NATIONAL GEOGRAPHIC

Encyclopedic Entry For Teachers

weathering

For the complete encyclopedic entry with media resources, visit:
http://education.nationalgeographic.com/education/encyclopedia/weathering/

Weathering is the breaking down or dissolving of rocks and minerals on Earths surface. Water, ice, acids, salt, plants, animals, and changes in temperature are all agents of weathering.

Once the rock has been broken down, a process called erosion transports the bits of rock and minerals away. No rock on Earths surface is hard enough to resist weathering. Together, the processes of weathering and erosion carved the Grand Canyon, in the U.S. state of Arizona. This massive canyon is 446 kilometers (277 miles) long, as much as 29 kilometers (18 miles) wide, and 1.6 kilometers (1 mile) deep.

Weathering and erosion constantly change the Earth. Weathering wears away exposed surfaces over time. It smoothes sharp, rough areas on rocks. Weathering also helps create soil as tiny bits of weathered rock mix with plant and animal remains.

Weathering can be a mechanical or a chemical process. Often, these two types of weathering work together.

Mechanical Weathering

Mechanical weathering, also called physical weathering, causes rocks to crumble. Water seeps into cracks and crevices in rock. If the temperature drops low enough, the water will freeze. When water freezes, it expands. The ice then works as a wedge. It slowly widens the cracks and splits the rock. When ice melts, water performs the act of erosion by carrying away the tiny rock fragments lost in the split.

Mechanical weathering also occurs as the rock heats up and cools down. The changes in temperature cause the rock to expand and contract. As this happens over and over again, the rock weakens. Over time, it crumbles.

Another type of mechanical weathering occurs when clay or other materials near hard rock absorb water. The clay swells with the water, breaking apart the surrounding rock.

Salt also works to weather rock. Saltwater sometimes gets into the cracks and pores of rock. If the saltwater evaporates, salt crystals are left behind. As the crystals grow, they put pressure on the rock, slowly breaking it apart.

Plants and animals are agents of mechanical weathering. The seed of a tree may sprout in soil that has collected in a cracked rock. As the roots grow, they widen the cracks, eventually breaking the rock into pieces. Over time, trees can break apart even large rocks. Even small plants, such as mosses, can enlarge tiny cracks as they grow.

Animals that tunnel underground, such as moles and prairie dogs, also work to break apart rock and soil. Other animals dig and trample rock aboveground, causing rock to slowly crumble.

Chemical Weathering

Chemical weathering changes the materials that make up rocks and soil. Sometimes, carbon dioxide from the air or soil combines with water. This produces a weak acid, called carbonic acid, that can dissolve rock.

Carbonic acid is especially effective at dissolving limestone. When the carbonic acid seeps through limestone underground, it can open up huge cracks or hollow out vast networks of caves. Carlsbad Caverns National Park, in the U.S. state of New Mexico, includes more than 110 limestone caves. The largest is called the Big Room. At about 1,200 meters (4,000 feet) long and 190 meters (625 feet) wide, it is the size of six football fields.

Sometimes, chemical weathering dissolves large regions of limestone or other rock on the surface of the Earth to form a landscape called karst. In these dramatic areas, the surface rock is pockmarked with holes, sinkholes, and caves. One of the worlds most spectacular examples of karst is Shilin, or the Stone Forest, near Kunming, China. Hundreds of slender, sharp towers of limestone rise from the landscape.

Another type of chemical weathering works on rocks that contain iron. These rocks rust in a process called oxidation. As the rust expands, it weakens the rock and helps break it apart.

Weathering and People

Weathering is a natural process, but human activities can speed it up. For example, certain kinds of air pollution increase the rate of weathering. Burning coal, natural gas, and oil releases chemicals such as nitrogen oxide and sulfur dioxide into the atmosphere. When these chemicals combine with sunlight and moisture, they change into acids. They then fall back to Earth as acid rain.

Acid rain rapidly weathers limestone, marble, and other kinds of stone. The effects of acid rain can be seen on gravestones. Names and other inscriptions can be impossible to read.

Acid rain has also damaged many historic buildings and monuments. At 71 meters (233 feet) tall, the Leshan Giant Buddha at Mount Emei in China is the worlds largest statue of the Buddha. It was carved 1,300 years ago and sat unharmed for centuries. But in recent years, acid rain has turned its nose black and made some of its hair crumble and fall.

VOCABULARY

Term	Part of Speech	Definition
acid	*noun*	chemical compound that reacts with a base to form a salt. Acids can corrode some natural materials. Acids have pH levels lower than 7.
acid rain	*noun*	precipitation with high levels of nitric and sulfuric acids. Acid rain can be manmade or occur naturally.
air pollution	*noun*	harmful chemicals in the atmosphere.
Appalachian Mountains	*noun*	large mountain range stretching from southeastern Canada to the southeastern United States.
atmosphere	*noun*	layers of gases surrounding a planet or other celestial body.
Buddha	*noun*	(c. 563-483 BCE) Indian prince, spiritual leader, and founder of the Buddhist religion. Also called Prince Siddhartha and Gautama Buddha.
carbon dioxide	*noun*	greenhouse gas produced by animals during respiration and used by plants during photosynthesis. Carbon dioxide is also the byproduct of burning fossil fuels.

carbonic acid	*noun*	chemical produced as carbon dioxide dissolves in water.
Carlsbad Caverns	*noun*	network of caves in the U.S. state of New Mexico.
cave	*noun*	underground chamber that opens to the surface. Cave entrances can be on land or in water.
clay	*noun*	type of sedimentary rock that is able to be shaped when wet.
coal	*noun*	dark, solid fossil fuel mined from the earth.
contract	*verb*	to shrink or get smaller.
crevice	*noun*	crack in a rock.
dissolve	*verb*	to break up or disintegrate.
effective	*adjective*	useful or able to perform a task.
erosion	*noun*	act in which earth is worn away, often by water, wind, or ice.
evaporate	*verb*	to change from a liquid to a gas or vapor.
expand	*verb*	to grow or get larger.
football field	*noun*	space where the game of football is played, often used as a unit of measurement: 109.7 meters (360 feet) long by 48.8 meters (160 feet) wide.
freeze	*noun*	weather pattern of temperatures below 0 degrees Celsius (32 degrees Fahrenheit).
Grand Canyon	*noun*	large gorge made by the Colorado River in the U.S. state of Arizona.
gravestone	*noun*	stone marking a person's burial place, often engraved with the person's name and dates of birth and death.
iron	*noun*	chemical element with the symbol Fe.
karst	*noun*	landscape made of limestone.
limestone	*noun*	type of sedimentary rock mostly made of calcium carbonate from shells and skeletons of marine organisms.
marble	*noun*	type of metamorphic rock.
mechanical weathering	*noun*	process of rocks crumbling due to rain, wind, or other atmospheric conditions. Also called physical weathering.
mineral	*noun*	nutrient needed to help cells, organs, and tissues to function.
monument	*noun*	large structure representing an event, idea, or person.
moss	*noun*	tiny plant usually found in moist, shady areas.
natural gas	*noun*	type of fossil fuel made up mostly of the gas methane.
nitrogen oxide	*noun*	one of many chemical compounds made of different combinations of nitrogen and oxygen.
oil	*noun*	fossil fuel formed from the remains of marine plants and animals. Also known as petroleum or crude oil.

oxidation	*noun*	chemical process of a substance combining with oxygen to change the substance's physical and molecular structure.
physical weathering	*noun*	process of rocks crumbling due to rain, wind, or other atmospheric conditions. Also called mechanical weathering.
pockmarked	*adjective*	scarred with many small indentations.
pore	*noun*	tiny opening.
remains	*noun*	materials left from a dead or absent organism.
rock	*noun*	natural substance composed of solid mineral matter.
rust	*verb*	to dissolve and form a brittle coating, as iron does when exposed to air and moisture.
salt	*noun*	mineral often used as a preservative or flavoring.
salt crystal	*noun*	single particle of salt, or sodium chloride.
seep	*verb*	to slowly flow through a border.
sinkhole	*noun*	hole formed in a rock or other solid material by the weight or movement of water.
soil	*noun*	top layer of the Earth's surface where plants can grow.
spectacular	*adjective*	dramatic and impressive.
Stone Forest	*noun*	karst formation in southern China. Also called Shilin.
sulfur dioxide	*noun*	greenhouse gas that can cause acid rain.
temperature	*noun*	degree of hotness or coldness measured by a thermometer with a numerical scale.
weather	*noun*	state of the atmosphere, including temperature, atmospheric pressure, wind, humidity, precipitation, and cloudiness.
weathering	*noun*	the breaking down or dissolving of the Earth's surface rocks and minerals.
wedge	*noun*	triangle shape.

FOR FURTHER EXPLORATION

Articles & Profiles

- National Parks Service: What's the Difference Between Weathering and Erosion?

Websites

- National Geographic Science: Erosion and Weathering