5A: Development of Plate Tectonic Theory

Content Area: **Science**
Course(s):
Time Period: **March**
Length: **2 Weeks**
Status: **Published**

Unit Overview

Almost a hundred years ago German meteorologist Alfred Wegener proposed continental drift, based on matching coastlines and corresponding rock and fossil formations. In the 1960s the discovery of seafloor spreading provided concrete evidence for this drift. This concept will examine Plate Tectonic Theory and how it has developed over time.

Enduring Understandings

Lesson Objectives

By the end of the lesson, students should be able to:

- Compare the theory of continental drift and the theory of plate tectonics
- Describe how the theory of continental drift led to the theory of plate tectonics

Essential Questions

- **Overarching Question**
    - How and why is Earth constantly changing?
- **Focus Question**
    - Why do the continents move, and what causes earthquakes and volcanoes?
- **Lesson Questions**
    - How did the theory of plate tectonics evolve?
    - What is the difference between the theory of continental drift and the theory of plate tectonics?
- **Can You Explain?**
    - What is the theory of plate tectonics, and how did scientists develop it?

Instructional Strategies & Learning Activities

- The Five E Instructional Model

  Science Techbook follows the 5E instructional model. As you plan your lesson, the provided Model Lesson includes strategies for each of the 5Es.

- Engage (45–90 minutes)

  Students are presented with the basic concept of continental drift as they begin to explore Earth's structure. Students begin to formulate ideas around the Can You Explain? (CYE) question.

- Explore (90 minutes)

  Students investigate evidence that supports the theory of continental drift and plate tectonic theory. Students complete an Exploration to identify evidence supporting the two theories.

- Explain (45–90 minutes)

  Students construct scientific explanations to the CYE question by including evidence of how scientists developed the theory of plate tectonics.

- Elaborate with STEM (45–90 minutes)

  Students apply their understanding of plate tectonics as they interpret ocean-floor data, imagine the effects of future continental drift, and calculate how long it takes for continents to move.

- Evaluate (45–90 minutes)

  Students are evaluated on the state science standards, as well as Standards in ELA/Literacy and Standards in Math standards, using Board Builder and the provided concept summative assessments.

Integration of Career Exploration, Life Literacies and Key Skills

	An individual's strengths, lifestyle goals, choices, and interests affect employment and income.
	Gathering and evaluating knowledge and information from a variety of sources, including global perspectives, fosters creativity and innovative thinking.
9.4.8.CT	Critical Thinking and Problem-solving
	Multiple solutions often exist to solve a problem.
	An essential aspect of problem solving is being able to self-reflect on why possible solutions for solving problems were or were not successful.
	Increases in the quantity of information available through electronic means have heightened the need to check sources for possible distortion, exaggeration, or misrepresentation.
9.4.8.IML.1	Critically curate multiple resources to assess the credibility of sources when searching for information.

9.4.8.IML.3	Create a digital visualization that effectively communicates a data set using formatting techniques such as form, position, size, color, movement, and spatial grouping (e.g., 6.SP.B.4, 7.SP.B.8b).
9.4.8.IML.12	Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience. Some digital tools are appropriate for gathering, organizing, analyzing, and presenting information, while other types of digital tools are appropriate for creating text, visualizations, models, and communicating with others.
CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP9	Model integrity, ethical leadership and effective management.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Technolgy And Design Integration

Technology is fully integrated with the Discovery Techbook

Interdisciplinary Connections

LA.RI.6.1	Cite textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferences drawn from the text.
LA.RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts.
LA.RI.6.2	Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
LA.RI.6.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings.
LA.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).
LA.RI.6.7	Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
LA.RI.6.8	Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.
LA.RI.6.10	By the end of the year read and comprehend literary nonfiction at grade level text-complexity or above, with scaffolding as needed.

LA.W.6.1	Write arguments to support claims with clear reasons and relevant evidence.
MA.7.EE.B.4	Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
LA.W.6.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
LA.WHST.6-8.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research.
MA.6.EE.B.6	Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

Differentiation

Struggling Students

1. Be aware that students who are not able to record their prior knowledge may not fully understand the questions. Help students reword questions in a way that is easy for them to understand and address. Reword "How did the theory of plate tectonics evolve?" as "How did the theory develop? What ideas came before the modern theory? How did scientists' ideas about how the Earth works change over time?" Reword "What is the difference between the theory of continental drift and the theory of plate tectonics?" as "How are they the same? What do they explain? Which came first?"
2. If students have trouble organizing their notes about the differences between continental drift and plate tectonics, you may want to provide

ELL

1. If English Language Learners find it difficult to understand the narration of the videos, remind them that they can use the transcript function or the closed caption function to read the text as they listen.
2. Make sure students fully understand the lesson questions. It may help to provide synonyms and antonyms and related words that are different parts of speech (difference/different; similar/same; evolve/evolution/change).
3. Consider allowing English Language Learners to conduct research for their projects using resources published in their native language. Challenge them, however, to summarize their findings in English and prepare the final Board in English.

Accelerated Students

1. Encourage students to come up with their own scientific questions related to plate tectonic theory, and add those to the Scientific Explanation Key Questions. Remind students to think about these questions as they go through the rest of the lesson.
2. Challenge students to find additional video segments about the development of plate tectonics using the Discovery search function. Students should think about what keywords to use and how to narrow down the results so that they are manageable.
3. Once they have completed their timelines, students conduct research to add other events to the timeline. These could be political events (wars), natural disasters (earthquakes and volcanic eruptions), inventions (e.g., radar), or other scientific discoveries (discovery of DNA or

them with a copy of the Venn 2 Graphic Organizer.
3. Students may need assistance differentiating the claim from the evidence and the reasoning. In this case, the claim can consist of a summary statement about the evolution of plate tectonics from continental drift. The evidence that students use to back up their claim is in the form of video segments, reading passages, and Core Interactive Text. The reasoning is in their own synthesis and analysis of events.

development of various models of the atom). Challenge students to make connections between these events and the development of the theory of plate tectonics.

Differentiation in science can be accomplished in several ways. Once you have given a pre-test to students, you know what information has already been mastered and what they still need to work on. Next, you design activities, discussions, lectures, and so on to teach information to students. The best way is to have two or three groups of students divided by ability level.

While you are instructing one group, the other groups are working on activities to further their knowledge of the concepts. For example, while you are helping one group learn the planet names in order, another group is researching climate, size, and distance from the moon of each planet. Then the groups switch, and you instruct the second group on another objective from the space unit. The first group practices writing the order of the planets and drawing a diagram of them.

Here are some ideas for the classroom when you are using differentiation in science:

- Create a tic-tac-toe board that lists different activities at different ability levels. When students aren't involved in direct instruction with you, they can work on activities from their tic-tac-toe board. These boards have nine squares, like a tic-tac-toe board; and each square lists an activity that corresponds with the science unit. For example, one solar system activity for advanced science students might be to create a power point presentation about eclipses. For beginning students, an activity might be to make a poster for one of the planets and include important data such as size, order from the sun, whether it has moons, and so on.

- Find websites on the current science unit that students can explore on their own.

- Allow students to work in small groups to create a project throughout the entire unit. For example, one group might create a solar system model to scale. Another group might write a play about the solar system. This is an activity these groups can work on while they are not working directly with you.

Differentiation in science gets students excited to learn because it challenges them to expand their knowledge

and skills, instead of teaching the whole group concepts they have already mastered.

Modifications & Accommodations

Refer to QSAC EXCEL SMALL SPED ACCOMMOCATIONS spreadsheet in this discipline.

Modifications and Accommodations used in this unit:

IEP and 504 Accommodations will be utilized.

IEP and 504 plans will be utilized.

Benchmark Assessments

Benchmark Assessments are given periodically (e.g., at the end of every quarter or as frequently as once per month) throughout a school year to establish baseline achievement data and measure progress toward a standard or set of academic standards and goals.

Schoolwide Benchmark assessments:

Aimsweb benchmarks 3X a year

Linkit Benchmarks 3X a year

Additional Benchmarks used in this unit:

The students will complete two summative benchmark tests administered by the teacher via Google Forms and Google Classroom. There is one benchmark test administered in the middle of the year around January, and a second one administered in May.

Formative Assessments

Assessment allows both instructor and student to monitor progress towards achieving learning objectives, and can be approached in a variety of ways. **Formative assessment** refers to tools that identify misconceptions, struggles, and learning gaps along the way and assess how to close those gaps. It includes effective tools for helping to shape learning, and can even bolster students' abilities to take ownership of their learning when

they understand that the goal is to improve learning, not apply final marks (Trumbull and Lash, 2013). It can include students assessing themselves, peers, or even the instructor, through writing, quizzes, conversation, and more. In short, formative assessment occurs throughout a class or course, and seeks to improve student achievement of learning objectives through approaches that can support specific student needs (Theal and Franklin, 2010, p. 151).

Formative Assessments used in this unit:

Formative assessments as listed in unit.

Summative Assessments

Summative assessments evaluate student learning, knowledge, proficiency, or success at the conclusion of an instructional period, like a unit, course, or program. Summative assessments are almost always formally graded and often heavily weighted (though they do not need to be). Summative assessment can be used to great effect in conjunction and alignment with formative assessment, and instructors can consider a variety of ways to combine these approaches.

Summative assessments for this unit:

Summative assessments as listed in unit.

Instructional Materials

Lesson Overview

Allow approximately 175 minutes to complete this lesson.

- **Observing Phenomena** [15 min]**:** Students observe how fossil patterns of plant life in Antarctica do not match Antarctica's climate.

Suggested Reading: Introduction

- **Investigation 1** [100 min]**:** Collecting Evidence to Support the Continental Drift Hypothesis

Students record data on the distribution of fossils and rocks that support Wegener's Continental Drift hypothesis. Then, students reassemble the pieces of a world map into the supercontinent of Pangaea in order to see how Wegener analyzed the evidence that supported his hypothesis.

Suggested Reading: Section 1

- **Investigation 2** [45 min]**:** Exploring How Plate Tectonic Theory Works

Students use models to construct a scientific explanation for how tectonic processes change Earth's surface.

Suggested Reading: Sections 2-7

- **Making Sense of Phenomena** [15 min]**:** Students use their understanding of continental drift and the Theory of Plate Tectonics to explain why fossil patterns of plant life in Antarctica do not match Antarctica's climate.

Standards

MS-ESS2	Earth's Systems
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.
ESS1.C	The History of Planet Earth
	Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches.
ESS2.B	Plate Tectonics and Large-Scale System Interactions
	Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart.