Bryce Canyon National Park

Weathering and Erosion

Sheer cliffs, rocks appearing to be impossibly balanced on one small tip, massive underground caves, and giant sand dunes: what do all these things have in common? These and other spectacular and bizarre landforms around the world are the result of the processes of weathering and erosion.

Weathering and erosion also create (and can destroy) the soils we depend on to grow the food humans need to survive. Soil erosion in Africa supports life in rain forests in South America and damages coral reefs in the Caribbean Sea!

How can weathering and erosion do all that? Let's look at the investigations you have done so far to get some clues as to how these processes work. As you know, **weathering** is the breaking down of rock into smaller pieces. **Erosion** is the process of the smaller pieces being carried to a basin by water, wind, or ice.

Physical Weathering and Round Rocks

When you shook rocks in a jar, little pieces broke off to become sand. This is one example of **physical weathering**. Physical weathering occurs when large rocks are broken into smaller rocks that are still the same kind of rock. The sand you made was still the same material as the larger piece of granite, only smaller. (You will learn about chemical weathering, a different type of weathering, later.)

You saw that the shaken granite pieces were more rounded than the pieces of fresh granite. The sharp edges and corners had been worn away by hitting other rocks. This occurs naturally when rocks have tiny particles knocked off of them by being hit by wind-blown sand or rock particles in moving water. The name for this type of physical

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ARTICLE—WEATHERING AND EROSION, P. 12

Sand abrasion is one kind of physical weathering.

Talus is evidence of a rock fall at the base of a cliff.

weathering is **abrasion**, where rocks break down by hitting or scraping against other rocks. Abrasion also happens when falling rocks hit other rocks, causing them to break apart.

When you looked at beach sand, you could see smooth, polished sand grains. These pieces of sand had been moved back and forth by waves, causing them to hit other grains of sand, rounding off any rough edges. You also observed sand particles in the stream table bouncing and hitting other grains of sand as they moved along. Now it is all coming together to make sense: angular rocks and sand particles are rounded off as they are carried along by water or wind and bang into other rocks. The farther they travel

Round, smooth river rocks

and the more they get banged around and, the rounder they become.

Ice Wedging and Rock Falls

When ice freezes, it expands with tremendous force. You saw what happened when the water in the jar froze and expanded. The force shattered the jar! This is another form of physical weathering that happens naturally when water gets into tiny cracks in a rock. At night, temperatures fall, the water freezes and expands, and the crack enlarges. During the day as the temperature rises, the water thaws and moves down further into the crack. The water freezes again the next night. With repeated freezing and thawing, the crack becomes larger and pieces of the rock break off. Ice wedging can cause **rock falls**, which occur when rocks on the side of a cliff break away. You can see evidence of past rock falls by the piles of jagged rocks called **talus** found at the base of cliffs like in the above picture. These rocks fell because a tiny crack kept enlarging until the piece broke off. You may have seen where ice wedging damaged concrete sidewalks and

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ARTICLE—WEATHERING AND EROSION, P. 13

Ice causes bricks to flake apart.

Tree roots break rocks.

curbs. Ice wedging caused pieces of brick to flake off.

Plant roots will also cause weathering by growing into cracks. The roots expand as the plant grows, breaking the rocks apart. You have probably seen a tree root that lifted and broke a sidewalk or even cracked the foundation of a house.

Weathering and Erosion Produce Soil

As the Rocky Mountains, Appalachian Mountains, and other mountains and hills

A map of the United States showing mountains, valleys, and plains.

weather, they produce **sediments**. Rivers and wind transport these sediments into basins. Layers of past sediments make up the deep, rich soils of the Great Plains, the coastal plains, and interior valleys. We depend on the food that is grown on these soils. Sometimes these sediments are carried by wind or water from mountains hundreds of miles away.

Spectacular Scenery

You already know that weathering and erosion created Grand Canyon. These same processes created the spires and hoodoos of Bryce Canyon in Utah, the rugged Badlands in South Dakota, and the rounded Blue Ridge Mountains in North Carolina and Virginia. Even Mammoth Cave in Kentucky, the world's longest cave system, was created by weathering and erosion. All of these scenic wonders were once solid rock. And now hundreds of millions of people a year visit these and other similar spots around the world. They come to marvel at the beauty that weathering and erosion have created.

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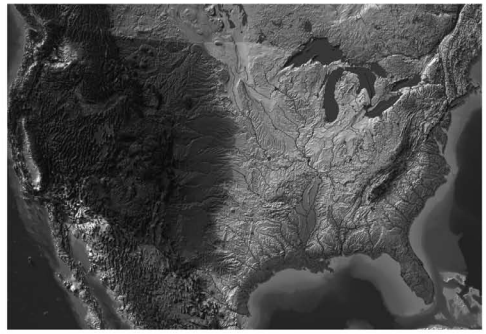

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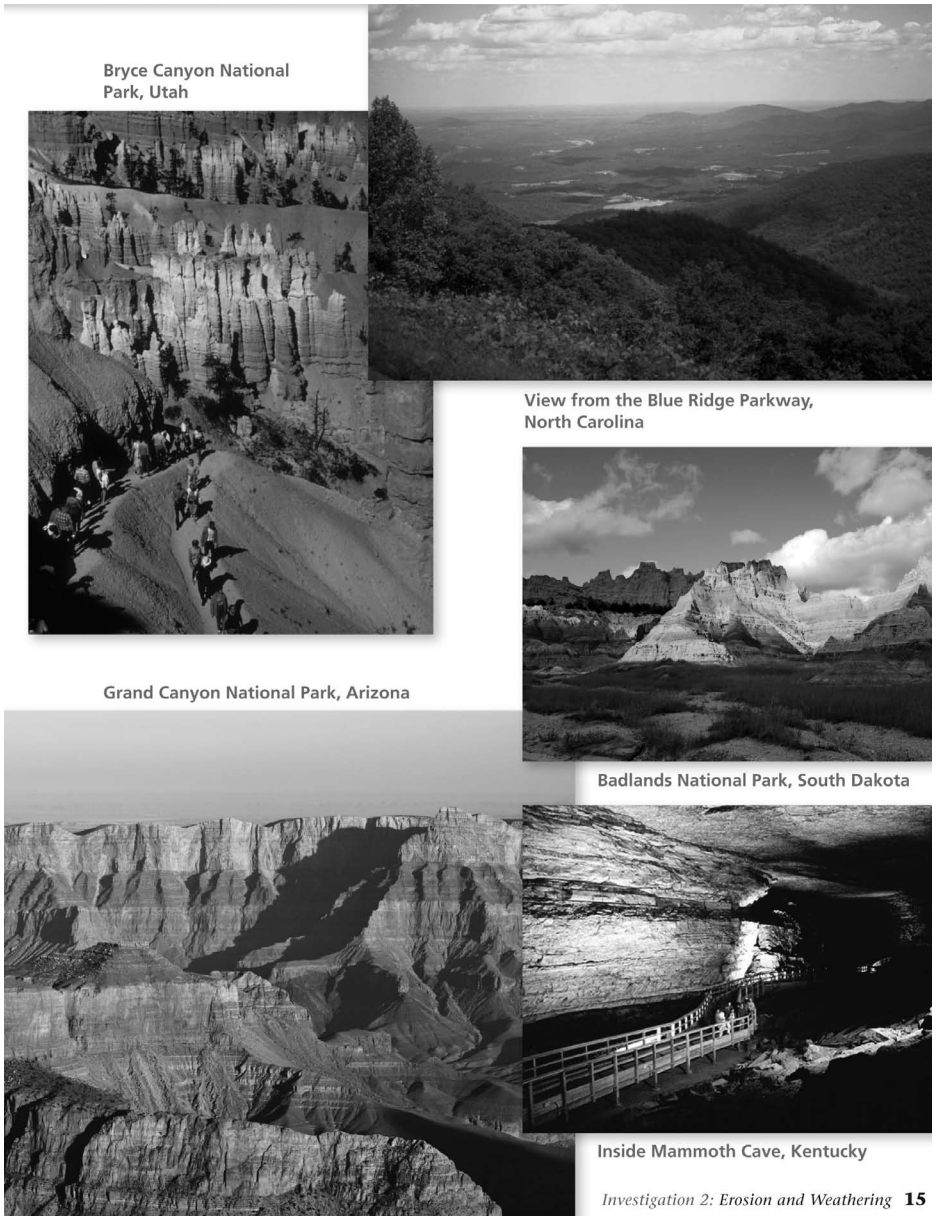
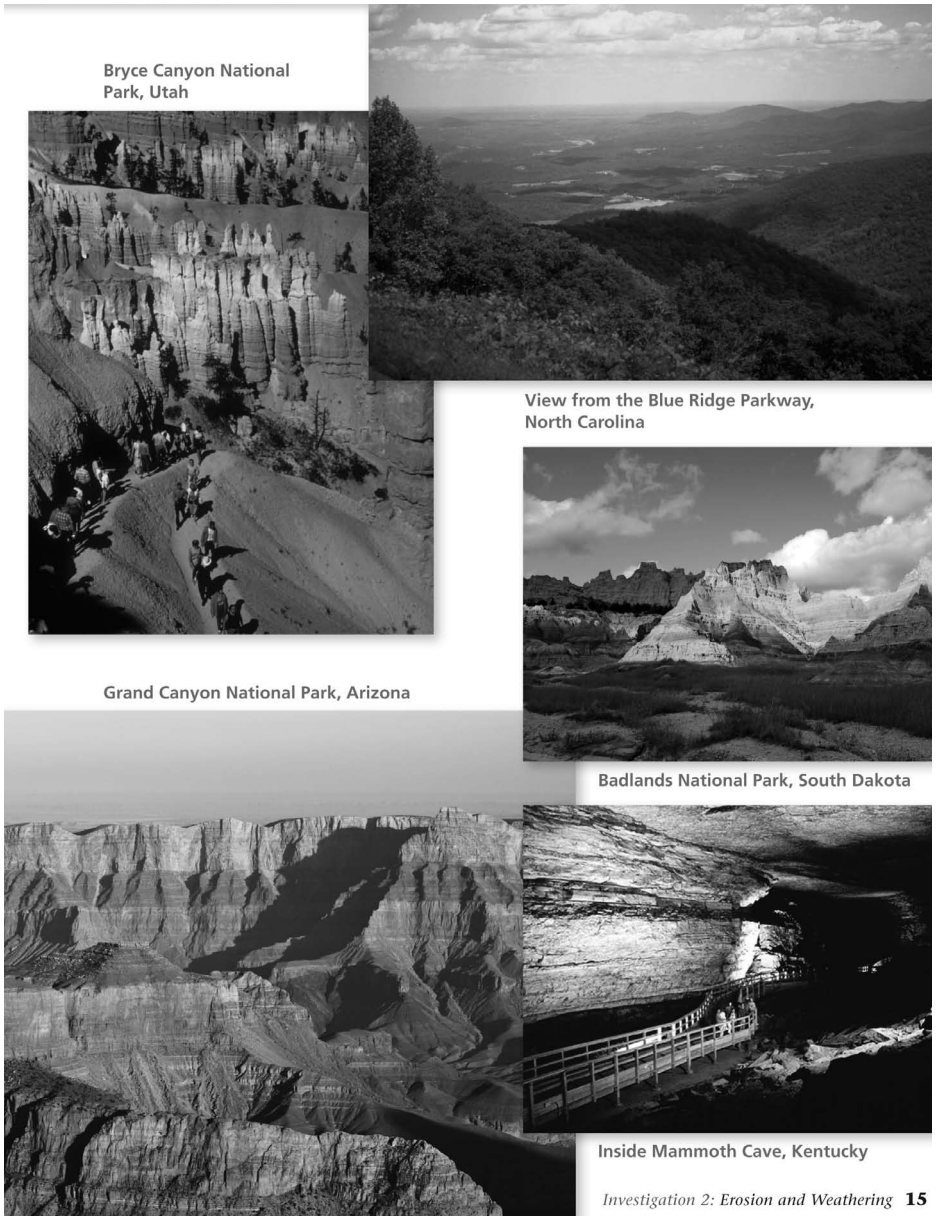
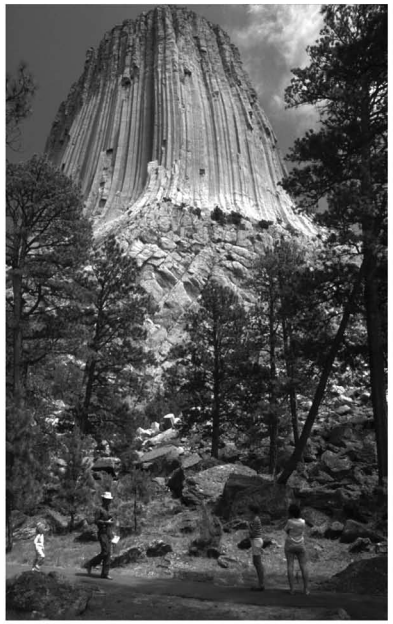
ARTICLE—WEATHERING AND EROSION, P. 14





ARTICLE—WEATHERING AND EROSION, P. 15



The surrounding sedimentary rocks have eroded away to expose the resistant igneous rock that forms Devil's Tower in Wyoming.

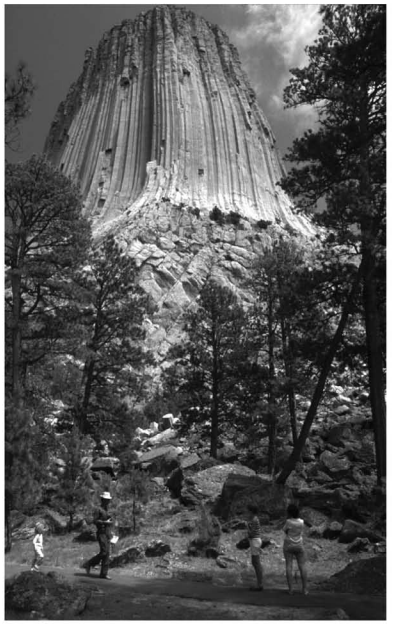
Differential Erosion

Some of the most dramatic scenery in the world occurs where softer rock is eroded more quickly than hard rock. You saw **differential erosion** in action when you watched the multimedia stream tables that had a layer of clay between two layers of sand. The water easily eroded away the top layer of sand, but the clay layer resisted erosion. As long as the clay layer was intact, the bottom layer of sand was protected. This is called **differential** erosion because the layers erode at **different** rates.

Differential erosion happens any time softer rock is eroded away leaving harder rock behind. Much of the scenery in Grand Canyon is due to differential erosion. Devil's Tower in Wyoming consists of hard rock that was once covered and surrounded by softer rock. Over the past one to two million years the softer rock weathered and eroded away leaving the column of hard rock standing.

Niagara Falls on the New York/Canadian border is another example of differential erosion. The water going over the Falls erodes the edge of the thick, soft shale layer under a hard limestone layer. This undercuts the limestone causing it to give way. This picture of the American Falls, one part of Niagara Falls, shows huge limestone boulders that have fallen. For the past 10,000 years, the Falls have continued to move upstream, eroding the rock at the higher part of the river, at an average rate of about one meter a year.

The Niagara River tumbles over a hard layer of dolomite to form 50-meter high Niagara Falls.



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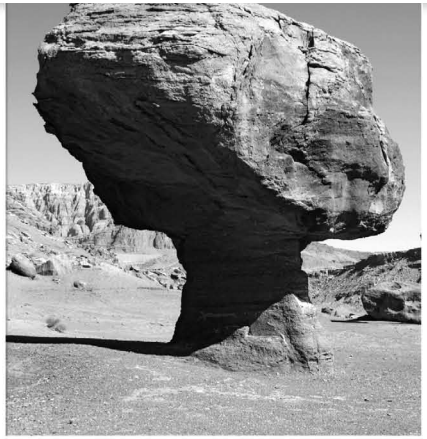
ARTICLE—WEATHERING AND EROSION, P. 16



This large mushroom rock near Lee's Ferry on the Colorado River in Arizona is another example of differential erosion.
Warning: Do NOT be standing under a rock like this when the column finally gives way.

Wind Erosion and Rain Forests

How could erosion in Africa help the Amazon rain forests, all the way across the Atlantic Ocean? Wind storms on the Sahara Desert carry dust high into the atmosphere. High altitude winds carry the dust east across the Atlantic Ocean, and sometimes to the rain forests of South and Central America. The soil in rain forests is normally of poor quality, because frequent rain washes the nutrients out of the soil. But the dust from Africa provides many of the nutrients needed by the plants there to survive.

There is also a negative side to all of this dust. Some of the dust settles on coral reefs in the sea. The dust carries bacteria and fungi that can kill or weaken the coral. When the dust settles over populated areas, it can trigger asthma and other respiratory diseases. Other places in the world are affected by dust sources other than the Sahara Desert. For

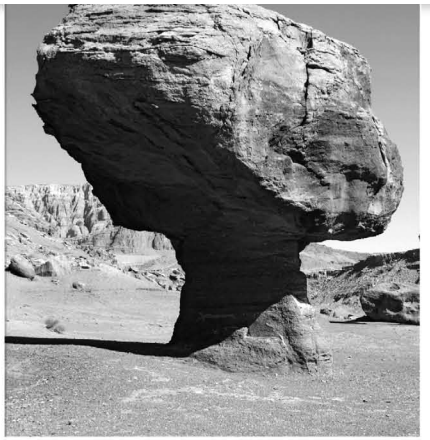
Massive dust storms can carry dust across the ocean.

example, dust from China sometimes affects people living in California!

Weathering and erosion affects soil, changes landforms, produces sediments that can form new rocks, and even can affect air quality. Think about that the next time you feel smooth, rounded sand between your toes at the beach, or eat a vegetable, or see a crack in a rock or a sidewalk!

Think Questions

1. Choose one of the pictures of rock formations on pp. 15–17. Make a sketch of the formation. Label which layers you think might be harder rock and which might be softer. What is your evidence?
2. Describe the processes you think might have produced the mushroom shaped rock in the picture above.
3. Think about your community. Give at least one example of where you have seen:
   - Weathering
   - Erosion
   - Differential erosion
   - A landform created by weathering and erosion



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ARTICLE—WEATHERING AND EROSION, P. 17