Science Benchmark: 04:03

Earth materials include rocks, soils, water, and gases. Rock is composed of minerals. Earth materials change over time from one form to another. These changes require energy. Erosion is the movement of materials and weathering is the breakage of bedrock and larger rocks into smaller rocks and soil materials. Soil is continually being formed from weathered rock and plant remains. Soil contains many living organisms. Plants generally get water and minerals from soil.

Standard III:

Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Shared Reading

Getting to Know Rocks and Soil

We live on a rocky world! Rocks are all around us. We live on rocks even though we can't always see them. These rocks are sometimes hidden deeply beneath our feet, and sometimes they are exposed on Earth's surface so we can see them. On mountaintops, where the soil is very thin, rocks often poke through.

All rocks are made of mixtures of different *minerals*. Minerals are the building blocks from which rocks are made. People who study rocks make observations of rocks they discover. They identify the different minerals in the rocks they find. How can they do this? Each mineral has a certain color (or colors), appearance, shape, hardness, texture, crystal pattern, and possibly a smell that sets it apart from another. As scientists test each mineral's characteristics, they are able to tell which minerals are in the rocks.

Rocks can change over a period of time. The rocks we see today may have looked differently millions of years ago. How rocks change depends on the type of rock and where it is found on Earth. Rocks on Earth's surface are changed by *weathering*. Weathering of rocks can be caused by the action of plants, wind, heat, or water. The roots of plants can grow into the cracks and soft parts of rocks. As the roots grow larger, they break off pieces of rock from the main rock. Plants can also grow on the rocks when the conditions are right. The acids in plants dissolve parts of the rocks that the plants are closest to. Wind blows sand and dirt onto the surface of rocks and wears them away. Heat from the sun causes rocks to expand. At night the rocks contract. This constant expansion and contraction will eventually break up the rocks.

---

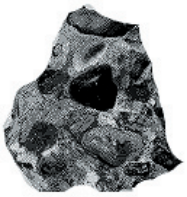
minerals : *solid materials formed in nature that has a specific crystal structure*
weathering : *the breaking down of rocks into smaller pieces called sediments*

Grade	Benchmark	Standard	Page
04	04 : 03	03	10.1.1

When running water carries rocks down a river or stream, the water knocks the rocks against each other and they break apart. Water can also dissolve the soft parts of rocks and leave holes or water lines where rocks are worn away. However, most weathering is caused by the action of water as it runs into the cracks of rocks. During the day when snow *thaws,* water seeps into the cracks of rocks. At night when the temperature gets cold, the water *freezes*. As it freezes, it expands and breaks the rocks apart.

The sediments resulting from weathering may not stay in one place very long. The broken rock or sediments can be carried away by wind, moving water, or moving ice. This is called *erosion*. The sediments gather at the mouths of rivers or the bottom of lakes or shallow seas. Over time, layers of sediments continue to build in these bodies of water and press down on the layers beneath. Some minerals in the sediment dissolve in the water and act like cement, holding the sediments together. When this happens a solid mass of rock is formed. These rocks are called *sedimentary* rocks. Sedimentary rocks usually have rounded sediments, or particles, and are often layered. Some common types of sedimentary rocks found in Utah are: sandstone, conglomerate and shale.

Sandstone



Conglomerate

Shale

There are three types of rocks: sedimentary, igneous, and metamorphic. In the next few paragraphs you will learn how and where these rocks form. *Igneous* rocks form when melted rock rises up from inside Earth and cools. This cooling may happen below Earth's surface or on Earth's surface. When melted rock is below Earth's surface (magma), it takes many years to cool. As it slowly cools, the igneous rock formed may have crystals, which are very easy to see. When melted rock is above Earth's surface (lava), it doesn't take long to cool. Because the surface cools rapidly, these igneous rocks may have air holes in them or appear glasslike. They hardly ever form crystals and are never layered.

---

erosion : *the movement of rock fragments from one place to another*
freezes : *turns to ice*
igneous : *rocks formed when magma, or melted rock, from deep inside Earth, rises and cools*
sedimentary : *rocks formed from sediments that have settled into layers*
thaws : *melts*

Many igneous rocks are found in Utah. Below are four igneous rocks that are very common in Utah. Obsidian looks like black glass. Native Americans often used this rock to make spears and arrow heads. Granite is often used as building material. It has visible crystals in it. Pumice floats on water because there are air pockets in this rock. Basalt is a heavy, dark rock because it has the element iron in it. It may have air holes throughout it also, but it doesn't float. Many people use this rock for decoration in their yards. Which of these igneous rocks formed inside Earth? Which ones formed on Earth's surface?


Obsidian


Granite


Pumice


Basalt

Metamorphic rocks are rocks that have been changed inside Earth by heat and pressure. Heat comes from volcanoes and hot rocks under Earth's surface. Pressure comes from the layers of rock pressing down on layers below them. Both heat and pressure must exist at the same time to form metamorphic rocks. Metamorphic rocks may have crystals or layers. Sometimes we call the crystals gems because they are rare or valuable. Some of the most valuable gemstones like rubies, sapphires and garnets are found in metamorphic rocks. Other kinds of metamorphic rocks may be used in buildings and art because of their beauty. Metamorphic rocks found in Utah are marble, gneiss (nice) and schist. Marble starts out as limestone. Under heat and pressure the crystals in limestone recrystalize, making marble harder and stronger than limestone. Marble is used in buildings and carving statues. Gneiss begins as granite. Under heat and pressure the minerals line up with each other, giving the rock a banded appearance. Schist begins as clay sediments. Erosion transports the clay sediments through water to the bottom of a lake or shallow sea. As pressure increases and mineral cementing takes places, the clay turns into shale, a sedimentary rock. If heat is also added, it will help turn shale into slate, a metamorphic rock. If the heat and pressure continue, mica crystals begin to form in the slate. These mica crystals grow together, giving schist a very shiny and sparkly appearance.


Marble

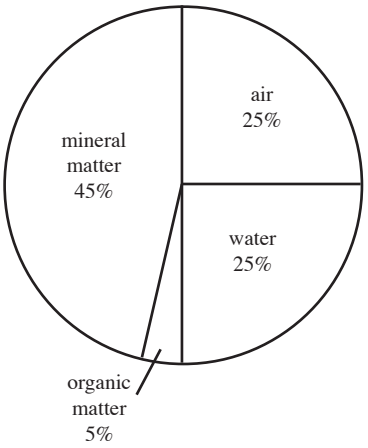

Gneiss


Schist

metamorphic : *rocks that has been changed by heat and pressure*

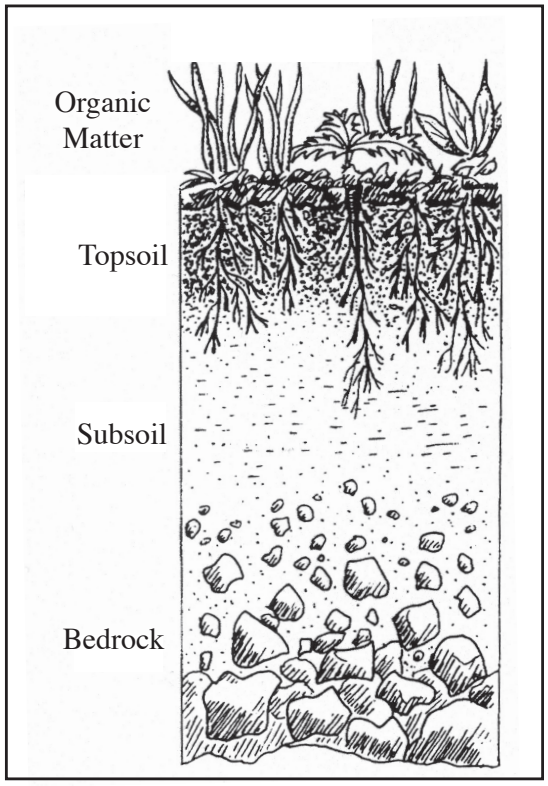
Soil forms as a result of weathered rock. Soil is partially made up of particles of rocks and minerals. Rocks and minerals are *nonliving* soil components. The particles of rocks and minerals found in soil have broken away from larger pieces of rocks and minerals. Most of the particles are in very small pieces but of different sizes. The best soils for growing crops have equal amounts of large, medium and small-sized particles. Other nonliving parts of soil are water and air spaces between mineral particles. They are important for plant growth. The circle graph at the right shows the percentage of these components on parts of topsoil.

Components of Topsoil



Soil also contains *organisms*. Living organisms are an important part of soil. Living organisms break down or decompose dead plants and dead animals. This makes soil rich and healthy for plants to grow in. Look at the *soil profile* to the right. If you dug a hole into the soil, you would see that it has layers like this one. An average soil profile consists of three layers: topsoil, subsoil, and bedrock.

Soil Profile



The top layer of soil is called *topsoil*. This layer is usually darker in color because it contains many living and dead organisms. Creatures that live in the soil, like earthworms, insects and snails live in this layer because the topsoil is rich in *nutrients*. When these living creatures decompose dead plant and animal material, more nutrients are added into the soil. These nutrients become small enough to be absorbed by the roots of plants. The topsoil layer is where plants can absorb water, mineral nutrients, and air. All animals live off this layer. Without this layer, life on Earth would be impossible. It takes about 1,000 years to create one inch of topsoil. In Utah, our topsoil depths range from one to 12 inches.

---

nonliving : *never lived*
organisms : *living plant or animal life*
soil profile : *side view"slice" of the different layers of Earth*
topsoil : *the top layer of soil that contains living organisms and nonliving things*
nutrients : *substances that organisms need in order to survive and grow*

The middle layer is the *subsoil*. It has larger grains of rocks and minerals and is usually lighter in color. Plants do not grow well in subsoil because it is tightly packed and has very few nutrients.

The bottom layer is *bedrock*. Bedrock is made up of different rocks in different places. It is the bedrock that erodes and eventually becomes topsoil. Bedrock can be within a few inches of the surface or many feet below it.

Since topsoil is very precious, we want to make sure that wind doesn't blow it away or that water erodes it away. Soil that has plants on it will not erode away. When plants are growing, the roots grow down into the soil. This helps prevent soil erosion. When we receive precipitation, it falls on hillsides with and without plants. The hillsides without plants will erode in a rainstorm, causing huge gullies. The hillsides with plants will keep the soil in place. When the wind blows, the soil with no plants will blow away. The soil with plants will stay. How can we prevent soil erosion from happening? Have you ever noticed that the hillsides next to our roads and freeways have plants on them? They were planted there so during storms the soil wouldn't wash away or blow off. Another way to prevent soil erosion is to place a retaining wall on a slope. Boulders, logs, bricks, and cement are used to hold back the soil.

Plants grow best when the supply of water, air, light, and nutrients are always available for them. Soil provides a holding place for water and nutrients. Soil also gives plants *structural support*. However, plants can grow without soil if they have other ways of getting water, mineral nutrients, and something else to hold them up, like gravel or a wire cage. Today, some food crops are grown entirely without soil. This is called hydroponics. Farmers who grow their crops using hydroponics use various support systems, and they carefully monitor the nutrients so the plants will produce fruits and vegetables. You might enjoy sprouting seeds without soil. Seeds will grow on a moist paper towel in a plastic bag. Try it!

---

bedrock : *solid rock that lies underneath the subsoil that has not yet been broken down*
structural support : *help to anchor the plant*
subsoil : *the layer below the topsoil*

Science Language that Students Should Know and Use

1. **bedrock**: solid rock that lies underneath the subsoil that has not yet been broken down
2. **erosion**: the movement of rock fragments from one place to another
3. **freeze**: turn to ice
4. **igneous**: rocks that are formed when magma, or melted rock from deep inside Earth, rises and cools
5. **metamorphic**: a rock that has been changed by heat and pressure
6. **minerals**: solid materials formed in nature that have a specific crystal structure
7. **nonliving**: never lived
8. **nutrients**: substances that organisms need in order to survive and grow
9. **organisms**: living plant or animal life
10. **sedimentary**: rocks formed from sediments that have settled into layers
11. **soil profile**: a side view "slice" of the different layers of Earth
12. **structural support**: help to anchor a plant
13. **subsoil**: the layer below the topsoil
14. **thaw**: melt
15. **topsoil**: the top layer of soil that contains living organisms and nonliving things
16. **weathering**: the breaking down of rocks into smaller pieces called sediments

Resources used:

Houghton Mifflin Science Discovery Works 2003-Level 4

Harcourt Science 2002 Level 4

Harcourt Science 2002 Level 3

Dirt: Secrets in the Soil- Special project of Utah Agriculture in the classroom
Note: The video in this project is excellent and highly recommended to use as a resource in teaching this standard. Lesson plans from this project can be found on the following website: http://www.nesoil.com/images.htm

USOE and JSD Elementary Science Teacher Hands On Science and Resource Book 1995

Kindersley, Dorling. Picturepedia Plants Kindersley, Inc. 1993 Juvenile literature

Gardner, Robert. Science Projects About Plants Enslow Publishers, Inc. 1999 pg. 66-67

Rybolt, Thomas R. and Meban, Robert C., Science Experiments for Young People Environmental Experiments about Land. Enslow Publishers, Inc. 1993

Additional Resources:

Ganeri, Anita. Nature Detective Plants Franklin Watts. 1992
Illustrations with explanatory text provide information about various types of plants and how and where they grow. Includes simple projects ISBN 0-531-14194-2 Juvenile literature

King, John. Reaching for the Sun-How Plants Work 1997. Cambridge University Press
ISBN 0-521-58738-7 adult reading

Penny, Malcolm. Nature's Mysterious How Plants Grow Benchmark Books. Describes the growth and development of various plants-Juvenile literature

JSD video Dirt-Wonder Why Series #134458 26 minutes

JSB video Soil: An introduction #12697 12 minutes