TEACHER GUIDE
Earth Science

LEARNING UNDEFEATED
Educate | Elevate | Empower

How Water Moves

Topic(s): Earth Science, geography, topography

Grade level(s): 6th-8th

Time: 45-60 minutes

NGSS Alignment: MS-ESS2-2

TEKS Alignment: 7.8B, 7.8C

LSSS Alignment: 8-ESS2-2

ACTIVITY OVERVIEW

This activity introduces students to modeling using simulations and visualizations through an AR Sandbox. Students will conduct an experiment using the scientific method to get a better understanding of how the movement of water impacts the land as well as potential human impact on water movement.

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ALIGNMENT TO STANDARDS

NGSS:

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

TEKS:

7.8B. Analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas.

7.8C. Model the effects of human activity on groundwater and surface water in a watershed.

LSSS:

8-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

LEARNING OUTCOMES

Students will know:

- How the Colorado River formed the Grand Canyon.
- How changing the movement of water impacts erosion and sedimentation.

Students will understand:

- The role of water in shaping our land.
- How humans can impact the movement of water.
- How models help us understand our world better.

Students will be able to:

- Do the scientific method: Ask, predict, test, analyze, conclude.
- Use the AR Sandbox to conduct an investigation.

CAREER CONNECTIONS

Geoscientist

Geoscientists study the physical aspects of the Earth.

Work Environment: Most geoscientists split their time between working indoors in offices and laboratories, and working outdoors. Doing research and investigations outdoors is commonly called fieldwork and can require irregular working hours and extensive travel to remote locations.

Duties: Professionals in these jobs have the following duties and more: plan and carry out field studies in which they collect samples and conduct surveys, make geological maps and charts, and analyze rock samples.

Median Salary: $93,580 (US Bureau of Labor Statistics, 2020)

Source: https://www.bls.gov/ooh/life-physical-and-social-science/geoscientists.htm

Environmental Engineer

Environmental engineers use the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems.

Work Environment: Environmental engineers work in a variety of settings because of the nature of the tasks they do. When they are working with other engineers and urban and regional planners, environmental engineers are likely to be in offices. When they are carrying out solutions through construction projects, they are likely to be at construction sites.

Duties: Professionals in these jobs have the following duties and more: design projects that lead to environmental protection, monitor progress of environmental improvement programs, analyze scientific data and do quality-control checks, and advise corporations and government agencies about procedures for cleaning up contaminated sites.

Median Salary: $92,120 (US Bureau of Labor Statistics, 2020)

Source: https://www.bls.gov/ooh/architecture-and-engineering/environmental-engineers.htm

Civil Engineer

Civil engineers design, build, and supervise infrastructure projects and systems.

Work Environment: Civil engineers generally work in a variety of locations and conditions. It is common for them to split their time between working in an office and working outdoors at construction sites so that they can monitor operations or solve problems onsite.

Duties: Professionals in these jobs have the following duties and more: oversee and analyze the results of soil testing to determine the strength of foundations, use design software to plan

and design structures in line with industry and government standards, and analyze maps and survey reports to plan and design projects.

Median Salary: $88,570 (US Bureau of Labor Statistics, 2020)

Source: https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm

TEACHING MATERIALS

- Projector
- PowerPoint Presentation

STUDENT MATERIALS

- Worksheet

LESSON PLAN

Slide 1: Do Now

- As students settle into class, pass out worksheets and ask students to complete the Do Now. They are to answer on their own before sharing out as a class.
- Where was the photo taken?
    - *Granite Rapids, Grand Canyon*
- What created the landform shape seen in the photo?
    - *The movement of water.*
- Is the water moving and how do we know?
    - *Yes, it is moving. We know from the white tops on the rivers and ripples.*
- What is the name of the river? Hint: It's famous for canyons and whitewater rapids!
    - *Colorado River*

Slide 2: How Water Moves

- Introduce today's activity on the movement of water and how it shapes the land.

Slide 3: Learning Objectives

- Inform students on what we will be covering that day.

Slide 4: Class Discussions

- Assess students understanding on topic.
- What is the disadvantage of using a picture to analyze?
    - *Not see how things happen, only what how things are now.*
- How do you think the Grand Canyon was formed?
    - *Colorado River running through it over a long period of time.*
- What exactly is the water doing to form the Grand Canyon?
    - *The water is removing the boulders, stones, rocks, and soil over time*
- What else can water do to shape landforms?
    - *Cause sudden shifts in the land.*
- What clues can we use to know if water shaped the land?
    - *Water carries the eroded rocks and soil and deposits them elsewhere.*
- Do you think it's possible to see water moving and seeing what it is doing to the land? How could we do that?
    - *Using models.*

Slide 5: AR Sandbox "This section and others written in orange text will be led by Learning Undefeated Staff"

- Briefly explain what an AR Sandbox is, the rules, and that we will do a brief demonstration.

- An AR Sandbox is a real sandbox that uses virtual topography (study of landforms and features) and water that is created with the help of a Microsoft Kinect 3D Camera, a projector, and some software from the computer. Using this technology, we can move the sand around in the sandbox and learn about geographic concepts in real time! However, since there are many of you and only one sandbox, we need to go over some rules!
- Rules (appear after you click)
    - Must use gloves.
    - Only the teacher can water the sand.
    - Only one group at a time!
        - If unable to connect computer to project, the number of students who come up to see the demonstration is up to the teacher. During the lab time, only one group at a time may come up.
    - All sand must stay inside the sandbox.

Sandbox Demo

Open normal AR Sandbox app and demonstrate the basic features of the AR sandbox.

- Lightly spray water over the sand to help create landforms, similar to how we make sandcastles at the beach.
- Show how we can make it rain, flood, and remove water. On the keyboard, "1" will flood the entire landscape, "2" will dry up the entire landscape. "3" will make it rain from where the cursor is and "4" will dry up where the cursor is.
    - *NOTE* The cursor and where it rains does not always line up. Place the mouse cursor in the center and make it rain from there and drag the mouse to where you want it to rain slowly. Keep track where it is raining, to make sure it rains where you want it to.
- Create a river valley in the AR sandbox similar to the landform in the picture. Make sure one side of the river is higher than the other so that water runs "down" the canyon. (Recommend going east to west so more space available. Let it rain from one side and see the water flow downstream by pressing the "3" key or using your hand.)
- Remove all water by pressing the "2" key.
- Ask students what happens with the water over time?
    - *It should get wider.*
- Ask students how do you think that impacts how the water flows? Demonstrate on AR sandbox to see.
- Ask students what was missing from the AR sandbox to help us understand erosion.
    - *It lacks the movement of sediments.*
- Close the normal AR Sandbox and open the Erosion and Sedimentation AR Sandbox app.
- Let students know this is a special version that was created to help us see and understand erosion better.
- Repeat the demonstration in the AR Sandbox.
- Ask students what they are seeing that is different this time.
    - *There is now a bright green and a red color also moving in the water.*
- Explain that the red color is erosion and the green color is sedimentation, i.e. red is showing how the rocks and soil are moving due to the water and the green is where that stuff is now staying.
- Have everyone go back to their seats if no projector was used.

Slide 6: Lab Investigation

- Introduce lab investigation to the class. Review the scientific method (students will fill in blank on their worksheet).
    - Ask a question
    - Background research
    - Make your hypothesis
    - Test your hypothesis
    - Analyze and Evaluate
    - Report your results

Slide 7: Independent Variables

- Review independent variables with the class. Class will identify the potential independent variables. There are four that will be used, so help the class if needed to identify all four. You will fill this in real-time with the students.
    - *Slope of the land*
    - *How fast/How much water comes down*
    - *The shape of the river*
    - *Objects/barriers in or along the river*
- Each variable must be covered collectively by the class. Multiple groups may pick the same variable.

Slide 8: Begin Your Investigation!

- Monitor groups as they work through their investigation. Groups will require teacher checks along the way to make sure they are on the right track before going up to the AR Sandbox. Groups will be required to draw a model of their hypothesis; some may need assistance in this. Explain that they are to draw what they think will happen based on their hypothesis. Ex. Higher slope will result in more erosion and sedimentation -> Their model should show a landform with a high slope, where the erosion and sedimentation occur after water runs down the high slope.
- **Learning Undefeated staff will support and run investigation tests with students on the AR Sandbox.**

Slide 9: Share Results

- Groups will have written their conclusion statement on the board; share out results to the whole class. Have each group read out their own conclusion statement. Make sure they state the independent variable they wanted to explore, their question, and their hypothesis before stating the conclusion.