(G4) Erosional Processes – Bizarre and Amazing
The Wonderful World of Erosion

Writing Topic: (G4) Erosional Processes – Bizarre and Amazing

VOCABULARY WORDS

1. Erosion: a process that breaks a rock into smaller pieces and carries away these pieces
2. Weathering: a process that breaks rocks into smaller pieces but does not move them away
3. Sediment: Small pieces of rock, sand, or dirt
4. Ice wedging: water freezes and expands in cracks which pushes the cracks open and breaks the rock
5. Glacier: a large gathering of ice and snow
6. Mass Movement: a large amount of land moves at the same time, also known as a landslide
7. Angle of repose: the steepest angle that a rock can support itself before it breaks
8. Erg: a large area covered in sand dunes

FOUNDATIONAL CONCEPTS

Have you ever been outside and seen a really cool rock and wondered why it looks like that? Maybe you've seen a cave or an arch or a big pile of rocks and wondered how it got there. The answer to these questions is **erosion.**

Erosion is when something causes a rock to break down into smaller pieces that can be carried away. There are two types of erosion. The first type is mechanical erosion, when physical processes like water or wind break up the rock. The other type is chemical erosion, when the rock is dissolved away by a liquid, like water or acid. Erosion occurs when the rock is broken down and moved away. If the rock breaks down but is not moved away this is called **weathering**.

Water contributes to a large amount of the erosion that we see. Rain collects in rivers that transport **sediment**, or small pieces of rock or sand, away from the original source. Rivers are often found in a valley between two mountains. These valleys have a shape like the letter V.

Figure 1. This shows a river at the bottom of a V shaped valley between two mountains. Image from freephotos.cc.

Another way that water can cause erosion is at the shoreline of an ocean where the waves are strong and smash into the shore over and over again, sometimes carrying heavy rocks in the waves. This can cause steep cliffs and pillars along the shoreline where the waves have been beating against the rocks.

Figure 2. This image shows cliffs where the waves from the ocean hit the rock really hard. Some pillars of rock remain standing in the ocean. Image from freephotos.cc.

Water does not have to be in its liquid form to cause erosion. When it is cold enough outside that water can freeze, a process called **ice wedging** can happen. **Ice wedging** normally happens on the side of a cliff or a mountain. Water gets into small cracks in the rocks when it rains or as the sun melts snow that that has fallen. At nighttime when the temperature drops below freezing the liquid water freezes, and as it freezes it expands. The expansion causes the small crack in the rock to break open some more and become a bigger crack. When this happens frequently the ice wedging can push a crack open wide enough that a whole block of rock will break off of the mountain. This is why you will find large boulders in a valley between mountains with steep cliffs. The Exploring Deeper section has instructions on how you can test ice wedging at home.

Figure 3. These rocks fell off of the mountain because of ice wedging and now they are at the bottom of the valley. Image from pexels.com

Ice can also cause erosion in the form of a **glacier**. A **glacier** forms when a lot of snow and ice gets packed together into a huge mound. It is so big that it will fill up a whole valley between two mountains. This big mound of ice is so heavy that it will push any loose sediment out of its way. The ice can also pick up boulders, rocks, and even trees, and carry them away. This forms a valley, but these valleys look different than valleys formed by rivers. Valleys formed by glaciers have the shape of the letter U.

Figure 4. This picture shows a glacier in the mountains in Alaska. The glacier is the part in the center of the picture that looks almost like a river of snow. Credit: Jeremy Littell, USGS Alaska Climate Science Center. Public domain

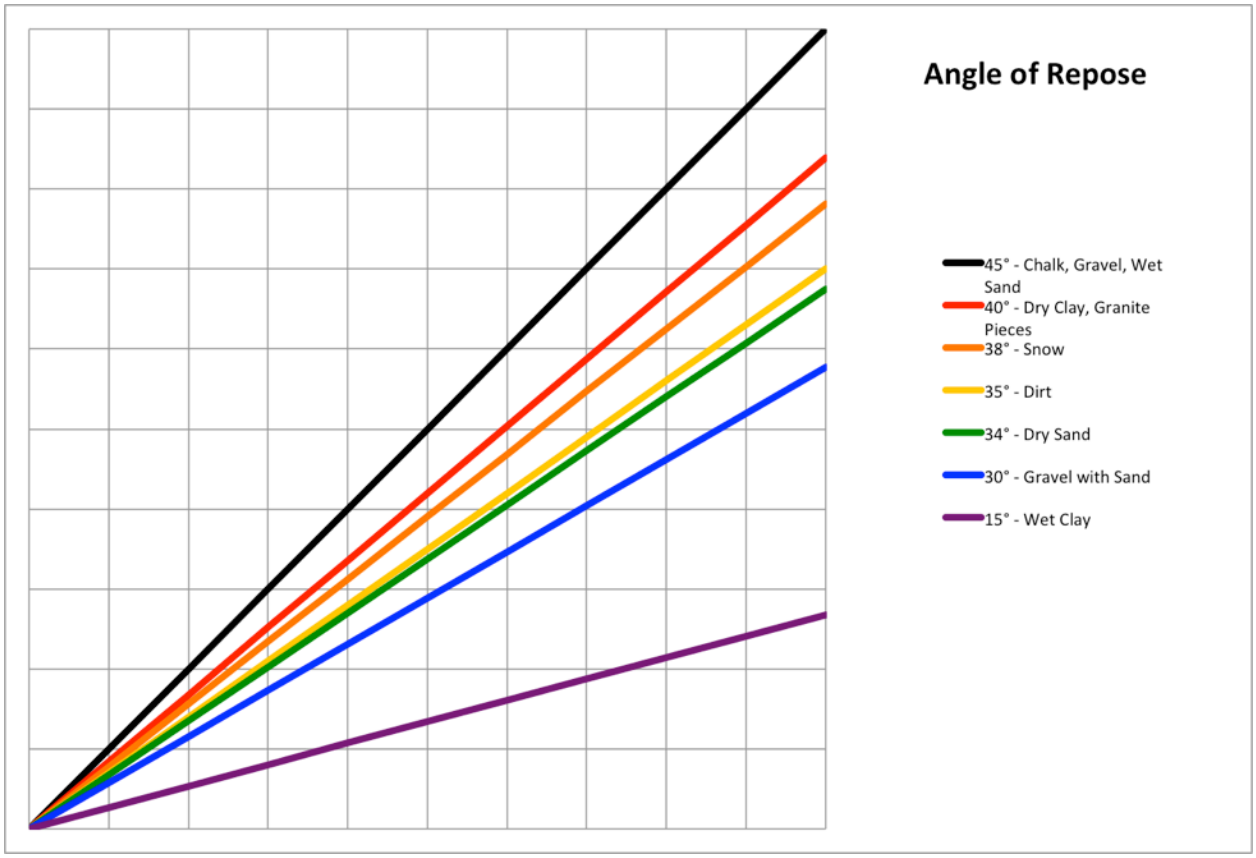
Figure 5. This picture shows a U shaped valley that was formed by a glacier. At one point in time the glacier filled up the whole U shape, but now it is all melted. Image from freephotos.cc

Water may be a strong erosional force, but wind can also cause erosion. If you have ever been outside on a very windy day you may have felt some sand hit you as the wind blew it around. Some areas are very sandy and have very strong winds that will carry the sand and make it hit larger rocks. This constant flow of strong winds carrying sand can cause erosion of the larger rock. Arches National

Park in Utah has many beautiful arches and pillars that were formed by wind erosion.

Figure 6. This is an example of the arches that can form from wind that hits sand against the rock. Image from pexels.com

Mass movement is another type of erosion. This is another name for landslides or rockfall, where a large mass moves all together. This happens when the rocks reach the **angle of repose.** Repose means to rest or to support. So the **angle of repose** is the steepest possible angle where the rock will be able to sit peacefully or support itself without breaking. If the angle becomes any steeper the whole thing will collapse. Sand has a much lower angle of repose than rocks because sand is made of loose grains, which makes it weaker than hard rocks. Sometimes a slope can become too steep but does not fall, but any small amount of energy can make it fall. This is how landslides can build up energy and become really big.



Graph 1. This graph shows the angle of repose for different materials. This is how steep a pile of each material can be without collapsing. Graph made by Lauren Franzen with data from Glover (1995)

EXPLORING DEEPER

Erosion of rocks can actually cause more rocks to be formed. We already talked about how rocks can be eroded into sediment, which can include sand particles. These sand particles are then blown around and collected together in a large sand field, called an **erg.** An **erg** is full of sand dunes with few or no plants and is often what people imagine when they think of a big desert. When all this sand is collected together it can form sandstone as it is compacted and cemented together.

Figure 7. This is what an erg looks like. There are almost no plants, but there is sand as far as you can see in every direction. Image from pexels.com

The sandstone that was formed from the erg can show layers of different colors, where different types of sand collected. Scientists can use the direction of these layers to discover which way the wind was blowing millions of years ago when it was an erg and had not yet been made into a rock. Besides being useful for scientists, these layers are also fun to look at!

Figure 8. Layers like these in sandstone can help scientists discover the direction the wind was blowing millions of years ago. They also look really cool. Image from pexels.com

In the previous section we discussed different types of erosion. In reality a combination of different kinds of erosion will happen to form a landscape. To form a valley a river first needs an opening to enter and flow through. The water will start to move through any small cracks it can find in the rock. When it finds a bigger crack where the rock has fractured it will follow that path. A river by itself does not make a very wide valley. Instead it will make a skinny slot canyon.

Figure 9. This is an example of a slot canyon that forms as water cuts down into a crack. This canyon is barely wide enough for a person to fit through. Image from pexels.com

To make a wide V shaped valley other types of erosion need to happen too. Ice wedging, as we talked about earlier, can happen at the same time as the river is cutting down deeper. The ice wedging breaks off larger chunks of rock making the valley wider. This is also why it is easy to find rocks in a riverbed.

You can see how water expands to cause ice wedging at home! To see how this works, take two unopened plastic water bottles. Put one in the freezer overnight and leave the other one at room temperature. In the morning compare the two water bottles. The frozen one will be bigger and will deform the plastic to make space for all the ice! This is how ice is able to break rocks apart.

There are other experiments you can do with erosion to see how it works. Scientists can use a stream table to model a landscape and see how a river will erode that landscape over time. A stream table is full of sand that can be built into mountains, or valleys, or any other feature that you want to make. There is also a water pump that makes the river. You don't need a fancy stream table to see how erosion works though. You can do this in a sandbox or at the beach. Next time you are near some sand try building some mountains and hills, and create a path you want the river to follow. Then use a hose or a bucket of water to fill up the river and watch how the path changes over just a few minutes!

Figure 10. This is a stream table that scientists use to model river erosion. Photo by Lauren Franzen

Erosion happens all around you. Next time you are outside try to find examples of erosion. Studying erosion can be fun and exciting because you can find it everywhere!

BREAKOUT SECTION

EROSION DANGERS

Erosion can create a lot of really cool landscapes. It can also be very dangerous! Landslides can take a whole house along with them. Ice wedging can cause huge boulders to fall and block roads or destroy buildings. The damage caused by erosion can cost a lot of money to fix. The most expensive event caused by erosion in the United States was the Thistle Landslide, which happened in Utah in 1983. It blocked the Spanish Fork River and it destroyed a large part of the highway. The sediment that blocked the river caused it to flood, so the whole town of Thistle had to evacuate before their town flooded. The total costs from the damages caused by this landslide were over 400 million dollars! The good news is there are geologists who watch areas that they know could be dangerous. If they know that a dangerous event will happen they will block off areas that will not be safe and warn people of the dangers. These scientists study erosion to keep people safe. This is why it is so important to know about erosion.

Figure 11. This is a picture of the Thistle Landslide. There was a highway, but in this picture it is completely covered by dirt. Credit: NOAA/NGDC, R.L. Schuster, U.S. Geological Survey. Public domain.

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Graph 1 was made by me, using data from Glover, 1995, cited above. I give permission to STEMTaught to use and publish this graph.