Ag@School

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Food Chain Basics

Plants use energy from the sun to make their own food; they are called **producers**. Plants are eaten by animals, and animals are eaten by other animals; they are all **consumers**. **Decomposers** break down all wastes, returning nutrients to the soil, and the process starts again. Farmers understand the importance of maintaining healthy soil so the decomposers can do their job. Every day is Earth Day for Washington agriculture!

Today's Children...**Tomorrow's Leaders**

Food Web, n. Many food chains together in an ecosystem

The World Depends on Soil

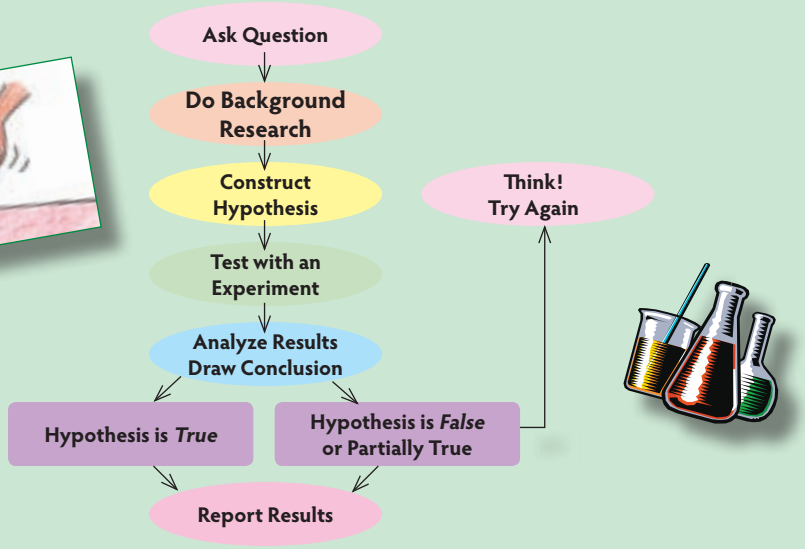
The importance of soil is often ignored. There is a saying, "as common as dirt", which means something of little or no value. Soil is not "dirt", and good soil is extremely valuable. Dirt is what you track across your mom's clean floor or what you find under your bed. Soil however, makes our lives possible. All living things depend on the soil for life. We eat food grown in soil. The soil cleans and stores the water we drink, and gives us a place to build our houses, roads, schools, and cities. We breathe air made by trees and plants growing in soil. We get medicines from soils and wear clothes made from plants and animals that need soil. The entire earth—every ecosystem, every living organism—relies on soil. Without soil, the earth's surface would be barren rock and sand and could not support life. Soil is a complex layer teeming with life, where the atmosphere, water, sunlight, and the earth's crust mix and interact. Almost all of the biological activity in the soil takes place in the top one or two inches, an area usually referred to as **topsoil**.

Farmers today use many methods to conserve soil, from advances in machinery, to increased knowledge of the chemical and physical properties of soil. Many Washington farms have major challenges to soil conservation because of precipitation (too much, too little, too fast) as well as the **topography** of the land (physical features like hills and valleys).

"Treat the earth well; we do not inherit the Earth from our Ancestors, we borrow it from our Children."
- Ancient Indian Proverb

Let's Use the Scientific Method

- The scientific method is a way to ask and answer scientific questions by making observations and doing experiments. These are the steps:



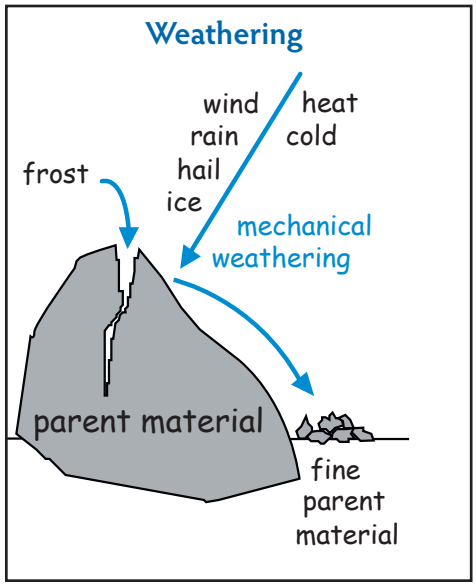
- It is important for your experiment to be a fair test. A "fair test" occurs when you change only one factor (**variable**) and keep all other conditions the same.

Let's do an experiment!

1. The question is, "Does motion increase erosion?"
2. Background research shows that agitation can cause items to break apart.
3. Our **hypothesis** (what we will assume is true) is that items will dissolve more quickly in water that is shaken.
4. We test the hypothesis with an experiment.
   - Into three clear jars, pour one cup of water, add a hard candy to each jar, close the jars with tight-fitting lids.
   - Place one jar where it will not be disturbed for two days.
   - Shake the second jar for one minute when you start the experiment, and once again for one minute on the second day.
   - Choose a place for the third jar that allows you to shake the jar every hour for one minute.
   - Ideally, if you have good scales you can weigh each sample. At least give a visual evaluation of the size of the remaining candy.
5. We conclude that candy pieces (like soil clods) will eventually dissolve in water if left undisturbed. Vigorous movement causes the water to rub against (erode) the candy, knocking off small pieces that then dissolve more quickly in the water.
6. So our hypothesis was true. Items dissolve more quickly in agitated water.

How Is Soil Made?

The world has thousands of different soils (70,000 just in the US). **Parent rock** (like lava, limestone, granite) is broken apart into finer particles by a process called **weathering**. Temperature and water are critical in this process. Water dissolves minerals and is important in chemical reactions. Freezing and thawing also break down rocks. Plant roots can enter cracks in the rocks and break them apart. Roots can form acids that help break down particles. When plants and animals die, they add organic matter to the weathered parent material. Bacteria, fungi, and worms enrich the soil by breaking down organic matter to form topsoil. Soil formation is very slow, taking thousands or even millions of years.



CAN YOU DIG IT?

Soils are made of three basic particle sizes called sand, silt, and clay. The difference in size between the three would be like comparing a basketball (sand), a golf ball (silt), and the tip of a ballpoint pen (clay). Soils from different locations vary in their amounts of each of the three particles. The amount of each type of particle is important because that determines the capacity of the soil to hold water and air. In the Columbia Basin soil can be very sandy whereas near Mica, WA the soil is nearly all clay, in fact there is a business there that uses the soil to make bricks.

Ideally soil is:

- 45% particles (sand, silt, and clay)
- 5% organic matter (dead plants and animals)
- 50% empty space (pores) with half filled with air, and half filled with water

Without decayed organic matter (**humus**), the soil loses its capacity to retain the water and air that soil organisms need.

Planning Your Next Summer Vacation?

Don't miss "Dig it! The Secrets of Soil"

The Smithsonian National Museum of Natural History exhibit is on loan at the Northwest Museum of Arts and Culture in Spokane until September 22, 2012. For information go to www.northwestmuseum.org

You can't live without soil!

Tokul -- Washington State Soil

You probably already know that Washington's state flower is the Western rhododendron, the bird is the Willow goldfinch, and the tree is the Western hemlock, but did you know that we also have an official state soil, named Tokul? The name Tokul comes from a small community and creek in King County. The State of Washington has more than 1,000,000 acres of Tokul soils located on the western side of the Cascade Mountains, from south of Seattle north to the Canadian border. Tokul soils are among the most productive soils in the world. These soils support conifer trees, which are the source of Washington's nickname, the Evergreen State.

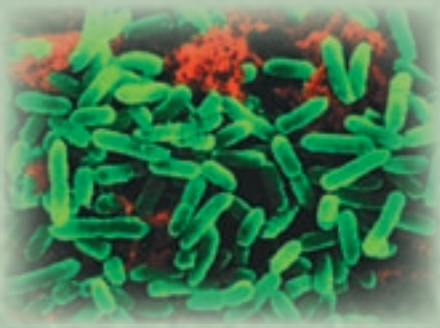
Washington was the first state to recognize a soil that formed in volcanic ash (Andisols) as a state soil. Volcanic ash is one common feature of the soils throughout the state. These Andisols are used for crop production, timber production, livestock grazing, recreation, and watershed.

More than 1600 Washington Soils

THE SOIL

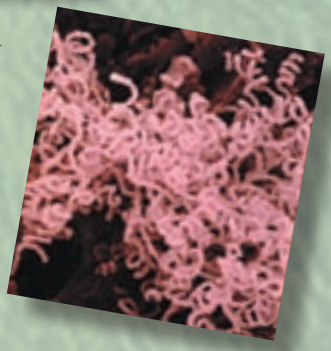
The soil is home to an incredible number of organisms, most of them so tiny we cannot see them without a microscope. They decompose organic matter, take nitrogen from the air and make it available to plants, improve soil structure, and control crop pests. There are all manner of creepy-crawlies---algae, bacteria, rotifers, fungi, protozoa, nematodes, arthropods, earthworms---all part of the soil food web.

Bacteria are tiny, one-celled organisms. They are the smallest and most numerous of organisms in the soil. A teaspoon of productive soil has between 100 million and 1 billion bacteria. Wow! That's a good reason to wash your hands after playing outside. A ton of microscopic bacteria may be active in each acre of soil (that's as heavy as two adult cows!)



Bacteria mostly decompose organic matter so it can be used by other soil organisms.

Actinomycetes are a special group of bacteria that grow like fungi. They are responsible for the characteristically "earthy" smell of freshly turned, healthy soil and the "smell of rain". A number of antibiotics are produced by actinomycetes.

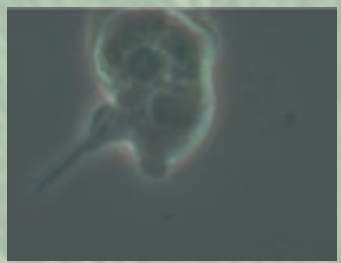


Fungi are microscopic cells that usually grow as long threads or strands called **hyphae**, which push their way between soil particles, roots, and rocks. Hyphae are usually only several thousandths of an inch in diameter, but can be many yards long. Yeast, are single celled fungi.

Along with bacteria, fungi are important as decomposers in the soil food web. They convert hard-to-digest organic material into nutrients that other organisms can use.

Protozoa are single-celled animals that feed primarily on bacteria, but also eat other protozoa, soluble organic matter, and sometimes fungi. They are several times larger than bacteria – ranging from 1/5000 to 1/50 of an inch in diameter. As they eat bacteria, protozoa release excess nitrogen that can then be used by plants and other members of the soil food web.

Ciliate protozoa



Amoeba

Some move by means of hair-like attachments (cilia)

iS ALiVE

The human food system would collapse without the complicated food web that exists in the soil. We are totally dependent upon the soil web to provide and maintain the growing environment for larger plants that feed us and the animals we use for food. Farmers understand this delicate balance. They know if they treat the soil well, it will be able to keep giving back…not just for us today, but for future generations too.

that act like oars to move rapidly through the soil. Amoebae are protozoas that move by means of a temporary foot or "pseudopod."

Nematodes are the most numerous multi-cellular animals on earth. Nematodes are non-segmented worms typically 1/500 of an inch in diameter and 1/20 of an inch in length. A handful of soil will contain thousands of these microscopic worms. There are a few nematodes responsible for plant diseases, but the majority of nematodes play beneficial roles in soil. They cycle nutrients as they feed on algae, bacteria, fungi, protozoa, and other nematodes.

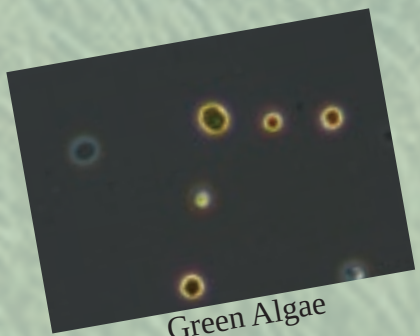
Arthropods are **invertebrates**, that is, they have no backbone, and rely instead on an external covering called an exoskeleton. They get their name from their jointed (arthros) legs (podos).

Arthropods range in size from microscopic to several inches in length. They include insects, such as springtails, beetles, crickets, and ants; crustaceans such as sowbugs; arachnids such as spiders and mites; also centipedes, millipedes, and scorpions.

Most soil-dwelling arthropods eat fungi, worms, or other arthropods. As they feed, arthropods aerate and mix the soil, shred organic matter, and eat other soil organisms.

Sowbugs are relatives of crabs and lobsters. Their powerful mouth-parts are used to fragment plant residue and leaf litter as they eat bacteria and fungi on the surface of the plant matter.

Earthworms eat fungi and bacteria, and shred organic matter making it more available to small organisms. Earthworms improve water infiltration and water holding capacity by improving soil structure. In addition, worm burrows provide quick entry for water and plant roots into and through soil.



Green Algae

Rotifer

Information source: NRCS Soil Biology Primer more available at:
soils.usda.gov/sqi/concepts/soil_biology/biology.html

Food Beneath Our Feet

Carrots are a good example of a **root vegetable**, meaning we eat the plant part that grows in the soil. Can you name other root vegetables?

Carrots originated in Afganistan more than 1000 years ago, and were purple or yellow in color. Growers in the Netherlands in the 15th or 16th century propagated orange mutations because they flattered their royalty (the House of Orange).

Washington ranks first in the US production of processing carrots and fourth for fresh market carrots. Fields are seeded from April to June. Carrot seed is very small compared to other vegetable seeds, and slower to emerge. Carrots are often grown in sandy soils (as found in the Columbia Basin) because the soil is well-drained, uniform, and free of rocks and clay soils that might cause the roots to be misshapen.

The carrot seed bed is shaped and smoothed. The planter uses a combination of vacuum and fine brass plates to meter out seed to produce carrots an inch apart which is the ideal placement since the fields are not thinned.

Carrots grow best in cooler temperatures. The cool nights of late summer and early fall in Washington help keep the sugar levels up to produce a sweet carrot.

Harvesting takes place from July to mid-November. Carrots are usually harvested when the roots are 3/4" in diameter at the top. Some small-scale producers harvest by hand, but large fields are harvested with self-propelled multi-row harvesters. The harvester cuts under the carrots and lifts them from the ground by their tops. The tops are sheared off, and the roots are dropped into a waiting truck running alongside the harvester.

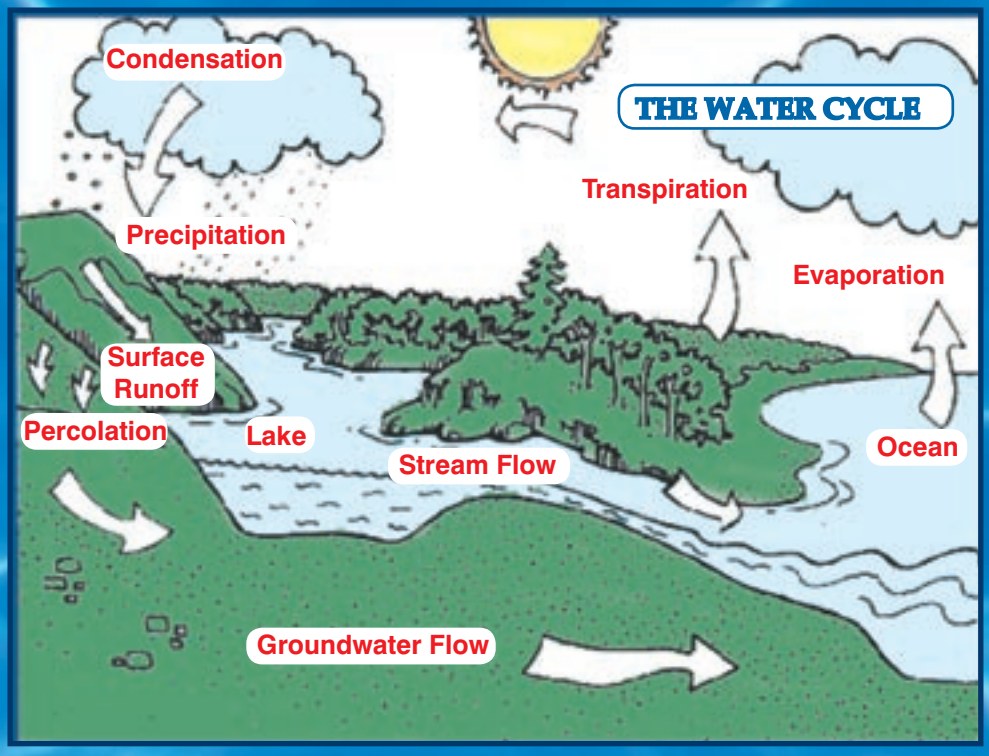
Carrots are washed before entering the processing plant. "Baby" carrots have become very popular as a quick, nutritious snack and easy to use in cooking as they are already peeled. Baby carrots aren't actually tiny carrots; they come from a large carrot that has been rolled over blades and thrown around in a metal cage to be rubbed down to create a short, round-ended "baby" carrot. Carrot waste from processing is used in pet and livestock feed.

Dark orange and dark green leafy foods are good sources of Vitamin A (carrots, sweet potatoes, spinach and other leafy greens, squash, apricots, mangoes, and cantaloupe). In fact, the more colorful foods are high in many other nutrients as well. Make your food choices by **eating a rainbow** everyday.

Are raw carrots more nutritious than cooked ones?

No. Cooking breaks down the carrot fibers, making Vitamin A more available.

Water–The Most Common Material on Earth

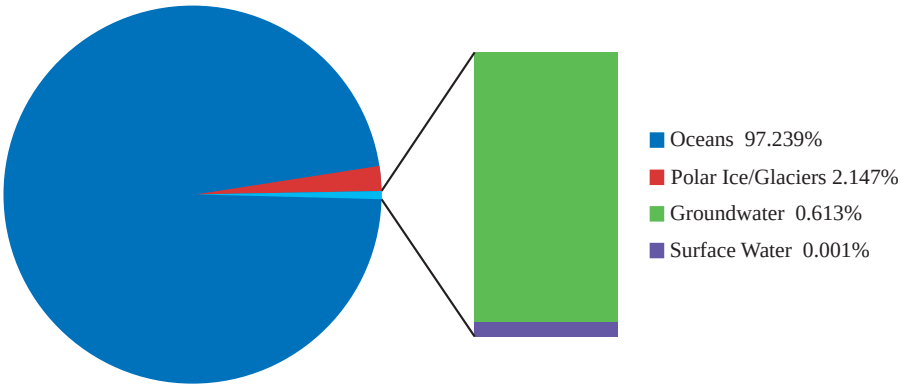


The water cycle is the circulation of the earth's water in a never-ending process. The heat from the sun causes (1) water from the ocean, streams, lakes, and even plants to evaporate. As the water vapor rises, it is cooled by the upper air. Cold air cannot hold as much water vapor as warm air so (2) water vapor condenses into water droplets and creates clouds. The wind carries clouds over the land and (3) water falls back to earth as precipitation.

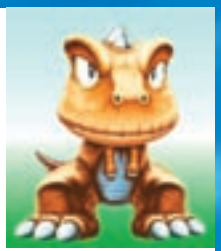
Water, water everywhere and just a drop to drink

Remember that about 70% of the earth is covered by oceans and those oceans hold more than 97% of all the water. Just over 2% of the water is frozen in glaciers. That means that less than 1% of the earth's water is available for drinking, and most of that is groundwater. The very thin purple line at the bottom of the bar to the right of the pie chart represents all the combined water in lakes (0.017%), the atmosphere (0.001%) and rivers (0.00001%)

Total Water on Earth



When you fill a glass of water to drink, you are drinking water that is billions of years old. At one time a dinosaur drank that same water. In the water cycle, water moves from the earth to the air to the earth again. It changes from solid to liquid to gas, over and over again. Water can change its form (solid, liquid, gas) and its location, but the total quantity remains the same.



Go to: *http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/watercycleq.html* to take quiz with animated water cycle

Water is Life!

All living things (plants, animals, humans) must have water to survive. The amount of water on earth stays the same. It is never 'used up', but continues to move through the water cycle. However, the water in a specific location can change in amount or form, sometimes we have a drought and sometimes we have extra snow or rain. A growing human population puts pressure on available water.

Condensation: The process of water vapor in the air turning into liquid. As water vapor rises it cools and becomes liquid again. These droplets form around dust particles in the air and become clouds.

Evaporation: Changing from a liquid or solid state to a vapor or gas. Only pure water evaporates. Substances like salt and minerals are left behind when water evaporates.

Groundwater: Water which has seeped below the earth's surface and is held there in the underlying sand and gravel. Water bearing layers are called **aquifers**. In Washington, 2/3 of the people get their drinking water from aquifers.

Percolation: The movement of water into soil through pores, holes and cracks.

Precipitation: Rain, snow, hail, sleet, dew, and frost.

Transpiration: Water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface through leaf pores.

Washington Agriculture

Dairy Cows

Provide over 90% of the entire planet's milk supply.

From the milk in your cereal to the hamburger you have for dinner, cows are a large part of your daily life. Farmers raise cows for the dairy products they produce like milk, ice cream, cheese and butter, as well as beef and a whole list of by-products.

Because cows are mammals, they must have a calf to cause their bodies to produce milk. After calving, dairy cows produce milk for 305 days and then are allowed a "dry" period for 60 days prior to calving again.

Colostrum is the first milk produced by mammals after giving birth. It contains antibodies that protect against disease and infection. It also provides energy and nutrition to newborns. Babies' immune systems are not fully developed when they are born. They rely on immunity to be passed to them through their mother's colostrum. A calf needs to receive colostrum as soon as possible following birth.

Research has proven that colostrum may improve human health as well. It contains more than 250 beneficial substances. Colostrum powder can be used in sports nutritional drinks and bars and yogurt. It also can be a benefit to cosmetics and hygiene products like lotions, cosmetic gels, shampoo, soaps, toothpastes and mouthwash.

Career Highlight

Name: Amber Curry

Career: Executive Assistant for La Belle Associates, Inc.(Bovine Colostrum products)

Education: BA in General Studies with a minor in Communication

Job Description: Directing sales calls, assisting with accounting, and helping the CEO track all aspects of the company.

Skills: Multi-tasking abilities, being very organized, and approaching each work day with good humor.

I grew up on a dairy farm so my knowledge of what Colostrum is has aided me in knowing how to do my job more efficiently.

Food, Agriculture and Natural Resources Careers

Each year we need new college graduates to fill 50,000 jobs in the food, agricultural and natural resource system.

http://www.agriculture.purdue.edu/usda/careers/

Fun Dairy Facts & Trivia

- Cows spend about 8 hours each day eating.
- *Cows eat between 80 and 90 pounds of grass, hay and feed daily.*
- Cows move their jaws about 40,000 to 60,000 times per day just chewing foods.
- The main breeds of dairy cows are Holstein, Jersey, Brown Swiss, Guernsey and Ayrshire.
- A cow udder holds between 25 and 50 pounds of pure milk.
- All cows are female. Male cattle are called bulls. A young female cow is called a heifer.
- Cows have no upper front teeth.
- Cows can sleep while standing.
- The average cow drinks from 30-50 gallons of water each day – about a bathtub's worth.

Check out these soil websites:

Smithsonian exhibit "Dig It! The Secrets of Soil" at http://forces.si.edu/soils/

"Dr. Watts"

Science for Kids, Agricultural Research Service http://www.ars.usda.gov/is/kids

http://www.ars.usda.gov/is/kids/ProtectOurPlanet/HealthySoil/SoilMicrobesHome.html

http://www.ars.usda.gov/is/kids/CreatureFeature/Nematodes/NematodesHome.html

Skagit Valley Tulip Festival

April 1 - April 30 is the 29th annual Skagit Valley Tulip Festival. Washington is known for beautiful fields of tulips and daffodils. The bulbs are harvested for sale after blooming.