Byte-Sized Geology- A Byte-Sized Science Lesson by XplorStem

Lesson Plan: Uncovering Earth's Layers and Forces

Grade Level: 3-5th Grade
Time: 1 Hour (core lesson) with optional extensions, and independent online activities to extend and reinforce learning.

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NGSS Standards Covered

Core Ideas

ESS1.C: The History of Planet Earth

- **Key Concept:** Fossils provide evidence of past life and how Earth's surface has changed over time.

- **How This Lesson Covers It:** Students learn how fossils form, what they tell us about Earth's past, and how geologists use them to study history.

ESS2.A: Earth Materials and Systems

- **Key Concept:** Earth's surface is constantly changing due to natural processes.
- **How This Lesson Covers It:** Students explore plate tectonics, volcanoes, earthquakes, and erosion through interactive research and hands-on modeling.

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

- **Key Concept:** The movement of Earth's tectonic plates shapes landforms over time.
- **How This Lesson Covers It:** The experiment models Earth's layers and discusses how mantle convection drives tectonic movement.

ESS2.C: The Role of Water in Earth's Surface Processes

- **Key Concept:** Weathering and erosion change Earth's surface over time.
- **How This Lesson Covers It:** Students investigate how wind, water, and ice break down and transport rock materials, shaping landscapes.

Performance Expectations (PEs)

- **4-ESS1-1:** Identify and analyze patterns in rock layers and fossils to construct an explanation of Earth's history.
    - **How This Lesson Covers It:** Students explore fossils, how they form, and what they reveal about Earth's past.
- **4-ESS2-2:** Analyze and interpret data from maps to describe patterns of Earth's features.
    - **How This Lesson Covers It:** Students examine tectonic plate maps to understand earthquake and volcano locations.
- **5-ESS2-1:** Develop a model to describe interactions among Earth's geosphere, biosphere, hydrosphere, and atmosphere.
    - **How This Lesson Covers It:** The experiment models Earth's layers, discussing how internal and external forces shape the planet.

Crosscutting Concepts (CCC)

Patterns

- **How This Lesson Covers It:** Students recognize patterns in Earth's layers, fossils, and tectonic activity.

Cause and Effect

- **How This Lesson Covers It:** Students investigate how plate movement causes earthquakes, volcanoes, and landform changes.

Stability and Change

- **How This Lesson Covers It:** Students explore how forces like weathering and erosion gradually change Earth's landscape.

Systems and System Models

- **How This Lesson Covers It:** Students create models of Earth's layers and examine how different Earth systems interact.

Science and Engineering Practices (SEP)

Asking Questions and Defining Problems

- **How This Lesson Covers It:** Students ask and answer questions about Earth's changing surface and geologic forces.

Developing and Using Models

- **How This Lesson Covers It:** Students build a clay model of Earth's layers to understand internal structure.

Analyzing and Interpreting Data

- **How This Lesson Covers It:** Students analyze maps of Earth's features and compare fossil evidence.

Constructing Explanations and Designing Solutions

- **How This Lesson Covers It:** Students explain how plate tectonics and erosion shape Earth over time.

Engaging in Argument from Evidence

- **How This Lesson Covers It:** Students use fossil and rock layer evidence to describe Earth's history.

Learning Objectives

By the end of this lesson, students will:

Understand Earth's Structure

- Identify and describe the four main layers of the Earth: **inner core, outer core, mantle, and crust**.
- Compare and contrast **continental and oceanic crust**.

Explore Plate Tectonics and Earth's Changing Surface

- Explain how **tectonic plates move** and how this movement causes **earthquakes, volcanoes, and mountain formation**.
- Describe how **convection currents in the mantle** drive plate movement.

Investigate Weathering, Erosion, and Fossils

- Differentiate between **weathering and erosion** and explain how they reshape Earth's surface.
- Describe how **fossils form** and what they reveal about Earth's history.

Model Earth's Layers and Geologic Processes

- Build a **hands-on model of Earth's layers** to visualize their structure and composition.
- Demonstrate how forces inside Earth impact its surface through interactive activities.

Materials

Basic Materials for Building the Earth Model:

- **Flour** (1 cup per group)
- **Salt** (½ cup per group)
- **Cream of Tartar** (1 teaspoon per group)
- **Water** (½ cup per group)
- **Vegetable Oil** (1 tablespoon per group)
- **Food Coloring** (red, orange, yellow, purple, blue, green)
- **Plastic Bowl** (1 per group)
- **Plastic Fork or Spoon** (for mixing)

Materials for Layering the Earth Model:

- **Wax Paper or Paper Plates** (to work on and prevent sticking)
- **Toothpicks** (6 per group, for labeling Earth's layers)
- **Small Pieces of Tape** (to attach labels to toothpicks)
- **Markers** (for labeling)
- **String or Dental Floss** (for cutting the model in half to reveal layers)

Optional Materials

- **Cardstock or Poster Board**
  - For drawing and comparing cross-sections of the Earth
- **Map of Tectonic Plates**
  - For reference and discussion

Lesson Outline

A. Introduction (10 Minutes)

1. **Lesson Overview Video**
   - Play the *"Scout vs Chaos"* video, introducing how the Earth was formed
   - Use Scout's adventure to engage students and build excitement.
2. **Hypothesis Generation**
   - Play the introductory hypothesis video, encouraging students to think about how the Earth moves and changes over time.
   - Ask: *Where does the lava in volcanoes come from?*

B. Research and Exploration (15 Minutes)

1. **Research Videos and Q&A**
   - Play the Shape by Chaos rock ballad video and reinforce key concepts introducing the how the chaos of the Earth's formation is personified in the character "Chaos"
   - Play a series of interactive research videos exploring the Earth's layers, tectonic plates, volcanoes, erosion and fossils
   - Students answer multiple-choice questions to reinforce concepts, with hints and feedback provided.
2. **Classroom Discussion**

- Discuss how the Earth is shaped and still changing due to earthquakes, volcanic eruptions, weathering and the significance of fossils.
- Encourage students to revise their hypotheses based on what they've learned.

C. Experiment (20 Minutes)

1. **Experiment Video**
   - Play the experiment video explaining the different layers of the Earth.
   - Talk about characteristics and temperature of the different layers.
2. **Hands-On Activity**
   - Students **create a layered model of the Earth** using different colors of dough to represent the **inner core, outer core, mantle, and crust**.
   - Starter Question: *What do you think the inside of the Earth looks like? How can we study something we can't see?*
3. **Guiding Questions During Experiment**
   - *How do the layers of the Earth differ from each other?*
   - *Which layer do you think is the hottest? Why?*
   - *What might happen if the mantle wasn't moving beneath the crust?*

D. Reflection and Conclusion (10 Minutes)

1. **Revisit Hypothesis**
   - *Were your predictions correct? Why or why not?*
2. **Discussion Questions Found in the Conclusion section: Students may fill these out or you can discuss as a class.**

Question	How It Connects to the Experiment	NGSS Standard	Possible Student Answer
1 When you built your model, you created different layers. Do you think the Earth's temperature is the same in every layer? Why or why not?	Helps students think about how the inner core is hotter than the crust, reinforcing what they saw in their model.	ESS2.A - Earth Materials and Systems	No, the temperature changes in each layer. The inner core is the hottest because it's under a lot of pressure, while the crust is cooler because it's at the surface.

2️⃣ You labeled both the oceanic crust and continental crust in your model. Which one do you think covers more of the Earth? Why?	Encourages students to compare land vs. ocean crust size after physically labeling them.	ESS2.B - Plate Tectonics and Large-Scale System Interactions	The oceanic crust covers more of the Earth because most of the Earth is covered by oceans! The continents are large, but the ocean is even bigger.
3️⃣ When we cut our model open, we could see inside the Earth. Do you think geologists can really see inside the Earth? If not, how do they study it?	Gets students thinking about how scientists use models, earthquakes, and volcanoes to learn about Earth's interior.	SEP: Developing and Using Models	No, geologists can't actually see inside the Earth. They study how earthquakes move through different layers and look at lava from volcanoes to learn about the inside of the Earth.
4️⃣ The inner core in our model was solid, but the outer core was liquid. Why do you think that happens inside the Earth?	Helps students explain why extreme pressure keeps the inner core solid while the outer core remains liquid.	ESS2.A - Earth Materials and Systems	The inner core is solid because it's under so much pressure that the metal can't melt, even though it's super hot. The outer core has less pressure, so the metal stays liquid.
5️⃣ What did you notice about the mantle layer in your model? How does the mantle affect the Earth's surface?	Connects the thickness of the mantle to how it moves tectonic plates, leading to volcanoes and earthquakes.	ESS2.B - Plate Tectonics and Large-Scale System Interactions	The mantle is really thick and made of hot rock. It moves very slowly and pushes the tectonic plates around, which can cause earthquakes and volcanoes.
6️⃣ If we wanted to add one more detail to our model to make it more realistic, what would you change or add?	Encourages critical thinking about improvements—could be adding more layers, showing movement, etc.	ETS1.C - Optimizing the Design Solution	I would add labels for the tectonic plates to show how they move. Or, I'd add arrows to show how the mantle moves the crust.
7️⃣ If you wanted to test how different layers react to heat, how could you design an	Pushes students to think scientifically about how scientists study Earth's interior.	SEP: Planning and Carrying Out Investigations	I could test how different materials (like playdough or sand) react to heat by warming them up and seeing what happens. This would help show how the Earth's layers

experiment?			behave at different temperatures.

E. Final Assessment (optional)

- Students take a short quiz based on **CAST-style questions** to evaluate their understanding of DNA, inheritance, and traits.

Question	Answer A	Answer B	Answer C	Answer D	NGSS Standard Alignment	Correct Answer
1️⃣ What is the Earth's outermost layer called?	Mantle	Core	Crust	Outer Core	DCI (ESS2.A) Earth's Materials and Systems CCC: Structure and Function	C: Crust
2️⃣ What is the difference between weathering and erosion?	Weathering moves rock, erosion breaks rock down	They are the same process	Weathering breaks rock into smaller pieces, erosion moves them	Erosion happens only in deserts	DCI (ESS2.A) Earth's Materials and Systems CCC: Cause and Effect SEP: Developing and Using Models	C: Weathering breaks rock into smaller pieces, erosion moves them
3️⃣ What happens when two tectonic plates collide?	They form mountains	They melt into magma	They create fossils	They disappear	DCI (ESS2.B) Plate Tectonics and Large-Scale Interactions CCC: Cause and Effect SEP: Constructing Explanations	A: They form mountains

4 What causes earthquakes?	Wind shaking the ground	Tectonic plates rubbing against each other	Rain falling on the land	Volcanoes always erupting	DCI (ESS2.B) Plate Tectonics & Large-Scale System Interactions CCC: Stability and Change SEP: Analyzing and Interpreting Data	B: Tectonic plates rubbing against each other
5 Where does lava come from before a volcano erupts?	The ocean	The mantle	The crust	The inner core	DCI (ESS2.B) Plate Tectonics & Large-Scale System Interactions CCC: Energy and Matter	B: The mantle
6 Why do some places have more earthquakes than others?	Some places are closer to tectonic plate boundaries	Some places get more rain	Earthquakes only happen in deserts	The Moon's gravity pulls on the ground	DCI (ESS2.B) Plate Tectonics & Large-Scale System Interactions CCC: Patterns SEP: Analyzing and Interpreting Data	A: Some places are closer to tectonic plate boundaries
7 How do fossils help scientists understand the past?	They tell us how Earthquakes happen	They show what animals and plants lived long ago	They help scientists dig tunnels	They tell us the color of ancient water	DCI (ESS1.C) The History of Planet Earth CCC: Patterns SEP: Constructing	B: They show what animals and plants lived long ago

					Explanations and Designing Solutions	
8️⃣ What keeps the inner core of the Earth solid even though it's so hot?	It is made of ice	It is under very high pressure	It is not actually that hot	It is surrounded by a layer of water	DCI (ESS2.A) Earth's Materials and Systems CCC: Structure and Function SEP: Engaging in Argument from Evidence	B: It is under very high pressure
9️⃣ How does the mantle cause tectonic plates to move?	Wind blows on the plates	Heat in the mantle causes slow movements	The ocean pulls the plates along	People digging tunnels push the plates	DCI (ESS2.B) Plate Tectonics & Large-Scale System Interactions CCC: Cause and Effect SEP: Developing and Using Models	B: Heat in the mantle causes slow movements
🔟 If you wanted to test how fast weathering happens, what could you do?	Put different rocks in water and observe changes over time	Watch a rock and see if it moves	Bury a fossil and dig it up later	Look at a volcano	DCI (ESS2.A) Earth's Materials and Systems SEP: Planning and Carrying Out Investigations CCC: Stability and Change	A: Put different rocks in water and observe changes over time

Optional Extensions and Activities

- **Weathering and Erosion in Action**: Use sugar cubes and water to show how rocks break down over time.
- **Tectonic Plate Puzzle Challenge**: Print a **world map with tectonic plate boundaries** and cut it into pieces. Move around to model how tectonic plates move.

Tips for Teachers

- **Time Management**: Pre-mix the flour, salt and cream of tartar ahead of time.
- **Key variable:** Encourage the students to mix thoroughly. It can take some time to form the dough. Only add more water if the mixture is very dry.
- **Safety First**: Emphasize that we do not eat our experiments!
- **Cleanup Plan**: Assign roles for cleanup to ensure a quick and smooth wrap-up. Students may wear gloves to keep hands from becoming temporarily dyed with the food coloring.
