Learning to teach ideas and evidence in science: a study of school mentors and beginning teachers

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Abstract

This article reports on a small-scale evaluation of how beginning teachers undertaking a PGCE in secondary science worked collaboratively with their school based mentors to enhance practice in the use of ideas and evidence in science. Mentors and beginning teachers were introduced to the resources and teaching strategies previously developed at King's College London as part of the Nuffield funded IDEAS curriculum development project (Osborne, Erduran & Simon, 2004a). The judicious selection of resources and strategies from the IDEAS pack formed the basis of mentors' workshops, where mentors were encouraged to put into practice IDEAS and other argumentation activities and strategies. Collaborative work with their mentors enabled the BTs to initiate their teaching of ideas and evidence. They experienced both positive aspects and limitations when attempting IDEAS activities in their science classrooms.

Introduction

The preparation of new science teachers at the Institute of Education involves intensive training during a one-year course that includes both taught sessions and school-based mentoring in London schools. One aim of the course is to enable beginning teachers (BTs) to appreciate that science education should extend beyond the teaching of science content and include an emphasis on how evidence is used to construct explanations in science. BTs themselves have limited knowledge and understanding of the nature of science and its importance in science education. The course provides them with an introduction to scientific argument, opportunities where they examine the data and warrants that form the basis of scientific ideas and theories, and teaching strategies necessary to enhance argumentation skills of their students.

Previous research on argumentation in science has shown that scientific argument needs to be explicitly taught if students are to enhance their argumentation skills (Osborne, Erduran & Simon, 2004b). In a context where conceptual knowledge predominates, emphasising alternative aims for science teaching is notoriously difficult, even though studies show that exploring evidence to construct scientific arguments that challenge misconceptions can advance conceptual understanding (Hynd, Alvermann & Qian, 1997). Teaching strategies to promote discussion and argument have not been widely implemented in secondary science classrooms (Newton, Driver & Osborne, 1999), and many teachers find it difficult to reconcile the need to help students understand established scientific knowledge with time spent on debating alternative theories. Since the implementation of the Key Stage 3 national framework and research on dialogic teaching (Mortimer & Scott, 2003) there has been a growing awareness of the value of social learning, and a broadening of aims for science education is becoming more widely acceptable. With the changing emphasis now reflected in the new specifications for the Key Stage 4 science curriculum, beginning teachers are recognising the need for resources and strategies that will help them teach ideas and evidence in science.

Much of the taught part of the PGCE course has to focus on science subject knowledge and basic teaching strategies such as lesson planning and assessment. The time spent in college on ideas and evidence is minimal and very introductory. The main implementation of teaching for ideas and evidence needs to be supported within the partnership schools, as our BTs spend two thirds of their course on school placement. Their experience in this aspect of science teaching is hugely variant and very much 'luck of the draw'. Some partnership schools have well-established practice that incorporates a wide range of teaching aims and resources, others are supported through in-service training to develop appropriate teaching strategies and resources. Many, sadly, are so focused on 'delivery' of a content laden curriculum that our BTs are somewhat stifled in their endeavour to broaden their approach and practice how to teach students the nature of scientific argument. It is with this variability in mind that the project reported here was devised. The opportunity arose when the argumentation work at King's College London (involving one of the authors) was culminating in a series of articles and the IDEAS curriculum pack (Osborne et al 2004a) from which our project could draw. We decided to explore the possibility of launching the project through one of our mentor training days, when all science mentors in partnership schools were invited to attend. These days usually focus on issues that help mentors in their support and assessment of BTs, but most mentors are interested in on-going research and a session that involves communicating the outcomes of research is often provided. Such a time slot coincided with the initial funding of this project. IDEAS activities, classroom strategies and video material were presented on the training day and 10 teachers volunteered to take part in the project.

A professional development programme was designed to enable the teacher mentors and their BTs to appreciate that argumentation needs to be specifically and explicitly addressed, and to provide strategies and resources for them to develop their practice in teaching argumentation. Research was undertaken to evaluate the effectiveness of this programme in enhancing the experience of the BTs.

The Professional Development Programme

The programme was adapted from the IDEAS training pack which consists of a series of six half-day in-service training sessions, a booklet of 15 argumentation activities including worksheets, and a training video. The IDEAS video was made by filming the classrooms of six experienced teachers whilst they used some of the 15 activities. The six sessions focus on the essential features that were considered by the King's team to be important in helping teachers develop their expertise in this area. The sessions include:

Introducing argument and the importance of evidence
Managing Small Group Discussions
Teaching Argument

Resources and aims for argumentation
Evaluating Argument
Modelling Argument

Within the time scale of this project it was not possible to use all six in-service training sessions. A selection of workshop activity was made that would help inexperienced teachers to immediately practice argumentation using the activities, and provide opportunities for shared reflection and collaboration. An analysis of the ways in which teachers had facilitated argumentation in their classrooms (Simon et al 2003, 2006) has been influential in helping to make this selection. First, teachers need resources, that is, actual activities they can use or adapt easily. Second they need teaching strategies, in this case, how to organise and manage small group discussion, how to introduce, sustain and round off argument, and how to evaluate argument. Third, they need some input on the theoretical ideas underpinning the approach. Fourth, they need opportunities to share and reflect on their experience.

The mentors' training day provided an opportunity to show video material from the IDEAS pack and carry out activities that would be used with BTs during their college based training. The mentors were shown a sequence of video that provided an overview of an argumentation lesson, where the teacher used a concept cartoon to stimulate small group discussion. The teacher was seen emphasising the need to produce a reasoned argument and interacting with small groups to enhance pupils' use of evidence in making decisions. The mentors were introduced to strategies for organising small group discussion, including listening triads, pairs to fours and envoys. Once the group of volunteer mentors had been established, three afternoon workshops (two and a half hours each) took place at the Institute, each one a month apart. The following account summarises the contents of these workshops.

Workshop 1- mentors only

The focus of this workshop was on **providing resources and strategies**.
Mentors were made aware of the aims of the project:

- To encourage the teaching of Ideas and Evidence in partnership schools
- To assist the training of Beginning Teachers in the use of Ideas and Evidence

An overview of the series of workshops was given with the programme for the day. A rationale for the focus on argument in science was provided:

- Science is more complex than 'doing experiments and finding patterns'
- Science is a process of reasoned argument
- Scientific argument is the basis of belief in science and scientific ideas about the world
- Learning to think is learning to argue

The mentors then engaged in an activity which involved them identifying evidence that supports or refutes a claim, followed by an activity where they were asked to construct a reasoned argument using evidence provided. Video clips were included and the strategies for organising small group discussion reviewed. The mentors were then taken through the process of 'getting a lesson started', 'sustaining argumentation' and 'finishing a lesson', using video clips and materials from the IDEAS pack. The exemplar lesson from the pack is about classifying Euglena using evidence statements and has proved highly popular in helping produce similar formats for IDEAS lessons.

The mentors were then provided with a set of IDEAS resources and asked to plan and teach their own lesson on a topic of their choice before the second workshop. They had to prepare feedback for Workshop 2 about the strategies they adopted in the lesson.

Workshop 2- mentors only

The focus of this workshop was on **sharing feedback and introducing theory**. Mentors began the session by making presentations about their 'IDEAS' lessons. This aspect of the workshop model was critical, as the mentors were engaged in questioning and discussing the details of each other's lessons and were able to learn from each other's experiences. The session leader helped to summarise the main messages:

- Organise groups carefully and think about roles pupils take
- Keep activities simple and provide enough evidence for pupils to think about
- Plan the timing – when to move between small group work and whole class discussion
- Think about the teacher's role, what to say to help pupils construct arguments
- Be clear about the argumentation outcomes
- Think about ownership – to emphasise what pupils contribute is valued

The mentors were then introduced to a theoretical framework for analysing arguments using a session taken from the IDEAS pack. The session is based on the work that informed analysis of data on the original project (Osborne, Erduran & Simon 2004b, Erduran Simon & Osborne 2004, Simon, Erduran & Osborne, 2006) and enables participants to analyse arguments using a framework derived from Toulmin (1958). In its simplest form the analysis requires an identification of a claim, data that supports the claim, and a warrant that provides the link between the data and the claim. The analysis of arguments using this framework enabled teachers to appreciate the structure and complexity of arguments through identifying their components. They then observed a video clip of how one teacher communicated the nature of argument (based on the theory) in her introduction of argument with Year 8.

Finally mentors were provided with ideas for supporting written argument and given the critical task of training and preparing their BTs for the third workshop. It was clear at this stage that some mentors had adopted IDEAS lessons more readily than others, so it was important to **provide choice** in how to help their BTs. They were asked to:

- Plan another lesson that they could either:
    - Teach and be observed by their BT
    - Team teach with their BT
    - Discuss with the BT and provide support for her/him to teach

- Prepare a presentation in collaboration with the BT for next time, based on the above, using:
    - Poster
    - PowerPoint
    - Handout
    - Video

The task provided sufficient choice for mentors to engage at a level appropriate for both them and their BTs. Essentially, the mentors were to support their BTs in planning and teaching an argumentation lesson, and to help them prepare a presentation of their teaching approach in the third workshop, which was attended by seven BTs and mentors.

Workshop 3 – mentors and BTs

This workshop was devoted to presentations by the BTs, with support from their mentors, and a discussion of the presentations.

Research design and methods

The research focused on the way in which the programme that was devised enabled mentors and BTs to engage in the process of teaching argumentation and to reflect on the success of their practical experience. The programme was short, due to limits of time and funding, so the aim was to see whether such a programme could initiate changes in practice with a small group of mentors and BTs. Research data to evaluate the effectiveness of the programme were collected in the third workshop. The BTs and mentors completed a short open-ended questionnaire about their experience, and the teaching materials that had been developed were collected. Further evaluation of the programme was undertaken through the PGCE course evaluation at the end of the year.

Data analysis and results

All seven BTs attending the third workshop had taken part in or taught a lesson involving ideas and evidence. Some BTs produced original resources and fully annotated lesson plans. Three examples were disseminated on CD-ROM via the Science Enhancement Programme and are shown in Appendices 1 to 3. The teaching materials demonstrated the extent to which BTs had assimilated the aims of argumentation in their work. Two BTs used existing IDEAS activities, yet three designed new activities modelled on IDEAS resources and two devised a class debate based on socio-scientific issues. BTs' presentations included teaching materials, PowerPoint displays, posters and video clips of teaching episodes. During the presentations one mentor commented that her BT was able to put into practice the teaching of argumentation more effectively than herself. She had understood the messages of the programme and was able to train her BT sufficiently to implement them, but her own existing practice remained resistance to change.

Questionnaire responses from the third workshop were collated to highlight the main points experienced by the mentors and BTs. Both groups focused on similar positive aspects of student engagement, participation and confidence, on effective strategies for group work, and on the thinking and reasoning that were evident in the argumentation lessons. The mentors identified problems associated with providing sufficient evidence for students, sustaining student involvement in discussion and knowing when to tell the students the ‘exact’ science. BTs were more concerned with management issues and knowing how to interact with students to encourage their thinking, however, they too were concerned with students being confused about the science.

Comments from mentors

What went well

- When the groups were carefully selected and individuals were assigned roles, this encouraged involvement. Using the envoy system kept the argument going.
- Having a debate forced students to present ideas logically and clearly. Students listened critically to each other. The Head of drama provided ideas about how to get the students participating and also ideas for follow up.
- Pupil confidence was built. Pupils begin to question facts and the teacher more often now. Pupils tended to appreciate that their opinions were heard and valued.
- Students using evidence to develop theories or finding evidence to support theories. The benefit of pupils actually <u>thinking</u>.
- Students working in groups. Good group discussions to ascertain whether evidence supported or disproved argument.
- Pupils enjoyed it. Pupils thought about argument. Pupils appreciated the need for evidence.

What were the problems

- Knowing when and whether to tell the students the ‘correct’ science was a problem. The lesson needs to be carefully planned to ensure there is enough for the students to discuss.
- Language used in some prepared resources. Involving/engaging all pupils at the same time. Sometimes discussion was sidetracked leading to lack of concentration and learning.
- Grouping. The unknown factor of how pupils will respond to ‘argument’ and each other.
- Justifying reasons for how they used evidence.

Comments from BTs

What went well

- Students were actively involved and were keen to argue from their own understanding.
- Lots of interesting ideas to help teach concepts which could be seen as boring by the students. In small group discussion there is more opportunity for each student to have a chance to speak than in whole class discussion.
- Built confidence in some of the quietest students in the class. This led them to present their scientific knowledge to the discussion group. Loop game for plenary showed significant learning and encouraged students to bring forward their ideas about scientific questions.
- Discussion good. Idea that evidence is needed, even if poor evidence used.
- This particular activity has really built my confidence in using Ideas and Evidence. Prior to this I had been left concerned with the results of an earlier lesson.
- Most pupils involved and on task in lesson. Plenty of evidence to access – helping discussion.
- Pupils were engaged. Pupils thought about ideas they had not considered before. It built pupils' confidence.

What were the problems

- A high standard of class management is needed to ensure that all students are actively involved in discussion and argumentation – arguing points being essential rather than a group of students simply picking a statement and sticking with it without knowing why.
- How much should students know before teaching a lesson such as this? Perhaps it is important to highlight a few key principles prior to the activity, or will this diminish the point of the argument? How convinced are students by the end of the lesson? There was an element of confusion as to the 'exact science' at the end with some pupils.
- It's difficult not to give away the answers, I still need practice at playing devil's advocate to make some of the ideas work. Discussion can often lead to lack of concentration and encourages children to go off at a tangent and become less focused on the task. Circulation and observation of the groups keeps students on task. Argumentation can also be a problem with EAL classes so choice of instructive language is important.
- Some pupils just placed evidence cards wherever they wanted – not thinking about the statements. I needed more time at the end to get a class debate between groups.

The post-course evaluations showed that the BTs considered their involvement in this programme to be the most important learning experience of the PGCE course.

Conclusions and Implications

The short professional development programme, based on previous research and associated training materials, has enabled beginning teachers to initiate the practice of teaching ideas and evidence and experience some success in doing so. There is still a need to support the wider group of teacher mentors in this work, but the dissemination of the findings, through a website and SEP CD-ROM, is alerting our partnership schools to its importance. As our new teachers take up positions in London schools, their enthusiasm and experience is being valued and there are signs that the programme is have a sustained effect.

The limitations experienced by the BTs and mentors demonstrate the importance of discussing epistemological goals during professional development. Teachers often do not appreciate how the process of argumentation can help students engage with and understand the conceptual basis of what is under discussion. By thinking about alternative theories and the nature of evidence that supports them, students can be helped to appreciate not only the reasons for established scientific views but also why alternative views are not accepted. Commitment to these epistemological aims is necessary for teachers to implement ideas and evidence lessons successfully.

An implication of this research for future professional development programmes is that teachers need to have opportunities for interacting with others to challenge and stimulate their own thinking. Leithwood, Jantzi & Steinbach (1999) suggest that the work of teachers is accomplished through 'practical thinking', a type of thinking embedded in activity, and that this thinking can be enhanced through 'participation with others' who have more expertise – whether they are teachers or curriculum developers.

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References

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Appendix 1

A: Sedna, planet or not?

Developed by Greg Mann. Sc4, Earth and Beyond
Drayton Manor High School

Introduction
There are millions of objects in the universe, ranging from huge stars to dust particles. Somewhere between the two extremes are planets, but when is a planet a planet and when is a big lump of rock? Sedna is a recently discovered object at the rim of the solar system and there is a debate over whether Sedna is the tenth planet or just another space body. In th lesson pupils grapple with this question and use evidence to decide on Sedna's status.

Objective
Pupils will learn about the role of evidence in science by evaluating the evidence provided on the recently discovered Sedna, and deciding whether the evidence supports the idea tha is a planet, an asteroid or whether it is neither planet nor asteroid.

Outcomes
By the end of the lesson:

• All pupils will be able to use the evidence to construct arguments for Sedna being a planet or not.

• Most pupils will be able to evaluate the evidence and use it to support their view on Sedna's status.

• Some pupils will be able to describe the Kuiper Belt and Oort Cloud, which contain millions of space bodies that are not considered to be planets.

Notes for Teachers
In this lesson pupils will need to be given background information on the Kuiper Belt and Oort Cloud, as well as reference material about other planets in the solar system in order for compare their ideas of Sedna to what is known about other planets.

Teaching Sequence

• Begin the lesson with a presentation on Sedna, giving pupils the opportunity to ask questions. The presentation lasts approximately 10 minutes and should include a lot of visual ma order to motivate and engage pupils in the subject. Before moving on to the next activity, stress that the importance of the lesson is how the answer is decided from the evidence an the decision is justified.

• Pupils then work in groups of 3 or 4 to consider the first set of evidence cards and arrange them on the activity sheet (columns), to indicate what they think the evidence implies. O person in each group should record the ideas. The teacher can support the activity by talking through their ideas, asking them to justify their reasoning and debate their ideas with o another.

• Groups who finish quickly can be asked whether they have enough evidence to support their ideas, and can be given the second set of evidence cards to consider.

• The plenary with the whole class involves selecting two groups, one to argue for Sedna being a planet and the other to argue against. Each group is asked to report their discussion final decision, using the notes made by the recorder.

• Finally, reveal that Sedna is not classified as a planet, but that no definition of a planet exists. An important point to make to pupils is that they have been doing what scientists do, evaluating evidence, debating ideas and justifying claims.

Pupil activity sheet - Sedna: Planet or not?

Sedna Evidence Cards Set 1

Sedna has a highly elliptical orbit.	Sedna is sphere (shaped like a ball).
Sedna only reflects light; it does not emit light.	Sedna is smaller than Pluto.
Sedna is bigger than any of the asteroids that we know about.	Sedna could just about be part of the Oort Cloud.
Sedna does not have an official name, apart from '2003 VB12'.	Sedna was discovered recently.

Sedna has no moon.	Sedna is a red object, almost as red as Mars.
Sedna’s surface temperature is approximately -240°C.	Sedna never enters the Kuiper belt.

Sedna Evidence Cards Set 2

Comets have highly elliptical orbits, getting close to the Sun very rarely.	Mercury and Pluto are both less than 5,000km in diameter.
Sedna rotates very slowly, but it does rotate.	Mars has two moons that are believed to be captured comets.
Sedna orbits the sun taking 10,500 years to complete one orbit.	Sedna orbits the Sun at a slow rate.
Pluto is not considered to be a planet by some scientists.	Sedna has no atmosphere.
The closest that Sedna gets to the sun is 76AU (the Earth is 1AU from the sun).	Sedna has no close objects of significant size.
Sedna is larger than any object in the Kuiper Belt.	Asteroids are generally irregular shapes.

Pupil activity sheet - Sedna: Planet or not?

Evidence to suggest that Sedna is a planet	Evidence to suggest that Sedna is not a planet	Inconclusive evidence (supports neither or both ideas)

Appendix 2

B: How does an elastic band stretch?

Developed by Bob Rollins. Sc4, Forces
Twyford Church of England School

Introduction
This lesson uses a competing theories approach similar to that in the 'Heating Ice To Steam' activity (Activity 13) in Osborne, Erduran and Simon, (2004). In this case the contrasting are about the characteristics of the extension of an elastic band under increasing load. Pupils are presented with three contrasting graphs of extension against load as an elastic band stretched. They are asked to evaluate a list of evidence in terms of usefulness in deciding which graph represents the best description of the behaviour of the elastic band. They are t asked to choose the graph which they believe represents the best description of the behaviour, justifying their choice by reference to what they discern as the 'the most helpful' evide

Objectives
Pupils will learn:

• to argue about what evidence is most relevant to making a decision regarding validity of a graphical description;

• to manipulate textual evidence data into graphical representation, using the evidence to justify their arguments in selecting a particular graph.

Outcomes
By the end of the lesson, pupils will:

• be able to identify key evidence from a wide selection of true statements to help them arrive at a conclusion;

• be able to state that for an elastic band the force required to extend it (by unit distance) increases with increasing extension;

• have discussed the evidence and graphs, and arrived at an agreed conclusion;

• have engaged in reasoned dialogue with other groups with competing views, referring to evidence statements as the basis for argument.

Notes for Teachers
Pupils will need to have some appreciation of graphs in general. Familiarity with an extension/load graph of a simple system such as a spring within its elastic region would be helpful also be helpful to preface the activity with a starter exercise, for example, miming stretching an elastic band, or relating the activity to a real life problem. One such problem could be wanting to make a spring balance from elastic to measure how well shoes grip on a slippery floor. Such contexts are needed to ground the evidence statements in everyday experien

Teaching Sequence

• Distribute the activity resources in envelopes. Explain that the envelopes contain three graphs together with a set of statements and that pupils will need to work in groups to decid graph is correct and why (and why the other graphs are not correct). Underline that the importance of the lesson is how the answer is decided from the evidence and how the decisio justified. 'This is an exercise in thinking, communicating and working in groups – something that scientists have to be able to do'.

• Ask the groups to use the evidence statements to justify why they believe their chosen graph is the correct one. Hand out a blank A4 sheet of paper to each group and ask each gr stick what they believe is the correct graph on the paper, together with what they found to be the top five pieces of evidence.

• Suggest that a strategy could be to start by sorting evidence statements into 'helpful' and 'not helpful' piles before considering the 'helpful' pile in more detail to arrive at a decision.

• Once all of the groups have made their decision, engage groups in discussions with each other, either by pairing groups with opposing views or by facilitating a whole class discussi regarding which evidence was most helpful.

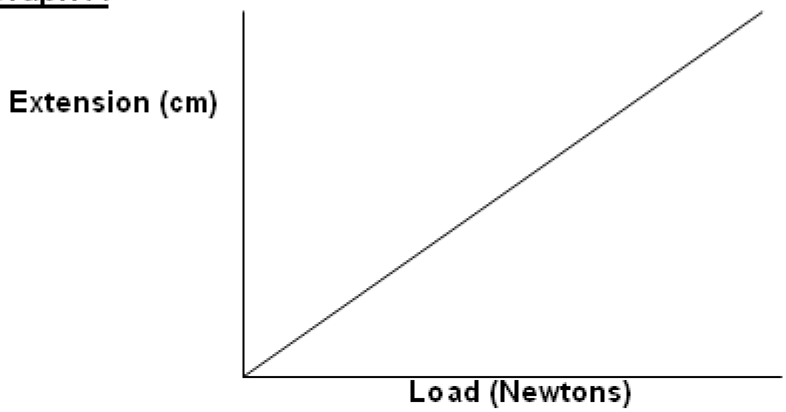
• When considering an evidence statement, encourage pupils to think whether/how the statement could be translated on to each of the graphs.

Reference
Osborne, J., Erduran, S., Simon, S., (2004) Ideas, Evidence & Argument in Science Resources Pack London: King's College, London.

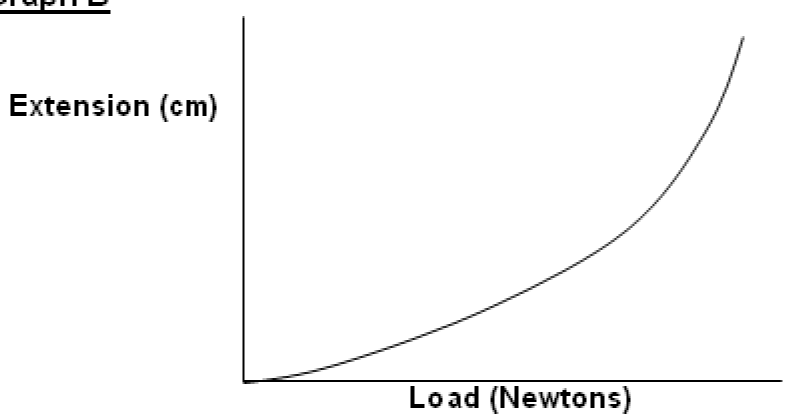
Pupil activity sheet: How does an elastic band stretch?

Graphs

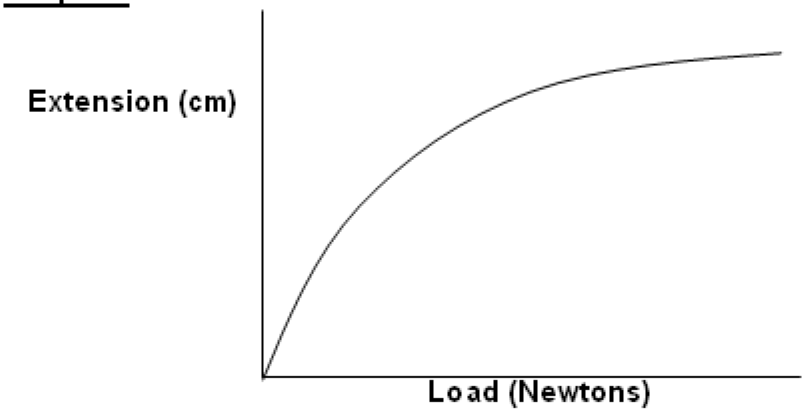
Graph A



Graph B



Graph C



Evidence Statements

Wire only extends by a very small amount if you try to stretch it.	If you stretch an elastic band too much, it will break.
When there is no force, the elastic band is not stretched at all.	As you increase the force on an elastic band, it gets longer.
'Extension' is the increase in length when a force stretches something.	When you release the elastic band, it returns to its original size.
Force makes the elastic band extend.	When you **start** to stretch an elastic band, it stretches easily.
When we stretch a spring a small amount, we get a straight-line graph.	Just before the elastic band breaks it feels hard, like wire.
If you stretch a spring too much, it bends out of shape and you can't fix it.	Wire is much stiffer than elastic.
	An elastic band gets hotter when you stretch it.

Appendix 3

C: Ideas about particles.

Developed by Sam Peyton. Sc3, Solids, Liquids and Gases.
Twyford Church of England School

Introduction
This lesson is based on a concept cartoon activity, in which students are presented with three theories and some evidence. Through discussion they have to select the theory that they believe and justify their decision by referring to the evidence. This lesson gives teachers the opportunity to elicit the students' ideas about particles, a concept that many find difficult and about which many hold misconceptions.

Objective
Pupils will learn about the role of evidence in science.
This lesson also provides the teacher with an opportunity to explore children's initial ideas about particles.

Learning Outcomes
By the end of the lesson, pupils will be able to:

- choose relevant evidence to support a statement;
- produce evidence to support a theory;
- produce evidence to disprove a counter argument;
- participate in discussion.

Teaching Sequence

- A starter activity is used to encourage and assess pupils' involvement. The pupils are presented with the statement; 'I am in a laboratory'. They are then asked, 'What evidence backs this up?' The teacher collates a list of evidence statements on the board, and asks the students which of the statements are relevant and which are not. The activity serves to model the idea of evaluating relevant evidence.

- The teacher presents a concept cartoon with evidence statements and asks the pupils to decide which character they agree with. They are then asked to select the evidence that backs up their choice. They can use the evidence statements provided or their own evidence.

- The teacher presents a scenario about condensation and gives the pupils three theories that can serve to explain the scenario. The correct theory is fairly obvious, but the task is for pupils to provide evidence why this theory is correct and the other theories are incorrect.

- In the plenary, the teacher provides a writing frame to help the pupils to document their choices and evidence.

Writing Frame: Theories and evidence

I believe __________'s theory.

I believe this theory because____

____

I don't believe ___________'s theory.

I don't believe this theory because____

____

I don't believe ___________'s theory.

I don't believe this theory because____

____

Ideas about particles

Who do you agree with?

Discuss with your partner who you agree with and why.
Select the evidence that backs up your choice.

- Helium Balloons float
- When you heat water it expands
- Steam rises
- Liquids become gases when they are heated
- Hot water is less dense than cold water
- Steam is very hot and can burn you
- When you pop a helium balloon it falls
- Clouds are droplets of water which float in the air

Not all the evidence will be useful.

If Jules held a mirror above the kettle as it boiled small water droplets would begin to appear. This is condensation.

How do the water droplets get there?

Theory 1	Theory 2	Theory 3
The mirror is upside down so the water in it runs to the outside and gathers on the shiny surface.	The steam hits the surface of the mirror and cools down and turns into a liquid.	When you are holding the mirror your hand gets hot and sweaty. The sweat drips down onto the mirror.

Which theory do you support?
When else do you see condensation?
Think of evidence to prove your theory.
Think of evidence to disprove the other theories.