NGSS ASSESSMENT DEVELOPMENT TEMPLATE

This NGSS Assessment Development Template was developed in alignment with [Creative Commons by the Research + Practice Collaboratory, 2016](). These five steps were designed to help teams develop assessment tasks.

- *Step 1: Define what you will assess by analyzing relevant sections of A Framework for K-12 Science Education and crafting learning **claims**.*
- *Step 2: Brainstorm Possible **Scenarios** for Eliciting Student Understanding.*
- *Step 3: Use Task Formats to Build **Questions** to Engage Students with the Scenario.*
- *Step 4: Imagine the Range of Possible **Student Responses** to the Questions.*
- *Step 5: Share, Review, and Revise.*

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STEPS TO DESIGNING A THREE DIMENSIONAL ASSESSMENT

Claims	Scenarios	Questions (Using Task Formats)	Hypothetical / Actual Student Responses

Original Framework Text: This can be found written in the *Framework for K-12 Science Education*. *Examples of original framework text (1, 2, 3).*

By the end of grade 12. Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. A deep knowledge of how feedbacks work within and among Earth's systems is still lacking, thus limiting scientists' ability to predict some changes and their impacts.

Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. The top part of the mantle, along with the crust, forms structures known as tectonic plates (link to ESS2.B). Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and the gravitational movement of denser materials ward the interior. The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic

activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. Pp. 181-82
https://www.nextgenscience.org/pe/hs-ess2-1-earths-systems

Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system.

ESS2.A: Earth Materials and Systems

- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior.

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection.

Energy and Matter

- Energy drives the cycling of matter within and between systems.

Step 1: Define what you will assess by analyzing relevant sections of *A Framework for K-12 Science Education* and crafting learning claims.

Claim: Using the original framework text, identify learning claims you want to be able to make about what students know and can do. Students will use evidence about Plate Tectonics to explain how the Appalachian Mountains were created. These mountains are significant because they do not lie along an active plate boundary today.

Step 2: Brainstorm Possible Scenarios for Eliciting Student Understanding

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Possible Scenario: 3D assessment tasks are multi-component tasks meaning there is one single scenario with multiple questions for students to answer relating to that scenario. These scenarios should also be based upon a new but related phenomenon. Brainstorm multiple scenarios and evaluate which is best for eliciting student understanding. Write a detailed description of the scenario and what you expect from students when approaching this scenario.

The Appalachian Mountains along the East Coast of the United States are dated to be some of the oldest mountains on Earth. Today, there is rarely any earthquake activity in this area. Students will develop a model to explain the Earth's past to determine if the Appalachians were formed by Plate Tectonics.

https://youtu.be/HhkyXrWNoVA

- Understanding of Wegener's contributions to the idea of continental drift.
- Use of SONAR technology to map the ocean floor.
- Study of paleomagnetism and age patterns of rock on ocean floor.
- Knowledge of features on Earth's surface that form from different tectonic plate interactions.
- Understanding of the process of convection as a mechanism for driving tectonic plate motion.

Step 3: Use Task Formats to Build Questions to Engage Students with the Scenario

Questions (Using Task Formats): Use the task formats in the Framework to help design specific questions for students to assess your claims. Keep in mind, scenarios should be accessible to all students and connect with their interests and experiences (Example 1).

1) Formulate a descriptive question as to why earthquakes are rare along the Appalachian Mountains. [Asking Questions]
2) Using the PHET Plate Tectonics Simulation (https://phet.colorado.edu/en/simulation/plate-tectonics), create a model that shows how the Appalachian Mountains formed. They print off screen shots and label OR label electronically. Include labels in the model that show the lithosphere, type of crust, mantle convection, and relative densities of the crust where appropriate. [Developing and Using Models]
3) Provide evidence that the Theory of Plate Tectonics is responsible for the formation of the Appalachian Mountains. [Engaging in Argument from Evidence]

Questions (Using Crosscutting Task Formats): This set of prompts is intended to help teachers elicit student understanding of crosscutting concepts in the context of investigating phenomena or solving problems.

1) Describe how the transfer of energy in the core is responsible for geological processes, such as earthquakes,mountain building, and volcanos. [Constructing Explanations & Energy and Matter]

Step 4: Imagine the Range of Possible Student Responses to the Questions

Hypothetical Student Response: (Example 1): Imagining how students will respond to your prompts is an important stage in designing assessment tasks. Through thinking like a student, you will get a better sense of how your prompts might elicit their understanding developed throughout the unit.

For each question created in Step 3, identify identify how a student with an (a) emerging, (b) proficient, and (c) exceeding understanding would respond.

Question 1.
Emerging

[Asking Questions]
Students emerging

- Why are the Appalachian Mountains not on a plate boundary?
- How did the Appalachian mountains form?
- Why are the Appalachian mountains not getting bigger?

- If plate motion is increasing in rate, what would be the impacts around the world?

https://www.newscientist.com/article/mg22329843-000-earths-tectonic-plates-have-doubled-their-speed/

[Developing and Using Models]
https://www.learner.org/interactives/dynamicearth/plate.html
Students draw a model that includes plate boundaries and explain that plates move over time.Student emerging will be able to use arrow to indicate that mountains are formed when two plates collide.

[Engaging in Argument from Evidence]
Students that are emerging would be able to explain that the Appalachian Mountains
[Constructing Explanations & Energy and Matter]
Students

Proficient

[Asking Questions]

- Why is there no tectonic plate boundary near the Appalachian Mountains?
- How high are the Appalachian Mountains compared to other mountains on Earth?
- How old are the Appalachian Mountains?
- What kind of rocks are found in the Appalachian Mountains?

[Developing and Using Models]
Students would have a model that shows the formation of a mountain range from the convergence of crust with similar density (continental to continental). Arrows would show the movement of magma in the mantle converging underneath the mountains and dissipating as the crust thickens forming the mountains.

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[Engaging in Argument from Evidence]
Students would have to explain the Appalachian Mountains are over 200 million years old and are no longer along a tectonic plate boundary. In the past, they were apart of Pangaea and formed when the supercontinent came together. Evidence for this is Wegener's discovery of similar rock layers in both North American and Northern Europe. Additionally, student could access information that the rock types found in the Appalachian Mountains are largely metamorphic, which support that they were once along a convergent boundary. This would be supported by describing how convection in the mantle caused the tectonics plate to move.

Exceeds
[Asking Questions]
- Was there ever any volcanoes in the Appalachian Mountains?
- Where were the Appalachian Mountains during the time of Pangaea?

[Developing and Using Models]
Student would demonstrate all the criteria described in the proficient category. In addition, the student would model the formation of a new ocean, as a rift develops along the mountain range and forms a new divergent boundary. This would show the evolution of the Appalachian Mountains to their current location away from an active tectonic plate boundary.

[Engaging in Argument from Evidence]
Student would include all the information from the proficient criteria. In addition, they would explain that the current position of the Appalachian Mountains is due to the movement of North America from the rifting that broke apart Pangaea over 200 million years ago. This action that formed the Mid-Atlantic Ridge moved the Appalachian Mountains away from the plate boundary that formed them.
[Constructing Explanations & Energy and Matter]

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Step 5: Share, Review, and Revise

Step 5: Parts 1 & 2 Share, & Review
Sharing revised models to work at reaching class consensus model.

Share your initial task with a colleague(s) - use this space below for them to include their feedback: Colleague 1:   Colleague 2:

Step 5: Part 3 Revise After colleagues have provided their feedback, how might you incorporate that into your assessment? Remember that after you pilot this assessment, actual student responses can be included as a way to further refine your initial task.

Plan for revising assessment task based on feedback and/or actual student responses:

References

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