**Observations**

1. For each observation below, state whether the process is boiling or evaporation.

Explain how you decided.

* 1. Some water is heated to 100°C. The volume of the water reduces.
  2. A puddle of water dries on a cold day.
  3. A liquid is heated. The volume reduces. Bubbles are formed.
  4. A liquid is heated. The volume reduces. No bubbles are formed.

*Chemistry > Big idea CPS: Particles and structure > Topic CPS5: Evaporation > Key concept CPS5.1: Explaining evaporation*

|  |
| --- |
| **Response activity** |
| **Observations** |

**Overview**

|  |  |
| --- | --- |
| Learning objective: | Evaporation takes place at any temperature between melting and boiling point. |
| Observable learning outcome: | Distinguish boiling from evaporation. |
| Activity type: | Response, application and practice |
| Key words: | Boiling and evaporation |

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

* Boiling or evaporation

**What does the research say?**

In their research paper Johnson and Papageorgiou (2009) comment that if the concept of substance is absent, the standard “solids, liquids and gases” framework (in which different materials are described as *being* a solid, liquid or gas rather than a substance being in the solid, liquid or gas state) makes no distinction between boiling and evaporation. Both are regarded as changes of state. The difference between the formation of a pure sample of a substance (e.g. water) in the gas state (boiling) and evaporation in which a water mixes with other substances (in the air) is ignored. Without this idea it is difficult for students to reconcile the requirement of water to be at 100°C in order for water particles to have enough energy to move apart from each other during boiling with water particles “escaping” at room temperature during evaporation.

This may be why some students believe that evaporation requires a temperature gradient (Coştu and Ayas, 2005).

**Ways to use this activity**

This activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should answer the question 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 share their answer 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*

If some students are working with a teaching assistant, then a list of prompt questions for the teaching assistant could help to make this activity more purposeful.

**Expected answers**

1a boiling (specific temperature)

b evaporation (below boiling point of water)

c boiling (bubbles formed)

d evaporation (no bubbles are formed)

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**References**

Coştu, B. and Ayas, A. (2005). Evaporation in different liquids, secondary students' conceptions. *Research in Science and Technological Education,* 23(1)**,** 75-97.

Johnson, P. and Papageorgiou, G. (2009). Rethinking the introduction of particle theory: A subtance-based approach. *Journal of Research into Science Teaching,* 47(2)**,** 130-150.