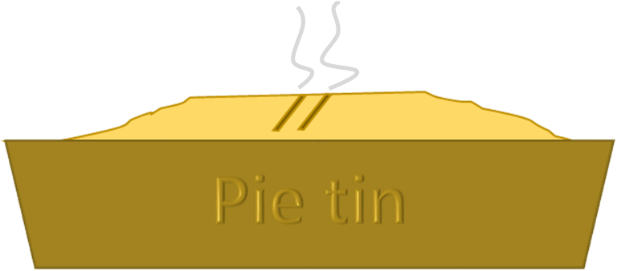
**Ouch!**

John has baked his fruit pie.

It is very hot.

When he takes it out of the oven he burns himself on the tin



Some students are talking about why they think the hot pie tin burnt John.

**Keira:** particles in the metal bash into John’s skin and damage it

**Lewis:** the tin is heating John’s hand

**Orla:** particles in the metal are vibrating very quickly

**Muhammad:** you can’t even see the particles with a microscope

**Nathan:** the temperature moves into John’s skin

**To answer**

1. Whose answers do you think explain how John’s hand was burnt?
2. Whose answers do you think are wrong?
3. Explain why John did not burn himself when he put the pie into the oven.

|  |  |
| --- | --- |
| Cards for PMA1.1  Ouch! | **Keira:** particles in the metal bash into John’s skin and damage it |
| **Lewis:** the tin is heating John’s hand | **Muhammad:** you can’t even see the particles with a microscope |
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*Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling > Key concept PMA1.1: Temperature*

|  |
| --- |
| **Response activity** |
| **Ouch!** |

**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 |
| Activity type: | Talking heads |
| Key words: | Particle, vibrate, temperature |

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

* Diagnostic question: Pie tin particles

**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. The statements are also provided as cut-out cards for students to physically organise.

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.

If there is disagreement when you take feedback, a good way to progress might be through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

The quality of the discussions can be improved with a careful selection of groups; or by allocating specific roles to students in the each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

1. Kiera and Orla describe the mechanism that explains how John’s hand was burnt.

(Lewis and Muhammad are right but do not explain why John now has a burnt hand. Some students may expand on Lewis’ answer and explain that heating John’s hand causes the particles in it to vibrate so much that they cause damage.)

1. Nathan is wrong because temperature is not a substance. Nathan may be confusing temperature with energy that transfers from the tin to the hand.
2. The pie tin was at room temperature and the particles were not vibrating quickly enough to be able to cause damage to John’s 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.