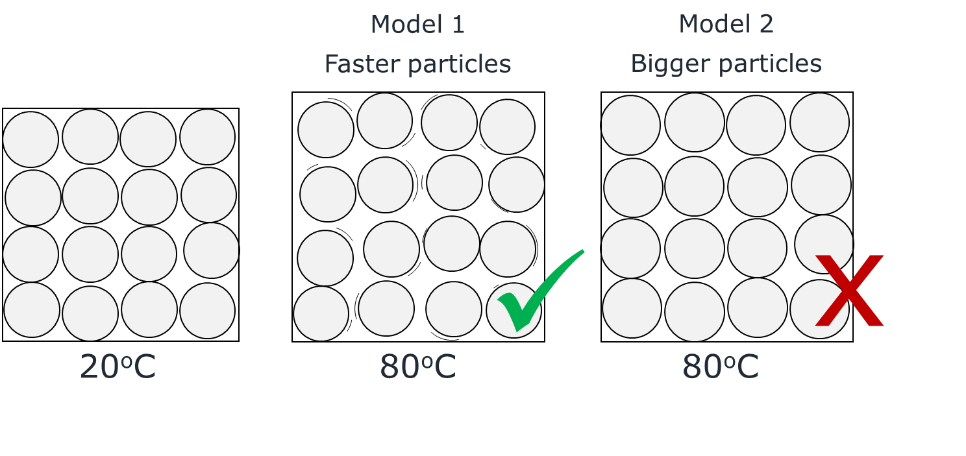
**Expansion model**

Heating a solid makes it expand.

The particles in the solid are too small to see.

How do we know what happens to the particles in a solid when it expands?



These statements help to explain the two models:

|  |  |
| --- | --- |
| Bigger particles are made of more stuff. | Heating a solid does not make it heavier. |
| Faster particles push each other apart. | Gaps between the particles are bigger. |
| Hotter air floats up. | Faster particles hit our skin harder and might damage it. |
| Bigger particles do not hit our skin harder. | Nothing has been added to the solid. |

**To answer**

1. Which statements help to explain why model 1 is correct?
2. Which statements help to explain why model 2 is wrong?
3. Model 1 is called the ‘**kinetic particle model**’.

The kinetic particle model states that particles move more quickly at a higher temperature.

Use this model to explain what happens to the particles in a solid when it expands.

Sort cards for BEST Response activity: PMA1.1 Expansion model

|  |  |
| --- | --- |
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Sort cards for BEST Response activity: PMA1.1 Expansion model

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*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.1: Temperature*

|  |
| --- |
| **Response activity** |
| **Expansion model** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | Temperature is a measure of the average speed at which the particles in a substance or material are moving |
| Observable learning outcome: | Describe the changes in particles of a substance or material when its temperature is changed  Explain the changes in volume of solids and liquids when their temperature is changed |
| Activity type: | Critique a representation |
| Key words: | Particle, vibrate, temperature, expand, contract |

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

* Diagnostic question: Pie tin particles
* Diagnostic question: A cup of tea

**What does the research say?**

An understanding of what happens to particles when they are heated is necessary in order to explain the mechanisms of heating, and to understand the difference between temperature and a thermal store of energy. Earlier ideas about the arrangement and movement of particles in solids, liquids and gases (BEST key concept: *CPS1.1: Particle model for the solid, liquid and gas states*) can be used to construct models in order to help develop students’ understanding of these things.

Johnson (1998) found research evidence showed that very few students have an appreciation of the intrinsic motion of particles. Many have difficulties with the idea that there is ‘nothing’ between particles. Others think of particles with the same properties as tiny pieces of the bulk material. This may lead to students thinking that particles expand when they are heated, in the same way that a substance does.

**Ways to use this activity**

Students should complete this activity in pairs or small groups, and the focus should be on the discussions. It is through the discussions that students can check their understanding and rehearse their explanations.

Philosophically science can be said to be a description of the ‘best model’ we have for the world. In this activity students should identify ways in which this particular model is a good representation of the real world, and ways in which it is not.

Students should work together to follow the instructions on either the worksheet or the PowerPoint. Giving each group one worksheet to complete between them is helpful for encouraging discussion, but each member should be able to report back to the class. Listening in to the conversations of each group will often give you insights into how your students are thinking.

Ending with the students completing the worksheet or questions from the PowerPoint individually, might help them to consolidate their learning.

*Differentiation*

You may choose to use simplified worksheets for some students, for example with gaps to fill in so they can focus on the science. In some situations it may be more appropriate for a teaching assistant to read and/or scribe for one or two students.

**Expected answers**

**Model 1 – explaining why it is the correct model**

Faster particles push each other apart, [so the] gaps between the particles are bigger.

Faster particles hit our skin harder and might damage it [which explains how we can get burnt].

**Model 2 – two arguments explaining why it is not correct**

Bigger particles are made of more stuff, [but] nothing has been added to the solid [and] heating a solid does not make it heavier. [In fact] hotter air floats up.

Bigger particles do not hit our skin harder [and] faster particles hit our skin harder and might damage it. [When we touch a hot object we can be burnt which suggests the particles are bashing into our skin.]

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Johnson, P. (1998). Progression in children's understanding of a 'basic' particle theory: a longitudinal study. *International Journal of Science Education,* 20(4)**,** 393-412.