EARTH CONNECTIONS

Resources For Teaching Earth Science

READING A WALL

Have you ever looked at a stone wall and wondered where all the different rocks came from and what story each might tell? Some stone walls are made of angular rocks, probably mined from a quarry. Others are made of rounded stones. Observing the differences in shape, size, color, mineralogy, and other characteristics of the stones in a wall can tell us a lot about the history of the stones and of the wall. Stone wall builders usually take advantage of the most readily available and, of course, best looking materials. Walls can be used to support a building or to hold back a hillside or as decorative landscaping (Fig. 1). Here in western Washington, many of the walls, such as those facing the buildings on the Capitol Campus, are built of angular stones quarried from the Wilkeson Sandstone near Tenino. In eastern Washington, many walls are made of basalt because of the abundance of that rock type there. A wide variety of metamorphic rocks can be found in the walls of north-central Washington.

Figure 1. A mortared stone wall in western Washington. Notice that it is thinner and more vertical than the wall in Figure 2. *Photo by Wendy Gerstel.*

In the Puget Sound area, we have an abundance of rounded stones of all sizes, carried here by glaciers that covered the area about 13,000 years ago. These stones have been tumbled, scraped, rolled, smoothed, and sculpted by the ice and its meltwater streams. The more rounded the stones, the longer they were rolled in streams. If they are faceted, that is, have rounded but distinct faces, they were probably deposited directly by the ice.

Rounded stones do not fit snugly against other stones in a wall and usually need mortar to hold them together. In New England and other areas on glacial deposits, however, farmers build walls with the stones cleared from their fields. Careful placement of the stones and annual spring maintenance preserve many miles of these walls built without any mortar. In Figure 2, the larger stones are at the bottom so they were probably put in place by hand. The smaller ones could be lifted, so were used in the upper layers.

This lesson will teach observation, analytic, and note-taking skills. It will encourage the observer to think about geology, history, transportation, engineering, and social sci-

ESSENTIAL SCIENCE LEARNING BENCHMARKS/OBJECTIVES

1.1 Uses properties to identify, describe and categorize landforms.

3.2 Understands that science and technology are human endeavors, interrelated to each other, to society. and to the workplace.

GRADE LEVELS

Grades 2–6, answer questions 1–3
Grades 7–12, answer questions 1–6

SUBJECTS

Earth science
Geography
Social science
Mechanics/engineering

CONCEPTS

Interpreting geologic origin of building materials and methods of transport and use

SKILLS

Observations; identifying relationships of rocks to where they originated; hypothesizing rock transport.

TIME NEEDED

30–45 minutes (more if field trip)

THE SMALL STONES WHICH FILL UP THE CREVICES HAVE ALMOST AS MUCH TO DO WITH MAKING THE FAIR AND FIRM WALL AS THE GREAT ROCKS; SO WISE USE OF SPARE MOMENTS CONTRIBUTES NOT A LITTLE TO THE BUILDING UP IN GOOD PROPORTIONS A MAN'S MIND.

Edwin Paxton Hood

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ences—and other aspects of wall building left to the creativity of the participants.

Figure 2. A dry-stacked stone wall in Connecticut. Notice the rounded edges of the stones, the wide base, and the placement of the largest stones at the bottom of the wall. *Photo by Eric Gerstel.*

QUESTIONS

Find your own stone wall and answer the following questions:

1. What do you notice about the shape of the individual stones? Are all of them rounded? Are any of them angular? Are some of them faceted? Was it built for decoration, to protect a garden, or to support a structure?

2. Did the wall builders use mortar? Why is this important? Could the wall have been built without it? What is the mortar made from?

3. What can you say about the color of the stones? Look closely. Do you recognize any of them from Washington State? from Canada? from Idaho? What do you notice about the mineralogy—the individual crystals within a stone?

4. How did the stones get here? Are they local? Were they transported by glaciers or streams, by trucks or trains?

5. Note the size and relative placement of the stones in the wall. Is this important? Does it tell you anything about how the wall was built—by humans or machine?

6. What can you say about the age of the wall? What do the surroundings (the building, the landscaping, the rock source, etc.) tell you? What condition is the wall in?

DISCUSSION

1. How does geology control/affect the availability of building materials and how they are used? And how does access to and transportation of the materials?

2. What can you say about the age of a wall and the use of particular materials? (How far they were transported? How they were put into place, etc.?)

3. How might the function of a wall have changed through human history in an area? In different areas, climates, cultures?

4. What are the advantages/disadvantages of stone walls? As compared to wooden fences? (Costs, resource availability, other?)

5. What might cause a wall to degrade or weather (chemical and mechanical [wind and water] break down)? Which would be more susceptible to weathering, a rounded wall or a wall of blocky, tight-fitting stones?

REFERENCES

Articles:

Guide to Geologic, Mineral, Fossil, and Mining History Displays in Washington, by David A. Knoblach: Washington Geology, v. 22, no. 4, p. 11-17, 1994.

The H. P. Scheel Family—A History in Stone, by David A. Knoblach: Washington Geology, v. 27, no. 1, p. 18, 1999.

Washington's Stone Industry—A History, by David A. Knoblach: Washington Geology, v. 21, no. 4, p. 3-17, 1993.

Books:

Rocks and Minerals and the Stories They Tell, by Robert Irving, illustrated by Ida Scheib: Knopf, 175 p., 1956.

Rocks and Minerals—Student Activity Book, by the National Science Resources Center, Smithsonian Institution, National Academy of Science: Carolina Biological Supply Co., 153 p., 1994.

Sermons in Stone—The Stone Walls of New England & New York, by Susan Allport with ink drawings by David Howell: W. W. Norton & Co., 205 p., 1990.

Time worships a well-built wall, for a wall's stones can wend through silent woods with an eerie eloquence, suggesting the lives and labors of settlers long gone. As Susan Allport demonstrates in this charming book, the stone walls of New England and New York speak with the voices of Native Americans and Yankee farmers, of slaves, servants, and children, evoking the past from the elemental geological struggles of the Ice Age through the fencing dilemmas of neighbors in the 19th century. Allport's scaling of these humble but pervasive walls—who built them? when? why? how?—is a narrative of fascinating and offbeat attention to the enduring tracks of the past. [downloaded January 1, 2001, from http://www.commonreader.com/cgi-bin/rbox/ido.cgi?7248]

Stone Wall Secrets, by Kristine and Robert Thorson: Tilbury House Publishers, 40 p., 1998. [grades 3-6]

Stone Wall Secrets—Exploring Geology in the Classroom (Teachers' Guide), by Ruth Deike: Tilbury House Publishers, 80 p., 1998.

Website:

Discovery.com has lessons, weblinks, and vocabulary at http://school.discovery.com/lessonplans/programs/rocks/index.html. ■

Free CD Available to Teachers

"Salmon Recovery Data Viewer: Lower Chehalis Watershed (WRIA 22)" gives data on the limiting factors that affect the recovery of salmon in the lower Chehalis watershed. For your copy, send a request by fax to Dave Wischer (360) 902-1790 or J. Roach, Association of Black Lake Enhancement, at (360) 357-9662 or Lee Hansmann, Grays Harbor Deputy Director of Community Development, at (360) 249-4222.

EARTH CONNECTIONS

Resources For Teaching Earth Science

DO ROCKS LAST FOREVER?

We think rocks last forever. The boulder we played on in our parents' front yard when we were children is still there for our grandchildren to enjoy. The rock steps to the church are still in use a hundred years later, and the gravestones in the cemetery still mark where our ancestors were laid to rest. These rocks, to us, have lasted forever. But, if you look closely, change is taking place.

This change is called weathering. The term weathering refers to the destructive processes that change the character of rock at or near the Earth's surface. There are two main types of weathering: mechanical and chemical. Processes of mechanical weathering (or physical disintegration) break up rock into smaller pieces but do not change the chemical composition. The most common mechanical weathering processes are frost action and abrasion. The processes of chemical weathering (or rock decomposition) transform rocks and minerals exposed to water and atmospheric gases into new chemical compounds (different rocks and minerals), some of which can be dissolved away. The physical removal of weathered rock by water, ice, or wind is called erosion.

Weathering is a long, slow process, which is why we think rocks last forever. In nature, mechanical and chemical weathering typically occur together. Commonly, fractures in rocks are enlarged slowly by frost action or plant growth (as roots pry into the fractures). This action causes more surface area to be exposed to chemical agents. Chemical weathering works along contacts between mineral grains. Crystals that are tightly bound together become looser as weathering products form at their contacts. Mechanical and chemical weathering continue until the rock slowly falls apart into individual grains.

We often think of weathering as destructive and a bad thing because it ruins buildings and statues. However, as rock is destroyed, valuable products are created. The major component of soil is weathered rock. The growth of plants and the production of food is dependent on weathering. Some metallic ores, such as copper and aluminum, are concentrated into economic deposits by weathering. Dissolved products of weathering are carried in solution to the sea, where they nourish marine organisms. And finally, as rocks weather and erode, the sediment eventually becomes rock again—a sedimentary rock.

Two experiments to illustrate the effects of mechanical and chemical weathering are presented below.

PLASTER AND ICE (MECHANICAL WEATHERING)

WHAT YOU NEED: plaster of paris, water, a small balloon, two empty pint milk cartons (bottom halves only), a freezer

WHAT TO DO: (1) Fill the balloon with water until it is the size of a ping-pong ball. Tie a knot at the end. (2) Mix water with plaster of paris until the mixture is as thick as yogurt. Pour half of the plaster in one milk carton and the other half in the other. (3) Push the balloon down into the plaster in one carton until it is about ¼ inch under the surface. Hold the balloon there until the plaster sets enough so that the balloon doesn't rise to the surface. (4) Let the plaster harden for about 1 hour. (5) Put both milk cartons in the freezer overnight. (6) Remove the containers the next day to see what happened.

WHAT TO THINK ABOUT: What happened to the plaster that contained the balloon? What happened to the plaster that had no balloon? Why is there a difference? Which carton acted as a control? Why? How does this experiment show what happens when water seeps into a crack in a rock and freezes?

WHAT SHOULD HAVE HAPPENED: The plaster containing the balloon should have cracked as the water in the balloon froze and expanded. Explain that when the water seeps into cracks in rocks and freezes, it can eventually break rocks apart.

ESSENTIAL SCIENCE LEARNING BENCHMARKS/OBJECTIVES

1.1 Uses properties to identify, describe and categorize weathering processes.

1.2 Understands that interactions within and among systems cause changes in matter, energy, and decomposition.

2.1 Develops abilities necessary to do scientific inquiry.

GRADE LEVELS

6th–10th grades

SUBJECTS

Earth science

CONCEPTS

Decomposition of rocks: mechanical and chemical weathering; observations while conducting experiments.

SKILLS

Observation; hypothesizing; analyzing; comparing and contrasting.

TIME NEEDED

45 minutes (not including freezing time)

I HEAR AND I FORGET.
I SEE AND I REMEMBER.
I DO AND I UNDERSTAND.

Ancient Chinese proverb

Lesson created by
Sherry L. Weisgarber

Reprinted with permission from *Ohio Geology*, Winter 1997, a publication of the Ohio Department of Natural Resources, Division of Geological Survey, http://www.dnr.state.oh.us/odnr/geo_survey/.

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A SOUR TRICK (CHEMICAL WEATHERING)

WHAT YOU NEED: lemon juice, vinegar, medicine droppers, two pieces each of limestone, calcite, chalk, and quartz

WHAT TO DO: (1) Put a few drops of lemon juice on one piece of each of the four rock types. (2) Put a few drops of vinegar on the other piece of each of the four types. (3) Look and listen carefully each time you add the lemon juice or the vinegar.

WHAT TO THINK ABOUT: What happens when you put lemon juice on each rock? What happens when you put vinegar on each rock? Did the lemon juice and vinegar act the same way on each rock? Why did some of the rocks react differently? What does this experiment have to do with weathering?

WHAT SHOULD HAVE HAPPENED: Lemon juice and vinegar are both weak acids. The lemon juice contains citric acid and the vinegar contains acetic acid. These mild acids can dissolve rocks that contain calcium carbonate. The lemon juice and vinegar should have bubbled or fizzed on the limestone, calcite, and chalk, which all contain calcium carbonate. There should not have been a reaction on the quartz, which does not contain calcium carbonate. Explain that water commonly contains weak acids that dissolve rocks containing calcium carbonate and other minerals.

Source: Ranger Rick's Nature Scope: Geology—The active Earth: National Wildlife Federation, 1988.

LIVE EARTHQUAKE COVERAGE

To see how guinea pigs react to an earthquake, go to http://www.oinkernet.com/equake.htm.

UPCOMING EVENTS

We would be happy to post your event on our calendar, both on our website and in Washington Geology. We need to know the topic, speaker and affiliation, sponsoring organization, date, time, place, and who to contact for more information, preferably a website or e-mail address. Send this information to lee.walkling@wadnr.gov.

Discover Washington's Natural Resources—A Two-Day Workshop for Middle and High School Educators

June 20 and 21, 8:00–5:00
Spokane/Dishman Hills

June 26 and 27, 8:00–5:00
Vancouver/CASEE Center

Registration deadline is June 1, 2001.
http://www.wa.gov/dnr/
teacherworkshop@wadnr.gov
360-902-132

2001 Northwest Regional Meeting of the National Association of Geoscience Teachers

June 21–24; Bellevue, Washington

http://www.btia.net/nagt/

Geological Society of America and Geological Society of London Global Meeting: Earth System Processes

June 24–28; Edinburgh, Scotland

http://www.geosociety.org or
http://www.geolsoc.org.uk

Geological Society of America GeoVentures Field Trip: Geology of Glacier National Park

July 14–19; Columbia Falls, Montana

http://www.geosociety.org/meetings/gv/gh012.htm

Crowding the Rim, 2001: International Geohazards Summit

August 1–3; Stanford University, California

http://www.crowdingtherim.org/

Tobacco Root Geological Society 26th Annual Field Conference

August 2–5; Wallace, Idaho

http://trgs.org/conference.htm

International Tsunami Symposium 2001

August 7–10; Seattle, Washington

http://www.pmel.noaa.gov/its2001

Northwest Geological Society (field trip)

September, TBA

Southern Coast Mountains of British Columbia—Murray Journeay

http://www.scn.org/tech/nwgs/index.htm

National Emergency Management Association Annual Conference

September 8–12; Big Sky Resort, Montana

thembree@csg.org
http://www.nemaweb.org

Mine Fill 2001: International Symposium on Mining with Backfill

September 17–19; Seattle, Washington

http://www.smenet.org/meetings/Minefill2001.cfm

Washington State Ground Water Association Fall Convention

September 28–29; Spokane, Washington

http://www.wsgwa.org/

Association of Engineering Geologists/American Institute of Professional Geologists 2001 Annual Meeting

Sept. 29–Oct. 5; St. Louis, Missouri

http://www.aegweb.org/
http://www.aipg.org/

Canadian Dam Association 2001 Annual Conference

September 30–October 4;
Fredericton, NB, Canada

cda2001@engineering.ca
http://www.cda.ca/cda2001

American Geological Institute's Earth Science Week

Oct. 7–13

http://www.earthscienceworld.org/week/
http://www.usgs.gov/earthscience/

Northwest Geological Society (meeting)

The state-of-affairs at the state survey—Ron Teissere of the Washington Division of Geology and Earth Resources

October 9; 7:30; University Plaza Hotel
NE 45th St., Seattle, Washington

http://www.scn.org/tech/nwgs/index.htm

Western States Seismic Policy Council Annual Conference

October 21–24; Sacramento, California

wsspc@wsspc.org or http://www.wsspc.org

Geological Society of America Annual Meeting: A Geo-Odyssey

November 1–10; Boston, Massachusetts

meetings@geosociety.org
http://www.geosociety.org

International Association of Emergency Managers Annual Conference

November 3–7; Riverside, California

iaem@aol.com or http://www.iaem.com

Northwest Mining Association Annual Meeting

December 3–7; Spokane, Washington

(509) 624-1158 or http://www.nwma.org

Association of Ground Water Scientists and Engineers Annual Meeting

December 7–8; Nashville, Tennessee

http://www.ngwa.org/education/cfpnat01.html ■