

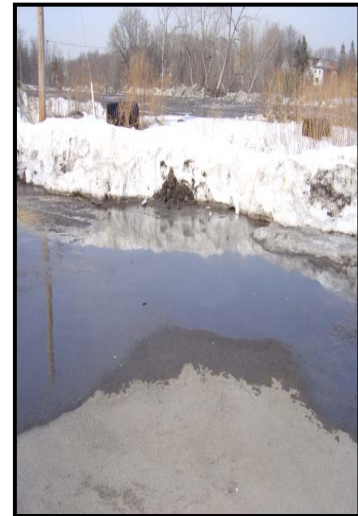
A Model of Matter: Part 4

Last week, as we discussed our model of matter (tiny particles in motion), we looked at evaporation of water. We left you with this task:

Puddle problem:



Our original puddle had a length of 1m and a depth of 25cm.



What if:
we *decrease* the length to 50cm but
keep the volume of water the same?



What if:

- we *increase* the length to 2m but keep the volume of water the same?

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Consider these questions:

- Compared to the original puddle, what happens to the rate of evaporation for each puddle?
- How does our model of matter (tiny particles in motion) help us to explain this?

In our model of matter, we explain evaporation by assuming that some of the water molecules at the surface of water are moving fast enough to be able to overcome the attractive forces that water molecules have for each other and escape from the puddle into the atmosphere. The three puddles in the task all have the same volume of water, they just have different lengths; therefore, their surface areas differ. If the molecules that are “breaking away” and becoming water vapor are the ones *at the surface*, it stands to reason that the puddle with the *greater* surface area (2m) will evaporate quickest, followed by those with *less* surface area (1m, then 50 cm).

While we’re considering surface area, let’s tie together the ideas of the last few emails with another task item:

If you get out of the shower or bathtub and stand for a moment, without drying off, why are you chilly?

This might feel good on a hot summer day, but considering recent temperatures, this can just be annoying. What’s happening?

This again, is an example of evaporation; molecules of water are moving from on top of your skin into the air. So how can we explain what is happening, based on our previous conclusions?

- *Evaporation occurs faster when more surface area is exposed.* After a shower, you are covered with a *very* thin layer of water; there is lots of surface area exposed to the air. A large number of molecules are in the right location (the surface of the water) to break away.
- *Evaporation occurs faster when more heat is available to increase the average kinetic energy of the molecules.* There’s lot of heat available...from you! The water molecules will use some heat energy from your body to increase their average kinetic energy. Again, there are a large number of molecules with the right amount of kinetic energy (very high) to break away. Since heat energy is being converted to kinetic energy wherever the water is located, you become chilly all over.

If you put these two variables together, being in the right place, with the right amount of energy, you’ve got rapid evaporation.

Coming up

For the next email in this series, we want to examine a common area of confusion for students. It concerns differences between scientific and everyday observations and language. In the meantime, go back to the boiling water in *A Model of Matter: Part 3...*

1. What do you observe as you watch a container of water being heated?
2. What do you observe as the water begins to boil?

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What do the New York State standards say?

In the Elementary Core Curriculum, Standard 3, The Physical Setting,

Major Understandings state:

- 3.1a Matter takes up space and has mass. Two objects cannot occupy the same place at the same time.
- 3.1c Objects have properties that can be observed, described and/or measured: length, width, volume, size, shape, mass or weight, temperature, flexibility, reflectiveness of light.
- 3.1f Objects and/or materials can be sorted or classified according to their properties.
- 3.2b Temperature can affect the state of matter of a substance.
- 3.2c Changes in the properties or materials of objects can be observed and described.

In the Intermediate Core Curriculum, Standard 3, The Physical Setting,

Major Understandings state:

- 3.1a Substances have characteristic properties. Some of these properties include color, odor, phase at room temperature, density, solubility, heat and electrical conductivity, hardness, and boiling and freezing points.
- 3.1d The motion of particles helps to explain the phases (states) of matter as well as changes from one phase to another. The phase in which matter exists depends on the attractive forces among particles.
- 3.3b Atoms and molecules are perpetually in motion. The greater the temperature, the greater the motion.
- 3.3a All matter is made up of atoms. Atoms are far too small to see with a light microscope.
- 3.3c Atoms may join together in well-defined molecules or may be arranged in regular geometric patterns.

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