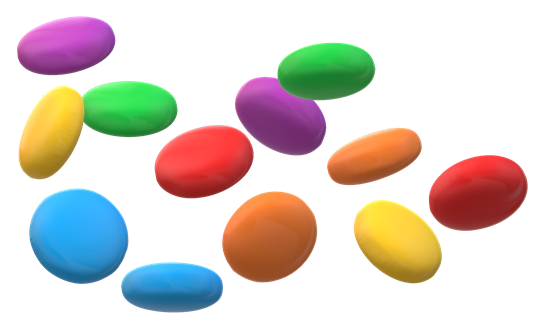
**Energy v temperature**

This model uses *Smarties* to represent energy.

Each one has a Joule of energy.



**Activity 1**

1. Your teacher divides the class into two groups. One group is twice as big as the other.
2. Each group is given some Smarties to share out equally between themselves.

**To answer**

* How many Smarties has each person got?
* Which group has the higher temperature?
* Which group has the higher energy?

*How do you explain your answers?*

**Activity 2**

1. Each person takes two Smarties (put all the other ones back)
2. Each group adds up how many Smarties it now has.

**To answer**

* Which group has got the most energy?
* Which group has the higher temperature?

*How do you explain your answers?*

*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.4: Thermal store of energy*

|  |
| --- |
| **Response activity** |
| **Energy v temperature** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Each different material will have more energy in its thermal store if either its temperature or mass is increased |
| Observable learning outcome: | Explain the difference between energy (in a thermal store) and temperature |
| Activity type: | Challenge to thinking - modelling |
| Key words: | Thermal store of energy, temperature |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Three bears
* Diagnostic question: Hot fill

**What does the research say?**

Most students correctly understand that raising the temperature of a particular object also increases the energy in its thermal store. However, fewer than half of 11- to 14-year-olds understand that, when they are at the same temperature, a larger mass of a material contains more energy in its thermal store than a smaller mass of the same material. It is common for students to think that an object at a higher temperature has more energy in its thermal store than an object at a lower temperature, even when the hotter object has a much smaller mass. (Gonen and Kocakaya, 2010)

It has been found that about a quarter of students aged 10-16 do not distinguish between temperature and energy in a thermal store. They often have the misunderstanding that temperature is a means of measuring energy in a thermal store. (Driver et al., 1994; Tiberghien, 1983)

**Ways to use this activity**

This model gives you the opportunity to explore and extend your students’ understanding through a structured teacher led discussion.

Carefully selected questions could be used to examine what the students think will happen and to encourage them to explain their reasoning. Some useful questions might be:

* what does each student represent in this model? (a particle)
* what happens to a particle when it gains energy? (moves more)
* why does a larger volume of water take longer to boil in a kettle? (energy from the heating element is shared between a greater number of particles)

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’

**Equipment**

For the class:

* Smarties, or other small sweets sufficient for at least two per student.

**Technician notes**

Check allergy information on packets of sweets, and avoid those that contain allergens (even if they are not to be eaten).

For activity 1 the smarties need to be divided into two equal amounts. Each group is given the same number (same amount of energy).

**Health and safety**

Eating food in a lab should not be allowed.

If students are not in a lab and are to be allowed to eat the sweets at the end of the activity then appropriate hygiene rules need to be adhered to, for example all students should wash their hands before the start.

It may be sensible to have ‘spare’ Smarties to distribute directly to students afterwards.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

Activity 1

The students in the smaller group will each have more Smarties than the students in the larger group. This means the temperature of the smaller group is higher (temperature is a measure of the average energy in the kinetic store of each particle); the energy in the thermal store of each group is the same as each group has the same total number of Smarties.

Activity 2

The larger group has more energy as they have a higher total of Smarties. Both groups have the same temperature as each student has the same number (energy) as everyone else.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

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