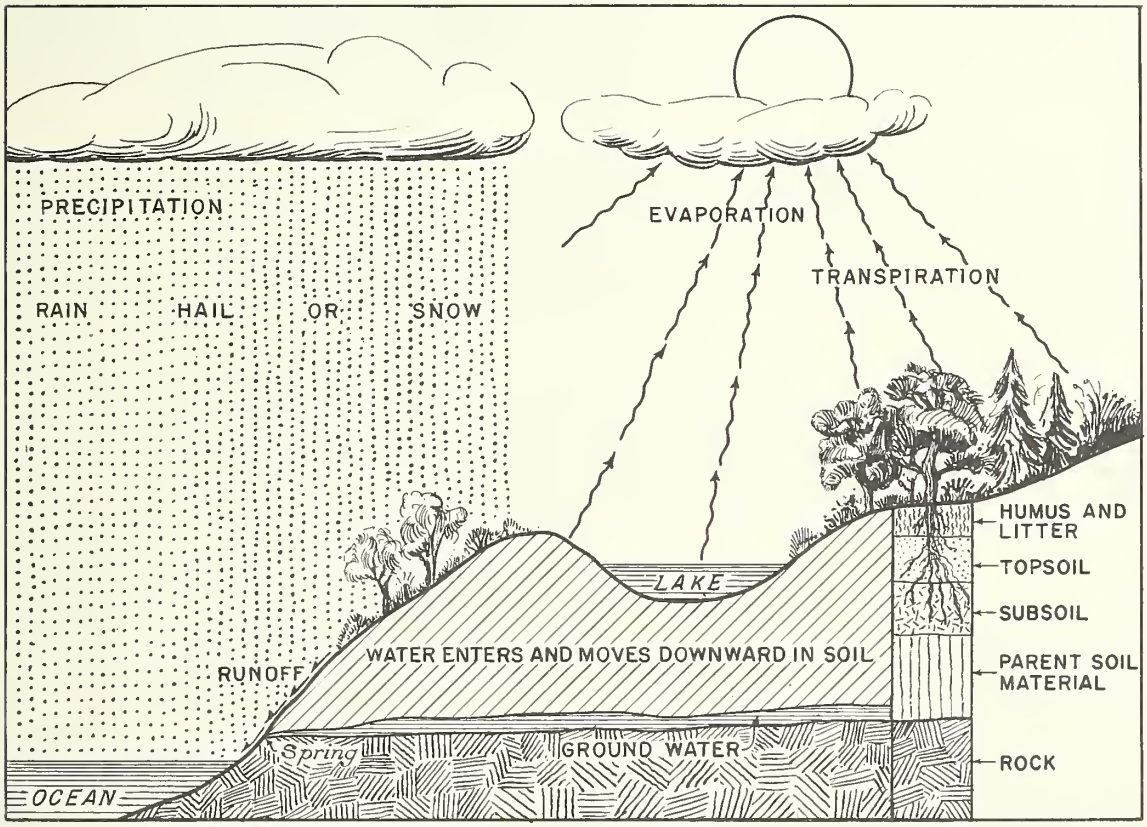
Forests and the Natural Water Cycle



A Conservation Teaching Aid

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Introduction. Forests are plant communities made up of trees, shrubs, grasses, herbs, and other plants. All these plants need water.

From man's point of view plant leaves are the most important chemical factories in the world. Without their basic product, carbohydrates, there would be no food for man or animal, no wood for shelter, no humus for the soil, nor would our valuable deposits of coal and oil have developed over past ages.

What has water to do with this? To produce carbohydrates the leaves must have water together with dissolved minerals, primarily from the soil, and carbon dioxide from the air. The leaves trap radiant energy from sunlight and use it for power to make carbohydrates from water and carbon dioxide. They give off oxygen as a by-product. This chemical process is called photosynthesis. Without water, carbon dioxide, and sunlight, photosynthesis could not take place. Without photosynthesis no life could exist.

Next, consider the animals. They get their food either directly from plants or from other animals, which in turn live on plants. If plants had no water, animals would have no food. But animals need water for more than food--they need it for drinking, bathing, and transportation. Some need it for their homes, some for protection, some for rearing their young. Thus water is a necessity in the vital processes of both plants and animals.

Now, consider man himself. He gets his food directly from both plants and animals. Without water neither plant nor animal food would be available, and man could not exist. But man also needs water for more than food. Like animals, he drinks it and uses it for bathing. He also uses it for his industries, crops, transportation, medicines, household work, public sanitation, and recreation. About 70 percent of man's weight consists of water.

Water becomes more and more important to man, and he must use his utmost skill in developing the supply available. This fact remains--without water there would be no life of any kind.

Outside, it is raining--raining hard! Technically rain is known as precipitation, the general term applied to rain, snow, and hail which return moisture to the earth. Precipitation is one of several major processes in the water cycle. Two others are evaporation and transpiration, and the forest has very definite effects on them. Let's discuss those effects.

Evaporation of water. Forests break the force of the wind, slow down air circulation, and shade the ground from the sun's rays. This action reduces evaporation of water from the forest soil and land surface. If the forest floor contains the leaf litter and humus necessary for a well-managed and productive forest, water evaporation is even slower. Thus more water is made available for plant growth and is later released into the air through transpiration. Soil water left in the small pores of the soil is gradually released to springs, streams, and underground reservoirs. Thus through the forest's influence, we have much longer and more effective use of that water before it is finally returned to the air as part of the water cycle.

Evaporation of snow. Forests store, conserve, and regulate water. They also store and conserve snow. These processes are of great importance in the mountainous West where as much as 80 percent of all precipitation falls as snow.

In a managed evergreen forest--where cutting is done scientifically to make small scattered openings--more snow may be stored and conserved than in a virgin or uncut forest. More snow falls to the ground in a managed forest, where it is protected from evaporating winds that are stronger in the treetops than on the ground. In a virgin or uncut forest, the treetops are blanketed with snow after each storm. This suspended snow may evaporate rather quickly, leaving only part to fall to the ground.

Transpiration. During the course of a water cycle, a large amount of water is returned to the atmosphere through the pores on the undersides of leaves. This biological process is called transpiration. The rate of transpiration is determined by the amount of water available in the soil and by the wind, temperature, and humidity. Therefore, the amount of water returned to the air through transpiration varies with the amount in the soil and with the seasons and even from hour to hour. The quantity may be considerable in a normal, healthy forest, especially if plenty of water is available in the soil during the growing season. If the soil is dry, less water is drawn to the leaves. Water performs a useful function in the plant by carrying to the leaves and growing twigs minerals from the soil and organic materials from storage places in the trunk and roots. The water is then returned to the air in the form of vapor, primarily through transpiration by the leaves.

Activities help to summarize what has been learned about the water cycle. The following have proved effective.

1. Make a chart of the water cycle.

2. Show motion pictures having to do with water, its use, and conservation. "Lifeblood of the Land," "Waters of Coweeta," "Mountain Water," "Adventures of Junior Raindrop"--all in 16 mm. and color--are some films produced and distributed by the Forest Service, U. S. Department of Agriculture. Other films concerned with water are available from some State conservation agencies, Encyclopedia Britannica Films, Inc., and certain industries. Describe the important points in each film.

3. Keep a record (by cups, quarts, or gallons) of water used for all purposes in any one day by any one person or family. (It may be desirable to obtain from local public water officials information on amounts of water used.) Change the total amount used to pounds of water and compare the result with the weights of the individuals to indicate the importance of water in our daily lives.

4. Find the combined weights of class members. Compute how many pounds of this weight is water. (The human body averages 70 percent water.)

Experiments

1. To show how much water plants use.

Fill some flowerpots with soil that has first been ovendried and weighed. Also weigh the pots. Plant flowers (not seeds). Fill the pots with measured (weighed) quantities of water--all the water the pots can hold. After this first watering of the soil, add no more. Use a dish to catch excess water that moves down through large pores in the soil and out of the pot. Weigh this water daily until no more comes out. Weigh pots including the soil, plants, and water. Weigh again every day. To eliminate evaporation, slit a piece of waxed paper, place the stem of the plant through the slit in the paper, and bind the paper around the top edge of the pot.

Note when the plants wilt. Weigh the pots including soil and plants. Subtract this amount from the weight of water put into the pot plus pot and soil, less the amount that drained out. The difference will indicate how much water was left when the plant wilted, and also how much it used in its life processes.

2. To show the water loss from leaves.

Insert the stem of a fresh, green leaf through a small hole in a piece of waxed paper. Put the paper over a glass of water so that the stem of the leaf reaches into the water. Invert a dry, empty glass over the leaf. Invert another dry, empty glass over a glass containing only water. What appears on the inside of the inverted glasses?

3. To show where transpiration in leaves is more rapid.

Apply vaseline or other petroleum jelly evenly over the entire undersides of some fresh, green leaves and over the entire upper sides of other similar leaves. Expose all leaves to the classroom air. Which leaves wilt more quickly? Can you explain why this happens?