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Taber, K. S., & Riga, F. (2007). Working together to provide enrichment for able science learners. In K. S. Taber (Ed.), ***Science Education for Gifted Learners*** (pp. 182-196). London: Routledge.

14. Working together to provide Enrichment for Able Science Learners

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This Chapter discusses an after-school enrichment programme (ASCEND) organised for secondary level students who were interested in, and considered ready to be challenged in, science. The two features of the ASCEND project which we will focus on are the use of the nature of science as a key organising theme, and the way the programme brought together students from several schools.

The ASCEND project

ASCEND, Able Scientists Collectively Experiencing New Demands, was a project undertaken in partnership between the Faculty of Education at Cambridge, the Federation of Secondary Schools in the City of Cambridge, and the Science Enhancement Programme (who provided the funding which made the project possible). ASCEND developed from the APECS (Able Pupils Experiencing Challenging Science) project, which had been the focus for a seminar series on Meeting the Needs of the Most Able in Science. ASCEND was an attempt to put into action some of the ideas that had been explored in those seminars, in the context of a programme of enrichment.

After informal discussion with local schools, it was decided to work with pupils in Y10 (i.e. 14-15 year olds in the year before decisions were made about college subjects and applications). The Comprehensive Schools in Cambridge were invited to nominate students who would be interested in attending after-school sessions, and who might benefit from being challenged in their science learning. Four schools nominated students. Part of the logic of working with several schools was to ensure there would be a 'critical mass'. By definition most schools only have a small number of exceptionally able students in a year group (indeed one of the Cambridge schools declined to participate on the grounds that it had no suitable students), and ASCEND would allow these to meet and work with similar-minded individuals from other schools. One of the complaints commonly heard from high ability students is that 'friends who really understand us are few and far between' (NDE, 1997, p.55). The Project was directed by the first author, a science education specialist, and organised in liaison with staff from the science departments in the four schools: Dr. Cathy Auffret (Chesterton Community College), Eloise Froment (Parkside Community College), Peter Biggs (St. Bede's Interdenominational School) and Susie Garlick (Netherhall School and Sixth Form College).

The programme was organised to run approximately fortnightly (during school terms) at a suitable time to allow students from the participating schools to walk, cycle or otherwise get to the Faculty of Education. The decision to hold the sessions in the University was a deliberate one: as well as being 'neutral' ground, this would be an adult environment, where the students could be treated as if conference or course delegates. To this end, the sessions were arranged such that they started with a thirty-minute window for a conference style registration during which delegates could take refreshments and socialise in the Faculty café (Taber & Riga, 2006). The group then moved to teaching accommodation for a ninety-minute academic session.

The total number of delegates from the four schools was about thirty, although not all were able to attend all seven sessions. The sessions were staffed by a group of about a dozen teaching/research assistants: these were science education research students and trainee science teachers who had all volunteered to be involved in the project. Some teaching staff from the schools came and observed or joined in some activities. Each session started-off with a short general introduction to that day's theme, given by the first author, followed by the delegates breaking-up into groups, and usually spreading among several adjacent teaching rooms to work on the set tasks.

Planning the ASCEND approach

Two key themes for ASCEND were the nature of science, and metacognition. The nature of science was selected because

a) it was considered to be an area where standard school provision was often weak;

b) it offered a relevant theme which would not simply duplicate school studies;

c) it was considered to offer suitable opportunities for challenging the most able (see also Chapter 2).

In the curriculum context where ASCEND was situated, i.e. the English National Curriculum (NC), 'scientific enquiry' was established as one of the four main sections ('attainment targets', AT, in the official jargon) of the science curriculum. In principle, it made up an important part of the school science curriculum. However, the English NC has had a troubled history in this regard (Taber, 2006). Scientific enquiry ('Sc1') was intended to represent the processes by which scientists undertook enquiry into the natural world. However, in practice, it largely came to be based around an impoverished curriculum model of scientific investigations due to the way this aspect of curriculum was formally assessed at GCSE (school leaving examination at age 16) level (Kind & Taber, 2005).

Other aspects of the nature of science were still supposed to be addressed through the teaching of the topics in Sc2-4: but this expectation initially took the form of a preamble to the statutory curriculum. When it was recognised that very little teaching about the nature of science took place in many classes, the curriculum was revised to give Sc1 two distinct threads, 'scientific investigations' and 'ideas and evidence'. Further it was made clear that explicit assessment of the ‘ideas and evidence’ thread would be included in national examinations (QCA, 2002).

National monitoring exercises suggested that this was often a weak aspect of science teaching, with many teachers feeling under-prepared and under-resourced for teaching about the nature of science (QCA, undated).

Many teachers consider the NC curriculum too ‘crowded’ with material (the prescribed material for 11-14 years olds is organised as 37 topics in the recommended scheme of work, see Kind & Taber, 2005) to allow exploration of topics in depth (essential for stimulating the gifted), and there was a strong feeling that this type of curriculum gives students the view that science is just about learning a great many well established ideas. However, it is more important that both future scientists, and the rest of the population (who need scientific literacy to support full participation in a technologically advanced democracy), develop scientific values and skills, and an appreciation of how knowledge comes to be judged reliable and the basis for making decisions (e.g. Millar & Osborne, 2000).

A great advantage of the nature of science as a focus for enrichment is that it is not intrinsically tied to any particular content. So even when students came from schools doing a good job introducing nature of science ideas, it was possible to explore the ideas further in contexts that did not repeat or precede standard school work.

Moreover, there is good reason to believe that the nature of science offers learning opportunities that can challenge the most able. Gilbert (2002) had reviewed work on teaching science to the gifted and offered a number of suggestions for the expected characteristics of gifted learners, and the types of learning foci that could match those characteristics (reproduced in Table 14.1).

Table 14.1: characteristics of gifted science learners – after Gilbert, 2002

Metacognition was introduced as a subsidiary theme, as it was considered that gifted learners would need well-developed metacognitive skills to work optimally. This was, in part, a recognition that effective students usually have already developed high levels of metacognition, and that exceptionally able learners are sometimes autodidacts who are able to largely teach themselves with little external input (see Chapter 6). One of the charactersitics to be *expected* of highly able students is that they show a high level of independence in their learning (Stepanek, 1999).

This consideration was also a reflection on the role of differentiation in effective teaching. Even in top sets there was likely to be a considerable range of ability, and exceptionally able students would remain exceptional among their able but less exceptional peers. Effective teaching across wide abilities ranges requires effective differentiation (through one means or another) by the teacher, and it is our view that for most forms of differentiation to be effective, learners have to be able to respond by taking some responsibility for regulating learning. This is likely to be especially so for the most able who are 'outliers' in the class population and may be assumed to be capable of high levels of independent learning. It was decided that ASCEND would be set up to assume, and test, the notion that more able students could indeed take responsibility for organising and monitoring their own progress on extended tasks. One of the common complaints reported from high ability students is that 'no one explains what being a high-ability learner is all about—it's kept a big secret' (NDE, 1997, p.55). It was decided to include an activity about learning and studying in one of the early sessions in the programme.

Organising the programme

A set of activities were designed for the ASCEND programme with a number of principles in mind. Firstly, as discussed above, the main organising theme would be aspects of the nature of science, with a subsidiary focus on metacognition. Secondly, most of the activities would be based around small group work, partly because being able to take on roles within groups is believed to be one characteristic of gifted learners in science (Gilbert, 2002). This also provided us with the ability to observe the students at work. The third key principle was that the work should be challenging, and so a minimum of guidance was provided in terms of exactly *how* to carry out activities. The delegates would be given tasks with overall aims, which they needed to plan and organise - and they also had to consider how they would evaluate their own achievements. In this way the 'default assumption', which was revisited during the project, was that when placed in a suitable, adult, learning environment, and offered responsibility for regulating their own learning, the delegates would be able to rise to the challenge.

In designing the activities, an attempt was made to provide contexts that would link with and support school learning, but without simply repeating or pre-empting work that the delegates would meet in school science. The activities devised (to be described more fully in Taber, forthcoming) were based around the following themes:

- What is science? (How do we decide if some activity is or is not scientific?)
- Learning science (– using information from psychology and brain science to identify good study habits, and model the science learner)
- Evaluating scientific explanations (criteria for a scientific explanation)
- Scientific laws (practical work: looking for patterns in data. This was linked to feedback cycles and exponential decay)
- Computer-based learning (an opportunity for delegates to work in a Faculty computer suite using materials designed to support independent study of physics at A level. This activity was the only one not organised in groups.)
- Philosophies of science (considering historical vignettes of scientists in terms of competing models of the nature of science)
- Plant synthesis (developing a model of plant nutrition by synthesising ideas from biology, chemistry and physics / considering objections to genetic engineering in terms of evolutionary principles/knowledge)
- Scientific analogies (a card game encouraging players to find analogies between scientific concepts and everyday ideas and phenomena)

- Evaluating models (comparing two particle models, and two models of ionic bonding, in terms of how well they can explain phenomena / properties)

The computer-based learning activity was not primarily related to the nature of science theme, but was an opportunity to work with some materials developed for independent learning of physics in the post-16 sector (see Kind & Taber, 2005, p.154). The 'learning science' activity was partly intended to inform the development of metacognition, but - in common with a number of other activities - also involved a modelling activity (see Chapter 7 for a consideration of the significance of modelling in science education).

What was learnt through ASCEND?

The space available here does not allow a detailed presentation of the rationale or nature of the different activities, nor an in-depth analysis of how students responded to the challenges. (It is intended that more detailed information will be presented in Taber, forthcoming). The activities were documented, mainly through field notes taken by the teaching/research assistants, and by audio recordings of groups at work. This evidence has been analysed by the second author, and here we draw some general lessons from the successes and limitations of the programme.

Working and taking on roles in groups

At the start of each session, delegates were asked to organize themselves into groups, preferably with students from different schools. Generally, each group operated much like a team, working closely together, collaborating with each other, yet allowing one or two member(s) to guide while others were quite happy to follow. For example, one group, when asked to produce a poster of 'a Scientific Model of the Human Learner', decided to make a sketch of the brain, with every member contributing information, which they each wrote around the diagram.

In almost every group, activities were led by one (less often two) members of the group, who took it upon themselves to direct the group through the tasks. These 'leaders' tended to dominate discussions and appeared to enjoy expounding their ideas and theories, sometimes appearing to only be prepared to listen to others' opinions if these were *'intellectual'* enough. Moreover, other members of the group seemed to seek approval from the leader. Roles such as leader, reader, scribe, errand runner, time-keeper, etc. seemed to be assumed naturally without any visible signal or arrangement.

There were two instances, however, where the leader of a group was far more subdued. In these cases, the leaders quietly gave direction, keeping their groups on task throughout the session. When a group strayed off the set tasks, the leader would get them back on track by employing strategies such as re-defining the topic in his/her own words, or, articulating the main idea under discussion. In one session, the 'leader' of one group reminded the members that they were '*not* trying to look at the quality of science but the quality of the *explanation* of the science', which then led on to a discussion about the relevance of explanations in science.

The students who assumed a leadership role, generally had the following characteristics in common:

- were vocal
- took sudden, snap decisions
- had a clear idea of *what* they wanted to do and *how* to do it
- had a sound knowledge base from which to draw on
- tried to elicit support from others to confirm their ideas/opinions

We also noticed that often a group might seem to have one delegate who seemed to take on the role of (what is referred to in the internet age as) a lurker. A lot of the time the lurker appeared 'zoned-out'. They were initially silent (sometimes this lasted for up to half a session), and superficially seemed preoccupied with something else, or even bored and disinterested. However when they periodically engaged with the rest of the group it appeared they had been paying attention to what had been going on. Indeed, when they finally *did* speak/participate, they often had something very worthwhile to say. Their ideas were well formulated, and they often launched into arguments that sometimes superseded preceding discussions.

On the whole, delegates seemed to be thinking and working together within their groups (and sometimes between groups), sometimes thrashing out questions, problems and dilemmas, as though they *themselves* were scientists.

Ready assimilation of new learning

The resource materials used to support sessions were generally designed to have minimal direction, and often to provide unstructured and/or redundant (and in at least one case, excessive) information. Generally, students appeared to handle the volume of reading material with confidence: showing an ability to filter out which information would be most relevant. The ease and speed with which delegates seemed to be able to absorb and assimilate information from the materials provided was sometimes impressive. A boy in the session on *The Science of Learning* seemed perfectly comfortable oscillating from absorption in the stimulus materials, to contributing relevant snippets of new information to the group's discussions. Another boy described the Induction Model of Scientific Method after about 3 minutes into the session on *Philosophies of Science*, as follows: 'Model 1 is the one where we collect data and then collect more data, and more and more, until you can make a new law'.

The sessions included examples of new terminology, unlikely to have been met in school science. Assimilation of new knowledge was frequently demonstrated by delegates' attempts to re-phrase information they had just acquired from the materials. In one group, a girl frequently asked her group members 'now how do we say that?', setting out to clearly paraphrase information before synthesising it into their activity. In a written task, a group had written 'neurones are responsible for Cognitive Processes (i.e. Thinking)', illustrating the need to paraphrase. There was also a tendency among some students to offer examples from their knowledge base, or from personal experience, to back up their reasoning or support their viewpoint. In the session on *Scientific Laws* students tried to recall knowledge from similar experiments performed at school in order to help them understand the experiments on negative feedback. In one interchange between a research assistant and a group, the former used the new term ‘exponential decay’, and later a boy from this group answered a question during the plenary at the end of the session, in which he correctly used the word *exponential* to describe the shape of a curve – demonstrating that he had already incorporated this new concept into his vocabulary.

Planning and evaluating work

The materials generally provided minimal direction for how to undertake tasks. A common feature of the sessions was that the majority of students seemed so eager to get involved with the tasks that they often launched right into them with some excitement, without fully exploring the resource material provided. In most ASCEND sessions there was little evidence of careful planning of tasks before setting about doing them. Even when designing posters, delegates tended to plunge in, putting pen to paper (without drafting), and simply improvised as they went along.

A few students *did* take the time to read through the instructions, and were thus able to channel other group members. In some cases a member of a group might be quietly immersing themselves in the reading material seemingly ‘in their own world’, unaware of the discussions going on around them. However, on occasions, when a another group member stated something contrary to what was being read, they then corrected their colleagues by reading relevant passages aloud from the reading material, fuelling discussions on the topic. Some other students appeared to be able to skim read the materials, and very quickly absorb the information, which they then disseminated to the rest of the group at various points during the session.

In some ASCEND sessions, delegates did spend time at the beginning of the session in silent reading. One group during the session on *The Science of Learning* took a very organized approach. A girl took charge and divided the reading materials among the members, each taking a small pile to read. A period of quiet reading was followed by each member then contributing points (and quotes) for discussion from the papers they had read.

Two sessions focused on delegates' abilities to evaluate material (*scientific explanations* and *models*). One task required delegates to select 2 or 3 examples from a bank of questions, discuss answers, and then write suitable explanations. They then swapped explanations and critiqued each other's suggestions, either using the set of criteria supplied (which outlined both what makes good explanations in science, and what flaws to look out for when assessing explanations), or using their own criteria. Another task required students to produce a poster illustrating a *model of plant nutrition*. In this activity, delegates seemed to spontaneously edit, comment on, and sometimes question each other's contributions.

Metacognition: awareness of learning processes, strengths and weaknesses

One of the early sessions of the project focused on *The Science of Learning*, where delegates were asked to use the resource materials supplied (a handout of information about aspects of learning, a set of stimulus figures, and reference books) to identify key points about learning that would be good advice to give students studying science. They were then required to produce a conference-type poster entitled 'a Scientific Model of the Human Learner' which incorporated key information about how scientists believe people learn. A girl described the learning process to other members of her group as follows:

> '…information…brain makes connections…brain begins to understand…therefore brain makes more connections to previously discovered ideas…and begins to put them all together…brain understands'

A similar notion was voiced by a boy in another group who stated that 'the brain learns from prior experience'.

One of the learning practices observed during the sessions, which could be classified as a strength, was that students tended to stop periodically at various points in a task – especially when they ran into difficulties – and clearly summarise what they had done and what they knew up to that point. Students seemed to be aware that this process of *summarising* served as a platform from which to proceed to the next level of understanding of the concept under investigation.

On the whole delegates seemed to find it a weakness that often they could not offer quick answers and/or explanations to some of the problems they were investigating – sometimes seeming to get really annoyed by this. A girl in one group became so frustrated that she could not explain some everyday questions such as *why do people have 5 toes on each foot?* that she announced 'I've got a lot of questions, so will have to go on the internet to find out answers' – a remark which received universal consensus in her group. In another group a girl posed the question 'How did people find answers to these questions?' to which a boy responded 'somebody got it wrong then somebody got it right', perhaps demonstrating a notion of *how* science, as well as individual learning, progresses.

Appreciating the nature of modelling

An aspect of primary importance when considering the nature of science is the ability of scientists to develop models. A model is also frequently described as a representation of a phenomenon initially produced for a scientific purpose (Gilbert and Boulter, 2000). During three sessions in the ASCEND programme, students were challenged to think about this particular aspect of the nature of science. The tasks they were set involved not only creating and developing models of their own to explain certain phenomena, but also evaluating/critiquing the extent to which certain models explained some selected phenomena.

A task students seemed to find particularly challenging was in the session on *evaluating models*, where they were required to consider two different ways of thinking about *particles* and had to judge each model by testing its usefulness in explaining what was happening in a number of different situations. The exercise gave students a taste of how difficult it is for scientists to try and explain a phenomenon, and how useful (and challenging) the development of a model can be. It also exposed delegates to the problems scientists experience when they grapple with forming sound explanations in terms of one particular model. The tasks required great patience and perseverance, and some students preferred to look for ways of simplifying the tasks and searching for generalisations. They tended to just go on to considering the next phenomenon / property when they got bogged down, rather than enter into in-depth discussions. They also tended to skip phenomena they knew little about – possibly because there were so many other items to choose from. Nevertheless, a couple of the groups *did* display a stubborn determination to resolve which model would be better at explaining a situation, and entered into fairly lengthy, detailed discussions.

Synthesis: making connections

Science is the attempt to understand and explain natural phenomena. In order to do this, scientists endeavour to process knowledge – a key element of which is making connections. Scientists make connections in a number of different ways, some of which are:

- through the process of *logical deduction*
- by constructing either concrete or mental *models*
- by devising and developing *theories*
- by conjuring up *examples* based on prior knowledge or experience
- by making *comparisons* – using metaphors and analogies – to help explain an event or observation

In science, it is not, however, sufficient to make connections simply for the sake of making connections. They must lead to a conclusion, or some overarching goal – such as disentangling a problem or providing an explanation of the causes/effects of a phenomenon. Making connections is important in that it may lead to one's commitment to a particular belief, which, in the case of a student, might mean commitment to a scientifically accepted explanation, or alternatively, to a misconception.

During the ASCEND Project, when students were presented with some sort of stimulus (e.g. an experiment or reading a handout), there was evidence (in virtually *every* task!) of students' thinking giving rise to a series of ideas, which most often incorporated examples drawn from familiar events or past experiences, and which helped them to make sense of the concept under scrutiny. So when explaining his concept of what makes something a *science* to his group, one boy drew on an example from building based on craft knowledge and engineering knowledge:

> 'it[science]'s much more of an organised thing . . . it's the difference between some person in Africa saying I can build my house out of these mud bricks, and an engineer saying I can build a skyscraper out of these steel girders *and* I know why it stands up'

One of the activities, the analogy game, actively encouraged students to form connections between scientific and more familiar ideas. Although some of the ideas presented were commonly used in science ('the nucleus is . . . like the brain because the nucleus controls what the cell does and the brain controls what we do'; 'a cell is like a brick . . . they're used to build up the body') there were also more novel suggestions:

> 'a *molecule* is a complex arrangement of atoms and a *bible* is a complex arrangement of stories . . . and books and things'

Working with complexity, ambiguity and uncertainty

Many tasks and activities used in the sessions were devised to challenge students by confronting them with situations which appeared complex and/or ambiguous, with students often facing solutions or explanations which were uncertain. When confronted with complexity, ambiguity and/or uncertainty, the strategies implemented by delegates were both numerous and diverse. These responses included:

Accessing provided materials

Once delegates had identified the problem they were required to investigate and realised that they did not have a quick answer or explanation to offer, they began to skim through the reading material provided, then scanned for hints as to how to tackle the question.

Accessing prior knowledge and experience

Another strategy employed early in the process of resolving a problem, was to pool together any prior knowledge or personal experience they might have regarding the situation, and share this information with other group members. In one task, which involved categorising activities/occupations as 'science' or 'not science', one girl who seemed to have extensive knowledge about 'SETI', used her knowledge to over-rule a boy in the group who suggested that it was more 'science fiction' than science. In another task (capacitor discharge experiment) a student who knew that voltage was directly proportional to current (although he admitted that they hadn't done it at school yet), shared this information with his group.

Defining/articulating the problem

Students sometimes resorted to defining, re-defining, or articulating questions before proceeding to tackle the given task. For example, before attempting to answer the question 'why do we feel pain?' one group began by defining pain. To answer the question 'why do people age?' another group felt they first needed to tackle this by asking 'age…in what sort of terms?', finally suggesting that aging occurs because it allows us to evolve faster.

Offering examples

One of the most frequent ways students seemed to try to make sense of complex or ambiguous situations was to attempt to give concrete examples. In one instance, a student gave the following example in an attempt to show that intuitive statements are not always true: '…it's intuitively true that the sun goes round the Earth, however it is not so – they're making decisions based upon their…how they see it'

Hypothesising

Students sometimes posed hypotheses or simply made predictions about what might happen. A fairly frequent way of addressing an issue was to use language such as 'suppose…', 'imagine…', or 'say…', e.g. 'say we send our photon to our mirror…'. In another case, a boy from one group asked another boy in a group on the other side of the room, if he could describe his theory on why little rounded balls formed after NaCl was heated. The entire room fell silent and everyone listened to the boy expounding his theory, with questions asked at the end – it was much like a scene from a science conference.

Following logical processes

At times, delegates were inclined to think ideas through as a logical chain of events. In a practical exercise to explore the pattern in how water in two connected burettes reaches a common level, a student noticed that the water flowed fastest at the beginning, and then went on to explain that 'there's more water pressing down, which then makes this go up, but there's less water or force afterwards, so it goes down slower'. Similarly, a group taking temperature readings from hot water in a test tube noticed the temperature was dropping at an ever-slowing rate. They suggested that when 'the liquid is closer to room temperature it means it loses less heat' because there is less 'difference between its surroundings'. And a group working on the third (analogous) capacitor discharge experiment concluded:

> 'well if you think of it in terms of a circuit…the capacitor…is giving out current which is recorded by the ammeter but then more current flows back…but it's getting diminished each time because the capacitor's running out…so I suppose you could say it's positive-positive-negative [stages in a feedback cycle] because it's being depleted, so it's the negative feedback thing'

Conclusions from the ASCEND project

Clearly what we have be able to do here is little more than outline the nature of the programme, and offer some first thoughts as to what was going on in the sessions, and in particular in and between, the minds of the delegates. Feedback from the young students was very positive (Taber & Riga, 2006): they generally enjoyed and felt they benefited from taking part in the programme. We certainly would not claim to have developed the ideal enrichment experience for gifted learners. For one thing, we do not claim *all* the delegates would generally be considered ‘gifted’: rather some would more likely be judged as ‘enthusiastic’ high attaining students. This was not an issue for us for three reasons. The lack of any objective definition of gifted in science (and so confidence in how these judgments are able to be taken in schools), and the desire to attract a ‘critical mass’ of delegates, meant that we invited schools to send their keen students that they considered would benefit from being challenged. More fundamentally, a strong belief that ability is not something firmly fixed (and that we do not have precise ways of measuring potential) encourages us to believe that some enthusiastic highly (but not currently exceptionally) achieving students may over time develop into exceptional scientists (se Chapter 1), and perhaps an experience such as ASCEND could act as a catalyst.

More significantly, our planning was based around two starting points: the notion of the nature of science as a suitable theme for the programme, and our interpretation of Gilbert’s (2002) characterisation of what giftedness in science might mean. ASCEND provided us with the opportunity to test out how to operationalise these ideas, and the limited discussion of our data presented here only offers a flavour of how delegates responded to the challenges we set them. A closer look at our evidence is needed to see how the ASCEND activities need to be fine-tuned to provide the right balance between scaffolding and challenging learners (Taber & Riga, 2006).

None-the-less, we do feel able to offer some important (if hardly novel) conclusions. As expected, the nature of science provided suitable opportunities to set up challenging tasks, and the choice of mainly group-based activities did facilitate both discussion and opportunities for individuals to show intellectual leadership. Groups were often able to organise themselves over extended periods of time, working on tasks without clear instructions, making use of various resource materials that were sometimes not of immediately obvious relevance.

Perhaps even more importantly, at a time when school science has become characterised as often a grand tour of superficial visits to the ‘key points’ that examiners look for in a wide range of topics, there are still youngsters of both genders who are prepared to give up their own time to be stretched to think like scientists (rather than just learn curriculum science). These youngsters are able to appreciate that being challenged to think about scientific questions for themselves is a positive experience (Taber & Riga, 2006).

Finally, we turn to one of the aspects of ASCEND that our sponsor, the Science Enhancement Programme, was especially interested in. ASCEND was a partnership project: the programme was designed and delivered at the University, but was organised in association with local schools. By definition, any one school would have a limited number of 'gifted' science students, and even less interested enough to seek an enrichment programme. We believe part of the success of ASCEND comes from holding the sessions outside of school, in an adult environment, with delegates from a number of schools. This allowed us to treat the delegates as young adults, with their own group identity, and they largely responded accordingly. The delegates enjoyed visiting the University, and enjoyed meeting like-minded individuals from other schools. Science is a collaborative activity, and we would like to think that ASCEND offers a model for how groups of schools might organise enrichment for their own students who would benefit from more challenge in science.