TAKE A DEEP BREATH
(Modified for ADEED)

This Alaska Department of Fish and Game lesson has been selected for Yukon Flats School District use by a team of education specialists at the University of Alaska Fairbanks Geophysical Institute.

This lesson was taken from the *Alaska's Ecology* notebook (2005). Page numbering is not consecutive as material has been obtained from different sections of the publication.

The lesson addresses the following Alaska Grade Level Expectations:

Science

[6] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

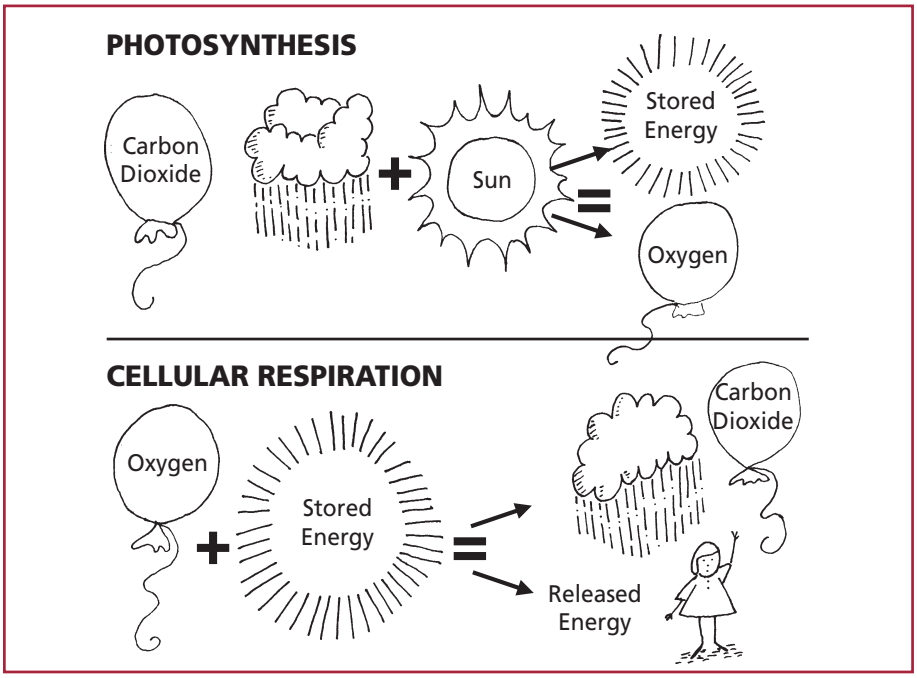
[6] SC3.1 The student demonstrates an understanding that all organisms are linked to each other and their physical environments through the transfer and transformation of matter and energy by recognizing that organisms can cause physical and chemical changes (e.g., digestion, growth, respiration, photosynthesis) to matter and recognizing the importance of energy transfer in these changes.

Added Materials

Alaska Ecology Cards

Take A Deep Breath

2 EXTENSIONS



Section 1
ECOLOGY ACTIVITIES

Grade level: K - 6

State Standard: S A-14

Subjects: Science

Skills: Inferring, generalizing, applying, predicting

Duration: 50 minutes

Group Size: small

Setting: Indoors

Vocabulary: Carbon dioxide, cellular respiration, energy, gas, living things, minerals, oxygen, photosynthesis, respire

Objective:

Students will explain that plants are needed by all other living things to survive.

Teaching Strategy:

Students play a card game that involves holding their breath to demonstrate photosynthesis.

Materials:

For each student: 4 or 5 Carbon Dioxide and Oxygen Cards (*following*). Table or floor space.
OPTIONAL: Stopwatch or watch/clock with a second-hand.

Background:

See INSIGHTS, *Section 1*, *Elements of Ecosystems*: "*Energy Exchange*."

Procedure:

1. Time students while they hold their breaths. Record the lengths of time if desired.

2. With the class, discuss why students had to stop and breathe. Explain that most **living things** need **oxygen** in order to use the **energy** and **minerals** in their foods. H*umans and most other living things, including plants and algae, breathe in oxygen and breathe out* ***carbon dioxide*** (this is called **cellular respiration** - *see the extension at the end of this activity*). The teacher may want to pantomime this process.

3. Spread the Oxygen and Carbon Dioxide Cards on a table or on the floor. Explain that each card represents the air of an ecosystem.

4. Ask 4 students to volunteer to be "animals," to model what might happen if there were no plants on earth to produce oxygen.

5. As each "animal" takes a turn, it breathes in, turns over an Oxygen Card into Carbon Dioxide, and breathes out to show the exchange of gasses that occurs when we breathe.

6. Animals must hold their breath until the next turn. Each animal can continue playing as long as

it can hold its breath and as long as it has oxygen to breathe.

7. Ask the class to guess what will happen to the players. Play the game to find out. (*Students will run out of breath as they deplete the oxygen cards.*)

8. Explain that plants and algae are very special because they take the carbon dioxide out of the air and put oxygen back in. No other group of living things does this to the extent plants and algae do. Explain that when plants and algae **photosynthesize**, they remove carbon dioxide from the air, combine it with water and sunlight, and make food (which they use) and oxygen (which they put into the air).

NOTE: *Although plants **respire** (take in oxygen and release carbon dioxide), they produce much more oxygen through photosynthesis than they take in through cellular respiration.*

9. Ask for 4 more volunteers to act like plants and algae in the game. Pair each animal with a plant or algae and place partners across the table from each other.

10. Take turns and breathe as before, but this time, the animals can breathe not only when they turn over an Oxygen Card, but also when their plant/algae partner turns over his or her plant/algae Carbon Dioxide Card.

11. Ask the class to predict what will happen when they replay the game with some players who are plants and algae and others who are living things. Replay the game to test the prediction.

VARIATION FOR OLDER STUDENTS
12. Play several rounds of the game and ask the students to adjust the number of plant players so that just enough oxygen get produced to support the cellular respirators, and just enough carbon dioxide gets produced to support the plants.

13. Discuss the need for a balance between the population of plants and animals as it relates to current environmental concerns (*human over-population, deforestation, ongoing development, pollution, etc.*)

Evaluation:
Students draw a picture or describe in writing the relationship between plants, animals, and the oxygen and carbon dioxide found in the air.

EXTENSION:
A. **Experiment with plants.** Put a well-watered potted plant inside a plastic bag and seal the bag (with a twist-tie or tape). Put the plant in a sunny or well-lighted spot. Observe what happens to the inside surface of the bag. Ask students where the water droplets came from. Discuss cellular respiration (*reverse of photosynthesis*).

B. ***Discuss The Lorax.*** *Read The Lorax* by Dr. Suess aloud to the students. Ask them to describe in writing, if possible, what problem wasn't discussed in the book when the Oncelers cut down all of the trees (*the depletion of oxygen*). Students should defend their ideas.

Curriculum Connections:
(See appendix for full citations)

Books:
The Air I Breathe (Kalman)

Ecology (Pollock)

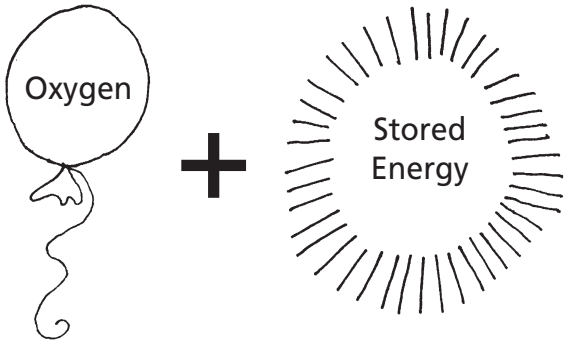
The Lorax (Seuss)

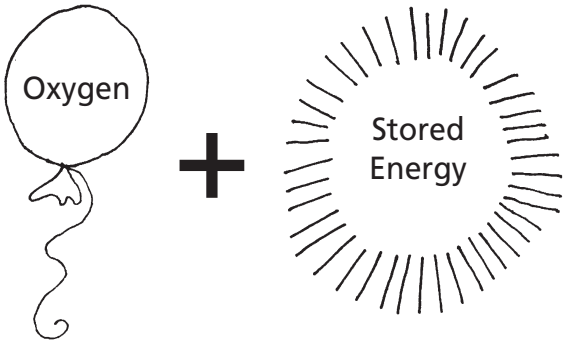
Photosynthesis (Silverstein)

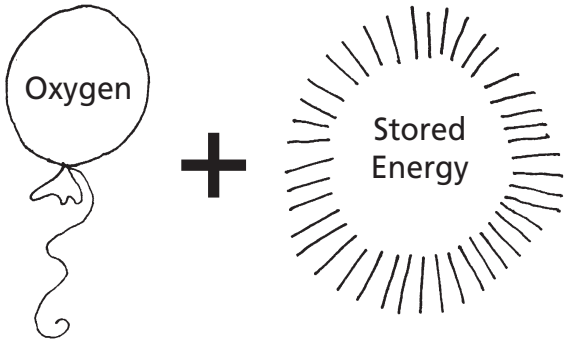
Media:
The Lorax

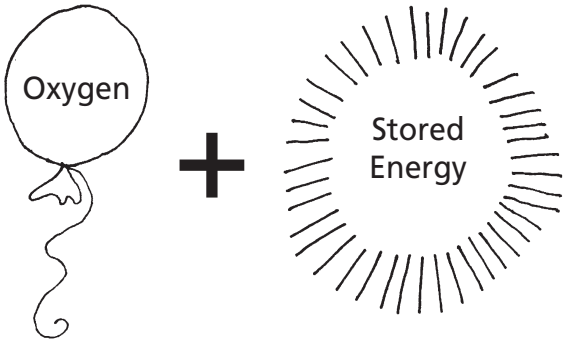
Teacher Resources:
(See appendix)

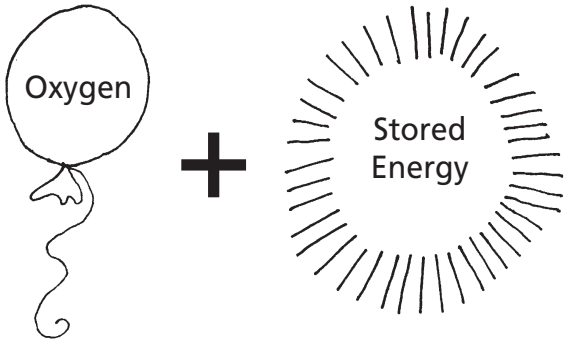
Oxygen Cards for "Take A Deep Breath"

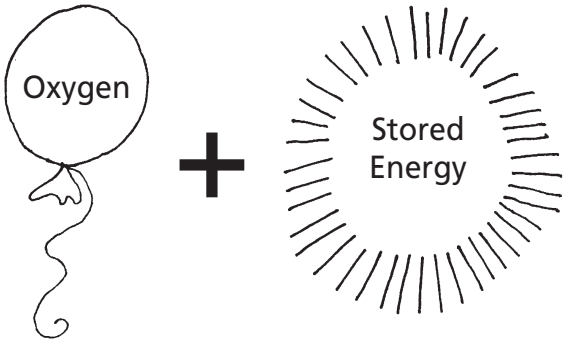


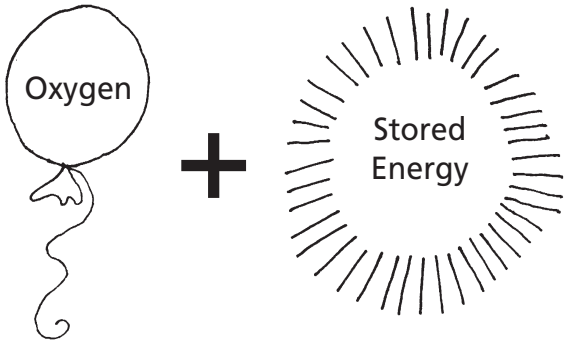


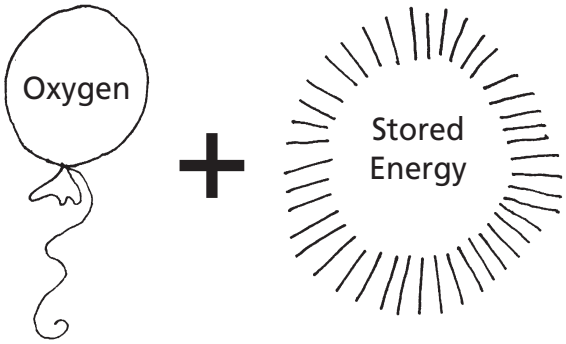




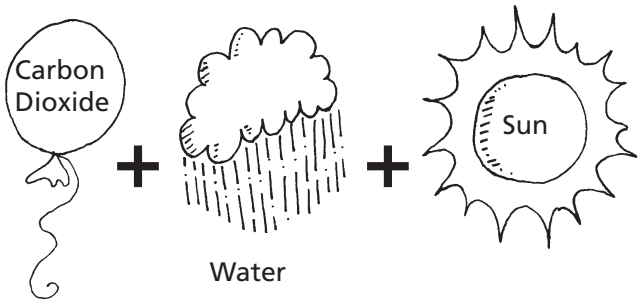


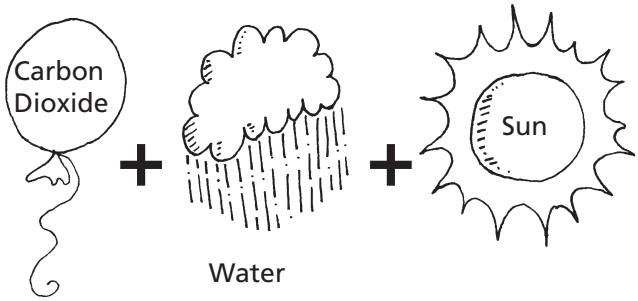


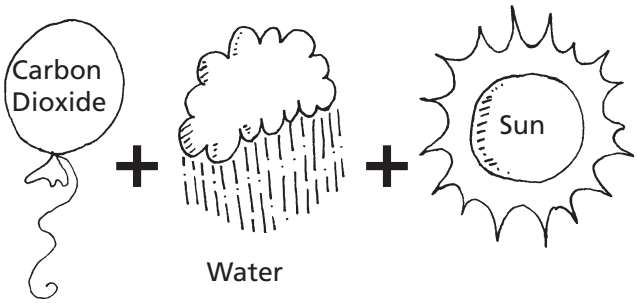


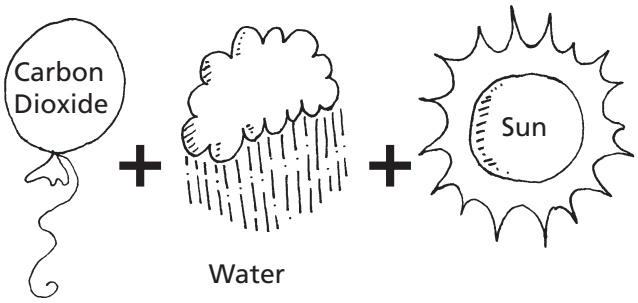


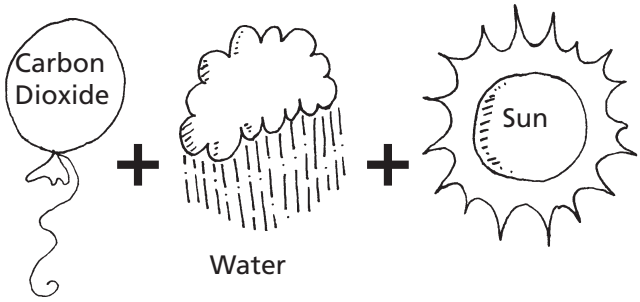
Carbon Dioxide Cards For "Take A Deep Breath"

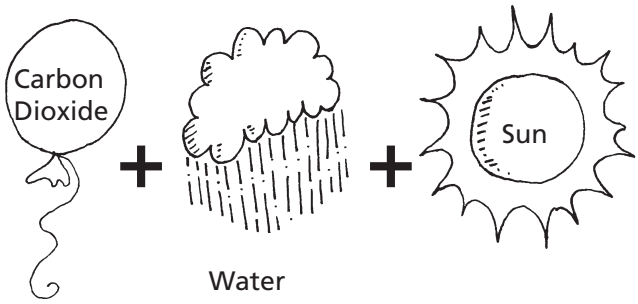


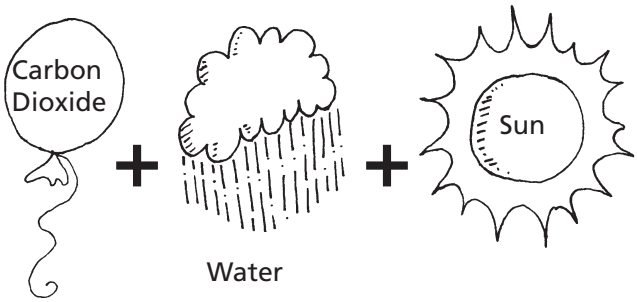


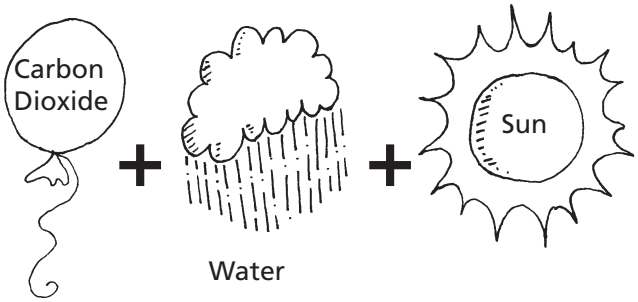












Elements of ECOSYSTEMS

Climate (*temperature, sunlight, wind, rain*), **topography** (*elevation, steepness, aspect*), and **soil** (*composition, depth, permafrost*) are the major **nonliving** elements that shape **ecosystems** for all **living things** and the **energy** exchange that links them.

Imagine a landscape devoid of living things. In a way, a lunar landscape, but with familiar landmarks. That is the canvas for painting an ecosystem – *the complex of living organisms and their physical environment*. These living and nonliving elements are *linked by a flow of energy and a cycling of materials.*

Section 1
ECOSYSTEM INSIGHTS

An ecosystem can be as small as a pond or as large as a continent. Prairie, rainforest, tundra, wetlands, coral reef – all are examples of ecosystems. All run on energy from the sun.

SUN'S ENERGY – ESSENTIAL FOR LIFE

Energy from the sun heats the surface of the earth to temperatures where life can exist. Both the amount of energy that reaches the surface and the duration of time the energy is present determine the **temperature**. The tilt of the earth's axis changes both of these factors on a daily and seasonal basis. This sets the stage for world **climate** differences, a major determinant of whether our local ecosystem is tundra, trees, or desert.

CLIMATE & ECOSYSTEMS

The sun's energy not only warms the environment to a degree where life can occur, but is a key ingredient in **photosynthesis** (food production from light energy, water, and carbon dioxide). This food production serves as the foundation for all life.

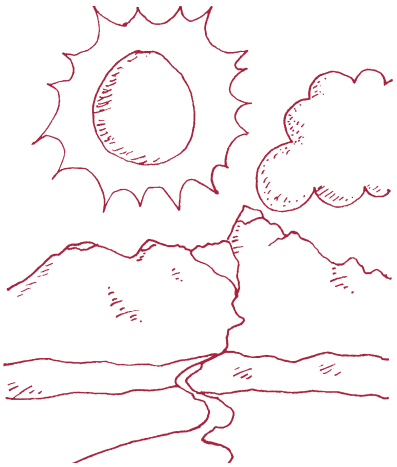
Photosynthesis Process. Plants and fungi absorb **photons** of sunlight from dawn to dusk. The energy contained in the photons is used by the cells to restructure chemical bonds and manufacture food sugars from mineral nutrients and water from the soil and carbon dioxide from the air.

Winter Dormancy. Plants cannot photosynthesize at temperatures below 19.4°F (-7°C). Other metabolic processes such as respiration also do not occur at temperatures much below this point. When cold temperatures and meager sunlight halt photosynthesis, growth stops and plants become dormant.

Summer Growth Surge. When temperature and sunlight allows, Alaska's plants grow more rapidly in order to complete their cycle in the short time available. Scientists studying white spruce in Alaska and Massachusetts found that the Alaska trees produced the same number of a certain cell, but in half as much time.

Comparative Study. Ironically, when scientists moved Alaskan trees to the Lower 48, they grew very slowly. In order to make them grow as fast as they do in Alaska, the length of daylight has to be increased to match Alaska summers.

ALASKA'S LANDSCAPE ICE AND FIRE



Glaciers and volcanoes have played major roles in shaping Alaska's landscape. About 100,000 glaciers still exist in Alaska, covering about 29,000 square miles or 5 percent of the state. Active volcanoes number more than 80.

Superlatives. Alaska's 365 million acres encompass about 34,000 miles of marine coastline, more than 3 million lakes, 39 mountain ranges (including North America's tallest mountain at 20,320 feet), places with more than 200 inches of precipitation annually, and places receiving as little as 5 to 7 inches of total precipitation.

Extremes. Alaska spans the latitudes of 51°13' to 71°23' north. The state experiences temperatures ranging from the 30s to 90s during the summer to the 50s to minus 70s during the winter. Daily sunlight varies from several months of total darkness to several months of total daylight above the Arctic Circle.

Permafrost Enhances Precipitation. Areas of **permafrost** (*perennially frozen ground*) which underlie a majority of Alaska keep water on or near the surface. Water seems abundant because snowmelt and rain cannot drain away. Because of that, even though **precipitation** in Arctic and Interior Alaska is similar to that of deserts, it is enough to support plant growth.

Rainy Coast. By contrast, Southeast and Southcentral Alaska's coastal lands are awash in rainfall. There is no permafrost. The rain makes the area prone to erosion if vegetation is stripped from the steep slopes.

ALASKA'S SNOWY BLANKET

Precipitation in Alaska comes from snow as well as rain. Snow affects the ecosystem in several ways.

1. *Extends Darkness.* Deep snow cover significantly reduces the amount of sunlight reaching buried plants, extending the period of darkness and reducing the time available for photosynthesis. (*See adaptation fact sheets in Alaska's Tundra & Wildlife*, INSIGHTS *Section* 3.)

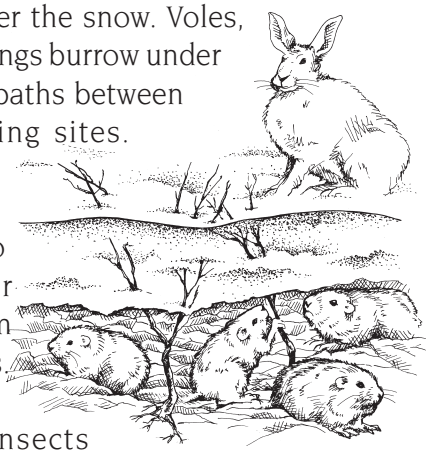
2. *Protects or Scours.* In many wind-blown areas, snow helps to shape vegetation patterns. Under its protective drifts, more plants can survive and thrive. On exposed ridges, wind-blown snow acts as an abrasive to scour away all but the most hardiest or smallest plants.

3. *Retains Earth's Heat.* Snow has great insulating qualities that help life survive in severe environments. Snow is a good **insulator** because air is trapped in between **snow crystals**. The trapped air, a poor **conductor** of **heat energy**, insulates the ground from winter temperatures.

When snow falls in autumn it covers soil that has stored heat energy over the summer. Without additional input of radiant energy from the sun, the ground cools gradually, but **uncompacted** snow acts as an insulating blanket and traps some of the heat given up by the ground. As a result, the ground stays

warmer than winter air, remaining close to 32°F (0°C) – as long as there is a sufficient covering of snow. The ground cools, or gives up heat energy relatively slowly as winter progresses.

Life Under Snow. Some animals are **subnivean** and remain active under the snow. Voles, shrews, and lemmings burrow under the snow and dig paths between feeding and resting sites. Ptarmigan and grouse fold their wings and dive into loose snow for protection from cold and predators.



Some dormant insects rely on the insulating properties of snow to protect them from cold and wind. Insect eggs, cocoons and adults find shelter under vegetation and in the soil.

TOPOGRAPHY & ECOSYSTEMS

Sea Level to Mt. McKinley. Since Alaska rises from sea level to the highest mountain on the continent, the topography of the land plays an important role in shaping the pattern of our weather and our ecosystems. Mountain ranges block rain systems, make their own weather and winds, or concentrate rainfall.

Drainage or Pooling? Steep slopes drain moisture quickly and hamper soil development, limiting what can grow there. Low-lying areas or flats may be underlain by permafrost, creating boggy soils that limit plant growth by drowning their roots. Plant growth on dry sites are different from those on wet sites.

Look for a Sunny Slope. The **aspect** or compass direction of a slope determines exposure to sunshine or wind, how soon the soil warms in spring, and if snow will be scoured away or lay as a protective blanket. Plant communities on north-facing slopes have different members from those on south-facing slopes.

SOIL & ECOSYSTEMS

Alaska's Young Soils. Recent glaciation over much of Alaska left behind coarsely crushed rock and fine rock flour devoid of organic material. These **young soils** lack variety and depth.

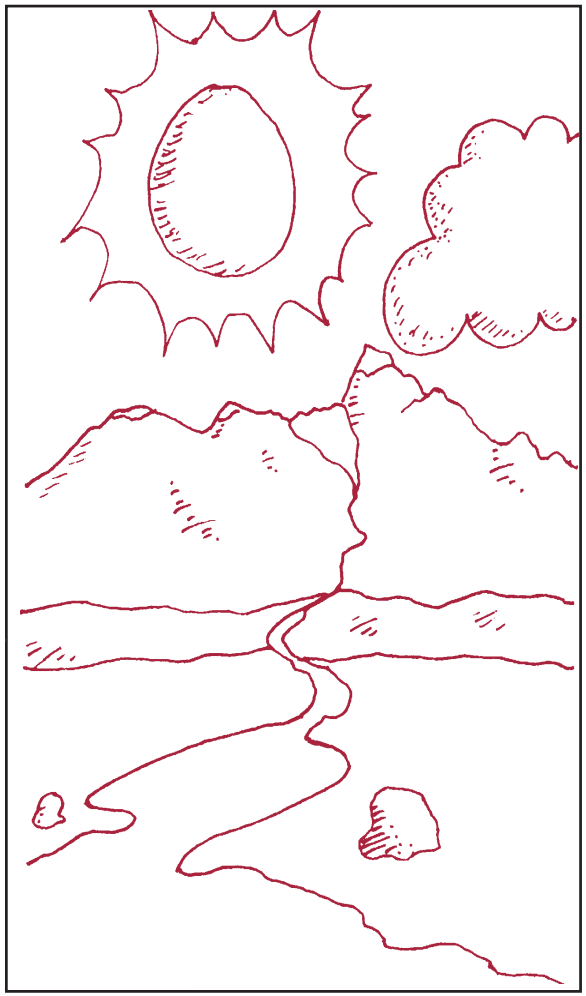
Other Plants Prepare a Base. Plants need a foundation for their **roots.** Trees especially depend on many years of other plant growth and accumulation of plant debris to form the **organic soils** that will support their growth.

Permafrost's Chilling Effect. Permafrost is most common in areas with a mean annual soil temperature below 27°F (-3°C). Locally, on south facing slopes or in areas of good drainage, no permafrost may exist.

Roots Need to Breathe. Soil depth and standing water affect a plant's ability to "breathe." Cells in leaves and the branches absorb **oxygen** from the air, but the cells in the roots must absorb oxygen from the soil. Trees literally drown if their roots become waterlogged. Even in arid environments like the Interior, trees and other plants can become waterlogged because permafrost does not permit water to drain away from their roots.

Cold Creates Treeless Muskeg Soils. Cold temperatures slow the growth and decay of plant materials and that slows the development of organic soils. If dead plants accumulate faster than they can be decomposed, an acidic basin called a **muskeg** forms. Muskeg soils, often found within boreal forests, are notoriously poor environments for most tree and plant growth.

Bacteria Make Nutritious Soil. Plants must also have **nitrogen** in order to grow. Most of the nitrogen on earth is in the air, but plants are only able to use nitrogen that is in the soil. Without the soil's nitrogen provided by microscopic bacteria called "nitrogen-fixers," plants could not survive.



Non-living Things

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Living Things

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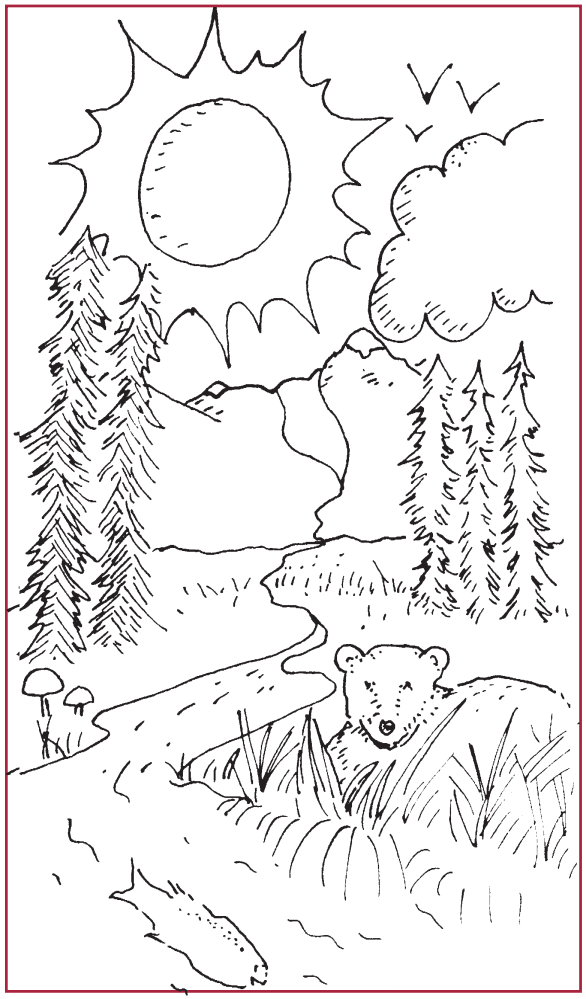

Ecosystems