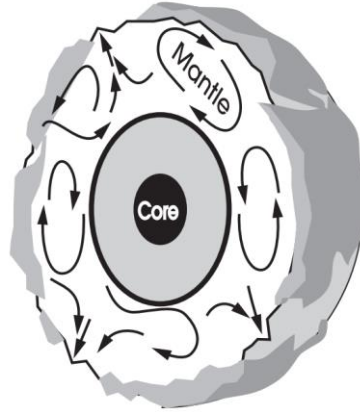


EARTH AND SPACE SCIENCE

All questions appeared on previous OGT Science exams or the public “practice test”.

Use the diagram to answer question 1.

Earth's Cross Section



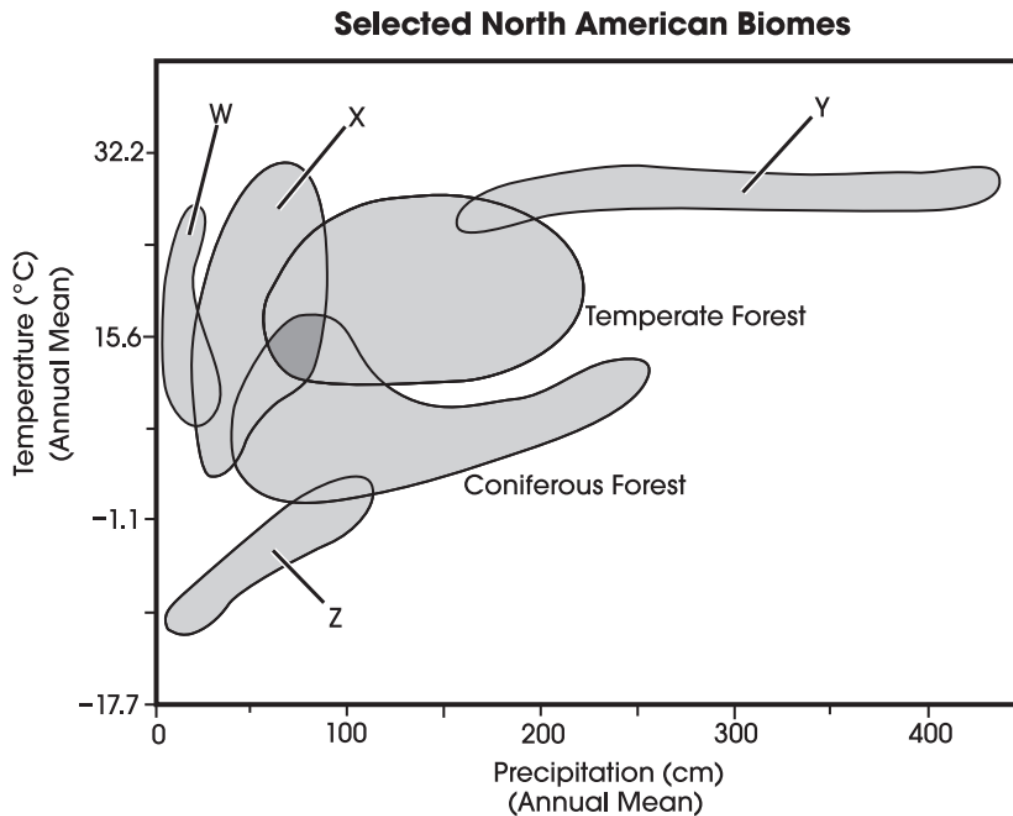
1. Scientists believe that forces in Earth's mantle move Earth's crustal plates.
What do the arrows in the diagram represent? (2005 #1 / ESS E)
 - A. ocean currents
 - B. gravity
 - C. convection currents
 - D. wind patterns

2. The early development of the theory of plate tectonics was supported by which of these observations? (2005 #8 / ESS F)
 - A. matching fossils on the continents of Africa and South America
 - B. glacier deposits far from existing continental glaciers
 - C. thick sediment layers at the mouths of rivers
 - D. sudden volcanic activity of long-dormant volcanoes

Use the information and graph to answer questions 3 – 8.

Biomes

The following graph shows the ranges of temperature and precipitation for six American biomes, two of which are identified by name.



3. Deserts are consistently the driest biomes in North America. They typically receive very little precipitation but have a wide variation in the mean annual temperature.

Which biome likely represents the deserts? (2005 #15 / ESS B)

- A. W
- B. X
- C. Y
- D. Z

4. Based on the graph, what is the primary difference between biomes W and X?
(2005 #16 / ESS B)
- A. mean number of species
 - B. mean annual temperature
 - C. mean annual precipitation
 - D. mean number of days with sunshine
5. Biome Z would likely be found in which of these locations? (2005 #17 / ESS B)
- A. in a valley along the Pacific coast
 - B. along a rocky shore in New England
 - C. in the middle of the Midwestern plains
 - D. above the tree line in the Rocky Mountains
6. Locate biome W and the temperate forest on the graph. Based on the information provided, describe one similarity and one difference between the climates of these two biomes. Respond in the space provided **below**. (2 points) (2005 #18 / ESS B)

7. Tropical forests typically have a narrow range of temperatures but a wide variation in the amount of rain that falls per year. Additionally, some tropical forests receive nearly twice as much precipitation as other wet biomes.

Which biome represents the tropical forests? (2006 #29 / ESS B)

- A. W
 - B. X
 - C. Y
 - D. Z
8. Which two biomes share the most similar precipitation ranges? (2006 #30 / ESS B)
- A. biome W and biome X
 - B. the temperate forest and biome Y
 - C. biome Z and the coniferous forest
 - D. the coniferous forest and temperate forest
-

9. The tundra is the coldest of the biomes, having extremely low temperatures and little precipitation.

What other characteristics would be expected for this biome? (2005 #19 / ESS B)

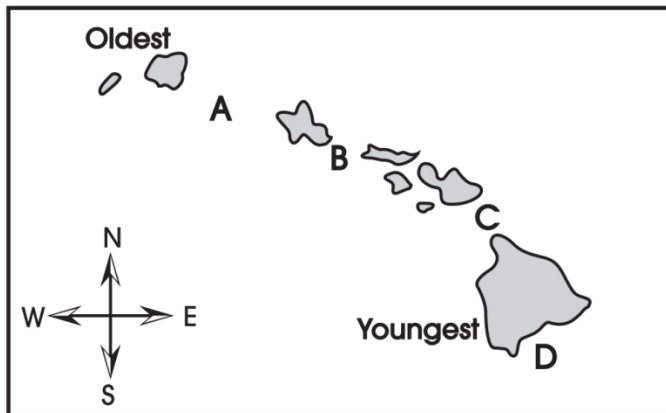
- A. low biotic diversity and sparse vegetation
- B. nutrient rich soil and a long growing season
- C. stable population numbers and high biotic diversity
- D. dense vegetation and large daily temperature fluctuations

10. What type of energy from the oceans is responsible for weather patterns? (2005 #20 / ESS B)

- A. electrical
- B. magnetic
- C. mechanical
- D. thermal

Use the map to answer question 11.

Map of the Hawaiian Island Chain



11. The Hawaiian Islands are riding on the Pacific Plate as it moves northwestward. They are being formed as the plate moves over a hot spot in the mantle.

Where is the next volcano likely to form? (2005 #22 / ESS E)

- A. A
- B. B
- C. C
- D. D

12. When examining the red shift of galaxies outside our own, every galaxy appears to be moving away from the observer. This observation supports the Big Bang Theory because it indicates that (2005 #23 / ESS A)

- A. our galaxy is not moving.
- B. the universe is expanding.
- C. most galaxies have the same mass.
- D. Earth is at the center of the universe.

13. Our solar system is thought to have formed from a nebula of dust and gas. Most of this nebula condensed to form the sun.

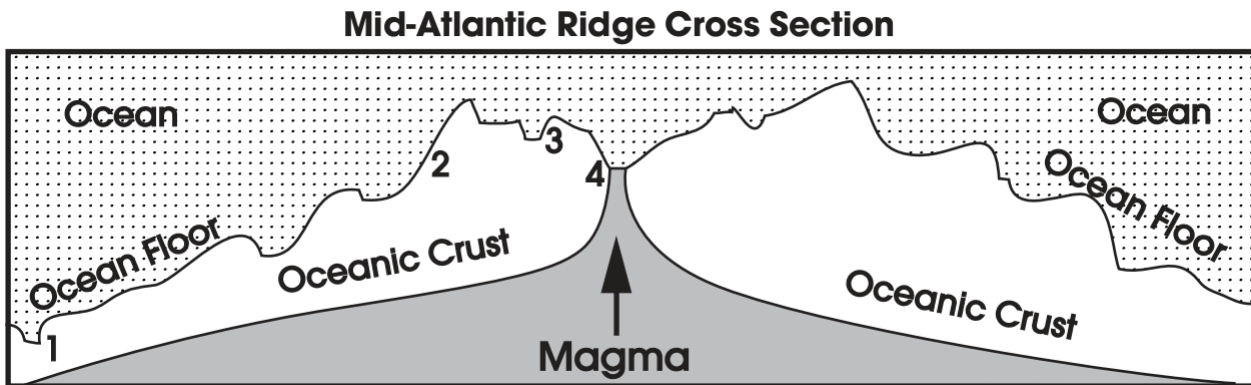
What is primarily responsible for causing these materials to condense? (2005 #26 / ESS C)

- A. electrical attraction between charged dust particles
- B. gravitational pull of nebula materials on each other
- C. heat released by nuclear fusion at the center of the nebula
- D. chemical reactions between hydrogen and other nebula gases

14. Which property of a star can be determined most directly from its color? (2006 #6 / ESS A)

- A. mass
- B. diameter
- C. precise age
- D. surface temperature

15. The following diagram shows a cross-section of the mid-Atlantic Ridge.



Which area is likely the oldest crust? (2006 #1 / ESS E)

- A. 1
- B. 2
- C. 3
- D. 4

16. A driver traveling from the coniferous region to the tundra region would most likely observe (2006 #24 / ESS B)

- A. a decrease in air quality.
- B. a decrease in biodiversity.
- C. an increase in deciduous tree species.
- D. an increase in nighttime temperatures.

Use the table to answer question 17.

Data on Select Organisms

Organism	Date of First Appearance in Fossil Record	Method of Obtaining Energy
purple sulfur bacteria	3.6 billion years ago	ingestion of particles/anaerobic respiration
cyanobacteria	3.3 billion years ago	photosynthesis/cellular respiration
bony fish	341 million years ago	consumption of other organisms/aerobic respiration
mammals	229 million years ago	consumption of other organisms/aerobic respiration

17. The appearance of which organism contributed the most to making it possible for humans and other organisms to breathe Earth’s current atmosphere? (2006 #28 / ESS C)
- A. bony fish
 - B. mammals
 - C. cyanobacteria
 - D. purple sulfur bacteria
18. Identify two savings that result from recycling aluminum cans and explain one ecological benefit of each. Respond in the space provided **below**. (4 points) (2006 #31 / ESS D)

19. In Aristotle's treatise *On Meteorology*, he stated that:

"The same parts of the Earth are not always moist or dry, but they change accordingly as rivers come into existence and dry up. And so the relation of land to sea changes too and a place does not always remain land or sea throughout all time, but where there was dry land there comes to be sea, and where there is now sea, there one day comes to be dry land. ..."

Aristotle was referring to the (2006 #34 / ESS F)

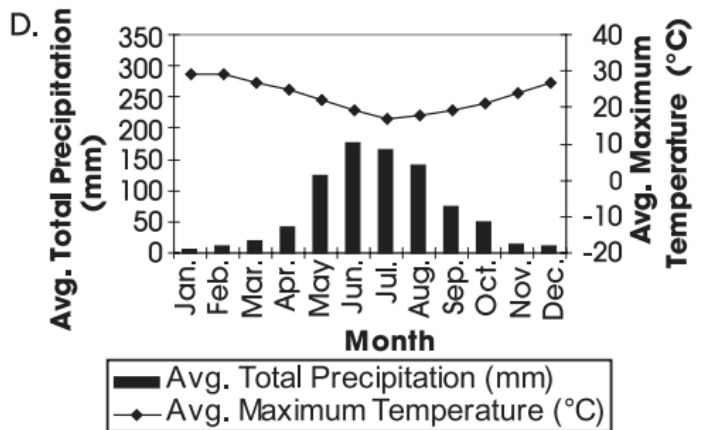
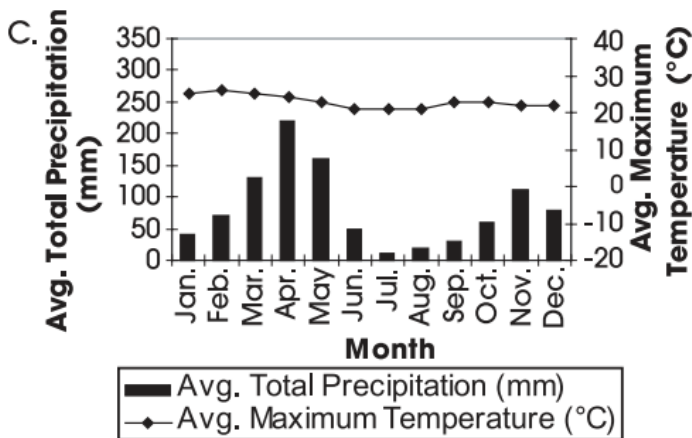
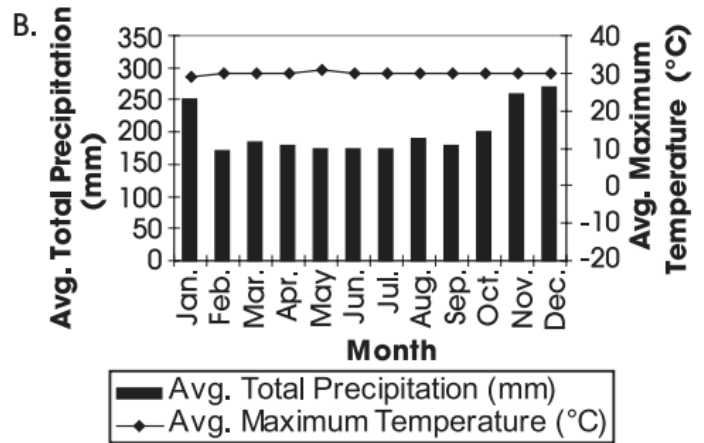
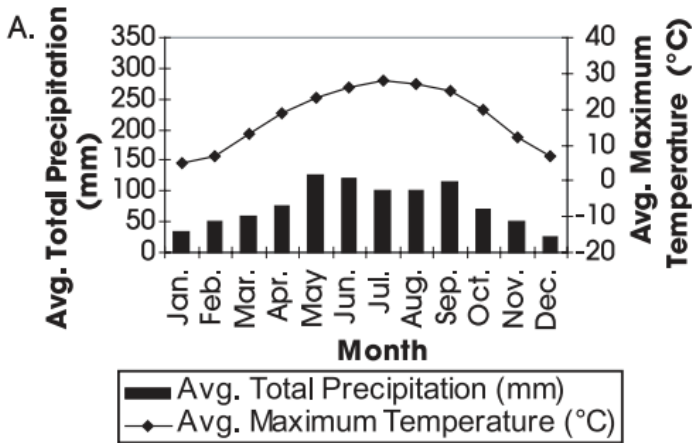
- A. depletion of natural resources.
- B. cyclic nature of Earth processes.
- C. relationship between latitude and climate.
- D. effects of humans on biogeochemical cycles.

20. What evidence has been used to support the theory of plate tectonics? (2006 #39 / ESS E)

- A. The Grand Canyon runs in the same direction as the mid-Atlantic ridge.
- B. There are deserts in the western parts of North and South America.
- C. The same fossil species are found in South America and Africa.
- D. Glacial till covers parts of the northern United States and Asia.

21. Climatographs are often used to represent a location's temperature and precipitation patterns. (Precipitation is represented by the bar graph because it is cumulative.)

Which climatograph most likely represents a tropical rainforest? (2007 #6 / ESS B)



22. Astronomers have formulated many models of the solar system over time. Ptolemy's early geocentric model gave way to Copernicus' heliocentric model on which the modern solar system model is based.

Which statement best describes why models of the early Ptolemy solar system were replaced by the Copernican model? (2007 #18 / ESS F)

- A. Computers are better able to develop scientific models than humans are.
 - B. A more precise age has been established for the formation of the solar system.
 - C. More direct observations have enabled scientists to change solar system models.
 - D. Scientists established that a different set of laws govern the motion of our solar system than govern the motion of other solar systems.
23. A study is planned to investigate the potential environmental impact of storing animal wastes in large, open lagoons on commercially owned farms. These lagoons sometimes rupture or overflow, spilling their contents into lakes and waterways.

Identify one negative consequence of increased animal waste in lakes and waterways and describe how the increased animal waste results in this consequence.

Then identify a second negative consequence of increased animal waste in lakes and waterways and describe how the increased animal waste results in this consequence. Respond in the space provided **below**. (4 points) (2007 #19 / ESS D)

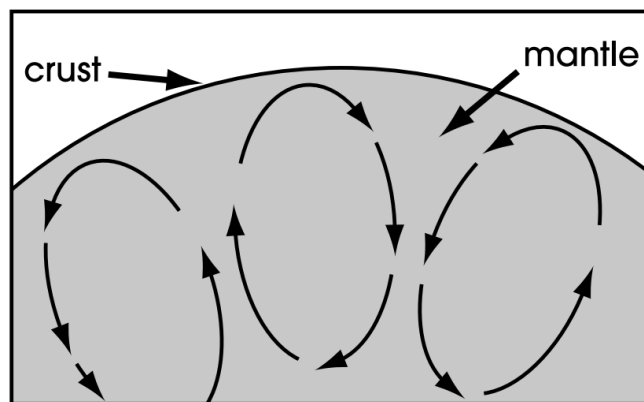
24. The Arctic tundra has an annual temperature range of -34°C to 12°C . Annual precipitation ranges from 15 cm to 25 cm.

Based on these conditions, what characteristic does the Arctic tundra exhibit? (2007 #24 / ESS B)

- A. high nutrients
- B. low biodiversity
- C. long growing season
- D. small population changes

Use the picture to answer question 25.

Simplified Diagram of Earth's Mantle



25. What is the process shown above by which molten material moves through Earth's mantle? (Practice Test #33 / ESS E)

- A. radiation
- B. convection
- C. plate faulting
- D. continental drift

Use the information and tables to answer questions 26 - 27.

Peppered Moths

The British peppered moth, *Biston betularia*, occurs in two colorations: light (mixed black and white) and black. Black coloration was first seen in 18th-century moth collections as a rare, highly prized mutant. Black coloration is controlled primarily by a single, dominant gene.

Before 1850, the overwhelming majority of peppered moths in northern England were light. As the Industrial Revolution swept through northern England, however, light moth populations dwindled as black moth populations grew. Overall, the total peppered moth numbers remained steady.

Peppered Moths in England

Year	Black Moths (%)	Light Moths (%)
1850	10	90
1900	90	10
1996	Fewer than 10	90+

In the same time period, the less industrialized rural England saw no such changes in moth populations. The only predators observed to prey on the moths were local birds. No migratory or population changes of birds occurred during that time.

British naturalist H.B.D. Kettlewell captured, marked and released known numbers of black and light-peppered moths in an unpolluted woodland and two similar groups in a polluted woodland. He later recaptured as many moths as possible. The following are some of Kettlewell's mark-and-recapture data.

Dorset, England (Unpolluted Woodland)

	Black Moths	Light Moths
Marked and Released	473	496
Recaptured	30	62
Percentage Recaptured	6.3%	12.5%

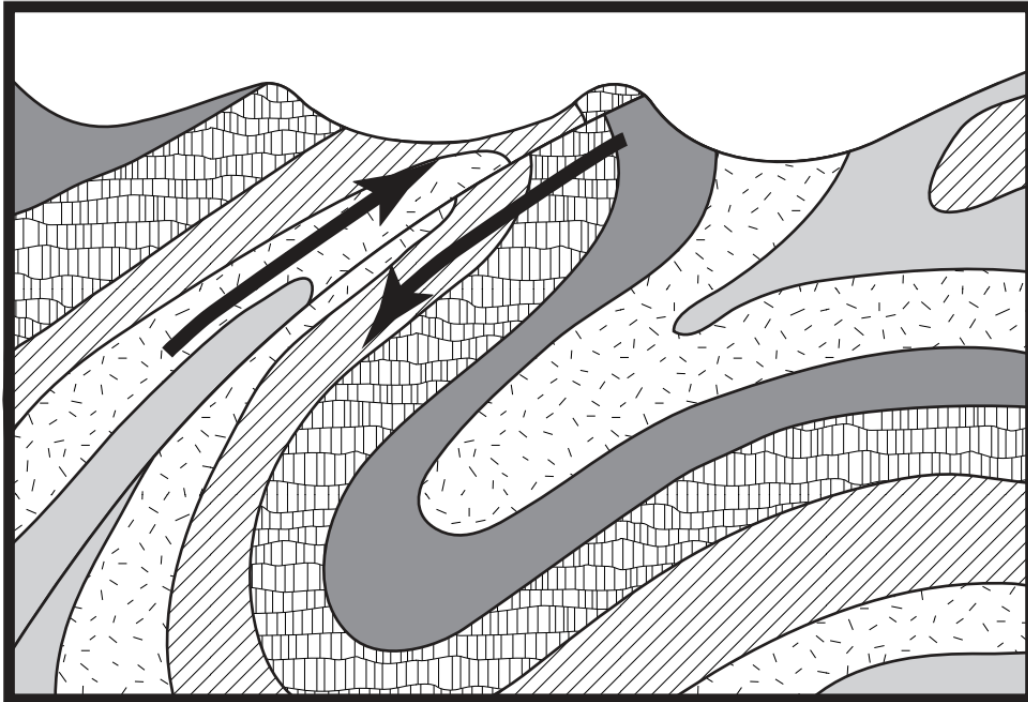
Birmingham, England (Soot-blackened Woodland)

	Black Moths	Light Moths
Marked and Released	447	137
Recaptured	123	18
Percentage Recaptured	27.5%	13.1%

26. What 20th-century event most likely had the greatest impact on the recovery of light moth populations? (2007 #29 / ESS D)
- A. higher taxes imposed on oil imports
 - B. invention of the silicon solar cell in 1941
 - C. clean air legislation passed in the 1950s
 - D. reduced fuel efficiency in new automobiles
27. The change in population numbers of black and light moths from 1850 and 1900 is most likely a result of the increased use of (2007 #31 / ESS D)
- A. fossil fuels.
 - B. solar energy.
 - C. geothermal energy.
 - D. pollution control technologies.
-
28. Methane (CH_4) from Ohio's Rose Valley coal mine has successfully been used to power fuel cells.
- Since the fuel used in these cells is not burned, using methane from the mine will help to (2007 #32 / ESS D)
- A. increase the concentration of atmospheric ozone.
 - B. reduce public demand for alternative fuel sources.
 - C. increase public awareness of global warming issues.
 - D. reduce pollutants commonly associated with fossil fuel combustion.

29. The cross-section below shows the orientation of rock layers in a given area.

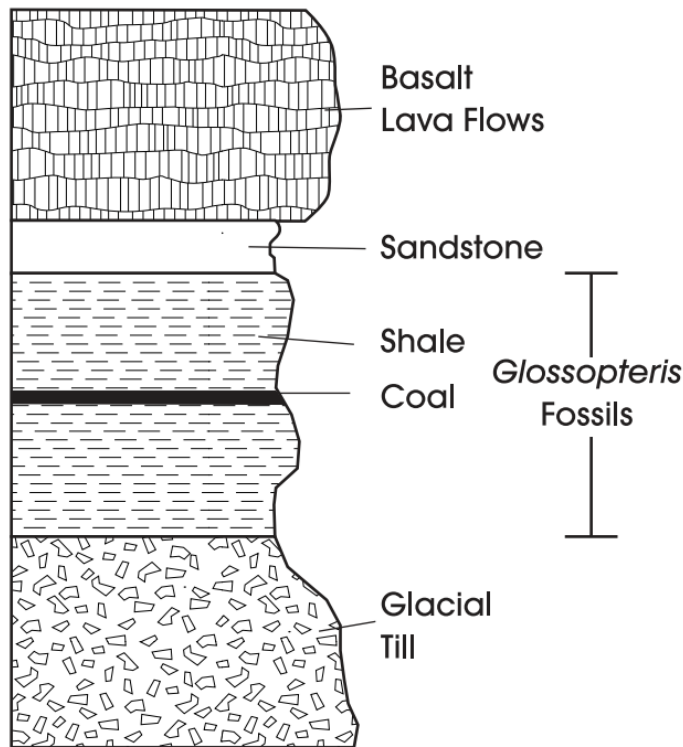
Geologic Cross-section



What geologic event most likely caused the folding and faulting of these layers?
(2007 #35 / ESS E)

- A. tectonic activity
- B. glacial advance
- C. magnetic reversal
- D. seafloor spreading

30. The cross-section below shows a series of rock layers that have been found in all of these landmasses: South America, Africa, India, Australia, and Antarctica.



Alfred Wegener's analysis of the similarities in these layers led to the conclusion that (2007 #38 / ESS F)

- A. continental plates float on top of a molten mantle.
- B. in undisturbed rock sequences, the oldest fossils will be on the bottom.
- C. these five landmasses were once joined together in a single landmass.
- D. magnetic anomalies are preserved in rocks formed at mid-oceanic spreading centers.

31. James Hutton (1726 - 1797) is often referred to as the father of modern geology. His detailed observations and theories about Earth processes opposed the accepted theories of his time. One of his contributions was the development of what he called the great geological cycle. Hutton theorized that most rocks were igneous in origin. The igneous rocks could then change into sedimentary or metamorphic rocks. The chart below shows locations of several rock types and the minerals they contain.

Location	Rock Type	Rock Name	Minerals Present
England	Sedimentary	Dirty Sandstone	Muscovite Mica, Quartz, Biotite Mica
Germany	Igneous	Granite	Quartz, Orthoclase Feldspar, Muscovite Mica, Biotite Mica
Australia	Metamorphic	Gneiss	Orthoclase Feldspar, Muscovite Mica, Biotite Mica, Quartz
North America	Sedimentary	Conglomerate	Muscovite Mica, Quartz, Biotite Mica

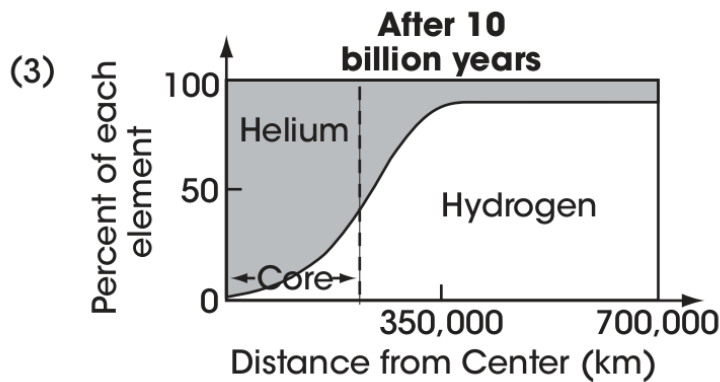
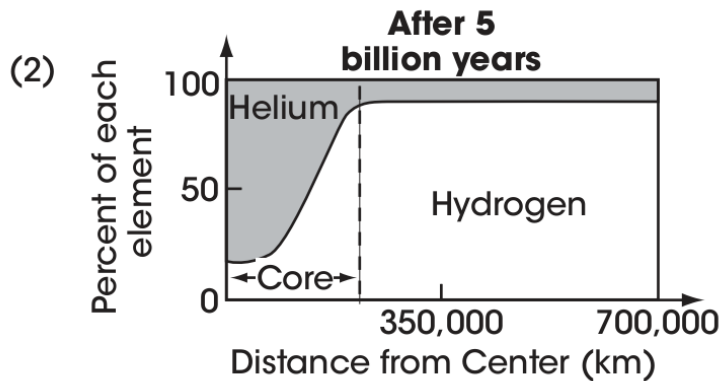
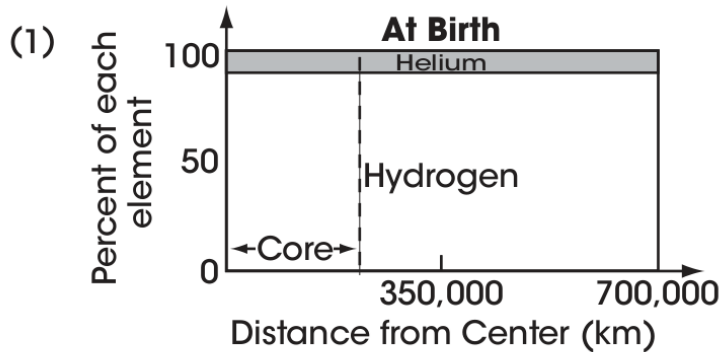
What evidence from the chart could be used to support Hutton's theory that most rocks are igneous in origin? (2008 #4 / ESS F)

- A. Igneous rocks are only found in Germany.
- B. Sedimentary rocks are found in both North America and England.
- C. The rocks found in the table are made up of many of the same minerals.
- D. The rocks found in the table are different types of rocks from different locations.

32. Thousands of acres of tropical rainforests are cut down each year, primarily for farming and wood products. Identify two negative environmental consequences of rainforest destruction. Explain the negative impact of each consequence. Respond in the space provided **below**. (4 points) (2008 #6 / ESS D)
33. Most geologists accept radiometric dating techniques as valid because (2008 #13 / ESS C)
- A. radioactive elements decay at a constant and measurable rate.
 - B. all radioactive elements used for dating purposes have the same decay rate.
 - C. elements used for radiometric dating have both radioactive and non-radioactive isotopes.
 - D. non-radioactive isotopes decay at the same rate as radioactive isotopes.
34. Geologists installed tiltmeters in a tectonically active area. Tiltmeters can detect very small changes in the slope (tilt) of Earth's surface. These changes result from the upward movement of magma beneath Earth's surface.
- What event could be predicted by monitoring these changes? (2008 #15 / ESS E)
- A. a potential volcanic eruption
 - B. reversal of Earth's magnetic field
 - C. a change in the composition of Earth's crust
 - D. decreased thermal energy transfer within Earth

35. According to some theories, Earth's sun is approximately 5 billion years old. After about 10 billion years, this type of star runs out of fuel. The hydrogen in the core becomes depleted and cannot be fused to form helium. The graphs below illustrate the chemical changes that occur inside a star at specific times.

Chemical Changes in a Star



Using the information provided, what is the hydrogen/helium content inside a star that is the approximate age of our sun? (2008 #20 / ESS A)

- A. The hydrogen content decreases as it reaches the outer edge of the star.
- B. The helium content is higher at the outer portion of the star than it is in the core of the star.
- C. The hydrogen content is higher at the center of the star and then decreases towards the outer edge of the star.
- D. The helium content is greatest at the center of the star and then decreases towards the outer edge of the star.

36. State two factors and explain how each influences the weather in Ohio.

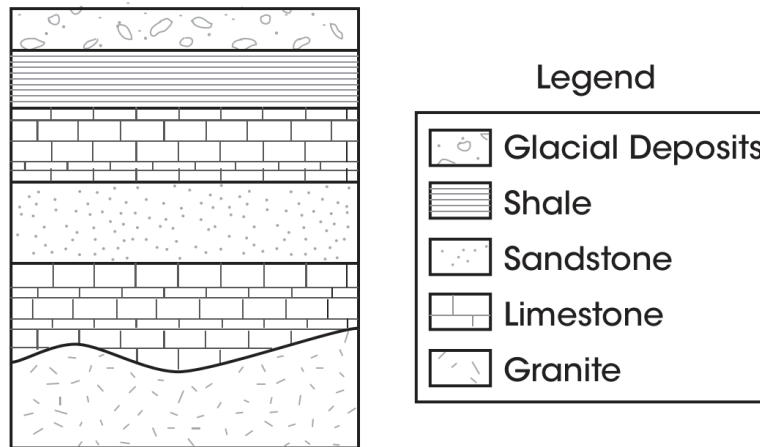
Respond in the space provided **below**. (4 points) (2009 #6 / ESS B)

37. An astronomer investigating a star determines that the light wavelengths she observes are longer than those expected to be emitted by the star.

What can be concluded about the motion of the star relative to Earth's position? (2009 #34 / ESS A)

- A. The star is moving closer to Earth.
- B. The star is moving away from Earth.
- C. The star is accelerating faster than Earth.
- D. The star is accelerating at the same speed as Earth.

38. In the 1600s, Danish scientist Nicholas Steno studied the relative positions of sedimentary rocks. He determined that sedimentary rocks typically form layer on top of layer, so if undisturbed, the bottom layer of sedimentary rock is the oldest. Today, this idea is known as the Law of Superposition. This law is one way to estimate the relative ages of sedimentary rocks. The diagram below is a geologic cross-section from Ohio.



How could the Law of Superposition be applied correctly to this cross-section? (2008 #22 / ESS F)

- A. The youngest sedimentary layer was deposited by glaciers.
- B. The layers in this cross-section are all igneous, so it will not work.
- C. The sedimentary layer in this cross-section is close to 5,200 years old.
- D. The youngest sedimentary layer can be found at the very bottom of the cross-section.

39. In some areas, magma chambers exist close to Earth's surface. Water seeping into the ground becomes heated by the rock overlying these magma chambers.

What is most likely to occur when the heated water under pressure rises back toward the surface through fractured rock? (2008 #38 / ESS E)

- A. plate subduction
- B. geyser formation
- C. volcanic eruption
- D. earthquake activity

40. Henri Darcy was a French engineer living in the 1800s. He observed that water flowed at different rates through different types of soil and rock. He applied his research to assist scientists in calculating groundwater flow rates, resulting in a formula called Darcy's Law.

Why do scientists use a formula to estimate groundwater flow, instead of taking direct measurements as they do in surface freshwater streams? (2008 #41 / ESS F)

- A. Groundwater does not move under the ground so it has no flow rate.
- B. Scientists cannot easily reach the groundwater to determine the flow rate.
- C. Groundwater freezes easily, so it is more difficult to measure the rate of flow.
- D. There is more surface freshwater than groundwater, so it is easier to measure.

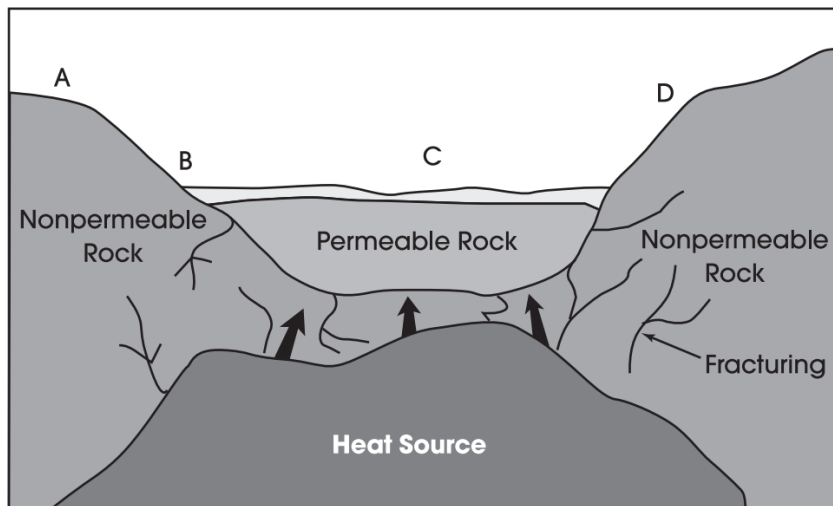
41. Many scientists hypothesize that a cloud of interstellar dust, gas and ice collapsed to form a nebula from which our Sun and planets formed.

What factor is responsible for causing most of this interstellar material to condense, forming our Sun? (2008 #30 / ESS C)

- A. magnetic attraction
- B. ultraviolet radiation
- C. dissipation of gases
- D. gravitational attraction

Use the diagram below to answer question 42.

Cross Section of an Area of Earth's Crust



42. In which area of the diagram above is a geyser most likely to form? (2009 #36 / ESS E)

- A. A
- B. B
- C. C
- D. D

43. Scientists have hypothesized for years that Earth's continents once formed a single landmass that broke apart and became the continents as we know them today. The model below shows the landmasses (Gondwanaland) as they started to break apart to form South America, Africa, Antarctica, India, and Australia.

Gondwanaland



What evidence best supports the model proposed above? (2009 #15 / ESS C)

- A. Igneous rocks have been found on all the continents.
- B. Similar fossils have been found in parts of Africa and South America.
- C. Australia has marsupial species that are not found on other continents.
- D. Indications of sea level changes have been recorded on all the continents.

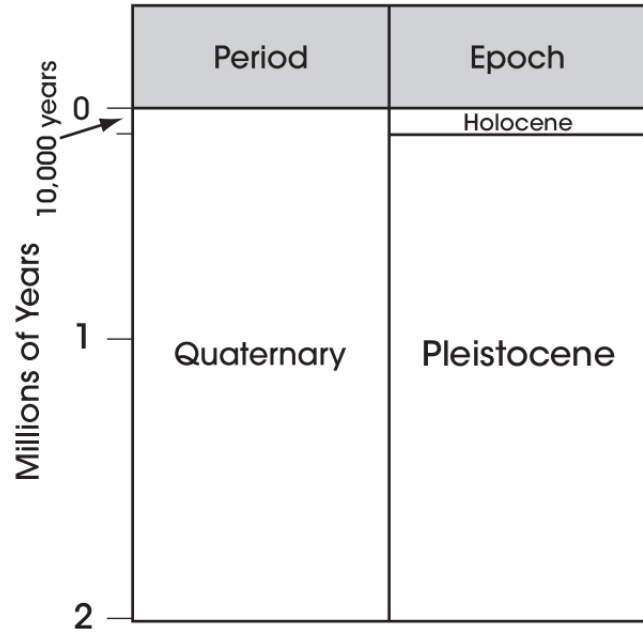
Use the tables to answer question 44.

Table A
Half-lives

Radioactive Isotope	Half-life
Potassium 40	1.25 by
Rubidium 87	48.8 by
Thorium 232	14 by
Uranium 238	4.47 by
Uranium 235	704 my
Carbon 14	5,730 yrs

by = billions of years
my = millions of years

Table B
Partial Cenozoic Time Scale

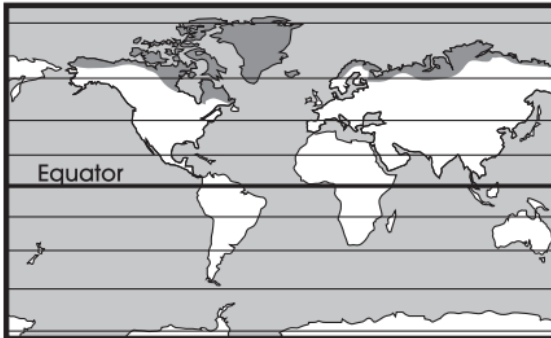


44. Which isotope from Table A is the only one with applications for dating Holocene materials? (2009 #17 / ESS C)

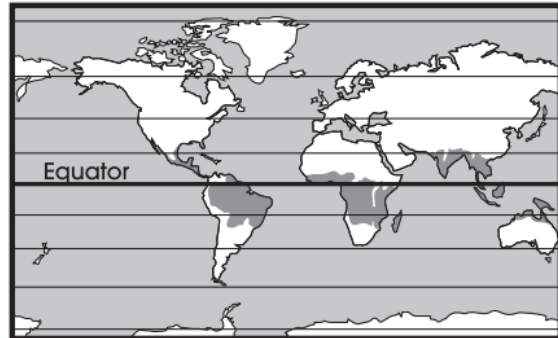
- A. carbon 14
- B. rubidium 87
- C. uranium 238
- D. potassium 40

45. On which map do the shaded land areas represent regions where the average annual temperature is greater than 18°C (64.4°F)? (2009 #21 / ESS B)

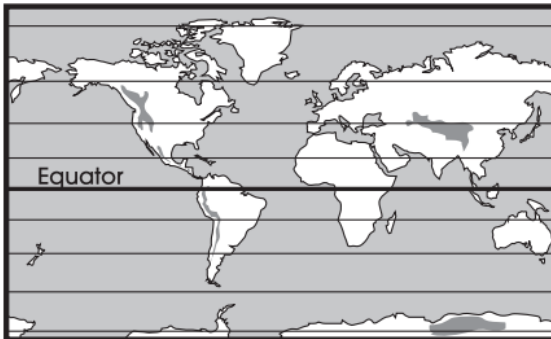
A.



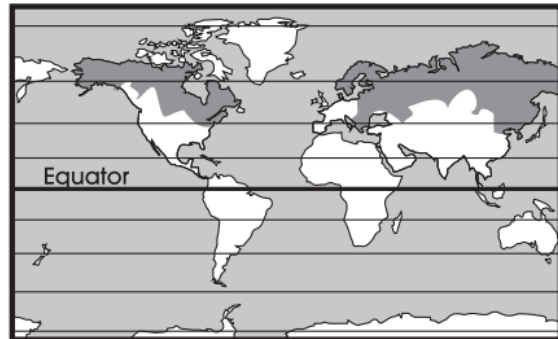
B.



C.



D.



46. An oceanographer is traveling from the west toward the east on the Atlantic Ocean. She collects rock samples from the seafloor every 5 kilometers. The oceanographer stops when she determines that the rock samples are getting progressively younger as she moves toward the east.

What conclusion is best supported by this data? (2009 #30 / ESS E)

- A. She is traveling toward a mid-ocean ridge.
- B. She is traveling toward a deep-ocean trench.
- C. She is traveling away from an underwater volcano.
- D. She is traveling away from a hot spot in the crust.

47. An earth science teacher places four pieces of carpet padding, representing sedimentary layers, between two large book ends, as shown in Figure 1. She then pushes the book ends toward each other, as shown in Figure 2.

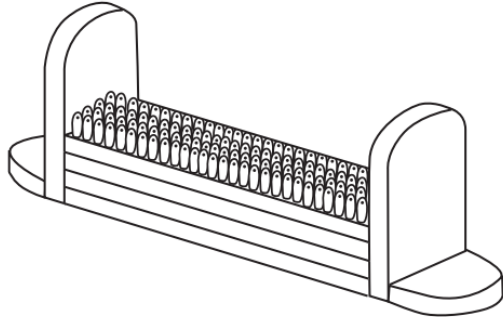


Figure 1

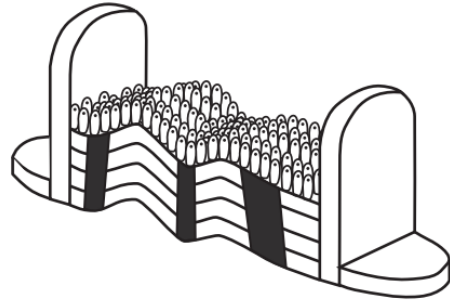


Figure 2

What geologic process has the teacher demonstrated? (2009 #38 / ESS E)

- A. folding
 - B. faulting
 - C. convection
 - D. divergence
48. The White Cliffs of Dover are made of a white sedimentary stone called chalk, which was formed when shells and skeletons of small marine organisms were deposited in a thick layer.

An examination of the Cliffs of Dover from top to bottom would show a change from (2009 #43 / ESS C)

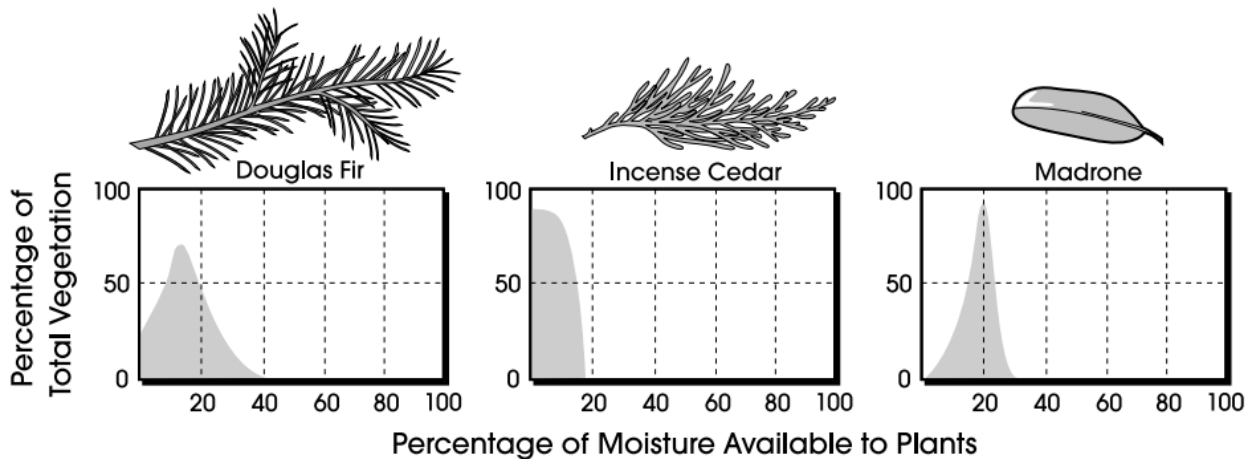
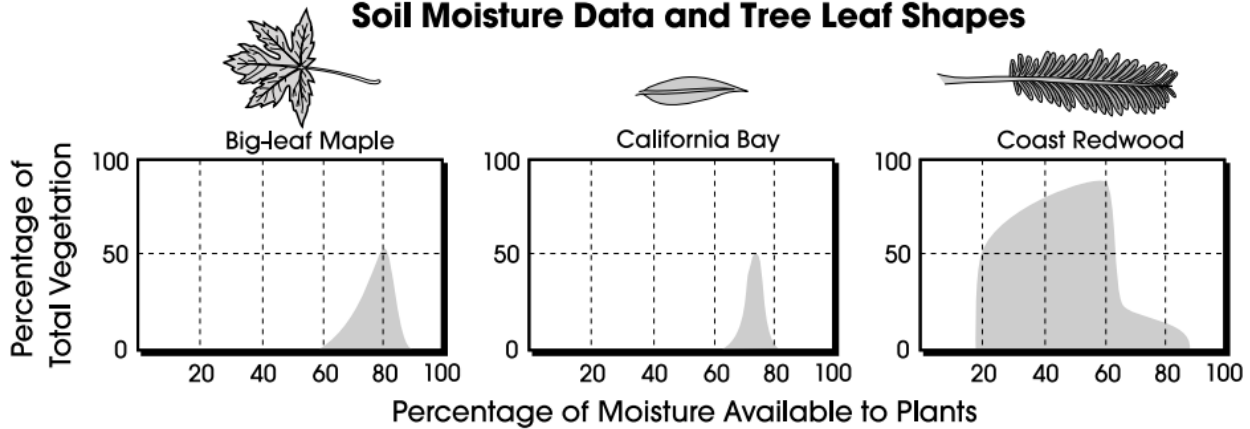
- A. younger fossils to older fossils.
- B. simple fossils to complex fossils.
- C. igneous rock to sedimentary rock.
- D. marine organisms to land organisms.

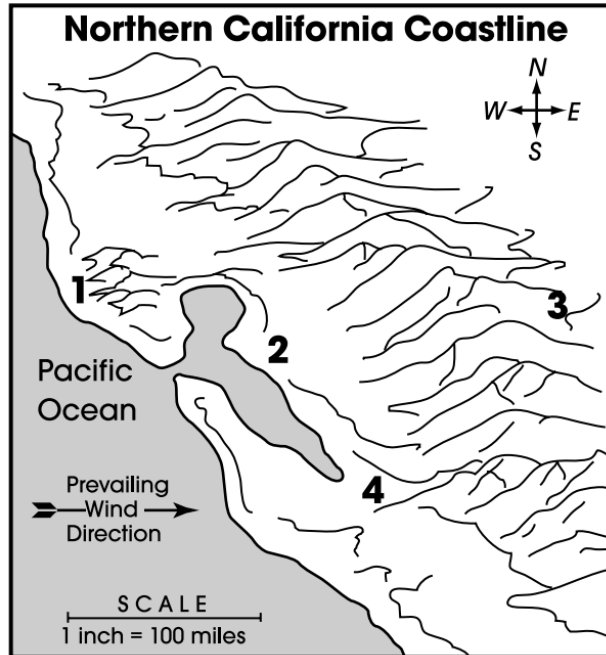
Use the information and map to answer question 49.

Plant Distribution

The distribution of plant species depends on many factors, including climate, topography, soil conditions and biological interactions. Data on moisture availability were collected along the coast of Northern California. In this area, each plant community has a dominant tree. The graphs below illustrate a dominant tree's percentage of the total vegetation compared to the percentage of soil moisture available. Each tree species studied has a distinct preference for a certain kind of habitat.

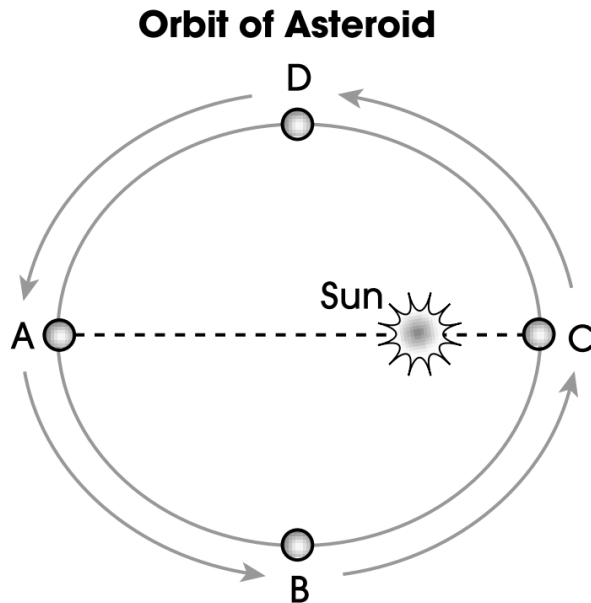
Soil Moisture Data and Tree Leaf Shapes



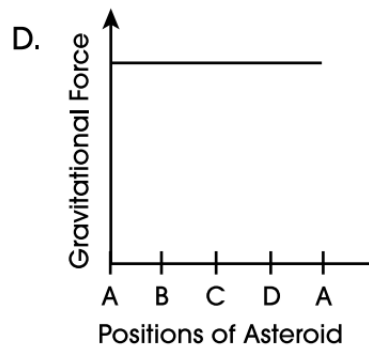
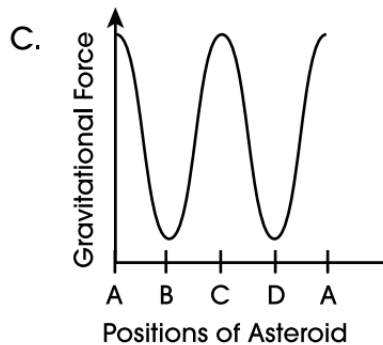
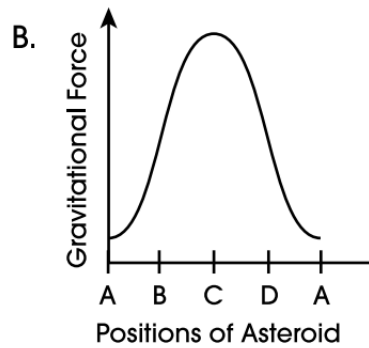
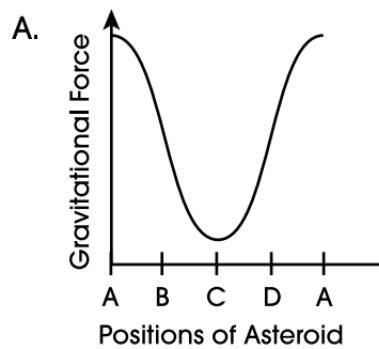


49. In which area would you expect incense cedar and madrone to dominate?
(Practice Test #10 / ESS B)
- A. 1
 - B. 2
 - C. 3
 - D. 4
50. In most areas of Ohio, the frost-free growing season is 150 to 180 days. Farms close to Lake Erie have a growing season closer to 200 days. One explanation of this fact is that (Practice Test #13 / ESS B)
- A. crops grown around the lake are frost-resistant.
 - B. industries around the lake prevent early freezes.
 - C. irrigation water from the lake freezes at a lower temperature.
 - D. heat given off by the lake extends the number of frost-free days.

51. Points A, B, C and D in the drawing below represent an asteroid's position during its orbit around the sun.

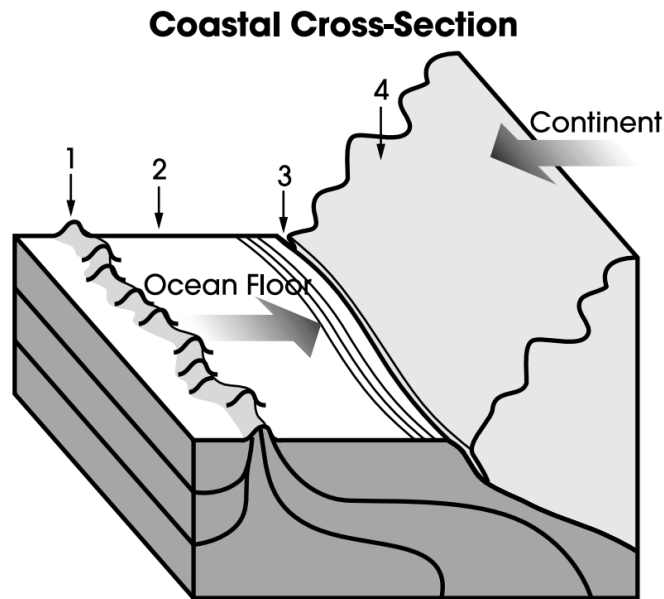


Which graph shows how the gravitational force between the sun and the asteroid varies with the asteroid's distance from the sun? (Practice Test #15 / ESS C)



52. Earth's crust is divided into many crustal plates. Their activity is described as plate tectonics. List two effects of plate tectonics and explain how plate tectonics causes each effect. Respond in the space provided **below**. (4 points) (Practice Test #18 / ESS E)

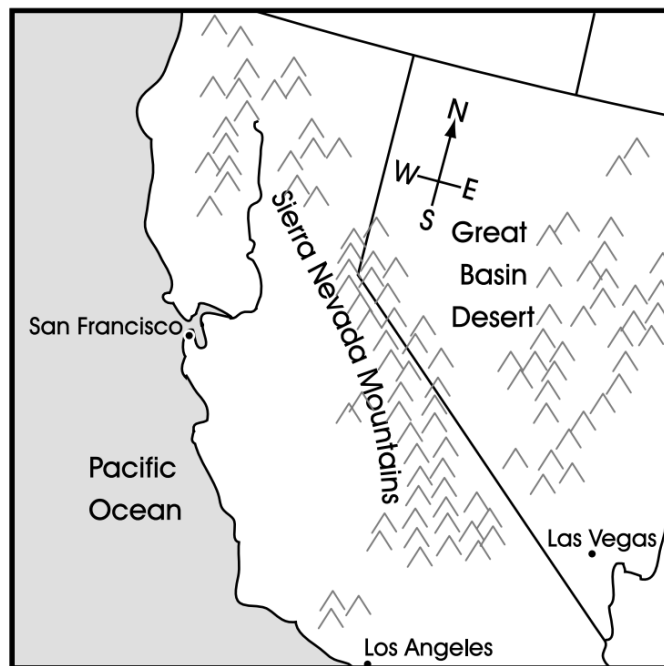
53. Which area of the diagram shows the subduction zone? (Practice Test #25 / ESS E)



- A. 1
- B. 2
- C. 3
- D. 4

54. The 19th-century hypothesis that sedimentary strata were laid down in chronological order had what immediate impact on geologic theory? (Practice Test #20 / ESS F)
- A. It provided proof of continental drift.
 - B. It provided calibration of data derived from radioactive decay.
 - C. It caused geologists to reconsider estimates about Earth's age.
 - D. It allowed geologists to better understand tectonic plate movement.

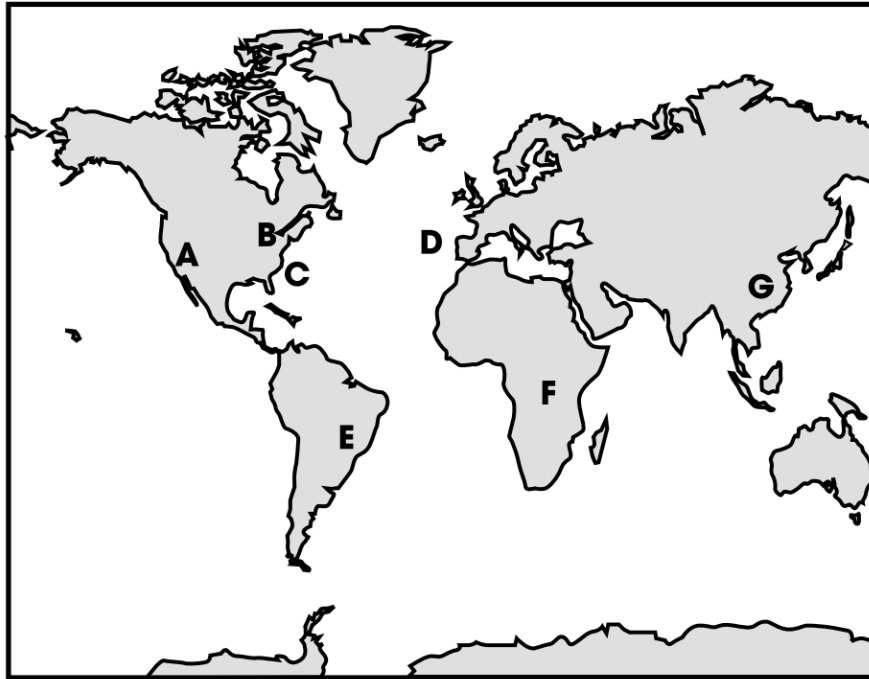
Use the map to answer question 55.



55. The interior of the western United States is arid to semi-arid because the western mountains (Practice Test #27 / ESS B)
- A. produce large amounts of moisture.
 - B. block moisture coming from the west.
 - C. prevent snow from melting.
 - D. reflect solar heat drying the air.

56. The following map shows the positions of Earth's continents today.

Map of Earth



Which piece of evidence would provide the strongest support for the hypothesis that Earth's continents were once joined? (Practice Test #38 / ESS E)

- A. Modern crops grown in region E can also be grown in region F.
- B. Fossilized sediments found in region A resemble those found in region B.
- C. Modern marine mammals found in location C are also found in location D.
- D. Fossilized land invertebrates found in location E are also found in location F.