4th Grade Physical Science
States of Matter/H2O Cycle

Big Idea

Water is all around us; sometimes it is visible and sometimes we cannot see it with our naked eyes.

Teacher Background Information – for teacher content knowledge only, NOT student learning goals

Matter exists in different states- solid, liquid, and gas. Water can be changed from one state to another by heating, cooling and change in pressure. Matter cannot be destroyed. A change in state from a liquid to a gas is a physical change. The substances, liquid water and water vapor, are still chemically the same. They do not change into a new substance or break down into hydrogen and oxygen atoms.

Contrary to what is often depicted in water cycle diagrams, water does not immediately go up to the clouds or Sun. It rises and exists in the air around us as invisible gas. Humid weather is an example of water in the air. The wet dew on grass in the morning or condensation of water on the outside of a cold beverage glass confirms that water exists in the air around us. The Standards use the term vapor to describe the invisible, gaseous form of water and explicitly point out that clouds and fog are made up of tiny droplets of water in order to distinguish forms of water in the air that can be seen from forms we cannot see.

Essential Question

In what ways can water change form? Where does water go – where does it come from?

AAAS Benchmarks/National and Science Education Standards

- Air is a material that surrounds us and takes up space.
- When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets or frozen crystals of water.
- Substances may move from place to place, but they never appear out of nowhere and never just disappear. 4D/E8 (ASL)
- Heating and cooling can cause changes in the properties of materials,
- Many kinds of changes occur faster under hotter conditions. 4D/E1b
- When warmer things are put with cooler ones, heat is transferred from the warmer ones to the cooler ones. 4E/E2b

Instructional Implications

Younger students learn to focus primarily on phenomena they can observe. As students progress to intermediate grades they begin to conduct investigations to explain the observations they made in the earlier grades. An important idea to develop before they move on to middle school is the notion that when water disappears it is in the air in the form of invisible water vapor. Elementary school students need concrete experiences to understand what happens to water during a change in state before developing the more sophisticated idea of a water cycle. Do not assume that because students use words like evaporation and condensation they actually know what is happening. Develop the concept before giving students the technical term for the processes that make up the water cycle. In addition, students must have opportunities to learn that air is a substance rather than existing as "nothing." Teaching about condensation involves the interrelated ideas of conservation of matter, phase change, and composition and nature of air.

Local Connections

Prior to any connections to the local watershed there must be a focus on the physical properties and states of matter.

A visit to Gold Creek, Salmon Creek, or Mendenhall watersheds

Tour CBJ water treatment plant

Materials/Resources

FOSS Water Kit

A Drop of Water by Walter Wick

Project WET www.projectwet.org

Assessments

Uncovering Student Ideas in Science
Volume 3; Probe 20: What Are Clouds Made Of?
Volume 3; Probe 21: Where Did the Water Come From?
Volume1; Probe #21: Wet Jeans

Science Notebooks

Student Difficulties and Misconceptions

Students go through different stages in understanding the water cycle. Before they understand that water is converted to an invisible form, they may initially believe that when water evaporates it ceases to exist, or that it changes location but remains a liquid. Some students can identify air as the final location of evaporating water, but they must first accept air as a permanent substance. This is a challenging concept for most students at this age. Students can understand rainfall in terms of gravity in middle school but not the mechanism of condensation, which is not understood until early high school.

Alaska GLE's

The student demonstrates an understanding of the process of science by

[4] SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating

[**4] SA1.2** observing, measuring, and collecting data from explorations and using this information to classify, predict, and communicate

The student demonstrates an understanding of the structure and properties of matter by

[4] SB1.1 identifying and comparing the characteristics of gases, liquids, solids

The student demonstrates an understanding of the interactions between matter and energy and the effects of theses interactions on systems by

[4] SB3.1 explaining that temperature changes cause changes in phases of substances (e.g., ice changing to liquid, water changing to water vapor, and vice versa)

The student demonstrates an understanding of cycles influenced by energy from the sun and by Earth's position and motion in our solar system by:

[**4] SD3.2** observing that heat flows from one object to another. (L)