Cognitive disequilibrium

A pre-condition to meaningful learning

By
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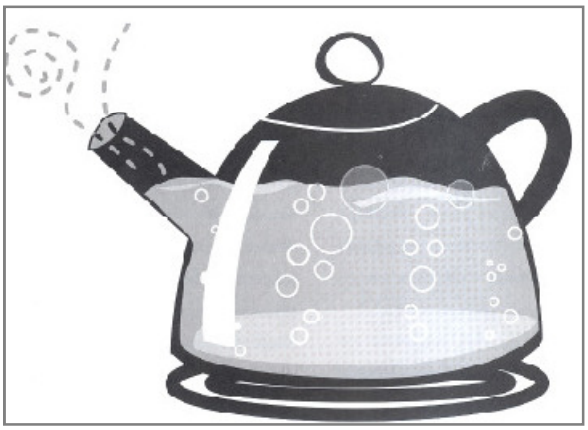
What's in the Bubbles?



[Adapted from Keely, P., Eberle, F., and Tugel, J. (2007). *Uncovering Student Ideas in Science*, Volume 2:25.]

Tevita is boiling water in a glass tea kettle. He notices bubbles forming on the bottom of the kettle that rise to the top and wonders what's in the bubbles. He asks his family what they think, and this is what they say:

Dad: "They are bubbles of heat."

Sione: "The bubbles are filled with air."

Grandma: "The bubbles are invisible form of water."

Mele: "The bubbles contain oxygen and hydrogen that separated from the water."

Which person do you agree with and why? Explain your thinking.

What are clouds?

On his way home with his mom and dad, little Jone watched the clouds moving in the sky. Wondering what clouds were, he asked his parents. This is what his parents said:

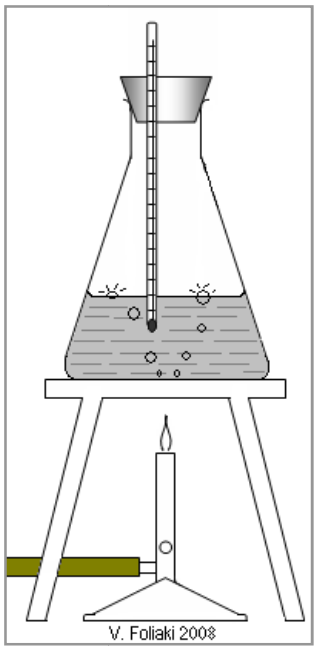
Mom: "Clouds are like balls of smoke from the fire."

Dad: "Clouds are balls of water in the sky".

After a while, Jone queried: "But we don't get wet when we run through smoke! And if they were balls of water, why don't fall down?"

Which person do you agree with and why? Explain your thinking.

Boil Water with Cold Water



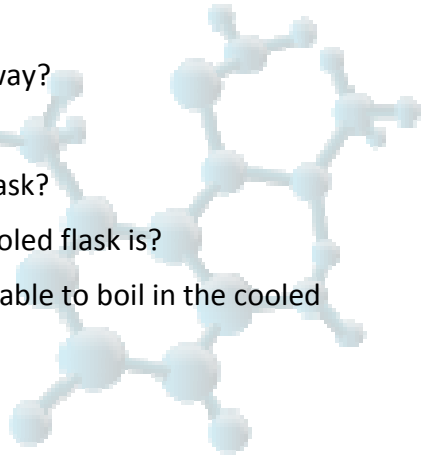
1. Fill a conical flask ¾ full with water, put a few boiling chips in it, and heat over the burner and stand until boiling.
2. Ask the students the following questions:
    a. "What is the boiling point of water?"
    b. "How do you know that water is boiling?"
    c. "Can water boil at other temperatures?"

    The purpose of these questions is to elicit your students' prior understanding of important concepts such as *boiling, pressure, density*, *change of state, water vapour, etc*. You could list down their ideas.
3. Attach a clamp on the flask's neck, shut the flame off and immediately close the flask with a one-hole stopper that is fitted with a thermometer. Have a students read off the temperature (should be about 98-100ºC).
4. Once the temperature has dropped to 90ºC (or even lower), invert the flask and hold it under a cold stream of water from the tap above a sink. Alternatively, wipe the bottom of the flask with a towel soaked in cold water.

5. Observe boiling water and have students read off the temperature.

Write down your answers to the following questions:

1. Why does the water stop boiling after the heat is taken away?
2. At what temperature does water boil at normal pressure?
3. What is the cold water doing to the water vapour in the flask?
4. What do you think the pressure above the water in the cooled flask is?
5. What is the lowest temperature at which the water is still able to boil in the cooled flask?



Summary

As you have learned, constructivism is a helpful learning theory to use as the basis for effective teaching strategies and for presenting your students with meaningful learning experiences. Your students enter your classroom at the beginning of the year with their own beliefs (preconceptions) about many things – both related and unrelated to the content of your subject. While some of their preconceptions agree with currently accepted beliefs, many however are inaccurate (or misconceptions). Constructivist teaching strategies can help you overcome these misconceptions.

It is also important for you to note that although changing your students' limited ideas is difficult, it **is** possible. The starting point is to motivate your pupils to examine their existing beliefs critically. (This is the major reason why we write reflections). You can encourage your students to reflect on their understanding and learning.

In addition, when your students do activities on simple discrepant events, they may see that their ideas do not work and they may then question the validity of those ideas (the stage of cognitive disequilibrium). When these activities, through our teaching, fail to support their preconceptions, they will be more willing to accept new ideas (reconstruction of understanding and conceptual change).

A constructivist classroom is usually a noisy classroom. But as as long as the discussion is focused on the task at hand and that the noise does not disturb the class next door, you don't have to worry about it. This noise is a sign of a healthy learning environment where your pupils are actively throwing out old ideas and constructing new ones.

Koe Fokisi moe fuhinga kalepi
(mei he ngaahi fepale ‘a Isope)

Tokua ne fononga mai ha fokisi he toafa.
Ne fieinua mo fiekaia he ne fuoloa ‘ene fononga.
Fokifaa pee kuo ne sio ki he fuhinga kalepi faka’ofo’ofa.
Koe pango pe he ne taukakapa si’ene feinga ki he kalepi.
Fiu he feingaa, hela’ia, ne ta’utu hifo e fokisi ‘one pehe:
Sai pee he ‘oku te’eki ai momoho. He kohai ‘oku ne fie kai ha kalepi mahi?
Ne fiemaalie ai pee fokisi pea hoko atu ‘ene fononga, mo kei fieinua pee.

Important lessons from Aesop’s fable

1. When there is an attempt by one to hold two incompatible ideas at the same time, there is cognitive disequilibrium. We are not comfortable holding two conflicting ideas.

2. To reduce the disequilibrium, the fox said what he said.

References

Keely, P., Eberle, F., and Tugel, J. (2007). Uncovering Student Ideas in Science. *The Science Teacher*, 2(25).