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The Nature of Science: Concept Cartoons

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Concept cartoons

Teachers' notes

Objectives

- To promote class or group discussions about difficult scientific concepts.
- To introduce questions that students can investigate.
- To help understanding of experimental results and observations.

Outline

Two examples of concept cartoons have been included in this material

- Brewing up
- Flickering candles.

Teaching topics

This material is aimed at 11–14 year olds and could be included in the following topics

- Combustion
- Burning fuels.

Background information

Using concept cartoons to introduce investigations helps students to think through the scientific ideas associated with the question.

In each concept cartoon a scientific question is asked. The rest of the concept cartoon presents the student with alternative viewpoints or different 'theories' on scientific concepts that relate to the question that has been asked. The concept cartoons can be designed to have more than one correct idea. During the discussion all ideas presented on the concept cartoon are given equal weighting, thus promoting an ideal opportunity to discuss scientific concepts within a safe environment. Students should then feel more confident to put forward their own ideas.

Concept cartoons can be used to promote group discussion in other situations such as after demonstrating an experiment (*eg* Brewing up) or after the students have carried out their own experiment and are trying to make sense of their observations or data (*eg* Flickering candles).

Sources of information

There are further examples of concept cartoon in the following books;

B. Keogh and S. Naylor, *Starting Points for Science*, Cheshire; Millgate House Publishers, 1997.

S. Naylor and B. Keogh, *Concept Cartoons in Science Education*, Cheshire; Millgate House Publishers, 2000.

The CONCISE project provides training for teachers in the use of concept cartoons and details may be obtained from B. Keogh and S. Naylor, Institute of Education, Manchester Metropolitan University.

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Teaching tips

Using concept cartoons as investigation starters

- Present the concept cartoon to the class either by using photocopies or an OHP.
- Read out the question to the class.
- Go through all the possible answers given on the sheet.
- Ask if anyone has any other suggestions.
- Ask the class which they think is correct. If possible they should try and give a reason. At this stage accept all answers.
- Tell the class that they are now going to plan an investigation to see if their hypothesis is correct.
- Depending on the class and the amount of planning they have done before, structure the rest of the lesson as a normal planning lesson.

Using concept cartoons to promote group discussions

- Carry out a teacher demonstration or class experiment.
- Give each group a copy of the concept cartoon and ask them to discuss the ideas.
- They then write a conclusion to their experiment and where possible they must give reasons to support their answers.

Brewing up

The concept

When heating a container of water on a gas stove, students will initially observe water droplets on the cold side of the container. As the container heats up, the water droplets will disappear.

When hydrocarbons are burnt, water is one of the products. The water condenses out on the cold surface, but evaporates as the surface is heated. One of the common misconceptions held is that water vapour already present in the air condenses out.

The investigation

Students should carry out an investigation, making sure that the sides of the beaker are dry at the start to see if any water appears on the side of the beaker during the heating of water. They should plan to carry out a fair test, with the source of heat being the variable. You will need to have a range of energy sources available.

Students should only observe the water droplets when hydrocarbon based fuels are used, and not when electric heaters are used. This should allow them to work out the answer.

Further investigations could be carried out to verify that the liquid really was water, by testing it with anhydrous copper sulfate or cobalt chloride paper. The more alert student will observe that after a while the liquid disappears. An investigation could be carried out to determine the temperature at which this starts to occur.

As this in an open-ended investigation the following list is a guide for possible resources and not meant to be a definitive list.

Resources (available for investigation)

- Bunsen burners
- Tripod
- Gauze
- Heat proof mat
- Electric hot plates
- Immersion heaters
- Camping gas burner
- Candles
- 250 cm^3 beaker
- 250 cm^3 metal or ceramic container (to heat the water in)
- 100 cm^3, 150 cm^3, 200 cm^3 measuring cylinders
- Thermometer
- Anhydrous copper sulfate
- Cobalt chloride paper
- Tongs
- Safety glasses
- Student worksheet
  – Brewing up

Flickering candles

The concept

Students are often puzzled and confused about what happens when a candle burns. It is quite common for the student to believe that only the wick burns and not the candle! The supporting evidence for this may come from observing liquid wax running down the side of the candle. This idea presents more room for confusion, as they try to work out how the wax became liquid. Was it by melting or dissolving? The other area of confusion lies in the distinction between evaporation and burning. Many students will fail to realise that, in the case of wax, the combustion products are gaseous.

The investigation

There is plenty of scope for investigating the combustion process. For example, students could carry out tests to distinguish between melting and dissolving or determine whether there was a mass change during burning. To distinguish between burning and evaporation students could collect the gases and test them by cooling then down to see if they condense out. If time permits, further tests for carbon dioxide and water should be carried out.

As this in an open-ended investigation the following list is a guide for possible resources and not meant to be a definitive list.

Resources (available for investigation)

- Candles
- Petri dishes

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- 250 cm^3 beakers or water containers
- 100 cm^3, 150 cm^3, 200 cm^3 measuring cylinders
- Balances
- Lime water
- Anhydrous copper sulfate
- Anhydrous cobalt chloride paper
- Droppers
- Tongs
- Safety glasses
- Student worksheet
  – Flickering candles

Timing

This really depends on how you want to use the rest of the lesson. 15 minutes should be allowed for the discussion.

A lesson and homework should be enough time to plan the investigation. Further lesson time would be needed to carry out the investigation and analyse the results.

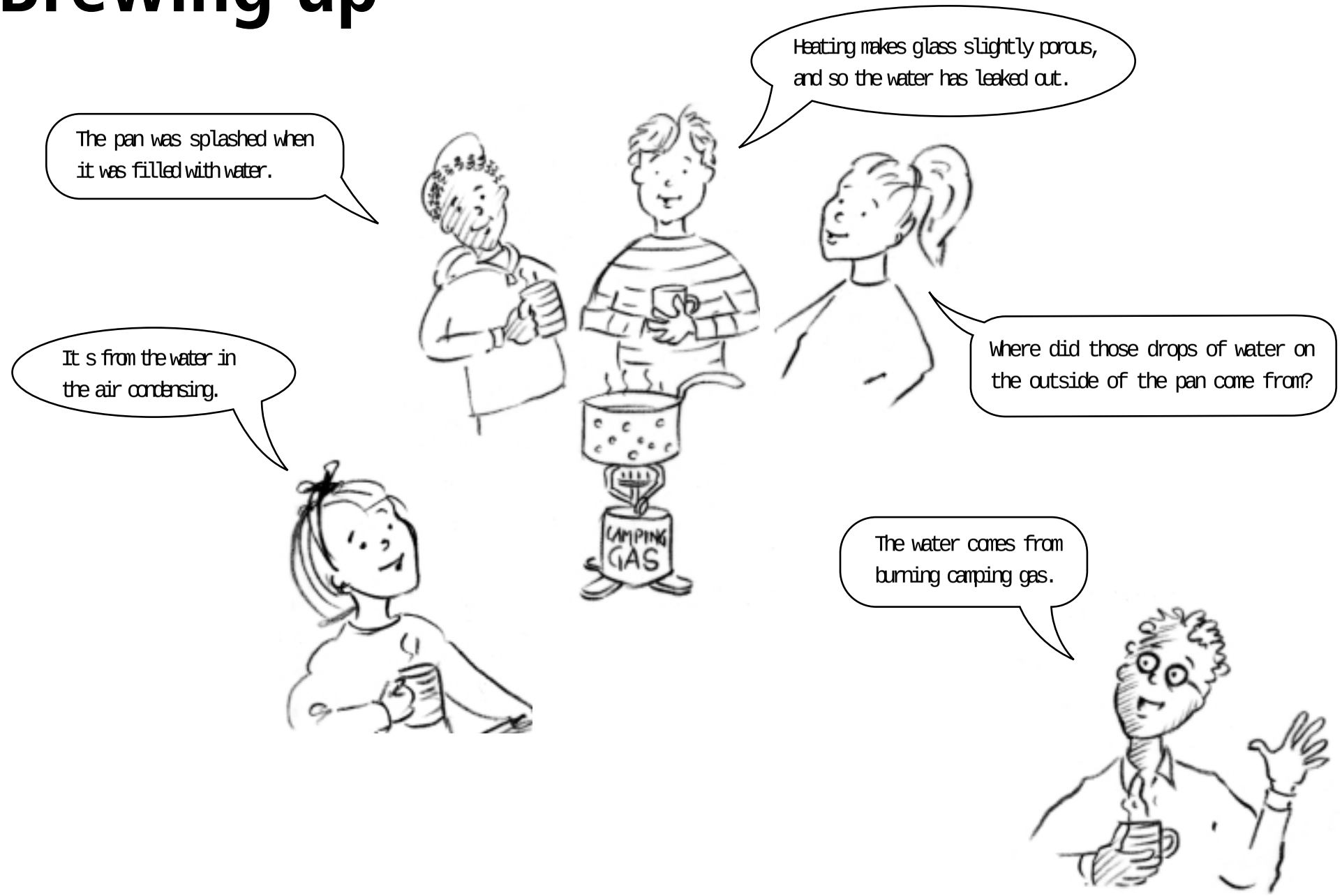
If the concept cartoon is being used for an assessment at the end of a topic, then it should only take a few minutes for the students to work out the correct answer.

Adapting resources

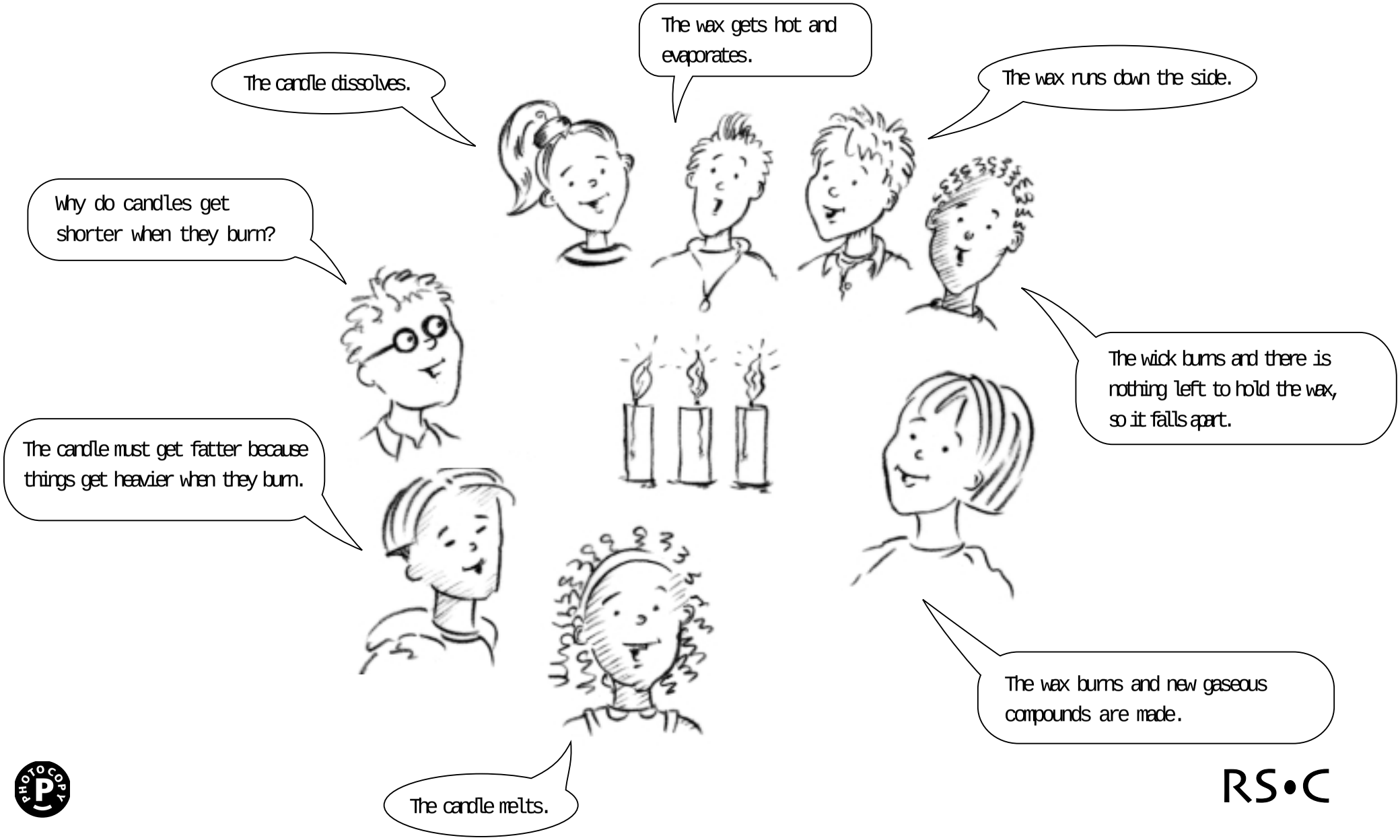
To enable less able students to plan their own investigations, the following sheets could be produced:

- A list of experiments that the student could match up to the statements in the cartoon. They could then choose which experiment they were going to carry out.
- A list of prompt questions for the student to answer *eg* What equipment will I need? How can I make this a fair test?

Brewing up



Flickering candles



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