

Cracked Marbles

4th Grade

Jeremy White, Brent Greene, & Kathleen Waugaman

References:

- Lesson plan from CPS 4th grade Earth Science curriculum guide

Benchmarks:

(Benchmark B): Summarize the processes that shape the Earth's surface and describe evidence of those processes. ES-9: Identify and describe how freezing, thawing, and plant growth reshape the land surface by causing the weathering of rock.

Objectives:

Students should be able to describe how weather events such as ice, snow, and freezing water cause weathering of the Earth's surface and rocks. Students should be able to distinguish between erosion and weathering, and understand that freezing water expands to create cracks and broken rocks over time.

Materials:

- Marbles
- Hand lens
- Ice cubes
- Safety goggles
- Potholder
- Water
- Paper towels
- Tin cans
- Small pan
- Bunsen burner or heat source
- Lab journal/paper
- Large pictures and handout about Mt. Rushmore

Initial Demonstration:

Each student should receive a handout about Mt. Rushmore. The students should be aware that Mt. Rushmore is made of granite rock, which is some of the hardest rock available on Earth. The formation of this rock is a result of volcanic magma cooling under the Earth's surface over millions of years. The pictures of the presidents' faces should be close up to demonstrate the cracks in the faces of the presidents. Use these pictures to show how heating and cooling have led to large cracks in the largest sculpture ever built. Discuss with the students that water can get into these cracks and cause them

to get larger between cooling and heating of the rock. Also point out that if nothing is done to prevent these cracks, the faces of the presidents could begin to fall off and ruin the sculpture. Also talk about ways that people can prevent any further damage to this landmark, such as using special sealants and caulking to fill the cracks, thus preventing water getting into those cracks.

Target Observations:

- Weathering causes rocks to break up, even some of the hardest rock on Earth.
- The faces of the presidents have large cracks as a result of expanding and contracting rock from changes in temperature.
- Further damage can be prevented by blocking off the cracks from water.

Target Model:

- Freezing water causes weathering of rocks, as demonstrated with the marbles.
- Water expanding and contracting as a result of temperature changes over several years will eventually cause large pieces of mountains to break off and break into smaller pieces, which eventually turns into dirt and sand.

Procedure:

Have each group get a set of materials they will need. Have the students examine the marbles with their hand lens. Do they see any cracks? Have them describe in their journals the way the marbles look and feel. Have students put ice cubes into a small tin can and cover the ice cubes with water. Place this to the side for later use. The students are then to place several marbles into a small pan and then bring them to you to heat over the burner for several minutes (3 should work). Have another student from the same group bring the tin of ice water over to where you are and very carefully tip their marbles into the cold water and ice. Have them sit for three minutes. During this time you can heat the other group's marbles. Keep trading off groups of cooling and heating for at least three more turns.

After the last turn of being heated, have the students take their ice water and marbles back over to their area. Have them remove the marbles from the water and dry them off with the paper towels. Students need to observe their marbles with their hand lenses and record their new observations in their journals. Have students write and complete the following questions in their journals: A. What happened to the marbles with the heating and cooling? B. How are our Earth's landforms heated and cooled? C. How does repeated heated and cooling change those landforms? D. What landforms near us might be affected by heating and cooling? Discuss student's answers after the lab has been cleaned up.

Target Observations:

- The marbles are smooth, round and contain no cracks in the first examination.
- The marbles expand and contract between the heating and cooling processes.

- After the final cooling stage, the marbles are still round, but they contain small cracks in them. Some marbles may have cracked in half upon observations.
- This heating and cooling causes rocks to expand and contract, thus cracking and breaking them into pieces. This is the definition of physical weathering.

Summary:

Landforms and especially rocks are worn down by wind and rain. Plants and freezing water help split them apart. Heating and cooling also play a major role in the erosion and weathering of the land. This lesson helps students see the effect of heat and cold on rocks.