Holyoke Public Schools

Middle School Science

Curriculum Map
Grade 6

Forces that Shape the Earth

Unit #2

December 2009

Overview of Curriculum Maps

Goals:

1. To ensure that students are exposed to a rigorous curriculum in every school and every grade
2. To have consistent instruction and assessment district wide
3. To prepare students for the MCAS test
4. to explain what is expected to be covered in each Science unit of study

Expectations:

The district's expectation is for students to successfully meet the Massachusetts Science and Technology/Engineering Standards, and the English Language Proficiency Benchmarks and Outcomes (ELPBO). In order to help facilitate this teachers are required to follow curriculum maps.

Accountable Talk:

To promote learning, explore solutions, and justify reasoning, conversations between students and students or students and teacher must be accountable – accountable to the learning community, to the science discipline, and to rigorous thinking.

Feedback to Students:

Feedback needs to happen daily in the classroom. There are many ways to give feedback. Conferencing, observations, questions asked during the workshop, and written responses to students' work and notebook entries.

Formative Assessments are embedded throughout the unit to provide diagnostic information, which teachers can use to inform their decisions about instruction for individual students and for the class. In general Formative Assessment should not be graded. They are intended to help teachers have greater insight into students' thinking.

Summative Assessments are used for evaluation purposes. Summative Assessments are graded. Assessments that are graded should occur at the end of an investigation.

NAEP Science Assessment sample questions
http://nces.ed.gov/nationsreportcard/science/

FIVE ESSENTIAL PRACTICES FOR TEACHING ENGLISH LANGUAGE LEARNERS

The five essential practices for teaching English language learners are practices developed by America's Choice to support the literacy needs of ELL students. These practices are a result of current second language acquisition research, literacy development, and effective classroom practices. *(America's Choice: Teaching English Language Learners: Literacy)*

Essential Practice 1	**Classroom Applications**
Develop Oral Language through Meaningful Conversation and Context. Oral language is the foundation of literacy and a main tool for learning and interacting in both academic and social settings. Natural exposure and planned experiences with oral language facilitates increases expression and understanding of the second language. Oral language also supports vocabulary development in context, paving the way for better comprehension and production. Exposure to rich oral and written language environments is vital for developing literacy and language skills.	• Develop oral language through meaningful conversation by planning language experiences and building consistent time to engage conversation. • Enunciate and rephrase difficult works allow extra time for practice and repetition. • Demonstrate and orally explain activities step-by step. Rephrase difficult instructions • Use think-alouds. Verbally share the comprehension thought process. • Provide opportunity for practice: allow extra time for practice and repetition in oral, reading, and writing activities with appropriate feedback. • Allow students to respond through Turn and Talk activities, oral, choral reading and re-reading. • Use audio recording of a text to provide extended to provide extended literacy opportunities where students listen to the reading of a text independently while developing fluency, accuracy, and language acquisition. • Plan daily read-alouds to model literacy strategies and to scaffold fluency, accuracy, and independent reading.

Essential Practice 2	Classroom Applications
Teach Targeted Skills through Contextualized and Explicit Instruction Full literacy is a fluid combination of oral, reading, and writing skills. These skills must be taught through explicit and contextualized instruction that scaffolds learning. Contextualized instruction provides students with extra linguistic clues that support understanding not only of the content but also of the language being used in the lesson. Combining contextualized practices with the knowledge of phonemic awareness, phonics skills, language structures and functions, text patterns, and literary devices such as metaphors, analogies, figurative language, and unfamiliar cultural concepts, will aid students in achieving stronger literacy skills. Explicit skills give the students the tools they need to comprehend increasingly complex literacy demands.	• Use clues of context to make instruction meaningful. Teach skills and strategies ;using materials, books or writing that students know and understand • Use Big Books or shared reading to teach phonics, vocabulary and language features. • Use student or teacher writing models to teach craft, spelling, and language use conventions. • Teach phonemic awareness within a context. ELL children must attach meaning and experience to phonemes they may never have heard before. Teach phonemic awareness while explicitly teaching vocabulary, meaning, or within-a-story context. • Understand the linguistic background native language and address these issues specifically. • Pay special attention to sounds of letters. Languages have different linguistic features. For example, while the vowel sounds in English vary, Spanish vowel sounds are consistent. Students will transfer what they know about one language and automatically, and sometimes incorrectly, apply it to English. • Use meaningful activities to teach phonemic awareness, such as language games, Word Walls, word banks, songs, poems, and rhymes that focus on particular sounds or letters.

Essential Practice 3	Classroom Applications
Build Vocabulary through Authentic and Meaningful Experiences with Words Developing and deepening a student's understanding of new words is essential for English language learners. Building vocabulary in the context of literature, experiences, and modeled writing ensures that students will own the new words they encounter. Vocabulary building is a lifelong process and students must learn ways to integrate and approach new and challenging words. Discussing, playing with, and using new words allows students to gain new vocabulary through meaningful, and therefore memorable, experiences.	• Vocabulary development must be taught intentionally. Since word knowledge correlates with reading comprehension and meaning-making strategies used in decoding, it must be a focus for instruction. • Vocabulary development must be taught in context. Connect word knowledge with background knowledge and instructional context. ELL students need both meaning and context to acquire new vocabulary. • Facilitate and plan activities that support the three main ways vocabulary is learned: 1. Through meaningful conversations with adults and other students. 2. Listening to adults read at slightly higher levels than the student's independent level. 3. Read extensively on their own at their reading level. • Pre-teach vocabulary words, prefixes/suffix, context clues, and cognates. Build students' skill box with vocabulary and give them tools to understand and connect new vocabulary. • Use content Word Walls or word webs. Support cognitive structuring for ELLs by connecting new vocabulary to themes, ideas, or generalizations. • Explicitly focus on and teach academic language. Students need to be consistently exposed to formal or content specific language and vocabulary. • Explicitly teach the building blocks of language. Students need to learn the connecting and transition words of the English language ("however," "in conclusion", etc.)Teach them in context and teach them explicitly. • Focus teaching Tier 2 words, as well as essential Tier 1 words. Although most explicit vocabulary instruction should focus on Tier 2 words (words with a high frequency in the written language, example: examine), ELLs need instruction around Tier 1, or basic spoken words as well.

Essential Practice 4	Classroom Applications
Build and Activate Background Knowledge Learning is based on establishing neural connections in the brain, drawing on previous experience, background knowledge, and prior and current environments. It is both the teacher's and the student's job to facilitate these connections in order to construct meaning and understand new ideas and concepts while expanding on their own world knowledge. Actively fostering these connections will enable students to more easily interpret their surroundings and assign meaning to new concepts while expanding their own	• Elicit student's experience and comments. Connect school, literary and personal events through talking, writing, and reading. • Consider the cultural background of students when selecting literacy materials such as books and poems. Support language development of Ell students by giving them new English words for experiences that are close to home. Using materials that represent their cultural background increases motivation and supports participation. • Discuss and build language around universal themes. Connect new language to universal experiences. • Build content-based word banks and webs. Connect new language to other known words, experiences, and ideas to support cognitive structuring. • Use native language and value home culture. View home cultures as a resource, rather then a liability. • Use hands-on experience based instruction in all academic areas. Language can be built upon common classroom experiences. • Encourage students to make connections before, during and after reading. • Find out what students know, and build on their experience.

Essential Practice 5	Classroom Applications
Teach and Use Meaning-Making Strategies Intentionally teaching meaning-making strategies provides students with a toolbox to approach future learning challenges. Meaning-making strategies vary from helping students comprehend text to various strategies students can use to understand English-dependent lessons. Modeling appropriate behaviors to students gives them the tools to be autonomous learners and supplies them with options they can use to interpret environmental input, both academically and socially.	• Explicitly teach student meaning-making strategies. Model for students how to visualize, make connections, monitor for meaning, determine importance, etc. • Provide opportunities for practice. Sustain daily work periods in reading and writing for students to practice these strategies. • Systematically assess students and adjust instruction. Monitor progress and use data to adjust the focus of mini-lessons, conferences and small-group instruction. • Model activities and thinking for certain skills. Students need to see and experience what is expected of them before they perform a task. • Beginning ELLs need more than just phonics and English Language Development instruction. EXPOSE STUDENTS RIGHT AWAY TO COMPREHENSION STRATEGIES. Waiting to address skills in chronological order hinders academic growth and English proficiency. • Teach students how to help themselves in English-dependent lessons. Model your thinking and how you approach problems. Build students cognitive toolbox by explicitly teaching the ways to help themselves during difficult language situations.

Resources: FOSS Landforms kit & the NEW Delta Science Module: Earth Processes (The teacher's Guide and a small book for students are found in the kit, purchased Fall 2009)

Prentice Hall Science Explorer 2005 edition

Student Text: Prentice Hall Science Explorer: ***Inside Earth*** and ***Earth's Changing Surface***

Student Edition on Audio CD, Teacher's Edition, Color Transparencies, All-in-One Teaching Resources

TeacherEXPRESS

- (4 CD-ROM Set) contains lesson management software

Differentiated Instruction

- Guided Reading and Study Workbook, Adapted Reading Study Workbook, & Adapted Tests

Misconceptions about Earth's Features

There is a layer of water under the soil.
River valleys were created by earthquakes or movements of the earth.
Mountains and valleys have always been on Earth.
Water can move dirt and rocks if they are really small.
River channels were there before the water and the water just follows them not creates them.
Earthquakes made cracks for rivers.
Dinosaurs made holes for oceans
Mountains by avalanches, tornado piled up dirt.
Glaciers retreat. Turn and go in the opposite direction. Instead of melt.
Rocks are stronger than the forces of nature (water, wind, ice).
Rocks can only be changed by a blow of a hammer or other powerful object.
Rock is a hard solid material.
Rocks are uniform inside.
Soil - dirt has always been here.
Soil or dirt can be used up and never replaced.
Soil is very deep - miles.
Soil is made of plants and animals.
Lava comes from the center of the Earth.

Misconceptions about Earthquakes and Volcanoes

Earthquakes are caused only by explosions from volcanoes.
It starts on fire and burns by people, sun, matches, lightening, hot core of the Earth, lava is a burning liquid
Core of the Earth is hot and flows to the surface, gets too full, decides to, gets too hot, boils over, explodes

http://www.huntel.net/rsweetland/science/misconceptions/earthFeature.html

Big Idea: The Earth is composed of layers/ La Tierra es compuesta de capas

Massachusetts Science and Technology Learning Standard
ESS # 2 Describe the layers of the earth, including the lithosphere, the hot convecting mantle, and the dense metallic core.
MCAS item analysis (What do students need to be able to do?)

- ✓ Know the layers of the Earth
- ✓ Know the relative density of the different layers of the Earth
- ✓ Interpret a graph of density versus depth of the Earth
- ✓ Know the relative temperature of the different layers of the Earth
- ✓ Be able to recognize a graph that represents the temperature versus the depth of the Earth

Guiding Question: What are the layers of the Earth?/ ¿Cuáles son las capas de la Tierra?

Vocabulary: Key vocabulary terms are in bold and translated throughout the curriculum map.

*S.1.5. Employ vocabulary essential for grade-level content learning.
*S.12.a. Identify cognates in printed, grade-level, academic content vocabulary terms.
*S.1.11. Clarify meaning of words, using beginning and bilingual dictionaries.
*R.2.15.a. Describe similarities and differences in the phonetic systems used in English and the student's first language.
***From the Massachusetts English Language Proficiency and Outcomes for English Language Learners (ELPBO)**

Design vocabulary cards as new science terminology is encountered. These index cards will host the term and a student-generated graphic on one side and the definition – either quoted directly from the textbook glossary or in each student's own words, dependent upon student's ability level – and will be added to each student's personal science dictionary throughout the school year. These cards are to be alphabetized by each student and threaded onto a clip ring within his/her binder. Class dissection of new vocabulary words will promote better student understanding of roots, prefixes, and word families, in order to make content discourse more accessible to all learners. (Kendra VanderGheynst)

Engage:

- **Demonstration:** A good analogy for teaching about earth's interior is a piece of fruit with a large pit such as a peach or a plum. If we cut a piece of fruit in half we will see that it is composed of three parts: 1) a very thin skin, 2) a seed of significant size located in the center, and 3) most of the mass of the fruit being contained within the flesh. Cutting the earth we would see: 1) a very thin crust on the outside, 2) a core of significant size in the center, and 3) most of the mass of the Earth contained in the mantle. http://geology.com/nsta/earth-internal-structure.shtml

  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning using pictures, actions, and/or objects.

- Ask students: What they know about what is below the Earth's surface? Discuss any experiences students may have had digging holes in the ground, visiting underground caverns, and or watching movies about the center of the Earth. *(elicit prior knowledge)*

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- ELL Strategy- Students can perform a Quick Write about their prior experiences with digging holes in the ground. Teacher may wish to ask the students to identify anything they found or saw in the hole.

  *S.3.8. Demonstrate comprehension of oral questions on academic content that require short answers.

  *S.1.5. Employ vocabulary essential for grade-level content learning

Explore:

- **Black Box Activity**: The term "black box" refers to any object that has hidden inner workings. Investigators can explore behavior, but cannot determine exact details of the objects' interiors. In the science game, narrowing the possibilities and agreeing on the best explanation is what it is all about. Having an "answer" is relative, given available data, tools, and techniques. When students model peer review (an important step in the scientific process often omitted from textbooks), they discuss **observations/** observations and collectively determine the best **explanation/** explicación. They model the process used to understand actual "black boxes" in science, such as an atom or planet Earth. We cannot literally slice the Earth in half to see if we are correct about its internal structure. Students are required to **infer/** inferir what they think is inside by observing indirect evidence. (see appendix and/or the following website) http://www.raft.net/ideas/Black%20Box.pdf

  *S.3.14. Ask and respond to oral questions.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- Students use concentric spheres to construct a **model/** modelo of the Earth that shows its layered structure. Activity 2: The Structure of the Earth, Earth Processes kit. Students make models of the Earth that show its inner structure. Using their models, have students work in pairs and quiz each other on the names and characteristics of each layer or Earth.

  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.

  *R.5.5.a. Identify facts in a text to answer the reader's or other questions.

- Students complete a diagram of the Earth's Layers by labeling **crust/** corteza, **mantle/** manto, **outer core/** núcleo externo, and **inner core/** núcleo. Students color the layers on the diagram using a key.

  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.

- Read the book *Planet Earth/Inside Out* by Gail Gibbons, and sequence key events in the Earth's formation, and composition.
  - ELL Strategy- Before the class reads the book *Planet Earth/Inside Out* by Gail Gibbons, have the students complete the activity Tea Party.
  - ELL Strategy- The teacher can use a 3-2-1 after the reading of the book *Planet Earth/Inside Out* by Gail Gibbons.

    *R.5.3.a. Identify graphic features found in text (such as illustrations, labeled drawings, type size, charts, maps, diagrams).

- Students read about and discuss the Earth's Interior, pages 6 to 13, *Prentice Hall Science Explorer: Inside Earth*. Students learn how scientists have learned about the Earth's interior using both **direct evidence/** evidencia directa and **indirect evidence/** evidencia indirecta.

  *R.2.11.a. Respond to stories and informational texts that are heard.

  *S.3.22. Make predictions or inferences based on a story or information that has been heard.

- Students read about and discuss: What is Inside the Earth, pages 2 to 3 in the Delta Science Reader: Earth Processes.

  *R.2.11.a. Respond to stories and informational texts that are heard.

  *S.3.22. Make predictions or inferences based on a story or information that has been heard.

Assessment about Earth's Layers:

- Students work in small groups to create a poster showing details about one of the layers of the Earth (**crust/** corteza, **the lithosphere/** litosfera, the **asthenosphere/** astenosfera, **lower mantle/** manto inferior, **outer core/** núcleo externo, **inner core/** núcleo). They must make a table to tell what their layer is made of, how thick it is, the range of **temperature/** temperatura of the layer, whether the layer is a **solid/** sólidos or **liquid/** líquido, and any other interesting attributes of the layer. Students must present their posters to the class. Each student in the group should present some information to the class. As students make their presentation the class must fill in a chart in their science notebooks with the information presented. Encourage students to ask questions. Encourage class discussions about material that is presented. The teacher may want to prepare some questions to ask each group ahead of time to make it more interactive.

  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning using pictures, actions, and/or objects.

  *R.5.5.a. Identify facts in a text to answer the reader's or other questions.

  *R.1.15.d. Use general dictionaries, specialized dictionaries, thesauruses, or related reference tools to increase learning.

Extend:

- Try to discover which shape is hiding in the virtual black box. http://www.fossweb.com/modules3-6/ModelsandDesigns/index.html

- Delve into the earth's interior, learn about its tectonic plates and their movements, and discover how mountains, volcanoes, and earthquakes are formed.
  http://www.learner.org/interactives/dynamicearth/

- This website lets you see the Structure of the Earth http://scign.jpl.nasa.gov/learn/plate1.htm

- Students examine websites about the Earth's interior. Students record information about the layers of the Earth in their notebooks.
  http://www.seismo.unr.edu/ftp/pub/louie/class/100/interior.html
  http://library.thinkquest.org/17457/platetectonics/1.php
  http://science.nationalgeographic.com/science/earth/inside-the-earth
  http://www.windows.ucar.edu/tour/link=/earth/Interior_Structure/interior.html

Evaluate: MCAS released questions

Q. Which is the thickest layer of Earth?

A. crust

B. inner core

C. mantle

D. outer core

Q. A layer of solid brittle rock comprises the outer 100 kilometers of Earth. This layer, which contains **both** the crust and the upper mantle, is called the

A. core.

B. sediment.

C. lithosphere.

D. hemisphere.

Guiding Question: What is the relative density of the different layers of the Earth?/ ¿Cuál es la densidad relativa de las diferentes capas de la Tierra?

Engage:

- Demonstration: Using an orange to model different **densities** of the Earth's layers (see appendix and/or the following website)
  http://aegsrv2.esci.keele.ac.uk/earthlearningidea/PDF/59_Oranges_and_Earth.pdf
  *S.3.14. Ask and respond to oral questions.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is gi

- Students need to be taught the concept of **density/** densidad here. Specifically, students need to understand that materials of greater density sink to the lowest areas and less **dense/** densa mate rise upwards. They need to understand that **pressure/** presión comes from pushing forces and tha pressure increases with more pushing.
  *S.1.5. Employ vocabulary essential for grade-level content learning

- ELL Students would benefit from a study of the phrases less dense, more dense, denser and dense

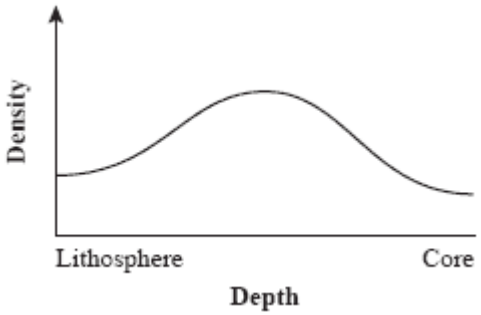
Explore:

- Students make a graph of the **density/** densidad of the Earth's layers versus the depth. What is t best estimate of the densities of the various layers of the Earth?
  Estimates vary, but some approximate values should be as follows (in grams per cubic centimet
  Continental Crust: 2.7 to 3.0
  Oceanic Crust: 3.0 to 3.3
  Mantle (silicates): 3.3 to 5.7 (increasing with depth?)
  Outer Core (liquid): 9.9 to 12.2
  Inner Core (solid): 12.6 to 13.0
  *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supportin details in text.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification given.

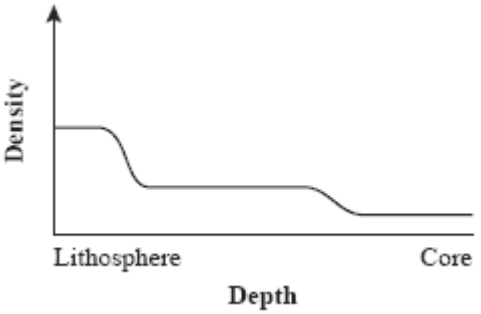
Explain:

Q. Which of the following graphs **best** represents the relationship between density and depth of material below Earth's surface?

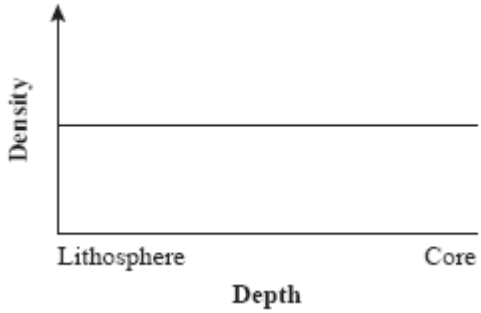
A.



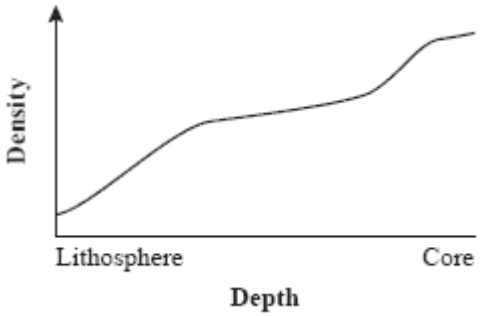
B.



C.



D.



Extend:

- Density Lab: Explain how density affects the organization of materials that make up Earth's crust interior. http://www.usoe.k12.ut.us/curr/Science/sciber00/7th/earth/sciber/earthden.htm

Evaluate: MCAS released questions

Q. Which of the following Earth layers has the **greatest** density?

A. crust

B. mantle

C. inner core

D. outer core

Q. Which of the following statements **best** explains why the lower mantle of Earth is much more rigid and dense than the upper mantle?

A. The lower mantle is older than the upper mantle.

B. The lower mantle is cooler than the upper mantle.

C. The lower mantle is under more pressure than the upper mantle.

D. The lower mantle is farther from the core than the upper mantle.

Guiding Question: What is the relative temperature of the different layers of the Earth?/ ¿Cuál es temperatura relativa de las diferentes capas de la Tierra?

Engage:

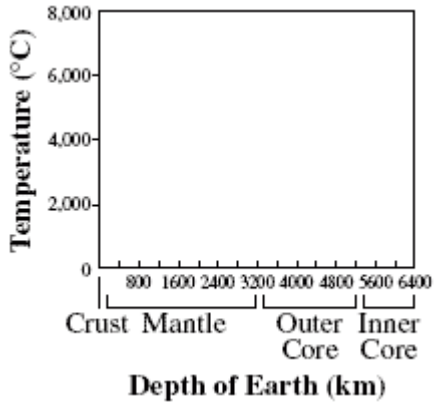
- Students interpret the graph "Temperature Inside Earth", p 12, Inside Earth. The graph shows ho **temperature/** temperatura changes between the Earth's surface and the bottom of the **mantle/** manto. Students record their observations in their notebooks.
  - *R.5.3.a. Identify graphic features found in text (such as illustrations, labeled drawings, ty size, charts, maps, diagrams).
  - *S.3.43. Participate in classroom discussions and activities, when frequent clarification is gi
  - *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topi

Explore:

- Students make a graph of the **temperature/** temperatura versus the **depth/** profundidad of the Earth's layers. (see the appendix and/or the following website) http://wwwf.countryday.net/facstf/ms/schniebec/Layers%20of%20Earth/Layers%20INFO%20P htm
  - *R.5.12.a. Identify and represent graphically main ideas, supporting ideas, and supporting details in text.

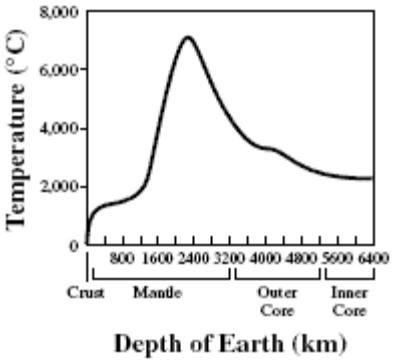
Explain: (released MCAS questions)

Q. The axes below relate the temperature to the depth below Earth's surface.

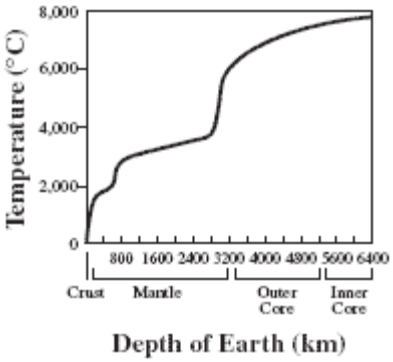


Q. Which of the following graphs **best** represents temperatures inside Earth?

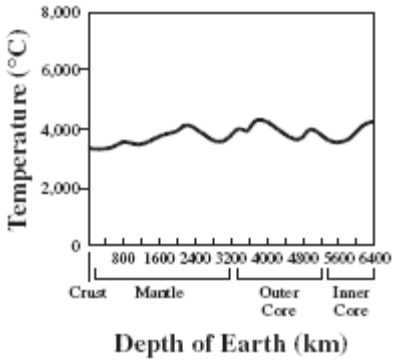
A.



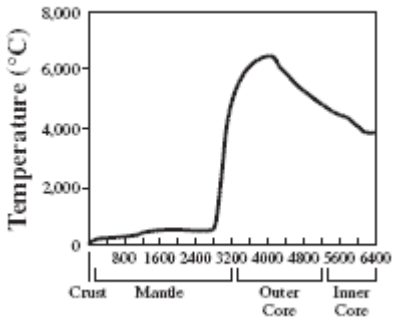
B.



C.



D.



Assessment about the Earth's Interior:

- **Students write a narrative about an imagined journey to Earth's center**. Describe characters, reason for the trip, and the vehicle used and its attributes. Note characteristics of each layer traveled through, including composition, state of matter, and changes in temperature and pressure Share difficulties encountered during journey. Conclude story with main character's reflection of his/her experience. Student exemplars will be bound as a collection, available for peer reading, as well as for future classes to reference.
  - ELL Strategy- Before students write the narrative, the students should complete a Carousel Brainstorm. This activity is important because the students will have the opportunity to discus and identify key points of the writing assignment in a group. This may relieve the stress of the writing process as students will preview the writing topics with classmates. Headings for this assignment might include characteristics of layers, difficulties and hazards and temperature a pressure.

    *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning using pictures, actions, and/or objects.
    *W.2.4.a. Draw or sequence pictures to tell or retell a story.
    *W.2.4.b. Dictate sentences to tell or retell a story in chronological sequence.
    *W.2.4.c. List details that describe story events.
    *S.4.6. Make informal oral presentations that have recognizable organization (such as sequence, summary).

Big Idea: Heat is transferred in different ways/ El calor es transmitido de diferentes maneras

Massachusetts Science and Technology Learning Standard
ESS #3 Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through the earth's system.
MCAS item analysis (What do students need to be able to do?)

- ✓ Be able to explain why dark colored objects absorb more of the Sun's energy than light colored objects.
- ✓ Recognize the different types of heat transfer (radiation, conduction, and convection)
- ✓ Describe how heat is transferred in the Earth's interior and the Earth's atmosphere

Guiding Question: How does the color of an object affect the temperature of that object when it is placed in sunlight?/ ¿Cómo el color de un objeto afecta a la temperatura de ese objeto cuando se coloca en la luz del sol?

Explore:

- o Guided Inquiry: How does the **color/** color of an object affect the **temperature**/ temperatura of that object when it is placed in sunlight? Have students write down their **hypothesis/** hipótesis before conducting the **experiment/** experimento. For this experiment, students have 4 identical cans. They wrap one with black construction paper, one with green construction paper, one with red construction paper and one with white construction paper. Each can is filled with the same amount of water, a thermometer, and is allowed to sit in the sun for some time (depending on the time available, this could be done with students from different classes taking the measurements over time). Take a reading with each thermometer, record the readings at time = 0 minutes. Take readings from all the thermometers every 10 minutes. Record the readings in a data table. Students graph the data, and analyze the graph. Did the time vs. temperature ratio look the same for all of the cans? Why or why not? Have students write a **conclusion/** conclusión that summarizes the results of the experiment.

  *S.1.5. Employ vocabulary essential for grade-level content learning
  *R.6.2.c. Visually represent data gathered through research (such as in a graph, chart, timeline).
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Explain:

- o Under which color material would you put ice if you wanted it to melt faster?

*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- On a clear sunny day, would a house with a white roof be cooler than a house with a dark roof? On a clear sunny day, would you rather wear white clothes or black clothes? Explain why?

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Extend:

- Students visit this website to learn about the annual average **solar radiation/** la radiación solar in the United States. Students investigate the question: What determines the amount of solar radiation that reaches the Earth? What region of the United Sates receives the most solar radiation? Why? The amount of solar radiation reaching the earth's surface varies greatly because of changing atmospheric conditions and the changing position of the sun, both during the day and throughout the year.
  http://www.thermotechs.com/usdata.htm

Evaluate:

Q. A class conducts an experiment to determine the best color to paint a solar water heater that they plan to build.

For their experimental test, the students have four identical cans. They paint one black, one green, one red, and one white. Each can is filled with 500 mL of 22°C water, and is allowed to sit in the sun for two hours.

Q. Which color can will have the **greatest** increase in water temperature?

A. black

B. green

C. red

D. white

Q. Kendra's mom is purchasing a car, but cannot decide what color to get. Kendra advises her mom that a car with a black exterior will be uncomfortable in the summer. This observation is correct because dark objects, as compared to lighter colored objects,

A. reduce heat transfer.

B. are generally more dense.

C. absorb more of the Sun's energy.

D. reflect sunlight more efficiently.

Guiding Question: How is heat transferred?/ ¿Cómo se transfiere el calor?

Engage:

- Students observe a demonstration: Using the radiator in the classroom or a toaster and a pinwheel, students observe that wind is created by convection current. The coils in the radiator, or toaster produces infrared radiation, heating the radiator or toaster. The heated metal then warms the air, making the air less dense, and therefore rises creating wind. The source for the earth's heat is the sun. The **radiation/** radiación from the sun heats the ground. The ground, in turn, heats the air and as demonstrated, the air rises. As it rises, cooler air comes in to replace the rising air; what we feel as wind. The faster the air rises, the faster the wind blows to take its place. Every time will feel the wind, regardless if is from the north, south, east, or west, somewhere else around the world the air is rising. The term for this rising air is **convection/** convección.
  http://www.srh.weather.gov/jetstream/global/ll_toast.htm
  *S.3.3. Demonstrate understanding when simple information is given.
  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

- Class Discussion: How do hot air balloons work?
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

Explore:

- Students explore **convection currents/** las corrientes de convección and the effect they have on the Earth's crust, Activity 12: Convection Currents, Earth's Processes Teacher's Guide, pages 105 to 110. Students will a) create and observe convection currents in water, b) compare convection currents in water to convection currents in the mantle, and c) explore the effect of convection currents on Earth's crust.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Popcorn Lesson: There are three ways to cook popcorn. 1) Put oil in the bottom of a pan. Cover the bottom of the pan with popcorn kernels. Place the pan on the stove and turn on the burner to medium heat. Cover the pan with a lid. Periodically shake the pan so the kernels move around in the oil. 2) Obtain a popcorn popper. Place the popcorn kernels in the popper. Plug in/turn on the popper. Hot air will transfer heat

to the kernels, making them expand and pop. 3) Microwave a bag of microwave popcorn. Students record the three ways to cook popcorn: **conduction/** conducción, **convection/** convección, and **radiation/** radiación in their notebooks. http://aspire.cosmic-ray.org/labs/atmosphere/popcorn.html

*S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students make a "Heat Transfer Table", with the following information: 1) the type of heat transfer, 2) describe the process of heat transfer, and 3) create an illustration of each of the three methods of heat transfer: radiation, conduction, and convection.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Class Discussion: What are some other examples of when we see radiation, conduction, and convection **heat transfer/** de transferencia de calor happening? When do we see evidence of heat transfer in our everyday lives?

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- Students label pictures as radiation, conduction or convection (see appendix for pictures drawn by Kendra VanderGheynst). Students are asked to draw 4 more examples in the blank spaces with labels.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- ELL Strategies – Students should create a word web here to link heat transfer to radiation, conduction and convection.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Extend:

- This website has lots of demonstrations of **convection currents/** las corrientes de convección. Students record different examples of convection currents in their notebooks. http://www.teachertube.com/search_result.php?search_id=convection

Evaluate: (MCAS released questions)

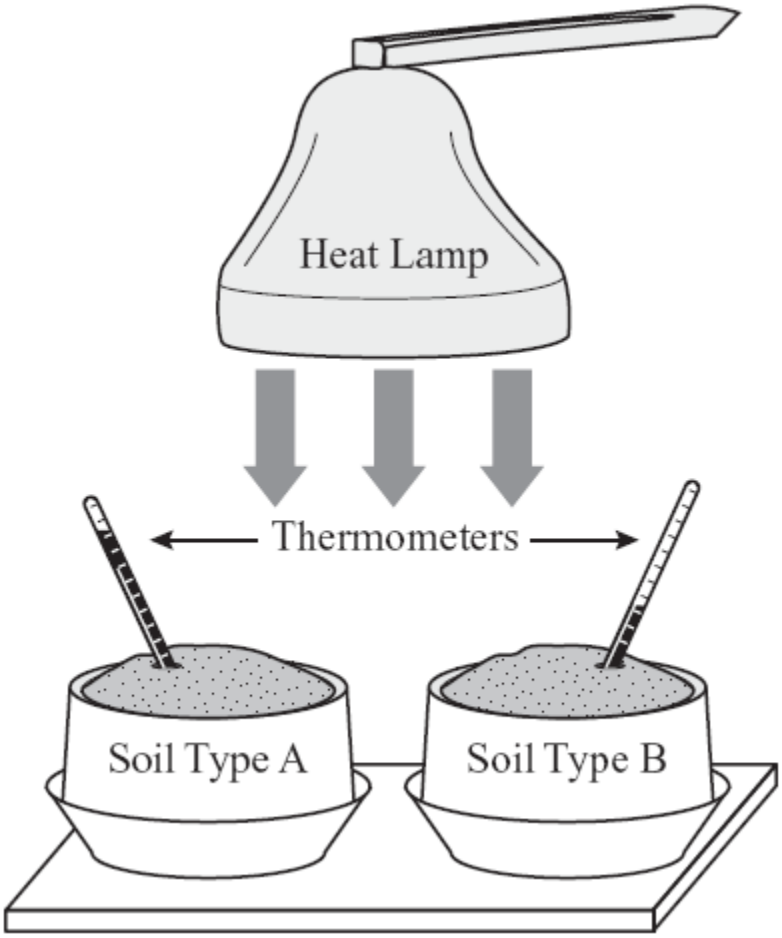
Q. Heat from deep in Earth's interior is transferred to its crust by which of the following?

A. conduction in the ocean
B. convection in the mantle
C. radiation from the solid core
D. evaporation at mid-ocean ridges

Q. When air near the ground is warmed by sunlight, which of the following occurs?

A. The warm air radiates and becomes cool again.
B. The warm air evaporates into the cooler air.
C. The warm air expands and rises, resulting in convection.
D. The warm air loses its ability to hold water and precipitates.

Q. The diagram below represents an experiment on different types of soil.



The thermometers are measuring the temperature of the center of the soil samples. Which of the following is a cause of the measured difference in the temperature of the two soils?

A. conduction within different soil types
B. condensation within different soil types
C. radiation emitted by different soil types
D. convection in the air above different soil types

Big Idea: The Earth's surface is constantly changing/ La superficie de la Tierra está cambiando constantemente

Massachusetts Science and Technology Science Standards
ESS # 5 Describe how the movement of the earth's crustal plates causes both slow changes in the earth's surface (e.g., formation of mountains and ocean basins) and rapid ones (e.g., volcanic eruptions and earthquakes).

MCAS item analysis (What do students need to be able to do?)

- ✓ Understand that the Earth's surface is made of tectonic plates
- ✓ Know the three types of plate boundaries (transform, divergent, and convergent)
- ✓ Be able to explain what happens (what geologic features are formed) when there is plate movement at the three types of boundaries
- ✓ Know that earthquakes are caused by sudden movement in the Earth's crust
- ✓ Understand that earthquakes and volcanoes cause changes to the Earth's surface
- ✓ Recognize that most volcanoes are located at plate boundaries

Guiding Question: How have the continents changed over time?/ ¿Cómo han cambiado los continentes con el tiempo?

Engage:

- o Ask students questions to elicit their ideas about changes on Earth's Surface. Ask them how long students think Mount Tom has existed. (elicit prior knowledge).
  *S.3.3. Demonstrate understanding when simple information is given.
  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

Explore:

- o Students work in small groups to complete the Activity: How are the Earth's continents linked together? p 18, Prentice Hall Science Explorer, *Inside Earth*. Students use a **globe/** mundo of the Earth to observe the Earth's **physical features/** características físicas, **continents/** continentes, **oceans/** océanos, and **mountains/** montañas. Discuss how the Earth's continents are connected, and describe the relationships observed between water and landmasses, as well as the ratio of continents to oceans. Students record their observations in their notebooks.
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *R.5.3.a. Identify graphic features found in text (such as illustrations,

labeled drawings, type size, charts, maps, diagrams).
*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students observe the location and shapes of the continents on a globe. They use paper cutouts of the continents to demonstrate how they fit together somewhat like pieces of a jigsaw puzzle. Activity #1: Pieces of a Puzzle, Earth's Processes Teacher's Guide, pages 13 to 21. In addition, students explore a variety of rocks, fossils, and glacial deposits and see how their distribution around Earth supports the **theory of continental drift**/ la teoría de la deriva continental.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- Students read Drifting Continents, on pages 18 to 22, in *Inside Earth*. Students learn about the evidence that supports Wegener's theory of Continental Drift.
  - ELL Strategy –This reading could be prefaced with a Tea Party activity.
  *R.5.5.a. Identify facts in a text to answer the reader's or other questions.
  *R.5.3.a. Identify graphic features found in text (such as illustrations, labeled drawings, type size, charts, maps, diagrams).

- Students read about and discuss: How has the Earth's Surface Changed over Time? Pages 4 to 6, in the Delta Science Reader: Earth Processes. In their notebooks, have students explain how plate tectonics differs from the original theory of continental drift.
  *R.5.5.a. Identify facts in a text to answer the reader's or other questions.
  *R.5.3.a. Identify graphic features found in text (such as illustrations, labeled drawings, type size, charts, maps, diagrams).
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students read about and discuss: Plate Movements, pages 7 to 10, in the Delta Science Reader: Earth Processes. In their notebooks, have students list the three types of plate boundaries, and explain what occurs at each type.
  *R.5.5.a. Identify facts in a text to answer the reader's or other questions.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students organize Alfred Wegener's Hypothesis of **Continental Drift/**la deriva continental with a graphic organizer (p 18, *Inside Earth*). What was his **hypothesis/** hipótesis? What **evidence/** pruebas did he have to support his **theory/** teoría?
  *S.3.43. Participate in classroom discussions and activities, when frequent

clarification is given.

- Students construct a flip book that illustrates how **Pangaea/** Pangea formed and then broke apart. Students draw or trace the positions of continents onto a large note card at several times from about 300 million years ago to the present. When assembled and flipped through, the continents will appear to move as they did through **geologic time**/ del tiempo geológico. See appendix and/or the following website for Pangaea Puzzle template http://imnh.isu.edu/digitalatlas/teach/lsnho/geog9ho.pdf

Explain:

- Have students make a **prediction/** predicción of what Earth's continents may look like 200 million years from now. Have students explain their prediction.
  *S.3.3. Demonstrate understanding when simple information is given.
  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students should perform a quick write about how they think the continents of the earth move. This is a good place to see if they connect convection currents to this topic of Continental drift.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Extend:

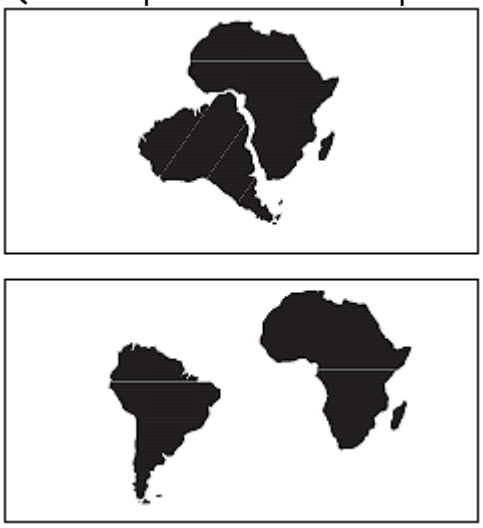
- Go Online: Continental Drift activity, p 36, *Inside Earth*. Students explore the movement of the continents from 225 million years ago to today. Students record their observations in their notebooks.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Evaluate:

Q. The surface of the earth will:
1) keep changing as plates keep moving
2) remain the same until the end of the world
3) slowly sink beneath the water surface

(MCAS released question)

Q. The maps below show the positions of two continents at two different times.



Q. The movement of the two continents as shown may **best** be explained by

A. volcanic eruptions.

B. magnetic changes.

C. coastal flooding.

D. plate tectonics.

Guiding Questions: What happens at plate boundaries? What are the three different types of plate boundaries?/ ¿Qué ocurre en los límites de placas? ¿Cuáles son los tres diferentes tipos de límites de las placas?

Engage:

- Use a draw-with-me presentation that will engage your students and help them understand the spatial and movement aspects of plate boundary environments. The process of drawing a picture involves students much more deeply than reading or discussion. This is because drawing gives students an opportunity to visualize sizes, shapes, motions, and spatial relationships. Important facts can be added through annotations and captions. Students remember best when they see and do! (see appendix and/or the following website) http://geology.com/nsta/

  *S.3.3. Demonstrate understanding when simple information is given.

  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

Explore:

- Students complete a table using the maps on page 33, 34 and 35. Students fill in a table with the following information: 1) the three different types of boundaries: divergent, convergent and transform 2) how the plates move: move apart, collide, one plate is **subducted**/ subducción beneath the other, or slide past each other, 3) what happens at the boundaries: **sea-floor spreading/** expansión del fondo marino, **mid-ocean ridge**/ dorsal oceánica, **fault/** culpa, **trenches/** trincheras, **rift valley/** Valle del Rift, **plateau/** meseta, **folding Earth's crust/** doblar la corteza de la Tierra [forming a **mountain range/** Cordillera], 4) the locations, and 5) illustrations for each type of boundary. This activity should stress the types of landforms that are created at each boundary.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students read "The Birth of the Himalayas" p 85, in the *All-in-One Teacher Resource, Inside Earth*. Apply content knowledge to develop an understanding of mountain building forces. Extend knowledge to determine where on Earth this phenomenon may occur next.
  - ELL Strategy – Before reading "The Birth of the Himalayas" teachers may want to have students perform a pre-reading activity such as Tea Party or Word Sort. After the reading, students could do a 3-2-1.

    *R.5.5.a. Identify facts in a text to answer the reader's or other questions.

    *R.3.6.b. Preview text features to predict meaning.

    *R.3.6.c. Pause while reading silently to check that information makes sense.

    *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Extend:

- Students compare and contrast **transform/** transformar, **convergent/** convergente, **and divergent/** divergentes **plate boundaries/** límites de las placas using a graphic organizer or Venn diagram. The following website has visual representations of the three types of plate boundaries. http://library.thinkquest.org/17701/high/tectonics/ptproc.html

  *S.3.21. Compare and contrast information orally.

- This website has demonstrations of the three types of plate boundaries. http://scign.jpl.nasa.gov/learn/plate4.htm

Evaluate: (released MCAS questions)

Q. Seafloor spreading provides evidence of which of the following Earth processes?

A. erosion of coastlines

B. weathering of mountains

C. movement of crustal plates

D. formation of sedimentary rocks

Q. Earth's crust and rigid upper mantle are broken into enormous slabs called tectonic plates that interact at plate boundaries. The three types of plate boundaries are transform, divergent, and convergent.

a) Describe the plate movements at two of these boundaries.
b) Give one example of a formation created at each of the boundaries that you described in part a.

Q**. Some of the geologic features found on Earth's surface were caused by the movement of Earth's crustal plates.

a. Name two geologic features found on Earth's surface that were caused by the movement of crustal plates.

b. For each of the features you named in part (a), describe how the movement of crustal plates caused the feature to form on Earth's surface.

**For this question, show students samples of released student work (remove the score before giving students the sample work) and have them score samples using the rubric provided. This will help students understand how open-ended questions on the MCAS test are scored. (see attached appendix)

Guiding Question: What causes earthquakes and volcanoes?/ ¿Qué causa los terremotos y los volcanes?

Explore:

- Students will plot the locations of volcanoes and earthquakes on a map of the Earth, Activity 10: Ring of Fire, Earth Process Teacher's Guide, pages 89 to 95. Students interpret data on the locations of **earthquakes/**terremotos and **volcanoes/** volcanes, to find patterns. Discuss with students the relationship between volcanoes, earthquakes, and plate boundaries.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Class discussion: Why is the Earth so restless? What causes the ground to shake violently, volcanoes to erupt with explosive force, and great mountain ranges to rise to incredible heights?

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

Explain:

- Explain why earthquakes and volcanoes commonly occur in the same areas.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Evaluate: (MCAS released questions)

Q. Which of the following statements **best** explains why earthquakes occur more frequently in California than in Massachusetts?

A. The rock found in California is igneous, but the rock found in Massachusetts is sedimentary.

B. California is located on the boundary of two crustal plates, but Massachusetts is not.

C. The rock under California is soft, but the rock under Massachusetts is hard.

D. California is located on a continental plate, but Massachusetts is not.

Q. An earthquake is caused by sudden shifts in which of the following layers of Earth?

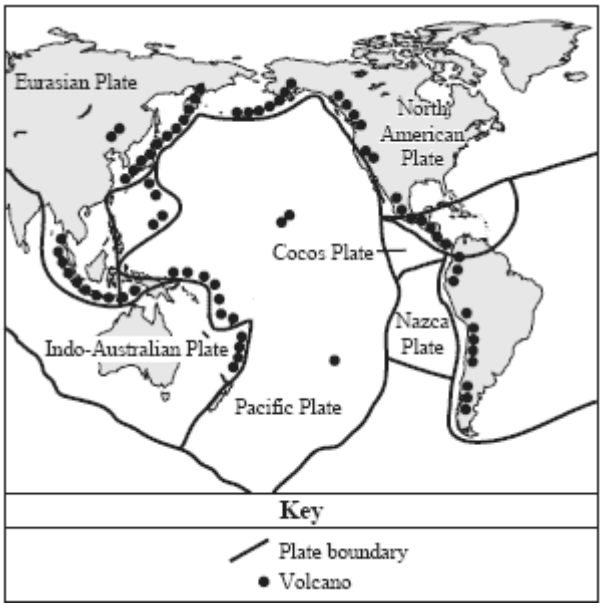
A. outer core

B. crust

C. inner core

D. mesosphere

Q. On the map below, dark circles indicate the positions of volcanoes in the "Ring of Fire" in and around the Pacific Ocean. Dark lines indicate tectonic plate boundaries of Earth's crust.



According to this map, which of the following describes where volcanoes are **most likely** to form in the Ring of Fire?

A. Volcanoes form in the middle of a tectonic plate.

B. Volcanoes form below the surface of tectonic plates.

C. Volcanoes form where tectonic plates meet other plates.

D. Volcanoes form where earthquakes are least likely to occur.

Big Idea: The Earth's surface is constantly changing/ La superficie de la Tierra está cambiando constantemente

ESS # 6 Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.

MCAS item analysis (What do students need to know?)

- ✓ Understand that the Earth's surface is constantly being eroded by wind, water, glaciers and other natural processes
- ✓ Know how rocks are broken down
- ✓ Know how rocks are formed (igneous, sedimentary and metamorphic rocks)

Guiding Question: What causes the Earth's surface to change over time?/ ¿Qué causa la superficie de la Tierra a cambiar con el tiempo?

Engage:

- o Show students the Grand Canyon poster (FOSS kit: Landforms). Point out the location of the Grand Canyon on a map of the U.S. if you have one. Ask students to turn to a partner and explain how they think the Grand Canyon was formed. Discuss and record their ideas.

  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

Explore:

- o Tell students we can't bring the Grand Canyon in the classroom but we can use a **model/** modelo to investigate the process. Demonstrate how to set up the stream table. Students work in small groups to investigate what happens when water flows over Earth materials. Investigation #2, Part 1: Erosion (FOSS kit: Landforms). Introduce the Landforms Vocabulary sheet, Students Sheet No.8 under duplication masters section, and have students look for examples of the **landforms/** Geografía in their stream tables. Discuss with students the kinds of landforms that can be created by rivers. Students make vocabulary cards for new terms.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- o Students compare and contrast stream tables and the Grand Canyon.

  *S.3.21. Compare and contrast information orally.

- o Read and discuss the story "Real People in the Grand Canyon", pages 9 to14 in

FOSS Science Stories: Landforms. After the story, ask students why they think the Grand Canyon is such a famous place?

- ELL Strategy – Students can use the 3-2-1 method when writing in their notebooks after reading "Real People in the Grand Canyon".
- ELL Strategy – Students can Sketch Their Way Through the Text while reading "Real People in the Grand Canyon." This is a good story for students to draw pictures about and even create captions for the pictures.

*S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

*R.5.5.a. Identify facts in a text to answer the reader's or other questions.

- Students work in small groups to investigate what happens to earth materials eroded by water. Investigation # 2, Part 2: Deposition (FOSS kit: Landforms). Have students focus on how particle size affects the distance a material travels downstream. Discuss landforms: Is a canyon formed by **erosion/** la erosión or **deposition/** deposición? Is a delta created by erosion or deposition? Discuss how **wind**/ viento and **glaciers/** glaciares can also **erode/** erosionar and **deposit/** depósito earth materials to form different landforms.

*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Explain:

- Ask students to look for examples of weathering, erosion, and deposition in their yards or on their way to and from school. Have them share these examples with the class and describe what they think happened at each location.

*S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students look at Figure 17: "Stream Erosion and Deposition" on p 90, Earth's Changing Surface textbook and talk about why a river deposits sediment on the inside curve of a river.

- Students interpret the graph: "Sediment on the Move", p 89, Earth's Changing Surface textbook. Students record the relationship between the speed of a stream and the size of the **sediment**/ sedimentos particles it can move.

*S.3.22. Make predictions or inferences based on a story or information that has been heard.

*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students read and discuss the story "Rivers and Controlling the Flow", found in the

FOSS Science Stories: Landforms, p 15 to 21. In their notebooks, students record notes about the factors that influence the shape of the river around river channels.

- ELL Strategy – Students complete a 3-2-1 activity after the above reading. Teachers may wish to assign this reading before the stream table investigation so students have a background.

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Extend:

- Geology of the Connecticut River Valley
  http://www.bio.umass.edu/biology/conn.river/geology.html

- Formation of the Connecticut River Valley
  http://www.bio.umass.edu/biology/conn.river/firstimpressions.html

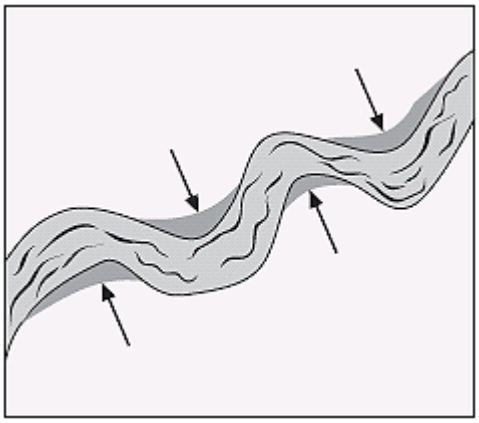
- New England Flood of 1927, picture of the Holyoke Dam
  http://www.erh.noaa.gov/nerfc/historical/nov1927.htm

- Students can read a story about the 1955 Flood
  http://www.onlarchlane.com/2009/08/1955-flood.html

- Remnants of Ida hit Western Mass, Street flooding reported in Holyoke: Saturday, 14 Nov 2009, 1:13 PM EST
  http://www.wwlp.com/dpp/news/local/Remnants-of-Ida-hit-Western-Mass

Evaluate:(MCAS released questions)

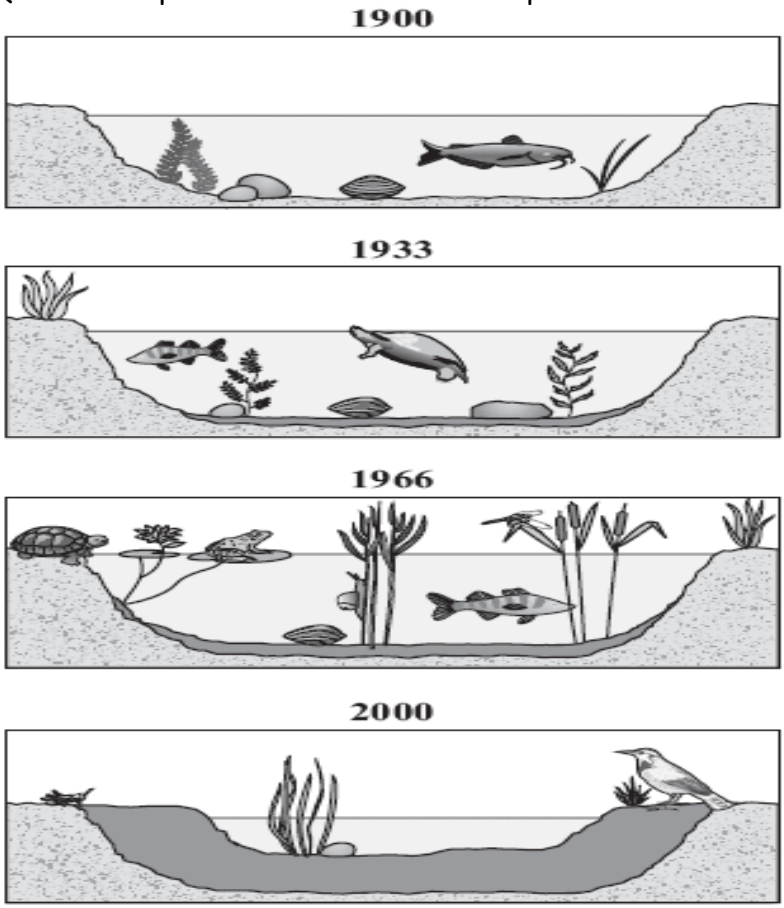
Q. The diagram below shows a river.



The shaded land areas on either side of the river were **most likely** formed by

A. tectonic activity.
B. the deposition of sediments.
C. land development by humans.
D. compression of preexisting rock.

Q. The four pictures below show how a pond environment changed from 1900 to 2000.



Which of the following processes was **most directly** responsible for the changes that occurred in the pond environment?

A. freezing

B. evaporation

C. sediment deposition

D. chemical weathering

Guiding Question: How are rocks formed?/ ¿Cómo se forman las rocas?

Explore:

- Students make sedimentary rocks and compare them to real ones, Activity 4: Sediments Become Rocks, Earth Processes Teacher's Guide, page 39 to 46.
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

- Students discover that rocks are continually changing from one kind to another in a process called the rock cycle, Activity 6: The Rock Cycle, Earth Processes Teacher's Guide, page 55 to 62. The students will explore the interactions of metamorphic, sedimentary, and igneous rocks in the rock cycle.
  *S.3.22. Make predictions or inferences based on a story or information that has been heard.

- Students read about and discuss how rocks form (**igneous/** ígneas, **sedimentary/** sedimentarias, **and metamorphic rocks/** rocas metamórficas) and how rocks change over time (the **rock cycle/** ciclo de las rocas), pages 16 to 19 in Earth Processes: Delta Science Readers.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *R.3.6.b. Preview text features to predict meaning.
  *R.3.6.c. Pause while reading silently to check that information makes sense.

Assessment about the rock cycle:

- **Students write a story about the rock cycle. Diagram your rock story in a rock cycle form.** (see next page)
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.
  *S.3.22. Make predictions or inferences based on a story or information that has been heard.

Extend:

- Students can see an animated version of the **rock cycle/** ciclo de las rocas and note the different ways that rocks can be changed by natural processes. http://www.geolsoc.org.uk/rockcycle
  - ELL Strategy – Word Web on the types of rocks and how they are formed.

- Interactive Rock Cycle
  http://www.learner.org/interactives/rockcycle/diagram.html

- See if you can name the different parts of the rock cycle http://www.learner.org/interactives/rockcycle/diagram2.html

Evaluate: (MCAS released questions)

Q. Which of the following areas is most likely to form metamorphic rocks such as gneiss and schist?

A. a sea floor
B. a windblown desert
C. a site deep underground
D. a site covered by a glacier

Q. Where is an igneous rock such as pumice most likely formed?

A. in a desert
B. in a creek bed
C. near a volcano
D. under a glacier

The Rock Cycle

Activity: The Rock Story

Students will use creative storytelling techniques to show their understanding of the rock cycle. Students should choose a type of rock and determine what might happen to it as it undergoes geologic changes. Then, think of a way to explain this in story form. Students might give their rock a name and describe his/her adventures. Students might write it as a mystery. Students should be creative and be sure to include the scientific information necessary to explain what happens to their rock. The story will be graded on the following components:

- Proper and liberal use of terminology (magma vs lava; intrusive/extrusive etc.)
- Accurate and thorough description of the processes and conditions that cause the rock to change
- Good physical description of what the rocks would look like at each stage of the rock cycle, and the proper name that would be given at each phase.
- Creativity

Suggestions for the rock cycle aspect of your story.

This outline is an example of the changes your rock might undergo. You can adjust it if you like, or you are welcome to use this format. Of course your story might start at any point of the rock cycle but should include all the possible phases of the rock cycle. This is the type of information that you should be sure to include!

I. Igneous Rocks
- A. You start as magma. Do you stay deep within to cool, or do you come to the surface.
- B. Cooling Rate
  - i. Fast or Slow
  - ii. Large or small crystals, or no crystals at all
  - iii. Are there any gases trapped within?
- C. What is your overall appearance. What would you be called at this phase of your life.

II. Sedimentary Rocks
- A. You are being broken into smaller pieces and carried away
  - i. What are these processes called?
  - ii. What is causing the breakdown? (winds, glaciers, rivers, waves?)
  - iii. What is carrying you away?
  - iv. Where are you going
  - v. Where did you end up
- B. You are surrounded by other rock fragments
  - i. Are all of the same size, shape and composition?

ii. What happens next, are you reworked or buried immediately?

C. You become a sedimentary rock

i. What changed you into a sedimentary rock

ii. Describe your overall appearance and give your self a name

iii. Explain how you have changed since your days as an ignous rock

III. Metamorphic Rocks

A. What occurs for you to change into metamorphic rock?

i. What factors are involved?

ii. Where will this change occur?

iii. How do you get there?

B. What do you look like now?

i. Foliated or non-foliated

ii. Crystalline or non-crystalline?

iii. What would your friends call you?

iv. How are you different from sedimentary and igneous rocks

IV. Explain what might happen next.

Activity: Rock Around the Rock Cycle

Diagram your rock story in a rock cycle form. To review basic rock types and to see a basic rock cycle diagram, go to http://www.cnwl.igs.net/~gvss/gca2a0/website/rock.htm However, your design should illustrate your rock story. Therefore, all the connections on the rock cycle may not be relevant in your diagram. Do be sure to include specific rock names on each part of the diagram and show what happens to your rock. Also, illustrate what else could happen to your rock (e.g. are there shortcuts it could take, but doesn't take in your story). Be creative and remember that this diagram should illustrate the story you wrote. Illustrate your rock cycle diagram to show the environment surrounding your rock and to show the forces acting upon it.

Your rock cycle diagram will be graded on the following components:

- Does it contain all the elements and processes necessary for your rock to complete its journey?
- Does it contain all the correct rock names in the right places?
- Is it neat and easy to read?
- Is it creative?

Access this lesson plan online at: www.pbs.org/americanfieldguide/teachers

Big Idea: The Earth's surface is constantly changing

Massachusetts Science and Technology Science Standards
ESS # 7 Explain and give examples of how physical evidence, such as fossils and surface features of glaciation, supports theories that the earth has evolved over geologic time.
MCAS item analysis (What do students need to be able to do?)

- ✓ Recognize how glaciers cause erosion and deposition
- ✓ Recognize geologic features (U-shaped valleys, drumlin, horn, cirque, moraine, kettle pond, glacial lake, Fjord, bedrock that is scraped and polished, glacial deposits) that provide evidence that glaciers once covered an area
- ✓ Know how fossils are formed
- ✓ Understand that some species that once lived on Earth are now extinct
- ✓ Understand the law of superposition
- ✓ Be able to explain how fossil evidence supports the theory of plate tectonics

Guiding Question: How do glaciers change the land?/ ¿Cómo cambiar los glaciares de la tierra?

Engage:

- o Make a KWL chart. Ask students what they know about glaciers (chart their responses). You could show them some pictures of glaciers from the textbook, the internet, other books, magazines, etc. (*elicit prior knowledge*). Ask them what they would like to know about glaciers (chart their questions).
  *S.3.22. Make predictions or inferences based on a story or information that has been heard.
  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

Explore:

- o Students complete the Activity: "How do Glaciers Change the Land"? p 91, Earth's Changing Surface textbook. Teachers may substitute clay for soap. Students observe that sediments in the ice change the clay by scratching and scraping the underlying rock.
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Explain:

- o Students read about and discuss: Glaciers, pages 91 to 95, Earth's Changing Surface textbook. Students should write definitions for key vocabulary terms about glaciers in their notebooks: **U-shaped valleys/** Valles en forma de U,

drumlin/ Drumlin, **horn/** cuerno, **cirque/** circo, **moraine/** morrena, **kettle pond/** estanque hervidor de agua, **glacial lake/** lagos de origen glaciar, **Fjord/** Fjord, **bedrock that is scraped and polished/** el lecho rocoso que es raspado y pulido, **glacial deposits/**los depósitos glaciales

*R.3.6.b. Preview text features to predict meaning.

*R.3.6.c. Pause while reading silently to check that information makes sense.

- Class discussion: Have students look at Figure 19, p 93, Earth's Changing Surface, and explain where all the materials went after the **glacier**/ glaciar disappeared?

  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.

- Students look at Figure 18: "Continental Glaciers", p 92 and write about what North America looked like during the last **ice age/** Ice Age.

  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Assessment about Glaciers:

- **Students will make a glacier travel brochure** (see appendix for directions and rubrics)

  *S.1.5. Employ vocabulary essential for grade-level content learning

  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

  *W.2.8.f. Write brief research reports with clear focus and supporting detail.

Extend:

- Online Activity: Students read about Glacial Lake Hitchcock to learn about local **geologic history**/ la historia geológica and record information in their notebooks
  http://www.bio.umass.edu/biology/conn.river/hitchcock.html
  http://www.bio.umass.edu/biology/conn.river/varvepub.html
  http://www.memorialhall.mass.edu/classroom/curriculum_6th/lesson1/bkgdessay.html
  http://www.earthview.pair.com/ctriver.html

- Students can use the Double-Entry Journaling process Described in the Strategies for Content Literacy Workshop handout. The Double-Entry Journaling process will help all students with the issues that they do not understand in the readings about Lake Hitchcock.

Evaluate: (MCAS released questions)

Q. When bedrock in Massachusetts is examined, it often appears scraped and polished. Which of the following most likely caused the bedrock to appear scraped and polished?

A. crustal deformation
B. frequent earthquakes
C. glacial movement
D. volcanic eruptions

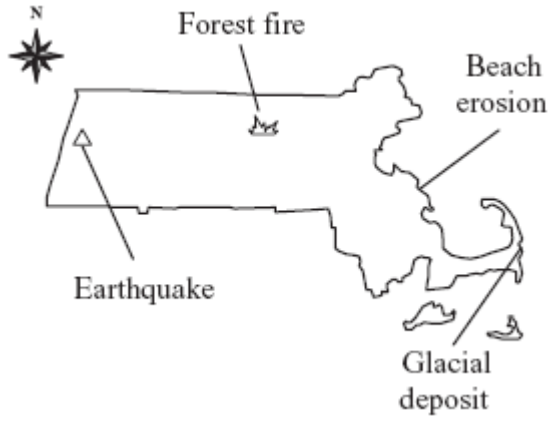
Q. The presence of which of the following geological features provides the best evidence that glaciers once covered an area?

A. wide riverbeds
B. U-shaped valleys
C. underground caves
D. groundwater springs

Q. Many areas of Massachusetts have small deep ponds called kettle ponds. Which of the following **best** explains the formation of these ponds?

A. avalanche
B. wind erosion
C. glacial depression
D. sediment deposition

Q. The map of Massachusetts below shows where physical evidence of changes can be found.



Which of these is the **best** indication that Massachusetts' climate has changed over time?

A. earthquake
B. forest fire
C. beach erosion
D. glacial deposit

Guiding Question: How do fossils form?/ ¿Cómo se forman los fósiles?

Engage:

- Ask students what they know about fossils. *(elicit prior knowledge)*
  *S.3.9. Identify important information about academic content, using prior knowledge and/or visual cues as needed.

Explore:

- Students work in small groups to complete the Activity: "What's in a Rock?" p 110, Earth's Changing Surface. Students hypothesize how **fossils/** fósiles in the rock might have formed. Students record observations in their notebooks.
  *S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students read about and discuss: How a Fossil Forms, pages 110 to 113, Earth's Changing Surface. Students make a drawing in their notebooks and explain how a fossil may form.
  *S.3.43. Participate in classroom discussions and activities, when frequent clarification is given.
  *R.3.6.b. Preview text features to predict meaning.
  *R.3.6.c. Pause while reading silently to check that information makes sense.
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students work in small groups to complete the Activity: "Modeling the Fossil Record" (see Teacher's Edition p 115). Students design and build a **model/** modelo representing rock layers and how organisms have changed through time. Students record observations in their notebooks. Students present and explain their models to the class.
  *S.1.5. Employ vocabulary essential for grade-level content learning
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Explain:

- What does the fossil record tell us about organisms and environments of the past?
  *W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

- Students work in small groups to complete the Activity: Finding Clues to Rock

Layers, p 122, Earth's Changing Surface. Students interpret data about various fossils found in rock layers and draw conclusions about the **relative ages of rock layers/** las edades relativas de las capas de roca. Students record observations and conclusions in their notebooks.

*S.1.5. Employ vocabulary essential for grade-level content learning

*S.1.3. Demonstrate comprehension of vocabulary essential for grade-level content learning, using pictures, actions, and/or objects.

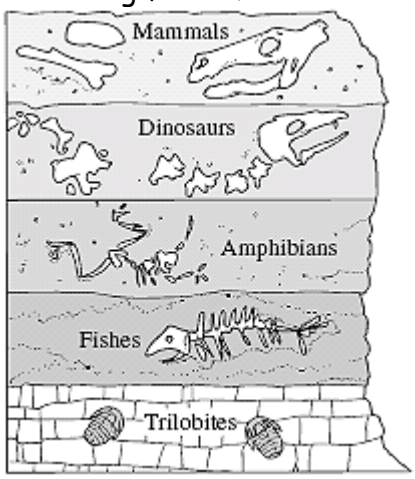
*W.2.7.a. Write short accounts of personal or familiar experiences, including academic topics.

Evaluate: (MCAS released questions)

Q. Index fossils help scientists estimate the age of a rock because index fossil species only existed for a relatively short time. What happened to the species that are now used as index fossils?

A. They became extinct.
B. They changed their diets.
C. They hid in marine sediments.
D. They migrated to new environments.

Q. The diagram below represents a cross-section of a cliff. It shows several rock layers containing fossils.



Q. Which of the following layers of rock is **most likely** the youngest?

A. the layer containing trilobites
B. the layer containing fishes
C. the layer containing amphibians
D. the layer containing dinosaurs

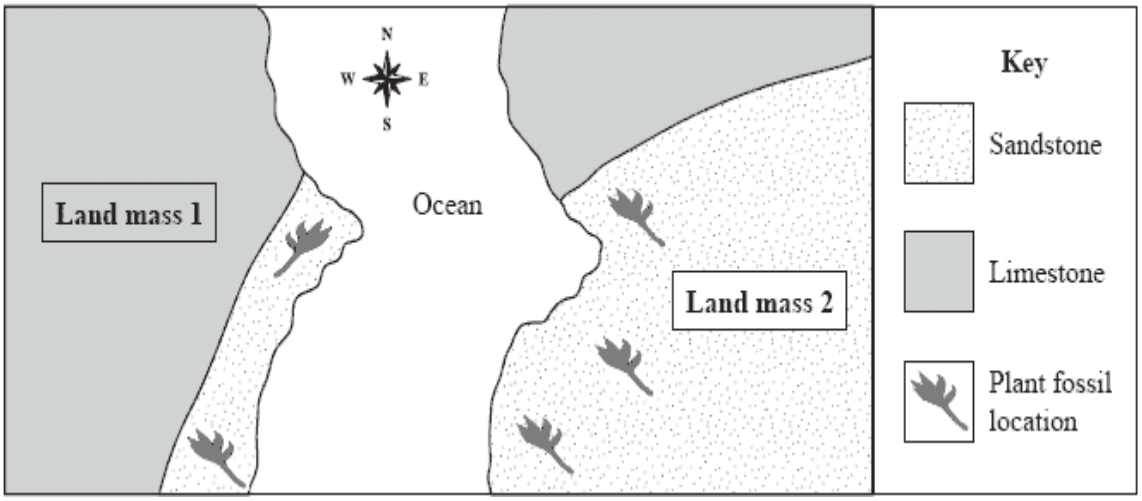
Q. A researcher found shark fossils on top of a mountain. This evidence suggests which of the following about this region?

A. It was once below a waterfall.
B. It was once part of a riverbed.
C. It was once covered by an ocean.
D. It was once near a freshwater lake.

Q. The **best** evidence that two land areas were once connected is the discovery that both land masses

A. have the same climate.
B. are in the same stage of succession.
C. exist along the same line of longitude.
D. have similar types of rocks and fossils.

Q. The diagram below shows two land masses separated by an ocean.



A scientist is studying these two land masses. The scientist hypothesizes that the land masses were once together.

a. Using the diagram, identify **two** pieces of evidence that support the scientist's theory that the land masses were once together.
b. Explain how **each** piece of evidence you identified supports the scientist's hypothesis.