Science & Technology Equipment News

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For Primary Schools and Teachers of S1/S2 courses

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"If you can't stand the . . ." – heat, temperature and thermometers

In the 5-14 guidelines[1] is a seemingly innocent, little knowledge and understanding requirement (aka "target") : "Distinguish between heat and temperature". Easy, peasy? Far from it, given that the pupils will come to this topic with all sorts of mental models of their own about heat and cold. Here we suggest a number of useful questions and some investigative work, which should assist to challenge children's preconceptions and help develop further understanding of what can be a tricky, and fairly abstract concept. As usual we've thrown in odd historical, technological and geographical references. This is in continuation of our vain, cross-curricular, quest for a 'joined-up' approach to science.

[1] Energy and Forces. Properties and uses of energy. Level D

What difference to our senses is there from a freshly made cup of hot chocolate and a chocolate ice-cream? Both taste much the same. One feels hot and the other feels cold. Are our senses determining the same thing and might that 'thing' be "heat"? Does ice-cream contain less heat than cocoa? In cold weather when we wrap ourselves in 'warm' clothing, is this to keep cold out or heat in? It would seem from observation that heat flows from a hot object to its cooler surroundings. Temperature is a measure of how hot an object is. For such measurement we can use a thermometer.

Around the end of the 16th century, both Gallileo and Sactorious investigated methods of measuring heat in air or liquids, both arriving at designs not unlike those of thermometers we use today, with a glass bulb and tube filled with water or alcohol. Early thermometers made an arbitrary measure of heat, the lowest mark on the scale would be the coldest day in winter and the highest mark the hottest day in summer. This meant that a thermometer made and marked in a town in Italy would not read the same degree of 'hotness' as one made in a town in Scotland.

It was left to Daniel Fahrenheit, a thermometer maker, to design an instrument that could be used anywhere in the world. Between 1707 and 1714, he developed designs for an alcohol-filled thermometer, with a three point scale. Zero was set as the freezing point of a salt/water mixture, 32° as the freezing point of water, and 96° body temperature (close but not quite right). In 1714 Fahrenheit did what no one had done before, he made a pair of thermometers that both gave the same readings. This was a great help to early chemists and wine producers. It made for lots of cheery alchemists. Later, Fahrenheit made mercury thermometers where he used the boiling point of water instead of the temperature of the human body, as a less arbitrary fixed point. A few years after, Anders Celsius introduced the Centigrade scale where the melting point of ice was 0° and the boiling point of water 100°. This is the scale we use today, but it is now named 'Celsius' after the inventor.

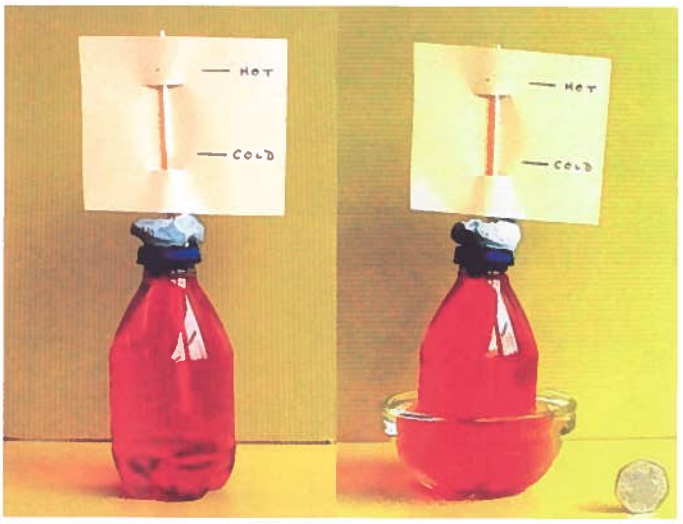

Figure 1 On left bottle at room temperature, on right in a bowl of warm water. The red colour is provided by food dye.

How hot is hot?

Pupils can make their own thermometers to show a rise or fall in temperature. They will need a small fizzy drinks bottle or drinks can, a clear straw, plasticine, food dye and a piece of card. Fill the container to the top with water, add enough food dye to give a noticeable colour. Insert the straw into plasticine then push into the neck of the container until the straw is about halfway between seal and bottom. This can be a messy operation, best to wear gloves and carry out the operation in a sink. Ensure a good seal around the neck with plasticine or blue tack. Press gently down on the plasticine 'till water rises above the plasticine. See Figure 1 above for how the card is attached, mark the water level on the card. Stand the bottle in a basin of warm water, the coloured water should rise up the straw, again mark the card. cont./over

Safety Note : If a proprietary thermometer is needed then mercury filled types are best avoided at this stage. The plastic, green, alcohol filled models are safer and cheaper - see "Be safe!" for more detail ...

When the container is removed from the basin, the temperature should drop to the original mark. This is a very crude thermometer. We found that the temperature rise was most rapid in a drinks can placed in hot water but the fizzy drink bottle appeared to work best as a crude thermometer. For more see:

www.bbc.co.uk/science/scienceshack/backcat/experiments/mathermometer.shtml

and

www.bbc.co.uk/history/historic_figures/fahrenheit_daniel_gabriel.shtml

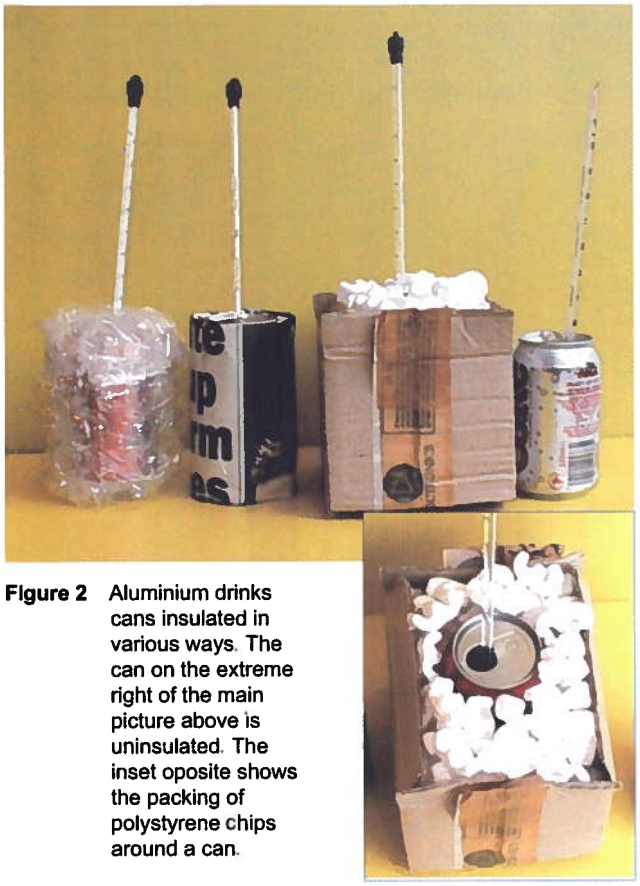

Figure 2 Aluminium drinks cans insulated in various ways. The can on the extreme right of the main picture above is uninsulated. The inset oposite shows the packing of polystyrene chips around a can.

Blowing hot and cold

How come we can blow on our cold hands to warm them up and blow on our soup or tea to cool them down? Some things feel cool to the touch e.g. metals, stone and ceramic tiles whilst others feel warm to the touch, wool, polystyrene and your own arm. Why is this?

If we wrap ourselves in a blanket to keep warm, will wrapping a container of hot water in a towel, bubble wrap, newspaper or polystyrene chips keep it warm? What will happen if we do the same with a container of ice?

These simple investigations on heat can be carried out using empty soft drink cans and alcohol filled thermometers. Remember the need for a 'fair test' – one of the cans should have no insulation.

Those who have access to Concept Cartoons will find that they have an excellent introduction to such an activity with the cartoon on the 'Snowman'. This activity brings out children's ideas on heat transfer and insulation etc through a discussion on a melting snowman. See figure 3, below, for an example from the web page at:

www.conceptcartoons.com

Figure 3 Sample cartoon from Concept Cartoons website.

Black or white?

We may speak of warm and cool colours. Children could be asked which colours they consider warm and which cool. Which is a warm colour - black or white? Paint one of the drinks cans black and one white and fill with water. Note the temperature of the water in each can then leave on a sunny window sill for fifteen minutes. Can the children guess in which one the water will become warmer?

Black surfaces absorb heat more readily than do white ones. In many Mediterranean countries, solar heating is used routinely for domestic hot water supplies. In Greece solar heating cylinders are as common-place as TV aerials.

Should we actually have a sunny day this coming Scottish summer, it is surprisingly easy to heat water, even with our solar radiation. A black bin liner filled with about a gallon of water and left in the sun, will heat up to around 40° C in a fairly short time. Similarly, a plastic hose full of cold water (especially a 'cheapo' black type) will quickly become warm enough to provide a DIY outdoor shower.

New resources from the BBSRC

"BBSRC" stands for the Biotechnology and Biological Sciences Research Council. This body has long supported secondary and higher education. It is now also offering a free service, with resources for schools, aimed at 5 to 12 year olds. We have looked at several of their free offerings. They are excellent, being easily read with pictures, cartoon characters and posters. The booklets and work sheets are copyright free for educational use.

For more information see the web site: www.bbsrc.ac.uk/schools or write to: BBSRC Liaison Service, Polaris House, North Star Avenue, Swindon, SN2 1UH, e-mail schools@bbsrc.ac.uk.

Improving Science 5-14- an update

You may have seen various references recently to the above national programme in august journals such as the Times Educational Supplement Scotland (TESS). If so, you might be forgiven for thinking that the programme was stalled or moribund (aka "deid"). This is not so, although we were saddened and disappointed that Bill Fleming had resigned his post as Project Manager at the turn of the year. He will be, indeed is, sorely missed.

SSERC, however, continues to work closely with the two national Development Officers who remain in post and a new implementation group should be up and running shortly. Now, in addition to looking after the ISE 5-14 website SSERC is about to finalise an agreement with the Scottish Executive Education Department (SEED) to facilitate those elements of the overall programme, which are relevant to practical activities and the continuing professional development of teachers.

Learning Teaching Scotland is, we understand, to manage other aspects of the overall programme such as development of formative assessment tools and homework activities.

In pursuing our own programmes of work, we intend collaborating closely with a wide range of partners including: the Scottish Local Authorities; Science Centres and their outreach programmes; other relevant visitor centres such as observatories and botanic gardens; the Scottish Universities; industry and commerce; research centres and government bodies, the major science education trusts and others. Currently we are looking at a number of proposals and models for the provision of CPD for teachers through practical activities. Ideally, we should like to see up to four centres of activity in various locations across Scotland and are working towards assisting with the setting up of at least two such centres in early course.

Useful Primary Science resources on CD ROM and the web

While the Scottish CPD project for 5-14 science gets underway, there are a number of potential sources of support and resources for use on a 'self-help' basis. Here we briefly review three such sources.

ASE SY Primary CD ROM

Published by ASE in 2002 under the auspices of Science Year and with support from ICI and NESTA (National Endowment for Science, Technology and the Arts) this was distributed to most schools throughout the UK. If it passed you by at the time, it's worth hunting down. It has seven major sections:

"About science; Managing Science; ICT; Living Things; Materials, Physical Processes and Promoting & Enhancing Science".

Although many of the references are to English curricula, and use QCA (Qualifications and Curriculum Authority) terminology, much of this material is relevant also to science within Environmental Studies 5-14. The CD is now also available online. If you missed out first time round then see:

http://www.sycd.co.uk/primary/index.htm

Figure 1 Opening or home page of the ASE Science Year Primary CD ROM

Astra Zeneca Science Teaching Trust

This site is an excellent source of information for primary science (see Figure 2 for a screenshot of the home page). The site can be found at:

www.azteachscience.co.uk

It's also a source of "Professional Development Units" (PDUs). These are accessible either online or by requesting a copy of the "Subject Leader's Professional Development Materials CD ROM".

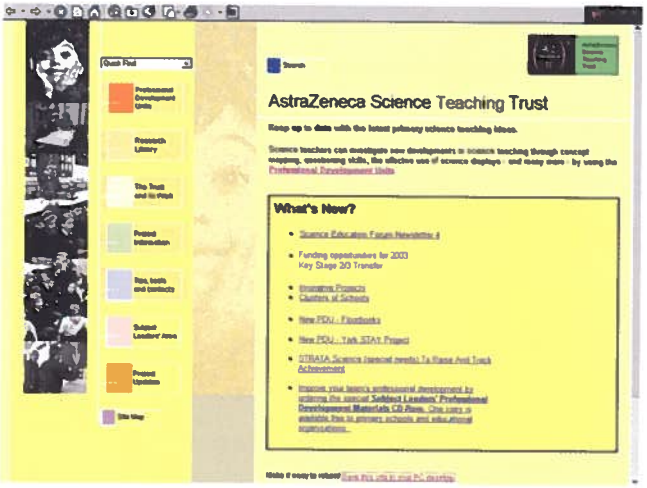

Figure 2 Opening or home page of the Astra Zeneca Science Teaching Trust site.

ICI Education site

ICI's educational site is another source of potentially useful materials and also of links to partner organisations such as 'SCIcentre' the "National (sic) Centre for Initial Teacher Training in Primary School Science". See:

www.ici.com/ici_schools/

Components & Materials

Item	Description	Price
593	Miniature motor, 1.5V to 3V, 2mm dia. shaft	30p
614	Miniature motor, 3V to 6V, 2mm dia. shaft. Both motors above can be used for project work but they run at fairly high speeds, some gearing will be required. See worm/gear, item 811.	45p
621	Miniature motor, 1.5V to 3V, now with 8 tooth pinion. The open body of this motor makes it ideal for showing how such a motor is constructed	25p
798	Pack of 24 gears, 6 each of 12, 20, 30 or 40 teeth, dia.15, 22, 32 and 40 mm. 12 tooth gear fits motor shaft and 40 tooth gear push fits in cotton reel	£2.00
799	Pack of 24 cams, 6 of each of 4 shapes	£1.00
800	Pack of 100 wheels, 39 mm dia., assorted colours, 3 mm axle hole	£5.25
811	Worm and gear, 34 to 1 speed reduction	35p
817	Axles 3 mm dia., nickel plated, round ends, push fit on SSERC plastic wheels, gears and pulleys: 70 mm long, per pack of 4	40p
818	As above but 95 mm long, pack of 4	40p
819	As above but 12 mm long, pack of 4	40p
820	Worms to fit 2 mm electric motor shaft, pack of 5	£1.00
821	Reducers 3mm to 2mm enables gears, pulleys and wheels, to be fitted to motor shaft, per 5	25p
867	Reducers, 4 mm to 2mm, as above, per 5	25p
868	Reducers, 4 mm to 3 mm, as above, per 5	25p
710	Sonic switch.Clap your hands, the motor starts, clap again the motor reverses and on the third clap the motor stops. Needs 4 AA cells.	85p
723	Microswitch miniature, lever operated	40p
822	Plastic toggle switch, low voltage	40p
688	Crocodile clips, red, miniature, insulated	5p
759	As above, but black.	5p
788	Crocodile leads, assorted colours, insulated croc. clips at ends,36 cm long. Pack of 10	£1.35
835	2 x AA Cell ('battery') holder	15p
845	2 x C Cell ('battery') holder	20p
729	Battery connector, PP3 type, snap-on press-stud, suitable for Items 835 and 845	5p

Item	Description	Price
789	MES (miniature Edison screw) bulbs 3.5 V	10p
691	MES battenholders for above.	20p
866	Lens end lamps, 1.2 V MES. Ideal for use where a narrow, concentrated beam of light is needed. Bargain pack of 100	£3.50
508	LED (light emitting diode) 3 mm, red, per 10	50p
761	LED 3 mm, yellow, per 10	60p
762	LED 3 mm green, per 10	60p
790	3V buzzer (works with solar cell see Item 838)	55p
846	Sound module with 'melody' chip	£1.00
838	Solar cell, 100 x 60 mm, 3.75 V per cell, max.	£2.10
839	Solar motor, body 25 dia.12 mm long with shaft 2 mm dia 6 mm long	£1.70
840	Solar pack : one of each solar cell, solar motor propeller (801), and 3 V buzzer - with notes.	£3.75
836	Motor mounts, plastic, push-fit with self adhesive base pad for SSERC motors 593 & 614, 10pk	£2.35
801	Propeller, 3 blade, to fit 2 mm shaft. Blade 62 mm long	35p
792	Propeller kit with hub and blades for ten 3 or 2 bladed propellers	£3.50
794	Cotton reels (for making buggies, rubber powered tanks etc.) pack of 20*.	75p
796	Pack of 20 pulleys, 5 of each of 10, 20, 30 and 40 mm diameters.	£2.50
837	Ring magnet, 40 mm o.d., 22 mm i.d.	35p
815	Ceramic square magnet, 19 x 19 x 5 mm	15p
823	Ceramic magnets, poles at ends, 10 x 6 x 22mm	12p
824	Ceramic magnets, poles on face - SOLD OUT	
861	Bimetallic strip, 10 cm length	30p
882	Quartz clock movement, dimensions 56x53x17mm, with wall hanging bracket, Suitable for dial thickness up to 10mm. Includes plastic hands suitable for dial diameter to 200mm. Requires an AA battery. See CD Clocks, Newsletter 18.	£1.75
884	Onager kit. Wood cut to length etc.	£2.00
885	Chariot kit. Templates and parts.	£2.00

*Item 794 **Not** 200 as previously stated in error

A fully illustrated version of this list is posted on the SSERC site at:

http://www.sserc.org.uk/Members/Primary/Surplus/body.htm

This Newsletter and a number of other issues can also to be found in web page format on the Improving Science Education 5-14 website at:

www.ise5-14.org.uk

Prices do not include VAT which will be charged at the ruling standard rate. Cash with order only when the total value is less than £5 and please add £1 for carriage solely to these small orders (except where an inclusive price is indicated eg kits, etc). For orders totalling more than £5 please do not send payment etc but await delivery and then pay on our advice note or invoice.

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