

Station 1 Reading

Small Organisms, Big Impact

Have you ever looked at an old rock or an old graveyard stone and noticed there was something growing on it? That something could be green, yellow, black, or possibly blue, but it may feel like carpet or flaky. The substances growing on it are small organisms, like lichens or moss. Just like humans, these smaller organisms need to eat to survive and also just like humans, part of their food source is minerals. Just as you were able to make the rocks bubble in your station, these organisms slowly break down the rock over time and gain minerals from dissolving the rock.



This rock is covered in small organisms that are breaking it down slowly.

Breaking Down Rocks

Small organisms aren't the only things that use chemicals to break down rock and layers of the earth. Humans have been doing this for decades. When humans burn fossil fuels and do other activities that release carbon into the atmosphere, it mixes with the atmosphere to create acid rain. Acid rain is not a human invention, though. Acid rain occurs periodically throughout history when things like volcanoes erupt and put extra carbon into the atmosphere. The acidic rain causes limestone and chalk to break down faster compared to most other rocks because they contain calcium carbonate. Calcium carbonate breaks down very easily compared to other types of minerals. While we may not see it from day to day, our environment is breaking down rocks and layers all around us!

Station 2 Reading

Nature's Bulldozers

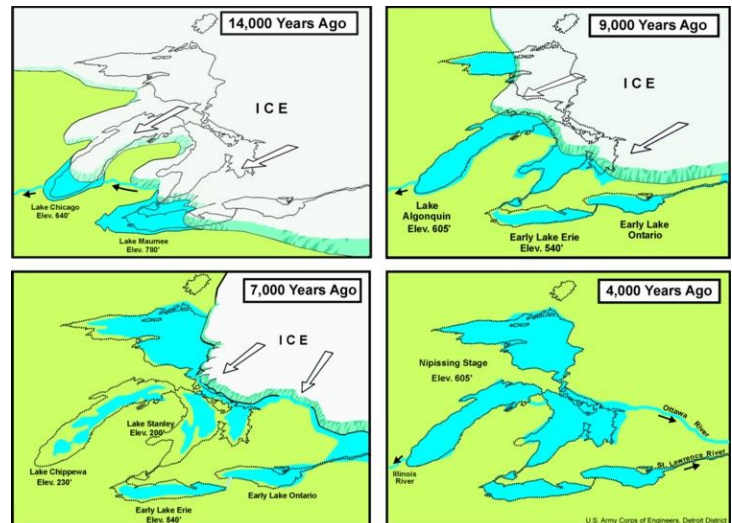
Have you ever seen a bulldozer run over a piece of land, or witnessed a snow plow moving snow out of the way? Earth, over time, has had its own natural version of bulldozers slide across its surface. During our last ice age parts of Earth were covered in glaciers. Due to their great weight, gravity pulled these glaciers downward, carving out mountains and valleys along the way. Since the glaciers are so big, they move very slowly. Imagine ice freezing on a rocky hillside. It would have a texture on the bottom similar to really rough sandpaper. This rough sandpaper, over time would carve out softer rocks and areas of the earth, just like a bulldozer running over softer dirt, rock, or clay.

Glaciers Paved the Way

While a glacier moves, it drops off some of the rocks, dirt, and clay to different locations. The glaciers of the ice age were known to move sediment and boulders thousands of miles! Long Island, New York was formed from this sediment that was moved from an ancient glacier. The Great Lakes were also carved out by an ancient glacier about 9,000 years ago.

Old Changes, New Landscape

Our landscape has been altered by glaciers over millions of years ago and some glaciers are still changing the landscape today. Glaciers are still around and acting on many of our mountains, including the Rocky Mountains in North America and the Swiss Alps in Europe. While the regions don't seem to change a lot in our lifetimes, over thousands of years they will change quite a bit!



This is a map of the glacier that once covered Michigan

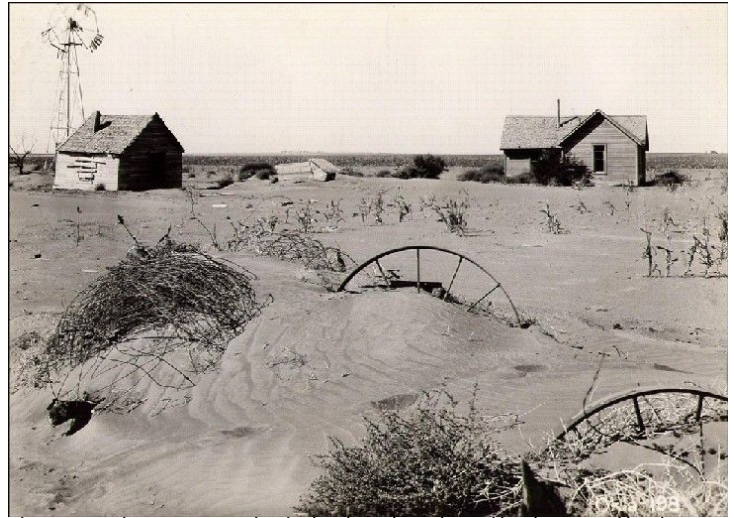
Station 3 Reading

Wind Moving Land

The United States has a tragic history with wind moving sediment. During the 1930s much of the United States was going through a drought. The lack of water caused the ground to become dry, loose, and dusty. The drought caused soil to become loose, since there was little water in the topsoil, sand, and clay to keep it clinging together. The result was massive dust clouds that formed from wind blowing over the dry ground from the Great Plains and the Midwest. These dust clouds were often referred to as “Black Blizzards.”

Farmers had a hard time planting crops, and people and livestock died. This happened during the Great Depression and made the conditions during that time even worse. The Dust Bowl moved a lot of sediment.

Historical accounts show that from one storm alone, over 12 million pounds of topsoil were carried eastward from the states of North Dakota, South Dakota, and Nebraska to Chicago. Some sediment even made it as far as Boston and New York. The storm even made red snow fall in New England. This area is not as dry now, but it is a reminder to us all to be careful with droughts, overfarming, and wind.



This picture shows wagon wheels that have been buried by dirt moved by the wind during a dust storm.

Wind's Carving Power

Wind doesn't only move sediment in the prairie. Wind can also move any loose sediment and rock. The Sahara Desert is known for its sandstorms, and beaches often lose sand to the wind moving it further onshore or out to sea. Sometimes the wind will pick up particles of sand or dust and even push it into other objects like larger rocks. Over time, the rocks will start to wear away from where the sand is constantly hitting them. We know how much it hurts to get hit in the eye by a flying piece of dirt or sand. Imagine that happening day after day, over millions of years--those poor rocks don't stand a chance! Wind can really move us!

Station 4 Reading

Waves Move Us

Waves can move many things. Waves move boats to and from shore, move in and out with the tides, and can move massive amounts of water during storms. Waves can also move layers of Earth over time. Rocks and rock layers that are made of softer minerals, like calcium, tend to wear down faster over time. This is especially true for layers that are made of sediment that are not compacted, or pressed tightly together, like layers of dirt and clay. On some coastal cliffs, waves continually crash against the sediment and slowly wear away at the side of the cliff over time.



Waves slowly wear away at the shoreline.

Slow and Fast Changes

This process can also happen quickly during storms. When large storm surges pound the coast line, large portions of the cliffside or shore can be washed out! This was seen in Santa Cruz, California in 1983. The Santa Cruz bluffs lose an average $\frac{1}{5}$ of a meter a year. In 1983, during one large storm, the bluffs lost 14 meters of shoreline! The same thing happened in 1944 in Long Island, New York. Long Island loses about $\frac{1}{3}$ meter of shoreline every year from the waves naturally going in and out, hitting on the banks and cliffs. In 1944, during a particularly strong hurricane, the shoreline lost 12 meters in a single day! Waves can really move us!

Station 5 Reading

The Power of Water

In the late 1980s a steamboat was found in the middle of a field, buried like a time capsule. The Steamboat *Arabia* had wrecked as it was transporting goods up and down the Missouri River, near Kansas City. Inside the steamboat were artifacts from the 1850s, including shoes for a general store, beads for trade, and countless dinner dish sets and tea cups.

How did a steamboat end up in a field?

Originally, the steamboat had wrecked in the river, but decades later it was in a field. How does that happen?

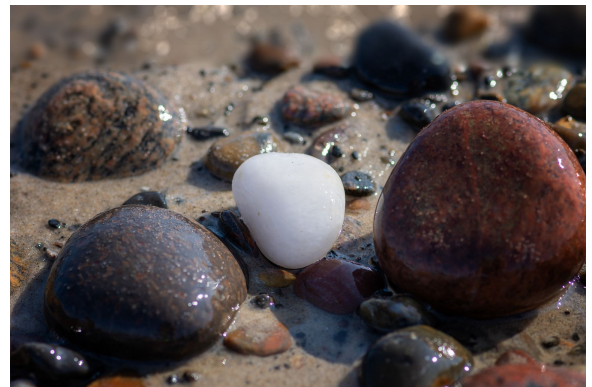
Moving water is much stronger than we think. Over the history of the Missouri River, and all moving water, water has changed the landscape many times. The moving water strikes against the riverbanks as it flows, causing parts of the bank to become loose. The water can also carry other objects in it, like small rocks or tree limbs, which can knock parts of the banks loose as well. The loose sediment then travels down the river, carried by the water. Eventually, the sediment will end up in a new place. Over time, some of this sediment ended up collecting around the steamboat until it was completely covered, and more sediment built up around the boat until the boat was eventually in the middle of a field.

Does this only happen in rivers?

This process of water slowly wearing away at surfaces happens all over the world. You may even notice after a rain, small tracks where the water has hit the ground, moved across it, and maybe even moved some dirt or other objects. Over longer periods of time, dripping water can wear holes into large rocks and make them smoother until they are round, tiny pebbles like the ones seen here. The movement of water can both expose and bury layers of rock and other material over time.



Steamboat Arabia.



These pebbles were found on a beach in Denmark. They were worn smooth over time by the ocean waves.

Station 6 Reading

Nature Has us Cracking Up

Many of us are familiar with the big faces on the side of a mountain in North Dakota. The presidents featured on Mt. Rushmore are located in the Black Hills. What we can't see from the ground, however, are the thousands of tiny cracks that are naturally present in the faces. These cracks become places where water settles, then freezes. When water freezes, the water expands, and slowly pushes the rock apart.

So why aren't the faces cracking apart?

The National Park Service has been working on preserving the faces for decades. The cracks are filled in periodically with flexible material that will expand and contract with the rocks, and keep the water out as much as possible. If the water can't get in and freeze to crack open the rocks, the rocks will break apart at a slower rate.

Living things do this too!

This isn't the only place where things expanding or contracting are breaking apart layers of rock or sediment. Many homeowners experience this with their house foundations. Sometimes tree roots grow too close to houses. When they grow, the roots push on the concrete, causing the house and the foundation to crack. Even animals can break apart layers of rock and soil!

Armadillos are known to dig burrows under houses, which can also cause houses and foundations to crack. When armadillos or other animals remove the layer underneath the foundation, the foundation has nothing to hold it up, so it can cause entire sides of buildings to sag or fall. Nature can really break things up!



Mt. Rushmore was carved out of the side of the Black Hills in North Dakota.



A tree root is growing through a rock