Constructing Scientific Ideas

Implications for teaching and learning

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Adapted from Driver, R., Squires, A., Rushworth, P., & Wood-Robinson, V. (1994). *Making sense of secondary science.* London: Routledge.

> **"Many of the ideas which children have about science are developed from their early experiences with the natural world around them"**

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- Many of the ideas which children have about science are developed from their early experiences with the natural world around them, through play and interaction with others in their lives. Many of the conceptions which children have are developed from their sensory experiences. Children have ways of constructing events and phenomena which are coherent and fit in with their domain of experience but which may be very different from the scientific view.
- If students' understandings are to be changed towards those of accepted science then negotiation with authority, usually the teacher is necessary. Teaching from this perspective is also a learning process with the teacher working with the children's ideas in mind and responding in ways to address these experiences. Teachers need to be aware of students' existing ideas, of the learning goals and of any difference between the two when they are planning and implementing teaching.

A wide range of techniques can be used to explore students' thinking about the nature of science. These are described by Driver et al (1994) as including:

- Written statements: students are asked to write sentences including the words to learn.
- Posters: students are asked to make posters to answer a particular question.
- Card sort: cards showing examples of for e.g. melting and dissolving and given and sorted.
- Thought experiment: students presented with problems which they are asked to solve.
- Design and make: use materials to find a solution to a problem.
- Explain: students are to explain why they think certain phenomena occur.
- Checklist/ questionnaire: given pictures and asked which fit into particular categories.
- Predict and explain: ask questions, like will a potato float in water.
- Practical experiments: carry out an experiment to develop a theory.

Once a teacher has identified the nature of any differences between students' thinking and the scientific viewpoint then it becomes easier to plan activities which will support the intended learning.

An example from teaching and learning about rusting

A teacher planned to teach some students about rusting starting from what the students already knew and moving on towards particular learning goals. Two weeks prior to the actual lesson on rusting he gave each student in the class a bright, shiny nail. The students were told to take the nail home and put in a place where they thought it would go very rusty. He also asked the students to answer a number of questions such as:

Where did you put your nail ?
What is it about that place which made you put it there ?
Why do you think that will make the nail go rusty ?
What do you think rust is ?

After two weeks the students brought back their nails into the classroom and set up a display placing the nails in sequence from rusty to least rusty. The students then discussed what caused the nails to go rusty The teacher could then move on to what the ideas presented by students to the new concept of rusting as a chemical change (Driver et al, 1994, p. 11).

This example clearly illustrates that:

- It is important to teach science with careful planning in which continuity of curriculum is designed with progression in students' ideas. **Progression** is what happens to the learner when children develop their ideas. **Continuity** is organised by the teacher and describes the relationship between experiences, activities and ideas which students meet over a period of time, in a curriculum which is structured to support learning.
- In planning teaching it is useful for teachers to think in terms of helping students to make a number of small steps towards big ideas. However it is important to remember that these small steps might also present students with difficulties.

Illustration by Peter Farmer (1970)