Unit 4: Geology and History of Earth

Content Area: **Science**
Course(s):
Time Period: **Trimester 3**
Length: **12-15 Weeks**
Status: **Published**

Brief Summary of Unit

In this unit, students will develop a foundational understanding of Earth's internal structure and the dynamic processes that shape the planet's surface. Through the use of scientific models and investigations, students will explore the evidence that supports the layered structure of the Earth, including seismic data and rock samples. They will analyze how convection currents in the mantle drive the movement of tectonic plates, leading to the formation of mid-ocean ridges, volcanoes, earthquakes, and mountain ranges.

Students will study plate tectonics and how interactions at plate boundaries produce distinct geological events and features. This knowledge will support their understanding of the causes and impacts of natural hazards such as earthquakes, tsunamis, and volcanic eruptions. Students will also examine methods used to reduce risks to life and property from these hazards.

In addition, students will investigate the processes of fossilization, learning how decomposition, sedimentation, and the presence of hard parts contribute to the preservation of ancient life forms. They will interpret fossil evidence to explain changes in Earth’s organisms over geologic time and apply principles of stratigraphy to understand how scientists construct the geologic time scale.

Students will explore the rock cycle, identifying and classifying igneous, sedimentary, and metamorphic rocks based on their properties and formation processes. They will use this knowledge to infer how Earth’s surface has changed over time and how it continues to evolve due to natural forces.

Throughout the unit, students will engage in Science and Engineering Practices, including developing and using models, analyzing and interpreting data, and constructing evidence-based explanations. Crosscutting concepts such as systems, cause and effect, patterns, and stability and change will guide their understanding of Earth's dynamic processes.

Revision Date: July 2025

Essential Questions

Essential Questions

What drives the movement of Earth’s tectonic plates, and how does this shape the planet over time?

What evidence supports the theory of plate tectonics and continental drift?

What can fossils tell us about Earth’s history and the evolution of life?

How does the rock cycle reflect Earth’s ongoing changes?

What can we do to minimize the impact of natural hazards like earthquakes and volcanic eruptions on human life and infrastructure?

Enduring Understandings

Earth's interior is composed of layers that we understand through indirect evidence such as seismic wave data.

Convection currents within the mantle drive the movement of tectonic plates, reshaping Earth's surface over geologic time.

The theory of plate tectonics explains the formation of many geological features and natural disasters.

Plate boundary interactions result in the creation of landforms and can cause natural hazards such as earthquakes, volcanic eruptions, and tsunamis.

Fossils provide critical evidence about organisms and environments from Earth's past and help scientists construct the geologic time scale.

The rock cycle demonstrates how Earth's materials are continuously transformed through natural processes.

Human understanding of geologic processes enables us to assess risks and develop strategies to reduce the impacts of natural hazards.

Students Will Know/Students Will be Skilled At

Students will know the structure and composition of Earth's interior and how seismic waves provide evidence of Earth's layers.

Students will know how convection currents in the mantle cause the movement of tectonic plates and reshape Earth's surface over time.

Students will know the characteristics of divergent, convergent, and transform plate boundaries and the geologic activity associated with each.

Students will be skilled at interpreting maps and datasets to identify patterns in the locations of earthquakes, volcanoes, and mountain ranges.

Students will know how fossil evidence and rock strata are used to understand changes in life and environments over geologic time.

Students will know the processes of the rock cycle and how rocks are formed, changed, and recycled by Earth's internal and surface processes.

Students will be skilled at classifying igneous, sedimentary, and metamorphic rocks based on physical

characteristics and formation processes.

Students will know the causes and effects of natural hazards such as earthquakes and volcanoes, and how these can impact communities.

Students will be skilled at developing and using models to represent Earth's interior, tectonic activity, and geologic processes.

Students will be skilled at planning and conducting investigations to examine rock samples, analyze fossil evidence, and model Earth processes.

Students will know how plate tectonics explains the movement of continents and the distribution of geologic features over time.

Students will know how conditions like rapid burial and mineral replacement influence fossil formation and preservation.

Learning Plan

Demonstration: Without any discussion or background information, students will observe the teacher cutting a hard-boiled egg in half and then discuss what they observe. *Discussion Questions: What could the egg be a model of? Why do you think this? Could it be anything else? Which idea fits best & why?*

Notes/Discussion – Takes notes on how scientists study the inner Earth, and how pressure and temperature change as depth increases.

Guided notes & powerpoints for students as needed

Graph Analysis – Students will complete a worksheet in which they must analyze a graph on temperature & pressure.

notes copied & given to students as needed

Demonstration: Dropping marbles through different substances to demonstrate how things move differently through different materials. Water, air, and syrup will be put into graduated cylinders, and the students will observe how quickly a marble moves through each cylinder. *Discussion Questions: What does this demonstration represent? Would you be able to tell me which material the marble was going through, by just knowing the speed and not looking at it? How does it correlate to how scientists study the Earth? What did you learn from this demonstration?*

Notes/Discussion/Diagram – students will draw and label a diagram of the layers of the Earth and take notes on each layer and how they affect the surface of the Earth. Assign a practice worksheet to reinforce concepts. *(most likely homework)*

*notes copied & given to students as needed**peer check with table for all learners, answers posted on board for student support**

Guided notes & powerpoints for students as needed

Lab Activity – students will be given three different liquids. They will record the mass and volume of each and then calculate the density. Then, the liquids will be poured into a clear cup, in any order they wish. Students will observe what happens to the liquids when they are combined and record their observations. Students will complete the analysis questions for the lab, which help the students make the real-life connection between their model and real life.

* mixed grouping*

Earth's Layers Foldable – students will create a foldable on the layers of the Earth, to use as a visual representation and a study guide. It will include a diagram of the layers along with information on each layer.

Journey to the Center of the Earth – Students will create a comic strip that shows what the different layers of the Earth are like as they take a trip to the inner core. Students must follow the rubric and include all the important characteristics about each layer. While their characters and stories do not have to depict real-life situations, their depictions of the layers themselves have to be true to form. A rubric will be used to guide and assess them.

varied forms of assessment

Tiered/ Differentiated Rubrics

Plate Tectonics Puzzle Activity – Without a discussion or prior background information, students will be given different landmass puzzle pieces and try to fit the pieces together to create on giant continent. They will tape their models down and answer a few questions about how and why they constructed their puzzle the way that they did. Students will share their models with the class, and a class discussion will follow. *Discussion Questions: What clues did you use to help fit the pieces together? Did you look at anything else besides the shape/outline? What about the key? Or did our current map influence your decisions? What was your reasoning for each piece? Do you think the Earth used to look like this, or do you think it's always looked the way it does now?*

Notes/Discussion – First, students will view maps & recall their experience from the plate tectonics puzzle to try to come up with a list of evidence to support the theory of continental drift. The maps will have keys that indicate mountain ranges, different types of fossils found, and other features. Students will share their lists with the class, and a class list will be compiled on the board. Then, students will come up with another list: why people didn't accept this theory/reasons against it. These lists will be shared as well, leading to a class discussion. Notes will then be taken on the topics.

Guided notes & powerpoints for students as needed

Demonstration & Notes– To help students understand convection, the teacher will do the following: The floor = core & the ceiling = crust & teacher = magma. As the teacher sits on the floor, they will ask the student what is happening to her temperature being so close to the core & explain that heat makes liquid less dense. Then ask what happens to something that is less dense, float, or rise. The teacher will step up onto the chair & ask what is going to happen to her temperature as she gets closer to the crust and further from the core. She will explain that colder liquid/magma becomes denser and ask what happens to something denser: it sinks. The teacher will repeat the process over and over until the students can narrate the whole process on their own without prompting. Notes will then be taken on convection & seafloor spreading. A quick video clip will be shown about the process of seafloor spreading, convection, and plate boundaries.

Demonstration: Part 2: Teacher will demonstrate convection in a beaker on a hot plate. The beaker will contain oatmeal and hole-punched circles from construction paper. The students will observe the movement of the oatmeal and paper as the water is heated. *Discussion Questions: What do you observe going on in the beaker? Why are the materials moving? What role is temperature playing? What role is density playing? How*

does this demonstration model the Earth? What does the hot plate represent? Would convection still occur if the heat source were coming from the top instead of the bottom? If the core of the Earth were freezing and covered in ice, and the surface was extremely hot, would the magma still move? How would this change affect us?

Demonstration - Students will each get two graham crackers/Play-Doh and follow along with the teacher as he demonstrates the different types of plate movements/boundaries. (divergent, convergent, transform) They will then be quizzed and asked to demonstrate the type of boundary that the teacher calls out. Students will fill out a graphic organizer chart as they go through the demonstrations

Notes/Discussion/Diagram – Following the text analysis, students will discuss earthquakes and take notes on a few terms that they didn't come across in their readings/video. Students will discuss and take notes on the three different scales used to measure earthquakes. Students will construct a Venn diagram comparing the three different scales. A review sheet on earthquakes will be given as homework whenever notes are complete and before moving on to volcanoes.

** copies of filled in notes & filled in Venn Diagram as needed**

Smartboard Simulation – Students will watch a simulation of the damage that occurs at every level of the Modified Mercalli Scale. Students will analyze which levels can/cannot be felt, which levels barely cause damage, which levels cause substantial damage, and which levels cause complete destruction.

Ongoing Real-Time Data Collection – Each day, students will access data from earthquakes that are occurring that day around the world, using an app either mirrored to the smart board using Apple TV, or individually on their iPads. Students will collect data, location & strength of the earthquake, and then plot the earthquakes on a world map using latitude and longitude. At the end of a week or two, the students will analyze their data by answering/discussing the following questions: *Do you notice a pattern of earthquake occurrence? Which boundaries had the most earthquakes occur within the past week? What was the average strength of all the earthquakes that occurred within the past week? Were most of the earthquakes able to be felt? Why/why not? Which earthquake was the strongest? Weakest? Were we "close" to any earthquakes that occurred this week?*

Volcano Introduction – students will be shown a short video clip on volcanoes to spark their interest, and then a discussion will follow to introduce the topic. *Discussion questions: What are volcanoes? Why are we learning about them at the same time as earthquakes? How are they similar? How are they different?* Students will then take notes while viewing PowerPoint on volcanoes.

Ring of Fire – Students will briefly discuss the Ring of Fire, view a map, and then plot the most recent volcanic eruptions on the same map that they plotted the most recent earthquakes to compare their locations. *Discussion/Analysis Questions – What is the Ring of Fire? Where is the Ring of Fire? Why is it called this? Do you notice a pattern between the earthquakes & volcanoes? Why are there so many earthquakes and volcanoes here? Why do they BOTH occur here? Why do you think people continue to live within the Ring of Fire, despite its dangers?*

Volcano Types Foldable – students will create a foldable on the three types of volcanoes, to use as a visual representation and a study guide. It will include a diagram of the volcanoes along with information on each one. If time is within the period, students will use the foldable to quiz each other.

Pompeii/St. Helens – students will view some pictures taken from the ruins of Pompeii (personal pictures & internet) and then watch a short video clip about the story of the city of Pompeii and Mount Vesuvius. Students will also watch a short clip about the 1980 eruption of Mt. St. Helens. The two volcanoes and their eruptions will be compared through class discussion. *Discussion Questions: How are the two stories similar? How are they different? Which one was more explosive? Why was Vesuvius more deadly? What were the*

major effects of both eruptions? What did we learn from each?

Group Activity to Introduce the Unit: FOSSIL ACTIVITY - Without any discussion or background information, students will be given envelopes to open. Students are working in groups and have to try to assemble an organism from the fossils in their envelopes. They will open the envelopes one at a time, in a specific order, and see how their ideas change over time, as more fossils are uncovered. Each group has fossils from the same organisms, but different pieces of the puzzle. Students will then team up with another group to try to come up with a final hypothesis, and to show that sharing ideas is very helpful. Students will compare their models with a "Reference Key" to see if they can identify what they discovered. Students will complete analysis questions at the end of class or for homework. *Discussion Questions: Was that activity hard? Easy? Why? Why didn't I tell you the answer? How did you work together to decide which idea was best? Did your initial guess change as the activity went forward? Why? Did the other groups have the same ideas as you? Is the job of paleontologists hard? Why? How can fossils like these help us learn about the past?*

Notes/Discussion – Takes notes on how fossils form, types of environments, and types of fossils. View a simulation that shows what happens to dead organisms in different environments, to demonstrate the best conditions for fossilization.

Guided notes & powerpoints for students as needed

Students Activity/Demonstration- Fossilization Simulation: Each student will represent a member of a particular ecosystem. (alligator, fish, seaweed, trees, scavengers, etc.) Students will act out their parts briefly and then freeze when the teacher calls freeze. The teacher will then walk around the room as students draw their "fate" cards. The cards will tell them if they became a fossil or not after their death. A list will be constructed on the board. The game is designed so that only 2 or 3 students in the whole class pick "fossil" cards. This will lead to a discussion on the bias of fossils.

Discussion Questions: Which organisms became fossils? Which got destroyed? What will paleontologists be able to determine about the organisms that once lived here? Is the list of fossils an accurate representation of the living community? Why not? What is the problem with studying fossils? Can we change this? Is it easy to study the past?

Formative Assessment – Students will write a two-paragraph essay supporting the claim that fossils are important but are bias regarding the past. Students will use their notes from the past few days and the fossilization simulation to back up their argument. They will also be given an article to reference in their essay.

Quizizz is used to assess students' knowledge before moving on to fossil types

Lab Activities - #1: PETRIFIED – teacher demonstration, place a paper towel in a mixture of glue and water, stand the paper towel on a paper plate, and let it set overnight. #2 MOLD/CAST – students will be asked to bring in a shell or take one from teacher, students will cover the shell in petroleum jelly, press it into modeling clay, and then plaster of paris will be used to fill in the mold and create a cast of the shell #3: TRACE – students will press different objects into clay, other groups will have to guess what the object is based on the trace evidence #4: DRY vs. ACID EVNIRONMENT – chicken bones will be placed in vinegar for a few days and others will be placed in a hot, dry environment. Students will compare the results and apply their observations to fossilization

Four Corners/Grouping Activity– Students will be given pictures or descriptions of different types of fossils and will have to move to the correct corner/side of the room based on their card. This will be done 2-3 times to review fossil types. Another variation: each table is given 5-6 examples or descriptions of each type of fossil, and the group must place each card into the correct category.

Strategic examples given to students to provide support/scaffolding, leveled grouping for the second activity

Quiz Is used to assess students' knowledge & determine if more practice is needed before the quiz

Short Quiz – Students will complete a short quiz on fossil types

modified versions as needed

Notes/Discussion/Practice – Teacher will discuss relative dating with students as they take notes, and show a demonstration/practice problem on the board. Students will complete a practice exercise/worksheet with tables, review & then complete another practice sheet on their own (most likely for homework)

** Peer review of homework, answers eventually put on the board to support students to check**

Guided notes & powerpoints for students as needed

Absolute Dating – Notes/Instruction/Demonstration on how to calculate the age of a fossil using Carbon-14. *Teacher demonstration* using a piece of paper, ripping it in half over and over to demonstrate a half-life. Practice problems will be put on the board as students are given time to complete them at their desks, and then answers will be reviewed. Students will then work to complete simple carbon-14 problems, using their group members for help if needed.

differentiated math problems, and calculations

Carbon-14 Lab – Students will work in pairs to complete the lab. They will be given 100 Skittles, shake them in a cup, and pour them on their desk. They will count the amount face up and face down, and remove the face-down ones. They will continue shaking and dumping until there are zero Skittles left. They will record the amount that "decayed" for each "half-life" and then graph their results. They will then answer analysis questions about the activity on the lab handout.

leveled grouping

Carbon-14 Station Race – Students will rotate through three stations. They will have certain tasks to complete in a set time frame. They must record their task/answers on their own worksheet. When the bell rings, they must move on to the next station. Each station will contain either relative dating or absolute dating problems to solve. They must work as a team to correctly complete as many as possible in the given time limit. Each group member must have all work shown on their own worksheet with the correct answer for the group to get credit.

stations in the back of the room for extension/challenge, stations in the front for required skills, and provide support through extra hints/clues, students are grouped by proficiency levels

Fossils Review Stations – Students will rotate through three stations to review the unit on Fossils.

#1 Absolute Age: At this station, students will complete the practice problems they find at Station 1 in the chart in the packet. They will work together until every member of their group has completed all of the questions. Then, students will check and correct their answers using the answer sheet provided in the manila envelope.

#2 Quizlet Station: At this station, students will use the Chromebooks to access the Quizlet app. They will play at least ten times and record their scores in their packet. Their goal is to increase their score each time they play.

differentiated math problems and calculations

***Texts will be leveled ***

Introduction Activity– Part 1 - Students will be given a half sheet of paper with a few major life events on it. The students will put the events in the order that happened in their own lives. *Discussion Questions- Was it easy to put the events in order? Can you put an exact date next to each event? Why is that harder? Can you at least narrow it to a year or two? Is that useful information? How can we apply this to the events of Earth's history?* Part 2à: Students will apply their experience with part 1 in order to work together in their group to put geological events in order from oldest to youngest. Events include the first life, dinosaurs, humans, etc. Groups will post their orders on the board and will compare. *Discussion Questions- How did you determine the order of these events? What events had to come first? Last? Would you be able to put exact dates next to each event? Could you give approximate dates?*

Notes/Discussion/Video Clip- students will take notes and discuss how Earth formed and what early Earth's conditions were like. National geographic video clip on Earth's formation (5-8 minutes)

Guided notes & powerpoints for students as needed

Time Scale Demonstration- students will each be given a different geological event that they will have to place on a classroom timeline (timeline will be set up in the hall way, spanning from science closet door to the end of the hallway near the bathrooms) Students will first guess where they think their event belongs on the timeline that spans from 4.6 billion years ago to present day and stand at that point along the timeline. Then, the real timeline will be revealed, event by event, starting with the more shocking ones… like first life and humans evolving. Students will then observe the timeline. *Discussion Questions- What observations can you make about Earth's timeline? Is there anything unusual? Do you notice any patterns? Is this timeline shocking? What does this tell you about the age of the Earth? What does this tell you about how long it takes for changes to happen on Earth?*

Notes/Discussion- Students will be asked if they can remember any of the events from the Time Scale Demonstration. They will be shown the 4 Eras of Earth's history(in the correct order) and try to identify which Era the events that they can remember belong in. Once they have been given a chance to try on their own, the answers will be revealed, which will most likely shock the students since the Pre-Cambrian Era takes up most of Earth's History. Students will then take notes and discuss the major events of each era. The fact that Eras are not equal in length but instead were created based on events will be stressed. *(play more clips from National Geographic video if time)*

Human Evolution Discussion- Students will be shown skull replicas of fossils that have been found in human ancestors. As a class, we will discuss the correct order of the skulls from oldest to most recent. *Discussion Questions: How have the skulls changed over time? Is anything bigger? Smaller? What are the benefits of these changes? Why do you think these changes occurred?* Students will then view a few pictures of our ancestors and take notes on the evolution of humans and when we split from apes/chimpanzees.

Group Time Scale Project- Students will work in groups to construct an accurately scaled timeline of Earth's geologic history. Students will tape multiple pieces of paper together to make the scale accurate and manageable. Students will mark every billion years on the scale as well as every 100 million years. Students will divide, label, and color the four Eras. The student will then plot 28 different events on the timeline and illustrate each one.

Introduction to Minerals: Students will have a Do Now question to answer, without any prior discussion in class: What are minerals? Students will share answers and, as a class, discuss & agree upon the best answer.

Class Demonstration/Discussion – Students will observe 10-15 items on the front table. With their table, students will make two lists: Made of minerals & Not made of Minerals. They will have two different whiteboards to write their lists on to share with the class. Groups will share their answers & attempt to come

up with one class list. This will lead to a teacher-led discussion on the correct answers & it will be revealed that ALL the materials were made from minerals. <u>*Discussion Questions*</u>*: What did you learn from this activity? What does this tell you about mineral uses? Do you think you can name any other common items that might have minerals in them?*

Mixed groupings

Mineral Mania Web Quest: Students will explore The Science Spot on laptops and complete a worksheet on the uses and commonality of minerals in our lives.

Notes/Discussion – Students will take notes on the 5 properties of minerals & how to identify minerals. Students will watch a quick video clip from the "geology kitchen" on the properties of minerals. Students will also take notes on the Mohs Scale of Mineral Hardness. <u>*Discussion Questions*</u>*: Does anyone know the hardest mineral? The softest mineral? What properties of minerals are very easy to determine?*

Guided notes & powerpoints for students as needed

Article & Questions – Students will read an article on mineral use in our homes & answer questions. *(most likely homework assignment)*

* leveled articles*

Mineral Lab – students will obtain 8 different mineral samples to be tested and identified. Students will perform six different tests on each mineral, which include hardness, smell, streak, cleavage, light, and color. Once students have collected all of their data, they will then compare their data to the chart of known mineral properties. They will attempt to correctly identify each mineral. They will answer analysis questions about the lab with their group or for homework.

<u>Introduction to Rocks</u>:

Assess prior knowledge – Students will be asked to name the 3 types of rocks and any characteristics of them that they can think of. Discussion will lead to notes on the topic.

Notes/Discussion – Students will take notes on the three basic types of rocks and their general characteristics. Students will view examples of rocks & try to place them in the correct category. *Guided notes & powerpoints for students as needed*

Game: Students will match characteristics to the correct type of rock

**mixed grouping **

<u>Igneous, Sedimentary, & Metamorphic</u>: Students will take notes on each type of rock, more in-depth from the introduction.

Igneous: article & questions for background knowledge, notes/discussion, geology kitchen video clip

Sedimentary: article & questions for background knowledge, notes/discussion, geology kitchen video clip

Metamorphic: article & questions for background knowledge, notes/discussion, geology kitchen video clip

* leveled articles*

Guided notes & powerpoints for students as needed

Who Am I Game – Students will come up with 10 "Who Am I" statements and then swap with another table to see how many they can get correct.

Rock Cycle: Prompt discussion of the rock cycle by asking the class: *What processes have we learned about that involve rocks? What do you think the rock cycle is? Do you think you can name any steps of the rock cycle?*

Diagram/Notes: Students will fill in a graphic organizer/diagram on the rock cycle and take notes on the steps. *Filled out notes & powerpoints for students with IEPs*

Worksheet: Homework to reinforce concepts learned in class

Rock Cycle Lab: Students will be given starbursts and a blank rock cycle diagram. They will try to demonstrate each step of the rock cycle with the starbursts using the given materials. They will not get any hints or procedure. They will have to come up with the steps on their own. When they have successfully demonstrated all the steps, they will answer the analysis questions on the lab sheet. *Class Discussion*: *How did you create each type of rock? What did you do to demonstrate each process? Was there only one way to fill the chart out? Could the steps have been reached in different ways? How are the rock cycle and water cycle similar?*

mixed grouping.

Lab Safety will be reviewed before beginning any lab activity

Evidence/Performance Tasks

Science courses are designed to promote skill attainment. Student progression and pace through which they proceed through the performance tasks is based on their affinity for and ability to reach skill attainment. The teacher will determine formative and summative skill attainment; alternative assessments will be incorporated for each student based on their strengths and challenges.

Formative Assessments:

- Worksheets
- Do Nows
- Exit Tickets
- Class Discussions
- Layers of the Earth Quiz
- Earthquake Quiz
- Volcano Quiz
- Fossil Types Quiz
- Absolute Dating Quiz
- Earth's History Quiz

- Rocks and Rock Cycle Quiz
- Minerals Quiz

Summative:

Unit Tests:

- Earth's Structure Unit Test
- Earthquake and Volcano Unit Test
- Fossils Unit Test
- Rocks and Minerals Unit Test

Bench Marks:

Formal Lab Reports

- Density Mini Lab
- Carbon-14 Lab
- Mineral Lab
- Rock Cycle Lab

Alternative:

- Earth's Layers Comic Strip
- Earth's layers foldable
- Volcano Foldable
- Plate Tectonic Activity
- Fossil Introduction Activity
- Fossil Four Corners
- Relative Dating Worksheets
- Absolute Dating Worksheets
- Timeline Project
- Mineral Mania Webquest
- Rock Matching Game
- Check for Understanding

Suggested Strategies for Modifications

See attached document

https://docs.google.com/spreadsheets/d/1wZeK2sYMgTDgqPB3B9-_tnn4GVTjdlgfbgsWmnSKX2E/edit?usp=sharing