

3D Science Performance Assessment Tasks

MIDDLE SCHOOL CYCLING OF EARTH'S MATERIALS

In Partnership with



3DSPA Assessment Tasks were developed by



A member of



In collaboration with



These materials were developed under a grant awarded by the Michigan Department of Education.

Task Title	Cycling of Earth's Materials
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Standards Bundle Information

Performance Expectations

- MS-ESS2-1 - Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
- MS-ESS2-4 - Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Science and Engineering Practices

- Developing and Using Models

Cross-Cutting Concepts

- Stability and change
- Matter and energy

Disciplinary Core Ideas

- ESS2.A: Earth's Materials and Systems
- ESS2.C: The Roles of Water in Earth's Surface Processes

CCSS ELA:

- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS Mathematics:

- MP.2 - Reason abstractly and quantitatively.

Overview / Introduction of the Assessment Task

In this task, students will be creating a water cycle, creating a rock cycle, modeling how the two cycles interact, and applying what they have learned to how potholes are formed.

Teacher Background

Teachers will need an understanding of the three dimensions of Michigan Science Standards. Science and Engineering practices in this task involve the use of models to explain content. Disciplinary Core Ideas include knowledge of the rock cycle and the water cycle. Cross-cutting concepts include stability and change in systems and how energy affects matter.

Information for Classroom Use

Connections to Instruction:

The purpose of this final task is to serve as a summative assessment after a unit on the rock cycle and the water cycle.

Approximate Duration for the Summative Task: (all components)

This assessment should take about 11 class periods to complete.

Assumptions:

The 3DSPA was designed to assess students' ability to perform the task by applying previous knowledge learned to the new phenomena in the performance assessment without having been exposed to this specific phenomenon in advance.

Prior knowledge necessary for performance task:

- Heat transfer
- Arrangement and motion of particles in solids, liquids, and gases
- Water expands when it freezes
- Definition of matter
- Definition of energy
- The three main types of rocks
- Three states of matter

Materials Needed:

Paper, pencil, computer, internet, rock cycle dice game

Supplementary Resources:

Cloud in a bottle activity

Learning Performances

Rock Cycle:

1. Students brainstorm to develop an initial model showing how the three main types of rocks will remain stable due to a balancing of events.
2. Students revise their model, adding arrows showing rocks changing and labeling the processes as rocks change from one type to another after energy is added.
3. Students will evaluate and communicate how stability can be disturbed by a change in the flow of energy in the rock cycle.
4. Students use models to explain the rock cycle and the processes involved which lead to changes within the rock types after stability is disrupted.

Water Cycle:

1. Students brainstorm to develop a model showing how water can change states due to the effects of the different forms of energy such as sunlight and gravity.
2. Students will revise the model to include the cycling of water on Earth as it relates to the transfer of energy.
3. Students evaluate and communicate with other groups to discuss how matter is conserved in the water cycle.

Interactions between the rock cycle and water cycle:

1. Students will use the model to explain how a change in the flow of energy can cause an interaction between the water cycle and the rock cycle.
2. Students will use the model to explain how a change in state of water can impact a system (roads and sidewalks).

Performance Assessments

Student Performances		
<i>Formative Assessment Task 1</i>	<p>Learning Performance:</p> <p>Water Cycle -</p> <p>Students brainstorm to develop a model showing how water can change states due to the effects of the different forms of energy such as sunlight and gravity.</p>	<p>Expected Duration:</p> <p>1 class period</p>
	<p>Description: Investigation of dew forming on a glass of cold water to help develop the model.</p>	
	<p>Directions</p> <ol style="list-style-type: none"> 1. Students will observe the formation of dew on a glass of water. 2. Students will brainstorm possible reasons for this phenomenon. 3. Students will draw a model that shows a possible explanation, labeling energy input and output as well as the changes in states of matter. This model should also include a drawing of each state at the molecular level. 4. Discuss these models as a class as well as any misconceptions. 5. Students will revise their model. 	
	<p>Scoring / Teacher Look-For's:</p> <p>An accurate model that explains the phenomenon using labels for changes in states of matter and arrows for energy transfer.</p>	
<i>Formative Assessment Task 2</i>	<p>Learning Performance:</p> <p>Students will revise the model to include the cycling of water on Earth as it relates to the transfer of energy.</p> <p>Students evaluate and communicate with other groups to discuss how matter is conserved in the water cycle.</p>	<p>Expected Duration:</p> <p>2 class periods</p>
	<p>Description (Phenomena, Scenario, Task) - Investigation of the water cycle in a closed system and design of a model illustrating and explaining the water cycle.</p>	

	<p>Directions</p> <ol style="list-style-type: none"> 1. Follow investigation for the water cycle experiment found at https://www.ucar.edu/learn/1_1_2_4t.htm . Resource provided through Project Learn at University Corporation for Atmospheric Research. 2. Students will discuss how this experiment correlates in the real world. 3. Students will discuss how matter (water) is conserved within the experiment system. 4. Students will revise the model from Task 1 to include the new information discovered in the investigation. 	
	<p>Scoring / Teacher Look-For's:</p> <p>Student models should include:</p> <ul style="list-style-type: none"> ● Labels showing the changes in state of water ● Arrows showing how water moves from one state to another ● Arrows showing where heat transfer is occurring ● An accurate explanation of how water is conserved on Earth 	
<p><i>Formative Assessment Task 3</i></p>	<p>Learning Performance:</p> <p>Students brainstorm to develop an initial model showing how the three main types of rocks will remain stable due to a balancing of events.</p> <p>Students revise their model, adding arrows showing rocks changing and labeling the processes as rocks change from one type to another after energy is added.</p> <p>Students will evaluate and communicate how stability can be disturbed by a change in the flow of energy in the rock cycle.</p> <p>Description (Phenomena, Scenario, Task)</p> <p>Initial model of the rock cycle that will be revised after using information gathered from a website.</p>	<p>Expected Duration:</p> <p>3 days</p>

	<p>Directions</p> <ol style="list-style-type: none"> 1. Students will develop an initial model of what they think happens to rocks in the rock cycle. This model will be revised throughout this activity. 2. Students will collaborate with others about their initial model of the rock cycle. 3. Students will go to an interactive website about the rock cycle. http://www.classzone.com/books/earth_science/terc/content/investigations/es0602/es0602page02.cfm¹ 4. Students will revisit and revise their initial rock cycle model based on information obtained from the website and notes taken in class. 5. Students will present their revised model of the rock cycle. 	
	<p>Scoring / Teacher Look-For's:</p> <ul style="list-style-type: none"> ● An initial model of the rock cycle and where misconceptions may be present ● Ongoing student revisions on rock cycle model while visiting the website ● Models must include: <ul style="list-style-type: none"> ○ 3 types of rocks ○ Processes involved in changing from one form to another ○ Arrows showing possible rock transformations ○ The flow of energy in the cycle and the possible source of energy to cause the rock to change form ● An accurate explanation of the model is given during the presentation 	
<p><i>Formative Assessment Task 4</i></p>	<p>Learning Performance:</p> <p>Students will evaluate and communicate how stability can be disturbed by a change in the flow of energy in the rock cycle.</p>	<p>Expected Duration: 2 class periods</p>

¹ "Interactive Rock Cycle Animation - ClassZone." 2009. 4 Aug. 2016
<http://www.classzone.com/cz/redirect/esm05_pg73_es0602-2.html>
3DSPA: MS: ES - Cycling of Earth's Materials Performance Task

	<p>Description (Phenomena, Scenario, Task)</p> <p>Students will participate in a Rock Cycle game.</p> <hr/> <p>Directions</p> <ul style="list-style-type: none"> • Rock Cycle game can be found at the following website: http://209.7.198.36/geologyonline/lessons/6.4/lesson.pdf • "Ride the Rock Cycle game." 2013. 4 Aug. 2016. http://209.7.198.36/geologyonline/lessons/6.4/lesson.pdf • Student will complete Journey on the Rock Cycle worksheet. • Students will complete a cartoon that depicts their journey on the rock cycle as they played the game. <hr/> <p>Scoring / Teacher Look-For's:</p> <ul style="list-style-type: none"> • Participation in the rock cycle game • Accurate representation of their journey in the cartoon <ul style="list-style-type: none"> ○ Evidence of change or stability within the rock cycle in the cartoon frames ○ Evidence of a disturbance in the rock cycle caused by a change in flow of energy 							
<p><i>Final Task:</i></p>	<p>Learning Performance(s):</p> <p>Interactions between the rock cycle and water cycle:</p> <p>Students will use the model to explain how a change in the flow of energy can cause an interaction between the water cycle and the rock cycle.</p> <p>Students will use the model to explain how a change in state of water can impact a system (roads and sidewalks).</p> <hr/> <table border="1" data-bbox="428 1415 1240 1919"> <tr> <td colspan="2" data-bbox="428 1415 1240 1524"> <p>Phenomena: Potholes and cracks in Michigan roads and sidewalks</p> </td> <td data-bbox="1240 1415 1479 1919" rowspan="3"> <p>Expected Duration: 3 class periods</p> </td> </tr> <tr> <td data-bbox="428 1524 834 1797"> <p>Goal - Student will design and use a model to explain the interaction between the rock cycle and the water cycle and how these interactions affect roads and sidewalks.</p> </td> <td data-bbox="834 1524 1240 1797"> <p>Role - Students will act as teachers explaining a concept through their model</p> </td> </tr> <tr> <td data-bbox="428 1797 834 1919"> <p>Audience - Elementary students</p> </td> <td data-bbox="834 1797 1240 1919"> <p>Situation -An elementary teacher is having a difficult time explaining the cause of</p> </td> </tr> </table>	<p>Phenomena: Potholes and cracks in Michigan roads and sidewalks</p>		<p>Expected Duration: 3 class periods</p>	<p>Goal - Student will design and use a model to explain the interaction between the rock cycle and the water cycle and how these interactions affect roads and sidewalks.</p>	<p>Role - Students will act as teachers explaining a concept through their model</p>	<p>Audience - Elementary students</p>	<p>Situation -An elementary teacher is having a difficult time explaining the cause of</p>
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		<p>the cracks in the sidewalks and potholes in the roads. The teacher asks middle school science students to come to the class to use a model to explain the concept to the elementary students.</p>	
<p>Product / Performance - Model</p>			
		<p>Directions -For the teacher</p> <ol style="list-style-type: none"> 1. Students will apply what they have done during the formative tasks to complete the final performance activity. 2. Present the phenomena of potholes in roads and cracks in sidewalks to students. 3. Have students brainstorm the relationship between potholes and cracks with the water and rock cycles. 4. Present the situation to the students. 5. Have students work on designing a model which will incorporate the interaction of the rock and water cycles to explain the phenomena. 6. Have them put together a presentation for the elementary audience. <p>Directions-for the students</p> <ol style="list-style-type: none"> 1. In the springtime, students in an elementary classroom noticed that there were a lot of cracks in the sidewalk and holes in the road. 2. Prepare a model which you can use to explain to the elementary students the scientific reasoning behind what caused the potholes and cracks. 3. Your model needs to include the interaction of the water cycle and the rock cycle on sidewalks and roads. Make sure you label and explain what is happening. 4. Prepare a presentation for the elementary classroom. 	

CheckBric

Learning Performance: Students will use the model to explain how a change in the flow of energy can cause an interaction between the water cycle and the rock cycle.					Comments
<i>Evidence Statements below:</i>					
Model shows: Freezing and expansion of water in rock, Rock cracking and breaking (weathering), Labels for the appropriate sections of the rock cycle and water cycle involved, Arrows showing the steps involved	1	2	3	4	
Model explains: <ul style="list-style-type: none"> ● Change in state of water <ul style="list-style-type: none"> ○ From liquid to solid ○ Arrangement of particles in both states of matter ● How the water cycle interacts with the rock cycle ● 2 ways that the water cycle impacts the rock cycle (Some examples include weathering/erosion, ice wedging, cave development) 	1	2	3	4	
Student explains: How the flow in energy causes a change in state of the water <ul style="list-style-type: none"> ● Heat enters/leaves the water ● The change in the arrangement of particles as a result 	1	2	3	4	
<i>LP Total:</i>					
Learning Performance: Students will use the model to explain how a change in state of water can impact a system (roads and sidewalks).					
<i>Evidence Statements here:</i>					
<ul style="list-style-type: none"> ● Model shows an application of content to real world example (potholes and sidewalk cracks) 	1	2	3	4	
<ul style="list-style-type: none"> ● Model shows how the freezing of water affects roads and sidewalks 	1	2	3	4	
<ul style="list-style-type: none"> ● Student explains how freezing of water damages roads and sidewalks as compared to warmer climates. 	1	2	3	4	
<i>LP Total:</i>					
Checkbric Total:					

4 Exemplary	Work at this level is of exceptional quality. It is both thorough and accurate. It exceeds the standard. It shows a sophisticated application of knowledge and skills.
3 Proficient	Work at this level meets the standard. It is acceptable work that demonstrates application of essential knowledge and skills. Minor errors or omissions do not detract from the overall quality.
2 Developing	Work at this level does not meet the standard. It shows basic, but inconsistent application of knowledge and skills. Minor errors or omissions detract from the overall quality. Your work needs further development.
1 Emerging	Work at this level shows a partial application of knowledge and skills. It is superficial (lacks depth), fragmented or incomplete and needs considerable development. Your work contains errors or omissions.

Item Production Information

Copyrighted Material and Sources

"Ride the Rock Cycle game." 2013. 4 Aug. 2016 <<http://209.7.198.36/geologyonline/lessons/6.4/lesson.pd>

"Interactive Rock Cycle Animation - ClassZone." 2009. 4 Aug. 2016
<http://www.classzone.com/cz/redirect/esm05_pg73_es0602-2.html>