EXPEDITIONARY LEARNING

Grade 5: Module 4: Unit 1: Lesson 2

Relationships Between Key Scientific Concepts:

Planning What Causes Earthquakes

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Long-Term Targets Addressed (Based on NYSP12 ELA CCLS)	
I can explain what a text says using quotes from the text. (RI.5.1) I can explain important relationships between people, events, and ideas in a historical, scientific, or technical text using specific details in the text. (RI.5.3) I can determine the meaning of academic words or phrases in an informational text. (RI.5.4) I can determine the meaning of content words or phrases in an informational text. (RI.5.4)	
Supporting Learning Targets	**Ongoing Assessment**
• I can explain the relationship between scientific concepts about earthquakes using specific details from the text. • I can use context clues to determine the meaning of new words in an article about earthquakes.	• Annotated "Earthquake" article • Earthquake Concepts note-catcher • Glossaries (scientific and academic vocabulary)

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Agenda	Teaching Notes
1. Opening A. Checking Independent Reading Homework and Engaging the Reader (8 minutes) B. Review Learning Targets (2 minutes) 2. Work Time A. First Read: What Is an Earthquake? (15 minutes) B. Second Read with a Partner: Cause and Effect Relationships about Earthquakes (15 minutes) C. Vocabulary to Deepen Understanding (13 minutes) 3. Closing and Assessment A. Debrief: What Have We Learned about Earthquakes? (5 minutes) B. Review Learning Targets (5 minutes) 4. Homework A. Reread the "Earthquakes" article aloud to someone at home. As you read, think about the causes and effects of an earthquake. B. Read your independent reading book. Be sure to read for evidence that can be added to the What Do We Know about Natural Disasters? anchor chart. Mark the evidence in your book using the evidence flags. C. Add vocabulary words to your scientific and academic word glossaries. Don't forget the academic words from the learning targets (relationship, concepts, context).	• This lesson is the first of two close reads in this unit in which students are reintroduced to standard RI.5.3. Students will explain the relationship between the scientific concepts behind the causes of an earthquake, as well as the effects on the environment and humans that categorize it as a natural disaster. • This unit is not designed for students to develop a full and deep understanding of the science behind earthquakes. Be sure to address these important scientific concepts much more fully during science lessons, including hands-on experiments or simulations as necessary. These literacy lessons "connect" to the science standards but do not fully address those standards. • Students read about certain scientific ideas (pressure and energy). They focus specifically on the concept of cause and effect relationships. Students have been introduced to this concept in previous modules (Jackie Robinson and the civil rights movement). This lesson includes a brief review of cause and effect relationships. The instruction aligns with RI.5.3. • In this unit, students will do most work with a partner. This allows for maximum engagement and participation by all members of the class. Consider purposefully partnering students so that stronger readers and writers are with those who struggle with complex text. Change students' partners periodically so that students can benefit from the thinking of other peers. • In this lesson, students use a new note-catcher: Earthquake Concepts. Students are accustomed to reproducing note-catchers into their journal and creating new ones as they continue practicing skills. However, due to the number of columns and wording in this note-catcher, students will be given the note-catcher to fill in. Consider stapling or taping the completed note-catcher into students' journals to keep all thinking about natural disasters in one place. • In advance: Write and post the vocabulary words and definitions for this lesson for students to refer to during Work Time, Part C and in preparation for homework. • Prepare necessary technology for the video. • Review: Give One, Get One protocol (Appendix 1).

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Lesson Vocabulary	Materials
relationship, concepts, cause, effect, chronological, before, during, after, causal chain of events, context; plates, pressures, interior, upward, results, fault, energy, seismic waves, radiate	• What Do We Know about Natural Disasters? anchor chart (from Lesson 1) • Students' independent reading books • Journals • Earthquakes 101 video clip. **Play only from 0:00 to 1:33**. National Geographic. "Earthquakes 101." Video. http://video.nationalgeographic.com/video/environment/environment-natural-disasters/earthquakes/earthquake-101/ • "Earthquake" article (one per student) • Earthquake Concepts note-catcher (one per student and one to display) • Earthquakes Concepts Note-Catcher (for teacher reference) • Vocabulary Strategies anchor chart (Module 3) • Earthquakes anchor chart (from Lesson 1) • Evidence flags (five per student)

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Opening	Meeting Students' Needs

A. Checking Independent Reading Homework and Engaging the Reader (8 minutes)
• Post the **What Do We Know about Natural Disasters? anchor chart** that students started in the last lesson. Ask students to take out their **journals** and turn to the anchor chart in their own notes. Ask them also to get out their homework: their **independent reading book** with evidence flags.
• Ask students to read the notes on the class anchor chart silently. Then invite them to turn to a partner:
  * "What is one piece of evidence from your independent reading book that you flagged for homework that could be added to the chart?"
• Call on several students to share their evidence. Add these notes to the class anchor chart. Invite students to do the same in their anchor charts in their journals as well as add any others they may have found evidence for during their reading.
• Tell students they will now be watching a video clip about earthquakes. Ask them to think about this question as they watch and listen:
  * "What happens during an earthquake?"
• Play the **Earthquakes 101 video clip**.
• Invite students to turn and talk with a partner about what they saw and heard happens during an earthquake. Have a few students share their discussions.
	• Some students may benefit from having a partner, or the teacher, read the lists from the anchor chart aloud.
	• Students who struggle with language would benefit from the teacher checking their evidence flags before class begins and letting them know they will be asked to share a particular one in front of the whole class, giving them time to prepare.
	• Consider playing the video clip more than one time for students to allow them more time for processing the information seen and heard.

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Opening (continued)	Meeting Students' Needs
B. Review Learning Targets (2 minutes) • Call on a student to read aloud the first learning target: * "I can explain the relationship between scientific concepts about earthquakes using specific details from text." • Ask students to think about the word *relationship* and share with a partner what they think it means in the learning target. Call on a student to share his or her definition. Listen for: "how things are connected or how they relate." Focus students on the parts of *relationship* that they may know, such as "relation" or "relate." Ask students to share out what they know about the meaning of those words. Listen for: "go together" or "belong together." • Ask students to think and talk with a partner about another word for *concepts.* Invite a few students to share their words. Listen for: "ideas," "understandings," etc. Clarify as needed: A concept is an abstract idea. • Explain that in today's lesson students will be learning scientific concepts that relate to earthquakes and then thinking about how those concepts relate to one another.	• Provide a nonlinguistic visual for the words *relationship* (two interlocking rings) and concepts (a light bulb).

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Work Time	Meeting Students' Needs
A. First Read: What Is an Earthquake? (15 minutes) • Distribute the article "**Earthquake**." Remind students of the process they have used when reading text for the first time. Ask them to share with a partner the first thing they do when reading a new text. Invite a few students to share their thinking. Listen for: "read for the gist," "read by ourselves," "if it is a really hard text, hear it read aloud as we read along," etc. • Ask students to read just the first three paragraphs of the article and annotate in the margin by writing the gist—what these paragraphs are about. Starting, "Earth's crust remains..." and ending, "...Aristotle said that underground winds shook the Earth." • After about 2-3 minutes, ask students to share with their partner the gist they wrote. Invite a few partners to share aloud. Listen for: "what causes an earthquake" or "damage that earthquakes cause." • Ask the class to listen to you read aloud the rest of the article, and tell them to write the gist in the margin when you pause after each section. • Then invite a student to share aloud the gist he or she wrote in the margin. Listen for ideas such as: – Causes of Earthquakes (paragraphs 4 and 5) —"slow movement of Earth's crust causes pressure; when large rocks break and slip there is an earthquake" – Seismic Waves (paragraphs 6, 7 and 8) —"seismic waves are shocks from the center of the quake that cause shaking" – Measuring Earthquakes (paragraphs 9 and 10) —"scientists read seismograms to learn about earthquakes" – Size and Strength of an Earthquake (paragraphs 11, 12 and 13) —"scientists measure earthquakes to learn more information about them" – How Often Do Earthquakes Occur? (paragraph 14) – "there are a lot of earthquakes every year, but most are small" – Predicting Earthquakes (paragraphs 15, 16 and 17) – "scientists are trying to figure out ways to help people prepare for earthquakes"	• Provide the "Earthquake" text in students' L1 language when possible. • Students who struggle reading complex text may need to have the article further chunked into single sentences rather than paragraphs. • Consider displaying the article on a document camera and modeling writing the gist in the margin after each paragraph is read and students share their thinking about the gist. • Some students may need the paragraphs read aloud more than one time.

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Work Time (continued)	Meeting Students' Needs

B. Second Read with a Partner: Cause and Effect Relationships about Earthquakes (15 minutes)
• Ask students to think again about what good readers do when they read closely:
  * "What do readers do after reading for the gist?"
• Call on a few students to share aloud. Listen for: "read again," "read for a specific purpose," etc.
• Tell students that they will read a portion of the article a second time, this time paying close attention to the relationships between scientific concepts, or ideas, that explain what causes an earthquake and what happens during and after an earthquake. Remind students of the work they did with *cause* and *effect* in Module 3A. Ask students to think about and share with a partner:
  * "What do you know about cause and effect?"
• Invite a few students to share aloud their discussion. Listen for: "Causes and effects are related," "An effect is a result of whatever caused it," and "You don't always know the cause of an effect. Sometimes texts actually describe the effect first, then the cause. Sometimes you have to infer the cause or effect. For example, in our study about Jackie Robinson (Module 3A), we read abut causes of the civil rights movement and effects of what some people did during that time."
• Clarify as needed. Explain that they will be reading to learn what causes an earthquake. Remind them that the text may not describe the causes and effects in the order they actually happen. In real life, cause always comes first, then effect. They happen in *chronological* (first, second, third, etc. ...) order. But writers don't always give us the information so clearly.
• Distribute and display the **Earthquake Concepts note-catcher**. Tell students that in the left-hand column they will write what happens *before* an earthquake, in the middle columns they will write what happens *during* an earthquake, and in the right-hand column they will write what happens *after* an earthquake. Answer any clarifying questions about the note-catcher.
• Ask students to read along in their heads as you reread the fourth paragraph. Set purpose: Ask them to pay attention to what the text says about what happens before an earthquake. Read aloud from "Seismologists, scientists who study..." to the end of the paragraph, "...brittle rocks near the surface."
• Ask:
  * "What happens before an earthquake?"
• Listen for: "slow moving material (plates) build up and push rocks to the surface." Model writing "slow moving material (plates) build up and push rocks to the surface" in the first column of the note-catcher and invite students to record this in their own note-catchers.
	• Consider posting all questions asked during the lesson on chart paper or the white board for students to refer to throughout the lesson.
	• Students who struggle with writing would benefit from a partially filled-in note-catcher.
	• Consider pre-highlighting details to focus on in the text for students who struggle reading complex text in order to help them fill out the note-catcher.

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Work Time (continued)	Meeting Students' Needs
• Ask students to take about 7-8 minutes with their partner to continue reading the next three paragraphs of the article and to record in the note-catcher what the text says about what happens during and after an earthquake (starting, "Earth's plates move only..." and ending, "...people feel a swaying or rolling motion.") Remind them that they should pause after every two to three sentences to consider and record relationships between concepts about earthquakes in their note-catchers. • Circulate among partners, redirecting or supporting students when necessary. • After about 7-8 minutes, refocus students whole group. Call on students to share what they wrote in their note-catchers. (See **Earthquake Concepts note-catcher, answers, for teacher reference** for ideas students may share.) • Help students notice that this is in effect a causal *chain of events*: A starting event causes the next effect and then that effect in turn causes another effect, and so on. Give students a concrete example (like dominoes falling) to help them understand this concept of a causal chain more clearly.	

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Work Time (continued)	Meeting Students' Needs
C. Vocabulary to Deepen Understanding (13 minutes) • Read aloud the second leaning target, "I can use context clues to determine the meaning of new words in an article about earthquakes." Ask students to think about the word context and what it means in the learning target. Invite a few students to share their thoughts. Listen for: "in the text, what the sentence is about, or "the parts of the text that help to explain its meaning," etc. • Draw students' attention to **Vocabulary Strategies anchor chart**. Remind students of the work that they have done in previous modules finding the meaning of new words in context. Ask: * "Which strategy has been most helpful to you and why?" • Ask a few students to share with the class. • Post and focus students on the list of vocabulary for this lesson. Assign each student a partner and two or three words from the list, ensuring that all words are assigned. • As in previous modules, ask students to do the following: 1. Work with their partner to find each assigned word in the text. 2. Underline or circle the words or phrases. 3. Using strategies listed on the anchor chart, determine the meaning of each word in context. 4. Write the word, what it means, and a visual in the appropriate Glossary section of their journal. • Allow partners 4 to 5 minutes to determine the meaning of their words. Circulate to offer support and redirect as needed. • Refocus students whole group. Tell them that they will now use the **Give One, Get One protocol** to share some of the words they worked on. Tell them that as they share, they should write the words, what they mean, and visuals in the Glossary section of their journals. • Begin: Have partners locate another pair and give one of their words and definitions as well as receive one. • Ask students to return to their seats. Call on students to share aloud their words and what they think they mean in context. Write the meaning next to the words posted for students.	• Consider pre-highlighting vocabulary for students who may have difficulty finding it in the text. • Consider assigning students who struggle with language words whose meanings are more easily found in context. • Students who struggle with multiple tasks at the same time may not be able to circulate during the Give One, Get One protocol and write a word and its meaning. Consider allowing their partner to write for them or give them extra time later in the day to go back to the vocabulary and write it in their glossaries.

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Work Time (continued)	Meeting Students' Needs
• Academic Words: – *interior*: inside part – *upward*: move up; go higher – *results*: outcome; consequence – *energy*: power, force • Scientific Words: – *plate*: a piece of the earth's crust made of masses of rock – *fault*: where the plates join – *pressure*: a force against another force – *seismic waves*: shock waves that come from the center of an earthquake – *radiate*: energy that spreads out in the form of waves • Ask students to look back at their Earthquake Concepts note-catchers and revise details based on their new understanding after having reviewed key vocabulary. • If time permits, remind students to add these words to their glossaries, or they may do so for homework. • Collect the annotated "Earthquake" articles and Earthquake Concepts note-catchers to review as an assessment for learning.	

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Closing and Assessment	Meeting Students' Needs

A. Debrief: What Have We Learned about Earthquakes? (5 minutes)
• Ask students to think about and share with a partner:
  * "What did you learn about earthquakes today?
  * "What questions do you now have about earthquakes?"
• Call on a few partners to share their discussions with the whole class. Add their ideas and questions to the **Earthquakes anchor chart**. Prompt students to add these new ideas to their anchor chart in their journal.
• Have the class silently skim the list to see if the new information added today answers any of the questions listed on the chart. If there are some questions answered, cross them off the anchor chart. Invite students to do the same on their own anchor chart.
	• Students who struggle with language would benefit from sentence stems such as: "I learned _____ about earthquakes today," and "One question I have about earthquakes now is ..."

B. Review Learning Targets (2 minutes) • Review the learning targets using the **Fist-to-Five protocol**. Read each learning target aloud and pause after each one to ask students to show a fist if they are still struggling with the learning target, five fingers if they have mastered the learning target, or any number of fingers in between to indicate their level of understanding of the learning target. Note any students showing a fist, one, or two fingers. Check in with those students individually to find out what they are struggling with. • Distribute five **evidence flags** to students for homework.	

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Homework	Meeting Students' Needs
• Reread the "Earthquake" article aloud to someone at home. As you read, think about the causes and effects of an earthquake. • Read your independent reading book. Be sure to read for evidence that can be added to the What Do We Know about Natural Disasters? anchor chart. Mark the evidence in your book using the evidence flags. • Add vocabulary words to your scientific and academic word glossaries. Don't forget the academic words from the learning targets (relationship, concepts, context). *Note: Review the annotated "Earthquake" articles and Earthquake Concepts note-catchers. Be prepared to return them to students by Lesson 4. Note any students who were not able to write the gist statements in the margins or list details about concepts appropriate for each column in the note-catcher. Plan to check in and review the reading with those students independently or in small groups.*	• Consider requiring students who struggle with independent reading to flag only three pieces of evidence to add to the class anchor chart. • Provide an audio recording of students' independent reading book for those students who struggle reading independently. • Allow students whose first language is something other than English the opportunity to read an independent book in their L1 language. • Prioritize the vocabulary words for those students who struggle with complex text (*relationship, concepts, context, continually, gradually*—all academic words).

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Grade 5: Module 4: Unit 1: Lesson 2
Supporting Materials

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"Earthquake"

Earth's crust remains in constant motion. Slowly but powerfully, its pieces rub against each other and collide. These collisions produce earthquakes. So does the movement of melted rock pushing up to Earth's surface.

Thousands of earthquakes occur on our planet each year. The largest cause deadly damage. They crumple buildings and bridges. They set off massive landslides. Some also spark devastating waves called tsunamis.

Throughout history, people have known the terror of great earthquakes. In Japan, legend blamed them on the movement of a giant underground catfish. The ancient Chinese thought that they were caused by a huge tortoise. About 2,300 years ago the Greek philosopher Aristotle said that underground winds shook Earth.

Causes of Earthquakes

Seismologists, scientists who study the motion of Earth, now know that quakes stem from forces deep inside our planet. There, heated rocky material is flexible. It moves slowly and steadily. Near Earth's surface the rocky material cools. The crust of Earth is formed of plates made of this material. Plate tectonics is the study of how these giant fragments move. These plates are brittle and cannot move easily. The slow movement of material deep in the interior builds up. It pushes on the brittle rocks near the surface.

Earth's plates move only a few inches every year. No one feels this movement except where the plates rub together or stretch apart. The slow movements create large pressures. This causes huge areas of rock to break and slip. During this violent fracture, some rock dives into Earth's interior. Other rock thrusts upward. This results in an earthquake. Often a break in Earth's surface occurs at a fault. A fault is a break where two blocks of rock have moved past each other previously.

Seismic Waves

The movement of Earth releases a huge amount of energy. Some of it takes the form of shock waves called seismic waves. These shocks radiate out from the center of the quake. They can cause violent shaking. There are two main types of seismic waves: surface waves and body waves.

Surface waves travel along the surface of the ground. In large earthquakes, they can cause people to feel a swaying or rolling motion.

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Body waves move deep underground. They are faster than surface waves. Compression waves are the fastest type of body wave. They are also known as P waves. Shear waves, or S waves, are the slower type of body wave.

Measuring Earthquakes

Scientists use seismometers to measure the distance the ground moves during an earthquake. This tells them how large the seismic waves are. There are thousands of seismometers in use all over the world.

Seismometers create records called seismograms. When an earthquake strikes, scientists read the seismograms to learn about the earthquake. These records show how powerful an earthquake is. By looking at several seismograms, scientists can also figure out the source of the earthquake. This source is called the epicenter. Directly below it is the hypocenter, the place where the rock actually breaks, causing an earthquake.

Size and Strength of an Earthquake

Earthquakes are measured in intensity, magnitude, and seismic moment. Intensity is how strong the shaking of an earthquake is. It is measured on the Modified Mercalli Intensity Scale. The scale uses 12 roman numerals. An intensity of I is the weakest; XII is the strongest. Measurements taken after an earthquake are used to create intensity maps.

The best-known gauge of earthquake magnitude is the Richter scale. It was invented by Charles Richter (1900–85) in 1935. The Richter scale starts at 0. Each whole-number increase represents a tenfold increase in earthquake size. That means that a 3.0 earthquake would be 10 times more powerful than one that measures 2.0. Today, scientists use many other scales in addition to the Richter scale.

Seismic moment measures the physical conditions at the earthquake source. The seismic moment is determined using three factors. The first is the fault slip. This is how far the rock slides along a fault surface after it breaks. The second factor is the area of the fault surface that is actually broken by the earthquake. And the third factor is the measurement of how rigid the rocks are near the broken fault. The seismic moment is found by multiplying these three numbers. It tells scientists an important combination of information about an earthquake's source.

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"Earthquake"

How Often Do Earthquakes Occur?

Earthquakes occur thousands of times each year. But most pass unnoticed. Small earthquakes happen much more often than large ones. For each increase of one magnitude, there are about 10 times fewer earthquakes. Every year, about 10,000 earthquakes of magnitude 4 or greater strike. But there are only about 1,000 earthquakes of magnitude 5 or greater.

Predicting Earthquakes

Accurate and timely earthquake predictions could save thousands of lives each year. Unfortunately, precise predictions remain difficult to impossible. Still, many experts are learning how changes in Earth's crust may provide warnings. These warning signs include underground movements and changes in water levels.

By studying such precursors and other predictors, scientists hope to help communities prepare for quakes. For instance, engineers have learned how to build quake-resistant buildings and bridges. Their designs improve every year with stronger and more flexible designs.

We may never be able to control earthquakes. But we can learn to live with them.

"Earthquake." The New Book of Knowledge. Grolier Online, 2013. Web. 15 Oct. 2013.

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Earthquakes Concepts
Note-Catcher

Earthquake Concepts:					
What happens before an earthquake?	What causes an earthquake?	What happens during an earthquake Chain of Events			What happens after an earthquake?
	Event/cause	Effect (what happen next) This, them, causes...	Effect (what happens next) This, then, causes...	Effect (What happen last)	

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Earthquakes Concepts

Note-catcher For Teacher Reference

Earthquake Concepts:					
What happens before an earthquake?	What causes an earthquake?	What happens during an earthquake Chain of Events			What happens after an earthquake?
	Event/cause	Effect (what happen next) This, them, causes...	Effect (what happens next) This, then, causes...	Effect (What happen last)	
The slow movement of material (plates) inside the Earth builds up and pushes brittle rocks to the surface.	**The slow movement of the plates creates pressure.**	**Pressure causes rocks to break and slip into the Earth's interior or to thrust upward.**	**An earthquake results (usually near a fault.)**	**A lot of energy is released and some of it forms shock waves called seismic waves.**	**Shocks radiate from the center of the earthquake and cause violent shaking.** **People sometimes feel a swaying or rolling motion.**

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