



Phase Change and the Particulate Model

NS 696 V: Weather and Climate for Educators

Colorado State Standard:

Standard 2

Physical Science: Students know and understand common properties, forms, and changes in matter and energy. (*Focus: Physics and Chemistry*)

Benchmark:

They physical characteristics and changes of solid, liquid, gas states can be explained using the particulate model.

Theory:

Matter can be found in one of four states; solids, liquids, gasses and plasma. The particles of the different states of matter are arranged and move differently in the different states. The particles of a solid are tightly packed and bounce off one another. Solids have a definite shape and volume. Ice is water in the solid state. The particles in a liquid are more loosely packed than the particles in a solid. They also bounce off of each other. Liquids have a definite volume, but not a definite shape. Liquid water is an example of this state. Gas particles are extremely loosely packed. They have no definite shape or volume. Water vapor is an example of water in the gas phase. Plasma exists when high energies strip electrons from atomic nuclei, so the nuclei and electrons are separated. Matter in the Sun is in the plasma state.

Matter can change its state of matter. A change in state of matter is a physical change. The substance retains its chemical properties, but changes its physical properties. These changes take place by a transfer in energy. When a substance goes from a solid to a liquid, energy is transferred into the substance. The temperature at which a specific substance changes from a solid to a liquid is referred to as its melting point. If more energy is transferred to the substance (in its liquid state) it will change to a gas. The scientific name for this process is vaporization. The temperature for a particular substance in which it changes from a liquid to a gas is called its boiling point. Another phase change is when a solid goes directly to a gas with an increase in energy. This change is referred to as sublimation. When energy is transferred out of the substance, physical changes can also occur. A gas can condense to a liquid when energy is released. This is referred to as condensation. A substance can also change from a liquid to a solid, when enough energy is released from the substance. All of the changes in states of matter have to do with a transfer of energy. This

energy is either moving into or out of the substance. This movement of energy causes the individual particles in the substance to change their speeds and behaviors. When energy is moving into the particles they speed up and bounce against one another faster and faster. These collisions cause the particles to spread out therefore changing their physical appearance. This changes the arrangement which in turn changes their state of matter. When energy is released from the particles, they begin to slow down and their number of collisions decreases. This causes the particles to become more compact and a change in the state of matter will occur.

Lesson

Engage:

Introduce students to reusable heat packs. Have them actually feel the transfer of energy to their hands. This transfer of energy can be felt as heat. Another great anticipatory set is to have the students observe as you demonstrate the super cooled solution of isopropyl alcohol and water. Both of these engaging activities can be found in our CMMAP binder from class. Actually I think the alcohol and water one is on the website.

Explore:

Students will be replicating the actual movement of particles in different phases of matter. You will need some open space and some students. This activity is similar to the one in the CMMAP binder, but we aren't really incorporating pressure into the activity. Have students model the movement of the individual particles in the three different phases of matter.

Explain:

A power point presentation with slides, images, charts, graphs, etc can actually be found in my textbook curriculum. I will utilize this information to have discussion with my students about the concept of phases of matter.

Extend:

Liquid nitrogen will be introduced into the classroom. Students will need to hypothesize what they think is happening to various types of matter based on their knowledge of phases and phase changes. Basic characteristics of nitrogen are introduced to the class before the extension begins. Students are made aware of physical characteristics of nitrogen (boiling point, melting point, freezing point, uses, etc.) Students will get to explore with the nitrogen under careful observation. Students can put balloons in nitrogen, Kleenex, simply observe the nitrogen in a beaker on the desk, ball and ring, bi-metal knife, and making of ice cream. The making of ice cream and the balloon activities are included in the CMMAP binder as well.

Evaluate:

I loved the introduction of “The Cube” to our class. This is a format of what the six sides of the cube could look like. Students have a cube with only 5 sides completed. They need to use their knowledge of all the previous activities to decide what the 6th side of the box might say.

Side # 1

Solid
Energy in
Loose particles

Side #2

Liquid
CO₂
Packed particles

Side #3

Ice
Energy Out
Free particles

Side #4

Water
Sublimation
Melting point

Side #5

Water vapor
Volume
Boiling point

Side #6 (can't see)

gas
shape
freezing point

Lesson generated by Cheri Jones