Environmental Science Institute
THE UNIVERSITY OF TEXAS AT AUSTIN

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Canyons of the Universe: A Look at Water Erosion

Lesson plan for grades 3-5
Length of lesson: 45 minutes to 60 minutes
Adapted by: Alexandra Murillo, Environmental Science Institute, November 2013
Authored by: Eco-Connections (http://www2.gsu.edu/~wwwmir/soil3.html)

SOURCES AND RESOURCES:

- Information from NASA on Valles Marineris of Mars. http://mars.jpl.nasa.gov/gallery/atlas/valles-marineris.html
- Animation of Valles Marineris. http://www.indiana.edu/~geol105/images/gaia_chapter_2/vidmars2.avi
- Pictures that indicate water may have shaped some of the landforms in the Valles Marineris. http://www.indiana.edu/~geol105/images/gaia_chapter_2/mars_geomorph.htm
- Video about Valles Marineris. "Valles Marineris" http://www.youtube.com/watch?v=crsqzZNUXsY
- Video about the Grand Canyon. "The Grand Canyon: How it Formed" http://www.youtube.com/watch?v=ktf73HNZZGY

POTENTIAL CONCEPTS TEKS ADDRESSED THROUGH THIS LESSON:

§112.14. Science, Grade 3: 7C, 7D
§112.15. Science, Grade 4: 7B
§112.16 Science, Grade 5: 7A, 7B

PERFORMANCE OBJECTIVES:

Students will be able to:

- Identify how water, wind and other forces can shape the Earth over time.
- Compare the processes that shaped the Grand Canyon to the processes that shaped the Valles Marineris on Mars.

MATERIALS (per group of two or three):

- Video clips (websites listed above)
- Cookie sheet or tray (small 10" x 14" or medium 14" x 14")
- Enough sand or soil to fill cookie sheet to rim
- Large, disposable plastic cup (16 oz. or larger)
- Plastic bin

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CONCEPTS:

Earth has been shaped over billions of years due to many geological processes, including weathering processes. Weathering refers to the breakdown of rocks at or near the surface of the earth. The movement of weathered rock fragments/sediment is called erosion.

BACKGROUND:

Valles Marineris is a large canyon located on Mars. It's a canyon that can be compared to the Grand Canyon by looking at how the canyons were formed. "Most researchers agree that Valles Marineris is a large tectonic "crack" in the Martian crust, forming as the planet cooled, affected by the rising crust in the Tharsis region to the west, and subsequently widened by erosional forces," (NASA). More importantly, there appear to be some channels that may have been formed by water that connect to the canyon. Learning about how the Grand Canyon formed can lead students to understanding important weathering processes such as: wind erosion, water erosion, and tectonic movement. The exploration portion of this lesson will focus on erosion caused by water.

PREPARATION:

Set up a materials station somewhere in the room so the groups of two will have easy access to the supplies when they begin the activity. The station should include: a cookie sheet, a large plastic cup filled with water, pre-portioned amount of soil or sand, a plastic bin large enough to fit the width of the cookie sheet. Each group should receive enough material to fill the cookie sheet to the rim when lightly packed in. It will be more organized all the supplies were put in the plastic bins so one student from each group can pick up the materials.

ENGAGE (5 minutes):

Show the animation of Valles Marineris from the Indiana website. Ask the students what they think the animation might be of and why they think that.

Ask:

- What is this animation showing?
- Why do you think that?
- Does it look like it could be on Earth, some other planet, or both?

Note to teachers: After the questions, explain to the students that the animation is of Valles Marineris, which is the largest canyon on Mars. At this point, the students can be shown a full picture of Valles Marineris so they can get an idea of how big it is. Draw comparisons of the canyon to how big the United States is. The Valles Marineris is longer than the U.S. from coast to coast. Also, let the students know they will be charged with figuring out one way the Valles Marineris might have formed.

EXPLORE (15-20 minutes):

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Start the section by transitioning from the Valles Marineris by stating that a comparable canyon on Earth is the Grand Canyon and how the Grand Canyon was formed is currently known. Task the students with the activity of showing stream erosion of the Grand Canyon through an experiment.

1. Group the students in groups of two or three depending on how large the class is.
2. Hand out the worksheet with the experiment instructions.
3. Assign one student to be the researcher and one to be the recorder initially; the other student can be the assistant-researcher.
4. Have the researcher pick up the bin with all the materials.
5. Allow the students to complete the activity.
6. Circulate the room to make sure students can effectively accomplish the task and answer the during-activity questions on the handout.
7. After all the students have completed the activity, have the students answer the corresponding questions as a group.
8. Circulate the room to help students to answer the after-activity questions on the handout.

EXPLAIN (5-10 minutes):

Get the students talking about the activity they did and the questions they answered. Randomly call on students from each group to answer the after-activity questions out loud. This section should compare the processes that shaped the Grand Canyon to the processes that shaped the Valles Marineris.

- Ask the same questions from the handout so they students will have had time to look at the questions, discuss them with their partners, and won't be surprised by being asked them again.
- Although this activity was to show one way the Grand Canyon was formed, these ideas can apply to the Valles Marineris. How do you think the Valles Marineris was formed?
- Do you think the formation of Valles Marineris was the same process that shaped the Grand Canyon? Why or why not?
- Give the students a couple of minutes to suggest a way Valles Marineris was formed and remind them how large the canyon is compared to the Grand Canyon.

ELABORATE (15 minutes):

This section should elaborate on the geological processes that shaped the Grand Canyon and how Valles Marineris was formed. The students can be shown the video "The Grand Canyon: How it Formed" and "Valles Marineris." Hand out the worksheet that will help the students gather similarities and differences between how the two canyons were formed. The students should fill in the blanks on the note-taking section and answer questions. If time permits, call on students or volunteers to share their thoughts.

EVALUATE (5 minutes):

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Explain to the students they will complete a short exit ticket to help you to better see if they understood the lesson. Have the students complete the exit ticket. The exit ticket will assess if the students met the lesson objectives.

Name _____
Date _____

Canyons of the Universe: A Look at Water Erosion

Water is one powerful tool that has helped shape the Earth's surface. The Grand Canyon is a testament to just how mighty water can be. But how can water be powerful enough to slash through rock? This activity will help show you how water might be able to cut rock.

Activity instructions:

1. *Researcher:* Collect a materials bin from the supplies station.
2. *Both*: Make sure the plastic materials bin contains:
    a. Soil or sand
    b. A large plastic cup
    c. A cookie sheet
3. *Researcher B*: Take the materials out of the bin and set them on your workstation.
4. *Researcher A*: Fill the cookie sheet with the soil or sand and lightly press it into the cookie sheet.
5. *Both*: At this point, raise your hands to have the teacher come and fill the plastic cup with water.
6. *Researcher A*: Pick up the cookie sheet with soil or sand and place one side into the plastic bin while elevating the other side.
7. *Researcher B*: With the cookie sheet angled into the plastic bin, pick up the plastic cup with water and slowly pour half of the contents down the middle of the soil or sand in the cookie sheet.
8. *Both*: Take notes on what happens when the first half of the water is poured down the middle of the sheet.
9. *Switch who holds the sheet angled in the plastic bin and who pours the cup of water*. *Researcher A* should now pour the rest of the water down the middle of the cookie sheet while *Researcher B* holds the cookie sheet angled in the plastic bin.
10. *Both*: Take notes on what happens when the second half of the water is poured down the cookie sheet.

Notes:

- What happened when you poured the **first half** of the cup of water down the cookie sheet?

- What happened when you poured the **second half** of the cup of water down the cookie sheet?

Questions:

1. Did a lot of soil or sand come off when water was poured over the cookie sheet?

2. Why did some soil or sand come off of the cookie sheet when water was poured over it?

3. Did more soil or sand come off the second time the water was poured? Come up with a reason why or why not?

4. What do you think would happen if a constant and strong stream of water were poured down the cookie sheet? Why?

5. How might this relate to how the Grand Canyon was formed? How could flowing water shape the Grand Canyon? Keep in mind that the Grand Canyon is up to a mile deep.

The Grand Canyon and the Valles Marineris

While watching the videos over the two canyons take notes over these things listed below, for each of the two canyons:

- **How big is the canyon?**

The Grand Canyon	The Valles Marineris

- **How old is the canyon?**

The Grand Canyon	The Valles Marineris

- **Main points of how the canyon formed?**

The Grand Canyon	The Valles Marineris

After viewing the videos about the Grand Canyon and the Valles Marineris of Mars, compare and contrast the way the two canyons were formed. Fill out the sections below, which will answer the following questions:
Similarities: How were the two canyons formed? How are the two canyons similar?
Differences: What is unique to how the Grand Canyon formed? What's unique to how the Valles Marineris formed?

Similarities:

Differences:

The Grand Canyon	The Valles Marineris