science news reporting and issues associated with evidence and conclusions. Also provided were news items on a range of topics from the physical and biological sciences, their associated intended learning outcomes and suggested lesson outlines

These were made available via the school intranet to all science staff and individual teachers were free to use them in whatever way they choose. For some, the experience was a cautious step into unknown areas and they were not inclined to take too many risks. They used the material provided in the ways described. Several, armed with the exemplar material, opted to use news items they had found themselves along with supporting resources they had developed

Students, thus, had a variety of experiences. The teachers who were most confident and enthusiastic about the project extended the suggested activities and approaches, for example encouraging students to write in the style of the newspaper, to engage in role play and to prepare poster displays

Figure 10.2 Cooperative teaching within the Newsroom Project

Coordinated approach

The coordinated approach is characterised by parallel or sequential teaching in different curricular areas. Teachers work closely together, planning their work to dovetail with what colleagues are doing with the same group of students in the other subject. Clearly, this requires surrendering some

independence in the classroom setting. Coordination will affect not only the timing of a teaching sequence, but also its context and content.

As examples, teachers of English and science could plan to coordinate news work so that science issues behind the news story to be used in English are familiar to pupils. Alternatively, the English teacher may lead the way by dealing with the media awareness issues relevant to the particular newspaper articles to be used as part of a science topic. In the Newsroom Project, other approaches to coordinated working involved both the science and English teachers using the same news article, each focusing on different learning outcomes. This level of coordination is a little more difficult to achieve and the choice of news resource is a critical factor in its success.

The coordinated approach, to a greater degree than the consultative and cooperative approach, possesses the potential for realising the benefits of collaborative working outlined earlier in the chapter. For teachers, tasks can be shared, perspectives can be exchanged and understandings can be deepened. In the classroom, teachers teach to their strengths, the work in one subject complementing that in another. Links are easily made explicit. For students, there is a greater awareness that they are engaged in a cross-curricular endeavour. Consistency and coherence are more evident. Learning outcomes relating to and stemming from 'making connections' are more easily achieved. Students have concurrent or near concurrent opportunities to use knowledge and skills gained in one curricular area as a resource for another.

However, the coordinated approach requires more planning than those described previously. There are many issues that need to be negotiated and the organisational demands can be substantial. In addition, the greater degree of interdependence means the greater the potential for frustration if partners do not follow through on commitments made. Within the Newsroom Project, two schools adopted this approach, but one subsequently relinquished it, deciding to operate more independently in a cooperative mode. This did not preclude some very interesting work being undertaken with that of the English department shown in Figure 10.3. The coordinated approach is shown in Figure 10.4.

Coincident approach

This approach calls for the highest levels of collaboration and corresponds with the lowest level of independence. Essentially, colleagues co-teach a particular topic or unit of work. Subject boundaries are blurred in favour of an integrated project. A learning environment is created that challenges the compartmentalisation of knowledge that often occurs at secondary level. Learning outcomes traditionally associated with science and English are pursued together.

In one 'Newsroom' school, a project was undertaken within the English Department to explore, with students, aspects of the journalist–audience relationship

Three 'reports' of a science-related story were composed; one blandly factual, one taking a positive position on the developments described and one adopting an actively campaigning stance, highlighting the negative features of the developments described. Each report was presented (with notable flair) by a student, the remainder of the group role playing the audience response. The scenes were videorecorded

During the first presentation, the 'audience' fell fast asleep; during the second, they became increasingly reassured and exhibited a confident view of science; during the third, they were propelled to protest – and vigorously!

The resulting video was a delightful and humorous exploration of possible 'media effects'. This activity opens up an opportunity to discuss with students the need for a media message to attract and hold an audience and some of the consequences that flow from this. It allows an examination of how media messages may be angled to present particular viewpoints. It offers a context for considering the power – but also the limitations – of the media as influencers of attitude and behaviour

Figure 10.3 An English department uses a science context to explore 'media effects'

Coordinated parallel teaching: a teacher's perspective

Having taken part in the 'Science in the News' project we were keen to experiment with the use of science-related news while building on existing links between the Science and English Departments. We decided to target a GCSE class that would be covering the topics of cloning and genetic modification in science

In an attempt to make this more meaningful for students and to improve their ability to analyse and deconstruct a range of newspaper articles on these chosen topics, we worked closely to determine our aims and objectives for this class. We recognised the importance of a partnership which didn't duplicate ideas and tasks, but rather provided students with a more holistic awareness of the topics

The focus within English was very much from a media perspective, as students were encouraged to analyse techniques employed by different newspapers and to be aware of how newspapers reveal bias and influence the reader. In science, the focus was different, but complementary. The process of cloning was explained and the ethical dimensions of these topical issues were explored. The young people were then required to prepare a short essay on genetic engineering and the social, economic and ethical issues surrounding it. This was undertaken in science but again their English teacher provided support for the task, discussing with pupils how best to structure their writing

The project proved very successful and both staff and students were highly motivated expressing an increased understanding of the topic and a firmer grasp of how science is presented in media texts

Figure 10.4 Coordinated parallel teaching within the Newsroom Project

This approach requires substantial effort at the planning stage and it makes particular demands on those involved. Specifically, teachers have to open up their classroom practice and persona to the scrutiny, not just of students, but of colleagues within their own subject area and beyond. To begin with at least this may result in some discomfort!

Coincident working is most likely to be associated with a special event, project day, science week etc. It will almost certainly require some manipulation of the timetable and so the support of senior management. In this regard, the so-called 'collapsed day' during which teachers work together and take students 'off-timetable' to explore a theme has shown itself a promising model in respect to cross-curricular initiatives involving science (Levinson and Turner 2001; Ratcliffe et al. 2004). This allows time for students to explore a topic from a number of different perspectives, to participate in workshops and other relevant activities and, importantly, to prepare a material outcome (display, drama, whatever) for presentation at the end of the session. If appropriate a visiting speaker can address the group.

Potentially, the benefits of this 'same time, same space' teaching are substantial. In particular, students will find it easy to see how learning in one subject relates to learning in another. This may, perhaps (and we accept it is a big perhaps) facilitate the transfer and integration of knowledge and skill more generally. Coincident working using 'collapsed day' arrangements can overcome some of the constraints imposed by the typical school timetable. Given this freedom, the nature of the tasks and the contexts in which they are presented can be extended. The novelty of the learning environment and the range of approaches that may be introduced can contribute to a learning experience that is purposeful, memorable and enjoyable.

However, this is an approach that is suitable for occasional rather than frequent use. The level of effort needed to organise and manage coincident working limits how often it can be employed. Furthermore, overuse of the approach would reduce its impact.

This book opened with a snapshot of an integrated 'science in the news' project. It will close with a more detailed description of the same project, which illustrates well the potential of coincident working.

A science in the news project day

As indicated earlier in the chapter, one school in the Newsroom Project adopted a coincident approach to collaborative working and organised a 'Science in the News' event for its Year 10 (14-year-old) students. The event brought together 60 students for a day of joint English and science

activities. For this group, the normal school timetable was suspended and sessions were based beyond the classroom in the youth and recreation centre linked to the school. Four members of staff (two science teachers and two English teachers) ran the event with support from a small number of classroom assistants with specific responsibility for particular pupils.

The aims for the day were defined with reference to aspects of scientific literacy and science in the media as expressed in *Beyond 2000* (Millar and Osborne 1998) and to the revised Northern Ireland Curriculum (CCEA 2003):

- to help young people to be able to understand and respond critically to media reports of issues with a science component
- to investigate how the media help inform the public about science-related issues. To explore some of the strengths and limitations of these sources of information.

These were amplified as a set of intended learning outcomes as shown in Figure 10.5. It is interesting to note the links between these and the more general outcomes set out in Figure 6.3a–d.

Learning outcomes

General

Pupils will
- be encouraged to read science articles in newspapers
- understand the structure of a news article
- be aware of the values and constraints influencing the writing of a newspaper article
- approach a science article with an attitude of critical evaluation based on their knowledge of the scientific research process
- have an understanding of the process involved in scientific research
- appreciate the effect of news text in helping to influence public opinion

Driving force of journalism

Pupils will
- recognise the structure of a newspaper article and know how it is put together
- appreciate the news values that influence the structure and content of a story
- understand the constraints under which articles are written
- appreciate the 'bias' of newspapers
- recognise the factors in journalism that can lead to distortion, errors or lack of balance in an article

cont.

Weight of evidence

Pupils will
- understand the methods that scientists use to gain new knowledge
- appreciate the process of peer review
- recognise that not all scientists follow the accepted process
- be able to identify key questions to ask about the sources of new scientific knowledge
- be able to evaluate information by comparing it to known information and other sources
- be able to read a scientific article critically

Figure 10.5 Intended learning outcomes of the 'Science in the News' day

The programme was divided into three main sessions:

- driving force of journalism
- weight of evidence
- your own front page.

Each session was further subdivided into a series of units (Figure 10.6). A range of activities was planned, including teacher exposition, discussion, role play, drama and a variety of individual and small group exercises. It was in this school that the now famous 'Newsbug' activity (Chapter 9) first saw the light of day.

The centre was set up, as described in Chapter 1, as a simulated newsroom complete with a larger-than-life newspaper editor played by a member of the science staff. The day began with a fun activity 'Hunt the headline' to arouse students' interest and proceeded at a brisk pace with the frequent change of task maintaining that interest. The day concluded with the young people constructing their own 'front page' reporting on issues associated with mobile phones. The material outcomes of the day's activities subsequently went on display in the school.

The success of the venture was quickly recognised. As one teacher noted:

> *This was a great experience of cross-curricular working. Science and English have worked really well together. Senior management was pleased with the day and they want the project to continue. The vice-principal has also suggested possible links to citizenship in the future.*

Session 1 **Driving force of journalism** This began with brief introductory activities – 'Hunt the headline' and 'Focus on the front page' – which targeted the structure of the newspaper. Other activities in the session aimed to examine news values, constraints and bias and the structure of the news article. In this session, the spotlight was on media awareness				
Unit 1 Hunt the headline	Unit 2 Focus on the front page	Unit 3 News values	Unit 4 Constraints and bias	Unit 5 Structure of a news story
Session 2 **Weight of evidence** The focus was on scientific evidence. Pupils had the opportunity to use news articles and other resources to look at the basic elements underlying scientific research. This was followed by an examination of the key questions that could be used to engage with science reported in a media context. The session concluded with a critical reading task				
Unit 1 Research methods	Unit 2 Key questions	Unit 3 Critical reading		
Session 3 **Your own front page** In the final session, pupils worked on a task to produce a front page reporting scientific issues relating to the use of mobile phones. This was an opportunity to consolidate work done during the previous two sessions. It was designed to integrate literacy, media awareness and science knowledge issues				
Unit 1 Evaluating resources	Unit 2 Selecting and editing	Unit 3 Composition		

Figure 10.6 'Science in the News' day programme

Members of staff reported that their coincident approach to collaborative working was a rewarding experience. It was also challenging and involved considerable additional work to ensure that the different elements of the project fitted together and that the students' experience was not disjointed.

We invited the Head of English to describe the day in her own words:

> *The preparation required for our collapsed day was much more significant than I'd first imagined. We'd talked about what we would do, congratulated ourselves on being so 'creative', planned on paper what was to be done in order to make the day a success, run the idea past the school principal, and then made a list – the longest 'to do' list I'd seen in a*

while! Not only did we have to plan the content, but we needed to secure the venue, organise the resources and take care of the minor details like jelly beans and lunch! We realised early on in the process that this was indeed a team effort – an effort far extending the input of two teachers who happened to attend 'a wee course at Queen's'!

Several meetings were held and at each we talked through what had to be done and divided the tasks among us. 'The driving force of journalism' was the responsibility of the English department. Science planned session 2, 'The weight of evidence', while session 3, 'Your own front page' was a joint effort. We agreed that both science and English teachers would 'present' in all three sessions – along with anybody else we could possibly 'rope in'.

On the day, the reality of our venture hit early. We had 60 enthusiastic Year 10 students placed in groups around tables eagerly awaiting something different – something out of the norm. Our comfort zones were about to be well and truly challenged.

Timing was critical. We relied on our colleagues to keep us within the designated boundaries as one activity ran into the next. Resources were all at hand and this was essential. The meticulous planning that we had found tedious at the time was now paying off – without it I can honestly say the day could have turned into chaos. The students were involved in ice breakers, role plays, decision making, negotiation, analysis, group work, sequencing, wall display creation and they were taking in vast amounts of information.

I thoroughly enjoyed the section on persuasion and bias – the interactive activity prompted more understanding of the concept than three periods with a textbook ever would. Colleagues took part in role play and improvisation. Science teachers being creative – what a shock to the system of an English teacher! The 'Newsbug' was another highlight when students got the chance to decide if a scientific article 'stood up' under scrutiny. I even found myself *asking serious questions about research! The day flew by and it was gratifying to see enthusiasm on the faces of even the most 'uninterested' of the year group.*

By 3.20pm, though, we were exhausted. We had underestimated the energy required to deliver our newspaper day. Weeks of planning were over – the delivery had been made and the outcome? According to our evaluation sheets it was significant. The pupils had enjoyed the day; they felt they had learned a lot; they understood how journalists worked … and thought they would read scientific articles with a bit more care!

The teaching staff, technicians, classroom assistants – all those involved acknowledged the benefits. We sat down and reviewed the process – what was good and what we would need to change for the next time – yes, the next time. We planned to do it all again, but not until next year!

And finally ...

We live in an age of 'ambient news' (Hargreaves and Thomas 2002: 6), an increasing amount of which relates to science and particularly to its applications and implications in and for society.

A strong case can be made for making this 'science in the news' a focus of study during formal education. As suggested in Chapter 1, this resource can be used to good effect to:

- illlustrate the 'relevance' of science
- foster students' engagement with science
- support learning in science
- support learning through science.

However, it is in relationship to scientific literacy and lifelong learning that the use of 'science in the news' comes into its own.

Almost all characterisations of scientific literacy will have as a key manifestation or requirement an aptitude to access and ability to appraise media reports with a scientific dimension. This is, after all, the channel through which the vast majority of individuals learn about advances in science, including those that, for better or for worse, impact on them, their families and their communities. On the basis of this information, perceptions may be formed, opinions altered and action taken. A science education, then, that aims to develop scientific literacy, should, consequentially, aim to encourage students to engage with science in the news and equip them to do so critically. By so doing, we prepare young people for one of the principal contexts in which they will encounter science in their everyday lives.

Our rationale, however, is not narrowly utilitarian. We are as eager that young people engage with science in the media for enrichment as for empowerment (although we accept the ideas are not distinct). We would wish, through the news, to convey something of the excitement of science at the frontiers of knowledge, to 'nurture intellectual curiosity' (Solomon and Thomas 1999: 70) and to promote a lifelong interest in a key element of our culture.

For all the exhortation that teachers should help young people be able to evaluate media reports of science-related issues, to date there has been surprisingly little guidance as to how this might be done. This book has

sought to address this gap. Drawing on research, we have offered suggestions for desirable learning outcomes relating to 'science in the news' and presented ideas for learning experiences through which these might be achieved. We have proposed a possible framework or operational model for planning a systematic and progressive programme for students throughout their school career. This can be used as a basis for work within a department or for cross-curricular collaboration.

There is still much to do in respect of reviewing and refining our approach and in developing appropriate assessment strategies. However, we hope this publication will provide some new ideas and new directions and that it will encourage, perhaps even enthuse you to extend your media-related work so as better to prepare our young people for living and learning as individuals and citizens in a news-rich society.

It is, perhaps, appropriate to end a book entitled *Developing Scientific Literacy: Using News Media in the Classroom* with a quotation from a science journalist we interviewed during the Newsroom Project:

> *Kids need to be taught to think; to be taught that they have the liberty to question, to evaluate, to look for agendas, to not believe. This is most important. This is what you prepare citizens for. I don't think the ability to ask critical questions about science or about news reports of science is a small skill. I think it is probably the most important thing you could teach someone.*

Appendix 1

Books about science in the media, including the coverage of risk-related issues

Communicating Science: Contexts and Channels, edited by E. Scanlon, E. Whitelegg and S. Yates, published in 1999 by Routledge, London

Communicating Uncertainty. Media Coverage of New and Controversial Science, edited by Sharon Friedman, Sharon Dunwoody and Carol Rodgers, published in 1999 by Lawrence Erlbaum, Mahwah, NJ

Media, Culture and the Environment, by Alison Anderson, published in 1997 by UCL Press, London

Media, Risk and Science, by Stuart Allan, published in 2002 by Open University Press, Buckingham

Science: Can We Trust the Experts, prepared by the Institute of Ideas, published in 2002 by Hodder & Stoughton, London

Science in Public. Communication, Culture and Credibility, by Jane Gregory and Steve Miller, published in 1998 by Perseus Publishing, New York

'Science, policy and risk (proceedings of a discussion meeting)', prepared by The Royal Society, published in 1997 by the Royal Society, London

Appendix 2

Always ask: critical analysis of a news report of a scientific 'study'

What is the context of the study?

Who did the research?
Where did they do it?
Who funded the study?
Are there any grounds for thinking that the institution/funder may have an 'interest' in relation to the study?
Where did the scientists report the results of their research?

How was the research conducted?

What were the subjects of the study?
What was the sample size?
How was the experiment carried out?
Over what time period was it conducted?

What is the basis for the conclusion?

What data were collected?
What conclusions were drawn?
Does the evidence appear to justify the conclusions?
How certain are the scientists about their conclusions?
Is any explanation of the effect offered?

Is there information about what other scientists think?

Is there any reference to other studies?
Is there support from other scientists?

What is the context of the media report?

Who wrote/presented the news report?
In what news outlet did the report appear?
Are there any grounds for thinking that the news outlet may have an 'interest' in the study?
Is the news outlet running a 'campaign' associated with the study?

What is the importance of this study?

What are the implications or applications of this study?
How important is it to you?
How important is it to others in your family or community?
Should you/how should you respond to the story?
What other sources of information could you consult should you wish to find out more or take action as a result of this news story?

Appendix 3

Always ask: critical analysis of a news report on a socio-scientific 'issue'

Who wrote/presented the report?

Does the writer/presenter have expertise/experience in relation to this issue?
Is it written presented by a specialist journalist?
Is it written by someone who has a special understanding of some aspect of the issue?

Does the writer/presenter hold a known position on the issue?

Is the writer/presenter known to hold a particular position on the issue?
Is the news organisation known to hold a particular position on the issue?
Are there grounds for thinking that the writer/presenter/news organisation may have an 'interest' in presenting a particular viewpoint on the issue?

Are the sources credible?

How many different sources are quoted?
Do they have expertise/experience which is relevant to this issue?
Are there grounds for thinking a source may hold or represent an idiosyncratic or minority view?
Are there any sources which you might have expected to be consulted, but which have not been referred to?

Are the arguments supported by evidence?

What is the balance of 'fact' and 'opinion'?
Is evidence presented in support of the opinions offered?

Does the report appear to be 'balanced'?

Does it appear that the report is trying to show alternative views/all sides of the argument in relation to this issue?
Does it appear that you are being encouraged to make up your own mind about the issue or is the writer/presenter trying to persuade you to take a particular position?
If so, what evidence do you have that the writer/presenter is attempting to persuade?

What is the significance of the report?

What are the implications of the story?
How important is it to you?
How important is it to others in your family or community?
Should you/how should you respond to the story?
What other sources of information could you consult should you wish to find out more or take action as a result of this news story?

Appendix 4

Useful references and further reading relevant to teaching about 'science and society'

Chapters in Books and Papers in Journals

'Citizenship: the case of science' by Gill Nicholls. In Teaching Values and Citizenship Across the Curriculum, edited by Richard Bailey, published, 2004, by RoutledgeFalmer. London

'Consensus projects: teaching science for citizenship' by Stein Kolstoe in *International Journal of Science Education* 22(6) (2000)

'Discussing socio-scientific issues in science lessons – pupils' action and the teacher's role' by Mary Ratcliffe in School Science Review (March 1998, 79(288))

'Learning about social and ethical applications of science' by Roger Lock and Mary Ratcliffe. In *ASE Guide to Secondary Science Education*, edited by Mary Ratcliffe, published,1998, by Stanley Thornes, Cheltenham

School Science Review (December 2004, 86(315)) has Ethics in Science Education as a special theme

'Teaching Ethics in Science' by Michael Reiss in *Studies in Science Education* 34 (1999)

Books and booklets

Improving Nature? The Science and Ethics of Genetic Engineering, by Michael Reiss and Roger Straughan, published in 1996 by Cambridge University Press, Cambridge

Independence Educational Publishers, Cambridge publish a series of 'Issues' booklets, many of which are science-related.

Key Issues in Bioethics. A Guide for Teachers, edited by Ralph Levinson and Michael Reiss, published in 2003 by RoutledgeFalmer, London.

The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education, edited by Dana Zeidler, published in 2003 by Kluwer Academic Publishers, Dordrecht

Strengthening Teaching and Learning in Science Through Using Different Pedagogies' Unit 5: Teaching the Science of Contemporary Issues, Key Stage 3 National Strategy, published in 2004 by DfES, London

Electronic resources

The BioEthics Education Project (BEEP) supports an excellent website, at www.beep.ac.uk

ASE CD-ROM Resources: Can we; should we?

Appendix 5

Teaching approaches that involve young people in discussion and debate and the clarification, justification and negotiation of ideas in relation to science and society

- Identify key individuals or groups in a science-related news story. Consider their goals, rights and responsibilities*
- Explore 'What if' questions – consequence mapping*
- Conduct structured cost–benefit analyses*
- Draw up a table showing arguments for and arguments against a particular position
- In small groups, present a case from a particular perspective
- For a particular issue in the news, carry out a structured discussion, debate, role play or drama exploring goals, rights and responsibilities, values and interests of those involved
- For a particular issue, role play contexts such as a public meeting, press conference, local council meeting, a UN debate, parliamentary debate, initiative or campaign planning group, committee meeting, board of governors meeting etc.
- For a particular issue, students imagine they serve on an associated regulatory body and devise guidelines in relation to that issue
- Statement or card sorts. I agree/I disagree/I am not sure; We support/we do not support etc.
- Suppose this matter is very important to you. Make a list of the questions you would like answered. How would you try to find out more information?
- Carry out an information search. Collect and present data relevant to the news story. Explore the evidence base associated with different positions represented in the story
- Produce a placard, flier, poster, collage, display or board game relating to a particular issue

- Produce a pupil presentation, with PowerPoint, relating to a particular issue
- Produce a 'school assembly' presentation relating to a particular issue
- Produce a 'school assembly for a local primary school' relating to a particular issue
- Write about an issue in the form of a news article, feature story, editorial cartoon, problem page response, letter to the editor etc. Specify a word limit and target audience
- Script and record a short segment on a particular issue for radio news *or* for a 'phone-in radio programme' answering listeners' questions about an issue or for use as a trailer for a longer radio documentary. Include interviews with those holding a range of viewpoints
- Script and record a short segment on a particular issue for TV news or for children's TV 'Newsround' or for use as a trailer for a longer TV documentary. Include interviews with those holding a range of viewpoints
- Produce a 'story board' for a TV advertisement relating to a particular issue
- In relation to an appropriate socio-scientific issue, make a lifestyle change for a week and keep a diary
- Conduct a lifestyle quiz on a socio-scientific issue in the news, first devising the questions and the rating scale. Students should survey only those known to them
- Conduct a survey on a socio-scientific issue in the news, first devising the questionnaire or interview questions. Students should survey only those known to them

* see Lock, R. and Ratcliffe, M. (1998) 'Learning about social and ethical applications of science', in M. Ratcliffe (ed.) *ASE Guide to Secondary Science Education*. Cheltenham: Stanley Thornes.

Appendix 6

A science in the news script

In the news room of ISPY World ...

Bob *I know a good story when I see one. And this is a good story Jenny. It's got everything – drama, intrigue, human interest – the public will be lining up to buy it!*

Jenny *But Bob, I'm not sure, I mean I don't know much about this topic – I'm no expert!*

Bob *Look Jen – find someone who does know. Use your contacts. That's what I pay you for!*

Jenny *Okay, okay … But I'm going to need more time – another day. I want to make sure my facts are right. It will take time.*

Bob *Time! Time! It's a newspaper I'm running here not a health farm. You've got to 10pm tonight. A deadline is a deadline!*

[Jenny leaves the office muttering under her breath.]

Jenny *He's never happy [looks at watch] – five hours! I'd better get my skates on. I'll have to speak to an expert to make sure I've got my facts straight. Great, that will probably take three hours. They never want to give me a straight answer. It's always a case of could be, might be, should be.*

[Grabs her coat and bag and hurries out of the news room]

[At a laboratory across town]

Jenny *I need to speak to someone who knows something about renewable energy.*

Sara *I might be able to help. I've been working on renewable energy for about 10 years.*

Jenny *Great! Well, can you tell me if this is correct?*

[Holds out a piece of paper covered in numbers]

Sara *[reads information] Well, it could be true.*

Jenny *What do you mean, could be?*

Sara *It depends on how this research was carried out. I mean how many readings were taken? Did they have a control? Have the results been reproduced?*

Jenny *[getting really annoyed] How am I supposed to know? I've just got this information [points to paper].*

Sara *I'd really like to help you but I'd need more information. If I had a little time. ...*

Jenny *Time! That's the one thing I don't have.*

Sara *Okay, let's sit down and I will see what I can do.*

[Next morning at a breakfast table in the suburbs]

Mabel *You know Joe, it's amazing what you learn from the papers. I mean did you know this [points to the newspaper] or that! Well, I never!*

Joe *I know, I know woman, sure didn't I hear the news on the radio this morning. It's incredible what those scientist can do!*

Mabel *[reads a very worrying story] Oh dear! Oh deary, deary me!*

Joe *What's the matter now?*

Mabel *Oh deary, deary, deary me!*

Joe *Now Mabel, you should know better than to believe everything you read in the papers!*

[Script written by Mary Kelly, now at St Brigid's High School, Armagh, and reproduced with her permission]

Appendix 7

Material for the 'newsbug' activity: analysing a newspaper report of a scientific study

Key question 1: Is there a good description of the design of the study?

What were the subjects of the study?
What was the sample size?
How was the experiment carried out?
How long did the study last?

Key question 2: Is there a good description of the findings and conclusions?

What data were collected?
What conclusions are drawn?
Does the evidence appear to justify the conclusions?
Is any explanation of the effect suggested?
How certain do the scientists appear to be about their conclusions or explanations?

Key question 3: Is there information about who did the study, where the study was done and how the results were made public?

Who did the research?
Where did they do it?
Who funded the study?
Is it likely that the scientist or funder has an 'interest' in the outcome?
Where did the scientists report the results of their research?

Key question 4: Is there information about what other scientists think?

Is there any reference to other studies?
Is there support from other scientists?
What do other sources say about the research or the topic?

Key question 5: Who wrote the story and in which newspaper is it found?

Who wrote the newspaper article?
What newspaper does it appear in?
Is it likely that the newspaper has an 'interest' in the story?
Is the newspaper running a 'campaign' associated with the story?

Key question 6: How important is this study?

What are the implications or applications of this study?
How important is it to me?
How important is it to others in my community?
How important is it to our understanding of science?

Few articles will answer all these questions. An important aspect of the evaluation any newspaper report of a science study, then, is the number of questions answered, this will give some measure of the quality of the information presented.

If readers really want or need to weigh up a story they should consider 'What questions can I answer', 'What questions would I like to be able answer to but cannot from this report alone' and 'Where might I find answers to these questions?'

References and further reading

Abd-El-Khalick, F. (2003) Socioscientific issues in pre-college science classrooms, in D. L. Zeidler (ed.) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Allan, S. (1999) *News Culture*. Buckingham: Open University Press.

Allan, S. (2002) *Media, Risk and Science*. Buckingham: Open University Press.

American Association for the Advancement of Science (AAAS) (1990) *Science for all Americans*. Washington, DC: AAAS.

Anderson, A. (1997) *Media, Culture and the Environment*. London: UCL Press.

Baggini, J. (2002) *Making Sense. Philosophy behind the Headlines*. Oxford: Oxford University Press.

Bauer, H. H. (1992) *Scientific Literacy and the Myth of the Scientific Method*. Urbana, IL: University of Illinois Press.

Bell, R. L. (2003) Exploring the role of NOS understandings in decision-making, in D. L. Zeidler (ed.) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Bennett, J. (1999) Science on television: a coming of age?, in E. Scanlon, E. Whitelegg and S. Yates (eds) *Communicating Science: Contexts and Channels*. London: Routledge.

Bingle, W. H. and Gaskell, P. J. (1994) 'Scientific literacy for decision making and the social construction of scientific knowledge', *Science Education* 72: 185–201.

Boorstin, D. (1961) *The Image: A Guide to Pseudo-Events in America*. New York: Vintage (reissue edition).

Boyd-Barrett, O. and Rantanen, T. (1998) News agencies, in A. Briggs and P. Cobley (eds) *The Media: An Introduction*. Harlow: Longman.

Branston, G. and Stafford, R. (2003) *The Media Student's Book*, 3rd edn. London: Routledge.

Bromley, M. (1994) *Teach Yourself Journalism*. London: Hodder & Stoughton.

Brookes, M. (2004) *Watching Alone: Social Capital and Public Service Broadcasting*. London: The Work Foundation/BBC.

Bucchi, M. (1998) *Science and the Media: Alternative Routes in Scientific Communication*. London: Routledge.

Burden, J. (2005a) 'The new science curriculum at key stage 4', *Education in Science Education* 213: 8–9.

Burden, J. (2005b) 'Twenty-first century science', *Education in Science Education* 213: 10–12.

Bybee, R.W. (1997) *Achieving Scientific Literacy: From Purposes to Practices*. Portsmouth: Heinemann.

Campbell, P. (2002) 'ASE-Wellcome citizenship and science project', *Education in Science* 196: 8–9.

CCEA (2003) *Pathways – Proposals for Curriculum and Assessment at Key Stage 3*. Belfast: Council for the Curriculum, Examinations and Assessment.

Chandler, D. (1994) The Construction of Reality in TV News Programmes, http://www.aber.ac.uk/media/Modules/TF33120/news.html, accessed 9 November 2005.

Chomsky, N. and Herman, E. (1994) *Manufacturing Consent: The Political Economy of the Mass Media*. New York: Vintage.

Clark, D. B. and Slotta, J. D. (2000) 'Evaluating media-enhancement and source authority on the internet: the knowledge integration environment', *International Journal of Science Education* 22(8): 859–71.

Connell, I. (1998) 'Mistaken identities: tabloid and broadsheet news discourse', *Javnost – the Public* 5(3): 11–31.

Crick, B. (2001) 'Citizenship and science; science and citizenship', *School Science Review* 83(302): 33–8.

Cross, R. T. and Fensham, P. J. (eds) (2000) *Science and the Citizen*. Melbourne: Arena.

Cross, R. T. and Price, R. F. (1992) *Teaching Science for Social Responsibility*. Sydney: St Louis Press.

Cross, R. T. and Price, R. F. (1999) 'The social responsibility of science and the public understanding of science', *International Journal of Science Education* 21(7): 775–85.

Cross, R. T., Price, R. F., Zatsepin, V. and Gavrilenko, I. N. (1996) 'Lessons for science education: the print media's reporting of the Chernobyl cloud over Britain in 1986', *Research in Science and Technology Education* 14(2): 125–39.

Curran, J. (1998) News and the press. Newspapers: beyond political economy, in A. Briggs and P. Cobley (eds) *The Media: An Introduction*. Harlow: Longman.

Davison, J. (1992) Theory in practice. Learning media concepts through practical work, in C. Bazalgette, E. Bevort and J. Savino (eds) *New Directions Media Education Worldwide*. London and Paris: BFI/CLEMI.

Dawson, C. (2000) Selling snake oil: must science educators continue to promise what they can't deliver, in R. T. Cross and P. Fensham (eds) *Science and the Citizen for Educators and the Public*. Melbourne: Arena.

De Boer, G. (2000) 'Scientific literacy: another look at its historical and contemporary meanings and its relationship to science education reform', *Journal of Research in Science Teaching* 37(6): 582–601.

Department for Education and Employment (DfEE)/Qualifications and Curriculum Authority (QCA) (1999a) *The National Curriculum for England: Citizenship*. London: HMSO.

Department for Education and Employment (DfEE)/Qualifications and Curriculum Authority (QCA) (1999b) *The National Curriculum for England: Science*. London: HMSO.

Devereux, E. (2003) *Understanding the Media*. London: Sage.

Donnelly, J. (2002) 'Instrumentality, hermeneutics and the place of science in the school curriculum', *Science and Education* 11: 135–53.

Dornan, C. (1999) Some problems in conceptualising the issue of 'science in the media', in E. Scanlon, E. Whitelegg and S. Yates (eds) *Communicating Science: Contexts and Channels*. London: Routledge.

Duggan, S. and Gott, R. (2002) 'What sort of science education do we really need?', *International Journal of Science Education* 24(7): 661–79.

Durant, J. and Lindsey, N. (2000a) *The 'Great GM Food Debate': A Survey of Media Coverage in the First Half of 1999*. London: Parliamentary Office of Science and Technology.

Durant, J. and Lindsey, N. (2000b) GM foods and the media, in House of Lords, Select Committee on Science and Technology. *Science and Society*. London: HMSO.

Dux, M. (2006) Health Hopes Sprout Eternal, http://www.theage.com.au/news/in-depth/health-hopes-sprout-eternal/2006/06/21/115, accessed 28 August 2006.

Falk, J. H. (2001) Free-choice science learning: framing the discussion, in J. H. Falk (ed.) *Free-choice Science Education. How we Learn Science Outside of School*. New York: Teachers' College Press.

Farmelo, G. (1997) From big bang to damp squib?, in R. Levinson and J. Thomas (eds) *Science Today: Problem or Crisis?* London: Routledge.

Felt, U. (1993) 'Fabricating scientific success stories', *Public Understanding of Science* 2 (4): 375–90.

Fensham, P. (1997) School science and its problems with scientific literacy, in R. Levinson and J. Thomas (eds) *Science Today: Problem or Crisis?* London: Routledge.

Fensham, P. (2000) Issues for the schooling of science, in R. T. Cross and P. J Fensham (eds) *Science and the Citizen*. Melbourne: Arena.

Fisher, R. (2000) Stories are for thinking: creative ways to share reading, in R. Fisher and M. Williams (eds) *Unlocking Literacy. A Guide for Teachers*. London: David Fulton.

Fowler, R. (1991) *Language in the News*. London: Routledge.

Fuenzalida, V. (1992) Media education in Latin America, in C. Bazalgette, E. Bevort and J. Savino (eds) *New Directions Media Education Worldwide*. London and Paris: BFI/CLEMI.

Fuller, S. (1998) 'The first global cyberconference on public understanding of science', *Public Understanding of Science* 7(4): 329–41.

Galtung, J. and Ruge, M. H. (1965) 'The structure of foreign news', *Journal of Peace Research* 2(1): 64–91.

Galtung, J. and Ruge, M. (1973) Structuring and selecting the news, in S. Cohen and J. Young (eds) *The Manufacture of News: Social Problems, Deviance and the Mass Media*. London: Constable.

Gayford, C. (2002) 'Controversial environmental issues: a case study for the professional development of science teachers', *International Journal of Science Education* 24(11): 1191–1200.

Gillmor, D. (2004) *We the Media. Grassroots Journalism by the People, for the People*. Sebastopol, CA: O'Reilly.

Glaser, R. E. and Carson, K. M. (2005) 'Chemistry is in the news: taxonomy of authentic news media-based learning activities', *International Journal of Science Education* 27(9): 1083–1098.

Gregory, J. and Miller, S. (1998) *Science in Public. Communication, Culture and Credibility*. New York: Perseus.

Hagendijk, R. and Meeus, J. (1993) 'Blind faith: fact, fiction and fraud in public controversy over science', *Public Understanding of Science* 2(4): 391–415.

Halkia, K. and Mantzouridis, D. (2005) 'Students' views and attitudes towards the communication code used in press articles about science', *International Journal of Science Education* 27(12): 1395–1411.

Hall, E. (2004) 'Science and ethics: give them a break', *School Science Review* 86(315): 25–8.

Hall, S. (1977) Culture, the media and the 'ideological effect', in J. Curran, M. Gurevitch and J. Woollacott (eds) *Mass Communication and Society*. London: Edward Arnold.

Hansen, A. (1994) 'Journalistic practices and science reporting in the British press', *Public Understanding of Science* 3: 111–34.

Hargreaves, I. and Ferguson, G. (2000) *Who's Misunderstanding Whom?* Swindon: Economic and Social Research Council.

Hargreaves, I. and Thomas, J. (2002) *New News, Old News*. London: ITC/BSC.

Hartley, J. (1982) *Understanding News*. London: Routledge.

Hastings, M. (2002) *Editor. An Inside Story of Newspapers*. London: Macmillan.

Hazen, R. M. and Trefil, J. (1991) *Science Matters: Achieving Scientific Literacy*. New York: Doubleday.

Herman, E. S. and Chomsky, N. (1988) *Manufacturing Consent: The Political Economy of the Mass Media*. New York: Pantheon.

Hodson, D. (1999) 'Going beyond cultural pluralism: science education for socio-political action', *Science Education* 83: 775–96.

Hornig, S. (1993) 'Reading risk: public response to print media accounts of technological risk', *Public Understanding of Science* 2: 95–109.

House of Commons, Science and Technology Committee (2002) *Science and Technology. Third Report*. London: HMSO.

House of Lords, Select Committee on Science and Technology (2000) *Science and Society*. London: HMSO.

Hunt, A. (1999) Challenges for science education, in Education Committee Forum (ed.) *The Challenges of Science Education*. Strasbourg: Council of Europe.

Hurd, P. De H. (1998) 'Scientific literacy: new minds for a changing world', *Science Education* 82(3): 407–416.

Hutton, N. (1996) 'Interactions between the formal UK school science curriculum and the public understanding of science', *Public Understanding of Science* 5: 41–53.

Jarman, R. and McClune, B. (1999) 'Newspapers in the secondary science classroom: a survey of practice in Northern Ireland schools', paper submitted for presentation at the 2000 annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

Jarman, R. and McClune, B. (2000) 'Newspapers in the secondary science classroom: a survey of practice in Northern Ireland schools', paper presented at the 2000 annual meeting of the National Association for Research in Science Teaching, New Orleans, LA.

Jarman, R. and McClune, B. (2002) 'A survey of the use of newspapers in science instruction by secondary teachers in Northern Ireland', *International Journal of Science Education* 24(10): 997–1020.

Jarman, R. and McClune, B. (2003) 'Bringing newspaper reports into the classroom: citizenship and science education', *School Science Review* 84(309): 121–9.

Jarman, R. and McClune, B. (2005a) '*Space Science News: Special Edition*, a resource for extending reading and promoting engagement with newspapers in the science classroom', *Literacy* 39(3): 121–8.

Jarman, R. and McClune, B. (2005b) *Science Newswise*. Belfast: Graduate School of Education, Queen's University Belfast.

Jarman, R., McAleese, L. and McConnell, B. (1997) 'Science and lifelong learning: a survey of science teachers' provision for the promotion of pupils' independent study at key stage 4', *Evaluation and Research in Education* 11(3): 149–63.

Jarman, R., McClune, B. and Pyle, E. J. (2005) 'Teaching about science-related images in the media: a professional development challenge', paper presented at the 2005 annual meeting of the National Association for Research in Science Teaching, Dallas, TX.

Jenkins, E. (1994a) Scientific literacy, in T. Husen and T. N. Postlethwaite (eds) *International Encyclopedia of Education*, Vol. 9, 2nd edn. Oxford: Pergamon.

Jenkins, E. W. (1994b) 'Public understanding of science and science education for action', *Journal of Curriculum Studies* 26(6): 601–611.

Jenkins, E. W. (1996) 'Book review', *Public Understanding of Science* 5: 65–6.

Jenkins, E. (1997) Towards a functional public understanding of science, in R. Levinson and J. Thomas (eds) *Science Today: Problem or Crisis?* London: Routledge.

Jenkins, E. (1999) 'School science, citizenship and the public understanding of science', *International Journal of Science Education* 21(7): 703–10.

Jenkins, E. (2000) 'Science for all': time for a paradigm shift?, in R. Millar, J. Leach and J. Osborne (eds) *Improving Science Education: The Contribution of Research*. Buckingham: Open University Press.

Jenkins, E. (2003) 'School science: too much, too little, or a problem with science itself', *Canadian Journal of Science, Mathematics and Technology Education* 3(2): 269–74.

Jenkins, E. (2004) Science, in J. White (ed.) *Rethinking the School Curriculum. Values, Aims and Purposes*. London: RoutledgeFalmer.

Jones, C. (2000) The role of language in the learning and teaching of science, in M. Monk and J. Osborne (eds) *Good Practice in Science Teaching. What Research has to Say*. Buckingham: Open University Press.

Kachan, M., Guilbert, S. and Bisanz, G. L. (2006) 'Do teachers ask students to read news in secondary science? Evidence from the Canadian context', *Science and Education* 90(3): 496–521.

Keeble, R. (2001) *The Newspaper Handbook*, 3rd edn. London: Routledge.

Kolstø, S. D. (2000) 'Consensus projects: teaching science for citizenship', *International Journal of Science Education* 22(6): 645–64.

Kolstø, S. D. (2001) '"To trust or not to trust, …" – pupils' ways of judging information encountered in a socio-scientific issue', *International Journal of Science Education* 23(9): 877–901.

Korpan, C. A., Bisanz, G. L., Bisanz, J. and Henderson, J. M. (1997) 'Assessing literacy in science: evaluation of scientific news briefs', *Science Education* 81: 515–32.

Korpan, C., Bisanz, G. L., Bisanz, J. and Snyder, J. (1999) 'Reading news briefs about science: how education is related to the questions people ask', paper presented at the 1999 annual meeting of the National Association for Research in Science Teaching, Boston, MA.

Laugksch, R. C. (2000) 'Scientific literacy: a conceptual overview', *Science Education* 84(1): 71–94.

Layton, D., Jenkins, E. and Donnelly, J. (1994) *Scientific and Technological Literacy. Meanings and Rationales. An Annotated Bibliography*. Leeds: Centre for Studies in Science and Mathematics Education, University of Leeds in association with UNESCO.

Layton, D., Jenkins, E. W., MacGill, S. and Davey, A. (1993) *Inarticulate Science? Perspectives on the Public Understanding of Science and Some Implications for Science Education*. Driffield: Studies in Education.

Lemke, J. L. (1990) *Talking Science: Language, Learning and Values*. Norwood, NJ: Ablex.

Levinson, R. and Turner, S. (2001) *Valuable Lessons: Engaging with the Social Context of Science in Schools*. London: Wellcome Trust.

Lewis, E. (2003) *Teaching TV News*. London: BFI Education.

Lietaer, D. (1999) Science teaching as a key component of education for democratic citizenship, in Education Committee Forum (ed.) *The Challenges of Science Education*. Strasbourg: Council of Europe.

Lock, R. and Ratcliffe, M. (1998) Learning about social and ethical applications of science, in M. Ratcliffe (ed.) *ASE Guide to Secondary Science Education*. Cheltenham: Stanley Thornes.

Lucas, A. (1983) 'Scientific literacy and informal learning', *Studies in Science Education* 10: 1–36.

Macdonald, M. (2003) *Exploring Media Discourse*. London: Arnold.

Manning, P. (2001) *News and News Sources: A Critical Introduction*. London: Sage.

Masterman, L. (1985) *Teaching the Media*. London: Camedia.

McClune, B. (2006) *Teaching Science Today for Living Tomorrow: a Conceptual Framework and Pedagogical Model for Promoting Students' Critical Response to Science in the News*. Unpublished PhD thesis, Queen's University Belfast.

McClune, B. and Jarman, R. (2000) 'Have I got news for you?! Using newspapers in the secondary science classroom', *Media Education Journal* 28: 10–16.

McClune, B. and Jarman, R. (2001) Making a place for newspaper in secondary science education, in O. de Jong, E. R. Savelsbergh and A. Alblas (eds) *Teaching for Scientific Literacy: Context, Competency and Curriculum*. Utrecht: CD-B Press.

McComas, W., Clough, M. P. and Almazroa, H. (1998) The role and character of the nature of science in science education, in W. McComas (ed.) *The Nature of Science in Science Education: Rationales and Strategies*. Dordrecht: Kluwer Academic.

McGregor, J. (2002) Restating News Values: Contemporary Criteria for Selecting News, www.bond.edu.au/hss/communication/ANZCA/papers/JmcGregorPaper.pdf, accessed 16 September 2005.

McInerney, C., Bird, N. and Nucci, M. (2004) 'The flow of scientific knowledge from lab to the lay public: the case of genetically modified food', *Science Communication* 26: 75–106.

McQuail, D. (1991) *Mass Communication Theory: An Introduction*. London: Sage.

Medway, P. (1989) 'Issues in the theory and practice of technology education', *Studies in Science Education* 16: 1–24.

Michael, M. (1998) 'Between citizen and consumer: multiplying the meanings of the "public understanding of science"', *Public Understanding of Science* 7(4): 313–27.

Millar, R. (1997) Science education for democracy: what can the school curriculum achieve?, in R. Levinson and J. Thomas (eds) *Science Today: Problem or Crisis?* London: Routledge.

Millar, R. (2000) Science for public understanding: developing a new course for 16–18 year old students, in R. T. Cross and P. Fensham (eds) *Science and the Citizen for Educators and the Public*. Melbourne: Arena.

Millar, R. (2004) The role of practical work in the teaching and learning of science, paper prepared for the 2004 meeting 'High School Science Laboratories: Role and Vision', National Academy of Sciences, Washington, DC, June.

Millar, R. (2006) 'Twenty first century science: insights from the design and implementation of a scientific literacy approach in school science', *International Journal of Science Education* 28(13): 1499–1521.

Millar, R. and Osborne, J. (eds) (1998) *Beyond 2000: Science Education for the Future*. London: King's College.

Miller, D. (1999) Mediating science. Promotional strategies, media coverage, public belief and decision making, in E. Scanlon, E. Whitelegg and S. Yates (eds) *Communicating Science: Contexts and Channels*. London: Routledge.

Monk, M. and Dillon, J. (2000) The nature of scientific knowledge, in M. Monk and J. Osborne (eds) *Good Practice in Science Teaching: What Research has to Say*. Buckingham: Open University Press.

National Research Council (NRC) (1996) *National Science Education Standards*. Washington, DC: National Academy Press.

Neidhardt, F. (1993) 'The public as a communication system', *Public Understanding of Science* 2(4): 339–50.

Nelkin, D. (1995) *Selling Science*, rev. edn. New York: Freeman and Company.

Newton, P., Driver, R. and Osborne, J. (1999) 'The place of argumentation in the pedagogy of school science', *International Journal of Science Education* 21(5) 553–76.

Nicholls, G. (2004) Science education for citizenship, in R. Bailey (ed.) *Teaching Values and Citizenship Across the Curriculum*. London: RoutledgeFalmer.

Norris, S. P. (1995) 'Learning to live with scientific expertise: towards a theory of intellectual communalism for guiding science teaching', *Science Education* 79: 201–217.

Norris, S. P. and Phillips, L. M. (1987) 'Explanations of reading comprehension: schema theory and critical thinking theory', *Teachers' College Record* 89, 281–306.

Norris, S. P. and Phillips, L. M. (1994) 'Interpreting pragmatic meaning when reading popular reports of science', *Journal of Research in Science Teaching* 31(9): 947–67.

Norris, S. P. and Phillips, L. M. (2003) 'How literacy in its fundamental sense is central to scientific literacy', *Science Education* 87: 224–40.

Norris, S. P., Phillips, L. M. and Korpan, C. A. (2003) 'University students' interpretation of media reports of science and its relationship to background knowledge, interest and reading difficulty', *Public Understanding of Science* 12: 123–45.

Osborne, J. (2000) Science for citizenship, in M. Monk and J. Osborne (eds) *Good Practice in Science Teaching: What Research has to Say*. Buckingham: Open University Press.

Osborne, J. (2002) 'Science without literacy: a ship without a sail?', *Cambridge Journal of Education* 32(2): 203–218.

Osborne, J. and Collins, S. (2001) 'Pupils' views of the role and value of the science curriculum: a focus-group study', *International Journal of Science Education* 23(5): 441–67.

Osborne, J., Duschl, R. and Fairbrother, R. (2002) *Breaking the Mould? Teaching Science for Public Understanding*. London: King's College.

Osborne, J., Ratcliffe, M., Collins, S., Millar, R. and Duschl, R. (2001) *What Should We Teach about Science? A Delphi Study*. London: King's College.

Paisley, W. J. (1998) 'Scientific literacy and the competition for public attention and understanding', *Science Communication* 20(1): 70–80.

Palmer, J. (1998) News production. News values, in A. Briggs and P. Cobley (eds) *The Media: An Introduction*. Harlow: Longman.

Pedretti, E. (2003) Teaching science, technology, society and environment (STSE) education, in D. L. Zeidler (ed.) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Pellechia, M. G. (1997) 'Trends in science coverage: a content analysis of three US newspapers', *Public Understanding of Science* 6: 49–68.

Peters, H. (1999) The interaction of journalists and scientific experts: cooperation and conflict between two professional cultures, in E. Scanlon, E. Whitelegg and S. Yates (eds) *Communicating Science: Contexts and Channels*. London: Routledge.

Phillips, L. M. and Norris, S. P. (1999) 'Interpreting popular reports of science: what happens when the reader's world meets the world on paper?', *International Journal of Science Education* 21(3): 317–27.

Phillips, Lord (2000) *The Inquiry into BSE and Variant CJD in the United Kingdom*. London: HMSO.

Philo, G. (1983) Bias in the media, in D. Coates and G. Johnston (eds) *Socialist Arguments*. Oxford: Martin Robertson.

Priest, S. (1994) 'Structuring public debate on biotechnology. Media frames and public response', *Science Communication* 16(2): 166–79.

Priest, S. (1999) Structuring public debate on biotechnology. Media frames and public response, in E. Scanlon, E. Whitelegg and S. Yates (eds) *Communicating Science: Contexts and Channels*. London: Routledge.

Ratcliffe, M. (1997) 'Pupil decision-making about socio-scientific issues within the science curriculum', *International Journal of Science Education* 19(2): 167–82.

Ratcliffe, M. (1998) 'Discussing socio-scientific issues in science lessons – pupils' actions and the teacher's role', *School Science Review* 79(288): 55–9.

Ratcliffe, M. (1999) 'Evaluation of abilities in interpreting media reports of scientific research', *International Journal of Science Education* 21(10): 1085–1099.

Ratcliffe, M. (2002) Ideas and evidence: tackling science-related issues, in D. Sang and V. Wood-Robinson (eds) *Teaching Secondary Scientific Enquiry*. London: John Murray.

Ratcliffe, M. and Grace, M. (2003) *Science Education for Citizenship. Teaching Socio-scientific Issues*. Maidenhead: Open University Press.

Ratcliffe, M., Harris, R. and McWhirter, J. (2004) 'Teaching ethical aspects of science – is cross-curricular collaboration the answer?', *School Science Review* 86(315): 39–44.

Reah, D. (2002) *The Language of Newspapers*, 2nd edn. London: Routledge.

Reiss, M. (1999) 'Teaching ethics in science', *Studies in Science Education* 34: 115–40.

Rennie, L. J. and Stocklmayer, S. M. (2003) 'The communication of science and technology: past, present and future agendas', *International Journal of Science Education* 25(6): 759–73.

Rensberger, B. (1997) Covering science for newspapers, in D. Blum and M. Knudson (eds) *A Field Guide for Science Writers*. New York: Oxford University Press.

Ross, K. and Nightingale, V. (2003) *Media and Audiences*. Maidenhead: Open University Press.

Roth, W.-M. (2003) 'Scientific literacy as an emergent feature of collective human praxis', *Journal of Curriculum Studies* 35(1): 9–23.

Roth, W.-M. and Barton, A. C. (2004) *Rethinking Scientific Literacy*. New York: RoutledgeFalmer.

Rusbridger, A. (2000) Foreword, in I. Mayes, *Corrections and Clarifications*. London: The *Guardian*.

Ryder, J. (2001a) 'Identifying science understanding for functional scientific literacy', *Studies in Science Education* 36:1–44.

Ryder, J. (2001b) 'Identifying science understanding for functional scientific literacy: implications for school science education', paper presented at the 2001 AERA conference: symposium '"Science-as-it-is-taught" and "Science-as-it-is-practised": teaching about science in the classroom', Seattle, WA.

Salisbury, D. F. (1997) Working outside the media: colleges and universities, in D. Blum and M. Knudson (eds) *A Field Guide for Science Writers*. New York: Oxford University Press.

Shamos, M. H. (1995) *The Myth of Scientific Literacy*. New Brunswick, NJ: Rutgers University Press.

Shapin, S. (1992) 'Why the public ought to understand science-in-the-making', *Public Understanding of Science* 1: 27–30.

Shaw, D. (undated) *Featuring the Frameworks. Linking Language Arts to your Newspaper*. Minneapolis, MN: Star Tribune Newspaper in Education Programme.

Shen, B. (1975) Science literacy and the public understanding of science, in S. B. Day (ed.) *Communication of Scientific Information*. Basel: Karger.

Solomon, J. (2001) 'Teaching for scientific literacy: what could it mean?', *School Science Review* 82(300): 93–6.

Solomon, J. and Thomas, J. (1999) 'Science education for the public understanding of science', *Studies in Science Education* 33: 61–90.

Sulston, J. and Ferry, G. (2003) *The Common Thread*. London: Corgi Books.

Swanson, D. (2001) *Nibbling on Einstein's Brain. The Good, the Bad and the Bogus in Science*. Toronto: Annick Press.

Tate, A. (1994) *Core Skills and Cross-Curricular Initiatives in Secondary Schools*. Slough: NFER.

Thoman, E. and Jolls, T. (2003) *Literacy for the 21st Century. An Overview and Orientation Guide to Media and Literacy Education*. Los Angeles: Center for Media Literacy.

Thomas, J. (1997) Informed ambivalence. Changing attitudes to the public understanding of science, in R. Levinson and J. Thomas (eds) *Science Today: Problem or Crisis?* London: Routledge.

Titterington, L. C. and Drummer, S. S. (1999) 'Cloning in the news: the popular media as a vehicle of informal science education', paper presented at the annual meeting of National Association for Research in Science Teaching, Boston, MA, 1999.

Toner, M. (1997) Covering the stories in science, in D. Blum and M. Knudson (eds) *A Field Guide for Science Writers*. New York: Oxford University Press.

Van den Brul, C. (1995) 'Perceptions of science: how scientists and others view the media reporting of science', *Studies in Science Education* 25: 211–37.

Walton, R. (2002) *Science Teaching and the Public Understanding of Science*. Sheffield: Sheffield Hallam University.

Watling, R. (2001) 'Practical media work and the curriculum of the future', *The Curriculum Journal* 12(2): 207–224.

Watson, F. (2000) Black holes and killer asteroids: the public perception of astronomy, in R. T. Cross and P. Fensham (eds) *Science and the Citizen for Educators and the Public*. Melbourne: Arena.

Wellington, J. (1991) 'Newspaper science, school science: friends or enemies?', *International Journal of Science Education* 13(4): 363–72.

Wellington, J. (1993) 'Using newspapers in science education', *School Science Review* 74(268): 47–54.

Wellington, J. (2004) 'Ethics and citizenship in science education: now is the time to jump off the fence', *School Science Review* 86(315): 33–8.

Wellington, J. and Osborne, J. (2001) *Language and Literacy in Science Education*. Buckingham: Open University Press.

White, R. (2003) Changing the script for science teaching, in R. Cross (ed.) *A Vision for Science Education. Responding to the Work of Peter Fensham*. London: RoutledgeFalmer.

Wilkie, T. (1991) 'Does science get the press it deserves?', *International Journal of Science Education* 13(5): 575–81.

Yore, L. D., Hand, B., Goldman, S. R., Hildebrand, G. M., Osborne, J. F., Treagust, D. F. and Wallace, C. S. (2004) 'New directions in language and science education research', *Reading Research Quarterly* 39(3): 347–52.

Young, P. (1997) Writing articles from science journals, in D. Blum and M. Knudson (eds) *A Field Guide for Science Writers*. New York: Oxford University Press.

Zeidler, D. L. (2003) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Zeidler, D. L. and Keefer, M. (2003) The role of moral reasoning and the status of socioscientific issues in science education. Philosophical, psychological and pedagogical considerations, in D. L. Zeidler (ed.) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Zeidler, D. L. and Lewis, J. (2003) Unifying themes in moral reasoning on socioscientific issues and discourse, in D. L. Zeidler (ed.) *The Role of Moral Reasoning on Socioscientific Issues and Discourse in Science Education*. Dordrecht: Kluwer Academic.

Zimmerman, C., Bisanz, G. L. and Bisanz, J. (1999) 'Science at the supermarket: what's in print, experts' advice and students' need to know', paper presented at the 1999 annual meeting of the National Association for Research in Science Teaching, Boston, MA.

Zimmerman, C., Bisanz, G. L., Bisanz, J., Klein, J. S. and Klein, P. (2001) 'Science at the supermarket: a comparison of what appears in the popular press, experts' advice to readers, and what students want to know', *Public Understanding of Science* 10: 37–58.

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SCIENCE EDUCATION FOR CITIZENSHIP
Teaching Socio-scientific Issues

Mary Ratcliffe and Marcus Grace

"This is overwhelmingly a valuable book - particularly in the context of science education in the UK. It is a book that deserves to be read more widely by science teachers, particularly those who seek not simply to extend their repertoire of teaching techniques, but who wish to place these techniques upon a sound academic footing."

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- helps teachers to provide students with the skills and understanding needed to address these multi-faceted issues
- explores the nature and place of socio-scientific issues in the curriculum and the support necessary for effective teaching

Science Education for Citizenship supports science teachers, citizenship teachers and other educators as they help students to develop the skills and understanding to deal with complex everyday issues.

Contents: *Acknowledgements - Preface - The nature of socio-scientific issues - Socio-scientific issues and the curriculum - Learning and assessment - Learning strategies - Ethical reasoning - Use of media reports - Decision-making about socio-scientific issues - Community projects - Effective teaching for the future - References - Index.*

192pp
978-0-335-21085-5 (Paperback) 978-0-335-21086-2 (Hardback)

ANALYSING EXEMPLARY SCIENCE TEACHING

Edited by Steve Alsop, Larry Bencze and Erminia Pedretti

"I read lots of books in which science education researchers tell science teachers how to teach. This book, refreshingly, is written the other way round. We read a number of accounts by outstanding science and technology teachers of how they use new approaches to teaching to motivate their students and maximise their learning. These accounts are then followed by some excellent analyses from leading academics. I learnt a lot from reading this book."

Professor Michael Reiss, Institute of Education, University of London

"Provides an important new twist on one of the enduring problems of case-based learning... This is a book that deserves careful reading and re-reading, threading back and forwards from the immediate and practical images of excellence in the teachers' cases to the comprehensive and scholarly analyses in the researchers' thematic chapters."

Professor William Louden, Edith Cowan University, Australia

Through a celebration of teaching and research, this book explores exemplary practice in science education and fuses educational theory and classroom practice in unique ways.

Analysing Exemplary Science Teaching brings together twelve academics, ten innovative teachers and three exceptional students in a conversation about teaching and learning. Teachers and students describe some of their most noteworthy classroom practice, whilst scholars of international standing use educational theory to discuss, define and analyse the documented classroom practice.

Classroom experiences are directly linked with theory by a series of annotated comments. This distinctive web-like structure enables the reader to actively move between practice and theory, reading about classroom innovation and then theorizing about the basis and potential of this teaching approach.

Providing an international perspective, the special lessons described and analysed are drawn from middle and secondary schools in the UK, Canada and Australia. This book is an invaluable resource for preservice and inservice teacher education, as well as for graduate studies. It is of interest to a broad spectrum of individuals, including training teachers, teachers, researchers, administrators and curriculum coordinators in science and technology education.

Contents: *List of Contributors - Foreword - Acknowledgements - Introduction: Creating Possibilities -* ***PART 1: Accounts of exemplary practice*** *- Kidney function and dysfunction: enhancing understanding of the science and the impact on society - Episodes in physics - Recollections of organic chemistry - The science class of tomorrow? - Science with a human touch: historical vignettes in the teaching and learning of science - Exploring the nature of science: re-interpreting the Burgess Shale fossils - Motivating the unmotivated: relevance and empowerment through a town hall debate - Mentoring students towards independent scientific inquiry - Account 9: Learning to do science - Practice drives theory: an integrated approach in technological education -* ***PART 2: Account Analysis*** *- Challenging the traditional views of the nature of science and scientific inquiry - Developing arguments - STSE Education: Principles and Practices - Conceptual development - Problem-based, contextualised learning - Motivational beliefs and classroom contextual factors: exploring affect in accounts of exemplary practice - Instructional technologies, technocentrism an science education - Reading accounts: central themes in science teachers' descriptions of exemplary teaching practice - Equity in science teaching and learning: the inclusive science curriculum - School science for/against social justice -* ***PART 3: Possibilities, accounts, hypertext and theoretical lenses*** *- voices and viewpoints: what have we learned about exemplary science teaching? - Integrating educational resources into school science praxis - References - Index.*

272pp
978-0-335-21311-5 (Paperback) 978-0-335-21312-2 (Hardback)

GOOD PRACTICE IN SCIENCE TEACHING
What Research has to Say

Edited by Martin Monk and Jonathan Osborne

This book offers a summary of major educational research and scholarship important to the field of science education. Written in a clear, concise and readable style, the authors have identified the principal messages and their implications for the practice of science teaching.

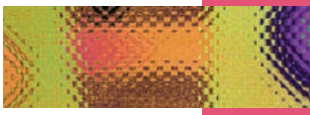
Aimed at science teachers of children of all ages, and others who work in teaching and related fields, the book provides an invaluable first guide for science teachers. All of the chapters are written by authors from King's College and the University of Leeds, both of which are institutions with an international reputation for their work in the field with top research ratings. Each chapter summarises the research work and evidence in the field, discussing its significance, reliability and implications. Valuable lists of further reading and full references are provided at the end of each chapter.

Contents: *Introduction* - ***Part one: The science classroom*** - *Strategies for learning* - *Formative assessment* - *Children's thinking, learning, teaching and constructivism* - *The role of practical work* - *The nature of scientific knowledge* - *The role of language in the learning and teaching of science* - *Students' attitudes towards science* - ***Part two: The science department*** - *Managing the science department* - *Summative assessment* - *Science teaching and the development of intelligence* - *Progression and differentiation* - *Information and communications technologies: their role and value for science education* - ***Part three: The science world*** - *GNVQ Science at Advanced level: a new kind of course* - *Science for citizenship* - *Index.*

978-0-335-20391-8 (Paperback)

Developing Scientific Literacy

Using News Media in the Classroom



Science-related news stories have great potential as a resource for teaching and learning about science and its impact on society. By demonstrating the relevance of the subject in everyday life, they can form a valuable bridge between the school classroom and the 'real world'.

Worldwide, those advocating science education reform stress the need to promote 'scientific literacy' among young people and typically this includes equipping students to critically engage with science reports in the media. However, very little guidance exists for those who wish to do so.

Developing Scientific Literacy addresses this gap, offering a much-needed framework for teachers wishing to explore 'science in the media' in secondary schools or colleges. It suggests how teachers across a number of subject areas can collaborate to promote among young people an aptitude and ability to engage thoughtfully with science in the media. Drawing on research and development work, the authors:

- Describe key characteristics of science news reporting
- Discuss its potential as a resource for teaching and learning about science and for developing young people's criticality in respect of such reports
- Identify appropriate instructional objectives and suggest activities through which these might be achieved

This timely book is a source of valuable ideas and insights for all secondary science teachers. It will also be of interest to those with responsibilities for initial teacher training and continuing professional development.

Ruth Jarman is a lecturer in Science Education at the School of Education, Queen's University Belfast, where she contributes to its initial teacher training and continuing professional development programmes.

Billy McClune is a lecturer in Science Education at the School of Education, Queen's University Belfast, where he coordinates the Physics and Chemistry courses within the PGCE programme and contributes to the continuing professional development programme.

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ISBN-13: 978-033521795-3
ISBN-10: 033521795-8

9 780335 217953

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