Earth Science Intro Weather and Climate (the water cycle)

Mission Team members will be able to:
• Recognize that because air, land, and water absorb and reflect sunlight differently, they all affect the water cycle.
• Document in a notebook or on a group-produced chart a "scientific investigation" using the terrarium. Observe, measure, and make predictions about changes to the components of the terrariums.
• Name the parts of a water cycle on Earth and in the terrarium: water, evaporation by the Sun, clouds, rain or snow (precipitation), rivers, lakes, oceans and ice, etc.
• Describe what happens to the soil and the plants in the terrarium when they have too much water (flood).
• Predict how too much rain might affect soils and plants on Earth.
• Describe what happens to the soil and the plants when they get sunlight but too little water (drought).

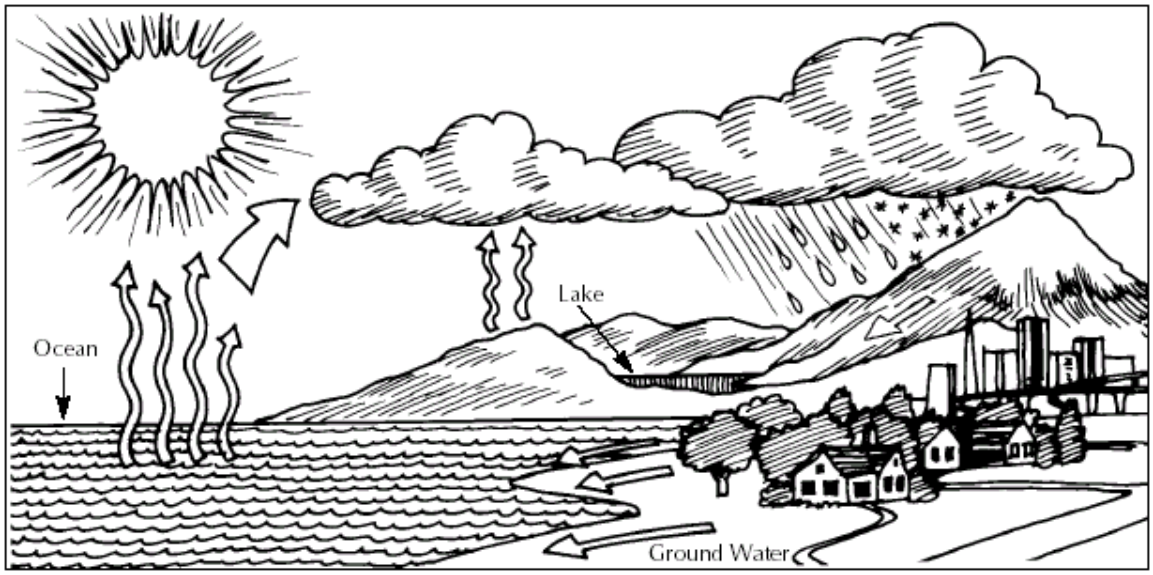
Mission Team Leader's Notes

A demonstration of the water cycle using a terrarium is an ideal model for your Mission Team to observe changes that occur in the Earth system. Looking at the whole planet, cycles include events occurring over very large areas and long periods of time, so they are difficult to see from the surface.

In the "model Earth," events can cause immediate and dramatic changes. In this mission we examine the water cycle and the effects of erosion and drought to demonstrate the principle of cycles in the Earth system. Cycles, like the seasons, are a natural occurrence on Earth. Earth's cycles provide a balance to which people and nature have adapted. The water cycle spreads life-giving water and minerals within local regions and around the world.

DISCUSSION:
A cycle is a sequence of events that repeats itself, such as the seasonal cycle: summer, fall, winter, and spring. In the Earth system, the same components interact repeatedly; the water cycle is a good example. Sunlight evaporates water; the moisture rises into the atmosphere, where it condenses as clouds. When the warm, moisture-laden clouds meet colder air, the temperature drop makes the water vapor precipitate and fall to Earth as rain

or snow. On land, water soaks into the ground or flows to the oceans and lakes by streams and rivers. This water is redistributed across Earth as water vapor, clouds, and rivers or snow and ice.



HOW CLOUDS ARE FORMED

Clouds are masses of water droplets or ice crystals that are suspended in the air. When the droplets or crystals become too heavy to remain suspended, they fall to the Earth. In order for clouds to form, three things are needed. First, the relative humidity must be close to 100 percent. Second, tiny bits of matter, such as dust, must be present. (Water collects or condenses around these particles.) Third, something must happen to cool the air. If all three conditions exist, clouds form. The type of clouds that form depends on how cold the air is and how much water is in the air.

CLOUD SHAPES

Just by studying a cloud's shape, a meteorologist can tell a great deal about the cloud. There are three basic kinds of clouds.

Cirrus clouds are thin, feathery clouds. They are high in the sky. They are so high that they are made up of the ice particles. They are generally white or whitish in color.

Cumulus clouds look like puffs of cotton piled in a heap. They are commonly known as fair-weathered clouds. They are usually nearer the earth than cirrus clouds.

Stratus clouds are low, flat clouds. They are often dark and bring rain. "Alto" means "high". Altostratus clouds are higher than stratus clouds.

Activity

Demonstrating the Water Cycle.

Glass or plastic to cover the terrarium, bowl or mirror, wet towel, household iron.

Demonstrating the Water Cycle: Catch a Cloud. Cover the terrarium and observe how moisture collects on the glass and drips down the sides of the terrarium. Ask the Mission Team members to guess why this happens. You can also generate water vapor by ironing a towel or boiling water in a covered pot. Either can represent the Sun heating Earth. Hold a glass bowl or large mirror over the rising steam and "catch a cloud."

Demonstrating Evaporation.
Demonstrate evaporation of water from a puddle. On a sunny day, pour a cup of water on the sidewalk. Have Mission Team members draw a circle around the perimeter with chalk. Tell them to come back in 30 minutes to see the puddle. Create a smaller puddle indoors by putting drops of water on a baking sheet. Use a hair dryer on the puddle to represent a warm, windy day when the Sun is shining. Ask them where the water went and why.

Record information about the terrarium experiment on a wall chart or in individual notebooks. Draw pictures of the different plant species before and after conditions are changed.

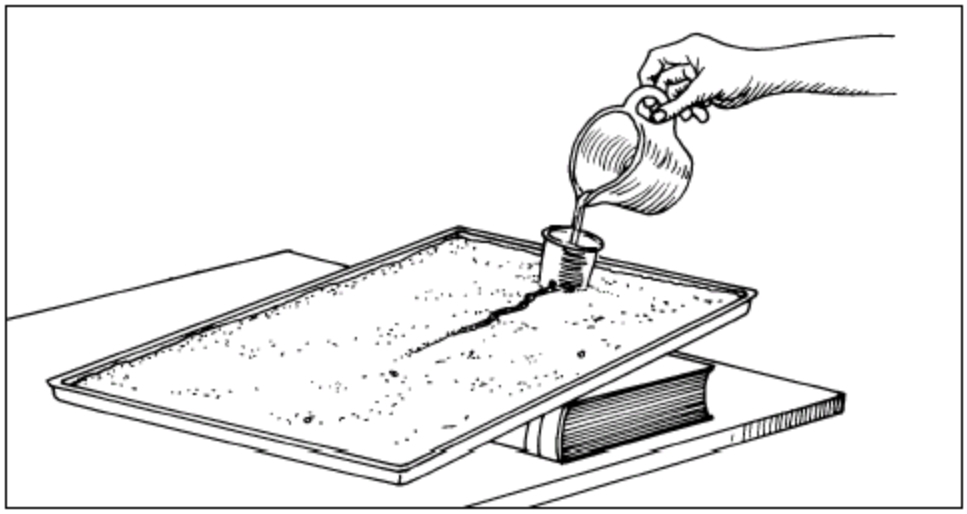
Changes to the System.
Continue to track the conditions of the plants in a terrarium. To make the terrarium climate more like Earth's, change one of the conditions (either provide more or less water or reduce or increase the exposure to light). Monitor each of the plants' growth under this new condition. Mission Team members should note all changes to the plants and how much water and sunlight they received. Plants grow long and weak and lose some of their color if they need more light, or they wilt and dry out when they need more water.

Living things are highly dependent on the water cycle. Some creatures living in lakes, rivers, or streams will be affected if water levels rise or fall. Too little rain, which results in a drought, can weaken or kill plants, thus reducing food for animals. People and animals can migrate to food and water, but if the drought continues or spreads, eventually they will die. Too much snow or rain, on the other hand, can drown plants or create floods that wash away land (plant and animal habitats) and flush pesticides and industrial chemicals into rivers. With flooding, erosion sometimes occurs. While erosion is a natural process, careless practices by humans can cause loss of valuable topsoil and contribute to the spreading of deserts in the world.

Demonstrating Erosion.
Use the terrarium as a model of Earth to demonstrate how water can carry materials from one place to another through erosion of soils or dissolution of minerals. One of the terrariums, or empty jar and soil; source of tap water; bag of salt; paper cups.
Demonstrate by pouring water onto the terrarium soil how land erodes and destroys vegetation. The water will wash soil into the terrarium pond and make it cloudy. Particles of dirt, sand, and small pebbles are suspended in the water as a mixture. If the Mission Team members did not build a terrarium, mix dirt with water in a jar and stir to show

how the particles are suspended when the water is moving. You could create a canyon on a baking sheet.

Fill a shallow pan with soil. To slowly pour water on the soil, poke a hole in the side of a Styrofoam cup half an inch from the bottom. Set the pan at a low angle. At the high end set the cup and fill it with water. The water will trickle out and make a small canyon in the pan.



Water can dissolve minerals from rock and soil. For example, mineral water comes from deep within the ground. Tell Mission Team members to watch salt crystals disappear as they stir a teaspoon full into a glass of water. By tasting, compare a glass of salted tap water to one of plain tap water.

Ask Mission Team members if they have ever swam in the ocean. Did they swallow any water? How did it taste? Why? Erosion/Drought.

1. Erosion Field Trip: Visit muddy creeks, ponds, river deltas, flood plains, or hillsides plagued by erosion. Explain how water washes away soil and then deposits it in another location.

2. Film or photograph viewing: Let the Mission Team members watch films or study pictures of drought-stricken farmlands to see what happens when valuable topsoil is blown away. Show photographs from NASA Space Shuttle flights (see lithograph “Water is a Force Changing”) of soil-laden rivers flowing into the ocean such as the mouth of the Amazon River. Photos from space show the huge areas subjected to flooding and the large volumes of water carrying soil. The color lithograph of the Nile River Delta/Sinai Peninsula shows how the river erodes the banks and carries soil down river. The soil is eventually deposited at the mouth of the river, where the materials form a new land mass.

3. Impact on Human Lives:

Find magazine and newspaper stories about floods, especially those that describe the plight of individual farmers and the efforts of volunteer sandbaggers, rescue groups, water and sewer pump-station managers. Read the news stories to the Mission Team members and ask them to embellish them with more details and pictures. They could invent additional family members and describe what happened to those people, too. Create little books, like photo albums, illustrated with drawings about these flood-time "heroes."

Discussion

What problem does erosion present for farmers and for nearby waterways?
How can farmers prevent erosion? Erosion also affects forests and beaches; what needs to be done to protect these lands?
• Erosion washes away rich topsoil—the soil in which plants grow best. Waterways are affected by runoff of chemical fertilizers and manure.
Farmers can prevent erosion by carefully plowing their fields and planting another crop or hay after harvest.
• Foresters should avoid clear-cutting trees and replace trees that they have logged.
• To stop beach erosion, people should maintain or plant grasses and trees, import sand after erosion has occurred, and avoid using jetties that trap sand in one area of the beach at the expense of another.