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| **3D-Student Science Performance** | | |
| **Grade: 2** | | **Lesson Title:**  **Slow it and Sink it for the Plants and To Prevent Erosion** |
| **Lesson Topic - Erosion and Earth Systems** | |
| **Standards:**  **2.E1U1.4 Observe and investigate** how wind and water change the shape of the land resulting in a variety of landforms.  **2.E1U3.7** **Construct an argument from evidence** regarding positive and negative changes in water and land systems that impact humans and the environment. Compare multiple solutions designed to slow or prevent water from changing the shape of the land.  **Note to the Teacher:**  *In science, reasoning and argument based on evidence are essential in identifying the best explanation for a natural phenomenon. In engineering, reasoning and argument are needed to identify the best solution to a design problem. Student engagement in scientific argumentation is critical if students are to understand the culture in which scientists live, and how to apply science and engineering for the benefit of society. (from NSTA Science & Engineering Practices)* | | |
| **Lesson Performance Expectations:**   * Students develop a model showing how wind and water change the shape of the land. * Students use models to determine the effectiveness of their engineering design in order to slow the rate of erosion. | | |
| ***Engage***    ***Explore***    ***Explain***    *The* ***core idea*** *that is addressed in this lesson is erosion and preventing erosion of the land via an engineering challenge.* | **Student Science Performance**  ***Part 1:***  ***Phenomenon:* *Runoff water changes water and land systems. (building on previous lesson)***    ***Gather:***   1. Students develop questions about the causes of erosion. 2. Students obtain information from the teacher and student readings for causes of erosion.     *Teaching Suggestions: Introduce the phenomenon by showing students in a walk around the school and with pictures of erosion. An example can be found at downspouts coming from the gutters catching rain from roofs. Students should stop and document their findings.*  ***Reason:***   1. Back in the classroom, teacher prompts students to think about other examples of erosion in their neighborhoods. 2. Students develop a physical model showing how water changes the shape of the land and begin to develop ways to slow the flow and sink the water. 3. Students construct an explanation for the causes of erosion on land surfaces and record them in their notebooks. 4. Students identify Cause and Effect Relationships   *Teaching Suggestions:*  *Option 1: Outside in an area with loose permeable earth materials and also hard impermeable surfaces. Something to create a slope that can be changed to different angles, containers of water to experiment with fast and slow flow.*  *Option 2: Inside using permeable sponges, impermeable slopes that can be changed to different angles, containers and sand pitchers to pour water from at different speeds.*  *Option 3: A stream table .. how does water move and flow and slow?*  ***Class Discussion while developing and using their physical models:***  *Questions to initiate Discussion:*  *Q: How does the weather affect the formation of land?*  *Q: Does this change happen quickly or slowly?*  *Q:*  *What happens to rain that falls on an impermeable surface?*  *Q: Why does the water wash down a ditch or channel like a river, but not through areas that have plants?*  *Q: Where does the “earth material” like dirt that is washed away go?*  *Q: Where and how does water sink into the ground?*  ***Communicate Reasoning:***   1. Students revise their model and explanations for the causes of erosion. They will rewrite explanations in their notebooks.   *Teaching Suggestions: Add local and regional weather events that affect the land and environment through photos projected for students.*  **\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***  ***Part 2***  ***Engineering Challenge*: *Develop a solution to maximize positive changes and minimize negative changes to the landscape for humans and the environment.***  ***Gather:***   1. Students define the problem of erosion. 2. Students obtain information about methods to slow and sink water to prevent erosion, including the constraints of their engineering design.   *Teaching Suggestions:*  *Have a discussion that engineers have constraints that include: cost, materials, time, appropriate for the area, stability, non-synthetic materials and many other things.*  *Provide Students with Various Materials: popsicle sticks, sponges, felt, clay, tape, paper, cardboard to form a slope, impermeable materials, plastic bottles, straws to form pipes and downspouts, glue, twigs, grass, dirt.*  ***Reason:***   1. Students find and build a solution to slow and sink water to prevent erosion and help control flooding 2. Students test models to determine the effectiveness of their design, measured by a slower rate of erosion and more water sinking for use by plants. 3. Students present their solution to the problem of runoff, soil erosion and flooding. 4. Using their observations from their tests, students examine relationships between Stability and Change.   *Teaching Suggestions:*  *Students can watch each other’s tests to compare the different solutions. First with just the flow of water and second with eroded materials like grass, dirt and leaves. Could be done in real-time or with video.*)  ***Class Discussion:***  *Questions to initiate Discussion:*  *Q: Why did you choose the materials that you did for your model?*  *Q: How did you decide where to put the materials to slow or prevent erosion?*  *Q: How did you get the water to sink in rather than run off?*  *Q: What made one model more successful than another?*  *Q: How could you make your model more successful?*  Q: *Would this model work out in the real world? What would be needed?*  *Teaching Suggestions:*  *More ideas on the last question: Prompt thinking about issues of erosion along stream banks. How can we improve water quality in streams and ensure water that flows downstream is cleaner by using scientific knowledge and engineering.*   * *How can plants help us?* * *What about the fire?* * *What can we do to keep water from running off?* * *How can we slow or manage water?* * *How about rerouting or engineering a dam, cleaning an area of trash, debris, etc, planting a rain garden?*   *Try to get students tThinking about how they can impact erosion that affects their own community.*  *Students could do a gallery walk applying the Critical Friends Protocol to provide constructive feedback and questions.  They use the sentence starters I notice … , I wonder … and What if …*  *Students can revise and improve their first model/design.*  ***Communicate Reasoning:***  Refer to the *Evidence Based Argument Worksheet* in this section.   1. Students use their model to present an oral explanation for how their solution slows the flow of water and sinks it. 2. A list of all solutions designed to slow or prevent water from changing the shape of the land is compiled as students present. This is Part I of the worksheet but can be done on the board for all to see. 3. Student groups then use the list of solutions to analyze explanations made by all groups in the class and determine which solved the problem the best and why. This is Part II of the worksheet. 4. In Part III, student groups combine and refine their ideas about what worked best. 5. Students use their reasoning from Part III to **construct an argument from their evidence** about how the land should be changed so that the water can be used to benefit humans and the environment. They can work individually or in groups. This is Part IV of the worksheet. | |

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| |  | | --- | | **Formative Assessment for Student Learning** | | **Elicit Evidence of Learning:** Students revise their explanation and model for the causes of runoff and erosion. | | | | |
| **Evidence of Student Proficiency**  *Students use information from the readings and models to support an explanation that erosion of the land can be caused by wind and water. Evidence from the investigation and design show the rate of erosion can be slowed or prevented. Evidence also shows that water can sink in to the ground for the benefit of plants. Models also provide evidence that the rate of change can be fast or slow.*  *Description of Assessment:*  *Responses should provide clear evidence the student understands that: 1. The strength of the rain can affect the rate of erosion. 2. The presence of plants affects the rate of erosion. 3. Erosion happens slower on land covered with vegetation.* | **Range of Typical Student Responses**  *Descriptors of grade-level-appropriate student responses:*  ***Full understanding -*** *Student explains more than one cause of erosion.  For example, land erodes because people walk on it and that breaks up the dirt and makes it easier to wash away when the water comes down.  Rain erodes some places more than others due to concentration of water in certain places which increases the speed of the water.*  ***Partial understanding –*** *Students can explain that water can cause erosion in the environment, but does not have clear evidence to support the explanation.*  ***Limited understanding-*** *Students would identify land, water runoff and erosion but have not been able to see relationships between them.* | **Acting on Evidence of Learning**  *Description of instructional action and response to support student learning.*   * *Action for students who display partial or limited understanding is to review or revisit reading materials together with the students on factors that contribute to erosion in the environment.*   *Extensions of learning for students who display a full understanding include:*   1. *Extend this entire lesson to test the effect of wind on the land surface. Envision how this could be modeled to demonstrate the effects of erosion from wind.* 2. *Experiment with land areas where water runs off the land and where water sinks in. Plan and carry out an investigation that shows which areas better support plants. Construct an explanation of the positive effects of keeping the water onsite for plants in an arid area.* 3. *Provide students with images of areas around them/world and have them analyze/reflect what types of erosion could have caused the impacts.* |

**Student Prompts for the Lesson -Engineering Challenge**

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| **Engineering Challenge: *Develop a solution to maximize positive changes and minimize negative changes to the landscape for humans and the environment.***    ***Group Performances:***   1. Define the problem of slowing and sinking water to prevent erosion. 2. Obtain information about the constraints of your design. 3. Build a solution to slow and sink water to prevent erosion. 4. Test your model to see if it slows and sinks water and/or prevents erosion. 5. Present your solution to the problem of runoff and erosion.     ***Class Discussion***    ***Individual Performances:***   1. Use your model to explain how your solution could be used to improve the landscape for humans and the environment. |

***Appendix B -******Reading***

*Weathering and Erosion Article from Readworks - Mid to Late 2nd grade reading level.*

*(includes read-aloud audio and question sets) -* [*https://www.readworks.org/article/Weathering-and-Erosion/766786c1-2b0c-4b35-b630-a7b2b16b6a8b#!articleTab:content/*](https://www.readworks.org/article/Weathering-and-Erosion/766786c1-2b0c-4b35-b630-a7b2b16b6a8b#!articleTab:content/)

*Excerpt:*

*Nature is always changing. Those changes are called natural events. Some natural events happen quickly. Think of a fire that starts when lightning strikes a tree. Other events occur slowly, such as when rocks are worn down over hundreds of years. This happens because of weathering and erosion.*

*Weathering is what happens when part of the rock is loosened. Parts of rocks are usually loosened by nature. Erosion (ih-ROH-jzun) happens after weathering. It is the process of moving water, moving ice, or wind carrying away a part of a rock.*

*Moving water can cause weathering and erosion. Have you ever seen the waves crash against rocks on the shore? The water can chip off small pieces of rock and carry them away. As more waves hit the rocks, more pieces are chipped off and carried away. Because of this, the rocks get smaller and smaller over time.*

***Student Reading:***

***Erosion of Soil***

*Erosion happens when the Earth materials are worn away and moved.*

*This can happen by natural forces like wind or water.*

*Erosion is mostly* ***caused*** *by water, wind, or ice.*

*Plants hold the soil together and prevent erosion.*

*Some trails become eroded when we walk on them too much.*

*We can use plants to slow or prevent erosion.*