DAY 33

Rock Classification

This lesson covers the last part of section 2.1 (pages 33-34).

Big Ideas

- Rocks can be classified by composition, which is the minerals and other materials that make up a rock.
- Rocks can also be classified by texture, which is the size, shape, and arrangement of the grains that make up a rock.

Materials

Teacher:

1. visualization exercises – day33.ppt

Students:

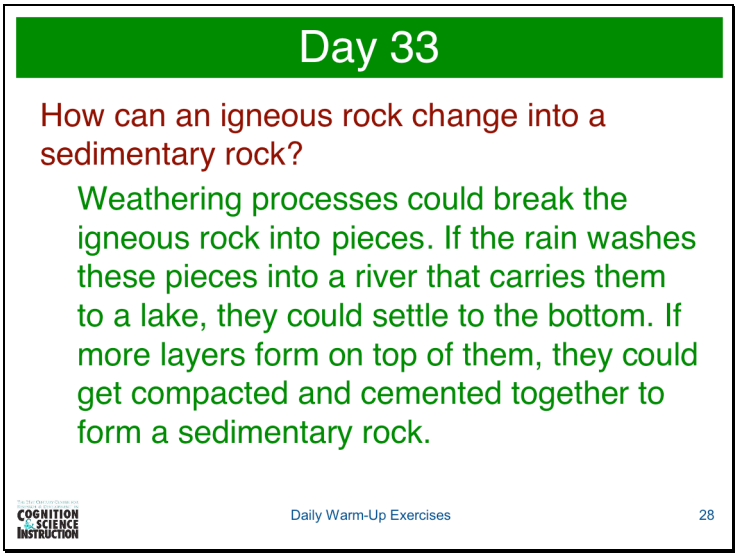
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 2.1c – Color, Labels & Captions
30 minutes – chapter 2.1, part 5

Day 33 – Rock Classification

Warm-Up Activity



What's it called when water picks up loose bits of rock?
erosion

What's it called when water carries bits of rock to another place?
transport

What's it called when the water slows down and the loose bits settle?
deposition or sedimentation

Day 33 – Rock Classification

Visualization Exercise 2.1c – Color, Labels & Captions

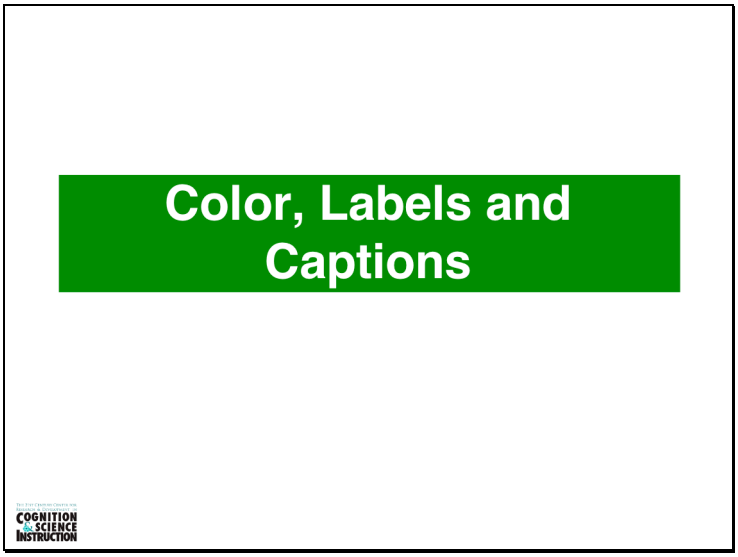


Image Comprehension Focus: Colors, Labels and Captions

Goal: 1) Reinforce students' understanding of the use of color in diagrams, 2) Re-emphasize labels and captions as critical parts of a diagram

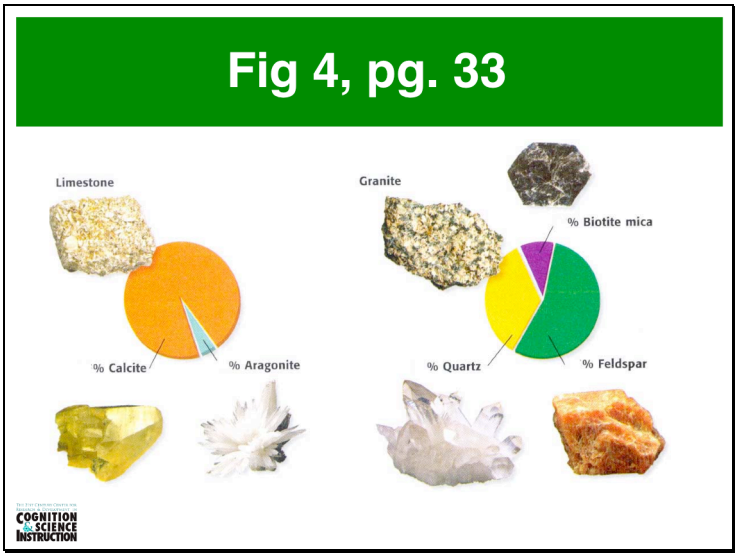
Type of Activity: Teacher-Guided Student Activity

Overview: This activity is designed to show students another way in which color can be useful at illustrating information in a diagram. This activity will also be used to re-emphasize the point that it is important to never skip labels or captions when looking at diagrams as they can contain crucial information that otherwise could be missed.

(Continue to the next slide)

Day 33 – Rock Classification

Visualization Exercise 2.1c – Color, Labels & Captions (cont.)



Procedure: The teacher projects the altered image (shown above) of Figure 4 from page 33 and asks students the following questions. [Please note that questions may be difficult to answer without the caption or other information that might be missing.]

What is the relationship between limestone and the circle on the left? What is the relationship between granite and the circle on the right? [The pie chart on the left shows the composition of limestone, whereas the pie chart on the right shows the composition of granite]

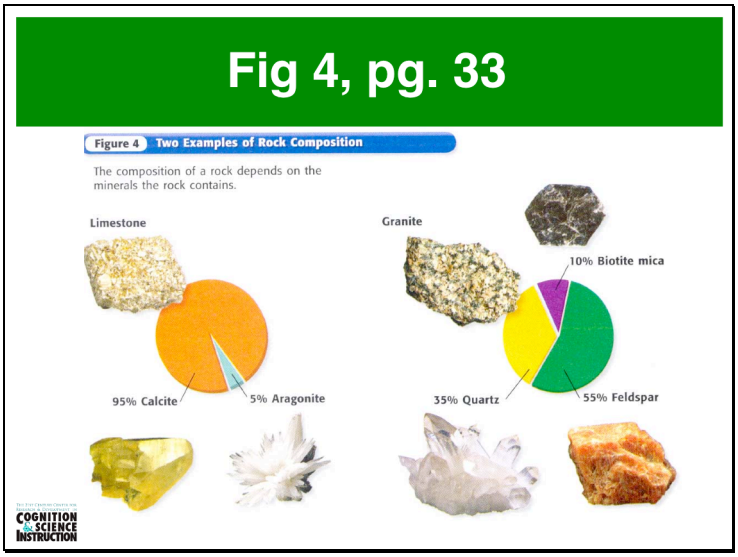
95% of limestone is _____ ; 5% of limestone is _____. [calcite; aragonite]

The composition of granite is: ___% biotite mica, ___% feldspar, and ___% quartz. [10, 55, 35].

(Continue to the next slide)

Day 33 – Rock Classification

Visualization Exercise 2.1c – Color, Labels & Captions (cont.)



The teacher has students turn to Figure 4 on page 33 of their textbooks. The teacher reviews the questions and answers from the previous slide, being sure to make the following points:

relationship between rocks and circles:

Here, the point to be made is that it would be difficult to get the answer without using the caption and/or the title and that these things should never be skipped when looking at diagrams as they often contain information that is key in understanding the image.

composition of limestone:

The teacher should point out that the author has decided to use different colors in order to distinguish the different minerals. that is orange for calcite, blue for aragonite, etc., and that using different colors makes the composition easier to see.

composition of granite:

Here, while students may not give answers that are exactly correct, they should be able to recognize that the percentage of feldspar is higher than that of quartz (and more than 50%) and that biotite makes up the smallest percentage. In addition, students' responses should add up to 100%.

DAY 34

Comprehensive Review

This lesson provides an opportunity for students to prepare for quiz 7, which is a full-period quiz that will cover everything they've learned so far (section 5 of chapter 3 and all of chapters 1 and 2).

Big Ideas

- See list of big ideas, Days 1-33.

Materials

Teacher:

1. vocabulary list – RE word list.doc
2. list of big ideas – RE big ideas.pdf

Students:

none

Activities & Allotted Time (40 minutes total)

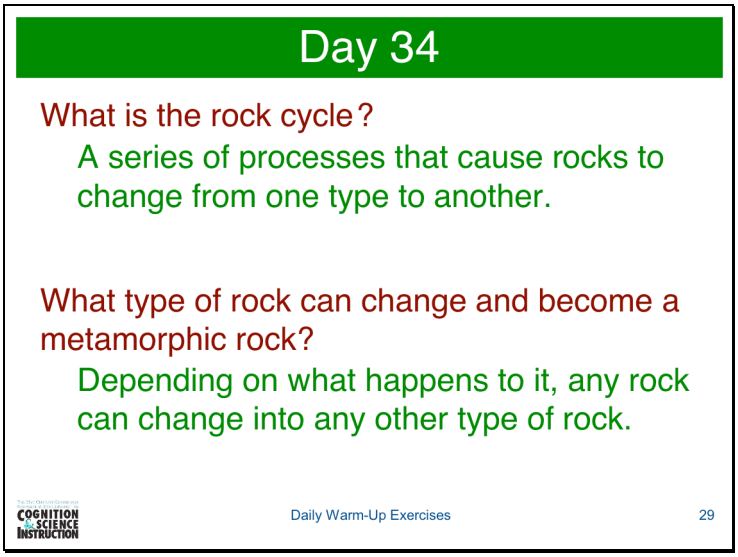
5 minutes – warm-up activity
35 minutes – review section 3.5 and chapters 1 & 2

Review Section 3.5 and Chapters 1 & 2

After reviewing the meanings of vocabulary words and the big ideas from days 1-33, use the Chapter 2 review on pages 52 and 53 and the section review questions on page 35 to identify areas that need additional attention.

Day 34 – Comprehensive Review

Warm-Up Activity



What changes can happen to a rock because of heat and/or pressure?

The minerals in the rock can combine and form new minerals..
The rock could fold, bend or twist into a different shape.
Its grains could line up with each other.
It could melt, or the increased pressure could prevent it from melting.

If it melted, what would it become?

magma, then igneous rock if it cools and hardens

DAY 35

Quiz 7

Quiz 7 is a comprehensive assessment that covers section 3.5 and chapters 1 and 2.

Big Ideas
See list of big ideas, Days 1-33.

Materials

Teacher:
none

Students:
1. Quiz 7

Activities & Allotted Time (40 minutes total)

40 minutes – quiz

Day 35 – Quiz 7

Quiz 7 – Page 1

1. The color of a mineral in powdered form is called _____.
   a. luster
   (b) streak
   c. pigment

2. Pumice is an igneous rock that has very low density. What does this mean?
   a. It does not have much ability to resist scratching.
   b. Its surface does not reflect light very well.
   (c) It is not very heavy for its size.

3. What is the main difference between intrusive and extrusive igneous rock?
   (a) where they form
   b. chemical composition
   c. mineral composition

4. Clastic sedimentary rocks are formed from _____.
   (a) fragments of rocks and minerals
   b. solutions of dissolved minerals
   c. the remains of plants and animals

5. What is the process in which sedimentary rocks are arranged in layers?
   a. strata
   (b) stratification
   c. foliation

6. If there were no weathering or erosion, which type of rock would be LEAST common?
   a. igneous
   b. metamorphic
   (c) sedimentary

Inside the Restless Earth

Day 35 – Quiz 7

Quiz 7 – Page 2

7. Which statement is true?
   - (a) Sedimentary rocks form on or near Earth's surface.
   - b. Igneous rocks only form below Earth's surface.
   - c. Metamorphic rocks form on, near, or below Earth's surface.

8. When a rock is changing because of pressure, its grains _____.
   - a. become smaller and less dense
   - (b) tend to line up with each other
   - c. gradually change to volcanic glass

9. Metamorphic rocks form from _____.
   - a. molten rock
   - b. sediments
   - (c) existing rocks

10. What rock-forming process happens when a rock is heated by nearby lava?
    - (a) contact metamorphism
    - b. regional metamorphism
    - c. clastic metamorphism

11. Which process moves rock fragments from one place to another?
    - a. weathering
    - b. erosion
    - (c) transport
    - d. deposition

12. Which process allows loose bits of rock to settle?
    - a. weathering
    - b. erosion
    - c. transport
    - (d) deposition

Inside the Restless Earth

Day 35 – Quiz 7

Quiz 7 – Page 3

13. What type(s) of rock can weather, erode, move, and settle to form sediments?
    a. sedimentary
    b. metamorphic and igneous
    (c.) igneous, metamorphic, and sedimentary

14. What type(s) of rock can change because of extreme heat and pressure?
    a. metamorphic
    b. igneous and sedimentary
    (c.) igneous, metamorphic, and sedimentary

15. Which process involves movements inside the Earth?
    a. erosion
    b. deposition
    (c.) uplift

16. How do geologists classify rocks?

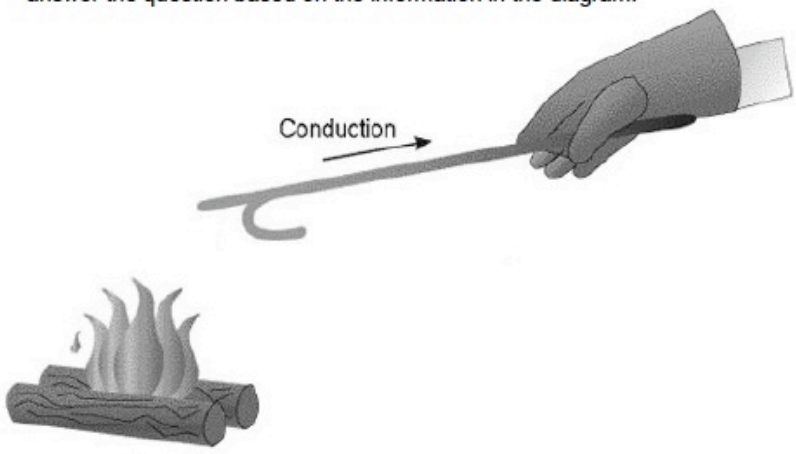
Rocks can be classified by composition, which is the minerals and other materials that make up a rock. They can also be classified by texture, which is the size, shape, and arrangement of the grains that make up a rock.

Inside the Restless Earth

Day 35 – Quiz 7

Quiz 7 – Page 4

17. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the diagram.



According to the above diagram, heat is being _____ the gloved hand.

a. convected toward
b. conducted toward
c. conducted away
d. radiated toward

Inside the Restless Earth

End-of-Section Survey – 2.4 & 2.1

activity	did as described	modified	didn't do	comments
Day 23 Warm-Up (page 168)				
cc 2.4–Compare Rock Formation, part 2a (pages 167-176)				
Day 24 Warm-Up (page 178)				
cc 2.4–Compare Rock Formation, part 2b (pages 177-192)				
Quiz 5 (pages 194-195)				
Reteach/Review Chp. 2.2 & 2.3 (page 193)				
Day 26 Warm-Up (page 197)				
vis 2.4a – Cut-Away (pages 198-199)				
chp 2.4, part 1 (page 196 & Holt, pages 44-45)				
Day 27 Warm-Up (page 201)				
vis 2.4b – Symbols, Labels & Captions (pages 202-205)				
vis 2.4c – Labels & Captions (pages 206-209)				
vis 2.4d – Arrows & Captions (pages 210-212)				
chp 2.4, parts 2 & 3a (page 200 & Holt, pages 46-47)				
Day 28 Warm-Up (page 214)				
chp 2.4, parts 3b & 4 (page 213 & Holt, pages 48-49)				

End-of-Section Survey – 2.4 & 2.1

activity	did as described	modified	didn't do	comments
Day 29 Warm-Up (page 216)				
modeling lab–*Metamorphic Mash* (Holt, page 185)				
Quiz 6 (pages 218-219)				
reteach/review chapter 2.4 (page 217)				
Day 31 Warm-Up (page 221)				
chp 2.1, parts 1 & 2 (page 220 & Holt, pages 28-29)				
Day 32 Warm-Up (page 223)				
vis 2.1a – Labels & Color (pages 224-227)				
vis 2.1b – Arrows, Labels & Color (pages 228-232)				
chp 2.1, parts 3 & 4 (page 222-223 & Holt, pages 30-32)				
Day 33 Warm-Up (page 234)				
vis 2.1c – Color, Labels & Captions (pages 235-237)				
chp 2.1, part 5 (Holt, pages 33-34)				
Day 34 Warm-Up (page 239)				
Comprehensive Review (page 238)				
Quiz 7 (pages 241-244)				

DAY 36

Composition of the Earth

This lesson covers part 1 of section 4.1 (pages 96-97).

Big Ideas

- Based on composition, the Earth has three layers – crust, mantle, and core.
- The core is the densest layer, and the crust is least dense.

Materials

Teacher:

1. visualization exercises – day36.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 4.1a – Arrows
5 minutes – visualization 4.1b – Cut-Away & Color
25 minutes – chapter 4.1, part 1

Chapter 4.1, part 1

Density is an important concept in today's lesson, so today's warm-up is designed to help students remember what they learned about density from *Introduction to Matter*. Before going over part 1 with your students, ask them to describe what they learned about liquid layers. They should recall that lighter (less dense) liquids float on top of heavier liquids. Have them read the first paragraph of part 1 and explain what it says. They should recognize that, although the Earth is mostly solid, the layers the book is talking about are similar to the liquid layers. The core is densest, the crust is least dense, and the mantle is in the middle.

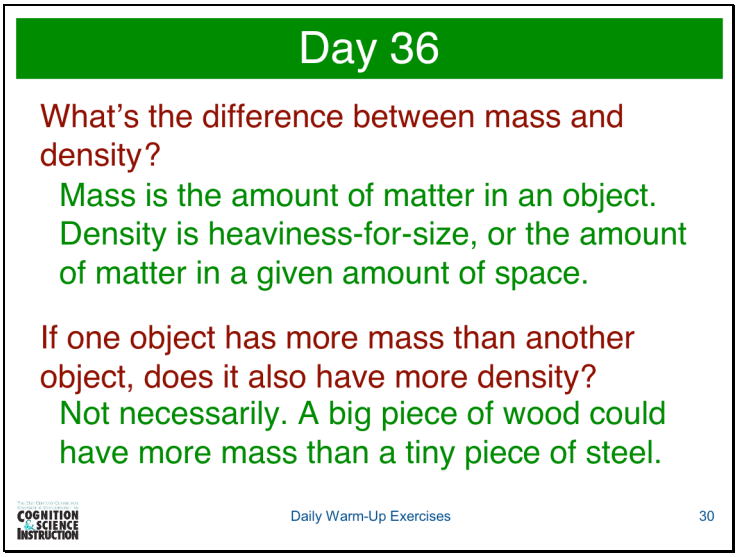
Density also plays a role in understanding the difference between oceanic and continental crust, which will be important later in the chapter. Figure 1 points

Day 36 – Composition of the Earth

Chapter 4.1, part 1

out that, although oceanic crust is thinner than continental crust, it is actually denser. Ask your students to explain why. How could such a thin crust be so dense? They should conclude that oceanic crust must be made of heavier minerals than continental crust.

Warm-Up Activity



Density is an important concept in today's lesson. This warm-up will help students remember what they learned about density from *Introduction to Matter*.

Encourage students to come up with additional examples of materials with high and low densities.

Emphasize that mass is a property of an object, and density is a property of the material an object is made of.

Day 36 – Composition of the Earth

Visualization Exercise 4.1a – Arrows

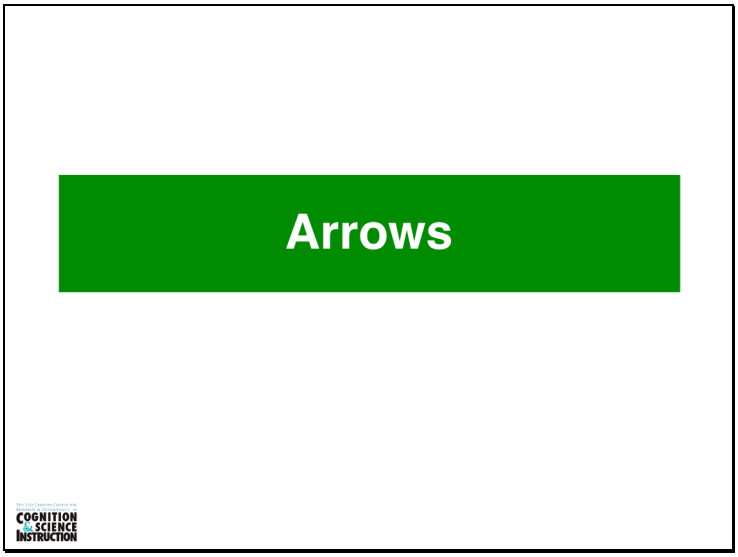


Image Comprehension Focus: Arrows

Goal: To briefly review one way that arrows can be used in a diagram.

Type of Activity: Teacher Guided Student Activity

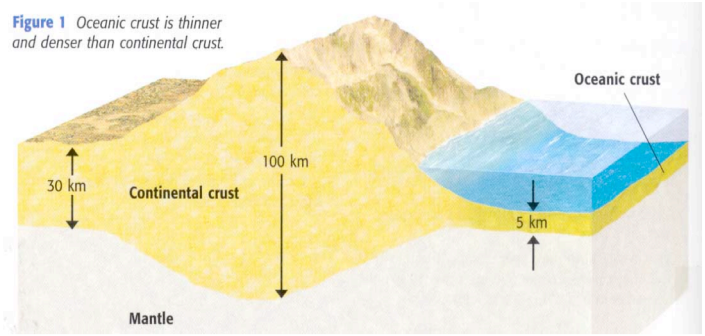
Overview: This activity is designed to briefly illustrate one way that arrows can be used to show information in diagrams.

(Continue to the next slide)

Day 36 – Composition of the Earth

Visualization Exercise 4.1a – Arrows (cont.)

Fig 1, pg. 96



Procedure: The teacher has students look at Figure 1 on page 96 (shown above if the teacher wants to project it). The teacher can then ask the students, what role do the arrows play in the diagram? [The arrows are representing distance.]

The teacher then points out to students that while the arrow to the left and the arrow in the center point away from the center, the arrow on the right-hand side points towards the center. The teacher can ask the students, why has the author chosen a different direction for the arrows on the right-hand side of the diagram? [The author is using a different direction for the arrows here because there is not enough room in the center to have the arrows pointing out from the center of the 5 km. This could be a source of confusion if the arrows were interpreted as showing the effects of a force. Students might think that the arrows show places where the crust is "growing" or "being squashed."]

The teacher then emphasizes again that it is important to pay attention to the role of each arrow in each diagram as arrows can take on different roles depending on the information in the diagram. (End of Activity)

Day 36 – Composition of the Earth

Visualization Exercise 4.1b – Cut-Away & Color

Image Comprehension Focus: Cut-Away and Color

Goal: To briefly review the concept of cut-away and one way in which color can be used in diagrams.

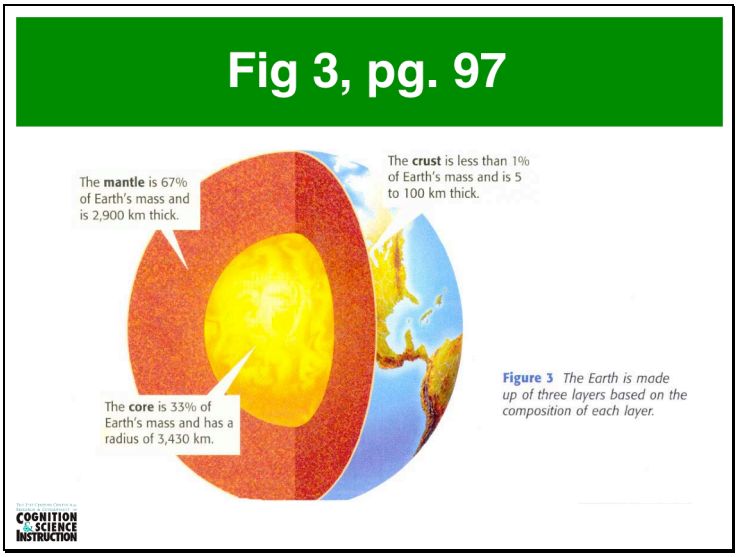
Type of Activity: Teacher-Guided Student Activity

Overview: This exercise is intended as a brief review, designed to reinforce the concepts of cut-away and color.

(Continue to the next slide)

Day 36 – Composition of the Earth

Visualization Exercise 4.1b – Cut-Away & Color (cont.)



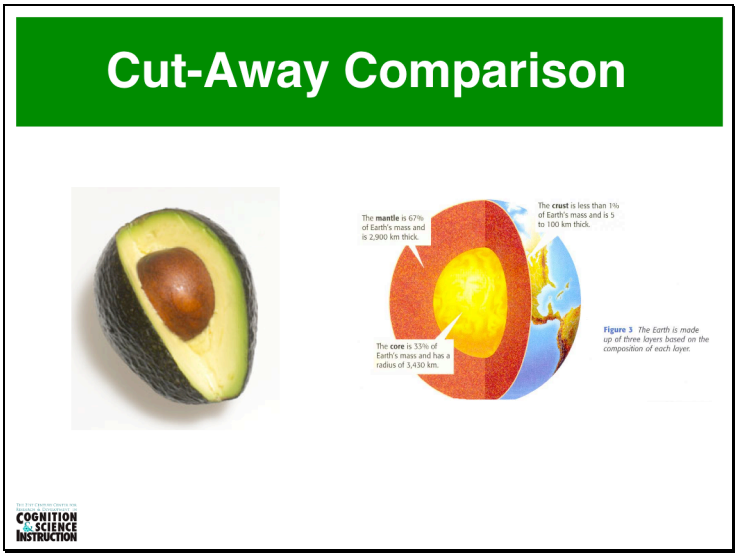
Procedure: The teacher has the students look at Figure 3 on page 97 (shown above if the teacher wants to project it).

The teacher asks students, what perspective is shown by this diagram and what is the author's goal in using such a perspective? [This perspective is a cut-away, the goal being to illustrate the layers of the Earth, with the core being at the center, surrounded by the mantle, which is then surrounded by the crust.]

(Continue to the next slide)

Day 36 – Composition of the Earth

Visualization Exercise 4.1b – Cut-Away & Color (cont.)

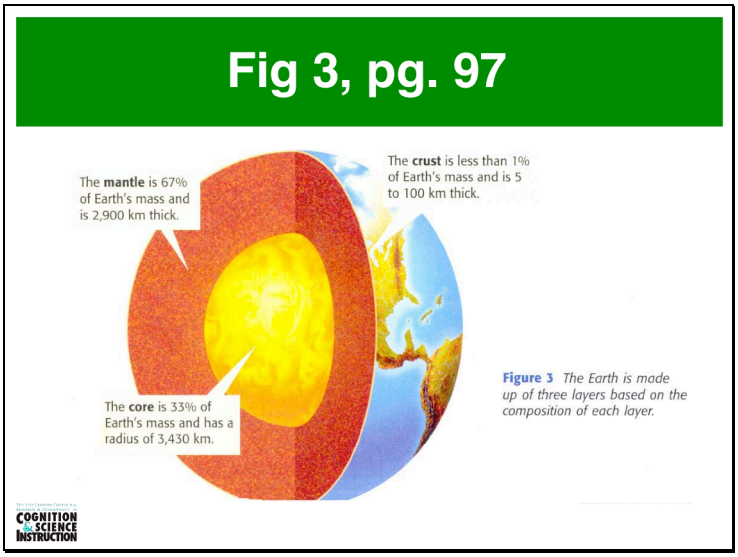


The teacher projects the above image of the avocado, next to Figure 3, asking students how the avocado is similar to the author's illustration of the earth. [The structure of the avocado is similar in the sense that the seed of the avocado is like the core, the part around the seed like the mantle, and the outside being like the crust. Also, the image shows what the planet would look if it had been cut in the same way as this avocado has been cut, revealing parts of the interior that would not ordinarily be visible.]

(Continue to the next slide)

Day 36 – Composition of the Earth

Visualization Exercise 4.1b – Cut-Away & Color (cont.)



The teacher then asks students, besides the labels, what else distinguishes the three layers of the Earth? [While students may have different answers to this, this is an opportunity for the teacher to point out the author's choice of using different colors to represent the different layers. Additionally, the teacher may also want to mention that this color scheme (an orange/yellow core and a red mantle) will be seen again with other diagrams in the text and that it can be important to pay attention to these schemes in order to quickly reference certain pieces of information in diagrams.

(End of Activity)

DAY 37

Physical Structure of the Earth

This lesson covers parts 2 and 4 of section 4.1 (pages 98-99 and 102).

Big Idea

- Based on physical properties, the Earth has five layers – lithosphere, asthenosphere, mesosphere, outer core, and inner core.

Materials

Teacher:

1. visualization exercises – day37.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 4.1c – Zoom & Arrows
30 minutes – chapter 4.1, parts 2 & 4

Chapter 4.1, parts 2 & 4

Some students may have trouble understanding why the three layers they learned about yesterday are being given different names today. You might explain that geologists have determined that the outer part of the core is liquid and the inner part is solid, so they often have to specify which part of the core they're talking about. Similarly, they determined that the crust and the outer edge of the mantle are rigid solids. They called that part of the Earth the lithosphere because *litho-* means rock. Below that, there's a section of the mantle that is called a soft or plastic solid because it bends like clay and flows very slowly. They called that part of the Earth the asthenosphere because *astheno-* means weak. Finally, they called the rest of the Earth – the part between the asthenosphere and the outer core – the mesosphere because *meso-* means middle. The book describes this layer as strong, but geologists now believe that the mesosphere must also be plastic.

Day 37 – Physical Structure of the Earth

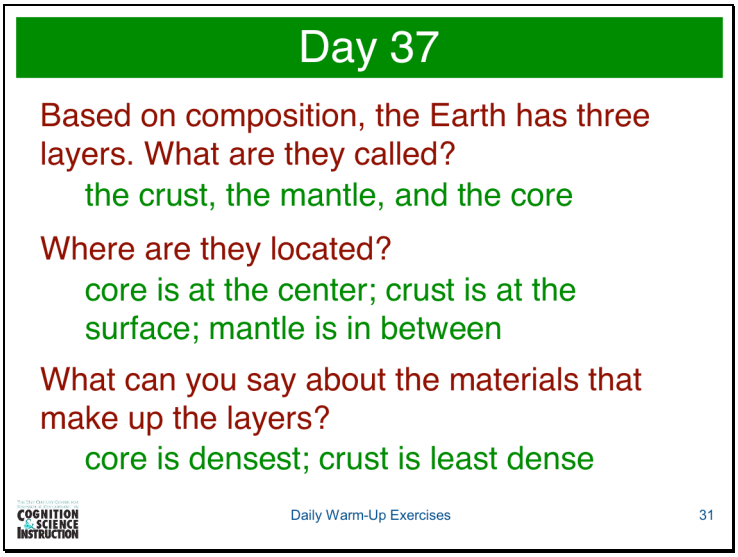
Chapter 4.1, parts 2 & 4
Challenge your students to explain why the inner core is solid. [Heat and pressure get more extreme the deeper you go. As pressure increases, melting point also increases. At the center of the Earth, even though it's very hot, the pressure is so extreme that the melting point is higher than the temperature.]

To begin part 4, ask your students the questions in the first paragraph. How do scientists know what it's like inside the Earth? Give them some time to generate and share ideas. They may recall that the textbook said rock from the mantle sometimes gets pushed to the surface, where it can be studied (page 97). Geologists have also learned about the mantle by studying magma that flows from active volcanoes on the ocean floor. When students finish sharing their ideas, tell them geologists have also studied seismic waves, which are the vibrations produced by earthquakes. The waves spread outward, like ripples when you drop a pebble in water.

Ask your students to think about the dot models of solids and liquids, then ask: Would waves travel faster through solids or liquids? [Waves travel faster through solids because the particles are closer together and collide more often.] By measuring how long it takes for seismic waves to pass through different parts of the Earth, geologists have been able to figure out which parts are solid, which are liquid, and which are sort of in-between.

Day 37 – Physical Structure of the Earth

Warm-Up Activity



What is density?
heaviness-for-size
the amount of matter in a given amount of space

Day 37 – Physical Structure of the Earth

Visualization Exercise 4.1c – Zoom & Arrows

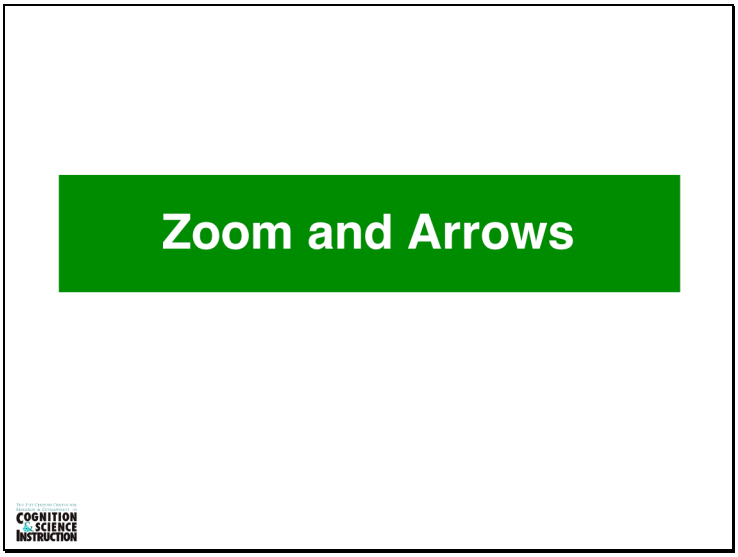


Image Comprehension Focus: Zoom and Arrows

Goal: 1) To reinforce students' understanding of the zoom convention, 2) Illustrate (again) one possible use of arrows in a diagram

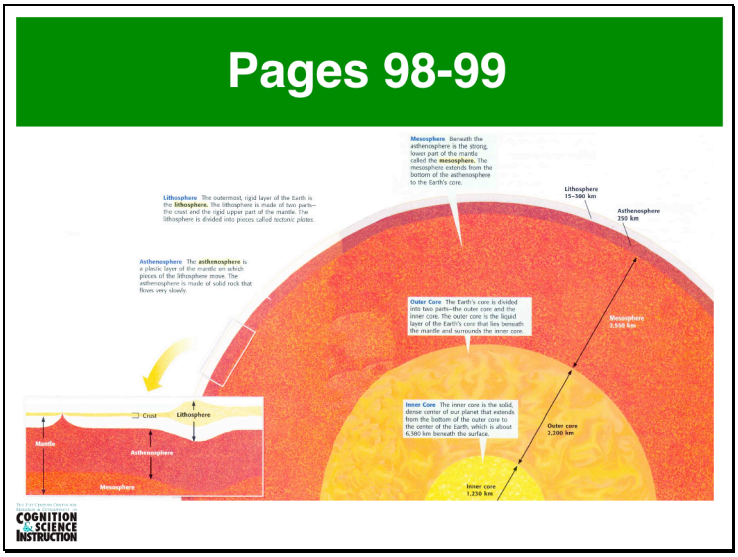
Type of Activity: Teacher-Guided Students Activity

Overview: This exercise is designed to illustrate the zoom convention in order to reinforce students' understanding of zoom as well as to show one way in which arrows can be used to convey information.

(Continue to the next slide)

Day 37 – Physical Structure of the Earth

Visualization Exercise 4.1c – Zoom & Arrows (cont.)



The teacher has students turn to pages 98-99 of their textbooks (shown above if the teacher wants to project it).

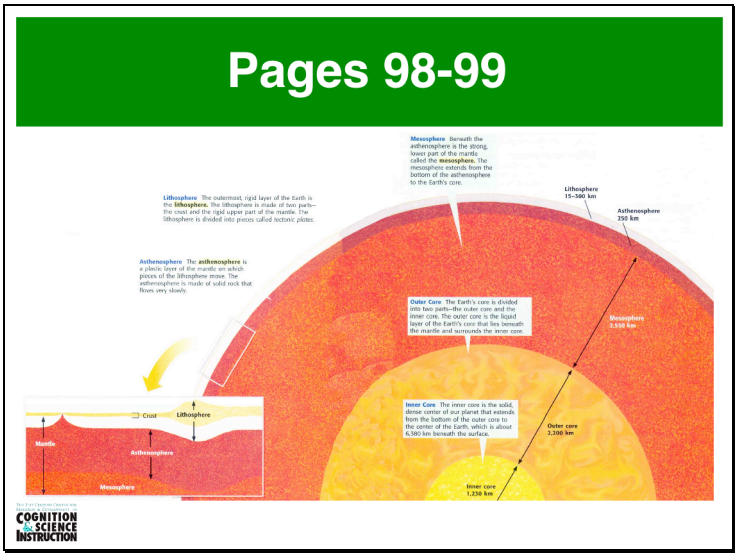
The teacher asks students: What convention is being shown by use of the smaller box and an arrow pointing to a larger box? [the zoom convention]

Why did the author choose to use this convention? [The zoom is being used in order to provide a more detailed view of the lithosphere and the asthenosphere. Without the zoom, it would be difficult to see that the lithosphere is made of two parts, the crust and the upper part of the mantle.]

(Continue to the next slide)

Day 37 – Physical Structure of the Earth

Visualization Exercise 4.1c – Zoom & Arrows (cont.)



After emphasizing the role of zoom, the teacher can then ask students to look at the black arrows labeled Mesosphere, Outer core and Inner Core.

The teacher then asks, what role do these arrows play? [These arrows are depicting the thickness of each layer in kilometers.]

The teacher can then point out how these arrows are similar to the arrows in the zoom box labeled Mantle, Asthenosphere and Lithosphere. They are also similar to the arrows they recently discussed from Figure 1 on page 96.

Additionally, the teacher can point out the use of the yellow arrow as part of the zoom, re-emphasizing the point that different arrows can point out different pieces of information in different ways depending on the diagram.

(End of Activity)

DAY 38

Tectonic Plates

This lesson covers part 3 of section 4.1 (pages 100-101).

Big Idea

- The lithosphere is the rigidly solid outer layer of the Earth that consists of the crust and the outer edge of the mantle.
- It is divided into pieces called tectonic plates.

Materials

Teacher:

1. visualization exercises – day38.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

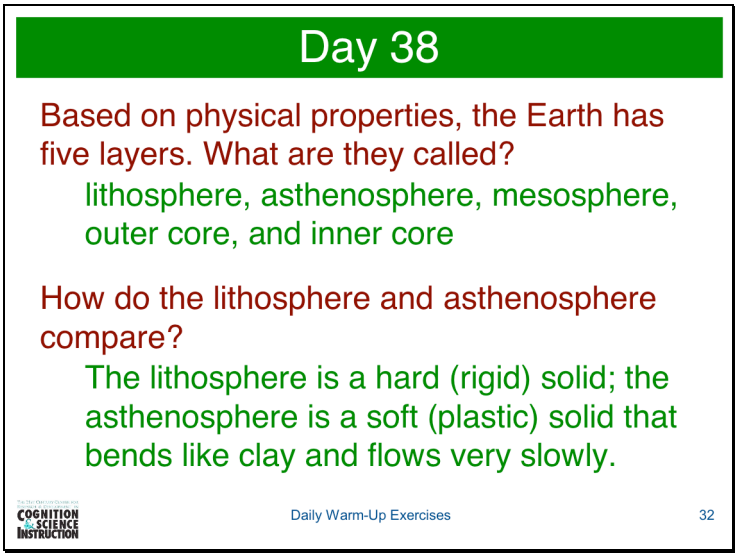
5 minutes – warm-up activity
5 minutes – visualization 4.1d – Color & Cut-Away
30 minutes – chapter 4.1, part 3

Chapter 4.1, part 3

Figure 4 on page 100 depicts the ten major tectonic plates that make up the lithosphere, and figure 5 shows what it might look like if you could lift one of the plates out of its position. Encourage students to examine both figures and describe what they see. In addition to comparing the sizes of different plates and noticing that some plates include both continental and oceanic crust, encourage them to examine the borders between plates and identify the types of crust that meet. For example, at the border between plates 1 and 4, oceanic crust meets oceanic crust. At the border between plates 4 and 5, oceanic crust meets continental crust. In section 3, when the book talks about collisions that involve different types of plate boundaries, encourage your students to refer back to these pages and connect the descriptions with the plates depicted in these figures.

Day 38 – Tectonic Plates

Warm-Up Activity



How do the outer core and inner core compare?
outer core is liquid; inner core is solid

What does *litho-* mean?
rock

What does *astheno-* mean?
weak

What does *meso-* mean?
middle

Day 38 – Tectonic Plates

Visualization Exercise 4.1d – Color & Cut-Away

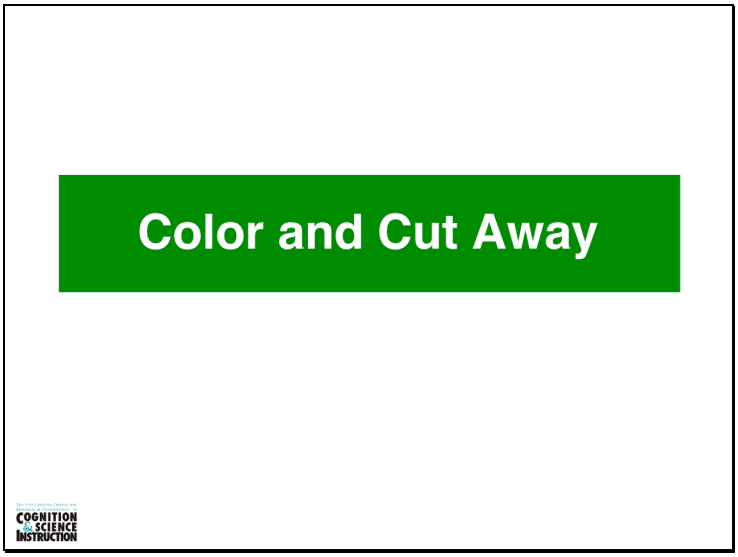


Image Comprehension Focus: Color and Cut Away

Goal: 1) Illustrate one role of color in a diagram, 2) Reinforce students' understanding of Cut Away

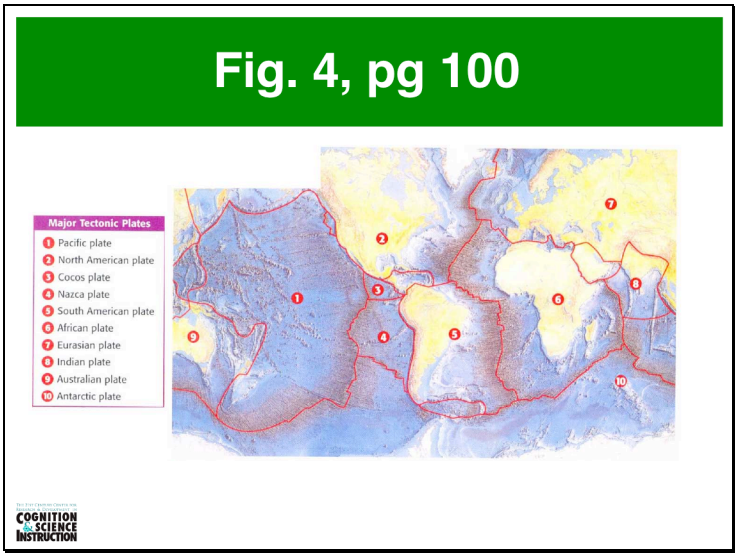
Type of Activity: Teacher Guided Student Activity

Overview: This exercise is designed to illustrate one way in which color can be used to show information in a diagram as well as one way that the cut away convention can be used to show information.

(Continue to the next slide)

Day 38 – Tectonic Plates

Visualization Exercise 4.1d – Color & Cut-Away (cont.)



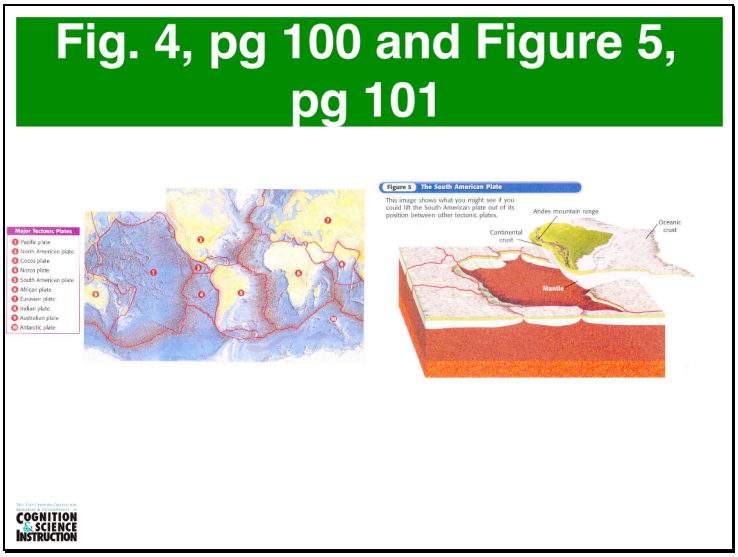
Procedure: The teacher has the students turn to Figure 4 on page 100 of their textbooks (shown above if the teacher wants to project it).

The teacher then asks students, what is the role of the red lines? [These lines show how the different tectonic plates fit together. Here the teacher should make a point to the students that these lines are not something that is actually seen by looking at the Earth and that the author is just using these lines as a way to more easily illustrate the boundaries of the tectonic plates.]

(Continue to the next slide)

Day 38 – Tectonic Plates

Visualization Exercise 4.1d – Color & Cut-Away (cont.)



The teacher has students look at both Figures 4 and 5 from pages 100 and 101 respectively and asks:

What is the connection between the two diagrams? [Figure 5 is an image of the South American plate that corresponds with plate number 5 from Figure 4.]

What perspective is shown in Figure 5 and what is that perspective trying to represent? [Figure 5 is a type of cut-away that is being used in order to illustrate a close-up view of the South American plate. This view allows you to see the three-dimensional shape of the plate that otherwise would be impossible to see without the cut-away. In particular, it emphasizes the different thicknesses of the continental and oceanic crust.]

(End of Activity)

DAY 39

Restless Continents

This lesson covers section 4.2 (pages 104-107).

Big Ideas

- Continental drift is the hypothesis that the continents once formed a single land mass, and they broke apart and drifted to their present locations.
- Sea-floor spreading is when new oceanic crust forms as tectonic plates move apart and magma rises and solidifies.

Materials

Teacher:

1. visualization exercises – day39.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

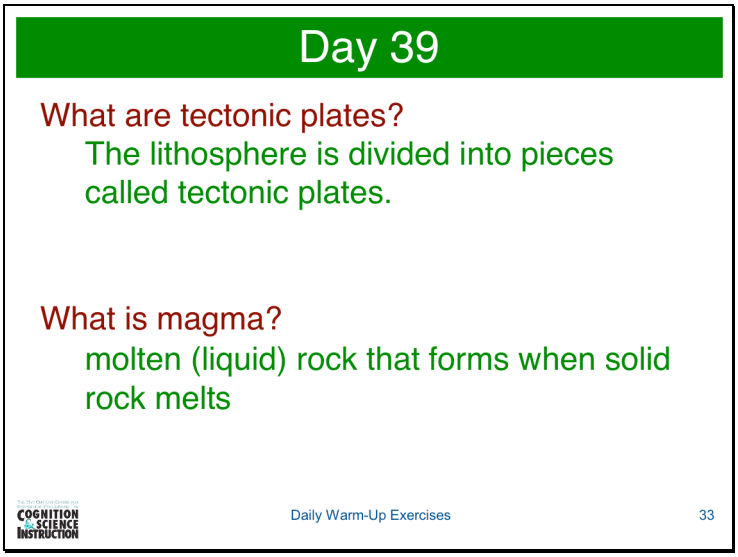
5 minutes – warm-up activity
5 minutes – visualization 4.2a – Captions
5 minutes – visualization 4.2b – Color
5 minutes – visualization 4.2c – Zoom & Arrows
20 minutes – chapter 4.2 – *Restless Continents*

Chapter 4.2

After discussing Wegener's continental drift hypothesis, tell your students that it was a good idea in its time because it explained why the continents appear to fit together like a puzzle and why similar fossils are found on different sides of the Atlantic. However, the continental drift hypothesis has since been replaced by the theory of plate tectonics, which students will learn about in section 3.

Day 39 – Restless Continents

Warm-Up Activity



What is the lithosphere?
the rigidly solid outer layer of the Earth that includes the crust and outer mantle

What type of rock forms when molten rock cools and hardens?
igneous

Day 39 – Restless Continents

Visualization Exercise 4.2a – Captions

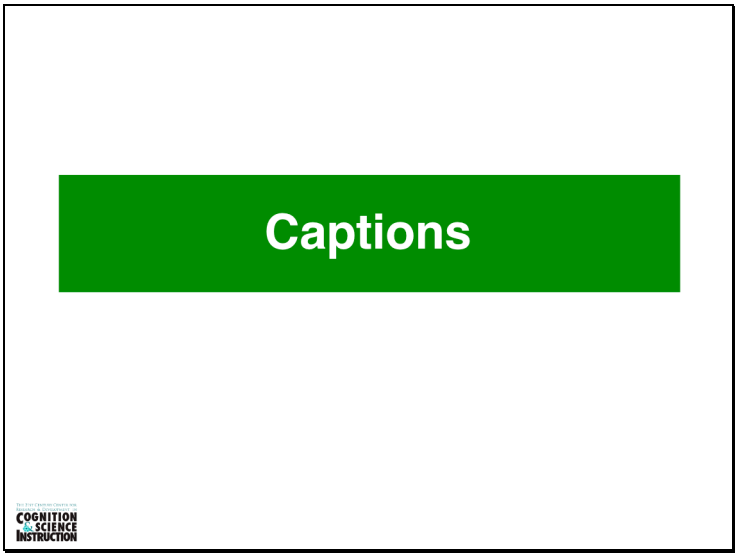


Image Comprehension Focus: Captions

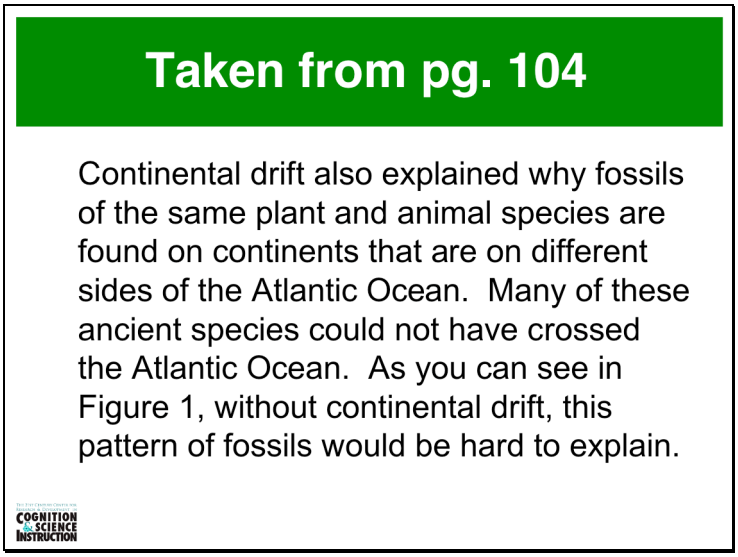
Goal: Re-emphasize the importance of captions

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to re-emphasize the importance of always reading the caption when looking at a diagram because it often contains important information that otherwise by not be known by only looking at the image.

(Continue to the next slide)

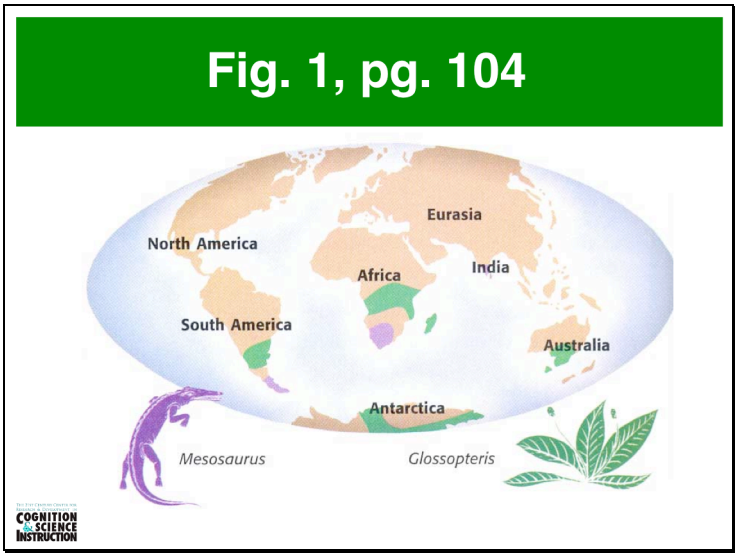
Visualization Exercise 4.2a – Captions (cont.)



Procedure: The teacher asks students to read the above paragraph from page 104.

(Continue to the next slide)

Visualization Exercise 4.2a – Captions (cont.)



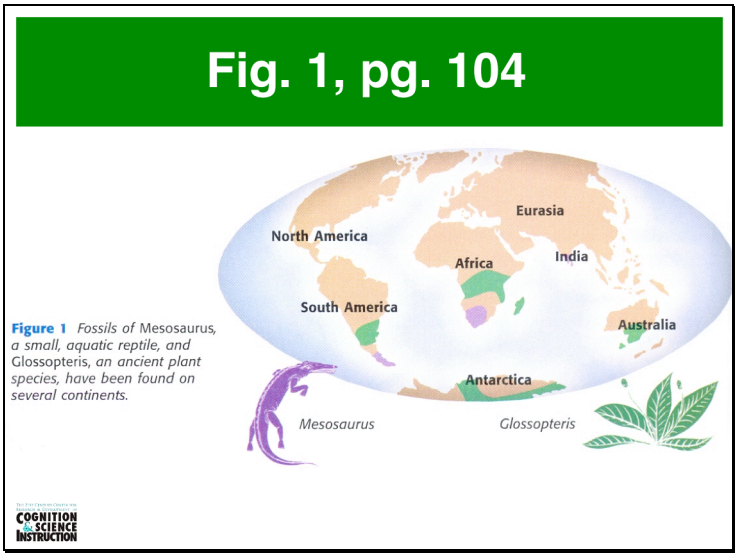
The teacher projects the above image of Figure 1 from pg. 104.

Then, either individually or in small groups, the teacher asks students to write a caption for the figure.

The teacher then has students share their captions.

(Continue to the next slide)

Visualization Exercise 4.2a – Captions (cont.)



The teacher then has students turn to Figure 1 on page 104 (shown above if the teacher wants to project it) and has students look at the original caption by the author.

The teacher can then lead a discussion on the similarities and differences between the students' own captions and that of the author, as well as what makes a good caption.

The teacher then re-emphasizes the importance of the caption and how it can sometimes be very difficult to tell what is happening in a diagram without reading the caption.

(End of Activity)

Day 39 – Restless Continents

Visualization Exercise 4.2b – Color

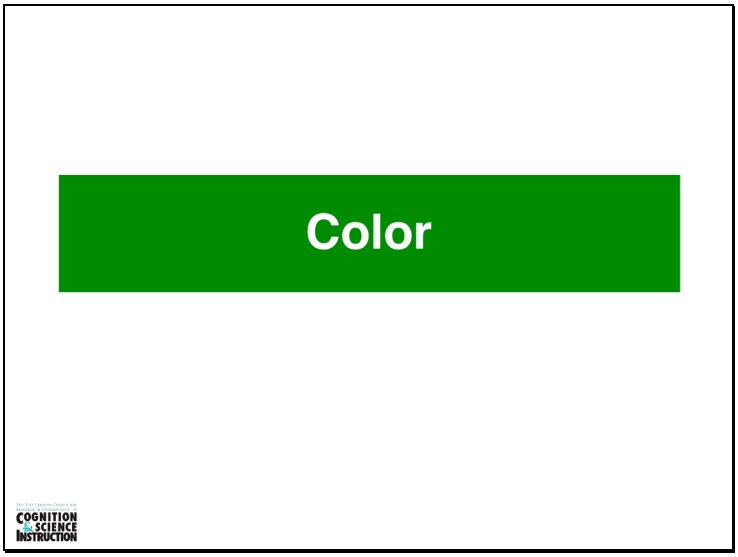


Image Comprehension Focus: Color

Goal: Reinforce students' understanding of one use of color in diagrams

Type of Activity: Teacher Guided Student Activity

Overview: This activity will reinforce students' understanding of one use of color in diagrams by illustrating one way in which color can be used to convey important information.

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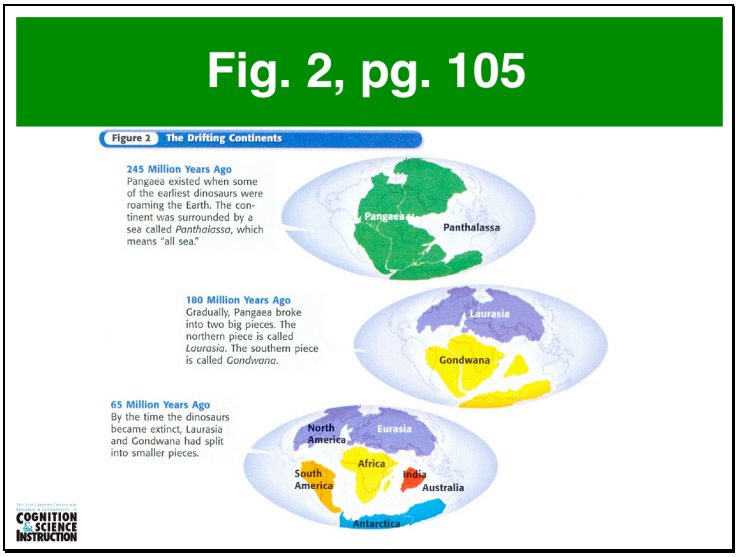
Visualization Exercise 4.2b – Color (cont.)



Procedure: The teacher has the students turn to Figure 2 on page 105 of their textbooks (shown above if the teacher wants to project it).

The teacher then asks the students, what is the role of the different colors in this diagram? [In this diagram, different colors are used to illustrate the idea of continental drift. Green is first used to show all of the continents being joined together. Next, purple and yellow are used to show the continent split into two pieces. Additional colors are then used to show additional splits.]

During this discussion, it is important for the teacher to point out that it is not necessarily the specific color used that is important, but rather the fact that different colors are being used in order to show different pieces of information.

(End of Activity)

Day 39 – Restless Continents

Visualization Exercise 4.2c – Zoom & Arrows

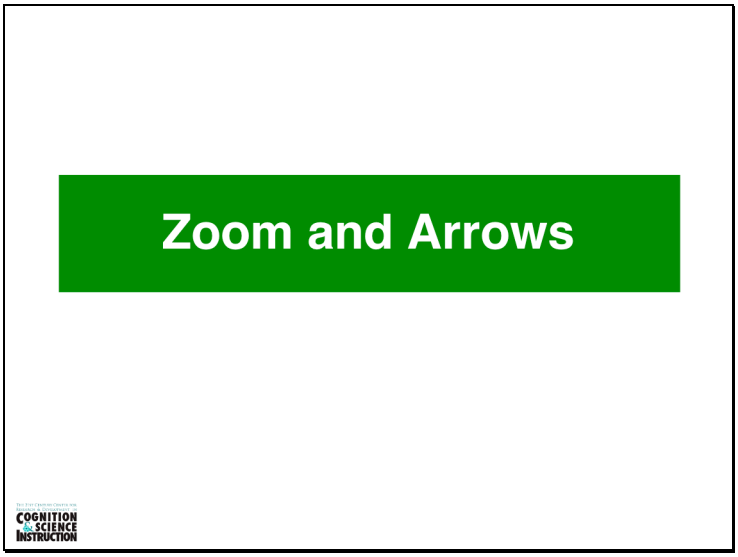


Image Comprehension Focus: Zoom and Arrows

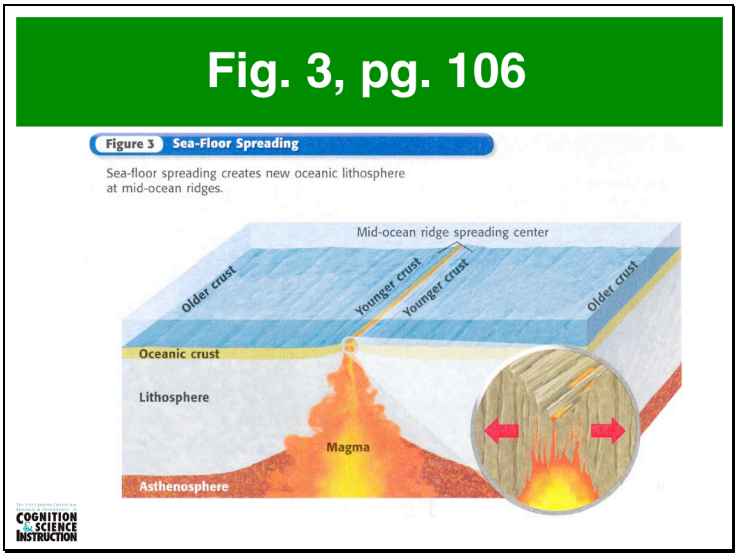
Goal: 1) To reinforce students' understanding of zoom, and 2) Illustrate one way that arrows can be used to show information

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to further students' understanding in the use of the zoom convention as well as to illustrate one way in which arrows can be used in diagrams.

(Continue to the next slide)

Visualization Exercise 4.2c – Zoom & Arrows (cont.)



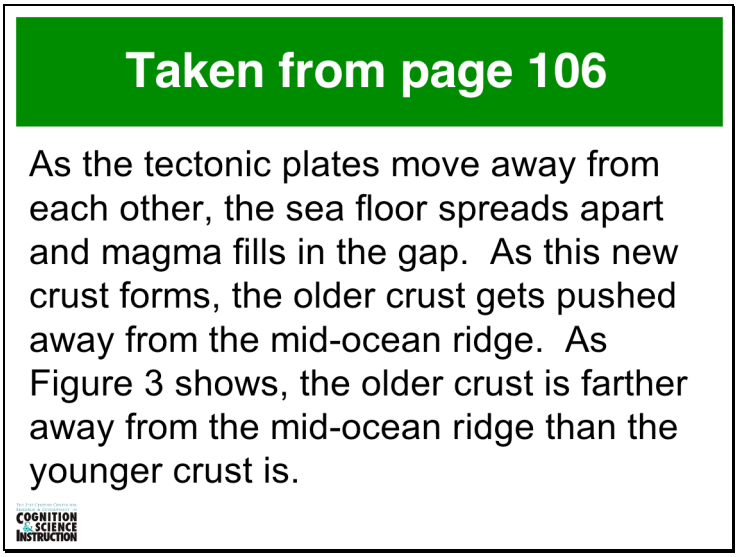
Procedure: The teacher has the students turn to Figure 3 on page 106 of their textbooks (shown above if the teacher wants to project it). The teacher then asks students, either individually or in small groups to answer the following questions:

- Where is an example of the zoom convention being used in this diagram? [The larger circle extending out from a smaller circle is an example of a zoom feature]
- What is this zoom trying to show? [The zoom is trying to show, in greater detail, the area of oceanic crust where sea-floor spreading is taking place. That is, the area where the magma has risen and solidifies, therefore forming new oceanic lithosphere.]
- What could be the author's purpose in using the zoom convention? [While students may have different answers to this, the teacher should use this opportunity to emphasize the usefulness of the zoom feature in being able to show certain things in detail that otherwise would be very difficult or nearly impossible to otherwise see.]

(Continue to the next slide)

Day 39 – Restless Continents

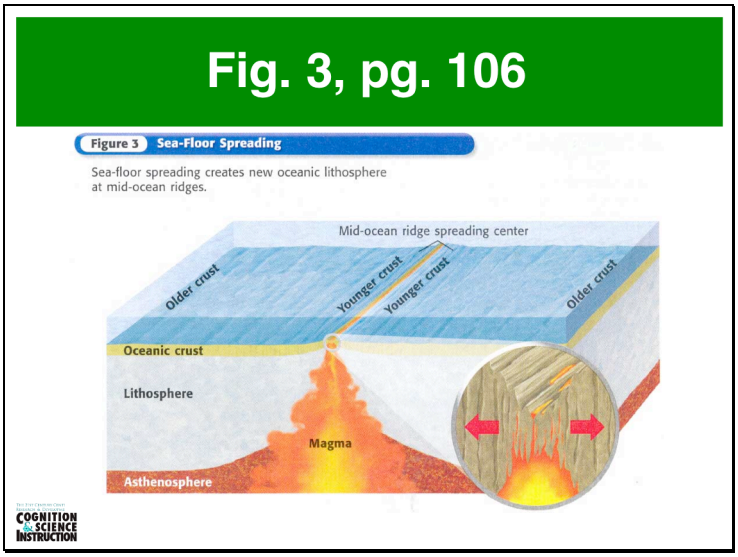
Visualization Exercise 4.2c – Zoom & Arrows (cont.)



The teacher has the students read the paragraph above which is taken from page 106.

(Continue to the next slide)

Visualization Exercise 4.2c – Zoom & Arrows (cont.)

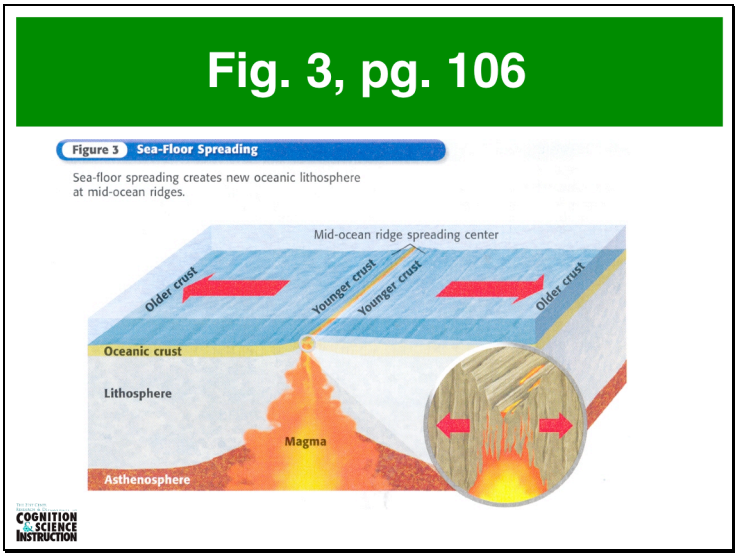


The teacher then again projects the above image of Figure 3 from page 106 (without arrows).

The teacher then asks students, either individually or in small groups, where/how could arrows be placed in order to show the direction/position of the older crust and younger crust?

(Continue to the next slide)

Visualization Exercise 4.2c – Zoom & Arrows (cont.)



The teacher then projects the above image of Figure 3 from page 106, this time with the correct arrows in place.

The teacher can then re-emphasize the point that this is only one way in which arrows can be used to show information in a diagram and that it is important not to assume that the role of arrows is the same for every diagram, since arrows can take on multiple roles (e.g. change of state, direction, distance, relationships, etc.), depending on the specific diagram.

(End of Activity)

DAY 40

Quiz 8/Reteach/Review

This lesson provides an opportunity for students to review what they've learned so far. For some, it may be an opportunity to understand an idea they didn't fully grasp the first time around.

Big Ideas
See list of big ideas, Days 1-39.

Materials

Teacher:

1. vocabulary list – RE word list.doc
2. list of big ideas – RE big ideas.pdf

Students:

1. Quiz 8

Activities & Allotted Time (40 minutes total)

10 minutes – quiz
10 minutes – go over quiz
20 minutes – reteach/review chapter 4.1 & 4.2

Reteach/Review Chapter 2.4
After going over the quiz and reviewing the meanings of vocabulary words and the big ideas from days 1-39, use the section review questions on pages 103 and 107 to identify areas that need additional attention.

Day 40 – Quiz 8/Reteach/Review

Quiz 8 – Page 1

1. If you were able to dig a tunnel to the center of the Earth, what conditions would you find?
   a. Temperature would increase, and pressure would decrease.
   (b.) Temperature and pressure would both increase.
   c. Temperature would decrease, and pressure would increase.

2. The changes that take place in the rock cycle do not _____.
   a. chemically change matter
   b. physically change matter
   (c.) create or destroy matter

3. If you think about the minerals that make up the Earth, where are the densest minerals located?
   (a.) near the center of the Earth
   b. near the surface
   c. between the center and the surface

4. How does oceanic crust compare with continental crust?
   a. oceanic crust is thicker than continental crust
   (b.) oceanic crust is denser than continental crust
   c. oceanic crust contains lighter minerals than continental crust

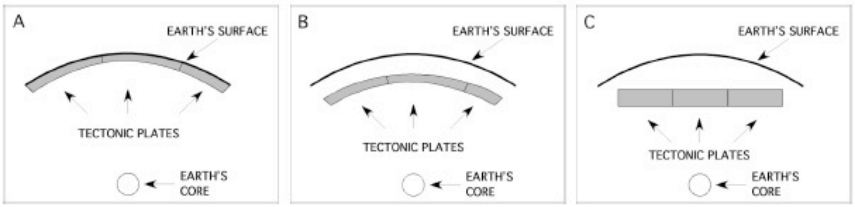
5. Which layer includes a section of the mantle that is solid but bends like clay and flows very slowly?
   (a.) asthenosphere
   b. lithosphere
   c. mesosphere

Inside the Restless Earth

Day 40 – Quiz 8/Reteach/Review

Quiz 8 – Page 2

6. Which diagram most closely represents the correct location of the Earth's tectonic plates?



ⓐ b c

7. What is continental drift?

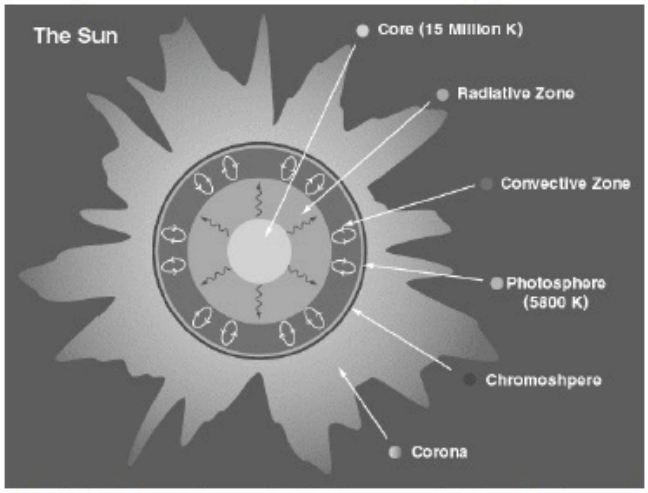
Continental drift is the hypothesis that the continents once formed a single land mass, and they broke apart and drifted to their present locations. It explained why the continents appear to fit together, but it has since been replaced by the theory of plate tectonics.

Inside the Restless Earth

Day 40 – Quiz 8/Reteach/Review

Quiz 8 – Page 3

8. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the figure.



According to the figure above, what is the correct order of the layers of the sun, starting from the center and moving outward?

a. corona, chromosphere, photosphere, convective zone
b. core, radiative zone, photosphere, convective zone
c. corona, radiative zone, convective zone, photosphere
(d) core, radiative zone, convective zone, photosphere

Inside the Restless Earth

DAY 41

Compare Convection Models

This lesson is contrasting case activity 4.3a, in which students compare two physical models of convection currents.

Big Ideas

- When part of a fluid is warm and part is cool, the warm part rises and the cool part sinks.
- This results in a motion cycle called a convection current.

Materials

Teacher:

1. slides – day41.ppt
2. matches or lighter
3. large heatproof glass bowl or 1000 ml beaker
4. cooking oil
5. fine-ground black pepper (about 1/2 tsp per cup of oil)
6. 1-inch squares cut from a Styrofoam or plastic plate

Students:

1. rectangular jar of rheoscopic fluid (sealed)
2. tea candle
3. wooden blocks
4. flashlight
5. drawings – worksheets 22 & 23

Activities & Allotted Time (40 minutes total)

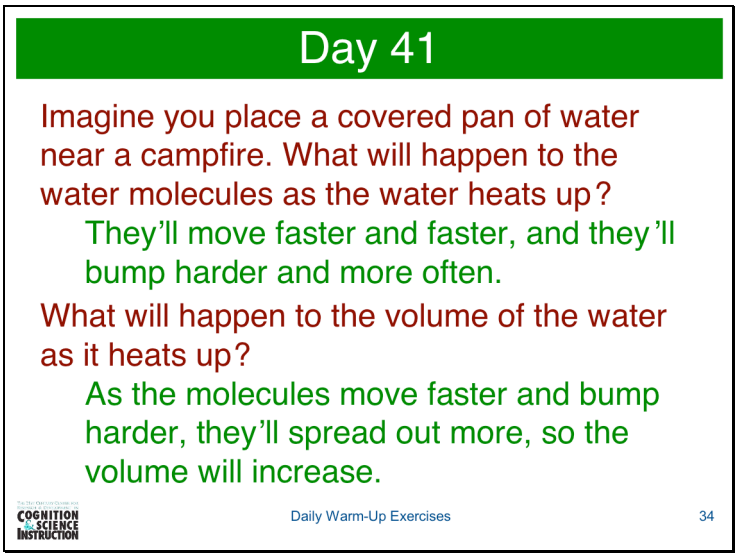
5 minutes – warm-up activity
35 minutes – cc activity – compare convection models

Warm-Up Activity

Today's warm-up is a review of two ideas from *Introduction to Matter* that are essential to understanding why convection currents happen. The first is that, when fluid molecules are heated, they move faster, bump harder, and spread

Day 41 – Compare Convection Models

Warm-Up Activity (cont.)
out more. Second, when they spread out, there are fewer molecules in the same amount of space, so density decreases. After students observe and compare the two models, you will use questions to help students generate an explanation based on these key ideas.

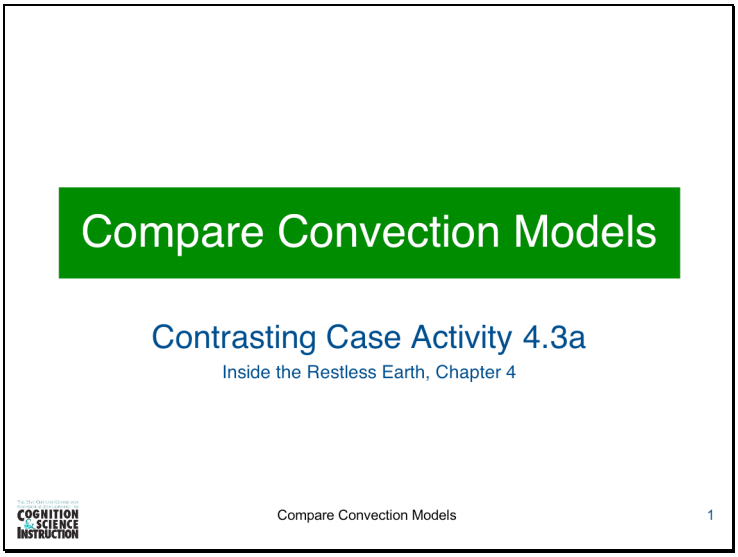


What will happen to the density of the water as it heats up?
As the molecules spread out, the density will decrease, because you have fewer water molecules in the same amount of space. (Or the same number of water molecules in a larger space.)

Compare Convection Models
In this activity, students compare two physical models of convection. In the first, each group has a rectangular jar filled with rheoscopic fluid and a candle. Rheoscopic fluid is a suspension of tiny crystals that show how the fluid moves when it is heated. The second is a demonstration that uses vegetable oil and black pepper. When added to the oil and stirred, the pepper will remain suspended and show how the oil moves when it is heated.

Day 41 – Compare Convection Models

Compare Convection Models (cont.)



Materials for students:

- rectangular jar of rheoscopic fluid (see note below)
- tea candle
- wooden blocks
- flashlight
- drawings (worksheets 22 & 23)

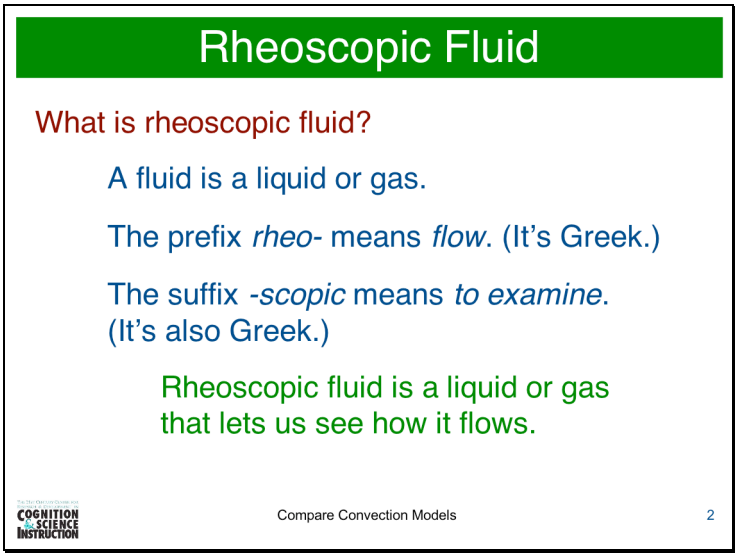
Materials for teacher:

- matches or lighter
- large, heatproof glass bowl (or 1000 ml beaker)
- vegetable oil
- fine-ground black pepper (about 1/2 tsp per cup of oil)
- 1-inch squares cut from a Styrofoam or plastic plate

rheoscopic fluid -- Dilute according to package instructions (for Pearl Swirl, 1 tablespoon per quart of water). Add a few drops of food coloring and shake well. Fill each jar so that, when turned on its side, there are as few air bubbles as possible. Seal each jar tightly. The filled jars can be stored and reused.

Day 41 – Compare Convection Models

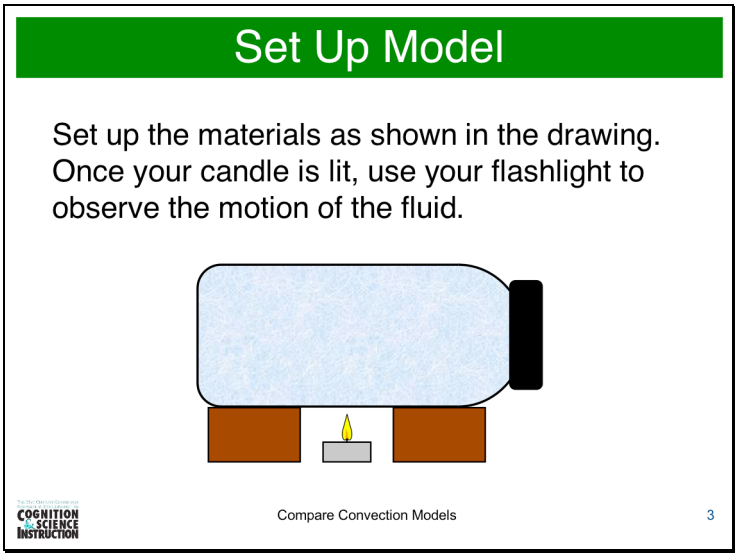
Compare Convection Models (cont.)



Distribute the jars of rheoscopic fluid and encourage students to examine the fluid and try to answer the question on the slide. The hints and answer will appear separately on keypress. Once they figure out what rheoscopic fluid means, tell them it contains tiny white crystals suspended in colored water. The crystals enable us to observe the motion of the fluid. In this experiment, they will use a candle to heat the liquid and see what happens.

Day 41 – Compare Convection Models

Compare Convection Models (cont.)

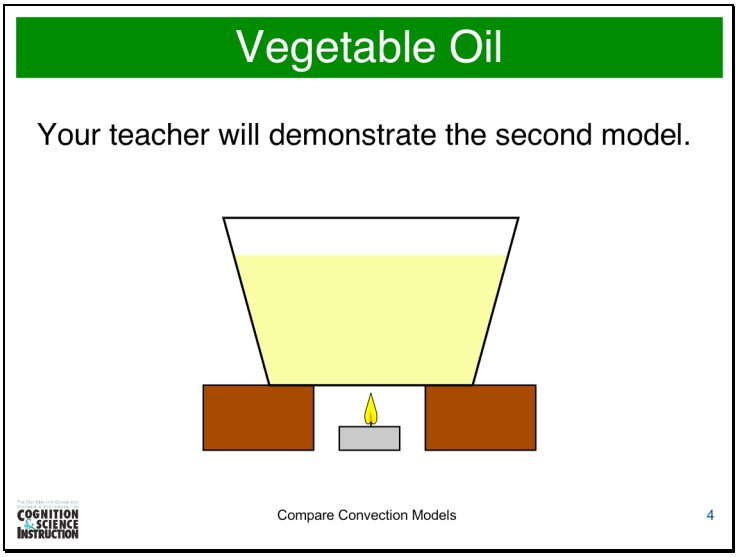


Distribute the wooden blocks, candles, flashlight and Rheoscopic Fluid drawing (worksheet 22). Tell students you will come around and light the candles when everyone is ready. Once the candle is lit, have students shine the flashlight on different parts of the jar, to see if different things are happening in different areas of the fluid. Use questions to help them focus on the area closest to the candle, the area farthest from the candle, and the top surface of the fluid. Encourage them to work together to come up with words or drawings that will clearly show what they are seeing.

As students work, use questions or hints to help them draw or describe the directions in which different parts of the fluid are moving. Your students may not see large, symmetrical currents like we show on the last few slides, but they should see that areas near the candle are moving upward, and areas farther away are moving downward.

Day 41 – Compare Convection Models

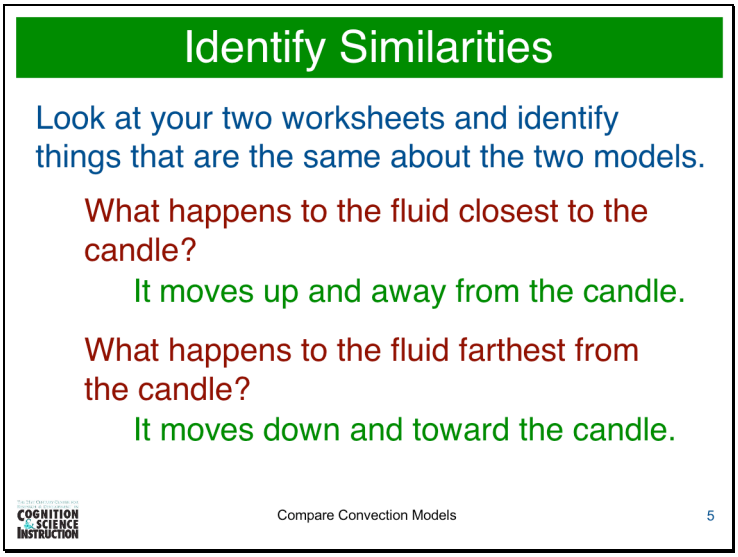
Compare Convection Models (cont.)



Distribute the Vegetable Oil drawing (worksheet 23) and set up the materials as shown. Stir the oil to suspend the pepper, then light the candle. Again, use questions to help students focus on the area closest to the candle, the area farthest from the candle, and the top surface of the fluid. When you can see the oil rising and separating at the surface, place two Styrofoam or plastic squares on the surface near the center. Try to get them close together but not touching each other. When the squares move to the edges of the bowl, push them back toward the center. Encourage students to work together to come up with words or drawings that will clearly show what they are seeing.

Day 41 – Compare Convection Models

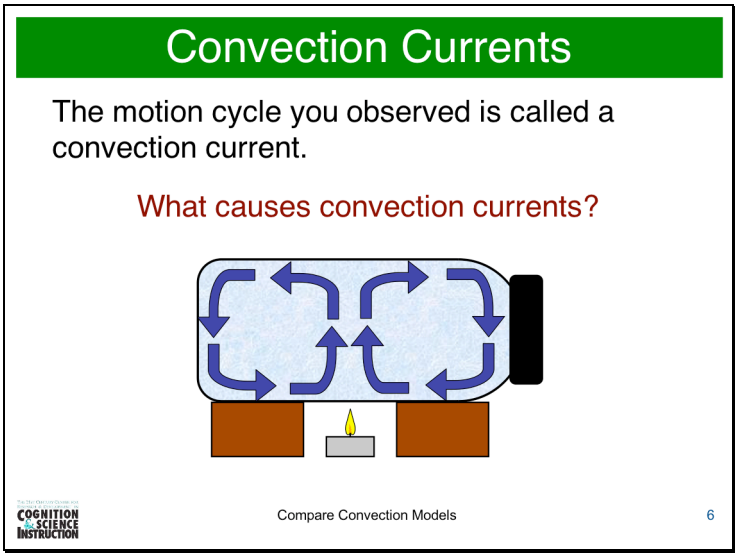
Compare Convection Models (cont.)



The questions and answers will appear one-by-one on keypress. Before displaying the first question, have students work in pairs or groups to identify similarities. At first, they may identify things like both have candles, both have fluids, both have containers, the candle is near the bottom of the container, and so forth. Use questions to get them to talk about the movement of the fluid in each model. Once they seem to have noticed the motion cycle in both models, press a key to display the first question and complete the slide as a whole-class discussion.

Day 41 – Compare Convection Models

Compare Convection Models (cont.)



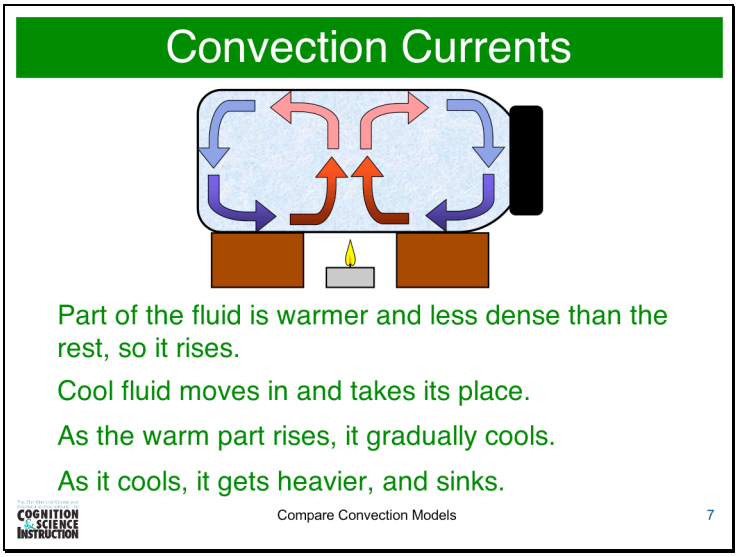
The question will appear on keypress. Have students discuss the question in groups, then share ideas with the class. Use questions to help students apply the ideas from today's warm-up.

For example:

- What happens to the fluid molecules near the candle?
  They move faster, bump harder, and spread out more.
- What happens to the density of the fluid near the candle?
  When the molecules spread out, density decreases.
- Why do liquids that have different densities form layers?
  Because lighter liquids float up and heavier liquids sink down.
- So as the fluid near the candle gets warm, what will happen to it?
  It will float up because it will get lighter than the cool fluid around it.
- What will happen to the cool fluid when the warm fluid floats up?
  It will move in and take the warm fluid's place near the candle.
- What will happen to the warm fluid as it rises away from the candle?
  It will get cooler. Its molecules will slow down and spread out less.

Day 41 – Compare Convection Models

Compare Convection Models (cont.)

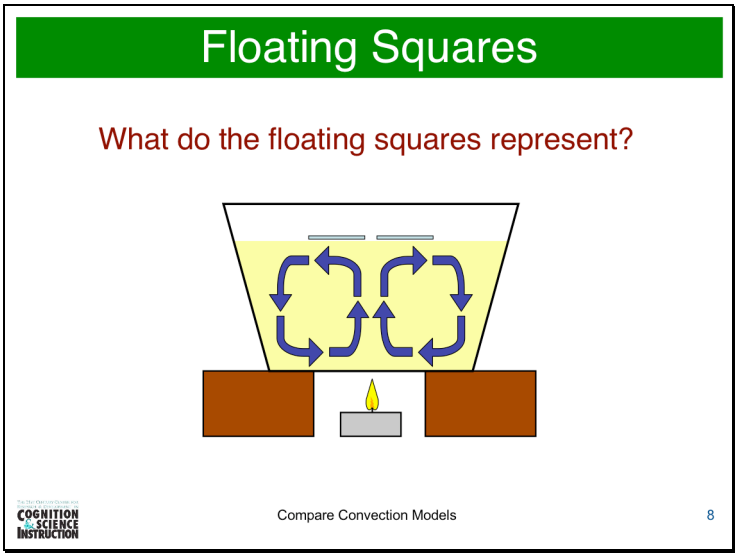


Arrows and descriptions will appear separately on keypress.

Tell students the cycle will continue as long as part of the fluid is warm and part is cool.

Day 41 – Compare Convection Models

Compare Convection Models (cont.)



Your students will probably guess that the floating squares represent tectonic plates, but if they don't, tell them they'll find out tomorrow.

Note: If your students do say the squares represent tectonic plates, explain that this model doesn't tell the whole story. For one thing, the mantle is not liquid like vegetable oil, and the heat inside Earth isn't caused by a fire. Also, the squares in the model are dragged apart by the convection currents, but the movements of tectonic plates are also driven by forces like ridge push and slab pull. Convection plays a role, but it is not the complete explanation.

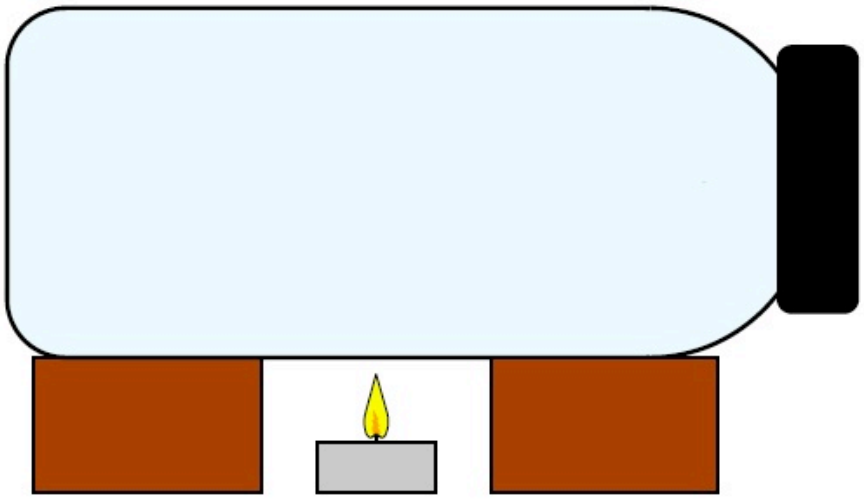
Day 41 – Compare Convection Models

Worksheet 22

Compare Convection Models

Rheoscopic Fluid

Use drawings and/or words to show what happens to the fluid after the candle is lit.



Chapter 4 – Plate Tectonics

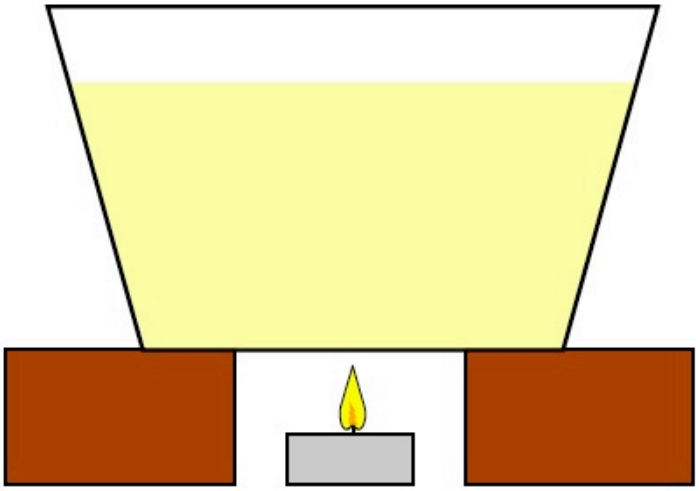
Day 41 – Compare Convection Models

Worksheet 23

Compare Convection Models

Vegetable Oil

Use drawings and/or words to show what happens to the fluid after the candle is lit.



Chapter 4 – Plate Tectonics

DAY 42

Compare Plate Motion

This lesson is contrasting case activity 4.3b, in which students compare diagrams that show how convection currents within the Earth's mantle cause tectonic plates to move.

Big Ideas

- Convection currents in the mantle cause tectonic plates to move.
- Divergent motion is when plates move apart, and convergent motion is when they move toward each other.
- Divergent boundaries form when plates move apart, and convergent boundaries form when they move toward each other.

Materials

Teacher:

1. slides – day42.ppt

Students:

1. convection diagrams – worksheets 24 & 25
2. plate diagrams – worksheets 26 & 27

Activities & Allotted Time (40 minutes total)

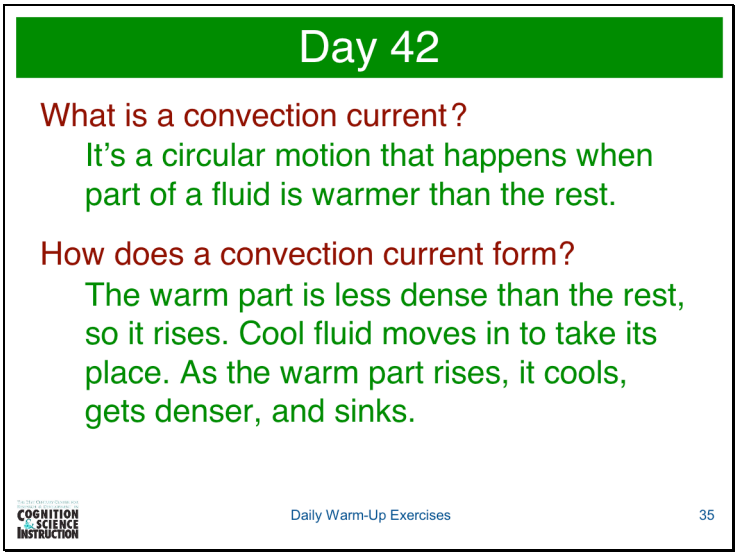
5 minutes – warm-up activity
35 minutes – cc activity – compare plate motion

Compare Plate Motion

In this activity, students will compare four diagrams, two that show convection and two that show plate motion. The convection diagrams are designed to help students recognize that there are convection currents in the Earth's mantle that work the same way as the currents they observed on Day 41. The plate diagrams show that the mantle's convection currents cause tectonic plates to move, and that the plates can move away from each other (divergent motion) or toward each other (convergent motion).

Day 42 – Compare Plate Motion

Warm-Up Activity

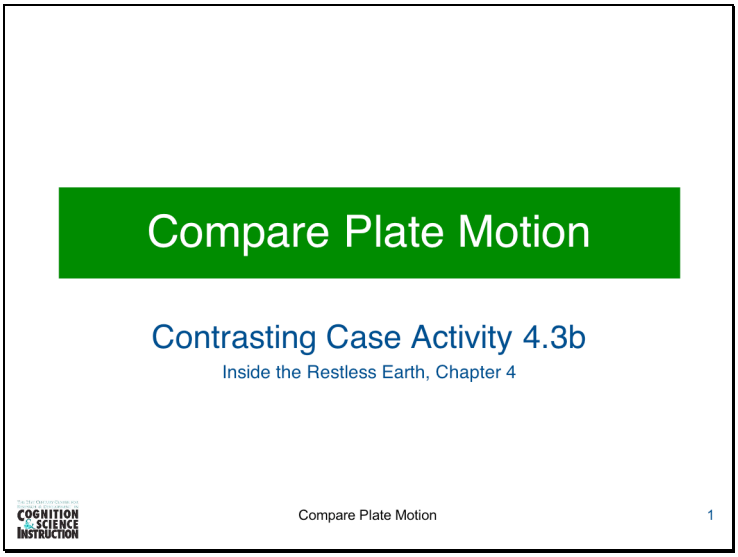


What is a fluid?
a liquid or gas

Why is the warm part of a fluid less dense than the cool part?
When a fluid gets warm, its molecules move faster, bump harder and spread out more. So you have fewer molecules in the same amount of space.

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)

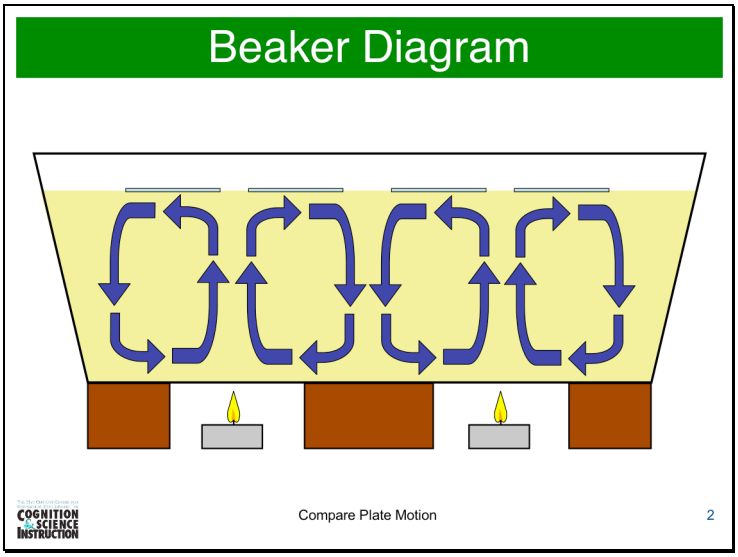


Materials for students:

- convection diagrams (worksheets 24 & 25)
- plate diagrams (worksheets 26 & 27)

Day 42 – Compare Plate Motion

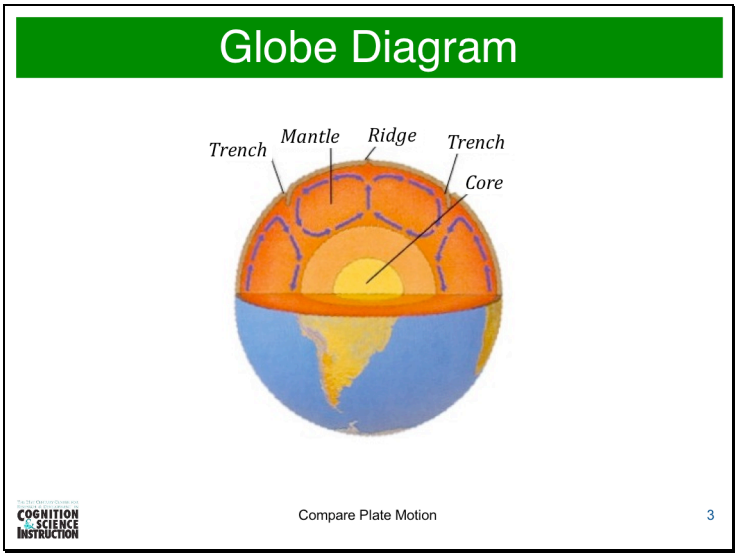
Compare Plate Motion (cont.)



Distribute the convection diagrams (worksheets 24 & 25) and ask students to examine the first one and explain what it shows. They should recognize that it is very similar to the vegetable oil drawing they worked with on Day 41, except the beaker is extra wide and, instead of one candle and one set of convection currents, there are two.

Day 42 – Compare Plate Motion

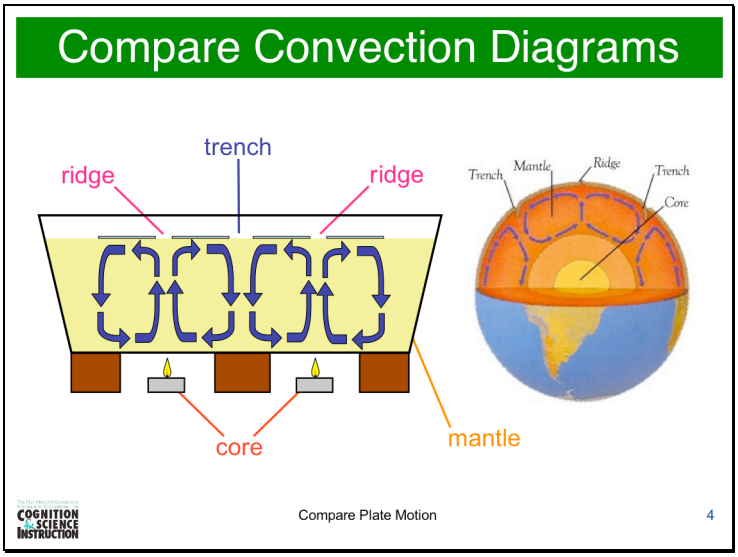
Compare Plate Motion (cont.)



Ask students to examine the second diagram and explain what it shows. They should recognize that this is a cut-away diagram of the Earth, and that the blue arrows in the mantle represent convection currents, just like the blue arrows in the beaker diagram.

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)

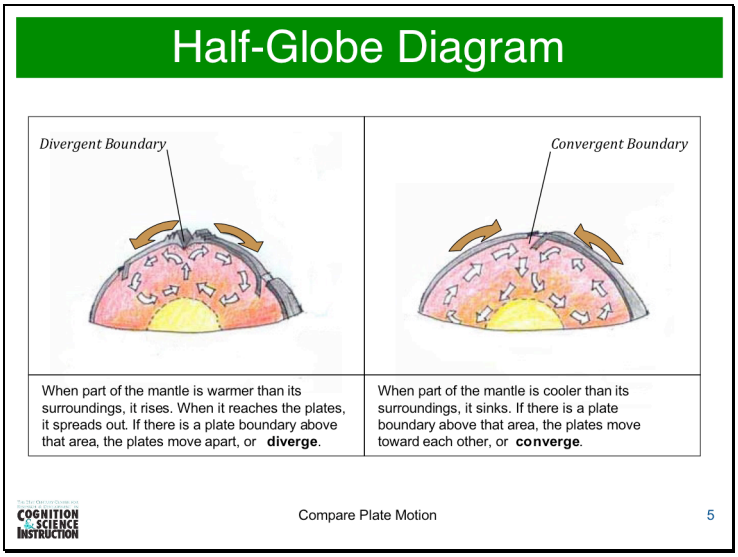


Have your students compare the two diagrams and add information from the second to the first. Use questions like those below to help them focus on key features. [Additional labels will appear on keypress.]

- Where does the heat come from that causes the convection currents in each diagram? [beaker=candles; globe=core]
- If the beaker diagram were a model of the Earth, what would the candles represent? [the core – Remind students that the heat inside Earth is not caused by fire.]
- What would the vegetable oil represent? [the mantle – Remind students that the mantle is not liquid like oil.]
- Where would a ridge be located? [This is a little tricky, because the currents don't match exactly in the two diagrams. Some students may need help to see that, in the globe diagram, a ridge forms where two current segments are rising and spreading apart. In the beaker, there are two places where this occurs.]
- Where would a trench be located? [A trench forms where two segments are moving toward each other and then sinking. In the beaker, there is one place where this occurs.]

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)

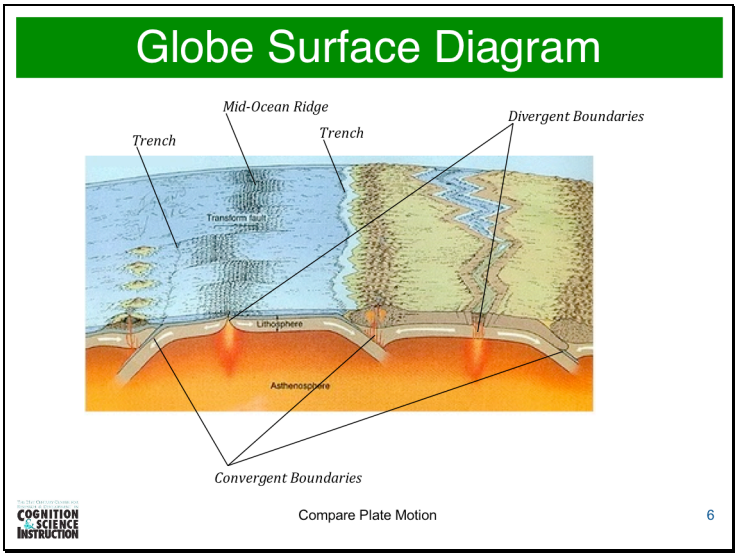


Distribute the plate diagrams (worksheets 26 & 27) and ask students to examine the first one and explain what it shows. They should recognize that the white arrows show convection currents in the mantle. The thin, gray arrows (fat and brown on the powerpoint slide) show which way the plates are moving. The caption explains the difference between divergent and convergent boundaries, which are labeled in the drawing.

Encourage your students to compare the convection currents in all three diagrams they've examined so far. They should see that the currents in the left panel match the currents in the center of the globe diagram (mantle rises and spreads out). The right panel matches the center of the beaker diagram (mantle cools and sinks).

Day 42 – Compare Plate Motion

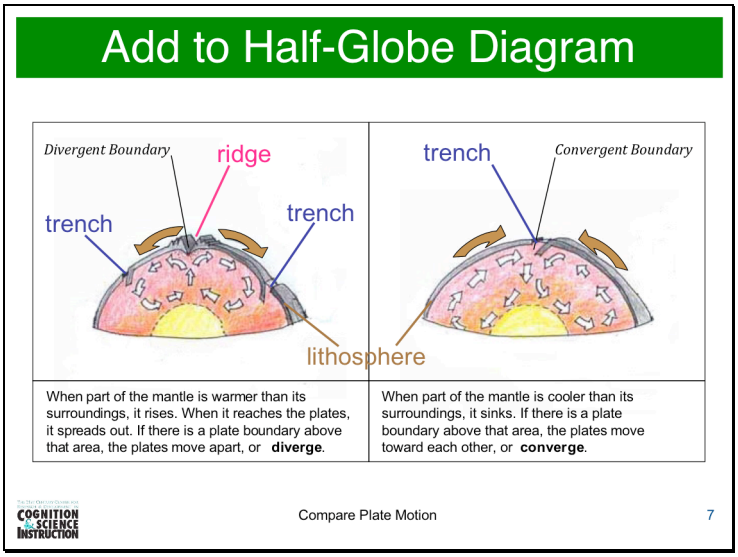
Compare Plate Motion (cont.)



Ask students to examine the last diagram and explain what it shows. They may need help to see that this is another cut-away diagram of the Earth, but it shows less of the inside and more of the surface than the other diagrams. It's as if we could rotate the globe diagram forward and look at the outer surface of the globe as well as the crust and top part of the mantle. It doesn't show convection currents, but it does have arrows that show which way the plates move.

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)



Have your students compare the diagrams and add information from one to the other. Use questions like those below to help them focus on key features. [Added labels will appear on keypress.]

Where would a ridge be located?

Ridges form where part of the mantle is rising and spreading out. This is also where divergent boundaries form, because the plates are moving apart.

Where would a trench be located?

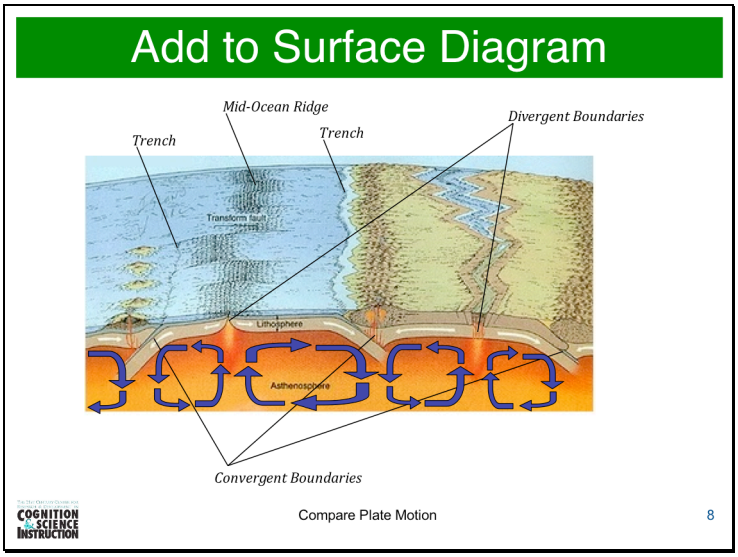
A trench forms where part of the mantle is sinking. This is also where convergent boundaries form, because the plates are moving toward each other.

What layer of the Earth do the plates make up?

the lithosphere

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)



Use questions to help students focus on key features. [Convection arrows will appear on keypress.]

Where do divergent boundaries form?

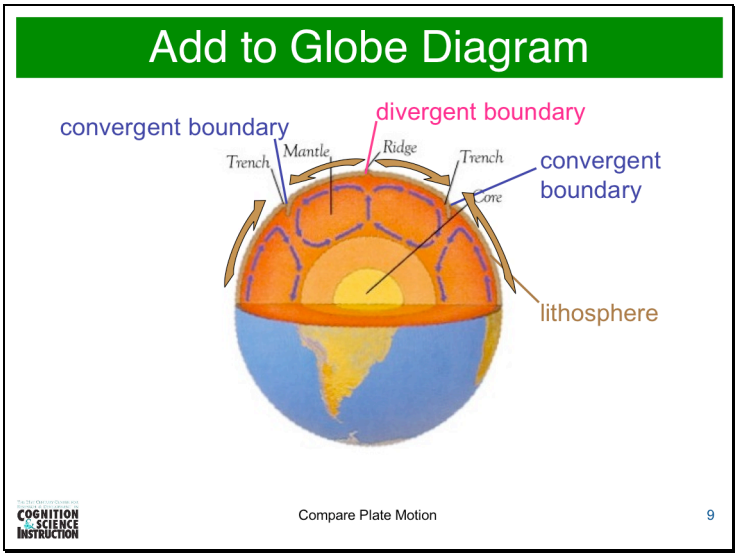
They form where part of the mantle is rising and spreading out.

Where do convergent boundaries form?

They form where part of the mantle is sinking.

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)



Use questions to help students focus on key features. [Added labels and arrows will appear on keypress.]

Where would a divergent boundary be located?

Divergent boundaries form where part of the mantle is rising and spreading out.

Where would a convergent boundary be located?

Convergent boundaries form where two areas of mantle are moving toward each other and sinking.

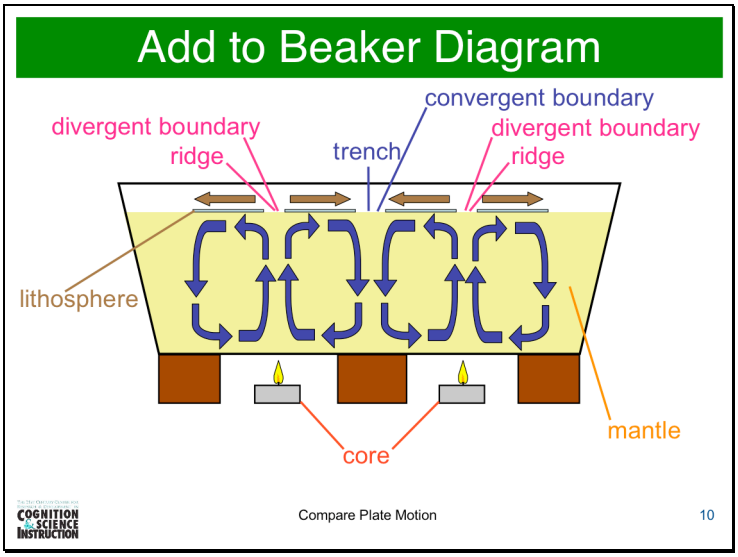
What layer of the Earth do the plates make up?

the lithosphere

Use arrows to show which way the plates are moving.

Day 42 – Compare Plate Motion

Compare Plate Motion (cont.)



Use the same questions to help students focus on key features. [Added labels and arrows will appear on keypress.]

Where would a divergent boundary be located?

Divergent boundaries form where part of the mantle is rising and spreading out.

Where would a convergent boundary be located?

Convergent boundaries form where two areas of mantle are moving toward each other and sinking.

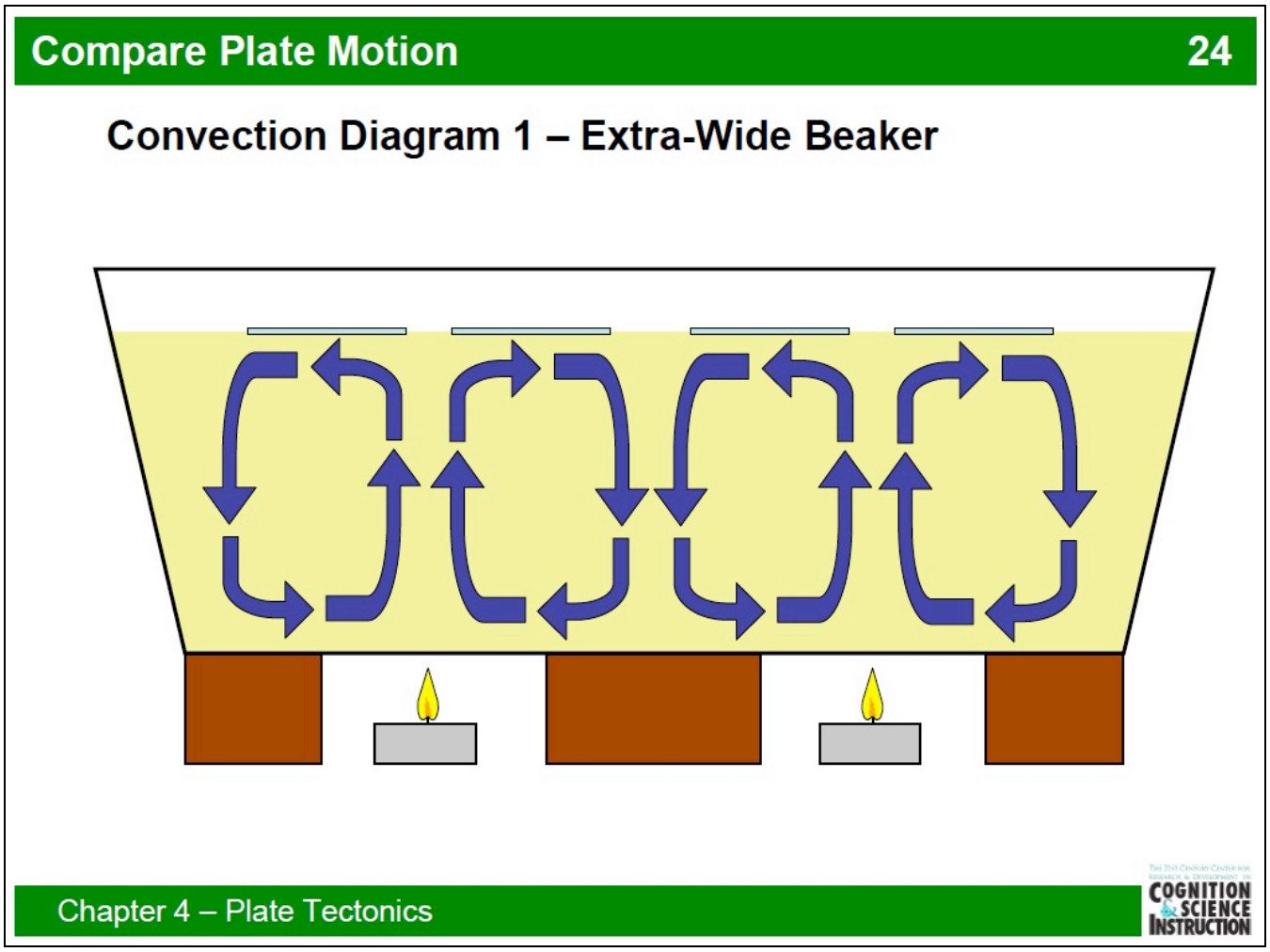
What layer of the Earth do the plates make up?

the lithosphere

Use arrows to show which way the plates are moving.

Day 42 – Compare Plate Motion

Worksheet 24

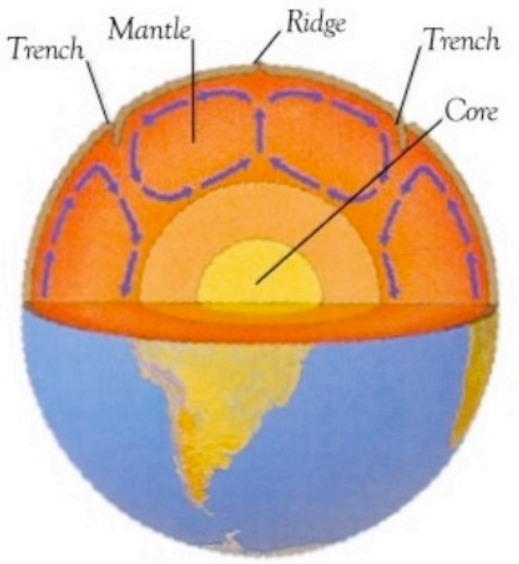


Day 42 – Compare Plate Motion

Worksheet 25

Compare Plate Motion

Convection Diagram 2 – Cut-Away Globe



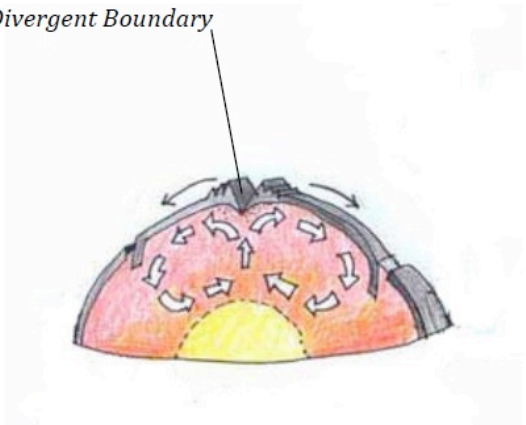
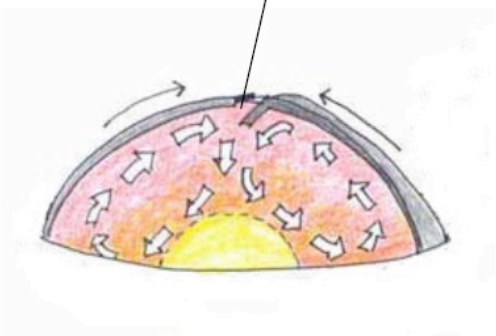
Chapter 4 – Plate Tectonics

Day 42 – Compare Plate Motion

Worksheet 26

Compare Plate Motion 26

Plate Diagram 1 – Cut-Away Globe Section

Divergent Boundary	*Convergent Boundary*
	
When part of the mantle is warmer than its surroundings, it rises. When it reaches the plates, it spreads out. If there is a plate boundary above that area, the plates move apart, or **diverge**.	When part of the mantle is cooler than its surroundings, it sinks. If there is a plate boundary above that area, the plates move toward each other, or **converge**.

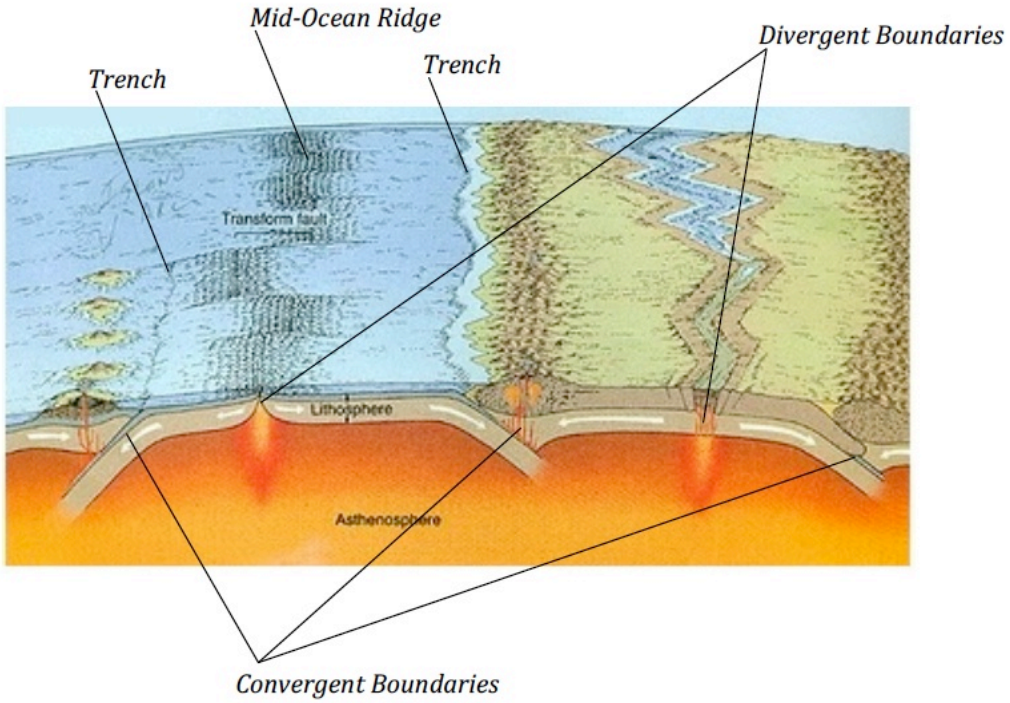
Chapter 4 – Plate Tectonics

Day 42 – Compare Plate Motion

Worksheet 27

Compare Plate Motion

Plate Diagram 2 – Globe Surface



Chapter 4 – Plate Tectonics

DAY 43

Tectonic Plate Boundaries

This lesson covers the first part of section 4.3 (pages 108-109).

Big Idea

- Convection currents in the mantle cause tectonic plates to move.
- Divergent motion is when plates move apart, and convergent motion is when they move toward each other.
- Divergent boundaries form when plates move apart, and convergent boundaries form when they move toward each other.

Materials

Teacher:

1. visualization exercises – day43.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 4.3a – Labels, Color & Arrows
30 minutes – chapter 4.3, part 1

Chapter 4.3, part 1

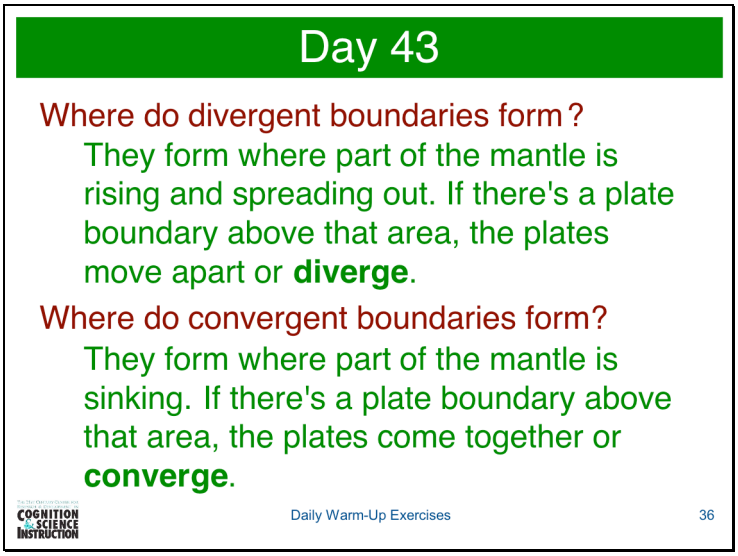
Today's warm-up reinforces the idea that plates move because of convection currents in the mantle. Although the book doesn't explain this until part 2, look for opportunities to make sure your students understand that connection. For example, encourage them to explain why the plates are moving apart at the divergent boundary in the diagram on page 109.

The last paragraph on page 110 points out that the San Andreas Fault in California is a good example of a transform boundary, and that it marks the place where the Pacific and North American plates are sliding past each other. Encourage your students to find this boundary in figure 4 on page 100, then see if they can find examples of convergent and divergent boundaries. They should recall that the mid-Atlantic ridge runs along the border between the

Day 43 – Tectonic Plate Boundaries

Chapter 4.3, part 1 (cont.)
South American and African plates (5 & 6), and the Pacific ridge is between the Pacific and Nazca plates (1 & 4). Since ridges form where plates are moving away from each other, they should conclude that these are divergent boundaries. Since the South American plate is moving away from the African plate, and the Nazca is moving away from the Pacific, the Nazca and South American plates must be moving toward each other, so it must be a convergent boundary. Again, encourage students to describe the convection currents that might be occurring beneath these boundaries.

Warm-Up Activity



Why does the warm part of the mantle rise?
because it's less dense than the surrounding mantle

Why is the warm part less dense than the cool part?
When a fluid gets warm, its molecules move faster, bump harder and spread out more. So there are fewer molecules in the same amount of space.

Day 43 – Tectonic Plate Boundaries

Visualization Exercise 4.3a – Labels, Color & Arrows

Image Comprehension Focus: Labels, Color and Arrows

Goal: 1) To provide a brief review of labels, 2) Provide a brief review of the role of color, 3) Re-emphasize one way that arrows can be used

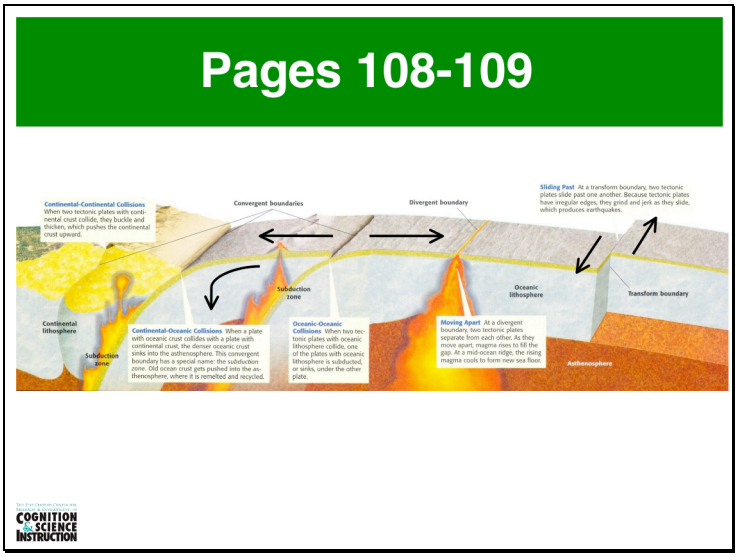
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to give a brief review of labels and the use of color. In addition, it is designed to give students practice with arrows and one way that arrows may be used to show information in a diagram.

(Continue to the next slide)

Day 43 – Tectonic Plate Boundaries

Visualization Exercise 4.3a – Labels, Color & Arrows (cont.)



Procedure: The teacher has students turn to the image on pages 108-109 of their textbooks (shown above if the teacher wants to project it).

The teacher then asks students, either individually or in small groups, to answer the following question:

What information could one use in the diagram to know where there are convergent, divergent and transform boundaries? [The students may have many different answers to this. In this discussion, the teacher should point out the usefulness and information provided by both the naming and explanatory labels. In addition, the teacher should point out the use of color, such as the color of the magma. For example, one can tell where there is a divergent boundary because of the naming label, the information in the explanatory label, as well as the illustration of being able to see the magma in between the two plates, indicating a separation or moving apart that happens at a divergent boundary.]

Day 43 – Tectonic Plate Boundaries

Visualization Exercise 4.3a – Labels, Color & Arrows (cont.)

After the teacher has led a discussion on the different conventions in the diagram that can assist the students, the teacher then advises that it can sometimes be useful to think about conventions that the author could have used in the diagram. The teacher should also indicate that colors are not always used consistently. For example, there should be a magma separation at the convergent boundary as well. The teacher can use this to reinforce the idea that it is critical to look at other things (e.g. the labels) in addition to color in order to obtain accurate information.

The teacher has the students think about arrows and asks the students, in what way could arrows be used in order to further understanding of the different boundaries in this diagram? Students may suggest arrows showing separation of plates at the divergent boundary. [If students have difficulty with this, remind them of having done something similar in exercise 4.2c.]

[Advance slide to show arrows.]

Draw attention to the transform boundary, and ask the students to describe what a useful set of arrows would look like in this part of the diagram. [Advance slide to show arrows.]

Finally draw attention to a subducting plate, and ask for suggestions about an arrow that would illustrate this kind of motion. [Advance slide to show arrows.]

(End of Activity)

DAY 44

Tectonic Plate Motion

This lesson covers the last two parts of section 4.3 (pages 110-111).

Big Idea

- Based on physical properties, the Earth has five layers – lithosphere, asthenosphere, mesosphere, outer core, and inner core.
- The lithosphere is the rigidly solid outer layer of the Earth that consists of the crust and upper mantle.
- Convection currents in the mantle cause tectonic plates to move.
- Tectonic plates move very slowly, no more than a few centimeters per year.

Materials

Teacher:

1. visualization exercises – day44.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

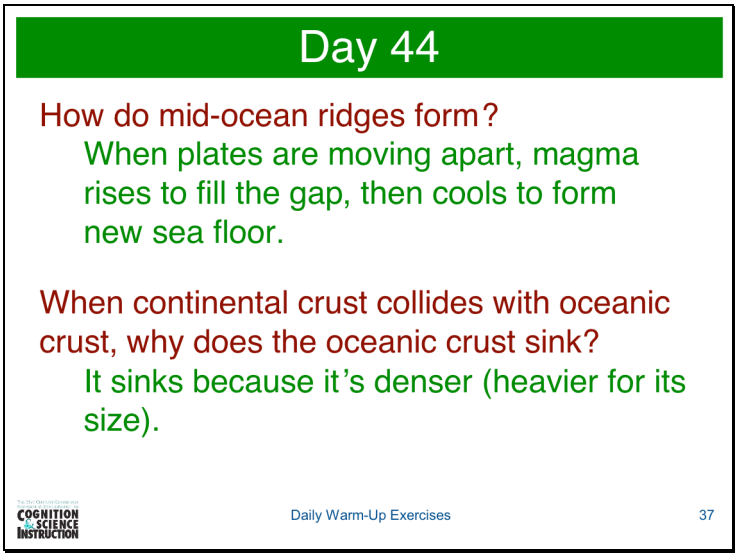
5 minutes – warm-up activity
5 minutes – visualization 4.3b – Cut-Away, Arrows & Color
30 minutes – chapter 4.3, parts 2 & 3

Chapter 4.3, parts 2 & 3

You might begin the lesson by asking your students to describe the physical layers of the Earth. They should recall that the lithosphere consists of the crust and the outer edge of the mantle, and that it is rigidly solid. The asthenosphere is the section of the mantle below the lithosphere. It is a plastic solid that bends like clay and flows very slowly. The next layer is the mesosphere. Geologists now believe that it, too, is a plastic solid. So when the book talks about rock expanding and rising and then cooling and sinking, it is referring to this bendable, putty-like material that makes up the asthenosphere and mesosphere.

Day 44 – Tectonic Plate Motion

Warm-Up Activity



What kind of rock is a mid-ocean ridge made of?
igneous

What causes tectonic plates to move?
convection currents in the mantle

What are convection currents?
motion cycles that happen when the warm part of a fluid rises and the cool part sinks

Day 44 – Tectonic Plate Motion

Visualization Exercise 4.3b – Cut-Away, Arrows & Color

Image Comprehension Focus: Cut-Away, Arrows and Color

Goal: To provide a brief review of cut-away, arrows and color

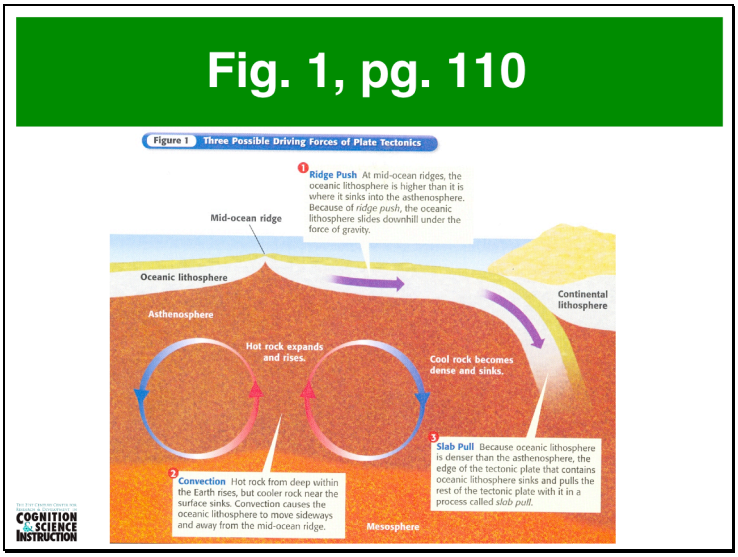
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to give a brief review of the use of cut-away, arrows and color, and why each can be important when looking at diagrams.

(Continue to the next slide)

Day 44 – Tectonic Plate Motion

Visualization Exercise 4.3b – Cut-Away, Arrows & Color (cont.)



Procedure: The teacher has students turn to Figure 1 on page 110 of their textbooks. The teacher first asks the students, what perspective is the author using in this diagram and why? [Here, the author has used a cut-away perspective in order to show something (processes dealing with plate tectonics) that otherwise would be impossible to see.]
Next, the teacher has the students focus on the arrows and asks:

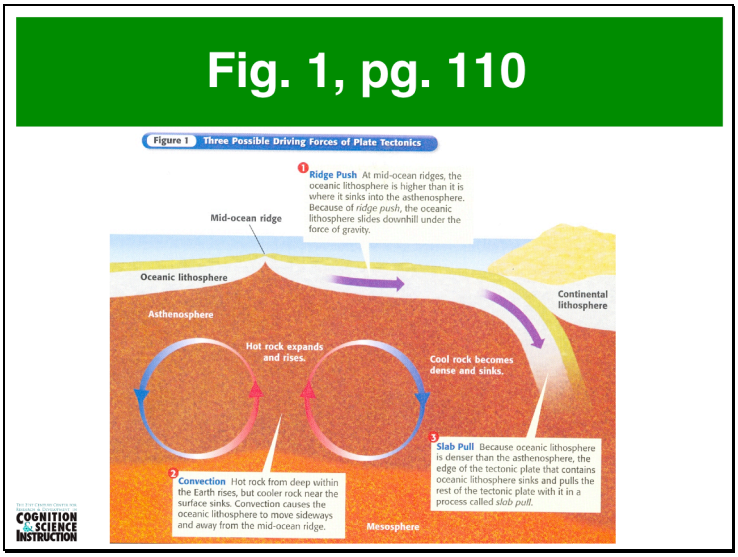
- What is the role of the purple arrows? [Here, these arrows are showing the direction of the oceanic lithosphere as it slides downward under the force of gravity because of ridge push.]
- What is the role of the red/blue arrows? [They are showing the cycle of convection; that is, the hot rock rising and the cooler rock sinking.]
- Do the colors of any of the arrows have any meaning? [While the specific color purple has no real meaning with these arrows, red is used in order to illustrate something that is hot while blue is used to illustrate something that is cool.]

(Continue to the next slide)

Day 44 – Tectonic Plate Motion

Visualization Exercise 4.3b – Cut-Away, Arrows & Color (cont.)

Fig. 1, pg. 110



Additional Teacher Comment: At this point, the teacher may want to take time to review the role of numbers in this diagram. The numbers in this diagram could be confusing to students, as the numbers do not correspond to processes taking place in that particular order. The teacher should point out that while the author chooses to use numbers to illustrate that there are three possible processes of plate tectonics, the author could just have easily used letters or no symbols at all.

(End of Activity)

DAY 45

Deforming Earth's Crust

This lesson covers section 4.4 (pages 112-119).

Big Ideas

- The movements of tectonic plates can cause rock layers to bend or break.
- When a rock layer breaks and forms two blocks of rock that grind past each other, the surface where they meet is called a fault.

Materials

Teacher:

1. visualization exercises – day45.ppt

Students:

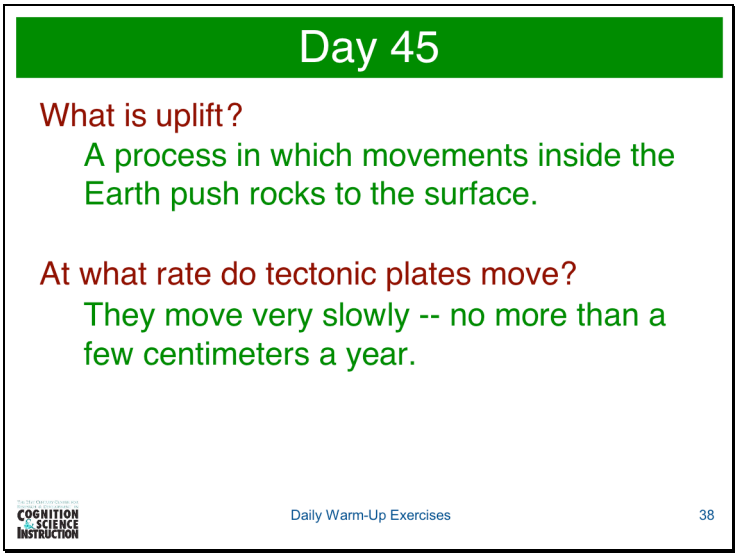
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
2 minutes – visualization 4.4a – Arrows & Labels
3 minutes – visualization 4.4b – Arrows
2 minutes – visualization 4.4c – Color & Captions
3 minutes – visualization 4.4d – Cut-Away & Arrows
25 minutes – chapter 4.4 – *Deforming Earth's Crust*

Day 45 – Deforming Earth's Crust

Warm-Up Activity



What is a transform boundary?

the border between tectonic plates that are moving past each other sideways [To illustrate, rub your hands together like you're trying to warm them.]

What is sea-floor spreading?

the formation of new oceanic crust as tectonic plates move apart and magma rises and solidifies

Day 45 – Deforming Earth's Crust

Visualization Exercise 4.4a – Arrows & Labels

Image Comprehension Focus: Arrows and Labels

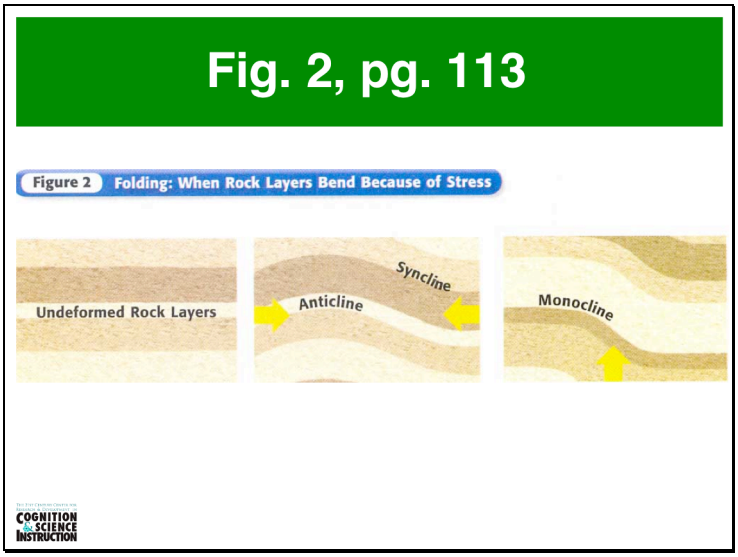
Goal: Reinforce the importance of the roles played by arrows and labels

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to reinforce students' understanding as to the important role that arrows can play in a diagram as well as the importance of labels.

(Continue to the next slide)

Visualization Exercise 4.4a – Arrows & Labels (cont.)

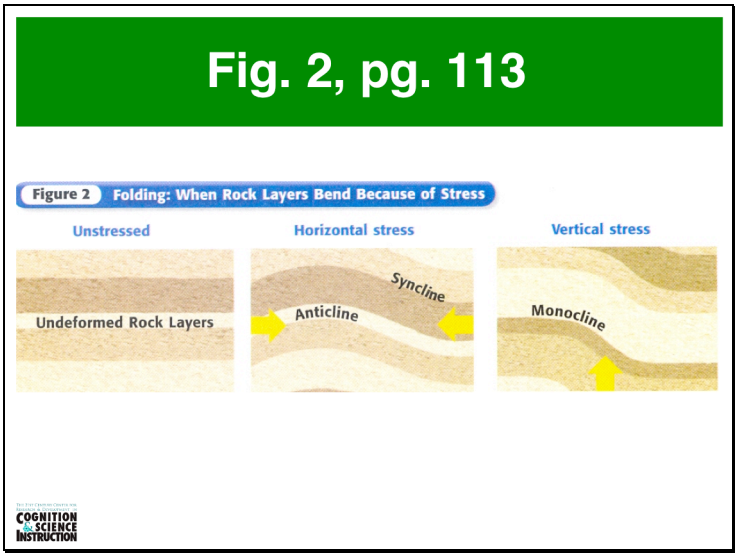


Procedure: The teacher projects the above image of Figure 2 from page 113 that has labels missing.

The teacher then asks the students, either individually or in small groups, to match the labels of Unstressed, Horizontal stress, and Vertical stress, with the appropriate image.

(Continue to the next slide)

Visualization Exercise 4.4a – Arrows & Labels (cont.)



Next, the teacher goes over the correct answers and asks the students, by show of hands, how many were able to label the images correctly? The teacher then asks those students what information from the diagrams enabled them to correctly match the label with the image?

While students may give different answers, it is here that the teacher can ask about the role that arrows play in this particular diagram. [The arrows represent the stress/direction of the stress in the earth's crust that causes the folding.] The teacher then points out that the direction of the arrows can assist students in labeling the images. For example, the image labeled horizontal stress shows the arrows pointing in a horizontal direction, while the image of vertical stress shows the arrow pointing in a vertical direction. The image labeled Unstressed does not have an arrow.

The teacher again emphasizes that the role of arrows can be different depending on the specific diagram, and that one needs to pay careful attention to the role in order to obtain the most accurate information.

(End of Activity)

Day 45 – Deforming Earth's Crust

Visualization Exercise 4.4b – Arrows

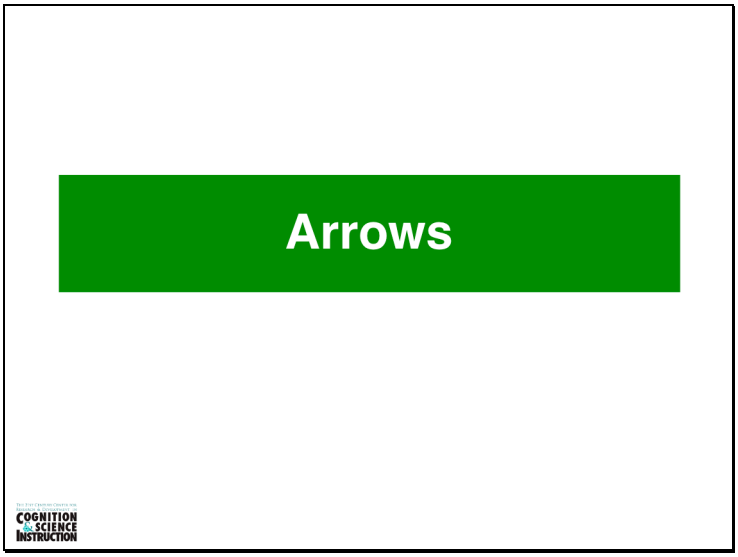


Image Comprehension Focus: Arrows

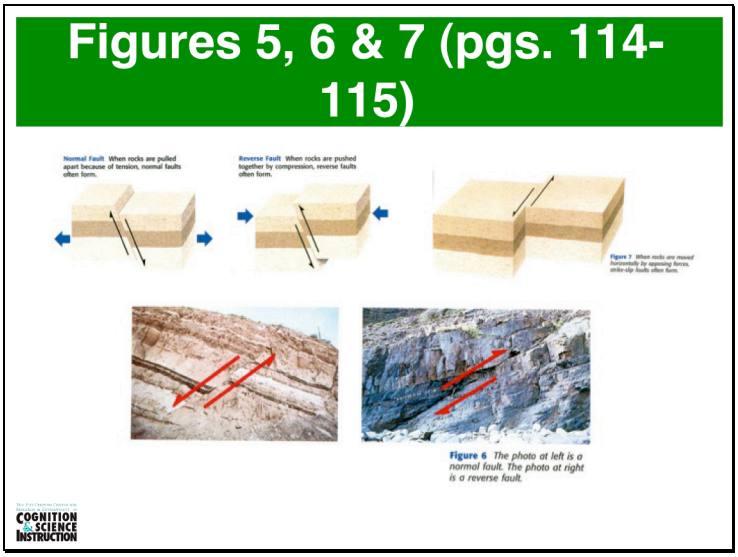
Goal: To illustrate another use of arrows in diagrams

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to illustrate another way that arrows can be used to show certain pieces of information in a diagram that otherwise could be difficult to see.

(Continue to the next slide)

Visualization Exercise 4.4b – Arrows (cont.)



Procedure: The teacher has the students turn to pages 114-115 of their textbooks (shown above, if the teacher wants to project it).

Next, the teacher asks the students, what is different about black and red arrows used in these diagrams, as opposed to the other images we have seen? [These arrows only have half of an arrowhead.]

What is the role of these particular arrows? [These arrows are being used to show the direction of movement along different fault lines.]

The teacher can then emphasize again the point that arrows can play different roles to show different pieces of information depending on the diagram, and that it is important to not assume that arrows are always showing the same types of information.

(End of Activity)

Day 45 – Deforming Earth's Crust

Visualization Exercise 4.4c – Color & Captions

Image Comprehension Focus: Color and Captions

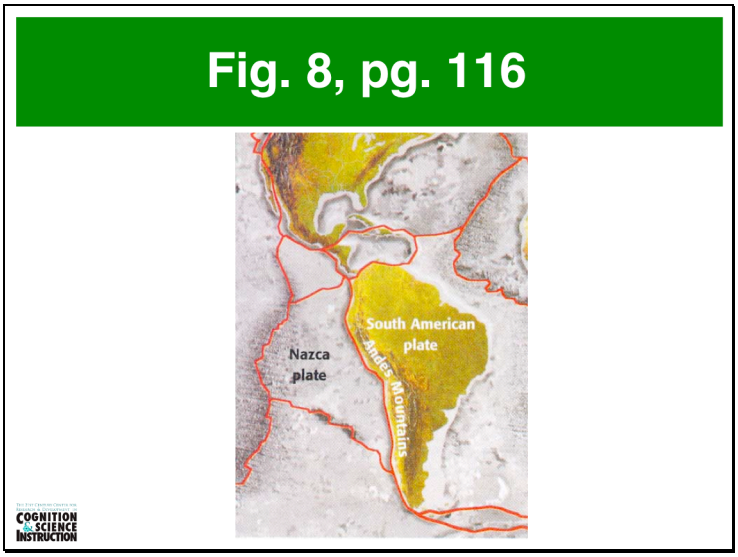
Goal: 1) Briefly review one way that color can be used in diagrams, 2) Re-emphasize the importance of captions

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to illustrate how color can be used the same way in multiple diagrams, as well as to enhance students' skills at writing and understanding captions.

(Continue to the next slide)

Visualization Exercise 4.4c – Color & Captions (cont.)



Procedure: The teacher projects the above image of Figure 8 from page 116 (shown without the caption).

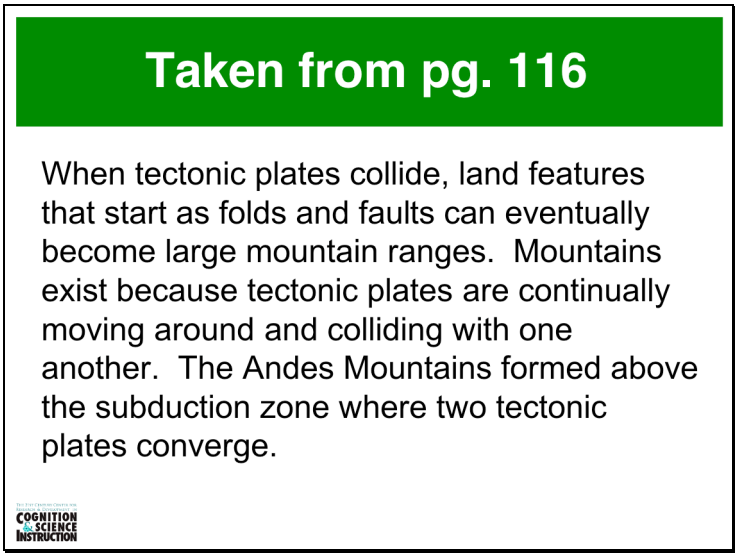
Next, the teacher asks the students, what is role of the red lines in the image? [The red lines show the borders of the different tectonic plates.]

The teacher can then remind students that they have seen a similar use of red lines before. [Here, the teacher can have students turn to Figure 4 on page 100 of their textbooks which the students have seen previously.]

The teacher makes the point that while not all colors are used in the same way, sometimes, particularly in textbooks, an author may consistently use some sort of color scheme, in this case red lines, in order to show similar pieces of information. If the reader pays attention to this, they can use this information to interpret similar diagrams that they encounter later.

(Continue to the next slide)

Visualization Exercise 4.4c – Color & Captions (cont.)



The teacher then projects the above slide with information taken from page 116 and has students read the paragraph.

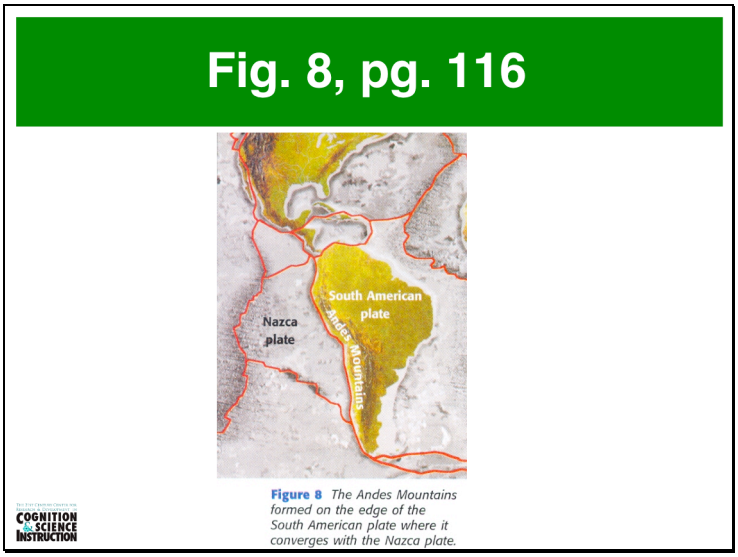
Next, either individually or in small groups, the teacher has the students write a caption for Figure 8 from page 116. [Here, the teacher can project the image of Figure 8 from the previous slide.]

The teacher then has students share their captions.

Note: The teacher should explain that many mountain ranges in the world have nothing to do with collisions. They are the result of different kinds of tectonics. Rift-related mountains, for example, are common, as are chains of volcanoes and foreland thrust belts in the absence of collisions. The important point for students to take from this is that convergence does not equal collision.

(Continue to the next slide)

Visualization Exercise 4.4c – Color & Captions (cont.)



After students have been given a chance to share their own captions, the teacher can project the above image or have students turn to Figure 8 on 116 of their textbooks to look at the caption written by the author.

The teacher can then lead a discussion on the importance of captions, including ideas from the students on what pieces of information they believe are necessary to have a good caption.

(End of Activity)

Day 45 – Deforming Earth's Crust

Visualization Exercise 4.4d – Cut-Away & Arrows

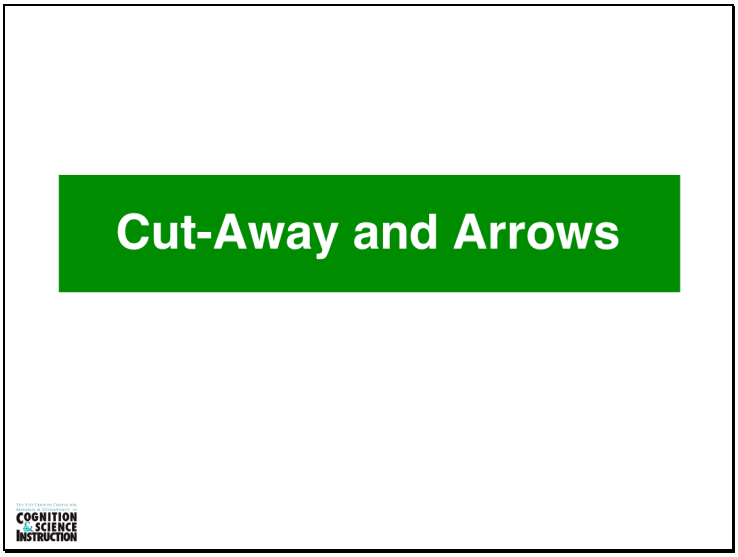


Image Comprehension Focus: Cut-Away and Arrows

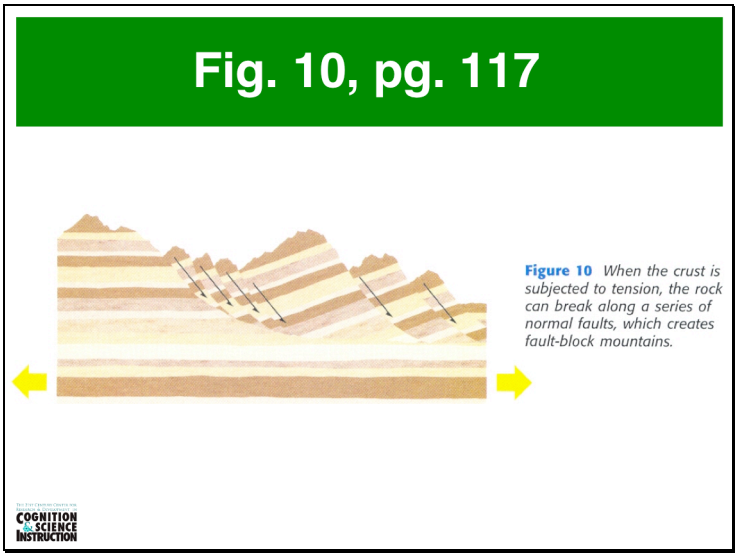
Goal: 1) Enhance students' understanding of cut-away, 2) Illustrate another use of arrows

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed as a brief review to enhance students' understanding of the use of cut-away as well as one use of arrows.

(Continue to the next slide)

Visualization Exercise 4.4d – Cut-Away & Arrows (cont.)



Procedure: The teacher has the students turn to Figure 10 on page 117 of their textbooks (shown above, if the teacher wants to project it).

The teacher then asks: What perspective is shown in this image and what is this perspective trying to show? [This perspective is a cut-away which is being used in order to show what happens to the different layers of rock (how rocks break) when there is tension placed on the crust.]

The teacher asks : Why do you think the author decided to use a cut-away perspective? [While students may have different answers to this, the teacher should emphasize that the cut-away convention is most often used in order to illustrate something, in this case the rock layers, that otherwise would be impossible to see.]

(Continue to the next slide)

Visualization Exercise 4.4d – Cut-Away & Arrows (cont.)

Fig. 10, pg. 117

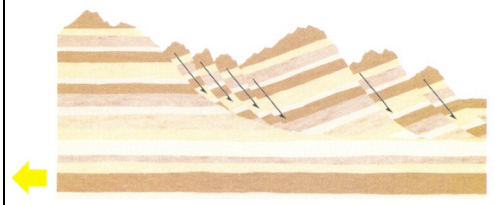


Figure 10 *When the crust is subjected to tension, the rock can break along a series of normal faults, which creates fault-block mountains.*

As a brief review, the teacher can then ask the students:

- Which arrows are being used to show the compression that the crust is subjected to? [the yellow arrows]
- Which arrows are being used to show the breaks along the faults? [the black arrows with the half arrow heads]

The teacher can point out that these arrows are similar to those used in figure 2 from page 113 and figures 4, 5 and 6 from pages 114-115, respectively. The teacher should also point out that in many diagrams, different arrows will serve different roles within the same image and that it is important to not assume the same role for all arrows even within the same diagram.

(End of Activity)

DAY 46

Oh, the Pressure!

In this lesson, students complete the modeling lab described on pages 186-188.

Big Ideas

- The movements of tectonic plates can cause rock layers to bend or break.
- When a rock layer breaks and forms two blocks of rock that grind past each other, the surface where they meet is called a fault.

Materials

Teacher:

none

Students:

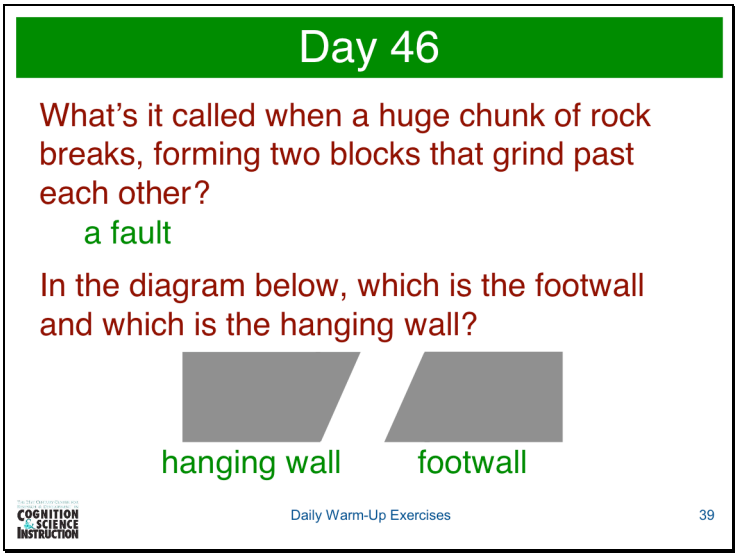
1. modeling clay (4 colors)
2. rolling pin (or soup can)
3. poster board strip (15 x 5 cm)
4. two poster board squares (5 x 5 cm)
5. plastic knife
6. colored pencils
7. newspaper

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – modeling lab – *Oh, the Pressure!* – pages 186-188

Day 46 – Oh, the Pressure!

Warm-Up Activity



What can cause a huge chunk of rock to bend or break?
the movement of tectonic plates

What causes tectonic plates to move?
convection currents within the mantle

What are convection currents?
motion cycles that happen when the warm part of a fluid rises and the cool part sinks

DAY 47

Comprehensive Review

This lesson provides an opportunity for students to prepare for quiz 9, which is a full-period quiz that will cover everything they've learned so far (section 5 of chapter 3 and all of chapters 1, 2, and 4).

Big Ideas

- See list of big ideas, Days 1-46.

Materials

Teacher:

1. vocabulary list – RE word list.doc
2. list of big ideas – RE big ideas.pdf

Students:

none

Activities & Allotted Time (40 minutes total)

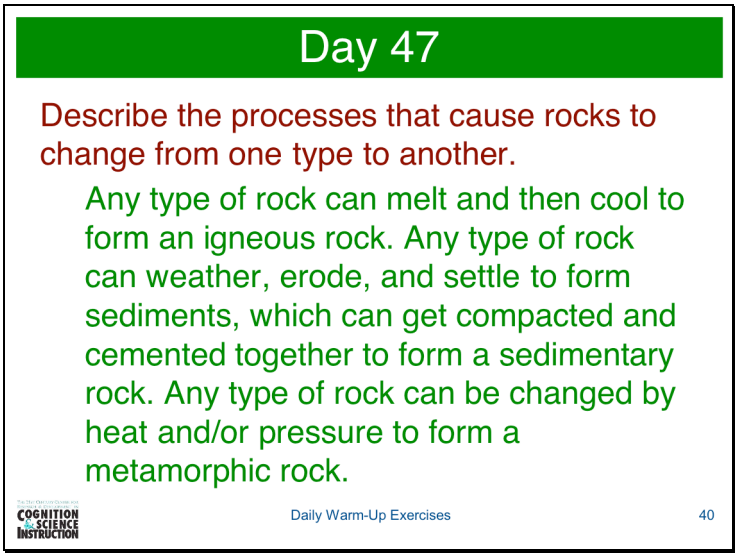
5 minutes – warm-up activity
35 minutes – review section 3.5 and chapters 1, 2 & 4

Review Section 3.5 and Chapters 1, 2 & 4

After reviewing the meanings of vocabulary words and the big ideas from days 1-46, use the chapter 4 review on pages 122 and 123 and the section review questions on pages 111 and 119 to identify areas that need additional attention.

Day 47 – Comprehensive Review

Warm-Up Activity



What do we call this series of processes?
the rock cycle

What does compacted mean?
to get squeezed or pressed together so it takes up less space

DAY 48

Quiz 9

Quiz 9 is a comprehensive assessment that covers section 3.5 and chapters 1, 2, and 4.

Big Ideas
See list of big ideas, Days 1-46.

Materials

Teacher:
none

Students:
1. Quiz 9

Activities & Allotted Time (40 minutes total)

40 minutes – quiz

Day 48 – Quiz 9

Quiz 9 – Page 1

1. What processes change sediments into sedimentary rock?
   a. weathering and erosion
   (b.) compaction and cementation
   c. stratification and folding

2. Metamorphism can best be defined as _____.
   a. compaction and cementation of rock fragments
   b. solidification of magma by cooling
   (c.) changing of a rock by heat and/or pressure

3. Metamorphic rocks _____.
   a. always contain fossils
   b. sometimes contain fossils
   (c.) rarely contain fossils

4. What processes will change a sedimentary rock into an igneous rock?
   (a.) melting; cooling; hardening
   b. heating; recrystallization; deformation
   c. deposition; compaction; cementation

5. Which statement about metamorphic rocks is the most complete?
   a. They are formed from sedimentary rocks.
   b. They are formed from sedimentary and igneous rocks.
   (c.) They are formed from all three types of rocks.

6. An igneous rock changes to sediment by _____.
   a. heat and pressure
   (b.) weathering and erosion
   c. melting and cooling

Inside the Restless Earth

Day 48 – Quiz 9

Quiz 9 – Page 2

7. Which layer includes the crust and rigid outer area of the mantle?
   (a.) lithosphere
   b. mesosphere
   c. asthenosphere

8. The hypothesis that Earth's continents were once connected into a single landmass is called _____.
   (a.) continental drift
   b. sea-floor spreading
   c. magnetic reversal

9. The process in which new oceanic crust forms as tectonic plates move apart and magma rises and solidifies is called _____.
   a. continental drift
   (b.) sea-floor spreading
   c. magnetic reversal

10. When an oceanic plate collides with a continental plate, _____ sinks into the asthenosphere.
    (a.) the denser oceanic plate
    b. the denser continental plate
    c. whichever plate is denser

11. What happens when part of a fluid is warm and part is cool?
    a. The warm part sinks and the cool part rises.
    (b.) The warm part rises and the cool part sinks.
    c. The warm and cool parts move toward each other.

12. At a divergent plate boundary, tectonic plates are moving _____.
    a. toward each other
    (b.) away from each other
    c. past each other sideways

Inside the Restless Earth

Day 48 – Quiz 9

Quiz 9 – Page 3

13. When a rock layer breaks and forms two blocks of rock that grind past each other, the surface where they meet is called a _____.
    a. monocline
    (b) fault
    c. ridge

14. About how far does a tectonic plate move in a year
    (a) a few centimeters
    b. a few meters
    c. a few kilometers

15. What causes tectonic plate to move?
    a. magnetic-pole reversals
    (b) convection currents in the mantle
    c. energy from ocean currents

16. What is a convection current and how does it form?

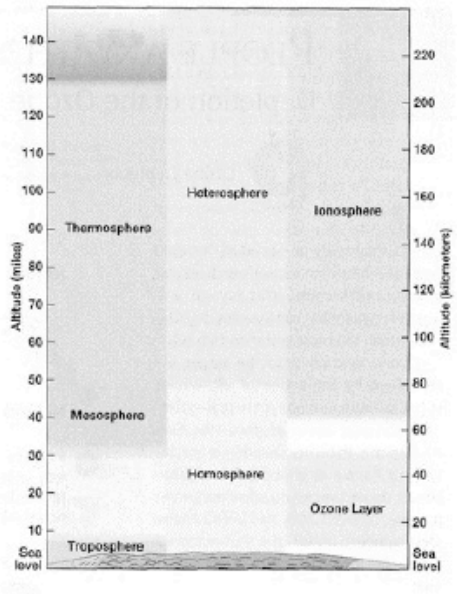
It is a motion cycle that happens when part of a fluid is warmer than the rest. The warm part is less dense than its surroundings, so it rises. Cool fluid moves in to take its place. As the warm part rises, it cools, gets denser, and sinks.

Inside the Restless Earth

Day 48 – Quiz 9

Quiz 9 – Page 4

17. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the figure.



The vertical distribution pattern of the various atmospheric spheres

According to the above figure, if you were to travel 30 kilometers above sea level, you would find yourself in the _____.

a. troposphere
(b.) ozone layer
c. mesosphere
d. ionosphere

End-of-Section Survey – Chapter 4

activity	did as described	modified	didn't do	comments
Day 36 Warm-Up (page 248)				
vis 4.1a – Arrows (pages 249-250)				
vis 4.1b – Cut-Away & Color (pages 251-254)				
chp 4.1, part 1 (page 247-248 & Holt, pages 96-97)				
Day 37 Warm-Up (page 257)				
vis 4.1c – Zoom & Arrows (pages 258-260)				
chp 4.1, parts 2 & 4 (page 255-256 & Holt, pages 98,99,102)				
Day 38 Warm-Up (page 262)				
vis 4.1d – Color & Cut-Away (pages 263-265)				
chp 4.1, part 3 (page 261 & Holt, pages 100-101)				

End-of-Section Survey – Chapter 4

activity	did as described	modified	didn't do	comments
Day 39 Warm-Up (page 267)				
vis 4.2a – Captions (pages 268-271)				
vis 4.2b – Color (pages 272-273)				
vis 4.2c – Zoom & Arrows (pages 274-278)				
chp 4.2 – *Restless Continents* (page 266 & Holt, pages 104-107)				
Quiz 8 (pages 280-282)				
Reteach/Review Chp. 4.1 & 4.2 (page 279)				
Day 41 Warm-Up (page 284)				
cc 4.3a – compare convection models (pages 283-295)				
Day 42 Warm-Up (page 297)				
cc 4.3b – compare plate motion (pages 296-310)				
Day 43 Warm-Up (page 312)				
vis 4.3a – Labels, Color & Arrows (pages 313-315)				
chp 4.3, part 1 (page 311 & Holt, pages 108-109)				

End-of-Section Survey – Chapter 4

activity	did as described	modified	didn't do	comments
Day 44 Warm-Up (page 317)				
vis 4.3b – Cut-Away, Arrows & Color (pages 318-320)				
chp 4.3, parts 2 & 3 (page 316 & Holt, pages 110-111)				
Day 45 Warm-Up (page 322)				
vis 4.4a – Arrows & Labels (pages 323-325)				
vis 4.4b – Arrows (pages 326-327)				
vis 4.4c – Color & Captions (pages 328-331)				
vis 4.4d – Cut-Away & Arrows (pages 332-334)				
chp 4.4 – *Deforming Earth's Crust* (Holt, pages 112-119)				
Day 46 Warm-Up (page 336)				
modeling lab – *Oh, the Pressure!* (Holt, pages 186-188)				
Day 47 Warm-Up (page 338)				
comprehensive review (page 337)				
Quiz 9 (pages 340-343)				

DAY 49

Compare Major Events

This lesson is contrasting case activity 5.1, in which students compare two earthquakes and two volcanoes. In addition to conveying the catastrophic nature of each event, the description cards will help students begin to understand how earthquakes and volcanoes are caused by the movements of tectonic plates. This is the first lesson of chapter 5, Earthquakes.

Big Ideas

- Many earthquakes and volcanoes are caused by the movements of tectonic plates.

Materials

Teacher:

1. slides – day49.ppt

Students:

1. event descriptions & plates map – worksheets 28-32
2. markers or colored pencils

Activities & Allotted Time (40 minutes total)

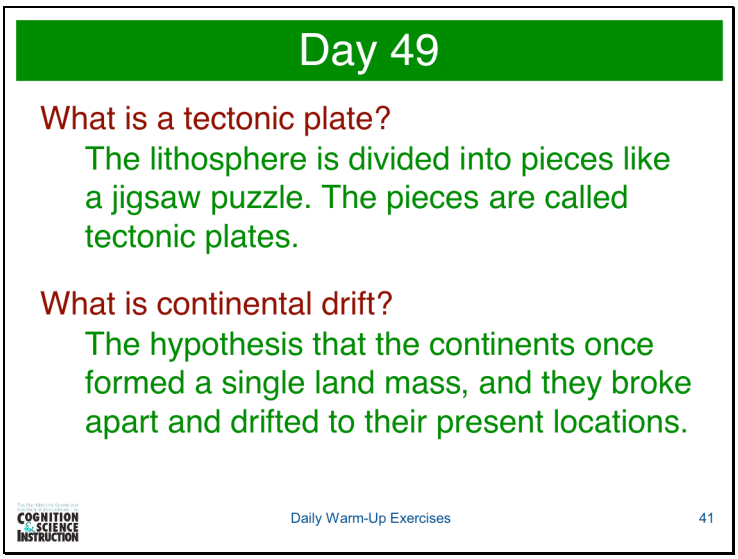
5 minutes – warm-up activity
35 minutes – cc activity – compare major events

Compare Major Events

In this activity, students read descriptions of four catastrophic events. The first paragraph describes the event itself, and the second paragraph describes the tectonic plate movements that caused the event. The powerpoint presentation includes a number of additional photographs and diagrams to help students understand each event and figure out where it occurred in relation to the tectonic plates that caused it. After reading about each event, students locate and mark the boundary between the plates that caused it, and they complete a table that lists the name of each plate, the type of crust (continental or oceanic), and the type of boundary (convergent, divergent, or transform).

Day 49 – Compare Major Events

Warm-Up Activity



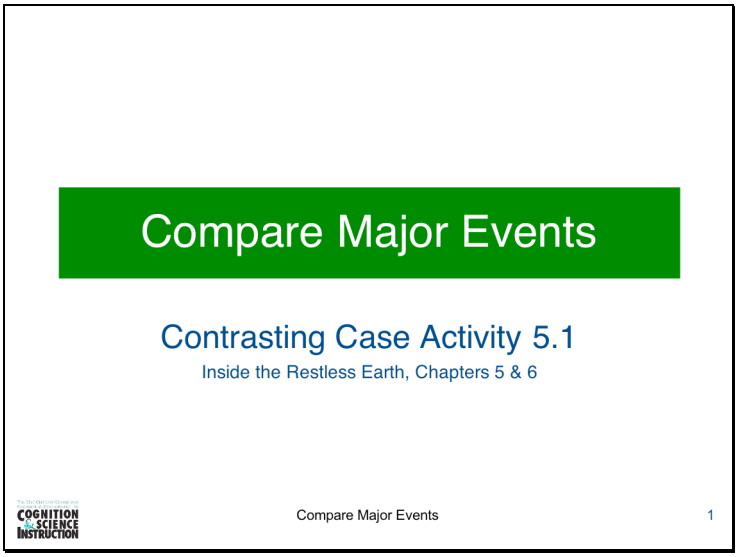
What is the lithosphere?
the rigidly solid outer layer of the Earth that consists of the crust and upper mantle

Which tectonic plate do we live on?
the North American plate

What causes tectonic plates to move?
convection currents in the mantle

Day 49 – Compare Major Events

Compare Major Events (cont.)

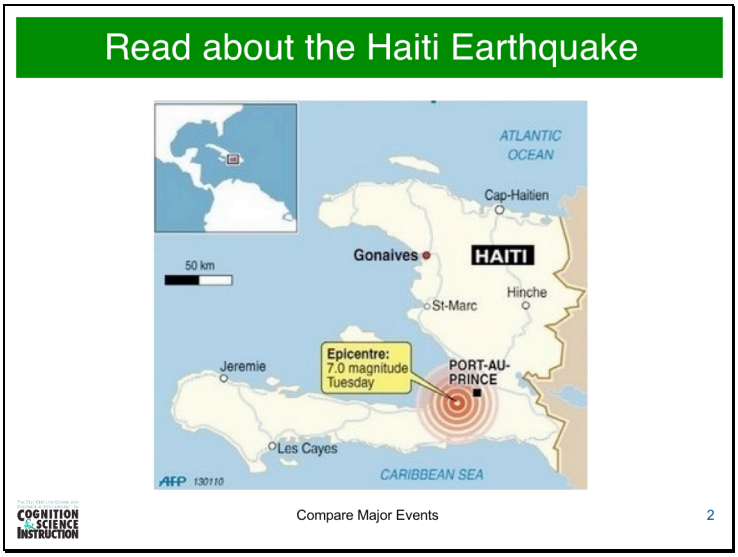


Materials for students:

- event descriptions & plates map (worksheets 28-32)
- markers or colored pencils

Day 49 – Compare Major Events

Compare Major Events (cont.)



Distribute the event descriptions & plates map (worksheets 28-32), and have students examine the Haiti description (worksheet 28). The map on this slide is the same as the map on the student page. Make sure students understand that the red circles show where the earthquake was centered and the small box in the upper left corner shows where the close-up view is situated. The next slide contains a map that may help students better understand where Haiti is located. You might want to go over both slides with your students, then read the description together. Encourage students to explain each paragraph in their own words.

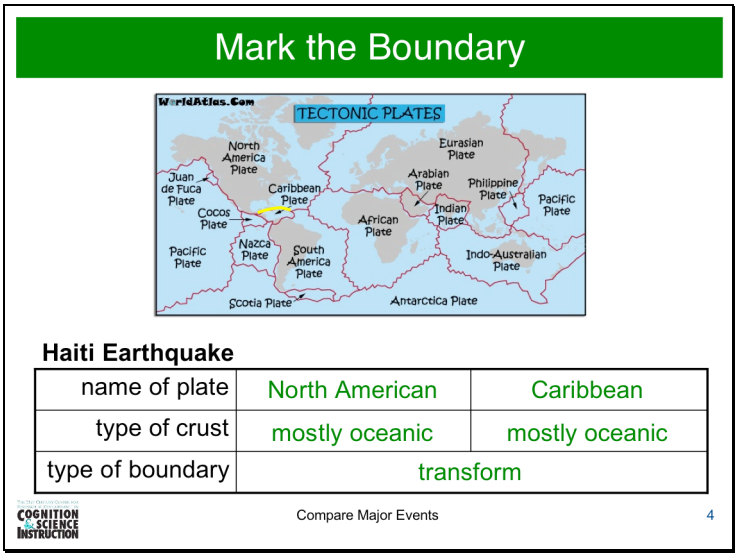
Day 49 – Compare Major Events

Compare Major Events (cont.)

This map shows where Haiti is located in relation to the United States. It also shows the top half of Columbia, where the second volcano (Nevado del Ruiz) is located.

Day 49 – Compare Major Events

Compare Major Events (cont.)

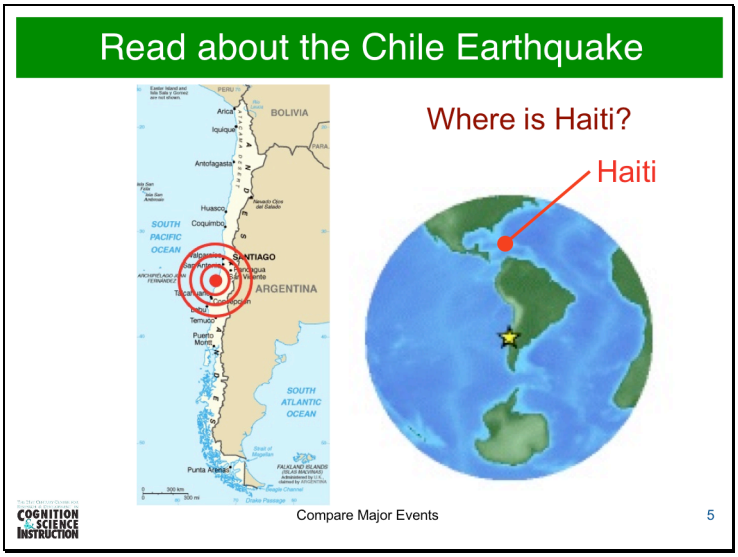


When students have finished reading about the Haiti earthquake, have them look at the plates map (worksheet 32) and try to find the boundary between the plates that caused the Haiti Earthquake. [The yellow line will appear on keypress.]

Have students complete the Haiti table by filling in information from the second paragraph. For "type of crust," they should describe what each plate is like at the yellow boundary. Have students work in groups, then go over the answers together.

Day 49 – Compare Major Events

Compare Major Events (cont.)

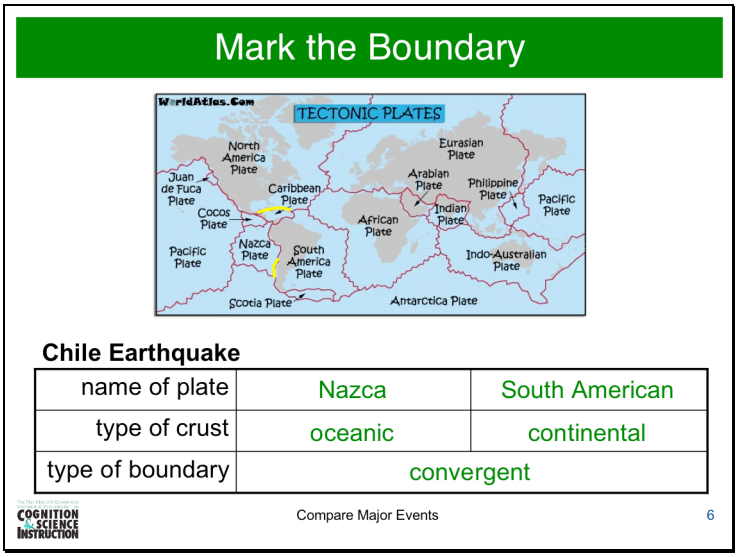


Have students examine the page about Chile (worksheet 29). The images on this slide are the same as on the student page. Make sure students understand that the yellow star on the globe shows where the close-up view is situated.

[The question about Haiti and its location will appear separately on keypress.]

Day 49 – Compare Major Events

Compare Major Events (cont.)

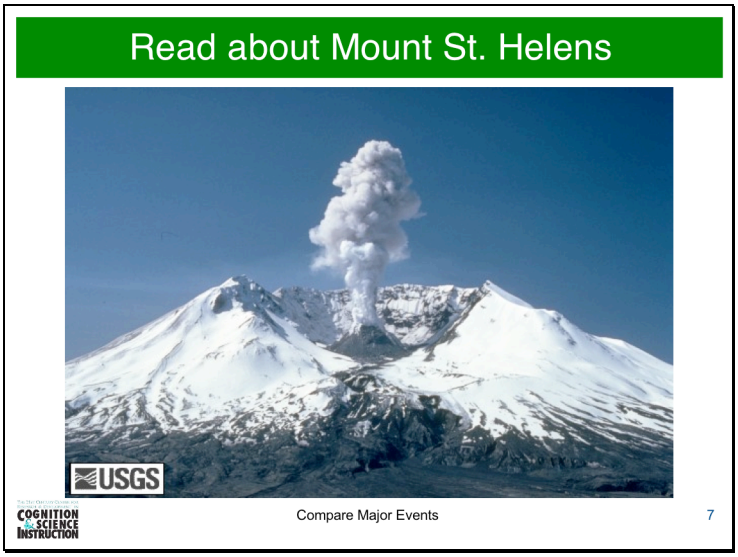


When students finish reading about the Chile earthquake, have them try to find the boundary between the plates that caused it. [The second yellow line will appear on keypress.]

Have students work in groups to complete the Chile table, then go over the answers together.

Day 49 – Compare Major Events

Compare Major Events (cont.)



Have students examine the page about the Mount St. Helens eruption (worksheet 30). The photo on this slide is the same as on the student page. As students are reading the first paragraph, show them the next three slides, which provide photos of the mountain before, during, and after the eruption.

As students are reading the second paragraph, show them slide 11. It provides two diagrams that may help students understand the plate movements described in the paragraph.

Day 49 – Compare Major Events

Compare Major Events (cont.)

U. S. Forest Service photograph taken before May 18, 1980, by Jim Nieland

Day 49 – Compare Major Events

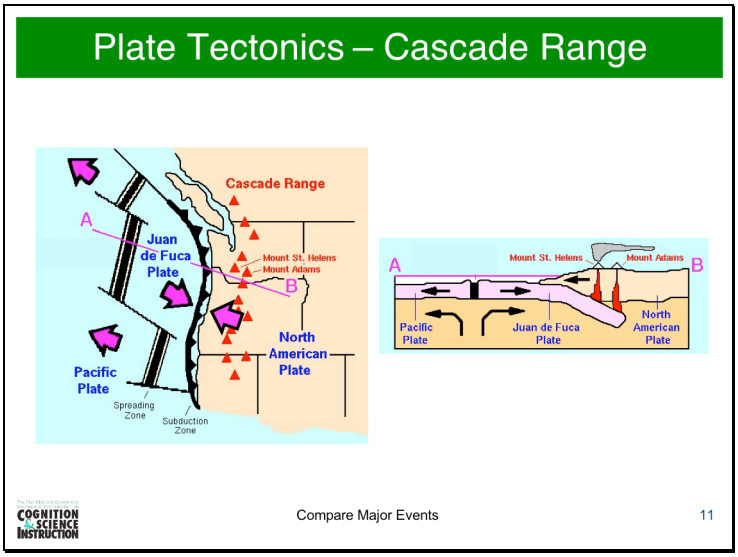
Compare Major Events (cont.)

U. S. Geological Survey photograph taken on May 19, 1982, by Lyn Topinka

Encourage students to compare this photo with the one taken before the eruption (slide 8). They should notice that the dense forests on this side of the mountain have been completely wiped out.

Day 49 – Compare Major Events

Compare Major Events (cont.)



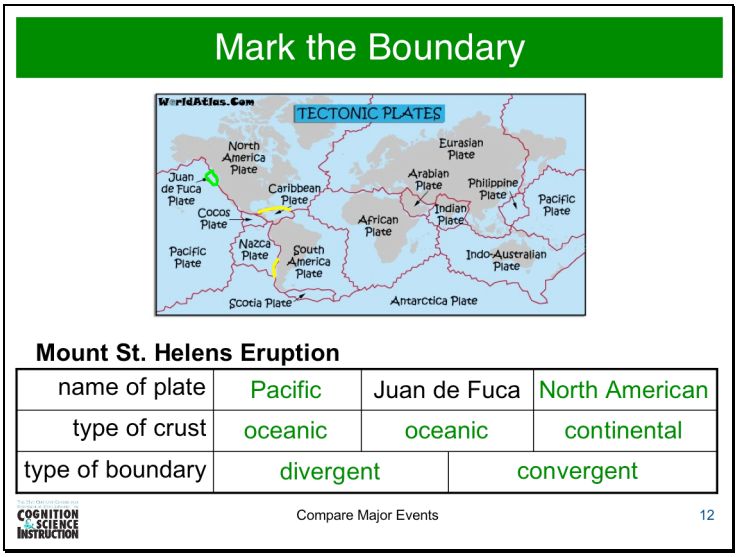
U. S. Geological Survey diagram

Tell students that the arrows on the left diagram show the movements of three plates. The Pacific and Juan de Fuca plates are moving away from each other, and the Juan de Fuca and North American plates are moving toward each other. (Note to teacher: The Pacific plate is not directly related to the eruption of Mount St. Helens. However, the divergent boundary between the Pacific and Juan de Fuca plates may help students understand why the Juan de Fuca plate is moving toward the North America plate.)

The diagram on the right shows a cross section of the area indicated by the A-B line in the left diagram. The cross section shows the convection current under the Pacific-Juan de Fuca boundary. In that area, the mantle is rising and spreading, which is why the plates are moving apart. This may help students understand the description of the Juan de Fuca plate "sinking and moving under the North American plate." It also shows magma forming and rising to the surface, which may help students understand why pressure builds when trapped gases expand as the magma rises.

Day 49 – Compare Major Events

Compare Major Events (cont.)



When students finish reading about Mount St. Helens, have them try to find the boundaries between the plates that caused the Cascade Range to form and Mount St. Helens to erupt. This case is more complicated than the others, because there are three plates instead of just two. [The first green line shows the boundary between the Pacific and Juan de Fuca plates. The second shows the boundary between the Juan de Fuca and North American plates.]

Have students look at the Mount St. Helens table. The Juan de Fuca plate is already entered, and the type of boundary row has two columns. The first is for the boundary between the Juan de Fuca and whichever plate is entered in the first column of the top row. The second is for the other boundary.

Have students work in groups to complete the table, then go over the answers together.

Day 49 – Compare Major Events

Compare Major Events (cont.)

Have students read the first sentence about Nevado del Ruiz (worksheet 31). The photo on this slide is the same as on the student page. It shows the town that was destroyed when the volcano erupted. The next slide provides a photo of the volcano itself, and slide 15 provides a map of Columbia.

Day 49 – Compare Major Events

Compare Major Events (cont.)

This photo shows the Nevado del Ruiz volcano. It will help students understand how melting snow and ice created flood waters that picked up soil and debris as they swept down the steep sides of the mountain.

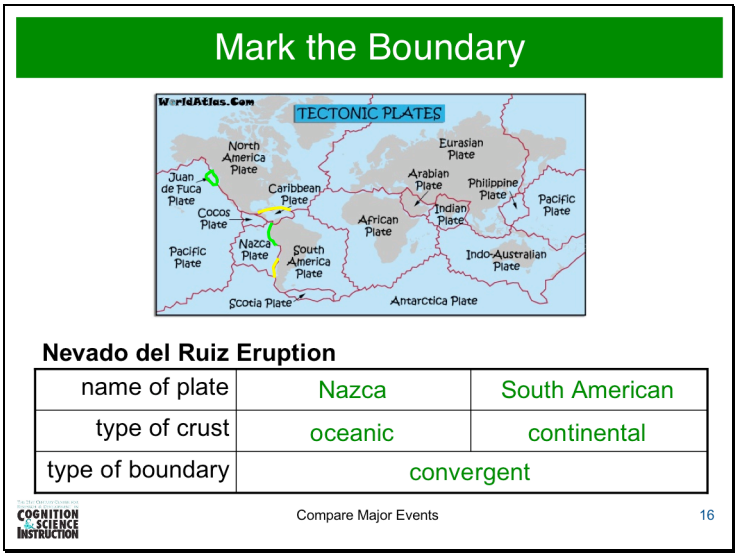
Day 49 – Compare Major Events

Compare Major Events (cont.)

U. S. Geological Survey map. Columbia is in the northwest corner of South America. This map shows the larger mountains in the Andes Volcanic Chain. It also shows the town of Amero, 45 miles east of Nevado del Ruiz. You might also return to slide 3, which shows where Columbia is located in relation to Haiti and the United States.

Day 49 – Compare Major Events

Compare Major Events (cont.)



When students finish reading about the eruption of Nevado del Ruiz, have them try to find the boundary between the plates that caused it. [The third green line will appear on keypress.]

Have students work in groups to complete the Nevado del Ruiz table, then go over the answers together.

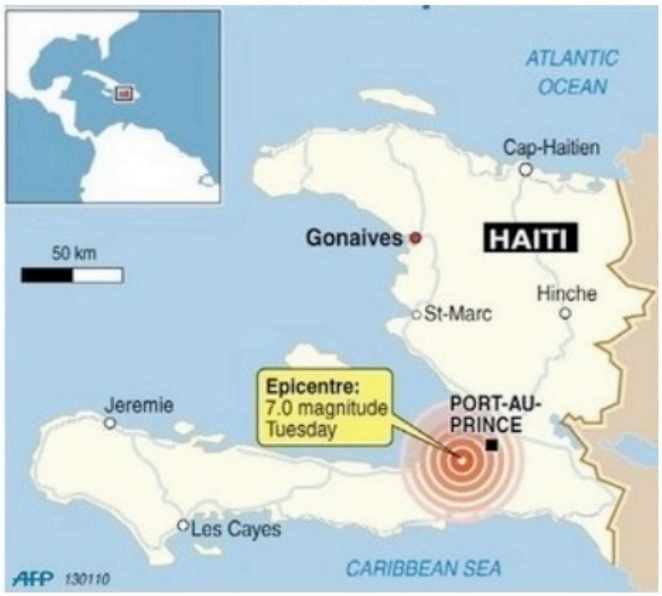
At this point, you might challenge your students to find out about the plate movements that caused the March, 2011 earthquake in Japan. Here are some web pages that might help, if they're still available:

- www.pbs.org/newshour/rundown/2011/03/japans-earthquake-and-tsunami-how-they-happened.html
- ibnlive.in.com/news/what-caused-the-japan-earthquake/145617-2.html
- montessorimuddle.org/2011/03/11/plate-tectonics-and-the-earthquake-in-japan/
- www.bbc.co.uk/news/world-asia-pacific-12725646
- www.iris.edu/hq/retm

Day 49 – Compare Major Events

Worksheet 28

Compare Major Events – Haiti 28



On Tuesday, January 12, 2010, a 7.0-magnitude earthquake struck Haiti. It only lasted for about 35 seconds, but more than 200,000 people were killed and at least 500,000 homes were damaged or destroyed. Government buildings, offices, hotels, schools, and stores collapsed during and after the earthquake, burying people beneath rubble. The earthquake also caused widespread power outages, destroyed roads and hospitals, and damaged communication systems, which hindered rescue and aid efforts. By January 24, at least 52 aftershocks measuring 4.5 or greater had been recorded.

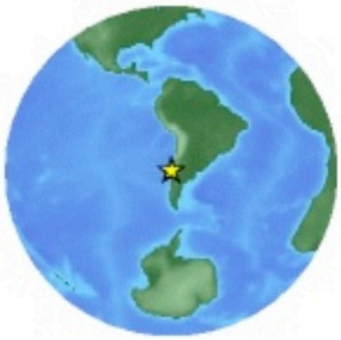
The earthquake was caused by the movements of two tectonic plates: the North American and the Caribbean. Haiti is part of a large island that lies on the boundary between these two plates. At that boundary, both plates have mostly oceanic crust. These two plates are not moving toward or away from each other. Instead, the two plates are moving side-by-side, with the North American plate heading west and the Caribbean plate heading east.

Chapters 5 & 6 – Earthquakes & Volcanoes

Day 49 – Compare Major Events

Worksheet 29

Compare Major Events – Chile 29



On Saturday, February 27, 2010, an 8.8-magnitude earthquake occurred off the coast of Chile. It lasted 90 seconds and triggered a tsunami that devastated several towns along the coast and caused minor damage in San Diego, California. The earthquake generated a blackout that affected 93% of the country and lasted several days in some locations. Although it was much stronger than the earthquake that struck Haiti, fewer than 1000 people died, perhaps because of Chile's strict laws requiring earthquake-resistant buildings.

The earthquake was caused by the movements of two tectonic plates: the Nazca and the South American. The Nazca plate has oceanic crust and, at that boundary, the South American plate has continental crust. As these plates move toward each other, the Nazca plate is sinking and moving under the South American plate.

Chapters 5 & 6 – Earthquakes & Volcanoes

Day 49 – Compare Major Events

Worksheet 30

Compare Major Events – Mount St. Helens 30

Mount St. Helens, in the state of Washington, is one of the most beautiful mountains of the Cascade Range. But on May 18, 1980, it erupted with a force that blew off the mountain's top and sent ash and debris more than 12 miles into the sky. Sixty two people were killed, and thousands of acres of prime forest were destroyed.

The formation of the Cascade Range and the eruption of Mount St. Helens were caused by the movements of three tectonic plates: the Pacific, the North American, and a tiny plate called Juan de Fuca, which lies between the other two. The Pacific and the Juan de Fuca plates have oceanic crust, and they are moving away from each other. The Juan de Fuca and North American plates are moving toward each other. At that border, the North American plate has continental crust, so the Juan de Fuca plate is sinking and moving under the North American plate. As the plate sinks, magma forms and then rises to the surface. Volcanoes that form this way typically erupt with explosive force, because trapped gases expand as the magma rises, creating tremendous pressure. This pent-up pressure is suddenly released in a violent eruption.

Chapters 5 & 6 – Earthquakes & Volcanoes

Day 49 – Compare Major Events

Worksheet 31

Compare Major Events – Nevado del Ruiz 31

This is an aerial photograph of Amero, a town in Columbia that was destroyed when the Nevado del Ruiz volcano erupted on November 13, 1985. It ejected only about 3 percent of the magma that erupted at Mount St. Helens, yet this tiny eruption triggered mudflows that killed more than 23,000 people. The hot volcanic material melted the snow and ice that covered the mountain, creating floods of water that swept downward. As these floods descended, they picked up soil and loose debris forming hot mudflows. Two and a half hours after the start of the eruption, one of the mudflows reached Amero, 45 miles from the volcano. Within a few short minutes, most of the town was buried or swept away.

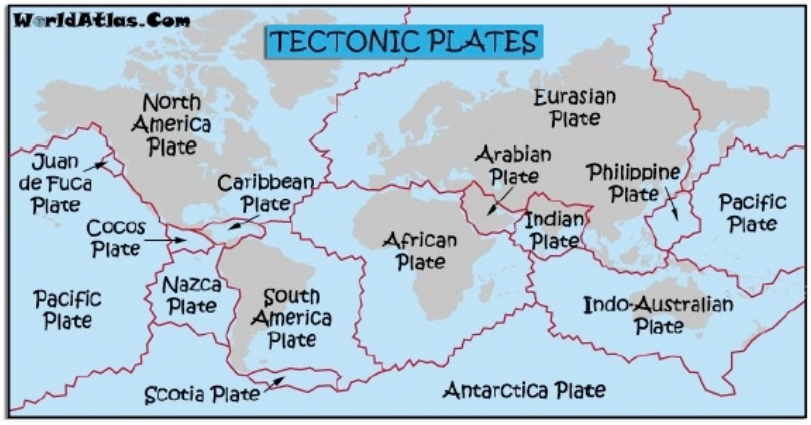
Nevado del Ruiz is in the Andes Volcanic Chain of western South America. The formation of the chain and the eruption of Nevado del Ruiz were caused by the movements of two plates: the Nazca, which has oceanic crust, and the South American, which has continental crust at that boundary. As these plates move toward each other, the Nazca plate is sinking and moving under the South American plate.

Chapters 5 & 6 – Earthquakes & Volcanoes

Day 49 – Compare Major Events

Worksheet 32

Compare Major Events – Plates Map 32



Haiti Earthquake

name of plate		
type of crust		
type of boundary		

Chile Earthquake

name of plate		
type of crust		
type of boundary		

Mount St. Helens Eruption

name of plate		Juan de Fuca	
type of crust			
type of boundary			

Nevado del Ruiz Eruption

name of plate		
type of crust		
type of boundary		

Chapters 5 & 6 – Earthquakes & Volcanoes

DAY 50

Origins of Earthquakes

This lesson covers the first three parts of section 5.1 (pages 130-133).

Big Ideas

- Most earthquakes happen near the edges of tectonic plates because the moving plates grind against each other.
- This can cause rock to change shape and, when it bounces back to its original shape, energy is released that causes an earthquake.

Materials

Teacher:

1. visualization exercises – day50.ppt
2. wooden blocks
3. sand paper
4. rubber band & thumbtack
5. cup of pennies

Students:

1. plates map from Day 49 (worksheet 32)

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 5.1a – Labels
5 minutes – visualization 5.1b – Zoom & Cut-Away
25 minutes – chapter 5.1, parts 1-3

Chapter 5.1, parts 1-3

Figure 1 provides a map of plate boundaries with red dots show locations of recorded earthquakes. Have students compare it with their plates map. They will see that both the Haiti and Chile earthquakes occurred in areas where earthquakes are fairly common.

Page 131 describes a teacher demo in which you glue sandpaper to blocks, then press them against each other and gently slide them in opposite directions until

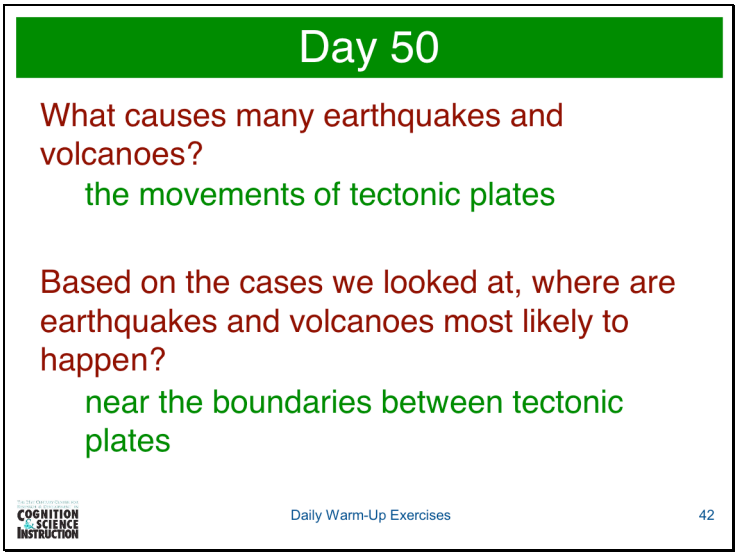
Day 50 – Origins of Earthquakes

Chapter 5.1, parts 1-3 (cont.)
there is sudden movement. This shows how two blocks of rock that are being pushed past each other tend to move in sudden bursts, sticking together until the force gets strong enough, then suddenly moving a great distance.

Another demonstration that may help students understand elastic rebound is to attach a rubber band to a wooden block and place the block on sandpaper. Place a cup on the block and add enough pennies so that, when you pull gently on the rubber band, it will stretch quite a bit before the block moves. (A video that explains this demonstration and suggests additional activities can be found at www.iris.edu/hq/programs/education_and_outreach/animations/1.)

Much of the information on pages 132 and 133 is a review of material from pages 114-115. Have students compare those two sections and see if looking at the explanations and diagrams together helps them better understand the ideas they convey.

Warm-Up Activity



What's the difference between divergent and convergent plate motion?
divergent is when plates move apart; convergent is when they come together

Day 50 – Origins of Earthquakes

Visualization Exercise 5.1a – Labels

Image Comprehension Focus: Naming & Explanatory labels

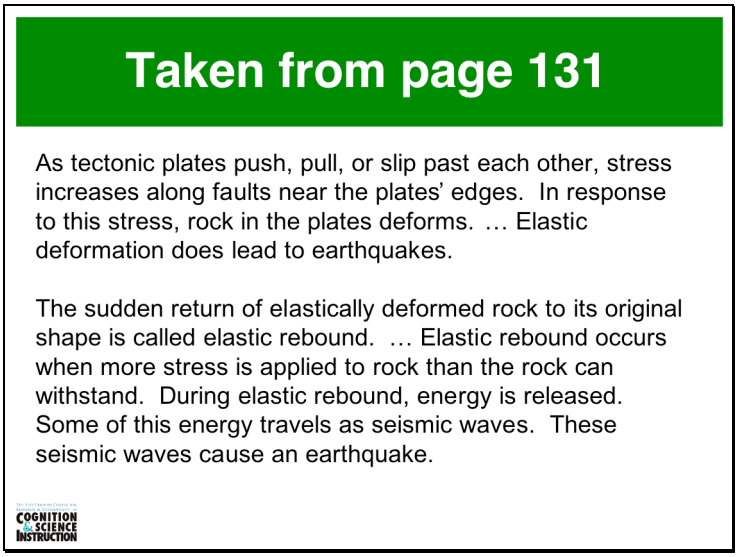
Goal: Review the role of naming and explanatory labels

Type of Activity: Teacher guided student activity

Overview: This exercise serves as a reinforcement of students' understanding as to the different types of labels and the important role of each type.

(Continue to the next slide)

Visualization Exercise 5.1a – Labels (cont.)

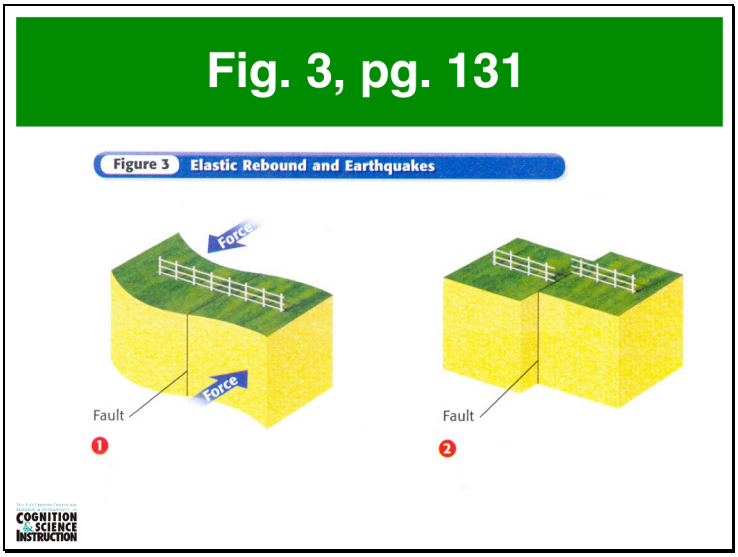


Procedure: The teacher has the students take a few minutes to read the above information, which is an edited selection of the text on page 131 of their textbooks.

(Continue to the next slide)

Day 50 – Origins of Earthquakes

Visualization Exercise 5.1a – Labels (cont.)



Next, either individually or in small groups, the teacher has the students do the following:

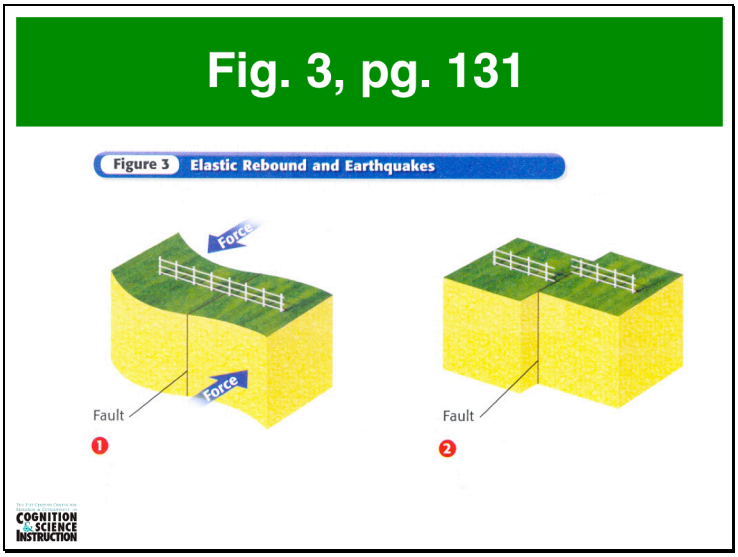
One of the above images represents before an earthquake and one represents after an earthquake. Please add the appropriate naming label, either, 'Before earthquake,' or 'After earthquake' to the appropriate image in Figure 3. ['Before' is on the left, 'After' on the right.]

The teacher should review the correct answers and ask the students how they knew which picture goes with which naming label. Here the teacher can point out that students could get the information either from the text, from the images themselves, or from the numbers that the author has chosen to add.

(Continue to the next slide)

Day 50 – Origins of Earthquakes

Visualization Exercise 5.1a – Labels (cont.)

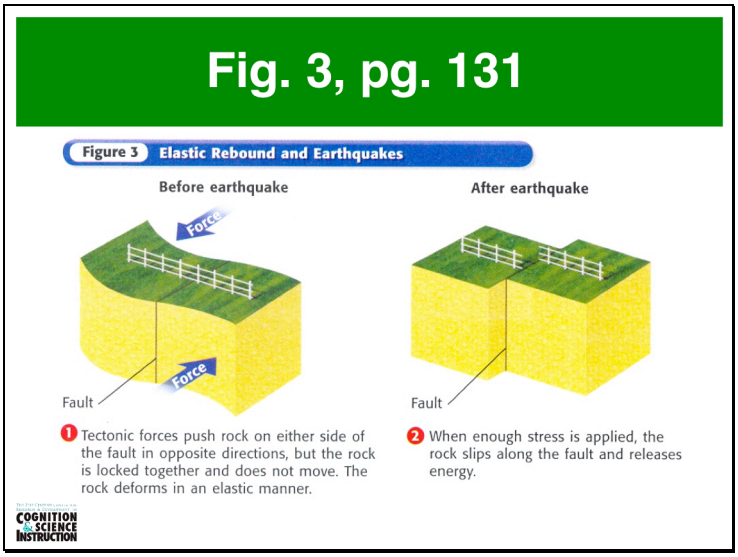


After the teacher has pointed out the numbers, the teacher then asks students, again either individually or in small groups, to write their own explanatory labels to correspond with each number. [Here, if the students are experiencing difficulty, the teacher may want to briefly review the role of explanatory labels. In this case, they provide a brief explanation of the process happening in the image.]

Next, the teacher has the students share their explanatory labels.

(Continue to the next slide)

Visualization Exercise 5.1a – Labels (cont.)



The teacher then has students turn to Figure 3, page 131 in their textbooks, shown above if the teacher wants to project it, and leads a discussion about the types of information that would be useful to use when writing an explanatory label.

(End of Activity)

Day 50 – Origins of Earthquakes

Visualization Exercise 5.1b – Zoom & Cut-Away

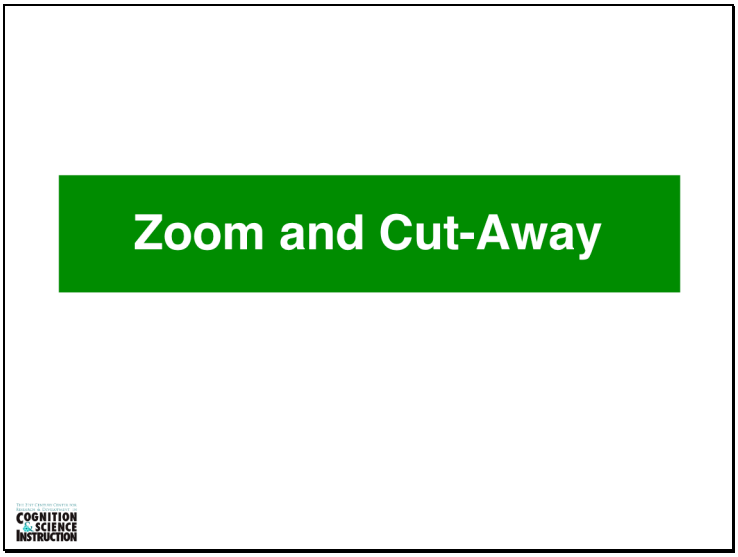


Image Comprehension Focus: Zoom and Cut-Away

Goal: Review the role of Zoom and Cut-Away in diagrams

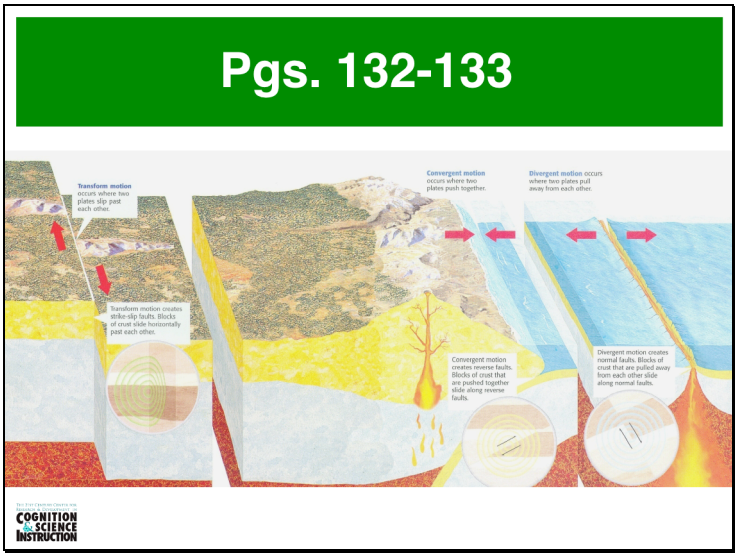
Type of Activity: Teacher Guided Student Activity

Overview: This exercise is designed to enhance students' understanding of the role/importance of zoom and cut-away when looking at diagrams.

(Continue to the next slide)

Day 50 – Origins of Earthquakes

Visualization Exercise 5.1b – Zoom & Cut-Away (cont.)



The teacher has the students turn to pages 132-133 in their textbooks, shown above if the teacher wants to project it.

The teacher asks: What is the role of the three large circles? [The three circles are zooms, which magnify something on an image that otherwise could be impossible to see. In this case, the view is that of a fault at the edge of a tectonic plate.]

The teacher then asks: What is the perspective inside of the zoom? [Inside the zoom, the perspective is a cut-away that is designed to show the different rock layers that otherwise would not be visible.]

Visualization Exercise 5.1b – Zoom & Cut-Away (cont.)

As an additional note, the teacher can ask the students about the concentric circles inside of the zooms. Specifically, the teacher can ask: For what purpose do you think the author is using the concentric circles inside of the zoom? [Here, it is a bit unclear what the purpose of the concentric circles is. Students may give different answers and may have difficulty with this. The teacher should then have the students turn to figure 1 on page 136 of their textbooks, which more clearly links concentric circles to an earthquake. Since authors will usually use a specific visual "trick" consistently within a text, the reader can use this as a clue to help understand this image.]

Once again, the teacher should point out that sometimes conventions can be used consistently to illustrate similar types of information in different diagrams, and that it is helpful to look for such patterns.

The teacher should also point out that this is a much better illustration of the magma chamber in a convergent zone than previous examples, and that they all should look like this one. The teacher may want to refer back to visualization 4.3a to provide an example of a poor illustration.

(End of Activity)

DAY 51

Seismic Waves

This lesson covers the last part of section 5.1 (pages 134-135).

Big Ideas

- Earthquakes release energy in seismic waves that travel away from the epicenter in all directions.

Materials

Teacher:

1. visualization exercises – day51.ppt

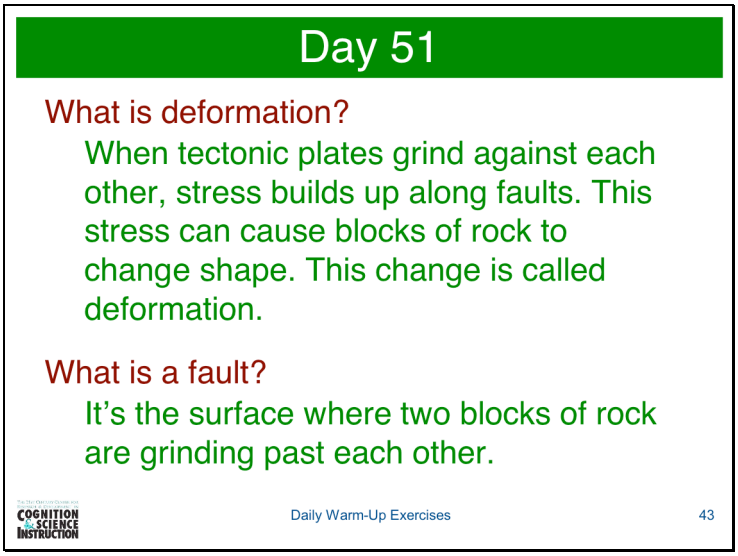
Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 5.1c – Labels & Arrows
30 minutes – chapter 5.1, part 4

Warm-Up Activity



Day 51 – Seismic Waves

Visualization Exercise 5.1c – Labels & Arrows

Image Comprehension Focus: Labels & Arrows

Goal: Enhance students' understanding of the role(s) played by labels and arrows

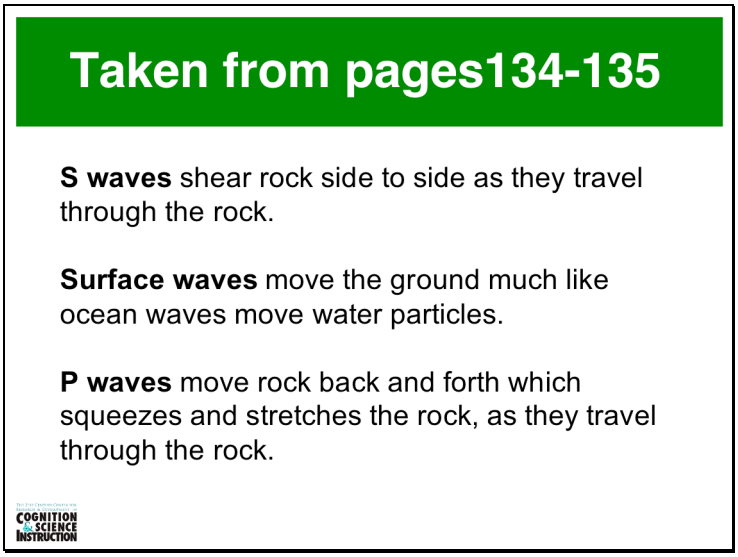
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed as a brief review of the importance of labels as well as the different roles played by arrows in diagrams.

(Continue to the next slide)

Day 51 – Seismic Waves

Visualization Exercise 5.1c – Labels & Arrows (cont.)



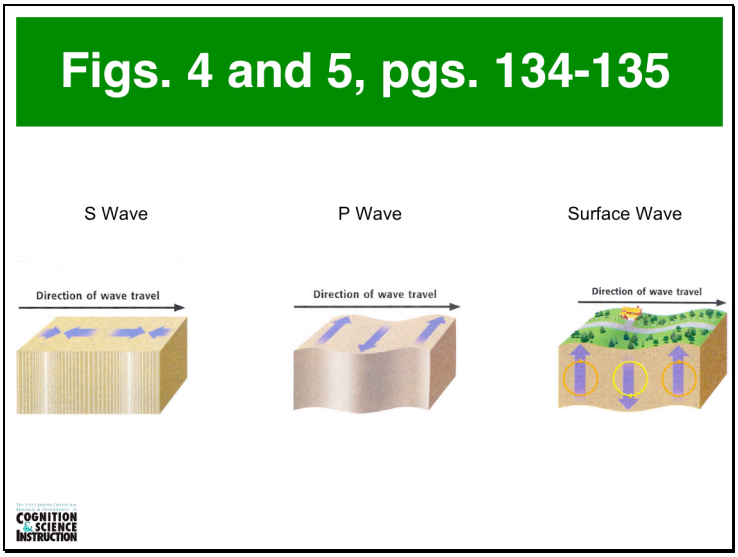
Procedure: The teacher projects the above information, taken from figures 4 and 5 on pages 134-135.

The teacher has the students take a few minutes to read and take notes from the information on the above slide.

(Continue to the next slide)

Day 51 – Seismic Waves

Visualization Exercise 5.1c – Labels & Arrows (cont.)



Procedure: The teacher projects the above image of figures 4 and 5 from pages 134-135.

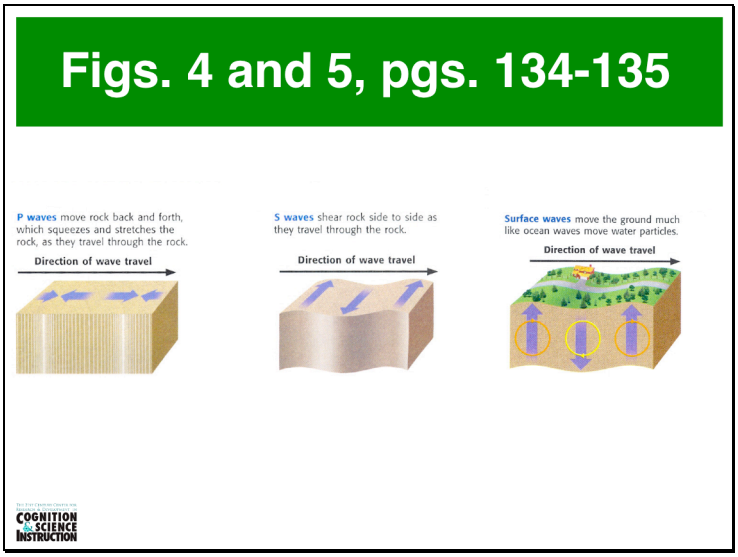
The teacher then explains that for each of the above images, the naming labels (S Wave, P Wave, Surface Wave) are not necessarily matched with the correct image.

Next, either individually or in groups, the teacher has the students match naming label with the correct corresponding image.

(Continue to the next slide)

Day 51 – Seismic Waves

Visualization Exercise 5.1c – Labels & Arrows (cont.)



The teacher then projects the above slide with the correct answers and asks students, by show of hands, how many were able to match the labels and images correctly.

The teacher can then ask the students, what pieces of information did you use in order to successfully match each label with the correct image? [Here, the teacher can take the opportunity to lead a discussion about how the arrows could have been used in order to match the words with the correct image. For example, S waves shear rock side to side, as illustrated by the arrows for that image.]

(End of Activity)

End-of-Section Survey – Chapter 5

activity	did as described	modified	didn't do	comments
Day 49 Warm-Up (page 348)				
cc 5.1–Compare Major Events (pages 347-368)				
Day 50 Warm-Up (page 370)				
vis 5.1a – Labels (pages 371-375)				
vis 5.1b – Zoom & Cut-Away (pages 376-378)				
chp 5.1, parts 1-3 (page 369-370 & Holt, pages 130-133)				
Day 51 Warm-Up (page 379)				
vis 5.1c – Labels & Arrows (pages 380-383)				
chp 5.1, part 4 (Holt, pages 134-135)				

DAY 52

Types of Eruptions

This lesson covers parts 1 and 2 of section 6.1 (pages 156-157).

Big Ideas

- A volcano is an opening that allows magma and gases to flow out onto Earth's surface.

Materials

Teacher:

1. visualization exercises – day52.ppt

Students:

1. volcano descriptions – worksheets 30 & 31

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 6.1a – Relative Scale & Magnification
30 minutes – chapter 6.1, parts 1 & 2

Chapter 6.1, parts 1 & 2

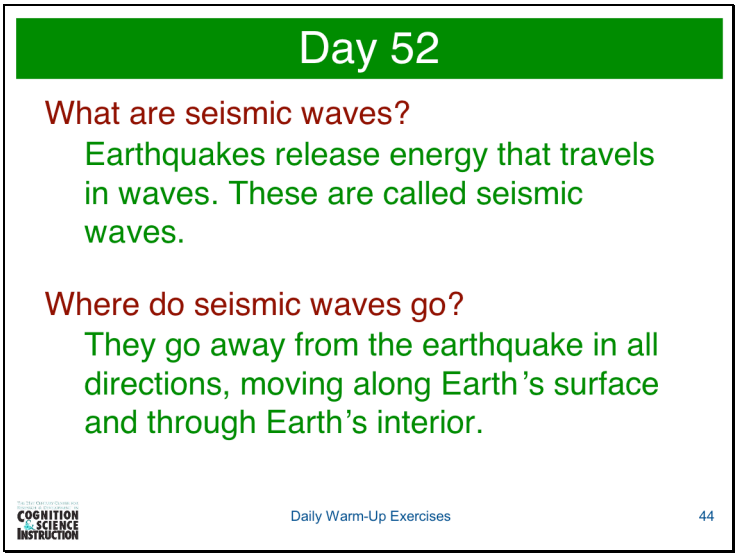
Parts 1 and 2 describe explosive and nonexplosive eruptions. Have your students reexamine the volcano descriptions from cc 5.1 and try to figure out whether each eruption was explosive or nonexplosive. They should have no trouble deciding that the Mount St. Helens eruption was explosive, because the first paragraph says "it erupted with a force that blew off the mountain's top and sent ash and debris more than 12 miles into the sky."

The Nevado del Ruiz description is trickier, because it doesn't say anything about the force of the eruption. It describes the eruption as "tiny" and says the amount of magma it released was only about 3% of the amount released by Mount St. Helens. But it doesn't say whether the lava flowed slowly or shot out rapidly. The only hint that the flow was sudden and forceful is that it melted snow and ice fast enough to create huge mudflows that traveled 45 miles within

Day 52 – Types of Eruptions

Chapter 6.1, parts 1 & 2
two and a half hours. After your students share their ideas, tell them the eruption was explosive. On the Volcanic Explosivity Index, Nevado del Ruiz was rated a 3, which is moderate to large, and Mount St. Helens was a 5, which is large to very large.

Warm-Up Activity



Why do most earthquakes happen near the edges of tectonic plates?
because the moving plates grind against each other

How can grinding plates cause an Earthquake?
When plates grind against each other, it can cause rock to change shape. When it bounces back to its original shape, energy is released that can cause an earthquake.

Day 52 – Types of Eruptions

Visualization Exercise 6.1a – Relative Scale & Magnification

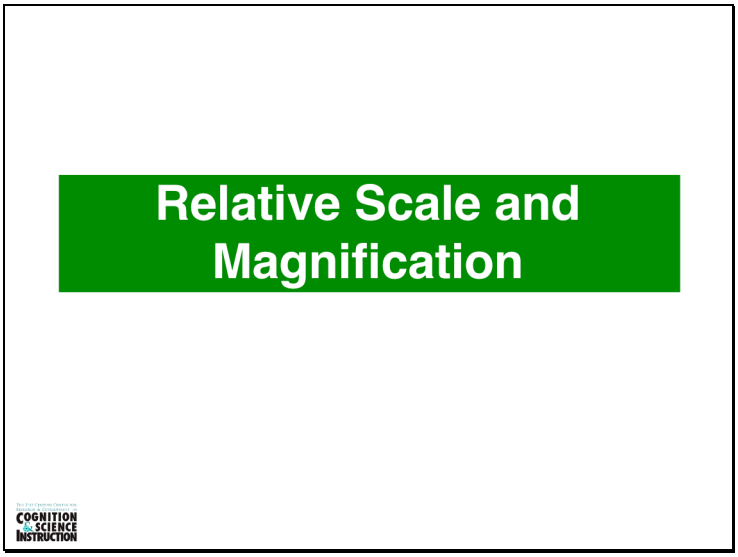


Image Comprehension Focus: Relative Scale and Magnification

Goal: To enhance students' understanding of relative scale and magnification.

Type of Activity: Teacher Guided Student Activity

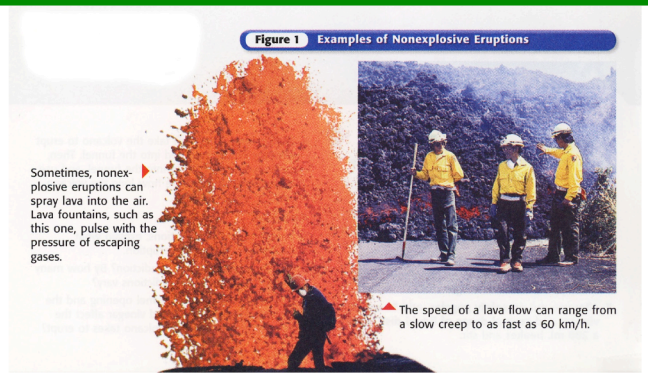
Overview: This activity is designed to introduce the concepts of relative scale and magnification.

(Continue to the next slide)

Day 52 – Types of Eruptions

Visualization Exercise 6.1a – Relative Scale & Magnification (cont.)

Fig. 1, pg. 156



Procedure: The teacher should ask the students to look at fig 1/p. 156, shown on the above slide if the teacher wants to project it.

Next the teacher should ask the students to speculate if the two images in the figure (the lava plume and the image of the three men in front of a lava flow) have the same scale (are at the same level of magnification).

The teacher should ask the students to support their responses with visual evidence from the image itself. [The two images most likely have different scales since the relative size of a man is different in each. In the lava plume image, the man is much smaller than the men in the other image. In fact, if one measured each they would find that the man in the plume image is approximately 2/3 the size of the men in the other image. While it is possible for there to be such a height difference, a more likely explanation is that the pictures use different scales.]

(End of Activity)

DAY 53

Magma

This lesson covers parts 3 and 4 of section 6.1 (page 158).

Big Idea

- Magma that contains a lot of water or silicon tends to cause explosive eruptions.

Materials

Teacher:

1. visualization exercises – day53.ppt

Students:

1. volcano descriptions – worksheets 30 & 31

Activities & Allotted Time (40 minutes total)

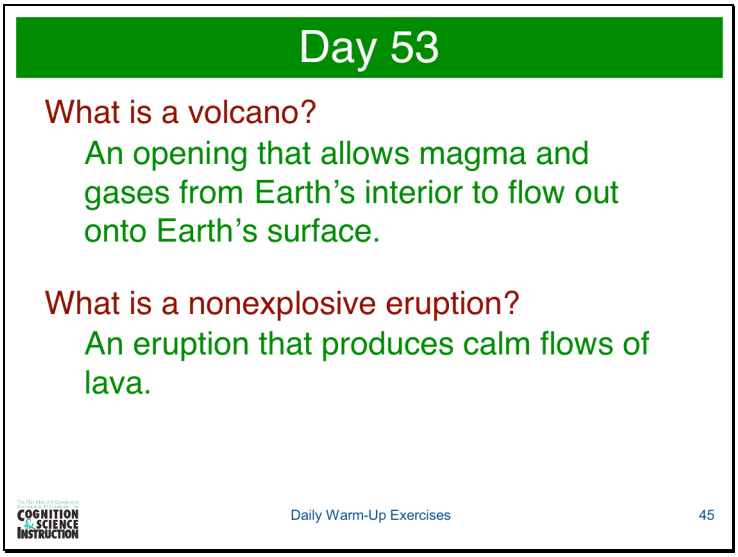
5 minutes – warm-up activity
5 minutes – visualization 6.1b – Cut-Away & Captions
30 minutes – chapter 6.1, parts 3 & 4

Chapter 6.1, parts 3 & 4

Page 158 explains why magma that contains a lot of water or silicon tends to cause explosive eruptions. Ask your students to relate this explanation to the volcano cards from cc 5.1. Both eruptions were explosive, and both were caused by an oceanic crust sinking and moving under a continental crust. Tell your students that, as oceanic crust sinks and undergoes metamorphosis, it releases water. This water is absorbed by the continental crust, causing it to melt and form magma that contains a lot of water.

Day 53 – Magma

Warm-Up Activity



Which is more common: explosive or nonexplosive eruptions?
nonexplosive

Day 53 – Magma

Visualization Exercise 6.1b – Cut-Away & Captions

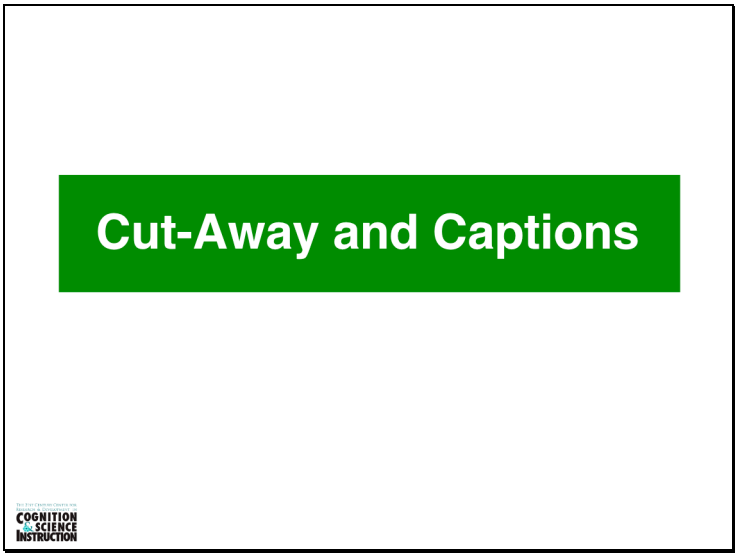


Image Comprehension Focus: Cut-Away and Captions

Goal: To review the idea of cut-away and emphasize the importance of captions.

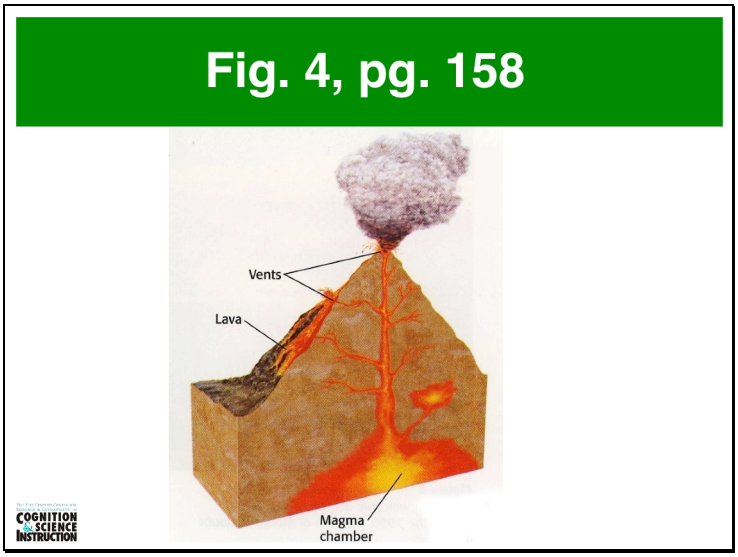
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed as a way to enhance students' understanding of the cut-away convention as well as re-emphasize the importance of captions and the features of a good caption.

(Continue to the next slide)

Day 53 – Magma

Visualization Exercise 6.1b – Cut-Away & Captions (cont.)



Procedure: The teacher projects Figure 4 from page 158 with no caption (shown above).

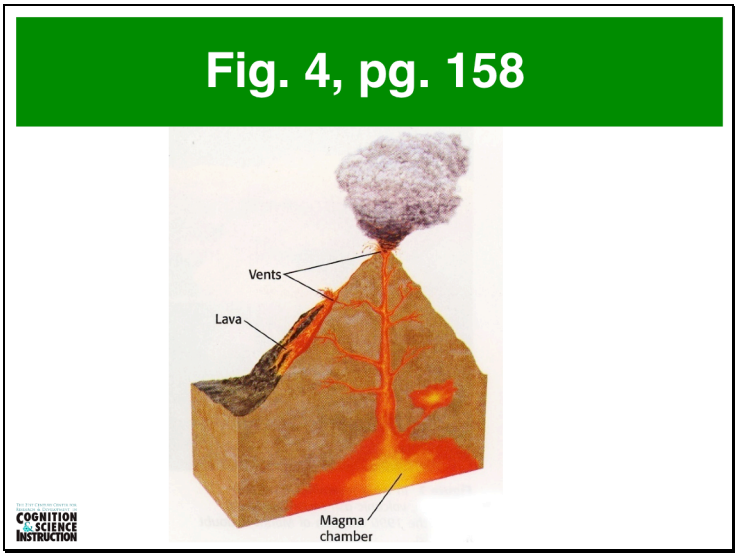
Next, the teacher asks the students, what perspective is being shown by Figure 4 and what is the perspective trying to represent? [The perspective is a 3D cut-away that is showing the inside of a volcano.]

The teacher then asks the students, why might the author have chosen to use this perspective? [While students may have different answers to this, the teacher should emphasize that without this perspective, it would be impossible to see certain features such as the magma chamber.]

(Continue to the next slide)

Day 53 – Magma

Visualization Exercise 6.1b – Cut-Away & Captions (cont.)



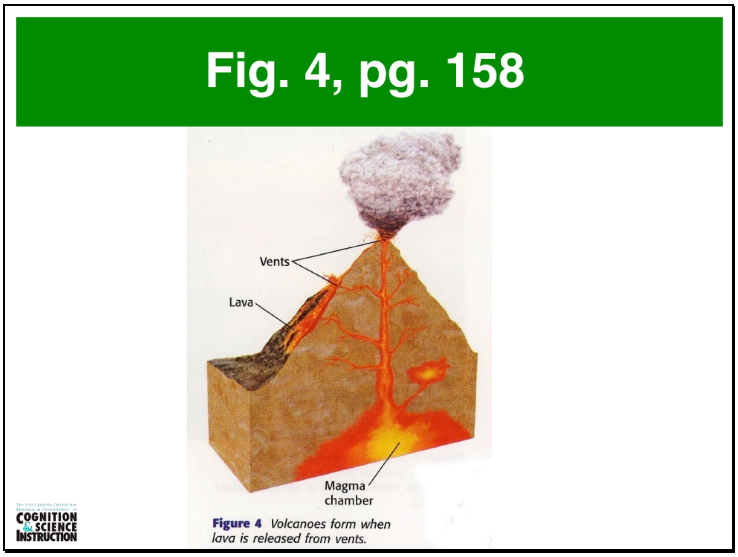
Next, either individually or in small groups, the teacher asks the students to write a caption for Figure 4 from page 158.

The teacher then asks the students to share the captions they have written.

(Continue to the next slide)

Day 53 – Magma

Visualization Exercise 6.1b – Cut-Away & Captions (cont.)



The teacher then has students turn to Figure 4 on page 158 of their textbooks (shown above with the caption if the teacher wants to project it).

The teacher can then lead a discussion on the importance of captions as well as what makes a good caption.

(End of Activity)

DAY 54

What Erupts?

This lesson covers the last part of section 6.1 (pages 159-161).

Big Idea

- Magma erupts as either lava (liquid) or pyroclastic material (solid).
- Pyroclastic material can range in size from huge boulders to tiny particles of volcanic ash.

Materials

Teacher:

1. visualization exercises – day54.ppt

Students:

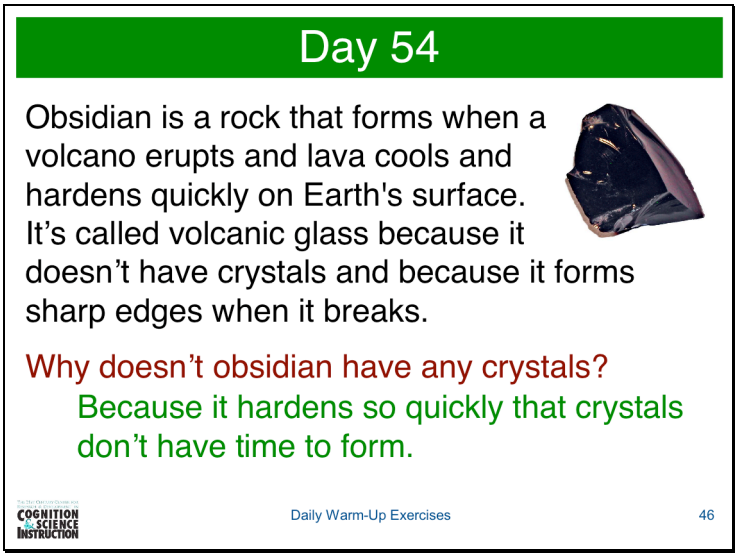
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 6.1c – Labels
30 minutes – chapter 6.1, part 5

Day 54 – What Erupts?

Warm-Up Activity



What type of rock is obsidian?
igneous

Is it an intrusive or extrusive igneous rock?
extrusive, because it forms on or near Earth's surface

Day 54 – What Erupts?

Visualization Exercise 6.1c – Labels

Image Comprehension Focus: Labels

Goal: Re-emphasize the importance of labels.

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to show students the importance of different labels, both naming and explanatory.

(Continue to the next slide)

Day 54 – What Erupts?

Visualization Exercise 6.1c – Labels (cont.)

The teacher projects the above images and explanatory labels from Figure 5 on page 159.

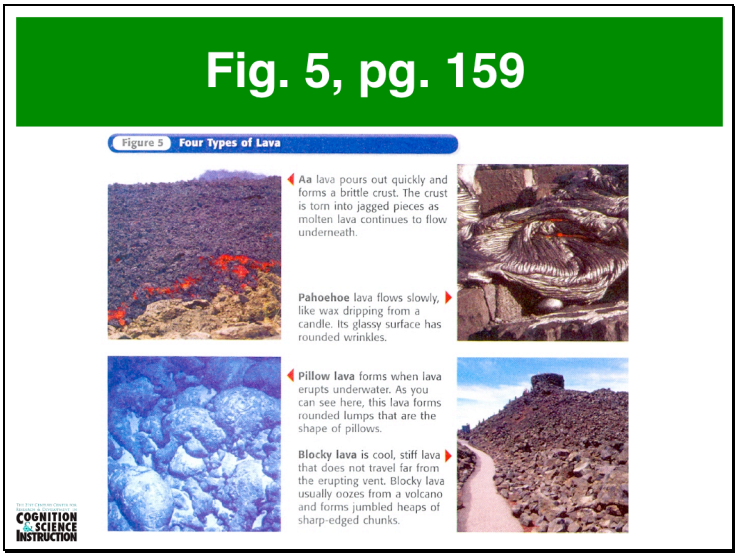
The teacher explains that the explanatory labels above are incorrectly matched with the images.

The teacher directs students, either individually or in small groups, to match each label with the image that best represents it.

(Continue to the next slide)

Day 54 – What Erupts?

Visualization Exercise 6.1c – Labels (cont.)



The teacher then projects the above image of the original figure with the correct answers.

The teacher can then take the opportunity to lead a discussion about various methods/pieces of information the students used in order to correctly match the labels and images. [Here, the teacher can point out the specific pieces of information from the labels that seem to go with each picture. For example, with Pahoehoe lava, the label suggests a glassy surface. The image that goes with this label is the only image that has a somewhat glassy surface.]

The teacher re-emphasizes the usefulness of labels when trying to explain parts of diagrams.

Note: The teacher should point out that the mechanism for Aa lava is incorrect. Aa lava forms as a flow degasses and cools. It is not simply Pahoehoe with the crust broken up.

(End of Activity)

DAY 55

Quiz 10/Reteach/Review

This lesson provides an opportunity for students to review what they've learned so far. For some, it may be an opportunity to understand an idea they didn't fully grasp the first time around.

Big Ideas
See list of big ideas, Days 1-54.

Materials

Teacher:

1. vocabulary list – RE word list.doc
2. list of big ideas – RE big ideas.pdf

Students:

1. Quiz 10

Activities & Allotted Time (40 minutes total)

10 minutes – quiz
10 minutes – go over quiz
20 minutes – reteach/review sections 5.1 & 6.1

Reteach/Review Sections 5.1 & 6.1
After going over the quiz and reviewing the meanings of vocabulary words and the big ideas from days 1-54, use the section review questions on pages 135 and 161 to identify areas that need additional attention.

Day 55 – Quiz 10/Reteach/Review

Quiz 10 – Page 1

1. What type of boundary is formed when tectonic plates move toward each other?
   (a.) convergent
   b. divergent
   c. transform

2. Magma tends to form at divergent plate boundaries because _____.
   a. temperature increases above the rock's melting point
   b. pressure increases, which lowers the rock's melting point
   (c.) pressure decreases, which lowers the rock's melting point

3. What causes convection currents in the mantle?
   a. ridge push and slab pull
   (b.) temperature differences within the mantle
   c. seismic waves within the mantle

4. What causes many earthquakes and volcanoes?
   (a.) tectonic plate movements
   b. magnetic reversals
   c. uplift and subsidence

5. Where do most earthquakes occur?
   a. near ridges in the middle of tectonic plates
   b. along faults near transform boundaries
   (c.) near the boundaries between tectonic plates

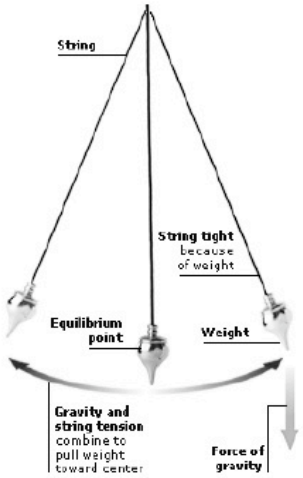
6. Earthquakes release energy in _____ that travel away from the earthquake in all directions.
   (a.) seismic waves
   b. pyroclastic materials
   c. subduction zones

Inside the Restless Earth

Day 55 – Quiz 10/Reteach/Review

Quiz 10 – Page 2

7. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the diagram.



According to the above model of a pendulum, both _____ and _____ are responsible for pulling the weight towards the center.

a. equilibrium and gravity
b. tension of the string and mass of the weight
c. tension of the string and gravity
d. gravity and density of the weight

8. Where do most earthquakes happen, and why do they happen there?

Most earthquakes happen near the edges of tectonic plates because the plates grind against each other. This can cause rock to change shape and then bounce back, releasing energy that causes an earthquake.

Inside the Restless Earth

DAY 56

Volcanoes & Climate Change

This lesson covers the first part of section 6.2 (page 162).

Big Idea

- Eruptions release large amounts of ash and gases that can block sunlight and cause global temperatures to drop.

Materials

Teacher:

none

Students:

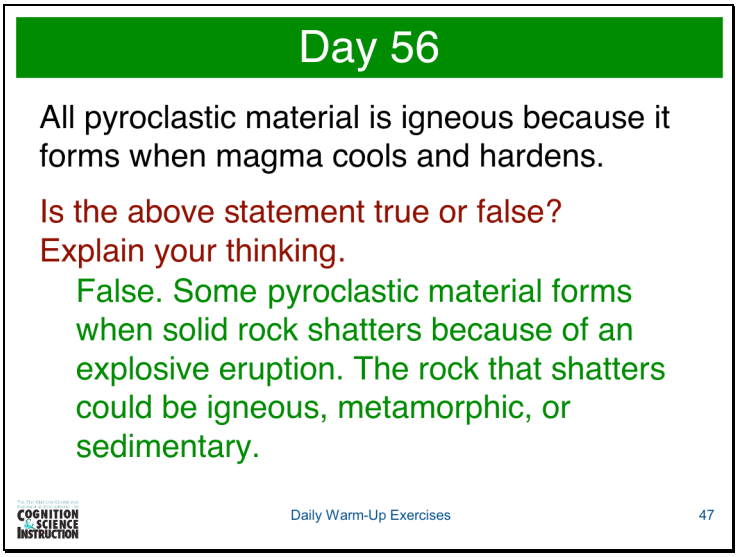
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – chapter 6.2, part 1

Day 56 – Volcanoes & Climate Change

Warm-Up Activity



How big is pyroclastic material?
can range from huge boulders to tiny particles of ash

What kind of magma tends to cause explosive eruptions?
magma that contains a lot of water or silicon

DAY 57

Types of Volcanoes

This lesson covers the parts 2 and 3 of section 6.2 (pages 163-165).

Big Idea

- Eruptions can cause drastic changes in Earth's surface.

Materials

Teacher:

1. visualization exercises – day57.ppt

Students:

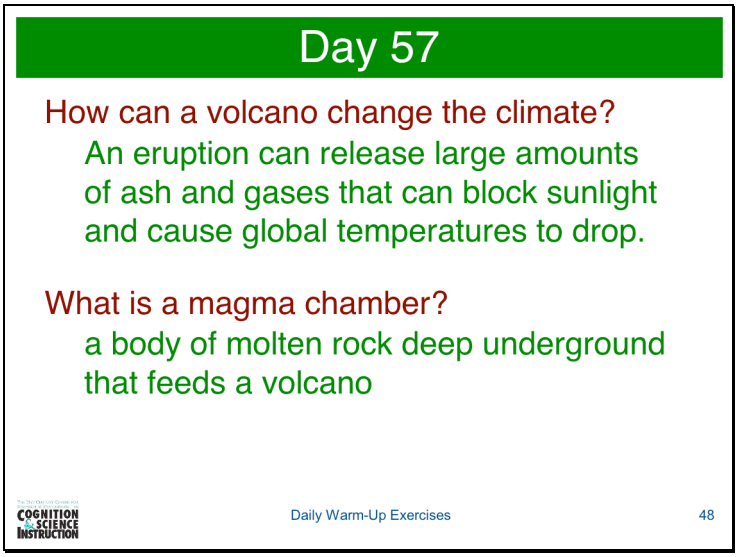
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 6.2a – Cut-Away & Labels
5 minutes – visualization 6.2b – Caption, Cut-Away & Labels
25 minutes – chapter 6.2, parts 2 & 3

Day 57 – Types of Volcanoes

Warm-Up Activity



When magma erupts as a liquid, what is it called?
lava

When magma erupts as a solid, what is it called?
pyroclastic material

Day 57 – Types of Volcanoes

Visualization Exercise 6.2a – Cut-Away & Labels

Image Comprehension Focus: Cut-Away and labels

Goal: Explore one use of cut-away and reinforce the importance of labels

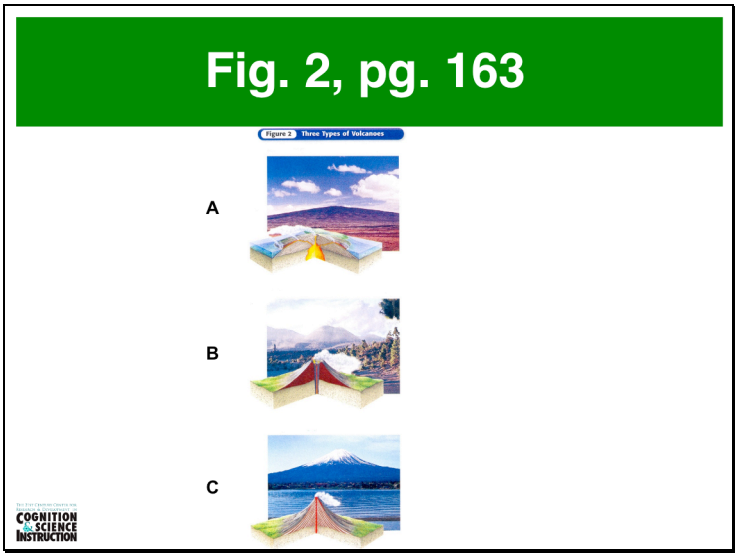
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to explore one reason why cut-away may be used in a diagram as well as reinforce the importance of labels.

(Continue to the next slide)

Day 57 – Types of Volcanoes

Visualization Exercise 6.2a – Cut-Away & Labels (cont.)

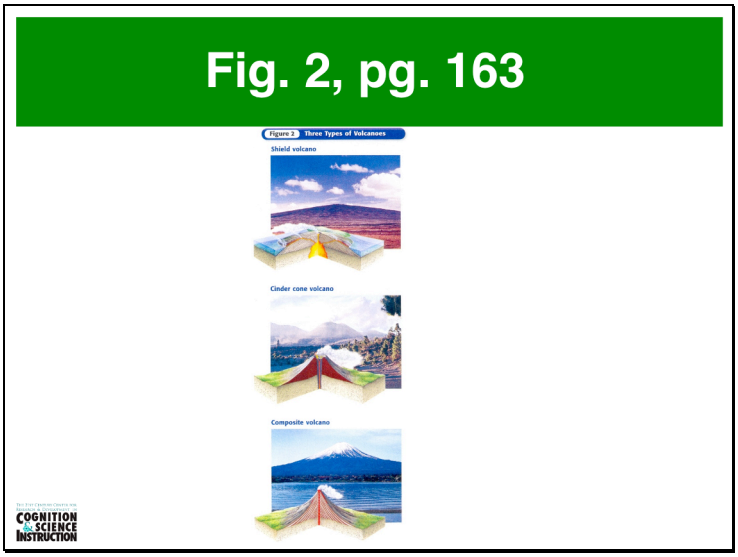


The teacher projects the above image of figure 2 from page 163. Next, either individually or in groups the teacher asks the students the following questions:

- Composite volcanoes have broad bases and sides that get steeper toward the top. This type of volcano is represented by the image labeled ____.
- Which image, 'A', 'B,' or 'C,' represent a Cinder cone volcano, which are made of pyroclastic material that forms steep slopes.
- Shield volcanoes, represented by the image labeled _____, has layers of lava that creates gently sloping sides.

(Continue to the next slide)

Visualization Exercise 6.2a – Cut-Away & Labels (cont.)



The teacher then has the students turn to figure 2 on page 163 (shown above if the teacher wants to project it).

The teacher reviews the correct answers, and leads a discussion about why students chose the answers that they did. [Here, the teacher can talk about the use of cut-away. A side view – or silhouette – would allow the reader to see which volcano had steeper sides, which had gently sloping sides, etc. However, the cut-away allows the reader to see why these different shapes form. It shows the reader that the shape depends on the way the molten rock reaches the surface. The teacher can also point out the usefulness of naming labels when trying to talk about different concepts.]

(End of Activity)

Day 57 – Types of Volcanoes

Visualization Exercise 6.2b – Caption, Cut-Away & Labels

Image Comprehension Focus: Caption, Cut-Away and Labels

Goal: Explore one use of cut-away and reinforce the importance of labels

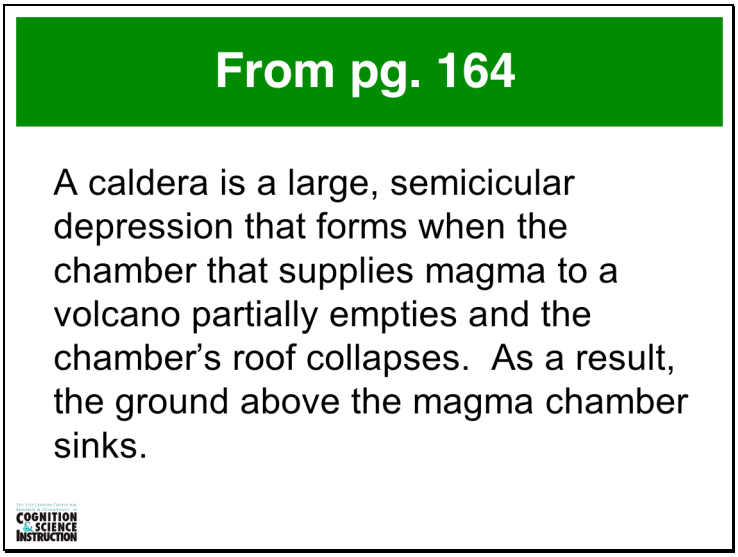
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to explore one reason why cut-away may be used in a diagram as well as reinforce the importance of labels.

(Continue to the next slide)

Day 57 – Types of Volcanoes

Visualization Exercise 6.2b – Caption, Cut-Away & Labels (cont.)

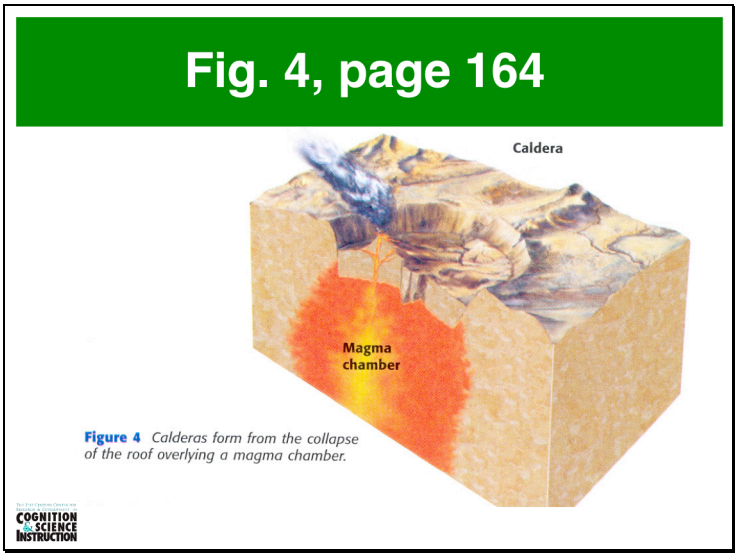


The teacher projects the above passage taken from page 164. The teacher then has students take a minute to read the passage.

(Continue to the next slide)

Day 57 – Types of Volcanoes

Visualization Exercise 6.2b – Caption, Cut-Away & Labels (cont.)

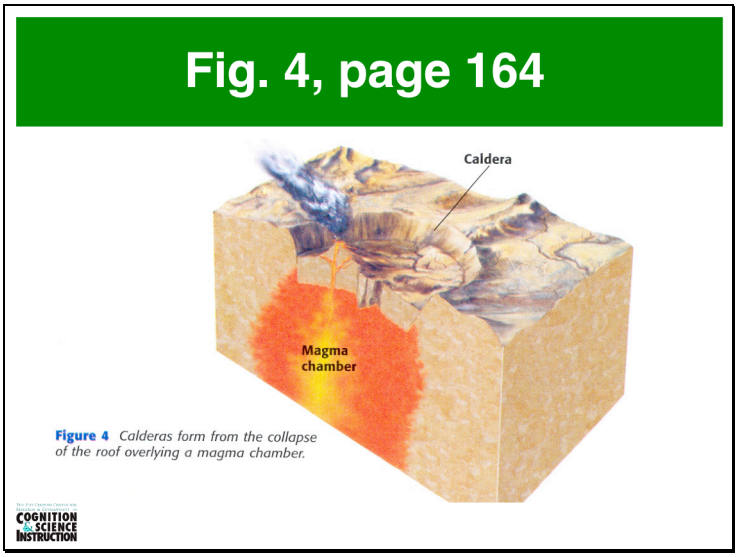


The teacher projects the above image of figure 4 from page 164. The teacher then points out to students that the label 'Caldera' does not have a line, indicating the location of the caldera on the image.

The teacher then asks students, where the line should be drawn to indicate the position of the caldera.

(Continue to the next slide)

Visualization Exercise 6.2b – Caption, Cut-Away & Labels (cont.)



The teacher projects the above image of figure 4 from page 164 in order to show where the line could be drawn indicating the position of the caldera.

The teacher asks the students what pieces of information they used in order to indicate the accurate position of the caldera.

The teacher can then use this as an opportunity to lead a discussion on the multiple sources of information that could have been helpful in doing this exercise such as information from the passage, information from the caption, as well as the cut-away view showing the magma chamber.

(End of Activity)

DAY 58

Causes of Volcanic Eruptions

This lesson covers parts 1 and 2 of section 6.3 (pages 166-167).

Big Ideas

- Magma often forms near the edges of tectonic plates, where pressure decreases enough to lower rock's melting point to its current temperature.
- Once formed, magma rises toward the surface because it is less dense than the surrounding rock.

Materials

Teacher:

1. visualization exercises – day58.ppt

Students:

1. plates map from cc 5.1 – worksheet 32

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 6.3a – Arrows & Color
5 minutes – visualization 6.3b – Captions
25 minutes – chapter 6.3, parts 1 & 2

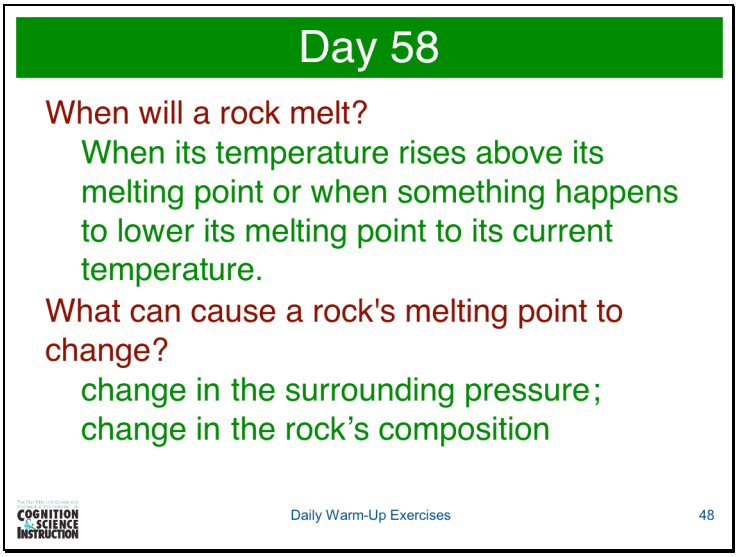
Chapter 6.3, parts 1 & 2

Today's warm-up reminds students of the relationship between pressure and melting point, which is key to understanding the description of magma formation on pages 166 and 167. Your students may need some help, but they should be able to explain those paragraphs in their own words.

Figure 2 provides a map of plate boundaries and shows the locations of the world's major active volcanoes and the Ring of Fire. Have your students compare figure 2 with their plates map from *Compare Major Events*. They will see that both Mount St. Helens and Nevado del Ruiz are in the Ring of Fire. In fact, Mt. St. Helens is labeled in figure 2.

Day 58 – Causes of Volcanic Eruptions

Warm-Up Activity



If the surrounding pressure decreases, what will happen to a rock's melting point?

it will decrease (the rock will melt at a lower temperature)

Remind students that rocks have one temperature at which they start to melt and a higher temperature at which they finish. You might also point out that, if the change in composition involves the addition of water, the relationship between melting and pressure may change. If a rock contains enough water, its melting point will decrease as pressure increases.

Day 58 – Causes of Volcanic Eruptions

Visualization Exercise 6.3a – Arrows & Color

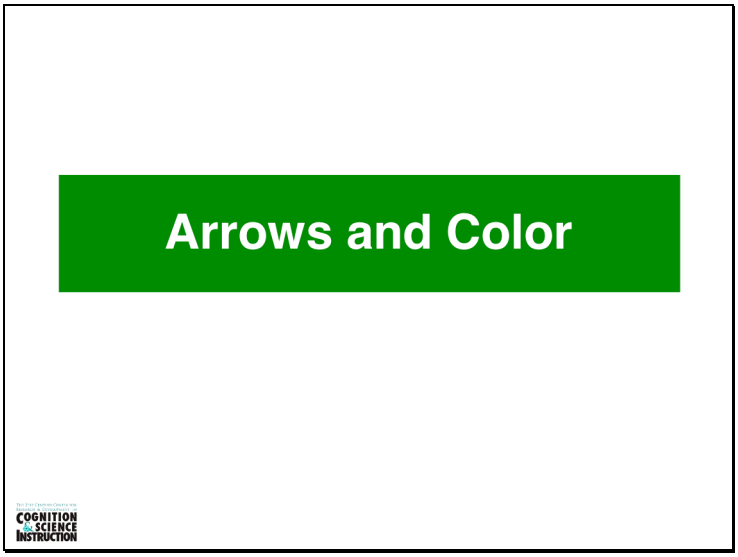


Image Comprehension Focus: Arrows and Color

Goal: 1) Review one role that arrows can play in diagrams, 2) Review the role of color in diagrams

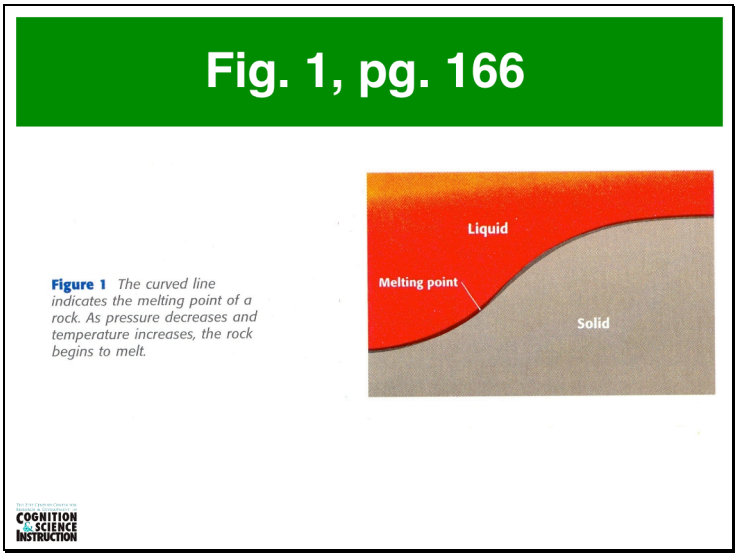
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed to review the use of both arrows and colors in diagrams

(Continue to the next slide)

Day 58 – Causes of Volcanic Eruptions

Visualization Exercise 6.3a – Arrows & Color (cont.)



Procedure: The teacher projects the above altered image of figure 1 from page 166 and asks students to review the diagram.

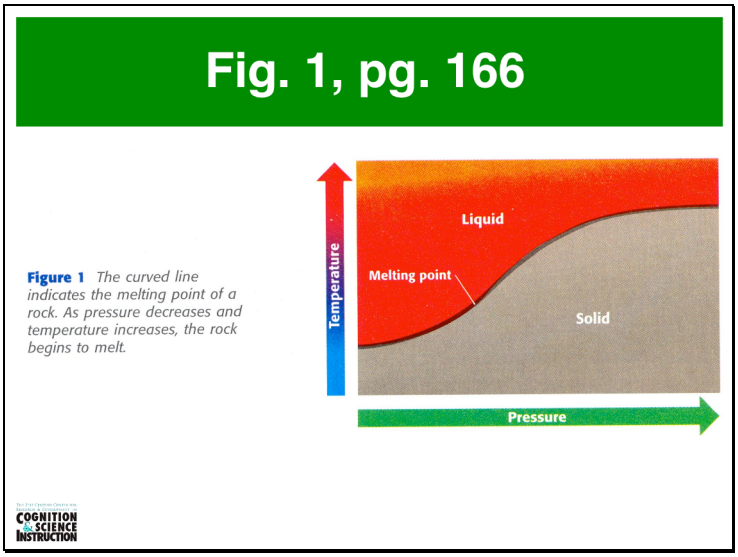
The teacher then asks students, what can be added to the diagram in order to show the pressure and temperature changes? [Arrows]

If there was an arrow showing pressure, and an arrow showing temperature, where could such arrows be placed? [An arrow showing temperature going up the left-hand side of the diagram and an arrow showing pressure going along the bottom of the diagram, shown on the next slide.]

(Continue to the next slide)

Day 58 – Causes of Volcanic Eruptions

Visualization Exercise 6.3a – Arrows & Color (cont.)



The caption refers to an "increase in temperature," and the temperature arrow shows temperature increasing. However, pressure is not as straightforward. In this case, the caption reads "decrease in pressure," but the direction of the arrow shows increasing pressure.

The teacher can ask "which end of the arrow is a lower temperature, and which end is a higher temperature?" [The bottom is lower, the top is higher.] The teacher can follow-up by asking how students knew this. There are several possible answer to this. Students may assert that "up always means bigger." This is usually true, but not always – encourage the students to find more certain explanations.

If necessary, direct students to pay particular attention to the author's use of color, and ask the students, are there any colors used by the author that are helpful in understanding the temperature arrow? [Here, if the students have difficulty, the teacher can point out that the arrow used to show an increase in temperature is both blue and red, colors traditionally used to represent cooler and warmer temperatures.

Visualization Exercise 6.3a – Arrows & Color (cont.)

The teacher can also emphasize that the specific color is not always important, but different colors are used to clearly show different pieces of information.]

Next, focus attention on the pressure arrow. The teacher can ask "which end of the arrow is a lower pressure, and which end is a higher pressure?" [The left is lower, the right is higher].

Again, ask the students how they know this. Students may, again, assert that "left is always lower, and right is always higher." This is, again, usually true but is not guaranteed, so encourage students to find other reasons.

The teacher can ask why the author has not used a color code for the pressure arrow as well. [Answers may include the idea that red and blue are commonly used color codes for heat and cold, but there is no equally common color code for pressure.]

The teacher can then show that, if you understand the caption and apply that information to the diagram, you will see that the pressure must increase from left to right. The caption states, indirectly, that the melting point gets lower, as the pressure gets lower. In this graph, low melting points occur on the left, so that must be the region of the graph where pressure is lower.

The teacher emphasizes again that the role of arrows can be different for different diagrams, and that while sometimes colors may not have significant meanings, other times certain colors can be used to represent certain ideas and that students need to pay close attention to these types of issues when looking at diagrams.

(End of Activity)

Day 58 – Causes of Volcanic Eruptions

Visualization Exercise 6.3b – Captions

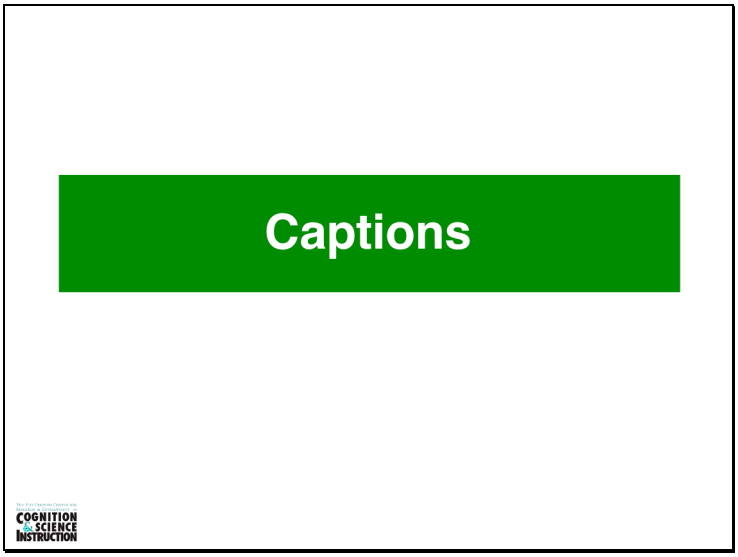


Image Comprehension Focus: Captions

Goal: Reinforce the importance of captions

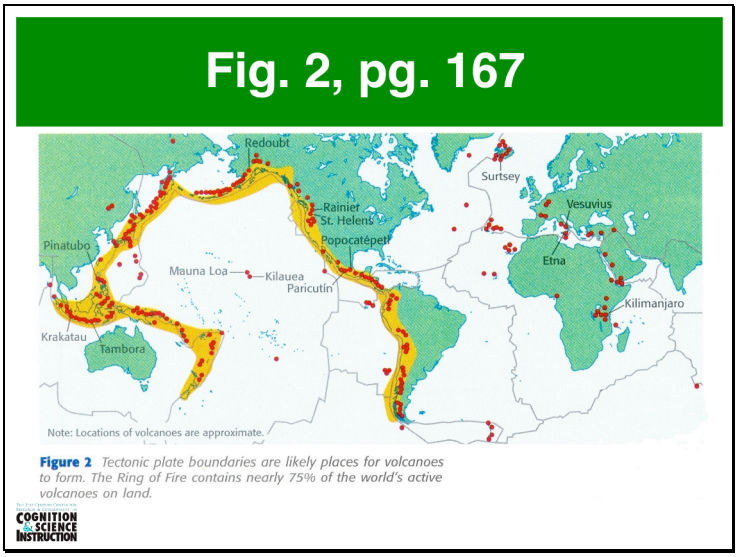
Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed as a brief review of the importance of not skipping the caption when looking at a diagram.

(Continue to the next slide)

Day 58 – Causes of Volcanic Eruptions

Visualization Exercise 6.3b – Captions (cont.)



Procedure: The teacher projects the above image of figure 2 from page 167 (with missing information), and asks the students (either individually or in small groups):

- What has the author chosen to use in order to show the volcanoes? [small, red circles]
- What has the author chosen to use that illustrates the Ring of Fire? [the orange, shaded area over some of the red circles]
- How can one tell the location of the tectonic plate boundaries? [the grey lines indicate the boundaries of the plates]

The teacher reviews the answers and asks students what information they used in order to answer the above questions. [While students may have different answers, the teacher can use this opportunity to point out that students could also get the answers by using the information found in the caption. Additionally, the teacher can point out that the author may often use certain symbols or patterns repeatedly, such as using the grey lines to show the boundaries of the plates, which have also been used in previous figures such as figure 1 on page 130 of the textbook.]

(End of Activity)

DAY 59

Tectonic Plates & Volcanoes

This lesson covers the rest of section 6.3 (pages 168-171)

Big Ideas

- Mid-ocean ridges form at divergent boundaries.
- When ocean crust sinks at convergent boundaries, it releases water that mixes with the surrounding rock and lowers its melting point.

Materials

Teacher:

1. visualization exercises – day59.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

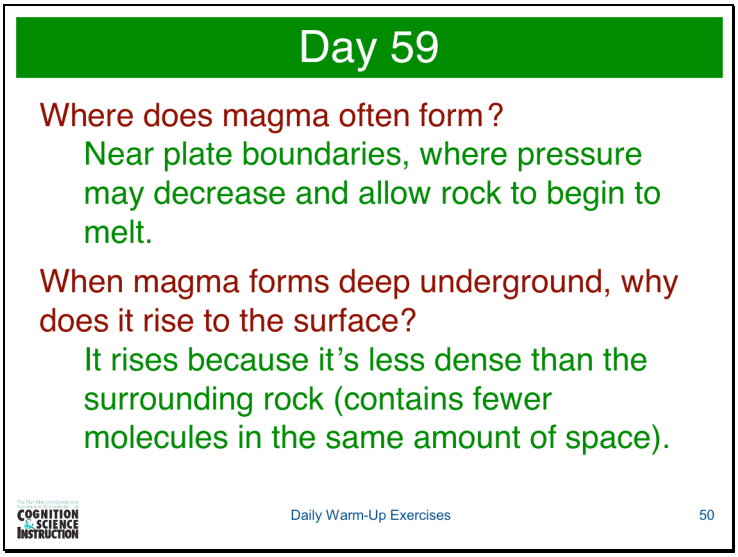
5 minutes – warm-up activity
5 minutes – visualization 6.3c – Labels & Color
30 minutes – chapter 4.4, parts 3-6

Chapter 6.3, parts 3-6

Parts 3 and 4 explain why magma tends to form at divergent and convergent boundaries. Your students may need some help, but they should be able to explain part 3 in their own words. To prepare them for part 4, you might ask if pressure change is the only thing that can cause melting point to change. They should recall that change in composition can also change melting point. The book explains that, as oceanic crust sinks, pressure and temperature increase. This causes the water in the oceanic crust to be released, and the water mixes with the soft rock around it. The added water lowers the rock's melting point to its current temperature, and it melts.

Day 59 – Tectonic Plates & Volcanoes

Warm-Up Activity



What is divergent motion?
when tectonic plates are moving apart

What do we call the boundary between such plates?
a divergent boundary

Day 59 – Tectonic Plates & Volcanoes

Visualization Exercise 6.3c – Labels & Color

Image Comprehension Focus: Labels

Goal: Give the students a chance to take the role of the author, and apply what they have been learning about the construction of effective diagrams. This activity will also reinforce the importance of labels and color.

Type of Activity: Teacher Guided Student Activity

Overview: This activity is designed as a capstone activity. Students will be asked to integrate information from throughout the unit by designing a diagram.

(Continue to the next slide)

Visualization Exercise 6.3c – Labels & Color (cont.)

Taken from pg. 168

At a divergent boundary, tectonic plates move away from each other. As tectonic plates separate, a set of deep cracks called a rift zone forms between the plates. Mantle rock then rises to fill in the gap. When mantle rock gets closer to the surface, the pressure decreases. The pressure decrease causes the mantle rock to melt and form magma. Because magma is less dense than the surrounding rock, it rises through the rifts. When the magma reaches the surface, it spills out and hardens, creating new crust.

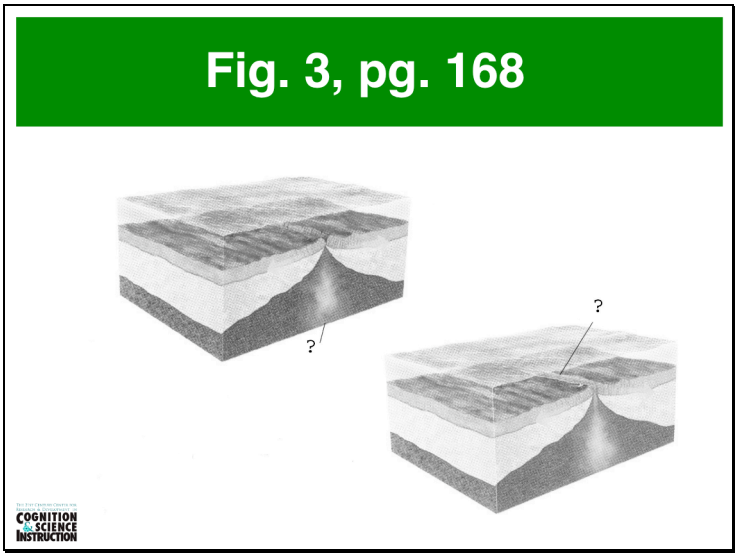
Procedure: Tell students they are going to try to design a diagram that would explain the contents of the paragraph above. That is, they will take the role of the author, and try to turn this text-based information into a diagram that conveys the same content.

The teacher projects the above paragraph taken from page 168 and has students take a few minutes to read it. The teacher also advises students to take notes on the paragraph.

(Continue to the next slide)

Day 59 – Tectonic Plates & Volcanoes

Visualization Exercise 6.3c – Labels & Color (cont.)



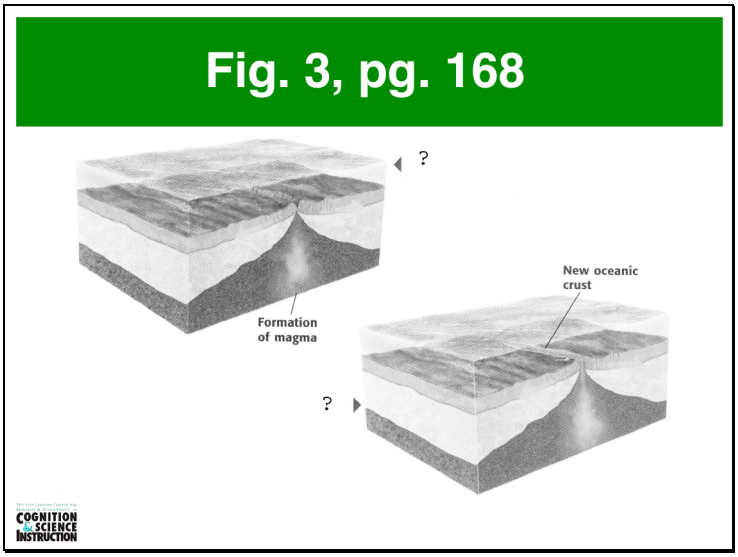
Next, the teacher projects the above image of figure 3 from page 168 without the naming labels. The teacher then instructs the students, either individually or in small groups, to write naming labels to be placed where the question marks are in the diagram.

The students can then take turns sharing their labels and what information was used in order to create the naming labels. [Here, the teacher can focus on the connection between the text and diagram, as well as similar diagrams that students may have seen in previous sections of the textbook. The first label points to an area that should be familiar to the students as magma, because the way it is drawn is similar to other images of magma throughout this unit. The label for the lower diagram is pointing to the ocean floor. Based on the text, it can be inferred that this is labeling new oceanic crust.]

Students may not choose the exact words that appear in the text, but they should be guided to settle on these two concepts.

(Continue to the next slide)

Visualization Exercise 6.3c – Labels & Color (cont.)



The teacher projects the above image of figure 3 from page 168 showing the correct naming labels. The teacher indicates to students that the diagram is now missing explanatory labels.

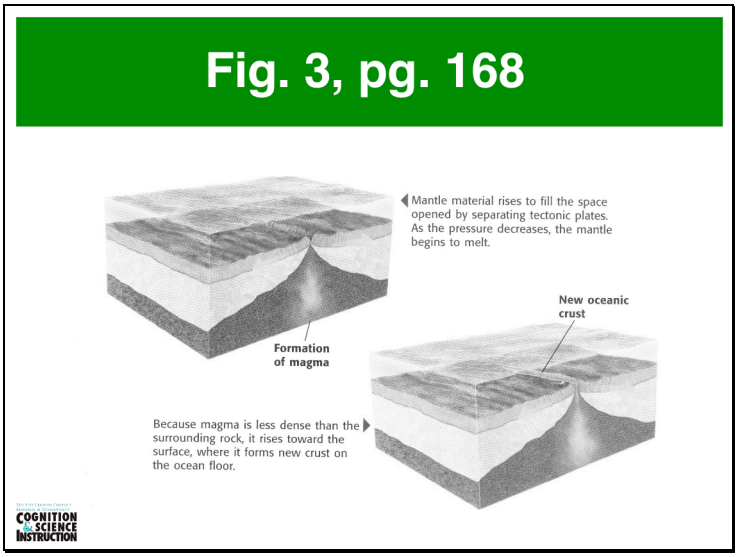
The teacher then instructs students, either individually or in small groups, to create explanatory labels for each image using the information from the paragraph. [Again, the teacher can reemphasize the importance of connecting the text with the diagram. If necessary, the teacher can reproject the paragraph.]

The teacher then has the students share their explanatory labels.

(Continue to the next slide)

Day 59 – Tectonic Plates & Volcanoes

Visualization Exercise 6.3c – Labels & Color (cont.)

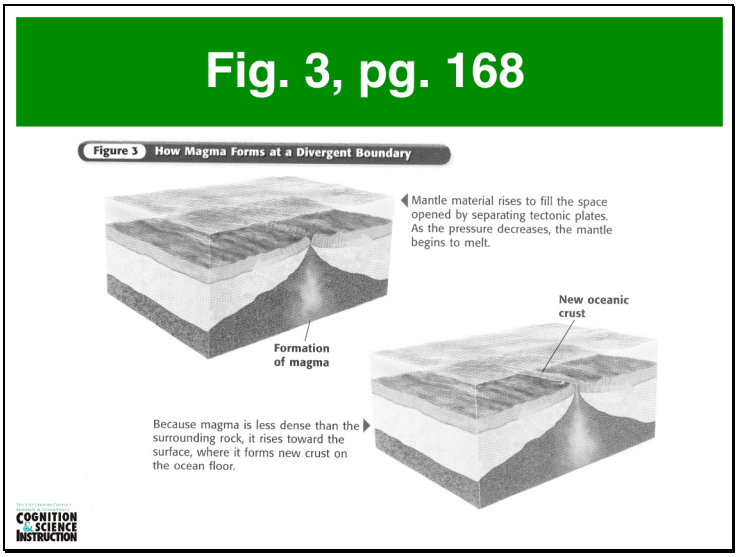


The teacher then projects the complete image of figure 3 from pg. 168 that includes the explanatory labels written by the author. The teacher can lead a discussion about what type of information should be included in explanatory labels as well as the importance of both types of labels.

After talking about naming and explanatory labels, the teacher can instruct the students to decide on a title for the diagram. Students then take turns sharing their titles.

(Continue to the next slide)

Visualization Exercise 6.3c – Labels & Color (cont.)



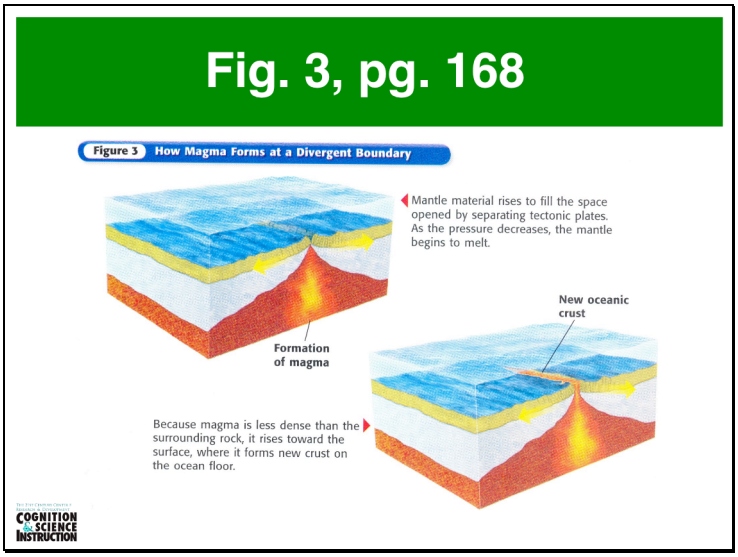
The teacher projects the above image of figure 3 from pg. 168 to reveal the title written by the author. The teacher can then lead a discussion about what type of information should be included in the title.

The teacher then asks the students to think about all of the conventions they have learned so far (e.g. labels, captions, color, arrows, etc.) and asks the students, if they were the author of the textbook, what more could be done with figure 3 in order to further make clear the information in the diagram? [While students may have different answers here, the teacher can use this opportunity to focus on the use of color).

Solicit specific ideas about assigning particular colors to particular areas of the diagram. For example, magma could be red or orange, and the water could be blue. You might also point out that if, for example, the water will be blue, then you should not choose blue for another area.

(Continue to the next slide)

Visualization Exercise 6.3c – Labels & Color (cont.)



The teacher projects the above (completed) image of figure 3 from page 168 (or has students turn to page 168 in their textbooks).

The teacher can wrap up by pointing out just how many decisions go into a good diagram. If the author understands all of the parts of a diagram, then he or she can use every one of those parts to make the diagram better.

Note: The teacher should point out that this diagram is another example of the magma chamber being depicted incorrectly. If necessary, go back to visualization 5.1b in order to reemphasize what a more accurate depiction should look like.

(End of Activity)