Primary Science & Technology *Bulletin*

Ideas and inspiration for teachers in Primary Schools and S1/S2

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Festive Fizz

Treats for the bath are popular gifts and bath fizzers (sometimes called bath ballistics) are an engaging way to illustrate both changes in state and also chemical reactions.

Figure 1 *- Lovely Bubbly - a rose petal bath fizzer effervescing in water.*

The activity described here could help to support the delivery of the following *Curriculum for Excellence* Experiences and Outcomes [1]:

> Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges - *SCN 1-15a*.
>
> By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed - *SCN 2-15a*.
>
> I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made - *SCN 2-19a*.

Learners may already be familiar with the use of this kind of product at home and will be able to describe what happens once the bath fizzer is dropped into water [Figure 1] Words like "fizzy" and "bubbly" may be used to describe the resulting effervescence, the gas (in this case carbon dioxide) can be observed forming and escaping at the surface of the bath fizzer. A similar effervescent reaction may have been observed between acids, such as vinegar (ethanoic acid) and bicarbonate of soda (sodium hydrogencarbonate), perhaps when making a model volcano [2].

In the case of the bath fizzer, citric acid is used instead of vinegar. Citric acid - the same acid found in citrus fruits (unsurprisingly!) giving them their distinctive tangy taste - is available in a powdered form via reputable school suppliers [3, 4] or it can be ordered from your local chemist. Citric acid can irritate eyes so should be handled with care; advice can be sought from SSERC [5] or see 4th edition of ASE publication "Be Safe" [6]. Many vitamin C tablets and health salts also effervesce in contact with water and these could be used to illustrate the process, allowing learners to make observations at first hand. A shallow transparent plastic bowl is an ideal container in which to carry out the reaction, and to encourage learners to observe closely and describe what they see. Learners may not have thought about where the bubbles come from during effervescent reactions such as this one. Using a Millgate House Education *Concept Cartoon*® [7] (Figure 2) such as "Alka Seltzer" (Figure 3) may help to get learners thinking and talking about their ideas.

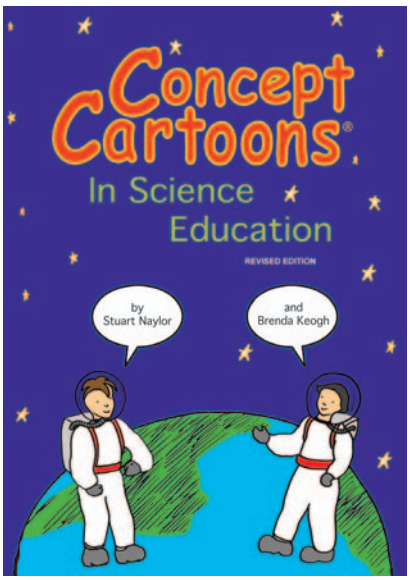

Figure 2 *- Concept Cartoons© in Science Education. (Image courtesy of Millgate House Education.)*

When the chemicals contained in the bath fizzer or effervescent vitamin C tablet come into contact with water the solid mixture of citric acid and bicarbonate of soda dissolves in the liquid water. Once a solution has been formed, a chemical reaction takes place and a gas, carbon dioxide, is released. It is apparent that this is not simple dissolving - the very obvious production of a gas indicates that there is a chemical reaction occurring too. Simple changes of state, such as from solid to liquid, are reversible but it should be clear that the changes occurring here cannot readily be reversed.

We can see that a new substance (carbon dioxide), one which was not present at the start of the reaction, is produced.

Note that some effervescent tablets contain paracetamol or asprin and should therefore not be used - contact SSERC [5] for advice or see 4th edition of ASE publication "Be Safe" [6].

The ingredients and equipment needed for one bath fizzer are (Figure 4):

- Citric acid 20 g.
- Bicarbonate of soda (sodium hydrogencarbonate) 20 g.
- Plant sprayer filled with water (sprayer should not have previously contained any harmful substances).
- Plastic bag.
- Teaspoon of dried herbs e.g. mint, lavender flowers, rose petals or lemon zest (optional) to add to the fizzer.
- Silicone muffin tray/mould or paper cake cases.
- Packaging materials - cellophane/tissue paper/ribbon.
- Label/gift tag.

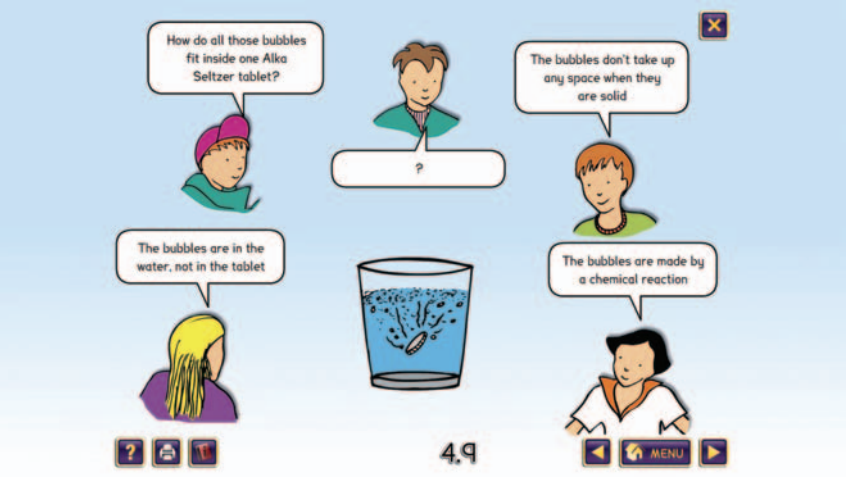

Figure 3 *- Concept Cartoons© 4.9 Alka Seltzer. (Image courtesy of Millgate House Education.)*

In our experience it is best to avoid using food colouring in the bath fizzer as it has the potential to stain baths. The plant materials mentioned are unlikely to cause any allergic reaction but should be omitted if in doubt. The pieces of plant materials used should be small enough to avoid clogging the drainage pipes leading from the bath.

How to make a bath fizzer

Place the citric acid, bicarbonate of soda and plant materials (if using) into the plastic bag and mix thoroughly (Figure 5).

Use the plant sprayer to spray a little water into the bag, onto the dry ingredients. It is difficult to be precise here, but you should spray a very small quantity of water at a time, using the finest mist

Figure 4 *- Ingredients and equipment for making bath fizzers.*

Figure 5 *- Dry ingredients in plastic bag ready for water spray.*

setting possible. The trick here is to get enough water to mould the fizzer into a shape without adding so much water that the reaction takes place in the bag instead of in the bath. Having added a little water, thoroughly mix the ingredients, there is no need to place hands in the bag, gently squeeze the mixture together from the outside. If necessary add a little more water, one squirt at a time, until the mixture starts to hold together.

Squeeze the mixture firmly until the ingredients have formed a ball. Place it into the muffin tray, mould or cake case, to dry out. Alternatively you may just wish to place it on a piece of paper while it dries.

Once the bath fizzer is dry (this typically takes an hour or two under normal classroom conditions) it can be packaged up attractively. Learners should then write an advice and instruction label.

Remember to include the following information:

- The bath fizzer should not be eaten.
- Not suitable for small children.
- List of all ingredients.
- When ready for use it should be placed into a bath where it will fizz!

Cross-curricular opportunities exist here for learners to weigh or measure out the ingredients, produce, then package the finished product, and write instructions ready for use. The cost per bath fizzer could also be calculated as part of an enterprise project. If there is a school garden then lavender, mint or rose petals could be collected and dried ready for inclusion in the bath fizzer. Scented plant material has been used for centuries to produce feelings of relaxation or invigoration.

Through carrying out practical activities and investigations, I can show how plants have benefited society - *SCN 2-04b*.

We found that a 1:1 ratio of citric acid to bicarbonate of soda produced the most impressive effervescence but other ratios could be tried. Learners could carry out an investigation into the proportions of citric acid/bicarbonate of soda that produce the "best" fizzer.

Learners often assume that all acids are poisonous, dangerous or highly corrosive and while this can be the case, other acids such as vinegar (ethanoic acid) and citric acid are frequently used as flavourings and preservatives. A close examination of a selection of food packaging and labels will demonstrate just how often acids are used in food production. Learners may already link acids with a sour taste e.g. citric acid in lemons, but clearly tasting chemicals in order to classify them is inappropriate - and potentially dangerous!

Other methods of classifying chemicals can be introduced. If learners have been investigating acids and bases they could make up solutions of citric acid and bicarbonate of soda and test these with red cabbage indicator [8, 9] or pH indicator papers [3, 4] before making the fizzer. They could then test the resultant solution once the fizzer has been dropped into a bowl of water.

References

[1] www.educationscotland.gov.uk/thecurriculum/howisthecurriculumorganised/experiencesandoutcomes/index.asp
[2] www.ehow.co.uk/about_4597237_papier-mache-volcanoes.html
[3] www.scichem.com/
[4] www.tts-group.co.uk/shops/tts/Range/Classroom-Essentials/b607f396-f85c-4771-ab7f-285ed0db09ce?pagesize=21&page=2
[5] Contact sts@sserc.org.uk
[6] www.ase.org.uk/bookshop
[7] www.millgatehouse.co.uk
[8] www.bbc.co.uk/learningzone/clips/acid-test/10854.html
[9] www.tes.co.uk/teaching-resource/Red-Cabbage-Indicator-Guidance-Sheet-3009560/

Colour changing stickers - using novel materials

Novel materials are widely used in everyday situations and many learners will be aware of some examples of their uses, for instance in colour changing mugs, putty, jewellery and liquid crystal thermometers (of the type often used in aquaria). *Thermochromic paper* [1] is another application of liquid crystal technology and can form the basis for a number of investigations into thermal energy transfer and insulation in the primary classroom - see SSERC Bulletin 49 [2].

A novel or smart material is best defined in terms of its behaviour as follows; *a novel material can sense some stimulus from its environment and react to it in a useful, reliable, reproducible and usually reversible manner.* A change in temperature often provides this environmental stimulus, although UV light can also trigger a change, as in the example of UV sensitive beads [1] [3].

Colour changing stickers that react to a change in temperature are a good example of a fun and engaging way to demonstrate the practical applications of a novel material. Learners may well be familiar with the use of peel-off paints to make window stickers and sun-catchers, as it is a popular craft activity [4]. In this activity, smart colour paints [1] are incorporated into regular peel-off paints. An image is created on acetate using the paints. When the image is peeled off, it forms a temperature-sensitive sticker. Each tube of smart colour paint provides enough material for many classes as only one drop of one colour is required. The stickers could have a number of practical uses, for example: on kettles to indicate they contain hot water or on cookers and mugs to indicate they are too hot for a child. Making the stickers also demonstrates knowledge of subtractive colour mixing.

Figure 1

All you need is:

- a clear acetate sheet or poly-pocket;
- black peel off paint - to outline the image (Figure 1);
- coloured peel off paints
- smart colours.

Decide what colour you would like your sticker to be when it is cold and what colour you would like the sticker to be when it is hot. The cold colour is made by mixing a drop of the smart colour into the peel-off paint. The smart colour becomes transparent when hot, thereby revealing the original colour of the peel-off paint. For example, if the cold colour is to be green then this can be made by mixing regular yellow peel-off paint with a drop of blue smart colour (Figures 2 and 3). Outline the image on the acetate sheet - we used black peel-off paint for our outline. Printed images can be traced through the acetate sheet and details filled in with the selected peel-off paints. You may wish to use the colour changing paints only on selected areas

Figure 2 *- to make a sticker that is green at room temperature mix yellow peel off paint with a drop of blue smart colour.*

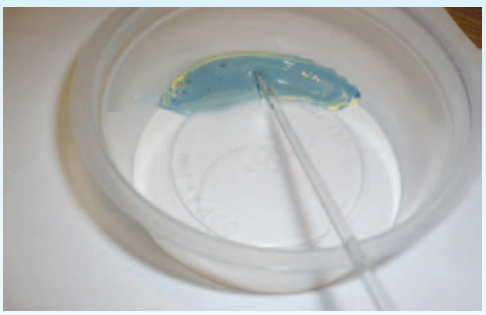

Figure 3 *- Ensure the colours are well mixed together to give a uniform colour.*

e.g. eyes or noses (Figure 4). Regular peel-off paints can be used for the other areas. Leave the finished sticker to dry for 24 hours, then carefully pick the sticker off the acetate sheet or poly-pocket. Place the sticker onto a surface that is likely to change temperature e.g. a south facing window, the sticker will stick to most smooth surfaces. Once a high enough temperature is reached then the blue smart colour will become transparent, revealing the original yellow colour (Figure 5 and 6).

Figure 4 *- You can make seasonal changes for example here is a reindeer that becomes Rudolf when hot. Smart colours have only been used on selected areas in this case.*

Figure 5 *- Fill the shape with the mixture and leave it to dry for at least 24 hours.*

Figure 6 *- Pick around the edge of the sticker and gently pull it off the acetate sheet. Place it on a warm surface and watch it change colour.*

This activity could be used to exemplify some of the main purposes of learning in the sciences as they are described in the document, Sciences: Principles and Practice [5] including:

- Recognise the impact the sciences make on their lives, the lives of others, the environment and on society.
- Recognise the role of creativity and inventiveness in the development of the sciences.

This 'novel materials' activity is very versatile and could be used to help meet the following Experiences and Outcomes [6].

I am learning how to manage risk, to protect myself and others, and to reduce the potential for harm when possible - HWB 0-16a/ HWB 1-16a/ HWB 2-16a/ HWB 3-16a/ HWB 4-16a.

Through exploring properties and sources of materials, I can choose appropriate materials to solve practical challenges - SCN 1-15a.

I can work with others to generate, discuss and develop imaginative ideas to create a product of the future - TCH 1-01b.

When exploring technologies in the world around me, I can use what I learn to help to design or improve my ideas or products - TCH 2-01a

From my studies of technologies in the world around me, I can begin to understand the relationship between key scientific principles and technological developments - TCH 3-01a.

Throughout my learning, I experiment with the use of colour to develop an awareness of the effects and impacts it can have - TCH 2-15b.

References

[1] www.mindsetsonline.co.uk/ (accessed 8th October 2012).
[2] www.sserc.org.uk search thermochromic sheet (accessed 8th October 2012).
[3] www.sserc.org.uk search UV beads & sun awareness (accessed 8th October 2012).
[4] www.millers-art.co.uk/ (accessed 8th October 2012) search window paints. The peel-off paint used was Marabu-fun - an 80 ml bottle makes up to 100 stickers, but clearly this will depend on the size of your sticker.
[5] www.educationscotland.gov.uk/Images/sciences_principles_practice_tcm4-540396.pdf (accessed 24th September 2012).
[6] www.educationscotland.gov.uk/learningteachingandassessment/curriculumareas/sciences/eandos/index.asp (accessed 8th October 2012).

Autumn activities – all change!

As the days shorten and nights start to draw in, pupils often begin to notice changes in the world around them.

Figure 1

As stated in Sciences: Principles and Practice [1], participating in the experiences and outcomes in the sciences will: *develop a curiosity and understanding of their environment and their place in the living, material and physical world.*

Autumn provides a fantastic opportunity to discuss the order of the seasons; the position of the Earth in space and our dynamic relationship with the Sun. Closer to home, however, the autumnal weather may provide learners with the chance to go outside and observe some of the more subtle changes at first hand.

Figure 2

The Woodland Trust [2] provides a Nature Detective website [3] with downloadable resources linked to the seasons. The vivid change in the colour of leaves is often one of the first indicators that summer is coming to an end. The drop in light intensity and day length triggers the re-absorption of the green pigment chlorophyll by deciduous plant species. Removal of the green pigment reveals yellow and orange pigments (e.g. carotenes) that were masked by the chlorophyll during spring and summer (Figure 1).

Toxins accumulated by the plant during the growing season are deposited within the leaves to be discarded when they are shed. These toxins (tannins) contribute to the often astonishing palette of colours visible at this time of year. Purple and red colours are attributed to anthocyanin pigments; these anti-oxidants also occur in many familiar fruits and berries, elderberries, blueberries etc. Many of these brightly coloured berries and fruits form in hedges and on trees at this time of year and can provide an excellent chance to explore the life-cycles of plants.

Seed pods, burrs and delicate seed heads mean that the amazing variety of seed dispersal techniques can be looked at in detail using local examples. The SAPS (Science and Plants for Schools) website provides an excellent source of ideas for engaging practical activities [4]. Autumn has certainly proven to be an inspirational season for many artists and poets including John Keats' often quoted line *"season of mist and mellow fruitfulness"* taken from his poem To Autumn, written in 1820. A number of festivals and celebrations, some dating back to pre-history, are also celebrated during this time of year.

Learners may already be aware of some animals preparing to hibernate or migrate. Hedgehogs will be building up reserves of fat by consuming large quantities of earthworms and other invertebrates. Shelters could be constructed to encourage a variety of wildlife [5]. Squirrels may be seen collecting and burying nuts and seeds in nearby parks and gardens, which they will access during the winter months. Some of the nuts and seeds that they bury will remain un-eaten, assisting in the dispersal of the plant involved. This process can be demonstrated with simple sultana hiding game [6]. Native and migrant birds can be observed visiting feeding stations more regularly as food becomes scarce elsewhere. Swallows and swifts are no longer swooping overhead. Many areas for inquiry present themselves - how does the observed behaviour, or indeed species, differ from that noticed during the previous seasons? What adaptations are made by organisms in the local environment to changes in their environment? Day length and temperature measurements, as well as readings from a school weather station, could be taken and links made to technology, mathematics and numeracy experiences and outcomes [7].

References

[1] www.educationscotland.gov.uk/Images/sciences_principles_practice_tcm4-540396.pdf (accessed 24th September 2012).
[2] www.woodlandtrust.org.uk (accessed 10th October 2012).
[3] www.naturedetectives.org.uk (accessed 10th October 2012).
[4] www.saps.org.uk (accessed 10th October 2012).
[5] www.rhs.org.uk search "making a bug hotel" (accessed 10th October 2012).
[6] www.saps.org.uk search "the sultana game"(accessed 10th October 2012).
[7] www.educationscotland.gov.uk/index.asp (accessed 10th October 2012).

Calling probationers and NQTs - an opportunity not to be missed!

'So well organised and chock full of immediately useful ideas '

The above quote is from a primary teacher who attended a SSERC two-part, residential course last session.

We will run a similar 2-part course, to be held in March and May 2013, that aims to support probationers and teachers in their first year of teaching who work in the Primary sector. The course will focus on some of the "big ideas" of science and will provide opportunities for participants to take part in a range of practical workshops and discussion activities which will transfer directly to the classroom. Between Parts 1 and 2, course participants will be asked to carry out a "Gap Task" back in their schools and then share what they have done with other course members on their return to Part 2.

Part 1 of the course will be held on Friday 1st and Saturday 2nd March 2013, with Part 2 on Monday May 13th 2013. The course will be held at SSERC, Dunfermline with overnight accommodation provided in a local hotel. All meals throughout the course are provided together with dinner, bed and breakfast for the night of Friday 1st March 2013.

The course is funded through Project ENTHUSE. Local Authority schools and FE colleges will be entitled to receive an ENTHUSE Award of £600 per delegate upon completion of this 2-part course. The course fee is £450 to include meals, accommodation and course materials. The ENTHUSE Award is administered through the National Science Learning Centre.

Only 20 places are available, so make early application to join us for the course!

To view the programme and book on-line go to:
www.sserc.org.uk/index.php/cpd-sserc/probationers/2872-biology-to-support-cfe-1st-3rd-november-2015

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