

**LESSON: Breaking Down and Moving Out Rocks****INSTRUCTOR:** Paul Nance**E-MAIL ADDRESS:** paul.nance@jordan.k12.ut.us**DISTRICT:** Jordan**GRADE LEVEL:** 4**CORE CURRICULUM**

**Science Standard 3:** Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

**Objective 2:** Explain how the processes of weathering and erosion change and move materials that become soil.

**Intended Learning Outcomes:**

1. Use science processes and thinking skills

**Lesson Objective:** The students will be able to understand the different processes of weathering and erosion of rocks and know the differences between weathering and erosion.

**Content Connections:**

Writing, Art

**INTRODUCTION****Background Information**

Weathering and erosion are happening all around us, all the time. Sometimes they happen so slowly or subtly that we don't know weathering and erosion are happening. Other times they can happen quickly, right before our eyes. It is important for students to know what weathering and erosion are and how they are different from each other.

The definition of weathering is the physical breakdown of the rocks on Earth's surface into smaller pieces of rock or sand. The forces of water movement, freezing, plant growth, and wind cause weathering. The experiments to show these forces of weathering of rocks are rocks tumbling in water, freezing water breaking plaster, bean seeds expanding and breaking plaster, and how sand has the capability of wearing down softer material.

The definition of erosion is movement of sediments and small rocks from one place to another. The forces that weather rocks are some of the same forces that cause erosion, such as water, and wind. Other forces that cause erosion are glaciers and gravity. The experiments to show these forces of erosion are water moving sand downhill, simulation of wind blowing sand, and gravity moving rocks.

As you will see, weathering and erosion happen simultaneously. However, it is best to

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teach them separately so students can understand each process. Then you can bring in the fact that these forces are breaking down rocks and moving them at the same time. For example, when water is moving downhill, not only is the water moving the sediments (erosion), but it is also causing the rocks in the water to hit against each other and breaking them down (weathering).

### **INVITATION TO LEARN**

Put the students in groups of five and pass out a few calendar pictures to each group displaying scenes of Utah's state and national parks that show the results of weathering and erosion.

Explain to the students that over the course of millions of years, the Earth's surface has changed, and it continues to change. Earth's surface is changed by the forces of nature. (Don't tell them what these forces are yet.) While looking at these pictures, give the students five or ten minutes to write in their journals what types of forces of nature may have changed the land.

Have a class discussion about what forces they came up with. They may come up with running water, gravity, rain, expanding ice, and wind. Tell them that for the next few days we are going to learn about these forces and see how they can change Earth's surface.

### **INSTRUCTIONAL PROCEDURES**

#### **Weathering**

Put the class into groups of five. Students need to use their journals to write their thoughts, answer the questions, and write about experiments throughout the whole weathering lesson.

Begin with a discussion about weathering.

- What is weathering?
- What are the different processes of weathering?
- Is weathering happening today?

#### **#1: Expanding Ice**

1. Show pictures of rocks that have fallen from a cliff.
  - Give the students a broken rock to look at.
  - This is a result of weathering.
2. Have a discussion of what water does when it freezes. (expands)

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- Discuss the reasons why ice expands.
  - Look at the inside of an ice cube. There is air inside. Why?
3. Discuss how ice is one of the weathering forces.
    - In the spring and fall, there is a huge contrast in temperatures. During the day it is up in the 40s and 50s and at nighttime it drops below freezing.
    - In the spring and fall, snow melts during the day and runs into the cracks of rocks.
    - At night, when the water freezes, the ice expands.
    - The expanding ice breaks the rock apart and sends the pieces falling down the mountain cliff.
  4. Have a concluding discussion.
  5. Do the "Expanding Ice" activity.

### **#2: Water Abrasion**

1. Show pictures of rocks at the bottom of dry streambeds.
  - Give each student two round rocks to look at.
  - This is a result of weathering.
2. Have a discussion of what happens to rocks while in a stream.
  - They roll down with the water.
  - The rocks hit against other rocks.
3. Discuss how water is one of the weathering forces.
  - Small fragments break off the rocks when they hit each other.
  - The small fragments become sediments that are carried downstream.
  - The rocks become rounded.
4. Have a concluding discussion.
5. Do the "Water Abrasion" activity.

### **#3: Root Expansion**

1. Show pictures of plants that are growing or have grown in cracks of rock.
2. Have a discussion of what happens to rocks when plants begin to grow in the crack of rocks.
  - Dirt is blown into the cracks of rocks.
  - Seeds are blown into the cracks of rocks.
  - Water runs into the cracks of rocks.
3. Discuss how plant roots are one of the weathering forces.
  - When the plant begins to grow, not only is the plant growing up, but also

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- roots are forming and growing deeper into the crack of the rock.
  - As the roots go further into the cracks, they begin to split them.
  - Finally, the roots will go deep enough to break the rock apart.
4. Have a concluding discussion.
  5. Do the "Root Expansion" activity.

### **#4: Wind Abrasion**

1. Show pictures of hoodoos found in southern Utah.
  - Give each group a sandblasted stone to look at.
  - This is a result of weathering.
2. Have a discussion of what happens to rock structures when blowing sand hits it.
  - The rough sand will hit it at a great force.
  - The rock structure will begin to get smaller.
3. Discuss how blowing sand is one of the weathering forces.
  - Small pieces will break off.
  - The small pieces become small sediments
  - The small sediments become part of the blowing sand.
  - The rock structure wears down smaller and smaller.
4. If possible, look under a microscope at sand.
  - Have a discussion of why the sand can be destructive.
5. Have a concluding discussion.
6. Do the "Wind Abrasion" activity.

### **Erosion**

Put the class into groups of five. Students need to use their journals to write their thoughts, answer the questions, and write about the experiments throughout the whole erosion lesson.

Discuss erosion.

- What is erosion?
- What are the different processes of erosion?
- Is erosion happening today?
- Discuss the different types of erosion.

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**#5: Blowing Sand**

1. Show pictures of the results of sand being blown from one place to another.
  - What are the holes called where the sand used to be? (depressions)
  - What are the hills called where the sand has been deposited? (dunes)
2. Have a discussion of what happens to sediments that are blown from one place to another.
  - The sediments are picked up and blown from one place to another causing depressions.
  - The sediments are blown in the direction of the wind. The sediments deposited are called dunes.
  - The wind deposits these sediments, forming a gradual slope on the windward side of the dune.
  - The leeward side of the dune has an abrupt drop-off.
3. Discuss how wind is one of the forces of erosion.
  - The sediments are blown from one place to another.
  - Depressions and dunes are the results of wind erosion.
4. Have a concluding discussion.
5. Do the "Blowing Sand" activity.

**#6: Water Run-off**

1. Show pictures of the results of water flowing down a mountainside.
  - What are the cuts in the hillside called? (gouges)
  - What are the sediment deposits called at the base of the gouge? (deltas)
2. Have a discussion of what happens as water runs down a mountainside.
  - The sediments are picked up and brought down the hill by the water.
  - As the sediments are picked up, they leave a gouge in the mountain.
  - When the water gets to the bottom of the mountain the sediments are deposited, forming a delta.
  - Each time water runs down the mountainside, the gouge gets deeper and deeper, putting more sediments at the bottom of the gouge.
3. Discuss how water is one of the forces of erosion.
  - Sediments are washed out from the mountainside as water comes down and deposited the sediments at the base of the mountain.
  - Gouges and deltas are the results of water erosion.
4. Have a concluding discussion.
5. Do the "Water Run-Off" activity.

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## Invitation to Learn

- Different pictures of mountains that show weathering

## #1: Expanding Ice

- Ice
- Broken pieces of rock

## #2: Water Abrasion

- Round rocks

## #3: Root Expansion

- Pictures of plants growing out of cracks of rocks

## #4: Sand Abrasion

- Pictures of formations weathered by blowing sand
- Hand lenses
- Microscope (optional)
- Glass slides (optional)
- Student flex cam (optional)

## #5: Blowing Sand

- Pictures of sand dunes

## #6: Water Run-Off

- Pictures of water running down hillsides

**ASSESSMENT SUGGESTIONS**

- Look in the students' journals to make sure they are writing about the different experiments. They should be making predictions, making observations, and writing conclusions. Check for misconceptions and inaccuracies.
- Ask questions after the experiments to make sure the students understand the concepts being taught.
- Have the students write in their journals about each topic of what they learned about each experiment.
- Have the students write a summary paper of what weathering is, using the ideas of the experiments that were done in class.
- Have the students write a summary paper of what erosion is, using the ideas of the experiments that were done in class.

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**POSSIBLE EXTENTIONS/ADAPTATIONS/INTEGRATION**

**"Expanding Ice" Extensions**

- Put a container of bottle water in the freezer. Explain what happened.
- Fill a film canister with water. Put it in the freezer. Explain what happened.

**"Water Abrasion" Extension**

- Measure the amount of sediments that were at the bottom of the bottle. Shake the bottle a few more times and measure the amount of sediments at the bottom of the bottle each time.

**"Root Expansion" Extension**

- Put the results of the broken plaster with the beans in an enclosable plastic bag. Let the beans continue expand and break the plaster. After a week, the beans begin to grow, showing how they could grow roots and break the plaster more.

**"Sand Abrasion" Integration-Art**

- Students can continue to stir chalk into the white sand until they have many colors and make Native American sand art or bottle designs.

Read the three books called *Erosion* and discuss how they apply to what we have learned.

**RESOURCES: BOOKS, MEDIA, ARTICLES, WEB SITES, AND ORGANIZATIONS**

**BOOKS**

- *Erosion: Changing Earth's Surface*, by Robin Michal Koontz, ISBN: 9781404822016



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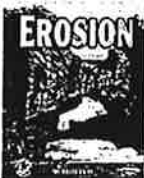
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- *Erosion*, by Rebecca Olien, ISBN: 9780736833653



- *Erosion*, by Joelle Riley, ISBN: 9780822559498



**MEDIA**

- *Weathering and Erosion*, DVD, Schlesinger Media 2007, ISBN: 1-41710447-3
- *Weathering and Erosion*, DVD, Earth science Collection, 2002, ISBN: 1-58541-100-0

**ARTICLES**

Black, R. (2005). Why demonstrations matter. *Science and Children*, (Volume 44), (Number 1).

Bransford, J.D., Brown, A.L., & Cocking, R. R. (Eds). (1999). How people learn: Brain, mind, experience, and school, *Washington, DC: National Academy Press*.

Kennedy, C. Long, K. and Camins, A., The reflective assessment technique, *Science and Children*, (Volume 47), (Number 4).

**WEB SITES**

Retrieved from the World Wide Web on January 10, 2010:  
[http://teamcarterlces.com/Geological\\_Features\\_of\\_Earth.htm](http://teamcarterlces.com/Geological_Features_of_Earth.htm)

Retrieved from the World Wide Web on January 10, 2010:  
[#D](http://plantandsoil.unl.edu/croptechnology2005/soil_sci/?what=topicsD&informationModuleId=1086025423&topicOrder=18&max=20&min=0)



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Retrieved from the World Wide Web on January 10, 2010:

<http://www.bing.com/reference/semhtml/Erosion?src=abop&fwd=1&q=erosion&qpv=erosion>

**ORGANIZATIONS**

- Utah Museum of Natural History, 1390 East Presidents Circle, Salt Lake City, Utah 84112, 801-581-6927, <http://www.umnh.utah.edu>

**FAMILY CONNECTIONS**

- Have the students teach their families about the different ways that rocks are weathered by nature—expanding ice, water abrasion, root growth, and wind abrasion. As a family, walk around the neighborhood and look for signs of weathering. Take pictures of them and have them printed on the computer. Bring them to school to share.
- Have the students teach their families about the different ways sediments are carried away by nature's forces—blowing sand and water runoff. As a family, walk around the neighborhood and look for signs of erosion. Take pictures of them and print them up on the computer. Bring them to school to share.

**LESSON AND ACTIVITY [TIME SCHEDULE]**

- The lesson is 55 minutes.
- The activity is 30 minutes.
- Total lesson and activity time is 85 minutes.

**ACTIVITY CONNECTED TO LESSON**

**Weathering**

The students need their journals to write what they see happening during the following weathering experiments.

**#1: Expanding Ice**

1. Explain the nature of water freezing and then expanding. Look at an ice cube and look at the air inside of it. There is air inside because when the water expanded, air is a filler to compensate for the expansion.
2. Whenever water runs into cracks of rock and the temperature drops below 32

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degrees, it will freeze while in the rock. Water expands when it freezes; therefore, it will break the rock apart.

3. Show pictures of rocks that have fallen from a cliff as a result of water freezing and then expanding in cracks of rocks breaking them off.
4. Pass out a paper towel, 5 oz. cup, small balloon with water in it, and craft stick to each student or a group of four students.
5. Mix some Plaster of Paris in the ice cream bucket. Put in the ratio of 1 cup of water to 2 cups of Plaster of Paris. (Do this over the tarp on the floor.) Use the wisp to make it smooth. The consistency should look like a runny milkshake.
6. With a cup, pour the liquid Plaster of Paris into the small cups. Have the students put the small water balloon into the plaster and push it down into the cup with the craft stick so the whole balloon is covered.
7. Have the students write in their journals this procedure. Have them write what they think will happen.
8. Put the cups in the freezer for at least twelve hours.
9. The following day, with a paper towel under the cup, tear off the paper off the cup. Examine the outcome. Have the students write in their journals what happened.
10. Have the students explain in their journals why this happened.
11. Tell how this relates to rocks breaking with water freezes in the cracks of rocks.
12. Have the students draw a picture and label it in their journals of what the plaster looked like with the experiment was over. Have them write a caption about the picture.
13. Let the Plaster of Paris harden in the ice cream bucket. Push in the sides of the bucket and the dried plaster will break up. No cleaning necessary.

### **#2: Water Abrasion**

1. Show pictures of a dry streambed showing the round rocks. Whenever water is running downhill, the rocks in the water will knock into each other, resulting in breaking the rocks into smaller pieces.
2. Put the students in groups of five. Give each student a round rock. Tell them that this rock has been in a stream. Discussion: Ask them how we know it has been in a stream.
3. Have the students share the rocks with each other, and have the students knock two rocks together for about 15 seconds. Examine the rocks and the desks. Have a discussion as to what happened.
4. Put some small rocks in a clear plastic bottle to fill the bottle up about halfway.

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- Fill the bottle with water up to the top.
5. Have the students write in their journals what the inside of the bottle looks like before the experiment begins.
  6. Tell the students that they are going to shake the bottle for three minutes. So that everyone will have a chance to shake, each student will shake the bottle twenty times and pass the bottle on until the three minutes are up.
  7. When the three minutes are done, have the student examine what the inside the bottle looks like now. Have the students write in their journals what they observe.
  8. Have the students explain in their journals why this happened.
  9. Tell how this relates to rocks that are in a stream of water.
  10. Have the students draw and label a picture in their journals of what the bottle looked like after the experiment. Have them write a caption about the picture.

**#3: Root Expansion**

1. Show pictures of plants that are growing out of cracks. Some of the roots may have even cracked the rock. Plants can grow in the cracks of rocks given certain circumstances. Discuss these circumstances.
2. Over the years the roots get larger and larger and eventually break the rock. Have a discussion of how roots can do this to rocks.
3. Pass out a paper towel, 5 oz. cup, 15 beans, and craft stick to each student or a group of four students.
4. Mix some Plaster of Paris in the ice cream bucket. Put in the ratio of 1 cup of water to 2 cups of Plaster of Paris. Do this over the tarp on the floor. Use the wisp to make it smooth. The consistency should look like a runny milkshake.
5. With a cup pour some liquid Plaster of Paris into the small cups. Have the students put the beans into the plaster. Have the students take the craft stick and stir the beans around in the plaster.
6. Have the students write in their journals this procedure. Have them write what they think will happen.
7. Leave the cups in the classroom for 24 hours.
8. With a paper towel under the cup, the following day, tear off the paper of the cup. Examine the outcome. Have the students write in their journals what happened.
9. Have the students explain in their journals why this happened.
10. Tell how this relates to rocks breaking when roots expand in the cracks of rocks.

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11. Have the students draw a picture and label it in their journals of what the plaster looked like with the experiment was over. Have them write a caption about the picture.
12. Let the Plaster of Paris harden in the ice cream bucket. Push in the sides of the bucket and the dried plaster will break up. No cleaning necessary.

**#4: Wind Abrasion**

1. Show pictures of hoodoos. Ask the students how rock formations could be formed like this.
2. Whenever the wind blows, it carries with it sand and other sediments. These sediments hit objects that are stationary (not moving). When sediments hit these stationary objects, they can wear them down eventually to almost nothing.
3. Put the students in groups of five. Give each group of students a low cup or container with white sand in it and colored chalk.
4. With hand lenses, have the students look at the sand. Have a discussion as to what it looks like.
5. Optional: Put some sand on a microscope slide. With a student flex cam, show what the sand looks like up on a screen.
6. Have the students examine the chalk before the experiment. For three minutes, have the students stir the chalk in the white sand. Have them watch what is happening.
7. When the time is up have the students write down their observations by looking at the chalk and the sand.
8. Have the students explain in their journals why this happened.
9. Tell how this relates to rocks breaking down when sand is blowing.
10. Have the students draw a picture and label it in their journals of what the plaster looked like with the experiment was over. Have them write a caption about the picture.

**Erosion**

The students need their journals to write what they see happening during the following weathering experiments.

**#5: Blowing Sand**

1. Show pictures of the effects of wind blowing sand. Ask the students to discuss how wind can make formations like this.

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2. If wind blows strongly enough, it will carry sand and other sediments to other places. The places where these sediments are finally placed are called dunes. The gentle slope of the dune is the windward side of the dune. The cliff side of the dune is the leeward side of the dune.
3. Put the students in groups of five. Give each group of students a shoebox-sized plastic container with dry sand in it. Make sure the sand is flat.
4. Tell the student that we are going to pretend our hands are the forces of the wind. Starting at the one of the ends of the container, have the students scrape their hands across the top of the sand, taking some sand with the scrape. Gently exert less pressure on the sand by going up on an angle, leaving sand behind and forming a slope of sand that looks like the windward side of a sand dune. Let others in the group do the same thing in different places in the container until there are finally four or five sand dunes.
5. Tell how this relates to erosion of sand in a real setting.
6. Have the students draw and label a picture in their journals of what the sand dunes looked like when the experiment was over. Have them write a caption about the picture.

**#6: Water Run-Off**

1. Show pictures of the effects of water going downhill. Ask the students to discuss how water can do this.
2. When it rains or snow is melting, the water will collect together while going downhill in the form of a stream. The stream will carry with it a lot of sediments and even rocks if the stream is moving fast enough. When the stream levels off, the water runs slower and will drop its sediments. This drop-off area is called a delta.
3. Put the students in groups of five. Give each group of students a shoe box-sized plastic container with semi-wet sand in it, a soup can with 5 holes in it, and a soup can with no holes in it. Put some ice cream buckets around with water in them so they are easily accessible to the students.
4. Tell the students to form a mountain with the sand by pushing the sand inward from the sides. Pack it down pretty tight. (This is so the sand won't run down hill too fast.)
5. Tell one of the students to go over to one of the water buckets and fill the non-holed can with water.
6. Tell the students that they are going to pour the water into the cup with holes in while it is over the sand mountain. Have them write a prediction of what they

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think will happen when the water goes down the mountainside.

7. Have one of the students quickly pour the water into the can with holes. When the water is in the can, the student is to move it around across the ridge of the mountain. Have the students write down what happened. Changing students, have the students do this two or three times more, each time writing down what they observe.
8. Have the students explain in their journals why this happened.
9. Tell how this relates to erosion on a real mountainside.
10. Have the students draw and label a picture in their journals of what the mountainside looked like when the experiment was over. Have them write a caption about the picture.

**ACTIVITY MATERIALS****#1: Expanding Ice**

- Plaster of Paris
- Tarp
- Ice cream bucket
- Wisp
- Pouring cup
- 5 oz. cups
- Paper towels
- Small water balloons
- Water
- Craft sticks

**#2: Water Abrasion**

- 10 oz. clear plastic bottles with the lid (like Gatorade bottles)
- Different types of small rocks
- Water

**#3: Root Expansion**

- 5 oz. cups
- Beans
- Plaster of Paris
- Water
- Paper towels
- Pouring cup
- Craft sticks
- Tarp

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- Ice cream bucket
- Wisp

**#4: Sand Abrasion**

- Low cups
- White sand
- Colored chalk
- Hand lenses
- Microscope (optional)
- Glass slides (optional)
- Student flex cam (optional)

**#5: Blowing Sand**

- Plastic shoe boxed-sized container
- Dry sand

**#6: Water Run-Off**

- Soup can with 5 holes in the bottom
- Soup can with no holes
- Plastic shoe boxed-sized container
- Semi-wet sand
- Water