Breaking it Down
Lesson Overview

GRADE LEVEL: 9-12

TIME ALLOTMENT: Two 45 minute classes

OVERVIEW: This lesson discusses the processes of weathering and erosion and how they work together to shape the earth's landscape. An online game introduces students to the basic modes of erosion. The processes of chemical and physical weathering that enable erosion are then explored in detail using online media and hands-on laboratory experiments. Next, video clips from the NATURE episode "Violent Hawaii" are used to revisit in greater detail the causes and effects of erosion in the real world, and human attempts to limit it. The lesson culminates with an online game that reinforces students' understanding of the lesson's vocabulary and concepts.

SUBJECT MATTER: Geology/Earth Science

LEARNING OBJECTIVES:

Students will be able to:

- Differentiate and describe the processes of weathering and erosion
- Differentiate and describe the processes of mechanical and chemical weathering
- Model the process of mechanical and chemical weathering, drawing conclusions from their results
- Determine which environments and climates are most likely to promote different types of weathering and erosion
- Describe various human attempts to limit erosion

STANDARDS AND CURRICULUM ALIGNMENT:

National Science Education Standards

http://www.nsta.org/publications/nses.aspx

CONTENT STANDARD D: *Geochemical cycle*

All students should develop an understanding of:

GEOCHEMICAL CYCLES

- The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical

reservoirs. Each element on earth moves among reservoirs in the solid earth, oceans, atmosphere, and organisms as part of geochemical cycles.

- Movement of matter between reservoirs is driven by the earth's internal and external sources of energy. These movements are often accompanied by a change in the physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide, and in all organisms as complex molecules that control the chemistry of life.

New York State Regents Core Curriculum Alignments:

Physical Setting: Earth Science Core Curriculum

http://emsc.nysed.gov/ciai/mst/pub/earthsci.pdf

STANDARD 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.

Key Idea 2: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.

Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.

STANDARD 2: Students will access, generate, process, and transfer information, using appropriate technologies.

Key Idea 1: Information technology is used to retrieve, process, and communicate information as a tool to enhance learning.

STANDARD 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

Key Idea 2: Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land**.**

Performance Indicator 2.1p: Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.

Performance Indicator 2.1s: Weathering is the physical and chemical breakdown of rocks at or near Earth's surface. Soils are the result of weathering and biological activity over long periods of time.

Performance Indicator 2.1t Natural agents of erosion, generally driven by gravity, remove, transport, and deposit weathered rock particles. Each agent of erosion produces distinctive changes in the material that it transports and creates characteristic surface features and landscapes. In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.

Performance Indicator 2.1u The natural agents of erosion include:

-*Streams (running water):* Gradient, discharge, and channel shape influence a stream's velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries.

- *Glaciers (moving ice):* Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock. Glacial features include moraines, drumlins, kettle lakes, finger lakes, and outwash plains.

- *Wave Action:* Erosion and deposition cause changes in shoreline features, including beaches, sandbars, and barrier islands. Wave action rounds sediments as a result of abrasion. Waves approaching a shoreline move sand parallel to the shore within the zone of breaking waves.

-*Wind:* Erosion of sediments by wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sand-blasted bedrock.

-*Mass Movement:* Earth materials move downslope under the influence of gravity.

Performance Indicator 2.1v Patterns of deposition result from a loss of energy within the transporting system and are influenced by the size, shape, and density of the transported particles. Sediment deposits may be sorted or unsorted.

Performance Indicator 2.1w Sediments of inorganic and organic origin often accumulate in depositional environments. Sedimentary rocks form when sediments are compacted and/or cemented after burial or as the result of chemical precipitation from seawater.

STANDARD 6: Students will understand the relationships and common themes that connect mathematics, science, and technology and apply the themes to these and other areas of learning.

Key Idea 1: Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.

MEDIA COMPONENTS

Video

NATURE, *Violent Hawaii*, selected segments:

Clip 1: "Hawaiian Coastal Cliffs"

Explains the geologic forces beind the creation of Hawaii's dramatic shoreline.

Clip 2: "Water Erosion"

Demonstrates the erosive action of water on the Hawaiian landscape, and human efforts to limit it.

Access the streaming and downloadable video segments for this lesson at the Video Segments Page (http://www.pbs.org/wnet/nature/lessons/breaking-it-down/video-segments-violent-hawaii/1702/).

WEB SITES:

Shape it Up!

http://www.kineticcity.com/mindgames/warper/

An interactive game from the American Association for the Advancement of Science that challenges students to correctly identify geological processes that shape the Earth's surface.

Types of Mechanical Weathering

http://www.uky.edu/AS/Geology/howell/goodies/elearning/module07swf.swf

Interactive Web site from the University of Kentucky featuring animations of the different varieties of mechanical weathering.

Graphing Tutorial

http://nces.ed.gov/nceskids/help/user_guide/graph/whentouse.asp

This tutorial from the National Center for Education Statistics explains the various kinds of graphs and demonstrates how to build them.

Erosion and Weathering

http://nsdl.org/resource/2200/20070126213743204T

Web site from the National Science Digital Library describing different causes and effects of erosion, and human efforts to limit it.

Relationship between Transported Particle Size and Water Velocity

http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf

Earth Science Reference Tables from the New York State Education Department charting the relationship between sediment particle size and the velocity of water necessary to transport it.

Weathering & Erosion Jeopardy

http://www.regentsearthscience.com/jeopardy/erosion/jeopardy.htm

Interactive "Jeopardy" style vocabulary game based on the New York State Regents' Earth Science Standards, with answers to each question found by scrolling to the bottom of the page.

MATERIALS:

For each student:

- "Mechanical Weathering" student organizer
- "Erosion" student organizer
- Printout of page 6 of the Earth Science Reference Tables (http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf).

For each group:

- "Weathering and Erosion Jeopardy" student organizer
- "Chemical Weathering" student organizer

- 6 effervescent antacid tablets
- 1000 ml beaker (filled with hot tap water)
- 250 ml beaker
- stopwatch
- thermometer
- graph paper

For the class:

- "Weathering and Erosion Jeopardy" student organizer answer key
- "Mechanical Weathering" student organizer answer key
- "Chemical Weathering" student organizer answer key
- "Erosion" student organizer answer key
- a hammer
- plaster of Paris (available at art or hobby supply stores, or from your art department)
- a small balloon
- two empty pint milk cartons (bottom halves only)
- a freezer
- 2 effervescent antacid tablets
- Blackboard or whiteboard

PREP FOR TEACHERS

Prior to teaching this lesson, you will need to:

Preview all of the video clips and Web sites used in the lesson.

Download the video clips used in the lesson to your classroom computer, or prepare to watch them using your classroom's Internet connection.

Bookmark the Web sites used in the lesson on each computer in your classroom. Using a social bookmarking tool such as del.icio.us or diigo.com (or an online bookmarking utility such as portaportal.com) will allow you to organize all the links in a central location.

Download and make copies of student organizers and handouts as outlined in "Materials."

INTRODUCTORY ACTIVITY

1. Have students log on to the interactive game "Shape It Up!" (http://www.kineticcity.com/mindgames/warper/) Explain that this game will challenge them to identify the forces that shape the earth's surface and the relative speed with which they act. After explaining that "erosion" is generally a process whereby the earth's surface is worn down, provide students with a FOCUS FOR MEDIA INTERACTION by

asking them to determine which of the game's four earth-shaping forces (wind, water, glacial and volcanic activity) is NOT a force of erosion. Allow students to play the game for approximately 5 minutes-enough time for everyone to have played every scenario in the game.

2. Review the focus question by asking which of the four earth-shaping forces in the game is NOT a force of erosion. (*If students don't answer "volcanoes," explain that while erosion is generally a process whereby the earth's surface is worn down, volcanic activity generally raises up the earth's surface.)* Have students click on the "Learn More" button and ask for four volunteers to each read one of the paragraphs describing the geological process in the game. Explain that water, wind, and glaciers are all forces of erosion. Erosion describes the process by which small particles of rock (or sediment) are washed, blown, or scraped away, wearing down the surface of the earth.

3. Explain that large rocks first need to be broken down into smaller pieces in order to be worn away by erosion, and that this is accomplished by weathering-the breaking down of rock by chemical or mechanical processes. Explain that the remainder of this lesson will explore and explain the phenomenon of weathering and erosion in greater detail, beginning with weathering.

LEARNING ACTIVITY 1 - MECHANICAL WEATHERING (Part I)

1. Explain that weathering involves two processes that generally work together to decompose rocks at or near the earth's surface: mechanical weathering and chemical weathering.

2. Place an effervescent antacid tablet on a table and break it with a hammer. Explain that this is a form of mechanical weathering-the physically breakdown of rocks into smaller fragments without changing their chemical composition. Ask: What are some things that might cause mechanical weathering? (*Answers will vary but may include: extreme heat, extreme cold, exfoliation, crystal growth, the growth of lichens and plant roots-also called biological weathering-and human and animal traffic*.)

3. Have students log onto the "Types of Mechanical Weathering" Web site (http://www.uky.edu/AS/Geology/howell/goodies/elearning/module07swf.swf) and click "next" twice, which should take them to the "Mechanical Weathering - Exfoliation" page. For this and the next four pages of the Web site, provide students with a FOCUS FOR MEDIA INTERACTION by asking them to complete the "Mechanical Weathering Student Organizer." Allow ten minutes for completion of the organizers.

4. Review the students' answers to the organizer questions, correcting and explaining as necessary. Ask if they can think of any other types of mechanical weathering. (*Answers will vary.)* Tell them that in temperate climates like our own, frost wedging is one of the most common types of mechanical weathering. Explain that this is a different process than the thermal expansion and contraction they just learned about. Tell students that they will now be conducting a demonstration that will illustrate how frost wedging works.

5. Ask two student volunteers to come to the front of the class. Have one student fill a balloon with water until it is the size of a ping-pong ball, and then tie a knot at the end. Have another mix water with plaster of Paris; once the mixture is as thick as yogurt, have him or her pour half of the plaster in one milk carton and the other half in the other. Have the student with the balloon push it down into the plaster in one carton until the balloon is about 1/4 inch under the surface. Have him or her hold the balloon there until the plaster sets enough so that the balloon doesn't rise to the surface. Let the plaster harden for about 1 hour. Put both milk cartons in the freezer overnight.

6. Ask students to predict what they think will happen when the milk cartons are frozen? (*Accept all answers.)* Tell students that they will see tomorrow what happened. Explain that in the meantime they will be looking at the other primary type of weathering: chemical weathering.

LEARNING ACTIVITY 2 - CHEMICAL WEATHERING

1. Explain that chemical weathering describes a process in which rock is broken down through a change in its chemical composition-most commonly through the dissolution of minerals in the rock by water. One common form of chemical weathering is oxidation of iron in rocks-otherwise known as rust. Another is when carbon dioxide from air combines with water to form carbonic acid, which dissolves rock-especially rock containing high amounts of the mineral calcium carbonate (e.g. marble or limestone).

2. Illustrate this last point by dropping an effervescent antacid tablet into a beaker of water. Explain as it dissolves that these tablets contain sodium bicarbonate which dissolves in water in much the same way that carbonate rocks dissolve in carbonic acid. Ask students if they think that temperature is a factor in chemical weathering? (*Accept all answers*.) Tell students that they will now be conducting an experiment to determine how the rate of chemical weathering might be affected in different climates around the world.

Divide the class into groups of 4-5 students. Distribute to each group an empty 250ml beaker, a 1000ml beaker filled with hot tap water, a tray of ice, a thermometer, a stopwatch, and the "Chemical Weathering" student organizer.

3. Have each group combine some ice and hot water in their empty beaker until the temperature reaches the 40-50°C range, at which po int any remaining ice in the beaker should be removed. Ideally, the total volume in the beaker should be about 200ml, although a little less or more won't matter. Record the temperature of the water on the organizer.

4. Have one member of each group start timing with a stopwatch at the moment another group member drops an antacid tablet into the beaker. Stop the stopwatch when the tablet has completely dissolved and no traces of the tablet are visible. (Don't wait for the bubbling to stop.) Record the dissolving time in the organizer. Also record the water temperature again; calculate the average temperature during the experiment (i.e. add the starting and final temperatures and divide by 2) and enter that into the organizer.

5. Empty the beaker (rinsing well to get rid of any antacid remnants) and repeat the experiment four more times, lowering the temperature range each time by 10 degrees (i.e. round two of the experiment should be 30-40° C, round three should be 20-30°C, and so on.) NOTE - if you are short on time, assign different temperatures to different groups of students rather than having all the groups repeat the experiment four times.

6. Direct students to the "Graphing Tutorial" Web site (http://nces.ed.gov/nceskids/help/user_guide/graph/whentouse.asp), providing a FOCUS FOR MEDIA INTERACTION by asking students which types of graph would be best suited to easily and effectively plot the data they've just collected. *(A bar or line graph would be simplest and best.)* Which would be least suitable? *(A pie chart would be unsuitable as it does not reflect changes over time.)* Have each group graph their tablet dissolution time answers in a bar or line graph on their graph paper (where the X axis is the Average Water Temp and the Y axis is Dissolving Time).

7. Have students answer the questions at the bottom of the organizer.

8. Ask students what else might accelerate the chemical weathering process they just modeled? Offer the hint that they learned about it earlier in the lesson. (*Mechanical weathering*.) Pull out another antacid tablet and crush it with a hammer. Drop the crushed bits into water-they will dissolve almost instantly. Explain that this shows how mechanical weathering facilitates the chemical weathering of rocks.

9. Ask students if they think the opposite is true (i.e. that chemical weathering facilitates mechanical weathering)? (*Yes*.) Have each group drip a few drops of water on antacid tablets-just enough to start its fizzing reaction. After a few seconds, have them rub the dissolving tablet between their fingers. Explain that the antacid residue coming off on their fingers shows how chemical weathering (i.e. the water dissolving the tablet) can facilitate mechanical weathering (i.e. the fingers rubbing-or abrading-the tablet).

DAY TWO - LEARNING ACTIVITY 1: MECHANICAL WEATHERING (Part II)

1. Review the previous activity's experiment with the milk cartons. What were students' predictions about what would happen when they froze? (*The plaster containing the balloon should have cracked as the water in the balloon froze and expanded.)* Remove the plaster-filled milk containers from the freezer. Ask students: what happened to the plaster that contained the balloon? (*It cracked.)* What happened to the plaster that had no balloon? (*It did not crack*.) Why the difference? (*The water in the balloon expanded as it froze*.) Explain that this is the same process which occurs when water seeps into cracks in rocks and freezes-a process called frost wedging.

2. Have students log on to the "Types of Mechanical Weathering" Web site (http://www.uky.edu/AS/Geology/howell/goodies/elearning/module07swf.swf) and have them click "next" until they get to the "Frost Wedging" page. Provide students with a FOCUS FOR MEDIA INTERACTION by asking them to find the name of the process that describes how small frost wedging cracks can become larger over time? (*The freeze-thaw cycle.)* Ask a student volunteer to describe this process. (*As water frozen in*

rock cracks thaws, it seeps deeper into the cracks it made when it froze before; when it freezes again, it widens the crack.)

LEARNING ACTIVITY 3: EROSION

1. Explain that once a particle of sediment loosened by any type of weathering is somehow transported somewhere else, the process is called erosion. Ask the class to name forces that might drive that movement, writing them on the blackboard or whiteboard. (*Answers may include wind, water, ice, and gravity. Accept all*.)

2. Explain that the class will now be taking a closer look at these forces that drive erosion. Distribute the "Erosion" student organizer. Have students log onto the "Erosion and Weathering" Web site (http://nsdl.org/resource/2200/20070126213743204T) and click "view" at the center of the page. Provide a FOCUS FOR MEDIA INTERACTION for students by explaining that each of seven pages on the site has one corresponding question on the organizer, which they will have 5 minutes to complete.

3. Review the organizer questions with your students, correcting or clarifying their answers as necessary. Ask the class if they think all major factors of erosion were covered by the Web site (*Accept all answers*). Explain that water is an erosive agent not just in streams (where it forms V-shaped valleys), but along coasts, where wave action erodes shorelines over time. Explain that glaciers also scrape away the landscape (forming U-shaped valleys) as they move over time. Tell students that they will now be watching a video clip that describes the action of one of the most important forces behind erosion. Provide students with a FOCUS FOR MEDIA INTERACTION by asking them to form a hypothesis about whether the massive Hawaiian costal cliffs they'll be seeing were mainly created by water erosion (i.e. like a river bank).

PLAY Clip 1, "Hawaiian Coastal Cliffs" (access the video segments for this lesson at the Video Segments Page, http://www.pbs.org/wnet/nature/lessons/breaking-it-down/video-segments/1702/).

4. Review the focus question: Were the Hawaiian coastal cliffs mainly created by coastal water erosion? (*No. They were created by gigantic landslides*.) What is the main force behind a landslide? (*Answers may vary and might include Hawaii's volcanic/tectonic activity, but explain that gravity is always the prime mover of any landslide-the geological term for which is "mass wasting." Explain that gravity also promotes erosion through the downward flow of water and ice, which is one of the most important forces behind erosion.*)

5. Explain that, in addition to being an inherently unstable volcanic land mass, Hawaii has a tropical climate: hot, humid, and rainy. Based on their chemical weathering experiment yesterday, ask students if they think chemical weathering is common there? (*It is*.) What type of erosion is probably most common? (*Water erosion.)* Tell students they will now be looking at another clip, which shows the effects of Hawaii's heavy rainfall on its terrain. Provide a FOCUS FOR MEDIA INTERACTION by asking students to write down three places where the clip shows water flowing.

PLAY Clip 2, "Water Erosion" (access the video segments for this lesson at the Video Segments Page, http://www.pbs.org/wnet/nature/lessons/breaking-it-down/video-segments/1702/).

6. PAUSE the clip after the shot with the child and the boulder. Review the FOCUS question: Name three places in the clip where water is flowing? (*A road, a river, and a waterfall*.) Explain that all three represent channels, which confine the flow of water into a stream, and that this confinement increases the water's velocity. Distribute copies of page 6 of the NY State Earth Science Reference Tables PDF (http://emsc32.nysed.gov/osa/reftable/esp1-7.pdf) and direct students' attention to the "Relationship of Transported Particle Size to Water Velocity" chart.

Ask students what they can conclude about the capacity of higher velocity streams to carry sediment particles. (*The greater the velocity of a stream, the larger the sediment particles it can carry.)* Explain to students that Hawaii's mountainous terrain tends to create high-velocity streams such as they've just seen in the video, and that this renders the landscape highly susceptible to water erosion.

7. Provide a FOCUS FOR MEDIA INTERACTION for the remainder of the clip by asking students to note measures Hawaiians have taken to prevent waterlogged hillsides from falling onto their homes.

PLAY Clip 2, "Water Erosion" through to the end.

Review the focus question: What measures have Hawaiians taken to prevent their homes from landslides? (*Steel mesh draped over hillsides*.) Ask student to name the term from the "Erosion and Weathering Web" site that describes this. (*Erosion management*.) Ask if the mesh will prevent weathering. (*No-it will only temporarily control erosion*. *The mesh will do nothing to protect the soil from the physical and chemical weathering effects of rainfall*.)

9. Tell students that they will now be reviewing what they've learned about the major forces and factors of erosion and weathering.

CULMINATING ACTIVITY

1. Load and project the Web site for "Weathering and Erosion Jeopardy" (http://www.regentsearthscience.com/jeopardy/erosion/jeopardy.htm) and tell students that they will be playing a *Jeopardy*-style game designed to review their understanding of key terms in the game's first two subject categories-"Weathering" and "Erosion." Divide the class into three groups, and have each group select one member to be its representative, or "contestant."

2. Distribute a "Weathering and Erosion Jeopardy Student Organizer" to each group. Provide a FOCUS FOR MEDIA INTERACTION by explaining that for each point value

selected by a contestant from either category, the game will give a definition. Groups may confer with their contestants about the correct answer, but once one of the contestants has raised his or her hand, all discussion must stop, and that contestant must give a term (phrased as a question!) corresponding to the definition. If he or she answers correctly (which should be checked against the "Erosion Jeopardy Answer Key"), scroll down in the game's lower window to reveal and confirm the answer, and add that question's point value to his or her group's score. If the answer is incorrect, those points are deducted from the group's score, and the other two contestants are free to raise their hands and attempt to answer. Use a blackboard or whiteboard to keep score, and have each group write down each question and correct answer on their "Weathering and Erosion Jeopardy Student Organizer."

CROSS-CURRICULAR ACTIVITIES

History

Have students research the Dust Bowl of the 1930s, when much of the American Great Plains suffered catastrophic wind erosion after protective prairie grass was removed and the soil loosened to support overly-intensive agriculture.

Chemistry

Have students study and model other chemical weathering reactions common in nature. Possible experiments could include the corrosive effect of acid rain.

COMMUNITY EXTENSIONS

Invite a civic engineer, landscape architect, or farmer to speak to the class about the various types of erosion and management and prevention strategies in the local environment.

NATURE®

NAME: _____

DATE: _____

“MECHANICAL WEATHERING”

Student Organizer

1. What is the force behind weathering by Exfoliation?

1a. Where is it most likely to occur?

2. What is the force behind weathering by Thermal Expansion and Contraction?

2a.Where is it most likely to occur?

3. What is the force behind weathering by Crystal Growth?

3a. Where is it most likely to occur?

4. What is the force behind weathering by Tree Roots?

4a.Where is it most likely to occur?

5.What is the force behind weathering by Abrasion?

5a. Where is it most likely to occur?

5b. What else do you think might abrade rock besides sediments?

NATURE®

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DATE: _____

“EROSION”

Student Organizer

1. What is one factor which makes rocks more or less vulnerable to erosion?

2. The cause of erosion described here is rock broken apart by _____, which is a process of _____ weathering.

3. In which environment would wind erosion be most pronounced? (circle one)

    a. Rain forest
    b. Desert
    c. Mountain range

4. The erosion on the left is the result of what type of weathering?

5. How does agriculture lead to increased erosion?

6. In what way do the large rocks lining the riverbank protect it from erosion?

7. The sand fences on a beach are a defense against what type of erosion?

NATURE®

NAME: _____

DATE: _____

WEATHERING AND EROSION JEOPARDY

Student Organizer

WEATHERING	EROSION
The breakdown of rocks…	The number one agent of erosion…
Disintegration of rocks into smaller pieces of the same stuff…	This type of erosion is common in a hot, dry climate…
Decomposition of rocks into different substances…	The primary force behind all mass movements…
When Oxygen reacts with minerals changing them into iron oxide…	This agent of erosion produces U-shaped valleys…
When rocks peel off the[ir] layers because of pressure unloading…	This provides the energy for rivers and glaciers…

NATURE®

NAME: _____

DATE: _____

“CHEMICAL WEATHERING”

Student Organizer

Staring Water Temp	Dissolving Time	Ending Water Temp	Avg. Water Temp

a. In which temperature range did the antacid tablet dissolve most quickly?

b. In which temperature did the antacid tablet dissolve most slowly?

c. What does this tell us about the effect of temperature on chemical weathering?

d. Based on this conclusion, in what climates/environments would we chemical weathering to be most pronounced?

NATURE®

NAME: _____

DATE: _____

WEATHERING AND EROSION JEOPARDY

STUDENT ORGANIZER ANSWER KEY

WEATHERING	EROSION
The breakdown of rocks…*What is weathering?*	The number one agent of erosion…*What is water?*
Disintegration of rocks into smaller pieces of the same stuff…*What is mechanical weathering?*	This type of erosion is common in a hot, dry climate…*What is wind erosion?*
Decomposition of rocks into different substances…*What is chemical weathering?*	The primary force behind all mass movements…*What is gravity?*
When Oxygen reacts with minerals changing them into iron oxide…*What is oxidation?*	This agent of erosion produces U-shaped valleys…*What are valley glaciers?*
When rocks peel off the[ir] outer layers because of pressure unloading…*What is exfoliation?*	This provides the energy for rivers and glaciers…*What is the sun?*

NATURE®

NAME: _____

DATE: _____

“MECHANICAL WEATHERING”

STUDENT ORGANIZER ANSWER KEY

1. What is the force behind weathering by exfoliation? (*As surface layers of rock erode, pressure on the layers beneath is “unloaded,” and the lower levels expand upward and outward, resulting in the cracking and “peeling” of surface layers.)*

1a. Where is it most likely to occur? (*Mountain ranges.)*

2. What is the force behind weathering by Thermal Expansion and Contraction? (*Rock crystals crack during cycles of expansion and contraction corresponding to exteme heat and cold.)*

2a.Where is it most likely to occur? (*Deserts.)*

3. What is the force behind weathering by Crystal Growth? (*Growth of salt crystals in spaces between rocks*.)

3a. Where is it most likely to occur? (*Coastal areas and deserts.)*

4. What is the force behind weathering by Tree Roots? (*Tree roots grow into and expand cracks in the rocks.)*

4a.Where is it most likely to occur? (*Any rocky area able to support tree growth.)*

5. What is the force behind weathering by Abrasion? (*Particles of sediment wearing against rock*.)

5a. Where is it most likely to occur? (*Anywhere, although most pronouncedly in harsh environments*.)

5b. What else do you think might abrade rock besides sediments? (*Human and animal activity*.)

NATURE®

NAME: _____

DATE: _____

“CHEMICAL WEATHERING”

STUDENT ORGANIZER ANSWER KEY

Staring Water Temp	Dissolving Time	Ending Water Temp	Avg. Water Temp

a. In which temperature range did the antacid tablet dissolve most quickly? (*40-50°C*)

b. In which temperature did the antacid tablet dissolve most slowly? (*0-10°C*)

c. What does this tell us about the effect of temperature on chemical weathering? (*Chemical weathering is accelerated by higher temperatures*.)

d. Based on this conclusion, in what climates/environments would we chemical weathering to be most pronounced? (*Hot, rainy, and humid; rainforests.)*

NATURE®

NAME: _____

DATE: _____

"EROSION"

STUDENT ORGANIZER ANSWER KEY

8. What is one factor which makes rocks more or less vulnerable to erosion? (*Their softness or porosity.*)

9. The cause of erosion described here is rock broken apart by (*Freezing water),* which is a process of (*Mechanical)* weathering..

10. In which environment would wind erosion be most pronounced? (circle one)

    a. Rain forest
    b. Desert
    c. Mountain range

11. The erosion on the left is the result of what type of weathering? (*Chemical.)*

12. How does agriculture lead to increased erosion? (*Vegetation—which helps hold soil in place-- is removed.*)

13. In what way do the large rocks lining the riverbank protect it from erosion? (*They are less likely to be washed away by the river's current than the river's usual soil banks.)*

14. The sand fences on a beach are a defense against what type of erosion? (*Wind*.)