It's the questions that count

How can science lessons provide opportunities for creative thinking, applied curiosity and fun? **John Senior** shares some of his ideas for intriguing enrichment activities

Science can appear to children to be about 'getting the right answers'. Their early experiences of the subject may well include facts already found out, and certainties already established. However, science progresses by the efforts of people who dare to think impossible things and to imagine solutions to problems that no one else has even noticed. The activities below may seem to invite a little chaos into the classroom, but when it comes to the exciting mental place where science, creativity and breakthroughs meet, this is no bad thing.

1. Five plus!

We experience the world using the five senses of touch, taste sight, smell and hearing. This activity is about 'new' senses that we can think of or discover.

The periodic table established in 1869 by Dmitry I Mendeleyev is a way of presenting all the elements so as to show their similarities and differences (www.webelements.com). In a similar way, ask your children to complete the 'Senses table' below.

- What other 'sense' can they imagine?
- What can the new sense do?
- Are some other new senses mixtures of one we already know about?
- What new sense will we need in the future?

2. Bio-indigestion

When we eat food we digest it, but while some foods are very easy to digest, others are more difficult and can sometimes cause indigestion and discomfort.

Invite your children to choose a dozen different items to bury in the ground. The task is to observe and measure the effects on the items by the earth they are buried in (how 'digestible' they are). They should decide how long the items should be left in the ground before they are examined. A site record should be made of all the buried items; if possible images of the state of the items before they are buried should be made and recorded. A weather diary should also be kept for the duration of the experiment. After an agreed time the items can be examined, photographed or drawn and wherever possible, reburied. This experiment can go on for weeks, months, days, or even years!

- How do your children explain the state of the buried objects?
- How far into the future do they think the items will exist, buried unchanged?
- What lessons can be learned from this experiment about how waste materials should be disposed of?
- What ideas can your children think of that would manage the re-use of items that will not biodegrade for a very long-time?
- What would an archaeologist find out about the world we live in if he/she found your buried items a hundred years from now?

'The scientist is not a person who gives the right answers; he's one who asks the right questions.'

Claude Lévi-Strauss, *The Raw and the Cooked*, 1964

3.Eureka!

Archimedes (circa 287-212 BC) was a mathematician and inventor of great importance to the development of scientific thought. He applied his mind to many practical problems, but perhaps the most famous thing that Archimedes is known for is how, having solved a difficult problem, he shouted 'Eureka!'

Ask your children to shout 'Eureka' all together as loud as they can. They may need one or two tries before they do so with gusto and enthusiasm. When they are happy with the shouting, ask them to think about a scientific problem that interests them, such as how to work out the weight of the Earth, or prevent the weakening of human muscles after long periods in outer space, or what to do with all the salt that is produced from making drinking water from sea water.

When they have chosen a problem that can be addressed by the application of scientific principles, ask them to write it down at the top of a sheet of paper and to write 'Eureka!' at the bottom. Their description of a solution can be written or drawn in the middle of the page.

However bizarre or unlikely their solutions, allow serious discussion as to the problem they found interesting and the solution they imagined.

(Resource: Archimedes and the Gold Crown Problem: http://library.thinkquest.org/4116/ History/stories.htm)

4. Electric hair!

When dry hair is brushed or combed, static electricity accumulates on the brush or comb and on the hair of the person's head. A charged brush or comb will pick up small pieces of paper about the size of confetti. How would you find out if different types of hair are more likely to hold a greater static electricity charge than others? What different characteristics of hair can you identify (colour, texture)? When you have devised an experiment or range of experiments to answer this question, carry out your experiments and test your hypothesis. When you have your results, identify the next range of questions that need answering. For example do

Senses table

Sight				Smell
		Hearing		
	Taste		Touch	

people with 'high static' hair suffer from headaches more than 'low static' haired people?

5. Looking for evidence

A good detective solves the crime using evidence. The detective looks for clues. Clues are another way of saying 'facts'. Forensic scientists provide factual, scientific evidence about things they find at the scene of the crime or on items and articles associated with the crime being investigated (such as fibres, hair or fingerprints).

Imagine you are going to have a forensic scientist follow you looking for clues about what you have been doing and where you have been for the last hour. What clues have you left behind? If your science lesson is in a room that others have used before your lesson, what clues would you look for or expect to find that would tell you who had been in the room before you and what they had been doing?

6. Cold light

We are used to the three main sources of light in our lives: sunlight, electric light and moon or star light. Another source of light is bioluminescence. This is the name given to light that is produced by living creatures, both large and very small. The angler fish, fireflies, some squids and millions of certain types of bacteria present in seawater produce and use bioluminescence in their daily life. This form of light, unlike electric lights, produces very little heat. The light is produced by chemicals reacting together; oxygen reacting with a substance called luciferin creates energy, which makes light. The brightness of the light can be adjusted by an animal reducing or increasing the amount of oxygen combining with luciferin. How could we use this source of light production to improve our daily lives? Would it be ethical to use living creatures to provide light for us?

7. Making your school invisible

The three essential primary colours are red, yellow and blue. By mixing red, yellow and blue in pairs we can produce secondary colours. Some colours cause us to become excited; some colours can calm and relax us. Colour can also be used for camouflage. Animals use camouflage to avoid being seen by predators and the armed forces use it to conceal military weapons such as tanks and aeroplanes, ships and buildings, and, of course soldiers. How would you use colour to camouflage a) you, b) your teacher or c) your school?
(Resource: Camouflage: http://en.wikipedia.org/wiki/Camouflage)

8. Laughitation

Precipitation is the term used for water released from the atmosphere. The water can be in different forms, such as snow, drizzle, rain or frost. One way of measuring precipitation that is in the form of rain is to make a rain gauge. Your children could make a rain gauge using a jar or bottle, a plastic funnel and a piece of plastic sheeting. The jar is buried in the ground so that the top is at ground level. The funnel is placed in the jar through a hole in the plastic sheet. Rainfall is collected in the funnel that in turn directs the water into the jar. Measurements of the amount of water in the jar are taken at regular intervals. In this simple way precipitation can be recorded and patterns of rainfall established from the records. However, a real challenge would be to measure 'laughitation', which could be the term used to measure the amount of laughter or smiling released into the classroom from children in a class. How could one measure the amount of laughter in a class over any given time? What scale could be used? What types of different laughing or levels of humour could be established and included in the general range of laughitation? When your children have considered the problem and designed some experiments, they should evaluate the effectiveness of those ideas and see if they can develop a working method of measuring laughitation levels. How could this new knowledge be applied in a way that would improve our lives?

Challenging questions for your children to consider:

- What are the ethical implications of the practical application of science?
- Can we be sure of anything, or are scientists just waiting for their theories to be disproved?
- How can we encourage ourselves to think about existing facts in new ways?

'The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.'

William Lawrence Bragg

9. Future present

Finding out about the history of scientific achievement is exciting. There are many resources that can provide 'milestones in science' timelines, which will give examples of past scientific discoveries. Ask your children to prepare and present a brief lecture on the achievements of science. The challenge being that they have to imagine they are living in the future and they are looking back at the most recent discoveries that have been made since our present time and the time in the future they choose to report from.

- What new discoveries do they expect will happen in the future?
- Why will the things they report on have happened?

The talk (not more than five minutes) could be illustrated and followed by a 'critical friend' group discussion about the ideas presented.
(Resource: Science timeline: http://scied.gsu.edu/Hassard/parrott_timeline.html)

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