THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

Continents on the Move

How can I construct a model of the earth from 250 million years ago?

GRADES 6–8

Earth & Space

VAN ANDEL EDUCATION INSTITUTE

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INQUIRY-BASED SCIENCE

Earth & Space

Continents on the Move

Grade Level/Content	6–8/Earth and Space Science
Lesson Summary	In this lesson, students analyze fossil and rock data to create a model of the Earth from 250 million years ago. Students will also be introduced to evidence used in the development of the Continental Drift Theory. This lesson is designed to be delivered before Observing the Seafloor.
Estimated Time	1, 45-minute class period
Materials	USGS Fossil and Mountain Chain Evidence, blue construction paper, scissors, glue, Investigation Plan, journal
Secondary Resources	LiveScience: Continental Drift Theory & Definition Observe the break up of Pangaea Lumen Learning: Theory of Continental Drift
NGSS Connection	**MS-ESS2-3** Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions.
Learning Objectives	• Students analyze fossil and rock data to create a model of the Earth from 250 million years ago. • Students use fossils, rocks, and the shapes of the continents to provide evidence for past plate motion.

How can I construct a model of the earth from 250 million years ago?

Earth is a dynamic planet that is constantly changing. All parts of the Earth, the geosphere, biosphere, hydrosphere, and atmosphere, experience change at microscopic and macroscopic levels. Sometimes these changes happen over millions of years, such as the movement of Earth's plates. Some changes happen in an instant due to natural disasters like volcanoes, earthquakes, landslides, hurricanes, etc. Scientists study these sudden and slow changes of the Earth to help understand the processes that shape our planet.

In this investigation, students make observations of fossil and rock data, as well as continental shapes, to model the Earth as it was 250 million years ago. Students will learn how the evidence they observe and analyze was used in the development of the Continental Drift Theory.

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science. In all investigations:

Students don't know the "answer" they are supposed to get.

Students play a driving role in determining the process for learning.

Teachers and students construct meaning together by journaling.

Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Students will need the following:

- USGS Fossil and Mountain Chain Evidence
- Blue construction paper
- Scissors
- Glue
- Investigation Plan
- Journal

Part 2

INVESTIGATION FACILITATION

Question

Introduce the investigation question.

How can I construct a model of the Earth from 250 million years ago?

Personal Knowledge

Students capture what they already know about Earth's continents, fossils, and continental crust.

- Find out what students already know about Earth's continents, fossils, and continental crust.
- Create a class list *(List may include: there are seven continents, each continent is unique, continental crust is what we live on, fossils are dead organisms preserved in rock).*

DISCOURSE

Have students participate in a *Take 10 Steps* activity to promote discourse and collaboration. Give students two minutes to think and respond to the prompt. Then, have them walk 10 steps in any direction. They will share their list with the person closest to them. They will continue this process until time is up. Students will share their ideas with the class.

Prediction

Students share a group model of the Earth based on prior knowledge.

- Students work in small groups to predict what they think the Earth looked like 250 million years ago.
- Students will use the following prompt for their group prediction:
  We predict (*group sketch*) because_____.
- Display the group predictions around the class to be revisited at the end of the investigation.

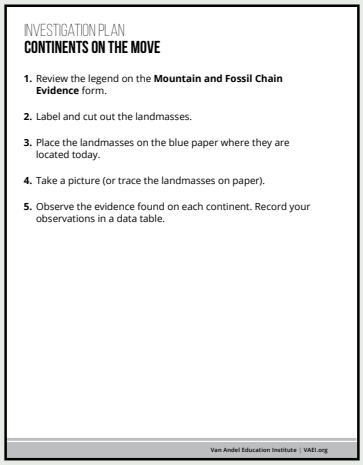
COLLABORATION

Conduct a *Brain Sketch*. Place the students in small groups. Provide each student with a sheet of plain white paper and a pencil. Ask each team member to do a quick sketch of what they think Earth may have looked like 250 million years ago along with their reasoning (because). After a designated time, have the students share their sketches with their small group. As a group, students decide on a group prediction to share with the class.

Investigation Plan

Students observe fossil and rock evidence from a secondary source.

- Have students work in teams of two.
- Review the Investigation Plan.
- Have students become familiar with the fossil/rock legend from the Fossil and Mountain Chain Evidence form. Then, have them label, cut out, and place the landmasses in their current day positions. Instruct them to either take a picture or trace the positions of each of the landmasses to be used for comparison later in the investigation.
- Have students examine the rock/fossil data and any other evidence (i.e. shapes of the landmasses) and record their observations in a data table.
- Remind students that they are observing and collecting data at this point. They will construct their model using evidence during data analysis.


INVESTIGATION PLAN
CONTINENTS ON THE MOVE

1. Review the legend on the **Mountain and Fossil Chain Evidence** form.
2. Label and cut out the landmasses.
3. Place the landmasses on the blue paper where they are located today.
4. Take a picture (or trace the landmasses on paper).
5. Observe the evidence found on each continent. Record your observations in a data table.

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Investigation Plan

CRITICAL THINKING

Use the Fair Test checklist to help students think critically about the investigation plan. Help them understand that a good investigation plan must include a test that is repeatable, generates quality data, and minimizes error. The more critically students think about their investigation plan, the more confident they can be in their results.

Observation

Students document their findings.

Have students create a data table to record fossil and rock evidence for each landmass. They may use check marks within their data table to identify the evidence found on each landmass. They may also want to indicate the location of the evidence (N,S,E,W) on each landmass.

Example of Data Table

INTEGRITY

Encourage students to record data objectively. Discourage them from trying to represent their data visually too soon. Disciplined researchers collect data first and then analyze it. This helps to avoid biased data.

Part 3

INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM

Data Analysis

Students make sense of their data by organizing it and representing it visually.

- Have students analyze their data. They may wish to use the Data Analysis prompt as a guide.
- Have students **evaluate** their data for trustworthiness.
- Then, have them analyze their data to find patterns and trends. Have them **organize** the data and look for connections between landmasses.
- Have students **represent** their organized data by creating a model of what the Earth looked like 250 million years ago. This representation will serve as each student's claim when they are developing their explanation.
- Ensure that students have enough data to support analysis.

Secondary Knowledge

Students use secondary sources to understand the evidence supporting Pangaea and the continental drift theory.

Provide resources for your students that include additional information and evidence for the Continental Drift Theory. Students will learn (if they have not already) that the landmass representing the Earth 250 years ago is called *Pangaea*, meaning "all land." Students should also learn that the Continental Drift Theory, proposed by Alfred Wegener in 1912, was not accepted at that time. He was not able to provide evidence for how the continents moved. The mechanism for how the continents move is what students will be investigating in the follow-up investigation, Observing the Seafloor. Students should also identify additional evidence, such as climatic evidence from secondary sources.

Possible resources:

LiveScience: Continental Drift Theory & Definition
Observe the break up of Pangaea
Lumen Learning: Theory of Continental Drift

Explanation

Students write a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from their analyzed data to write an explanation that answers their investigation question. Students may wish to use the Explanation prompt as a guide. Have them write their explanation in their journal.
- Have students develop a **Claim** to answer the question: How can I construct a model of the Earth from 250 million years ago?
- Then, have them add **Evidence** (the analyzed data) to support their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

Claim

We constructed a model of the Earth from 250 million years ago (as pictured) using the evidence provided.

Pangaea Model Example

Evidence

On the western coast of Africa and the eastern coast of South America, the Mesosaurus reptile, Glossopteris plant, and Cynognathus reptile fossils were found. Also, South America and Africa appear to fit quite well together like a puzzle. In Eastern North America, southern Greenland and western Eurasia, Glossopteris plant fossils and matching Alpine Mountain rock layers were found indicating that they were once connected. Southern India and southeastern Africa have fossil evidence of the Lystrosaurus reptile and Glossopteris plant. Based on their present day locations and evidence of the Glossopteris plant fossils, Antarctica and India were once connected.

Reasoning

Investigation: We followed the investigation plan carefully. We made observations about the fossil and rock evidence found on each landmass and made connections to this evidence in our data analysis.

Continued

Science: From our class readings and discussions, we learned that the Theory of Continental Drift, proposed in 1912 by Alfred Wegener, outlined the fossil and rock evidence indicating that all the continents were together over 250 million years ago. We also learned about glacial evidence connecting South America, India, South Africa, and Australia. Wegener's theory was not accepted at the time because he could not explain how the continents moved.

- Once the explanation is written, have students discuss their results using a Present and Defend.

DISCOURSE

Have students conduct a Present and Defend to develop presentation skills as well as audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning.

Evaluation

Students reflect on the investigation.

- Have students revisit their group predictions. Have them discuss similarities and differences within their small group.
- Have students compare how the world looks today and how it looked 250 million years ago. Have them make observations about the movement of the landmasses. Ask students what surprised them.
- Ask students what question they would like to investigate next.

Part 4

INVESTIGATION ASSESSMENT AND EXTENSION

Application

Students demonstrate understanding by using their learning in a new context.

- Have students create another model of what they think the world would look like 250 million years into the future and provide their reasoning. Then, have students view an animation of plate movement predicted for the future.
- Have students complete the follow-up investigation, Observing the Seafloor, to identify evidence of how the continents are moving.

Assessment

Students provide an explanation (**claim**, **evidence**, and **reasoning**) describing how fossil and rock data and the shapes of the continents provide evidence for Pangaea and the Continental Drift Theory.

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.

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INVESTIGATION PLAN

CONTINENTS ON THE MOVE

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