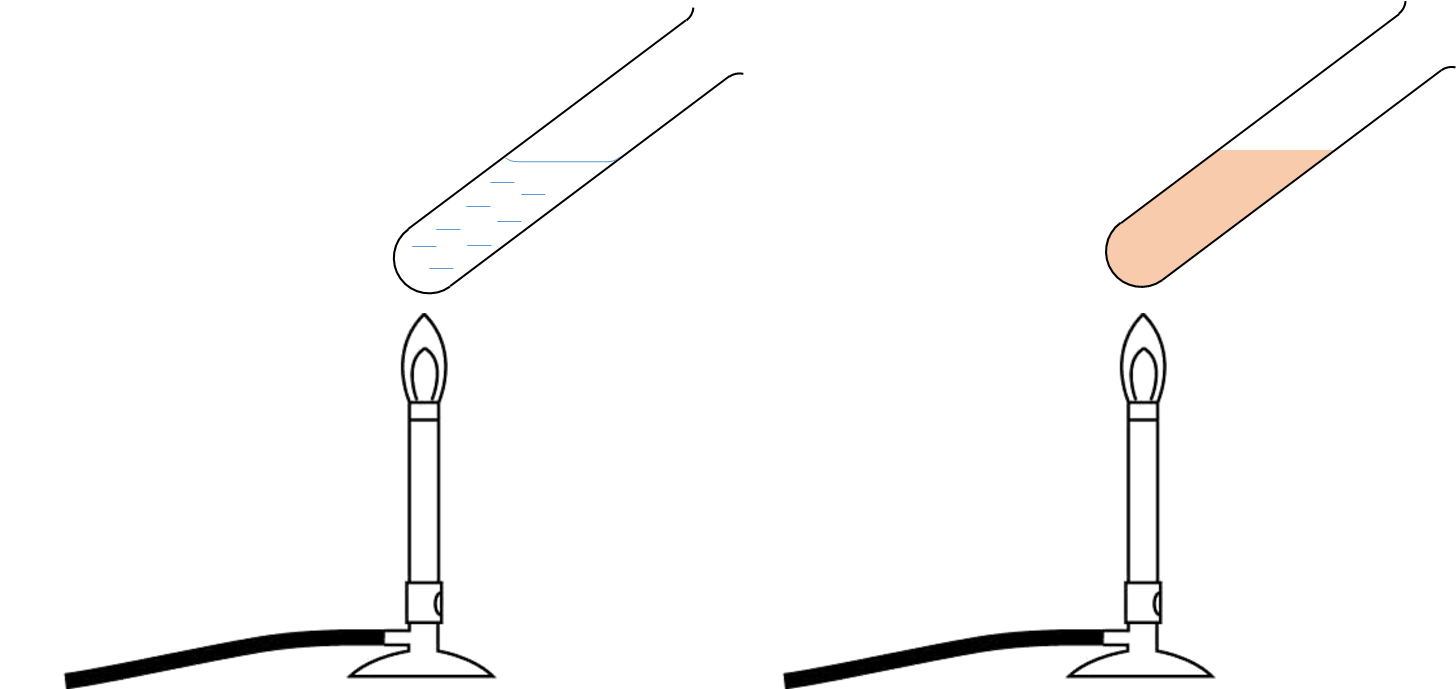
**Water and sand**

What happens to the temperature of water when it is heated?

What happens to the temperature of sand when it is heated in the same way?



**Apparatus**

* Bunsen burner
* heat resistant mat
* x2 boiling tubes
* test-tube holder
* test-tube rack
* stirring rod
* thermometer
* dry sand
* timer

**Method**

1. Half fill a boiling tube with water.
2. Use a thermometer to measure its temperature.
3. Heat the water in a Bunsen flame for 30 seconds.
4. Take the water out of the flame and give it a stir.
5. Measure its temperature.
6. Heat the water for 30 seconds two more times.
7. Measure the temperature of the water each time it is heated.
8. Repeat the investigation using sand instead of water.

**Results**

|  |  |  |
| --- | --- | --- |
| **How many times it was heated** | **Temperature of water / oC** | **Temperature of sand / oC** |
| ***Before heating*** |  |  |
| ***1*** |  |  |
| ***2*** |  |  |
| ***3*** |  |  |

**To answer**

1. Are the results what you expected?
2. What did you find out about heating water and sand?

*Give as much detail as you can*

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

|  |
| --- |
| **Response activity** |
| **Water and sand** |

**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: | Predict the temperature of different materials that are all in thermal equilibrium with the room |
| Activity type: | Application and practice - practical |
| Key words: | Temperature, test-tube holder, test-tube rack, stirring rod, boiling tube, Bunsen burner, thermometer |

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

* Diagnostic question: Three balls

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This activity explores ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

Students aged 11-12 are often able to use and read a thermometer to take temperature readings, but they often make judgements about the temperature of an object based more on the materials it is made from rather than on the temperature of its surroundings. When a piece of metal and a piece of wood are picked up, both at room temperature, the metal feels colder. This gives some students the belief that they are at different temperatures. It can also lead to the misunderstanding that some materials can be heated and others cannot, which is perhaps reinforced by ideas about thermal conductors and thermal insulators. Most teaching schemes take these ideas for granted. (Erickson and Tiberghien, 1985)

**Ways to use this activity**

This practical activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should complete the practical in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

Asking students to report their findings at end of the practical work is a useful check. After a group has fed back, it might be helpful to model an even better answer. You could do this, for example, by asking another group to add to, or clarify, the first observation. Then ask another group to sum up the important part of the observation, and so on.

*Differentiation*

Providing suitable recording sheets can help some students organise their observations so they can more easily focus on the science. If some students are working with a teaching assistant, then a list of prompt questions for the TA could help to make this activity more purposeful. Some students may benefit from being challenged to plan and organise their own record keeping.

**Equipment**

For each student/pair/group:

* Bunsen burner
* heat resistant mat
* x2 boiling tubes
* test-tube holder
* test-tube rack
* stirring rod
* thermometer
* dry sand
* timer

**Technician notes**

Each group will heat half a boiling tube of dry sand.

Thermometers (0-100oC) should be fitted with an anti-roll device (if not integral).

**Health and safety**

The main risks are burns and broken glassware.

Thermometers easily roll and need to be placed towards the centre of the table.

Boiling tubes are used as they are easy to transfer into a test-tube rack after heating where they can be left to cool. Alternatively the contents can be tipped away and the boiling tube laid on the heat-resistant mat with the test-tube holder still attached.

For each measurement contents should be gently stirred with a stirring rod and not a delicate thermometer bulb.

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**

The sand will increase in temperature more quickly than the water, which can be noticed at the beach on a hot day.

Some students are likely to predict that the sand will be resistant to heating. They may think that heating dos not raise the temperature of sand because it is made from crushed rock, which is hard and able to withstand heating. Alternatively they may think that because there are no visual changes when sand heats up that it is unchanged in temperature too.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG), from an idea by Erickson and Tiberghien (1985)

Images: Peter Fairhurst (UYSEG).

**References**

Erickson, G. and Tiberghien, A. (1985). Heat and Temperature. In Driver, R., Guesne, E. & Tiberghien, A. (eds.) *Children's Ideas In Science.* Milton Keynes and Philadelphia: Open University Press.