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International Handbook of Science Education

Part One

Edited by

Barry J. Fraser
Curtin University of Technology, Perth, Australia

and

Kenneth G. Tobin
University of Pennsylvania, Philadelphia, USA

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1.2 New Perspectives on Language in Science

CLIVE SUTTON
University of Leicester, UK

PERSONAL LETTERS AND THE START OF SCIENTIFIC PERSUASION

When Charles Darwin or Michael Faraday wanted to share their ideas with others, they often reached for pen and paper to compose a letter to a trusted friend or colleague. Many of their letters have survived and we can learn a lot from them that might make us better managers of learning and communication in the classroom.

The earliest of Faraday's letters which we still have were written in the summer of 1812 when he was not quite 21 years old (Williams 1971). They show him writing with great enthusiasm to his friend, Benjamin Abbott, about a wide range of topics – the value of letters, the cost of sheet zinc, how to use it to make a 'Voltaic pile', and sundry thoughts and adventures which he had experienced while running through London in heavy rain. They provide a vivid picture of a young man actively sorting out ideas and thoroughly animated about Humphry Davy's views on the new green gas, 'chlorine'. That's what Davy was calling it, even though others had insisted on naming it 'oxy-muriatic acid'.

Faraday used his letters to rehearse the arguments. Was the green gas truly a simple elementary substance as Davy maintained? If so, then the more well-known 'steamy' gas from salt which people called 'smoking spirit of salt' or 'muriatic acid gas' might be renamed 'hydrogen chloride' and recognised as a compound of two things only. The trouble was that to think and talk about it in that way would mean abandoning Lavoisier's idea that all acids contain 'oxy-gen', the 'acid-begetter'. Abbott had expressed objections to the 'chlorine as a simple element' scheme of thought, and Faraday was keen to persuade him to think again. Here are some extracts from his second attempt on 1 September 1812 (see Williams 1971, p. 21):

Chapter Consultant: Daniel Gil-Pérez (University of Valencia, Spain)

B.J. Fraser and K.G. Tobin (eds.), International Handbook of Science Education, 27–38.

Dear Obliging Abbott,

... In my last [letter] if I remember rightly I gave as proofs that Chlorine gas contained no Oxygen experiments in the following import

- *That the Carbonaceous part of a taper would not burn in it.*
- *That ignited Carbon ... would not burn in it.*
- *That when Chlorine and Hydrogen were united no results containing Oxygen appeared. ...*

... [M]y arguments in favour of the simplicity of Chlorine will be drawn from the nature of the results when it ... is made the supporter of combustion and when it is combined with other bodies – I have already observed one of these combinations ... – Hydrogen when united to chlorine forms a pure unmixed uniform binary compound Muriatic acid and no water is produced ...

Look into your Lavoisier into your Nicholson into your Fourcroy and what other chemical books you have at the article Oxy-Muriatic acid ... they will tell you that its Oxygen is held by an affinity so weak that the combustibles burn in it very easily and compounds of the oxygen ... are obtained as well ...

You will think me bold dear A if I deny all these authorities but Davy has done so and I will do it too ...

In my next I will continue the subject but positively will first hear from you so that I may know my opponent & his objections. ...

Adieu, dear Ab ...

Several features of this letter are important for what I want to say about sharing new ideas in science. First, there is a strong personal voice – we can hear Faraday 'speaking'. Second, he wants to share his viewpoint and to persuade his reader. Third, he writes with conviction because he has a clear image in his mind's eye.

Personal involvement and use of a new point of view linked with a new way of talking are key features of the initial stages of scientists' communication. Indeed that is what the word itself means in this context – *commun*-ication is an attempt to create a *commun*-ity of thought, a shared understanding. Teachers engage in a similar activity when they say 'Try looking at it like this' and the learners are invited to see something with new eyes. However, viewpoint sharing is not just a matter of passing over information. It involves winning agreement with a certain perspective, and winning attention to the points which matter from that perspective. When it is successful, the participants start to see the relevance of the evidence presented, and they come to possess both the new way of seeing and the new way of talking.

Nowadays letters take their place alongside other informal kinds of communication in scientific research, including both electronic mail and face-to-face discussion at scientific meetings. Above these, we have another layer of more formal written communication, whose form and function has received a lot of attention recently from historians, as part of a general trend in the history of science to recognise that communicative activities are central to the scientific endeavour. Experiment is a part of science, but so is writing and talk. It is through publication and discussion in learned societies that some of the new insights and claims of individual researchers get transformed into what becomes accepted scientific knowledge. So, writing for a journal or attending a congress is just as much a part of science as the more practical activities of handling apparatus and conducting experiments. A current problem with school science is that a heavy emphasis on experiments is in danger of giving students an unbalanced picture of the range of what a scientist does.

Even in writing, awareness of the range is incomplete. Although the formal article for a journal has often been held to embody the ideals of how writing in science 'should' be done, it is only one of the genres that scientists learn to use and not the only way in which they write. For a fuller understanding, both teachers and learners need to see those journal articles in relation to other kinds of writing, ranging from letters at one end to textbooks at the other.

HOW THE HUMAN VOICE OF THE SCIENTIST FADES

Despite the impersonal image of scientific writing, there is always a detectable personal voice when a scientist writes about something for the first time. When William Harvey put forward the idea of a circulatory movement of blood, he wrote: 'I began to think whether there might not be a motion, as it were, in a circle' (Harvey 1628, ch. 8). Nearer to our own time, James Watson and Francis Crick began their most famous paper with the words: 'We wish to propose a structure for the salt of deoxyribose nucleic acid (DNA). The structure has novel features which are of considerable biological interest' (Watson & Crick 1953, p. 737).

The sense of personal identification with a new viewpoint is captured in the expressions 'I began to think' and 'we wish to propose'. Even in more run-of-the-mill reports of experiments, fellow scientists know that the authors are making a *claim* which they hope will be taken into the body of accepted fact, and that such a contribution is deeply connected with the thoughts, hopes and fears of particular human beings. What historians and literary scholars have been exploring recently is how the personal connection is gradually diminished as the new science becomes established science, and the claim becomes no longer just 'So-and-so's idea' or interpretation, but something worthy to be called 'So-and-so's *discovery*'. We can trace the fading of personal attribution in a sequence of different kinds of writing – journals first, then research reviews and then textbooks. The journal account might be cited in a review alongside other researchers' claims, or mentioned in a *Handbook of Recent Research in XXology* which every researcher in that field will read. If it continues to be sustained, it then gets into the textbooks, and in this handing-on process phrases such as 'it is thought that' or 'So-and-so has suggested that' are gradually reduced or omitted. Ideas and claims which could be identified with individuals are made into common property. They are converted into agreed public knowledge which merits the status of 'fact', 'fact for the time being' or at least 'best available theory, which to all intents and purposes we can assume to be correct'. (For a fuller account of this process, see Sutton 1996.)

The texbook account as the end-product of this process of assimilation is important because it expresses the consensus about what is important in a particular branch of science. It also gives a powerful sense of 'what we have found out about how the world works'. Nevertheless, there are losses from an educational point of view because the definiteness of the language and its detachment from human beings can give a very misleading impression of how the knowledge was established.

WHAT ARE STUDENTS LEARNING – A DISTORTED CONCEPTION OF SCIENCE?

The Influence of Textbook Knowledge

It might seem strange that the textbook account, which is the product of successful science, can be a source of misunderstanding, but the problem is that learners encounter this product without experiencing any of the uncertainty and controversy that was involved in establishing it. 'Chlorine *is* an element', says the textbook. 'Air *is* a mixture of nitrogen and oxygen.' Just like that. These useful summaries of what we know today are not wrong, but what they fail to explain is that most of the words in those sentences were human inventions, hotly debated before they became an accepted part of current science. The definiteness of the textbook account sweeps away the memories of doubt or difficulty over what might be taken as true, and makes 'the facts' appear to be completely outside human agency. It is as if people had no part in shaping the facts or arguing what exactly could be believed. Facts were not argued into existence; language was not involved in creating them; the scientists' role was just to find them, ready-made.

To put the problem another way, constant exposure to long-accepted accounts of scientific knowledge can give too simple an idea of what a fact is. Learners pick up a Baconian view of the scientist as a 'fact gatherer' (Driver, Leach, Scott & Millar 1994), a person who goes out and makes discoveries by 'seeing what happens', rather than by any process of imaginative effort and painstaking construction. 'Atoms are made of protons, neutrons and electrons', we say, but without elaboration such an expression encourages an uncritical reification of these human constructs and implies that they were simply 'found' rather than being suggested, invented or built up as part of helpful systems of explanation. A statement like 'every atom has a nucleus' can be deeply misleading if the learner has never understood one of the fuller formulations such as 'Ernest Rutherford suggested that every atom has a nucleus'.

The problem for a teacher is to achieve an appropriate blend of definiteness and tentativeness. If we restore the human authorship and re-admit uncertainty and the possibility of argument, we can help students to gain a better idea of science-in-the-making. On the other hand, it is also a source of pride that scientists *have* managed to detach knowledge from individuals. They *have* got beyond 'So and so's opinion' and obtained agreement about facts which are understood as common to all – 'universal', 'public' or 'objective' knowledge as it is called, even by those who insist that it is consensual and more usefully thought of as 'intersubjective'.

The Influence of Custom and Form

Slavish imitation of a detached style of writing is another way in which learners pick up a distorted view of science, and it is here that historians can help teachers by showing the origins of scientific styles, and how they have changed since they were first invented.

'Detached' writing was first developed within the courtesies and customs of the early scientific societies, as they considered how to keep argument and discussion within manageable bounds. Shapin and Schaffer (1985) argue that, after the civil war in England, Robert Boyle and his cofounders of the Royal Society created what was then a new way of presenting and sharing ideas, and they were able to gain agreement about 'matters of fact' which would stand in sharp contrast to the political and religious 'enthusiasms' which had been socially corrosive in previous decades.

The need to stop philosophical disputes getting out of control was not a purely academic problem at that time, but one of war and peace, imprisonment or mutual toleration. Leading thinkers of the day discussed whether toleration of different views was compatible with the maintenance of civic order. In such a climate, the new approach to '*natural* philosophy' was a contribution to an urgent social problem. Its proponents developed what Shapin and Schaffer call a new 'literary technology' – a way of writing which separates the opinions of the writer from the 'matters of fact' being reported. It was accompanied by a 'material technology' (making use of instruments), so that investigators could withdraw their personal voices from a part of the report by saying that 'it is not we who say this but our equipment'. In addition, there was a 'social technology' of conventions and manners within the Society (e.g., in the courteous 'receiving' of a report of experiments). Through these ways of working, it was understood that 'data' could be something separate from 'speculations', and a challenge to the reliability of members' equipment could be separated from a challenge to their honour. This new approach was successful in recruiting people who were eager to collaborate in the search for 'natural knowledge' without fragmenting prematurely into factions.

One of Boyle's first techniques was to list the distinguished witnesses who had been present at an experiment, so that the reader more readily would agree that the phenomena must be as he said they were. Later, he developed a way of reporting the event in such detail that the reader became in effect a 'virtual witness' and the written account became acceptable as its own authority. From that small beginning, we can trace the idea of a separation of 'methods' from 'results' and 'discussion'. Journals did not immediately adopt a fixed format enshrining such divisions, but respect for the different components nevertheless became an important part of the ethic of all the societies. Whatever part of a report might be questioned or attacked, there is usually another part which can be respectfully accepted, or which can lead someone else into further experiments. The societies thus achieved a method of placing ideas before other people in a way which assists semi-collaborative inquiry. Bazerman (1988) shows that, in the first 150 years of the Royal Society, articles in its *Philosophical Transactions* kept changing in form, but belief in the value of separating 'findings' from other parts of one's writing grew in strength. By the 20th century, some journal editors were insisting on a standard format, and unfortunately this now features in the public imagination of 'how science should be done'. In the biological sciences, it includes such headings as Introduction, Previous Work, Methods, Results and Conclusions. Peter Medawar (1974, p. 14) called it 'a totally mistaken conception, even a travesty, of the nature of scientific thought', because it glosses over 'why we were doing this' and 'what our initial hunches were' and it pretends that thought (i.e., the discussion) is done mainly after the factual results have been collected. This criticism should be taken seriously when educating citizens at large about science, although the pretence has been successful in the research community.

Gradually, scientific writers found that various linguistic devices also could be helpful in creating distance between investigators and their 'findings'. One such device is to use the passive voice, as in 'Measurements were taken' rather than 'I measured' and 'Experiments were conducted' rather than 'My colleague and I carried out the experiments'. Another was to create new abstract nouns and noun phrases such as in 'The ray suffered linear refraction' rather than 'The light bent along a new line'. Halliday and Martin (1993) argue that the constant development of nouns and elaborated noun phrases is crucial to science because it separates the investigator from Nature. Generations of scientists have taken verbs like 'flowing' and chosen the noun form as their object of study (e.g., 'the rate of flow' or 'the current'). In the 20th century, this nominalisation of language has intensified in all academic discourse. Modern citizens require some competence in reading and understanding that kind of expression, but their science lessons should not be dominated by it.

The greatest misunderstanding about writing occurred when science was professionalised in the 19th century, and recruits to science were trained to write using conventions that in part were derived from the above devices and traditions. Schools inherited rituals for writing in 'objective' ways and holding back acknowledgement of one's own thought and involvement. In chemistry, for example, qualitative analysis was to be written up under the headings Test, Observation and

Inference. 'What I thought beforehand' or 'why I wanted to try this test' were absent. If such systems were ever justified in schools, it was in the limited context of training technicians for the routines of laboratory life; but they still influence ideas about what is permissible, even though guidance to students is now much less rigid.

Custom and form in scientific writing should be understood, rather than followed in a ritual manner. What's involved in writing a definition? Why are there so many '-tion' words in science? What's the best way to present a formal report? Students who address those questions with their teachers will be able to see the distinctively scientific genres as forms of expression which have useful functions in a certain context, rather than as something fixed and arbitrary (which you must use all the time, otherwise it's not science).

WHAT ELSE ARE STUDENTS LEARNING – A DISTORTED VIEW OF LANGUAGE?

Important as it is that learners should know how science works, it is even more important that they should sense the multiple purposes of language and be able to use it well in their own learning. A highly 'factual' account, distanced from human beings, is not a good model for them because it offers *giving and receiving of information* as the main thing that we do with language, as in the middle column of Table 1. With a more balanced view of human language, it should be clear that new learning involves employing language firstly as an *interpretive* tool, a means of making sense of what we see and what we think other people are saying (the right-hand column of the Table 1). Learners need to hear language used in that way – as expression of thought rather than as statement of disembodied fact.

Another idea about language which is sometimes held by students and teachers is that language in science *describes* what we see in experiments. This is misleading because what anyone is able to select with their eyes depends on the mental organisation which they already have. Strictly speaking, science is not about describing, but about *re-describing*. At points of change in scientific theory, the breakthrough usually involves a new way of talking. Someone starts to talk about enzymes as fitting their substrates 'like a lock and key'. Leaves are spoken of as 'chemical factories'. Water in a high lake is referred to as a 'store' of 'potential' energy, and mountains take part in a 'cycle' of erosion and re-building. In other words, scientists try out a new talk pattern in which they select a new metaphor in an attempt to figure out what is happening. If the re-description is successful, they are able to elaborate it into a testable model. For new learners, the teacher's job is to help them to get on the inside of the models and ways of talking which organise the different branches of science – current-talk for circuits, field-talk for magnets, and molecular bombardment-talk for understanding air pressure. Each of these began as a successful re-description of something which previously had defeated human comprehension. In each case, *the language is the theory* (see the right hand column of Table 1).

Table 1: Differences between language as a system for transmitting information and as an interpretative system

Characteristic		Role of language	
		A system for transmitting information	An interpretive system for making sense of experience
1.	What the speaker or writer appears to be doing	Describing, telling, reporting	Persuading, suggesting, exploring, figuring
2.	What hearers or readers think that they are doing	Receiving, noting, accumulating	Making sense of the other person's intended meaning
3.	How language is thought to work in learning	Clear transmission from teacher to learner is needed; the teacher's speech is important.	The main process is active re-expression of ideas by the learner; the learner's speech is important.
4.	How language is thought to work in communication generally	Like Morse Code in a wire. If the message is clearly sent and received, it will be an accurate copy, unchanged.	What the hearer constructs *can* approximate the speaker's intention, but communication is seldom complete. The important part is how to decode the Morse.
5.	What language seems to do *vis à vis* the world of Nature	Words correspond in a simple way to features of the external world, and generally there is one correct word for one thing.	There is always more than one possible word. A choice of words highlights certain features for further thought. For example, a mule could be called a 'hybrid', a 'herbivore' or just a 'beast of burden' according to context.
6.	How language is thought to work in scientific discovery	We find a fact, label it, and report it to others. Words stand for things.	We choose words which *influence* how we see things. For example, the scientist re-describes a 'Scottish glen' as a 'glaciated valley' and thus attends to previously neglected features.

Re-description is another word for change of metaphor and the traditional idea that figurative language is the enemy of good science is now in doubt. Many studies, summarised in Sutton (1992), show the centrality of figurative language in scientific theorising and how it provides the starting points for new thought. A phrase such as 'the orbit of the electron', which began as a figure of speech, sometimes gets treated as if it were a label for reality, while for other people it remains much less literal and no more than a working model; students need to get

a sense of the interpretive origins of such terms and to understand that *a human choice of language* was involved in shaping them. Much research on metaphors and analogies in the science classroom has been about their use as teaching aids (Treagust, Duit, Joslin & Lindauer 1992), but an equally urgent task is to help the learners to appreciate the metaphors which already lie *within* major scientific theories.

Because the distinction between the figurative and the literal is not sharp, we cannot reliably separate out 'scientific' language for reporting observations uncontaminated by theory. The hope for a clear division was strong in the 17th century and has persisted since (Sutton 1994), but the demarcation is no longer tenable because even the most elementary descriptions of what we see are shaped partly by language. One continuous language works *both* as an instrument of figurative interpretation *and* as a means of attempting to transmit to others what we think. Science needs both aspects, and so does education.

Unfortunately, the dominant traditions of the classroom have given too much prominence to one aspect, and learners quickly pick up what is allowable and 'proper' for science. Lemke (1990) describes what students in some American high schools take as the rules of the game, and traces the alienating effects of 'the one right way to talk science'. He describes it as serious and dignified, verbally explicit, full of detached universalised generalisations, and always about things rather than about people. It also involves continually correcting the everyday word in order to replace it by a technical term (not 'bent' but 'refracted'; not 'bounced' but 'reflected'). Lemke suggests that this 'sets up a pervasive and false opposition between a world of objective, authoritative, impersonal, humorless scientific fact and the ordinary, personal world of human uncertainties, judgments, values and interests' (p. 120).

Such alienation should not be taken lightly, for however much a minority of students are excited by science, there are many more for whom the ideas of science become neither their own ideas nor a part of their everyday tools of thought. Those students come to regard science as just 'information' which belongs to specialists, and they react to it mainly with indifference, fear and disengagement. Can we avoid the over-use of the language forms which create this detachment of 'knowledge' from 'people'? The styles of journals and textbooks are important in science but not appropriate as the dominant experience in school, where the re-working of ideas requires much greater flexibility.

Certain cultural trends at this end of the 20th century have taken the question of language and alienation from science much further. Consider for example the feminist critique of 'man' as the 'interrogator of Nature' or the concerns of environmentalists who point to the past mistakes of an over-confident technocracy. Writers on these topics are angry at those who, in the name of being scientific, appear to claim a privileged access to 'how things really are'. They suggest that, unless the conclusions of science can be presented better as a set of well-grounded but still potentially fallible *interpretations*, science might be rejected even more forcefully (Gough 1993).

TOWARDS A POLICY ON LANGUAGE FOR LEARNING

The problems outlined in the previous sections cannot be solved by science teachers alone, because they are entangled with general beliefs about the status of science in society and its claims for independence from the wider culture. Those beliefs are changing, however, and teachers can contribute to a better public understanding by developing a school language policy to recover the human voice and personal expression of thought. Some themes to include in such a policy are suggested below.

The Learner's Voice

Science teachers should guide students about the role of language in their own learning. Learners should experience language as a medium for conversation about ideas, not just for receiving 'the truth'. Students should re-work scientific ideas and practise using those ideas in argument and discussion.

The Scientist's Voice

We should present the language of scientists in such a way that students are conscious of human authors. The thoughts behind a particular choice of words should be explored, with the emphasis being on 'what these people thought and why they thought it', not just on 'what we know'.

The Teacher's Interpretive Voice

The teacher should set an example in the use of language for purposes other than handing on information. When we rephrase an idea and express it in a different way, we should draw attention to that process in order to show that language is *not* a fixed set of labels. Everyday expressions and technical terms should be put together, and students should discuss how well each succeeds in capturing a particular idea. Science teachers already do this informally by explaining, negotiating and joking with students to help them to wrestle with new concepts, but at the cost, in Lemke's terms, of breaking the assumed rules of what is 'proper'. Science teaching is humane at the informal level, but much less so in the formal structure of what people believe a science lesson should consist of. A language policy should attempt to make the formal aspects of lessons more consistent with the best practice of teachers in their spontaneous informal approaches.

Science as Story

One way to bring out the voice of the learner, the scientist and the teacher as personal expressions of thought is to present the lesson as a critical discussion of a scientific story (e.g., 'in this circuit, most scientists now think that . . .'). To work in this way places the ideas in a form in which they are open to discussion as well as to experimental test. Students are likely to explore the story and to respond with a personal voice (e.g., 'I think that what they mean is . . .'). Learners then have an incentive to work on their own thoughts so that a dialogue can be achieved.

The word 'story' has many advantages in comparison with 'fact' or 'truth'. It involves learners and invites them to think 'Is this reasonable?' It corrects the idea that science deals only in certainties and admits the students into a more genuine discussion of areas of doubt. At another level, it also gives a better idea of science by loosening the rigid division of fact from theory.

Science often is represented as uncontroversial, but this is true only of the most stable scientific stories. If students are to connect their science with the issues of the day and learn the discipline of using evidence in structured argument, some less certain stories also should be included (e.g., the one about whether the atmosphere is warming up or not). Gough (1993) argues that such topics involve a complex interaction of values and knowledge, and also that more overtly fictional narratives might offer a good way to draw students' minds onto the problem. To handle such work without letting it degenerate into fatuous talk, teachers need a new range of class management skills in addition to the conventional repertoire of practical work, demonstrations and question-and-answer sessions. Teachers need the confidence to organise debate and role play and to coach students in how to write clearly for a variety of audiences. Resources for such activities include *Active Teaching and Learning in Science* (Centre for Science Education, Sheffield Polytechnic 1992) and *Science and Technology in Society* (Association for Science Education 1986–1988). Textbooks in the conventional form are gradually being displaced by such materials. In the British course called Salters' Advanced Chemistry, the leading book is entitled *Chemical Storylines*.

CONCLUSION

The primary aim of this chapter has been to show that language in science evolves from personal reports in which investigators wrestle with uncertainty, and moves towards impersonal objectivised accounts of nature which lack the human voice and are alienating for some learners. From over-exposure to such accounts in science lessons, it is possible to pick up a distorted concept of science and a very limited idea of language as a system for transmitting unproblematic information. Students who are limited by that experience are likely to be less effective as learners and less skilled at connecting scientific understanding with their own human concerns. Much of this is unnecessary because the assumed 'rules' about how to talk and write about science are largely self-imposed as a result of misunderstandings of what science is. We can address the whole cluster of problems by developing a school language policy that emphasises the learner's voice, the scientist's voice, the teacher's personal voice, and science as story.

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1.3 Cultural Aspects of Learning Science

WILLIAM W. COBERN

Western Michigan University, Kalamazoo, USA

GLEN S. AIKENHEAD

University of Saskatchewan, Saskatoon, Canada

Over the past few decades, perspectives on learning science have evolved (Aikenhead 1996; Cobern 1991, 1996; Solomon 1994). Earlier psychological perspectives on the individual learner, such as Piaget, Ausubel and personal constructivism, have expanded to encompass sociological perspectives that contextualise learning in social settings, including social constructivism, science for specific social purposes, and situated cognition (Goodnow 1990; Hennessy 1993). This chapter addresses the next stage in the evolution of our thinking on learning science – an anthropological perspective that contextualises learning in a *cultural* milieu.

Although psychological and sociological approaches are useful in science education, a more encompassing perspective from cultural anthropology can provide fresh insights into familiar problems associated with students learning science. Despite sociologists' appropriation of ideas from cultural anthropology, the two disciplines of sociology and anthropology differ dramatically, even in their definitions of such fundamental concepts as society, culture and education (Traweek 1992). For example, from a sociologist's point of view, teaching chemistry tends to be seen as socialising students into a community of practitioners (chemists) who express in their social interactions certain 'vestigial values' and puzzle-solving exemplars. On the other hand, an anthropologist tends to view chemistry teaching as enculturation via a rite of passage into behaving according to cultural norms and conventions – especially the way in which the group makes sense of the world – held by a community of chemists with a shared past and future (Hawkins & Pea 1987). One consequence of the disparity between sociology and anthropology is the realisation that the anthropological perspective described in this chapter represents a significant change in our thinking about students learning science. Unfortunately, terms such as 'culture' and 'sociocultural' are found in the science education literature without a definition of what culture means in the context. Because an invocation of terms does not clarify the process of learning science, this chapter introduces appropriate terms from cultural anthropology to conceptualise cultural aspects of learning.

Chapter Consultant: Peter Taylor (Curtin University of Technology, Australia)

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