

CRT Science Review #8

Earth Science: Atmospheric Processes and the Water Cycle



Standard: Atmospheric Processes and the Water Cycle - Earth systems have internal and external sources of energy, both of which create heat. Driven by sunlight and Earth's internal heat, a variety of cycles connect and continually circulate energy and material through the components of the earth systems.

Indicators & Item Specifications:

E.8.A.1 Students know seasons are caused by variations in the amounts of the Sun's energy reaching Earth's surface due to the planet's axial tilt. E/S

- Understand the relationship between the sun and Earth and how equinoxes, solstices, and seasons occur.
- Know Earth rotates on an axis, tilted at 23.5° as it orbits the sun (the tilt does not change orientation as Earth orbits the sun).
- Know Earth's axial tilt produces winter in northern hemisphere when it is summer in the southern hemisphere and vice versa.
- Know location and latitude affect the amount of sun's energy received.

E.8.A.2 Students know how the processes involved in the water cycle affect climatic patterns. E/S

- Understand the movement of water through the water cycle.
- Understand the difference between climate and weather.
- Understand the role of convection in the water cycle, weather, and climate (i.e., convection is the expansion and contraction of matter due to temperature).
- Describe water in the atmosphere as water vapor, clouds, ice crystals, and describe its role as a greenhouse gas.

E.8.A.3 Students know the properties that make water an essential component of the earth system. E/S

- Understand that water exists in all three states of matter on Earth.
- Understand why ice floats on water and its impact on aquatic life.
- Describe water in the atmosphere as water vapor, clouds, and ice crystals and describe its role as a greenhouse gas.
- Know clouds, precipitation, glaciers, and polar ice caps are all sources of fresh water.

E.8.A.4 Students understand the composition of Earth's atmosphere, emphasizing the role of the atmosphere in Earth's weather and climate. I/S

- Understand how temperature and altitude change in the different layers of the atmosphere.
- Recognize that the Earth's atmosphere contains different gases and particulate matter, and is mostly nitrogen, and oxygen.
- Understand the role of atmospheric gases related to the greenhouse effect.

E.8.A.5 Students know the difference between local weather and regional climate. I/S

- Know how weather systems work and how there are daily variations.
- Compare regional climates and describe how climate regions are influenced.
- Recognize and use weather instruments to determine local weather.
- Understand the result of human impact on local weather and climate (heat island effect, deforestation, thermal inversion, and fires).

E.8.A.6 Students know topography and patterns of global and local atmospheric movement influence local weather which occurs primarily in the lower atmosphere. E/S

- Understand how topography affects local weather and seasons (e.g., rain shadow, global wind patterns, convection currents, lake effect, and global desert patterns).
- Recognize that most weather takes place in the part of the atmosphere closest to the Earth.

Sample Multiple Choice CRT-Style Questions Related to Atmospheric Processes and the Water Cycle

1. The water cycle would **not** occur if which of the following were missing?
 - A. Animals
 - B. Ice caps
 - C. Plants
 - D. Solar energy
2. What is the layer of the atmosphere in which weather occurs?
 - A. Troposphere
 - B. Mesosphere
 - C. Exosphere
 - D. Stratosphere

3. Which of the following describes the phase changes necessary to occur when water changes from: ocean water → glacier → fresh water → water vapor?

- A. freezing → melting → freezing
- B. evaporating → freezing → melting
- C. melting → freezing → freezing
- D. freezing → melting → evaporating

4. A sheet of ice would float on a freshwater lake because ice

- A. is more dense than water.
- B. is less dense than water.
- C. has less volume.
- D. has less mass.

5. Answer the question using the data table below.

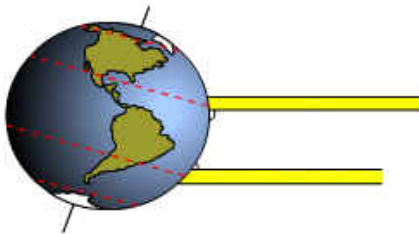
Water Source	% of Total Water on Earth
Oceans	97.2
Ice Caps/Glaciers	2.38
Groundwater	0.397
Surface Water	0.022
Atmosphere	0.001

(From http://www.epa.gov/NE/students/pdfs/ww_intro.pdf)

The majority of water on Earth exists as saltwater. Which water source would increase the most if ice caps and glaciers melt?

- A. Oceans
- B. Groundwater
- C. Surface water
- D. Atmosphere

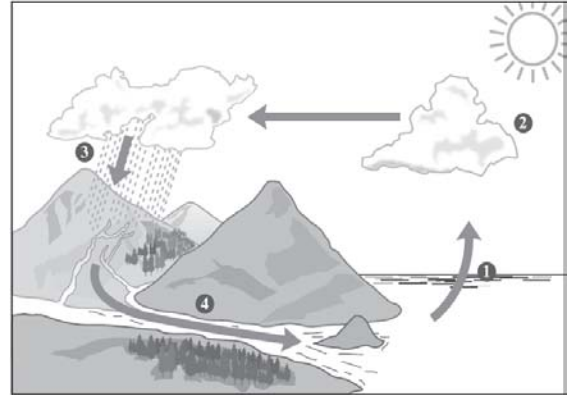
6. Use the diagram below to answer the following question.



Which of the following is **not** a contributing factor to the uneven warming of Earth's surface?

- A. Different surfaces warm at different rates.
- B. Different surfaces retain energy differently.
- C. The Sun is farther from Earth during the winter.
- D. The Sun's rays hit the surface at varied angles.

Use the diagram of the water cycle to answer questions 7 and 8.



(From <http://www.doe.mass.edu/mcas/>)

7. What change is occurring in stage 1 of the diagram? Water is changing from a

- A. liquid to a gas.
- B. solid to a liquid.
- C. gas to a liquid.
- D. liquid to a solid.

8. In what process is water vapor changing to a liquid?

- A. Condensation
- B. Convection
- C. Radiation
- D. Transpiration

9. The two most abundant greenhouse gases in Earth's atmosphere are

- A. water vapor (H₂O) and carbon dioxide (CO₂).
- B. carbon dioxide (CO₂) and methane (CH₄).
- C. ozone (O₃) and carbon monoxide (CO).
- D. nitrogen (N₂) and oxygen (O₂).

10. Greenhouse gases help keep Earth at a habitable temperature by

- A. blocking the cold winds and ices originating in outer space.
- B. serving as essential nutrients for atmospheric phytoplankton.
- C. allowing only infrared light to reach Earth's surface.
- D. retaining some of the Sun's energy in our lower atmosphere.

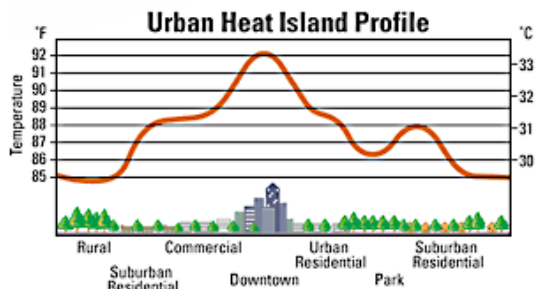
11. Weather patterns in the United States of America generally travel from the

- A. North Pole toward the Equator.
- B. Equator toward the North Pole.
- C. west toward the east.
- D. east toward the west.

12. Carbon dioxide concentration within Earth's atmosphere were approximately 315 parts per million (ppm) in 1960 and steadily rose to 355 parts per million (ppm) by 1990. The **most likely** cause of the overall change in the level of carbon dioxide from 1960 to 1990 is an increase in the
- number of violent storms.
 - number of volcanic eruptions.
 - use of nuclear power.
 - use of fossil fuels.

13. Convection in the oceans and atmosphere is a result of the difference in
- mass.
 - temperature.
 - weight.
 - volume.

14. Use the graph showing an Urban Heat Island Profile to answer the question that follows.

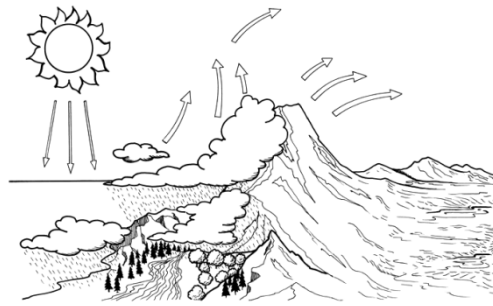


(Profile reference from <http://www.epa.gov/hiri/about/index.html>)

Where are temperatures the highest?

- Suburban areas
- Rural areas
- Downtown areas
- Commercial areas

15. Use the diagram of a rain shadow effect below to answer the following question.



(From: <http://www.fao.org/docrep/006/ad316e/AD316E79.gif>)

Clouds usually form on the windward side because this is where air

- rises and cools.
 - rises and warms.
 - sinks and cools.
 - sinks and warms.
16. When determining a region's climate, the two main variables considered are the average
- air temperature and the size of the region.
 - precipitation and average air temperature.
 - wind speed and the types of animals present.
 - barometric pressure and the average precipitation.
17. Which of the following statements **best** explains why it is warmer at the equator than the North Pole?
- The equator has more daylight hours per year than the North Pole.
 - The equator has a larger area than the North Pole.
 - The equator is closer to the Sun than the North pole.
 - The equator receives more direct sunlight than the North Pole.

Sample Constructed Response Question Related to Atmospheric Processes and the Water Cycle

18. Diagram the Earth in its orbit around the Sun and include the following labels and explanations.
- The Earth's tilt must be represented along with labels for each solstice and equinox as experienced in the Northern Hemisphere. The terms summer solstice, winter solstice, vernal (spring) equinox, and autumnal (fall) equinox must be used.
 - Identify the position that reflects the Southern Hemisphere receiving the greatest **and** least amount of direct solar energy. Provide evidence to support these choices.
 - Explain, with evidence, what seasons would be like on Earth if there were no axial tilt.

CRT Science Review #8 Key

Earth Science: Atmospheric Processes and the Water Cycle



Standard: Atmospheric Processes and the Water Cycle - Earth systems have internal and external sources of energy, both of which create heat. Driven by sunlight and Earth's internal heat, a variety of cycles connect and continually circulate energy and material through the components of the earth systems.

Answer Key

1. D, DOK Level 1
2. A, DOK Level 1
3. D, DOK Level 2
4. B, DOK Level 1
5. A, DOK Level 2
6. C, DOK Level 1
7. A, DOK Level 2
8. A, DOK Level 1
9. A, DOK Level 1
10. D, DOK Level 1
11. C, DOK Level 1
12. D, DOK Level 2
13. B, DOK Level 1
14. C, DOK Level 1
15. A, DOK Level 1
16. B, DOK Level 1
17. D, DOK Level 1

Constructed Response Answer

18. DOK Level 3

3 points	<p><i>Response addresses all parts of the question clearly and correctly.</i></p> <p>A. The diagram shows the Earth in a counterclockwise rotation tilted toward the Sun in the Summer Solstice for the Northern Hemisphere and away when it is Winter Solstice. The Vernal Equinox and Autumnal Equinox should be labeled in order respectively. At each of the equinoxes the Earth should not be tilted toward or way from the Sun.</p> <p>B. The Sun's rays would be the most direct in the position labeled as the Northern Hemisphere's winter as the Southern Hemisphere is tilted towards the Sun. The Sun's rays would be the least direct in the position labeled as the Northern Hemisphere's summer as the Southern Hemisphere is tilted away from the Sun.</p> <p>C. Without an axial tilt there would be no seasons, as the amount of direct sunlight an area receives would not change throughout Earth's orbit. The equatorial regions would receive the largest amount of direct energy, and the poles would consistently receive the least. This would be because Earth's axis of rotation would have a perpendicular relationship with the plane of the ecliptic, resulting in an angle of incidence of 90° at the equator and 0° at the poles.</p>
2 points	<i>Response addresses all parts of the question and includes only minor errors.</i>
1 point	<i>Response does not address all parts of the question.</i>
0 points	<i>The response is totally incorrect or no response provided.</i>

Visit RPDP's Middle School TIPS website for additional sample CRT questions: http://rpd.net/sciencetips_v3/

CRT Science Review #9

Earth Science: Solar System and Universe



Standard: Solar System and Universe - The universe is a dynamic system of matter and energy. The universe is extremely large and massive with its components separated by vast distances. Tools of technology will continue to aid in the investigation of the components, origins, processes and age of the universe. Earth is one part of our solar system, which is within the Milky Way galaxy. The Sun is the energy producing star for our solar system. Most objects in our solar system are in predictable motion, resulting in phenomena such as day/night, year, and phases of the moon, tides, and eclipses.

Indicators & Item Specifications:

E.8.B.1 Students know the universe contains many billions of galaxies, and each galaxy contains many billions of stars. W/L

E.8.B.2 Students know the solar system includes a great variety of planetary moons, asteroids, and comets. I/S

- Recognize the difference between moons, asteroids, and comets.

E.8.B.3 Students know characteristics of the planets in our solar system. I/S

- Describe general planetary motions.
- Explain the relationship between moons and planets.
- Understand the characteristics of rocky (terrestrial) and gaseous planets.

E.8.B.4 Students know Earth is part of a solar system located within the Milky Way Galaxy. E/S

- Identify the Earth as part of a solar system that is also part of a larger system that contains many thousands of star systems: the Milky Way Galaxy

E.8.B.5 Students know the Sun is many thousands of times closer to Earth than any other star, and billions of times closer than the far end of the Milky Way Galaxy. W/L

E.8.B.6 Students know the Sun is a medium-sized star located in the Milky Way Galaxy, part of which can be seen as a glowing band of light spanning the clear night sky. W/S

- Given examples, compare the mass, brightness, and color of the Sun to other stars.

E.8.B.7 Students know regular and predictable motions of Earth around the Sun and the Moon around the Earth explain such phenomena as the day, the year, phases of the Moon, and eclipses. E/S

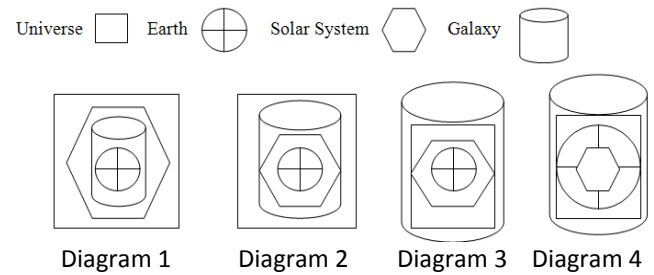
- Given a model, locate the position of Earth, the sun, and/or the moon that would produce a specific phase of the moon or type of eclipse, and determine the phase of the moon or types of eclipse based on the position of Earth, the sun, and the moon.
- Understand that the Earth/Moon system rotates and revolves around the sun and the moon rotates and revolves around Earth in a predictable pattern.
- Understand that our solar system is heliocentric.

Sample Multiple Choice CRT-Style Questions Related to the Solar System and Universe

1. Which of the following is the **best** estimate of the number of stars in a typical galaxy?
 - A. Hundreds
 - B. Thousands
 - C. Millions
 - D. Billions
2. Our solar system is referred to as heliocentric, that means the Earth
 - A. rotates around the Sun.
 - B. revolves around the Sun.
 - C. has a moon.
 - D. has life.
3. Planets orbit around
 - A. comets.
 - B. galaxies.
 - C. nebula.
 - D. stars.
4. In order for a lunar eclipse to occur, the moon must be in what phase?
 - A. Full moon
 - B. 1st Quarter
 - C. 3rd Quarter
 - D. New Moon

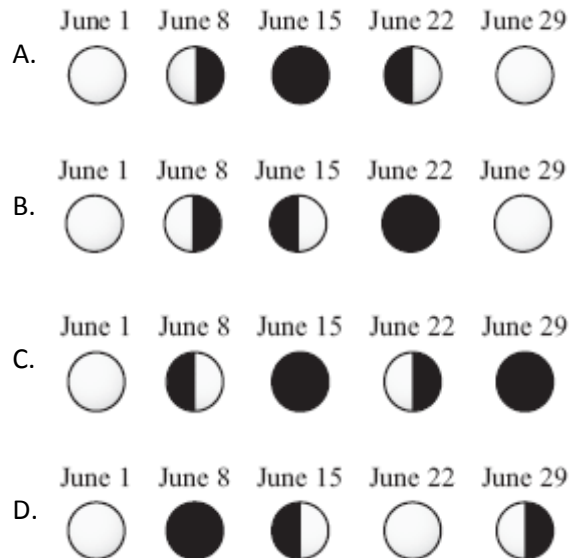
5. What type of galaxy is the Milky Way?
- Elliptical
 - Irregular
 - Lenticular
 - Spiral
6. Which of the following allows humans on Earth to experience day and night?
- Revolution
 - Orbit
 - Rotation
 - Axis
7. Which of the following keeps planets of the solar system in orbit around the sun?
- Electromagnetic energy
 - Thermal energy
 - Atmospheric pressure
 - Gravitational force
8. Which one of the following answers is the **best** explanation as to why the gas giant planets have so many moons as compared to the inner planets?
- Solar flares burned up the very small moons associated with the inner planets.
 - The gas giant planets have a stronger gravitational pull capable of holding more moons.
 - The inner planets rotate so rapidly that they throw off the moons.
 - New moons periodically grow from the thick atmospheres of the gas giant planets.
9. What planet has the shortest orbit around the Sun?
- Mercury
 - Venus
 - Earth
 - Mars
10. Compared to other stars, the Sun is a
- medium-sized star.
 - red giant.
 - supernova.
 - white dwarf.

11. The following symbols are used to represent separate regions of space.



Which of the following diagrams represents Earth's place in the universe?

- Diagram 1
 - Diagram 2
 - Diagram 3
 - Diagram 4
12. A student observed the shape of the Moon once every 7 days during the month of June. Which of the following sets of drawings shows how the Moon's shape could have changed during the month of June?



(From <http://www.doe.mass.edu/mcas/>)

Sample Constructed Response Question Related to the Solar System and Universe

13. Answer each of the following questions regarding a solar eclipse.
- Describe why a solar eclipse occurs.
 - Draw a labeled diagram of a solar eclipse including the moon, Sun, and Earth.
 - Explain why an observer's ability to view a total solar eclipse would depend on the observer's location on Earth.

CRT Science Review #9 Key

Earth Science: Solar System and Universe



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Answer Key

1. D, DOK Level 1
2. B, DOK Level 1
3. D, DOK Level 1
4. A, DOK Level 1
5. D, DOK Level 1
6. C, DOK Level 1
7. D, DOK Level 1
8. B, DOK Level 2
9. A, DOK Level 1
10. A, DOK Level 1
11. B, DOK Level 2
12. A, DOK Level 1

Constructed Response Answer

13. DOK Level 2

3 points	<i>Response addresses all parts of the question clearly and correctly.</i> A. A solar eclipse occurs when the moon passes between the Earth and the Sun and blocks out the view of the Sun for viewers on Earth. B. The drawing should be an appropriately scaled diagram (within reason) and accurately labeled. The moon should be located between the Earth and the Sun. C. Due to the size of the moon, only a small amount of viewers on Earth would see a total solar eclipse due to the small area of the shadow cast on Earth.
2 points	<i>Response addresses all parts of the question and includes only minor errors.</i>
1 point	<i>Response does not address all parts of the question.</i>
0 points	<i>Response is totally incorrect or no response provided.</i>

CRT Science Review #10

Earth Science: Earth's Composition and Structure



Standard: Earth's Composition and Structure - Earth is composed of materials that move through the biogeochemical cycles. Earth's features are shaped by ongoing and dynamic processes. These processes can be constructive or destructive and occur over geologic time scales.

Indicators & Item Specifications:

E.8.C.1 Students know sedimentary rocks and fossils provide evidence for changing environments and the constancy of geologic processes. E/S

- Understand why most fossils are found in sedimentary rock.
- Given examples, identify how fossils and sedimentary rocks provide evidence of changing environments.
- Understand rocks are dated by several methods (e.g., the law of superposition, radiometric dating, and index fossils).

E.8.C.2 Students know rocks at Earth's surface weather, forming sediments that are buried, then compacted, heated and often recrystallized into new rock. E/S

- Understand the rock cycle, identify each type of rock (igneous, sedimentary, and metamorphic) and identify the processes needed to create each type of rock.
- Recognize the processes of the rock cycle.
- Understand that matter is conserved in the rock cycle.

E.8.C.3 Students know Earth is composed of a crust (both continental and oceanic); hot convecting mantle; and dense, a metallic core. E/S

- Given a model, identify the major structural elements of the Earth (i.e., continental and oceanic crusts, mantle, and metallic core).

E.8.C.4 Students know the very slow movement of large crustal plates results in geological events. E/S

- Know earthquakes, volcanoes, and mountain building are caused by heat from convection currents in the upper mantle powering the movement of plates in a continuous process.
- Identify geological events that result from movements of crustal plates.

E.8.C.5 Students know how geologic processes account for state and regional topography. E/S

- Relate geological processes to certain topographical features (e.g., basin and range, canyon, alluvial fans, and volcanoes).
- Recognize and compare geologic processes that shape Nevada's regions.

E.8.C.6 Students know minerals have different properties and different distributions according to how they form. E/S

- Understand the properties of minerals (e.g., color, luster, hardness, reactivity, light transmission, and density).
- Understand how minerals form and where they are typically found.

E.8.C.7 Students know the characteristics, abundances, and location of renewable and nonrenewable resources found in Nevada. E/S

- Identify properties of renewable and nonrenewable resources.
- Identify the common renewable and nonrenewable resources found in Nevada (e.g., copper, oil, coal, geothermal, wind, and silver).
- Identify which resources are abundant and where they are found in Nevada.

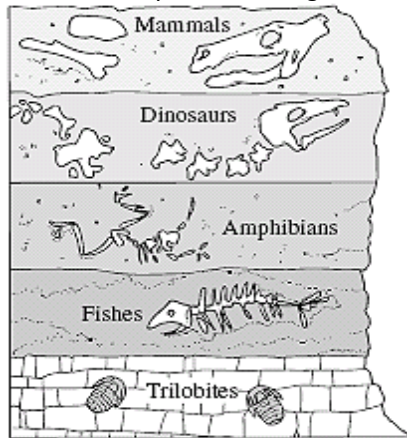
E.8.C.8 Students know soils have properties, such as color, texture, and water retention, and provide nutrients for life according to how they form. E/S

- Understand the relationship between particle size and soil composition and the ability of soil to retain water.
- Identify properties of soils such as color, texture, and water retention.
- Understand how soils form and the major components of soil.

Sample Multiple Choice CRT-Style Questions Related to Earth's Composition and Structure

1. What type of rock forms when lava cools?
 - A. Sedimentary
 - B. Igneous
 - C. Metamorphic
 - D. Transitional
2. Fossils and sedimentary rocks form under specific conditions, so their presence in certain locations provides evidence for
 - A. past environments.
 - B. stationary continents.
 - C. constant temperatures.
 - D. magnetic pole reversal.

3. The process by which rocks are broken down by water, wind, or ice is
 - A. mechanical weathering.
 - B. chemical weathering.
 - C. biological weathering.
 - D. structural weathering.
4. The diagram below represents a cross-section of several rock layers containing fossils.

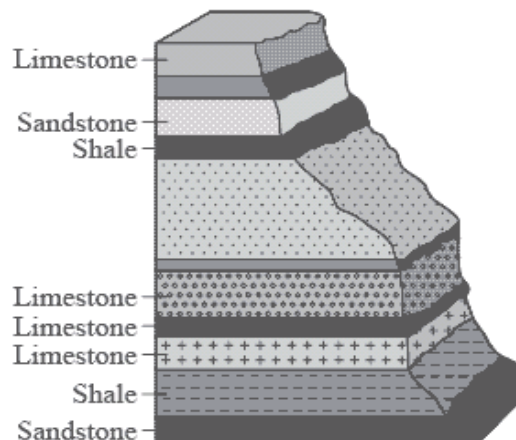


(From <http://www.doe.mass.edu/mcas/>)

Which of the following layers of rock is **most likely** the youngest? The layer containing

- A. dinosaurs.
 - B. amphibians.
 - C. fishes.
 - D. trilobites.
5. Throughout the rock cycle many processes take place (e.g. weathering, sedimentation, melting). What happens to the total amount of material?
 - A. It increases as its form changes.
 - B. It decreases as its form changes.
 - C. It stays the same as its form changes.
 - D. It fluctuates as its form changes.
 6. The outer layer of the Earth that contains both the crust and the upper mantle, is called the
 - A. core.
 - B. hemisphere.
 - C. asthenosphere.
 - D. lithosphere.
 7. The primary cause of crustal movement is
 - A. conduction.
 - B. convection.
 - C. magnetism.
 - D. radiation.
 8. The Basin and Range topography of Nevada is recognized for
 - A. volcanoes and rivers.
 - B. valleys and mountains.
 - C. volcanoes and earthquakes.
 - D. valleys and earthquakes.

9. The illustration below shows the layers found in the Grand Canyon. Scientists find these layers of rock useful for studying fossils.



(From <http://www.doe.mass.edu/mcas/>)

What type of rock is shown labeled in these layers?

- A. Metamorphic
 - B. Igneous
 - C. Sedimentary
 - D. Transitional
10. Which property is the **least** reliable for mineral identification?
 - A. Luster
 - B. Streak
 - C. Color
 - D. Hardness
 11. Use Mohs Scale of Hardness to answer the question.

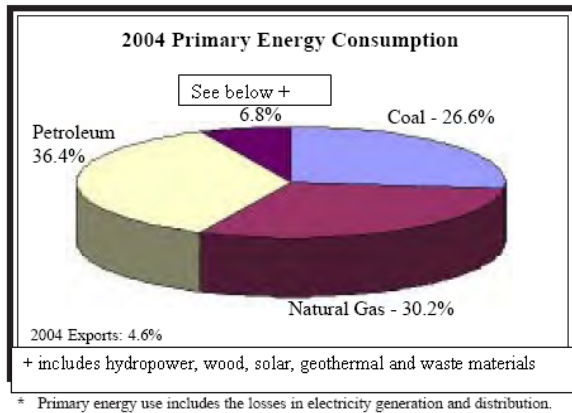
Mohs Scale of Hardness		
Mineral	Scale Number	Common Objects
Talc	1	
Gypsum	2	
Calcite	3	Fingernail Copper Penny
Fluorite	4	
Apatite	5	Steel Nail Glass Plate
Orthoclase	6	
Quartz	7	
Topaz	8	Streak Plate
Corundum	9	
Diamond	10	

(From <http://geology.csupomona.edu/alert/mineral/mohs.gif>)

Which mineral would be weathered the **most** after being placed in a rock tumbler for fifteen minutes?

- A. Gypsum
- B. Fluorite
- C. Topaz
- D. Diamond

12. Use the graph below to answer the question.



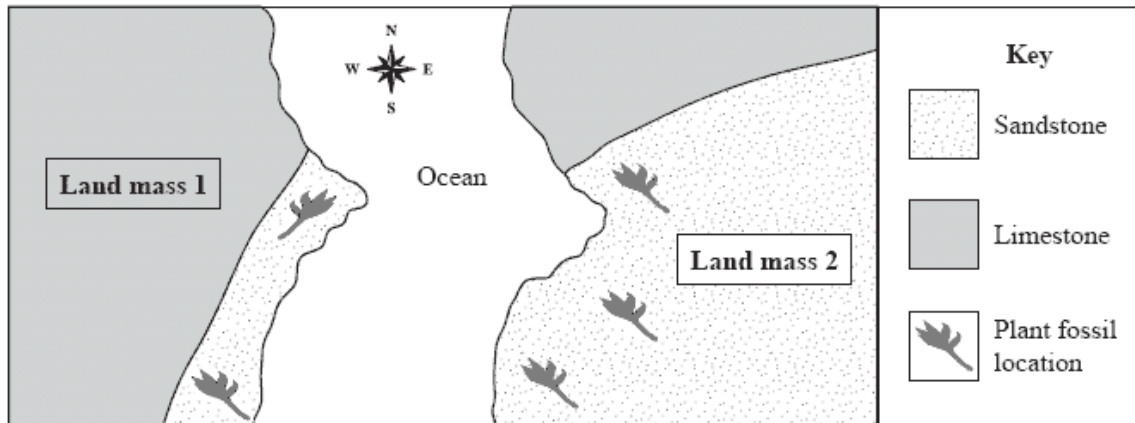
(From <http://www.swenergy.org/factsheets/NV-factsheet.pdf>)

How much of Nevada's energy usage comes from nonrenewable resources?

- A. 30.2%
- B. 56.8%
- C. 93.2%
- D. 100%

Sample Constructed Response Question Related to Earth's Composition and Structure

14. The diagram below shows two land masses separated by an ocean. Use the key to the right to aid in your written explanation.

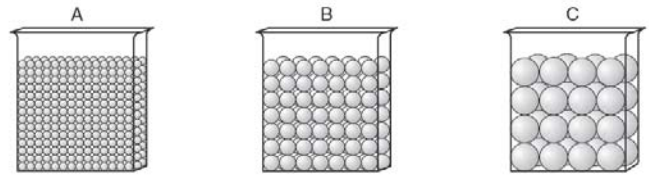


(From: <http://www.doe.mass.edu/mcas/>)

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

- A. Using the diagram, identify and explain two pieces of evidence that support the scientist's theory that the land masses were once together.
- B. Use your knowledge of plate tectonics to propose a reason why the land masses moved to their current position.
- C. If the crustal movement continues, predict where the land masses will move in the future.

13. Use the diagram showing plastic beads of different sizes sorted into three beakers to answer the following question.



(Not drawn to scale)

(From <http://www.nysedregents.org/testing/scire/es807.pdf>.)

Soil composed of which of the following particle sizes would allow for the greatest amount of water retention during a drought?

- A. Small particle size (beaker A)
- B. Medium particle size (beaker B)
- C. Large particle size (beaker C)
- D. Mixture of the particles in beakers B and C

CRT Science Review #10 Key

Earth Science: Earth's Composition and Structure



Standard: Earth's Composition and Structure - Earth is composed of materials that move through the biogeochemical cycles. Earth's features are shaped by ongoing and dynamic processes. These processes can be constructive or destructive and occur over geologic time

Answer Key

1. B, DOK Level 1
2. A, DOK Level 1
3. A, DOK Level 1
4. A, DOK Level 2
5. C, DOK Level 1
6. D, DOK Level 1
7. B, DOK Level 1
8. B, DOK Level 1
9. C, DOK Level 2
10. C, DOK Level 1
11. A, DOK Level 2
12. C, DOK Level 2
13. A, DOK Level 2

Constructed Response Answer

14. DOK Level 3

3 points	<p><i>Response addresses all parts of the question clearly and correctly.</i></p> <p>A. Student identifies two pieces of evidence that supports that landforms were once connected. The sandstone and/or limestone deposits correspond between the land masses. Also, the plant fossils match on each of the land masses.</p> <p>B. Accept any reasonable explanation. For example, a divergent plate boundary between the two land masses may have caused them to separate.</p> <p>C. Accept any reasonable explanation. For example, if a divergent plate boundary caused the land masses to separate, then it can be predicted that the land masses will continue to increase in distance from each other.</p>
2 points	<i>Response addresses all parts of the question and includes only minor errors.</i>
1 point	<i>Response does not address all parts of the question.</i>
0 points	<i>The response is totally incorrect or no response provided.</i>