"I don't think I can do it, but I'll try."
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<th>Page</th>
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Getting Ready for Earth Science

Place a checkmark next to each item that you can do! If a sample problem is given, complete it as evidence.

____ 1. I can state the direct and/or indirect relationship between the independent and dependent variables on a graph.

State the relationship between the years in school and the salary expectations.

____ 2. I can calculate the density of a material.

What is the density of a piece of basalt that has a mass of 27.0g and a volume of 9.1 ml?

____ 3. I can describe most of the changes in our environment.

Which event is cyclic and predictable?

(1) A volcano erupting above a subducting plate
(2) An earthquake occurring at the San Andreas fault
(3) Jupiter’s apparent movement across the night sky
(4) An asteroid striking the Earth

____ 4. I can calculate the rate of change.

Calculate the rate of change in the inside air temperature from 8 a.m. to 12 noon. (don’t forget units)

<table>
<thead>
<tr>
<th>Time</th>
<th>Inside Air Temperature (°C)</th>
<th>Outside Air Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 a.m.</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>10 a.m.</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>12 noon</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>2 p.m.</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>4 p.m.</td>
<td>24</td>
<td>17</td>
</tr>
</tbody>
</table>
## Mapping the Earth

1. I know the true shape of the earth and the best model.

   The true shape of the Earth is best described as a
   
   (1) perfect sphere              (3) slight oblate sphere
   (2) perfect ellipse              (4) highly eccentric ellipse

2. I can find the latitude and longitude of places on Earth.

   What is the latitude and longitude of
   
   A: ____________________
   B: ____________________

   Identify the latitude and longitude of the eye of Hurricane Wilma on October 24. Label your answer with the correct units and directions.

### Locations of the Eye of Hurricane Wilma

- Oct 18
- Oct 19
- Oct 20
- Oct 21
- Oct 22
- Oct 23
- Oct 24
- Oct 25
3. I can find the latitude and longitude to the nearest minute.

Using your New York State map, what is the latitude and longitude of Binghamton, New York?

(1) 44° 57'N, 74° 51'W  
(2) 42° 06'N, 76° 50'W
(3) 43° 05'N, 79° 00'W  
(4) 42° 06'N, 75° 55'W

Using your New York State city is located at 43° 15'N, 77° 35'W?

(1) Syracuse  
(2) Utica  
(3) Rochester  
(4) Buffalo

4. I can determine the latitude by Polaris.

Identify two cities on the map where measurements of the altitude of Polaris are within one degree of each other.

Base your answer on the map below which shows the location of Barrow, Alaska, at 71° N, 156.5° W.

State the altitude of Polaris as seen from Barrow. ____________
5. I can draw isolines.

On the map below, draw the 1012 mb, 1016 mb, and 1020 mb isobars. Extend the isobars to the edges of the map.

On the map below, draw the 60-meter and 70-meter contour lines. The contour lines should extend to the edges of the map.
6. I can find the steepest gradient on a topographic map. Put an X where the slope is the steepest. Explain how the contour lines indicate the slope is the steepest.

7. I can determine the direction of stream flow from a topographic map. Which direction is the Stone River flowing? How do you know?

8. I can determine the maximum elevation of a hill. What is the maximum possible elevation of the hill below.
9. I can calculate the gradient.

Calculate the gradient along the reference line from A to B, in meters per kilometer.

Calculate the pressure gradient along the line from D to F, in mb per kilometer.
10. I can construct a profile from a topographic map.

Use the map above and on the grid below, construct a topographic profile along line AB by plotting the elevation of each contour line that crosses line AB. Connect the plots with a line to complete the profile.
11. I can determine the time based on the rate of Earth’s rotation.

If it is noon at the Prime Meridian, what is the time at point X? Lines of longitude are drawn every 15°.

Explain, in terms of Earth’s rotation, why the time zones are 15° of longitude apart.

The diagram below shows the latitude and longitude lines on Earth. Points A and B are locations on Earth’s surface.

If it is 4 a.m. at location A, what time is it at location B?
(1) 2 a.m.       (3) 8 a.m.
(2) 6 a.m.       (4) 10 a.m.
Astronomy

1. I can state the age of the universe, the event that formed the universe and the evidence that supports it.

Use the diagram below to answer the questions.

Identify the name of the event that is inferred by scientists to have occurred when the universe first formed.

Identify one piece of evidence that led astronomers to infer that the universe is expanding.

Which evidence best supports the Big Bang theory?

(1) rate of rotation of the Sun
(2) existence of cosmic background radiation
(3) uniform radioactive decay of uranium-238
(4) separation of Earth’s interior into different layers

Light from distant galaxies most likely shows a

(1) red shift, indicating that the universe is expanding
(2) red shift, indicating that the universe is contracting
(3) blue shift, indicating that the universe is expanding
(4) blue shift, indicating that the universe is contracting

Fourteen billion years represents the approximate age of

(1) Earth
(2) Earth’s Moon
(3) our solar system
(4) the universe

2. I can read the Electromagnetic Spectrum diagram in the ESRT.

Which type of electromagnetic radiation has the longest wavelength?

(1) ultraviolet
(2) gamma rays
(3) radio waves
(4) visible light

Which diagram best represents the relative wavelengths of visible light, ultraviolet energy, and infrared energy?

(1)

(2)

(3)
### 3. I can determine the process that gives a star its energy.

Energy is produced within a star’s core by the process of:
- **(1) insolation**
- **(2) conduction**
- **(3) nuclear fusion**
- **(4) radioactive decay**

Identify the nuclear process that combines lighter elements into heavier elements to produce the energy radiated by stars.

### 4. I can read ESRT the Characteristics of Stars diagram.

Compared to the Sun, the star Betelgeuse is:
- **(1) less luminous and warmer**
- **(2) less luminous and cooler**
- **(3) more luminous and warmer**
- **(4) more luminous and cooler**

Which star has a surface temperature most similar to the surface temperature of Alpha Centauri?
- **(1) Polaris**
- **(2) Betelgeuse**
- **(3) Procyon B**
- **(4) Sirius**

### 5. I can state evidence of Earth’s rotation.

The direction of swing of a Foucault pendulum appears to change due to Earth’s:
- **(1) revolution**
- **(2) rotation**
- **(3) spherical shape**
- **(4) elliptical orbit**

The Foucault pendulum and the Coriolis effect both provide evidence of Earth’s:
- **(1) revolution**
- **(2) rotation**
- **(3) tilted axis**
- **(4) elliptical orbit**

### 6. I can state the 2 models of planetary motion.

__________________________ is where the Earth is the center of the solar system.

__________________________ is where the Sun is the center of the solar system.

### 7. I can state the difference between a terrestrial and a jovian planet.

Compared to terrestrial planets, jovian planets have:
- **(1) smaller equatorial diameters and shorter periods of revolution**
- **(2) larger equatorial diameters and longer periods of revolution**
- **(3) larger equatorial diameters and shorter periods of revolution**
- **(4) larger equatorial diameters and longer periods of revolution**

### 8. I can state the location of the Asteroid Belt.

Between which two planets are most asteroids located?
- **(1) Earth and Mars**
- **(2) Mars and Jupiter**
- **(3) Jupiter and Saturn**
- **(4) Saturn and Uranus**

### 9. I can read the Solar System Data Table in the ESRT.

Which planet’s day (period of rotation) is longer than its year (period of revolution)?
- **(1) Mercury**
- **(2) Venus**
- **(3) Jupiter**
- **(4) Saturn**

A major belt of asteroids is located between Mars and Jupiter. What is the approximate average distance between the Sun and this major asteroid belt?
- **(1) 390 million kilometers**
- **(2) 110 million kilometers**
### 10. I can state the definition of the Coriolis Effect.

The deflection of prevailing winds and ocean currents in the Northern Hemisphere is called:

1. eccentricity
2. refraction
3. the Coriolis effect
4. the Doppler effect

Earth’s planetary winds curve to the right in the Northern Hemisphere due to:

1. the Coriolis effect
2. the Doppler effect
3. the tilt of Earth’s axis
4. Earth’s gravity

### 11. I can provide evidence of Earth’s revolution around the Sun.

Which motion causes some constellations to be visible in New York State only during winter nights and other constellations to be visible only during summer nights?

1. Stars in constellations revolve around Earth.
2. Stars in constellations revolve around the Sun.
3. Earth revolves around the Sun.
4. Earth rotates on its axis.

State one factor, other than the tilt of Earth’s axis, that causes seasons to change on Earth.

### 12. I can determine the time that passed by looking at Star Trails.

A camera was placed in an open field and pointed toward the northern sky. The lens of the camera was left open for a certain amount of time. The result is shown in the photograph below. The angle of the arc through which two stars appeared to move during this time exposure is shown.

How many hours was the lens left open to produce the photograph?

### 13. I can identify where the velocity is fastest and the gravitational pull is the strongest when an object is orbiting a star.

On the orbiting line, label fastest velocity, slowest velocity, greatest gravitational pull and weakest gravitational pull as the smiley face orbits the star.
The diagram below represents planets A and B, of equal mass, revolving around a star.

Compared to planet A, planet B has:
1. weaker gravitational attraction to the star and a shorter period of revolution
2. weaker gravitational attraction to the star and a longer period of revolution
3. stronger gravitational attraction to the star and a shorter period of revolution
4. stronger gravitational attraction to the star and a longer period of revolution

14. I can state the reasons for the Seasons.

Why do we have seasons?

Seasonal changes on Earth are primarily caused by the
1. parallelism of the Sun’s axis as the Sun revolves around Earth
2. changes in distance between Earth and the Sun
3. elliptical shape of Earth’s orbit around the Sun
4. tilt of Earth’s axis as Earth revolves around the Sun

The diagram below represents Earth as viewed from space. Letter A represents the approximate angle of tilt between Earth’s rotational axis and a line (XY) perpendicular to the plane of Earth’s orbit.

What is the value of the angle represented by letter A?
1. 15.0°
2. 23.5°
3. 24.5°
4. 30.0°
15. I can identify the first day of each season, which way the earth is tilted, where the sun is at zenith, direction sun rises and sets and the general length of the day.

<table>
<thead>
<tr>
<th>Season</th>
<th>Date of 1st Day</th>
<th>Tilted toward, away from or perpendicular to earth</th>
<th>Where sun is at zenith</th>
<th>Direction of sun rise and sun set in New York</th>
<th>Length of day for New York</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Solstice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Solstice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vernal Equinox</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autumnal Equinox</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The diagram below represents Earth in space on the first day of a season.

Which season is beginning in New York State on the day represented in the diagram?

(1) winter
(2) spring
(3) summer
(4) fall

The model below represents the apparent path of the Sun across the sky on March 21 as seen by an observer on Earth.

At which latitude is the observer located?

(1) 90° N
(2) 42° N
(3) 23.5° N
(4) 0°
16. I can identify the first day of each season, which way the earth is tilted, where the sun is at zenith, direction sun rises and sets and the general length of the day.

Base your answers to questions 32 through 34 on the diagram of the Sun, Earth, and the constellation Sagittarius shown below. Positions A through D show Earth in its orbit around the Sun on the first day of each season. Sagittarius is represented in its position in space relative to Earth’s orbit.

How many hours of daylight will an observer in New York State experience when Earth is at position C?

The diagram below shows the yearly range of altitudes of the noontime Sun as seen by an observer in New York State. Write the letters for each of the four Earth positions, A, B, C, and D, in the Sun circles on this diagram to identify when the observer will see the Sun at these noontime altitudes in New York State. More than one letter may be written in a circle.

As the angle of the Sun’s rays striking Earth’s surface at noon changes from 90° to 43°, the length of a shadow cast by an object will

(1) decrease   (3) decrease, then increase
(2) increase   (4) increase, then decrease
17. I can identify the first day of each season, which way the earth is tilted, where the sun is at zenith, direction sun rises and sets and the general length of the day.

Base your answers to the question on the diagram below and on your knowledge of Earth science. The diagram represents the apparent path of the Sun across the sky at a New York State location on June 21. Point A represents the position of the noon Sun. Points A and B on the path are 45 degrees apart.

Compared to the Sun’s apparent path on June 21, the Sun’s apparent path on December 21 at this location will
(1) be shorter, and the noon Sun will be lower in the sky
(2) be longer, and the noon Sun will be higher in the sky
(3) remain the same length, and the noon Sun will be lower in the sky
(4) remain the same length, and the noon Sun will be higher in the sky

18. I can determine the time of the day from a sun path diagram.

Which diagram represents the approximate location of the Sun at 3 p.m. on March 21?

The diagram below represents the apparent path of the Sun across the sky at a New York State location on June 21. Point A represents the position of the noon Sun. Points A and B on the path are 45 degrees apart.

How many hours (h) will it take for the apparent position of the Sun to change from point A to point B?
(1) 1 h    (3) 3 h
(2) 2 h    (4) 4 h
19. I can state the reason why we see the same side of the moon.

The same side of the Moon always faces Earth because the Moon’s period of revolution (1) is longer than the Moon’s period of rotation, (2) equals the Moon’s period of rotation, (3) is longer than Earth’s period of rotation, (4) equals Earth’s period of rotation.

Explain why the Moon’s revolution and rotation cause the same side of the Moon to always face Earth.

20. I can identify phases of the moon.

Shade in the dark sides of the moon and then complete the moon diagrams below and label each moon phase. (turn your paper sideways!)

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

SUN (Light)
21. I can identify phases of the moon.

Base your answers to the question on the diagram below. The diagram represents the Moon at four positions, A through D, in its orbit around Earth as viewed from above the North Pole (NP). The shaded parts of the Moon and Earth represent darkness.

The Moon phase shown to the right was seen by an observer in New York State.

On the diagram below, place an X on the Moon’s orbit to indicate the Moon’s position when this phase was observed.

Base your answers to questions below on the table below. The diagram represents the Moon’s orbital position.

On the diagram in your answer booklet, shade the portion of the Moon that is in darkness to observers in New York City on May 13.
22. I can state the length of time the moon phases go from a new moon to the next new moon.

How many days does it take for the Moon to complete one cycle of phases as viewed from Earth?

23. I can determine the time between 2 consecutive high tides.

The graph below shows ocean water levels for a shoreline location on Long Island, New York. The graph also indicates the dates and times of high and low tides.

Based on the data, the next high tide occurred at approximately
(1) 4 p.m. on July 13  (3) 4 p.m. on July 14
(2) 10 p.m. on July 13  (4) 10 p.m. on July 14

Determine the length of time between the two high tides shown for May 13.

<table>
<thead>
<tr>
<th>Tide</th>
<th>Time</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>12:59 a.m.</td>
<td>1.92</td>
</tr>
<tr>
<td>low</td>
<td>7:15 a.m.</td>
<td>0.37</td>
</tr>
<tr>
<td>high</td>
<td>1:32 p.m.</td>
<td>2.07</td>
</tr>
<tr>
<td>low</td>
<td>7:59 p.m.</td>
<td>0.27</td>
</tr>
</tbody>
</table>
24. I can state the positions of sun, moon and earth for spring and neap tides.

The diagram below represents eight positions of the Moon in its orbit.

Why are high tides on Earth greatest when the Moon is in position A and in position E?
1) The Moon is closer to the Sun.
2) The Moon is closer to Earth.
3) The Moon, the Sun, and Earth are aligned.
4) The Moon is in the same phase at both locations.

Base your answer on the diagram in your answer booklet. The diagram represents the Moon at four positions, A through D, in its orbit around Earth as viewed from above the North Pole (NP). The shaded parts of the Moon and Earth represent darkness.

Describe the effect on the heights of Earth’s high and low tides when the Moon moves from position D to position A.

Height of high tide: _______________  Height of low tide: ______________

On the diagram, circle the two numbers on Earth’s surface that best represent the locations of high tide when the Moon is in the position shown on the diagram.
25. I can state the positions of sun, moon and earth for solar and lunar eclipses.

Base your answers to the two questions on the diagram below. The diagram represents the Moon in eight positions in its orbit around Earth. One position is labeled A.

Circle the type of eclipse that may occur when the Moon is at position A.

Circle one: **lunar eclipse**  **solar eclipse**

Explain why this type of eclipse may occur when the Moon is at this position.

Explanation:

Base your answer on the diagram below, which shows the Moon at positions A through H in its orbit around Earth.

At which Moon position could a lunar eclipse occur?

26. I can state why eclipses do not happen every month.

Solar and lunar eclipses rarely happen during a cycle of phases because the

1. Moon’s orbit is circular and Earth’s orbit is elliptical
2. Moon’s orbit is elliptical and Earth’s orbit is elliptical
3. plane of the Moon’s orbit is different from the plane of Earth’s orbit
4. plane of the Moon’s orbit is the same as the plane of Earth’s orbit
1. I can describe the evolution of our atmosphere. Earth’s early atmosphere contained carbon dioxide, sulfur dioxide, hydrogen, nitrogen, water vapor, methane, and ammonia. These gases were present in the atmosphere primarily because
(1) radioactive decay products produced in Earth’s core were released from Earth’s surface
(2) evolving Earth life-forms produced these gases through their activity
(3) Earth’s growing gravitational field attracted these gases from space
(4) volcanic eruptions on Earth’s surface released these gases from the interior

Scientists infer that oxygen in Earth’s atmosphere did not exist in large quantities until after
(1) photosynthetic cyanobacteria evolved in Earth’s oceans
(2) the initial opening of the Atlantic Ocean
(3) the first sexually reproducing organisms appeared on Earth
(4) the first multicellular, soft-bodied marine organisms appeared on Earth

2. In which atmospheric temperature zone does most precipitation occur?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>thermosphere</td>
</tr>
<tr>
<td>2</td>
<td>mesosphere</td>
</tr>
<tr>
<td>3</td>
<td>stratosphere</td>
</tr>
<tr>
<td>4</td>
<td>troposphere</td>
</tr>
</tbody>
</table>

3. The ozone layer protects life on Earth by absorbing harmful ultraviolet radiation. The ozone layer is located between 17 kilometers and 35 kilometers above Earth’s surface in which atmospheric temperature zone?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>troposphere</td>
</tr>
<tr>
<td>2</td>
<td>stratosphere</td>
</tr>
<tr>
<td>3</td>
<td>mesosphere</td>
</tr>
<tr>
<td>4</td>
<td>thermosphere</td>
</tr>
</tbody>
</table>

4. Equal areas of which type of Earth surface will absorb more insolation and radiate more energy back toward space in the same amount of time?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>light colored and rough</td>
</tr>
<tr>
<td>2</td>
<td>dark colored and rough</td>
</tr>
<tr>
<td>3</td>
<td>light colored and smooth</td>
</tr>
<tr>
<td>4</td>
<td>dark colored and smooth</td>
</tr>
</tbody>
</table>

The unequal heating rates of land and water are caused by
(1) land having a higher density than water
(2) water having a higher density than land
(3) land having a higher specific heat than water
(4) water having a higher specific heat than land

5. Which process releases 334 Joules (J) of energy for each gram of water?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>melting</td>
</tr>
<tr>
<td>2</td>
<td>freezing</td>
</tr>
<tr>
<td>3</td>
<td>vaporization</td>
</tr>
<tr>
<td>4</td>
<td>condensation</td>
</tr>
</tbody>
</table>

Which process releases 2260 joules of heat energy per gram of water?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>melting</td>
</tr>
<tr>
<td>2</td>
<td>freezing</td>
</tr>
<tr>
<td>3</td>
<td>condensation</td>
</tr>
<tr>
<td>4</td>
<td>evaporation</td>
</tr>
</tbody>
</table>

6. Most of which type of electromagnetic radiation is given off by Earth’s surface at night?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>gamma rays</td>
</tr>
<tr>
<td>2</td>
<td>ultraviolet light</td>
</tr>
<tr>
<td>3</td>
<td>visible light</td>
</tr>
<tr>
<td>4</td>
<td>infrared rays</td>
</tr>
</tbody>
</table>

In which region of the electromagnetic spectrum is most of Earth’s outgoing terrestrial radiation?

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>infrared</td>
</tr>
<tr>
<td>2</td>
<td>visible</td>
</tr>
<tr>
<td>3</td>
<td>ultraviolet</td>
</tr>
<tr>
<td>4</td>
<td>x ray</td>
</tr>
</tbody>
</table>
7. I can state the 3 ways heat is transferred.

Which process is responsible for the greatest loss of energy from Earth’s surface into space on a clear night?
(1) condensation                (3) radiation
(2) conduction                    (4) convection

Which diagram(s) best represents heat transfer mainly by the process of

conduction? ________ convection? ________ Radiation? ________

8. I can use the Temperature scales to convert temperatures between °F, °C and K.

35°C = ____________ °F
42 °F = ____________ °C

9. I can use charts on ESRT p12 to find the dewpoint and/or Relative Humidity.

What is the relative humidity if the dry-bulb temperature is 16°C and the wet-bulb temperature is 10°C?
(1) 45%                (3) 14%
(2) 33%               (4) 4%

If the air temperature is 20°C and the relative humidity is 58%, what is the dewpoint?
(1) 5°C                      (3) 15°C
(2) 12°C                     (4) 38°C

10. I can state the relationship between the temperature and the dewpoint for the best chance of clouds and/or precipitation.

The table below shows the air temperature and dewpoint at each of four locations, A, B, C, and D.

<table>
<thead>
<tr>
<th>Location</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air temp. (°F)</td>
<td>80</td>
<td>60</td>
<td>45</td>
<td>35</td>
</tr>
<tr>
<td>Dewpt. (°F)</td>
<td>60</td>
<td>43</td>
<td>35</td>
<td>33</td>
</tr>
</tbody>
</table>

Based on these measurements, which location has the greatest chance of precipitation?
(1) A                (3) C
(2) B               (4) D

Which station model represents a location that has the greatest chance of precipitation?

Based on these measurements, which location has the greatest chance of precipitation?
(1) A                (3) C
(2) B               (4) D

Based on these measurements, which location has the greatest chance of precipitation?
(1) A                (3) C
(2) B               (4) D

Based on these measurements, which location has the greatest chance of precipitation?
(1) A                (3) C
(2) B               (4) D
11. I can state the steps of cloud formation.

Which processes lead to cloud formation when humid air rises over India?
(1) compression, warming to the dewpoint, and condensation
(2) compression, warming to the dewpoint, and evaporation
(3) expansion, cooling to the dewpoint, and condensation
(4) expansion, cooling to the dewpoint, and evaporation

12. I can state the surface air flow around a high and low pressure system and describe the weather associated with each.

Which map best represents the surface wind pattern around Northern Hemisphere high-pressure and low-pressure centers?

<table>
<thead>
<tr>
<th>Map</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
</tr>
</tbody>
</table>

13. I can determine wind direction based on temperature and/or pressure differences.

Winds blow from _____ pressure to _____ pressure.

The diagram below represents the circulation of air above Earth’s surface at a coastal location during the day and at night.

This local air movement is best described as an example of
(1) conduction between Earth’s surface and the atmosphere above it
(2) condensation of water vapor during the day, and evaporation of water during the night
(3) convection resulting from temperature and pressure differences above land and water
(4) greater radiation from the warmer ocean during the day and from the warmer land at night
Which cross section best represents how surface winds form by midafternoon near a shoreline on a hot summer day? [Diagrams are not drawn to scale.]

Which area is the most common source region for cold, dry air masses that move over New York State? (1) North Atlantic Ocean (2) Gulf of Mexico (3) central Canada (4) central Mexico

Which type of air mass most likely has high humidity and high temperature? (1) cP (2) cT (3) mT (4) mP

Add the following to the station model.
- Temperature: 46°F
- Dewpoint: 43°F
- Pressure: 1013.3 mb
- Cloud Coverage: 75%
- Wind Direction: Northwest
- Wind speed: 15 knots
- Visibility: 3 miles
- Present weather: rain shower
- 6 hour precipitation: 0.38 inches
The station model below shows some weather conditions at a location on Earth’s surface.

Which present weather symbol represents the most likely type of precipitation occurring at this location?

1.  
2.  
3.  
4.  

16. I can change the station model pressure to the real atmospheric pressure.

<table>
<thead>
<tr>
<th>037</th>
<th>985</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>mb</td>
<td>mb</td>
</tr>
</tbody>
</table>

17. I can name the instrument used to measure weather variables.

Temperature:  
Dewpoint/RH:  
Atmospheric Pressure:  
Amount of Precip:  
Wind Speed:  
Wind Direction:  

Which weather instrument is most useful in measuring relative humidity?
(1) barometer  
(2) anemometer  
(3) psychrometer  
(4) wind vane

Which weather instrument is used to determine wind direction?

1.  
2.  
3.  
4.  

18. I can convert inches of Hg to millibars.

<table>
<thead>
<tr>
<th>1024.0 mb</th>
<th>29.85 in of Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>=</td>
</tr>
<tr>
<td>in of Hg</td>
<td>mb</td>
</tr>
</tbody>
</table>

19. I can compare and contrast storms.

Which weather map symbol is used to represent violently rotating winds that have the appearance of a funnel-shaped cloud?

1.  
2.  
3.  
4.  

Most of the hurricanes that affect the east coast of the United States originally form over the
(1) warm waters of the Atlantic Ocean in summer  
(2) warm land of the southeastern United States in summer  
(3) cool waters of the Atlantic Ocean in spring  
(4) cool land of the southeastern United States in spring
20. I can diagram fronts and describe typical weather changes at frontal boundaries.

The cross section of the atmosphere below represents the air motion near two frontal boundaries along reference line XY on Earth’s surface.

Which weather map correctly identifies these fronts and indicates the direction that these fronts are moving?

Which type of front is located between Buffalo and Detroit?
(1) stationary  (3) occluded
(2) warm       (4) cold

The map indicates the location of a low-pressure system over New York State during late summer. Isobar values are recorded in millibars. Shading indicates regions receiving precipitation. The air masses are labeled mT and cP. The locations of some New York State cities are shown. Points A and B represent other locations on Earth’s surface.

The cross section below represents the atmosphere along the dashed line from A to B on the map. The warm frontal boundary is already shown on the cross section. Draw a curved line to represent the shape and location of the cold frontal boundary.
21. I can determine where wind speed is the greatest from a surface map.

Which information shown on the weather maps best indicates that wind speeds in New York State were greater on December 9 than on December 8?
(1) The isobars were closer together on December 9.
(2) The fronts were closer together on December 9.
(3) The air pressure over New York State was lower on December 9.
(4) The air pressure over New York State was higher on December 9.

22. I can describe the jet stream.

The map below shows a position of the polar jet stream over North America in January.
Which map best shows the air-mass movements associated with this jet stream position?
1. I can identify factors that affect climate.

Which climate condition generally results from both an increase in distance from the equator and an increase in elevation above sea level?

(1) cooler temperatures  (3) increased precipitation
(2) warmer prevailing winds  (4) increased air pressure

Base your answers to questions on the map of Australia below. Points A through D on the map represent locations on the continent.

Explain why location A has a cooler average yearly air temperature than location B.

The cross section below represents a mountain between locations C and D and the direction of prevailing winds.

Explain why location D has a wetter climate than location C.

The cross section represents four locations on a mountain. The arrow indicates the prevailing wind direction.

Which location has the warmest and most arid climate?

(1) A  (3) C
(2) B  (4) D
The map below shows an eastern portion of North America. Points A and B represent locations on the eastern shoreline.

Which factor is primarily responsible for location A having a lower average yearly temperature than location B?

1. nearness to a large body of water  
2. elevation  
3. latitude  
4. prevailing winds

A city located on the coast of North America has warmer winters and cooler summers than a city at the same elevation and latitude located near the center of North America. Which statement best explains the difference between the climates of the two cities?

1. Ocean surfaces change temperature more slowly than land surfaces.  
2. Warm, moist air rises when it meets cool, dry air.  
3. Wind speeds are usually greater over land than over ocean water.  
4. Water has a lower specific heat than land.

What controls the direction of movement of most surface ocean currents?

1. density differences at various ocean depths  
2. varying salt content in the ocean  
3. prevailing winds  
4. seismic activity

Which graph best represents the general relationship between latitude and average surface temperatures?

1.  
2.  
3.  
4. 
2. I can read the Surface Ocean Currents chart in the ESRT.

Which ocean current directly warms Western Europe?
(1) North Atlantic Current  (3) Canary Current
(2) South Equatorial Current (4) Labrador Current

Which two 23.5°-latitude locations are influenced by cool surface ocean currents?
(1) the east coast of North America and the west coast of Australia
(2) the east coast of Asia and the east coast of North America
(3) the west coast of Africa and the east coast of South America
(4) the west coast of North America and the west coast of South America

3. I can determine where a place is located depending on its climograph.

The map below shows a portion of the western United States and Canada. Two cities in Canada, Vancouver and Winnipeg, are labeled on the map.

Which graph best represents the average monthly air temperatures for Vancouver and Winnipeg?
4. I can state the reason why lake effect snow develops.

The striped areas on the map below show regions along the Great Lakes that often receive large amounts of snowfall due to lake-effect storms.

These storms generally develop when
(1) cold air moves to the east over warmer lake water
(2) cold air moves to the west over warmer land regions
(3) warm air moves to the east over colder lake water
(4) warm air moves to the west over colder land regions

Base your answers to questions on the map below, which shows a portion of New York State and Canada. The arrows represent the direction of the wind blowing over Lake Ontario for several days early one winter.
Explain why Oswego, New York, usually gets more snow than Toronto, Canada, when the wind is blowing in the direction shown on the map.

Compared to the average winter air temperature in Watertown, New York, explain why the average winter air temperature in Old Forge, New York, is colder.

Explain why the surface of Lake Erie freezes much later in the winter than the surrounding land surfaces.

<table>
<thead>
<tr>
<th>5.</th>
<th>I can read Planetary Wind Belt and Moisture Belts in the Troposphere Diagram in the ESRT.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In which planetary wind belt do most storms move toward the northeast?</td>
</tr>
<tr>
<td></td>
<td>(1) 30° N to 60° N     (3) 0° to 30° S</td>
</tr>
<tr>
<td></td>
<td>(2) 0° to 30° N     (4) 30° S to 60° S</td>
</tr>
<tr>
<td></td>
<td>The seasonal shifts of Earth’s planetary wind and moisture belts are due to changes in the</td>
</tr>
<tr>
<td></td>
<td>(1) distance between Earth and the Sun</td>
</tr>
<tr>
<td></td>
<td>(2) amount of energy given off by the Sun</td>
</tr>
<tr>
<td></td>
<td>(3) latitude that receives the Sun’s vertical rays</td>
</tr>
<tr>
<td></td>
<td>(4) rate of Earth’s rotation on its axis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6.</th>
<th>I can state how a monsoon forms.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arrows on the maps below show differences in the direction of winds in the region of India and the Indian Ocean during January and July. Isobar values are recorded in millibars.</td>
</tr>
<tr>
<td></td>
<td><strong>January</strong></td>
</tr>
<tr>
<td></td>
<td><strong>July</strong></td>
</tr>
<tr>
<td></td>
<td><img src="image1" alt="Map of January" /></td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Map of July" /></td>
</tr>
</tbody>
</table>

Heavy monsoon rains usually occur in India during
(1) January, when winds blow from the land
(2) July, when winds blow from the ocean
(3) January, when winds blow toward high pressure
(4) July, when winds blow toward high pressure
The map below shows the location of India and the Indian Ocean.

Which statement best describes the monsoon winds during the rainy season in India?
(1) Warm, moist air flows from India to the Indian Ocean.
(2) Warm, moist air flows from the Indian Ocean to India.
(3) Cold, dry air flows from India to the Indian Ocean.
(4) Cold, dry air flows from the Indian Ocean to India.

---

I can determine changes in climate during El Niño years.

**El Niño**

Under normal Pacific Ocean conditions, strong winds blow from east to west along the equator. Surface ocean water piles up on the western part of the Pacific due to these winds. This allows deeper, colder ocean water on the eastern rim of the Pacific to be pulled up (upwelling) to replace the warmer surface water that was pushed westward.

During an El Niño event, these westward-blowing winds get weaker. As a result, warmer water does not get pushed westward as much, and colder water in the east is not pulled toward the surface. This creates warmer surface ocean water temperatures in the east, allowing the thunderstorms that normally occur at the equator in the western Pacific to move eastward. A strong El Niño is often associated with wet winters along the northwestern coast of South America and in the southeastern United States, and drier weather patterns in Southeast Asia (Indonesia) and Australia. The northeastern United States usually has warmer and drier winters in an El Niño year.

**Normal Pacific Ocean Conditions (non-El Niño years)**

Which statement best describes the planetary wind belts that produce the winds represented in the cross section above?
(1) Southwest and northwest winds diverge at the equator and blow toward the west.
(2) Southwest and northwest winds diverge at the equator and blow toward the east.
(3) Northeast and southeast winds converge at the equator and blow toward the west.
(4) Northeast and southeast winds converge at the equator and blow toward the east.
Compared to non-El Niño years, which climatic conditions exist near the equator on the western and eastern sides of the Pacific Ocean during an El Niño event?

1. The western Pacific is drier and the eastern Pacific is wetter.
2. The western Pacific is wetter and the eastern Pacific is drier.
3. The western and the eastern Pacific are both wetter.
4. The western and the eastern Pacific are both drier.

Which event temporarily slows or reverses surface ocean currents in the equatorial region of the Pacific Ocean, causing a disruption of normal weather patterns?

1. tsunami
2. volcanic eruption
3. El Niño
4. deforestation

---

**8. I can state the reasoning behind climate change/global warming.**

Most scientists infer that increasing levels of carbon dioxide in Earth’s atmosphere are contributing to

1. decreased thickness of the troposphere
2. depletion of ozone
3. increased absorption of ultraviolet radiation
4. increased global temperatures

Evidence supports the idea that increases in carbon dioxide and methane in Earth’s atmosphere are major contributors to global warming. This is based primarily on the fact that carbon dioxide and methane are excellent absorbers of

1. gamma rays
2. microwaves
3. visible light
4. infrared radiation

Which list contains three major greenhouse gases found in Earth’s atmosphere?

1. carbon dioxide, methane, and water vapor
2. carbon dioxide, oxygen, and nitrogen
3. hydrogen, oxygen, and methane
4. hydrogen, water vapor, and nitrogen

Describe the effect that global warming most likely will have on both present-day glaciers and sea level.

Glaciers: ________________________ Sea Level: ____________________

---

**9. I can state the effect a volcanic eruption has on the global air temperature.**

Large volcanic eruptions sometimes send dust and ash into the stratosphere. After these eruptions, global air temperatures are often

1. cooler than normal because the atmosphere is less transparent
2. cooler than normal because the atmosphere is more transparent
3. warmer than normal because the atmosphere is less transparent
4. warmer than normal because the atmosphere is more transparent
1. I can state the steps of the water cycle.

Label the steps of the water cycle.

1. ___________________________
2. ___________________________
3. ___________________________
4. ___________________________
5. ___________________________
6. ___________________________

The diagram represents the water cycle. Letters A through C represent different processes in the water cycle.

Which process is represented by letter A? (1) evaporation (2) transpiration (3) condensation (4) precipitation

Which process is represented by letter B? (1) capillarity (2) transpiration (3) infiltration (4) precipitation

Which process is represented by letter C? (1) capillarity (2) runoff (3) infiltration (4) precipitation
2. I can explain the relationships between particle size and permeability, porosity, capillarity and/or water retention.

The diagram below represents cross sections of equal-size beakers A, B, and C filled with beads.

A  

B  

C

Which statement best compares the porosity in the three beakers?

(1) Beaker A and beaker B have the same porosity, and beaker C has the least porosity.
(2) Beaker A and beaker B have the same porosity, and beaker C has the greatest porosity.
(3) Beaker B has the greatest porosity, beaker A has less porosity, and beaker C has the least porosity.
(4) Beaker C has the greatest porosity, beaker B has less porosity, and beaker A has the least porosity.

Base your answers to questions on the diagram below. The diagram represents four tubes, labeled A, B, C, and D, each containing 150 mL of sediments. Tubes A, B, and C contain well-sorted, closely packed sediments of uniform shape and size. Tube D contains uniformly shaped, closely packed sediments of mixed sizes. The particle size of the sediment in each tube is labeled.

Water was added to each tube to just cover the sediments and the volumes of water added were recorded. These data can best be used to determine the

(1) particle size of the sediments  (3) water retention of the sediments
(2) particle shape of the sediments  (4) porosity of the sediments

If tubes A, B, and C were set up to test for capillarity, the data would show that capillarity is

(1) greatest in tube A  (3) greatest in tube C
(2) greatest in tube B  (4) the same for tubes A, B, and C

If tubes A, B, and C were set up to test for permeability, the data would show that permeability is

(1) greatest in tube A  (3) greatest in tube C
(2) greatest in tube B  (4) the same for tubes A, B, and C

Which tube would show the greatest amount of water retention?

(1) tube A  (3) tube C
(2) tube B  (4) the same for tubes A, B, and C
3. I can describe how slope, particle size and soil factors (frozen, vegetated, permeable, saturated, etc) affect the rate of infiltration and/or run-off.

| After a heavy rainstorm, vegetation on a hillslope was completely removed. How will this removal of vegetation affect the relative amounts of infiltration and runoff that occur during the next heavy rainstorm? | (1) Infiltration and runoff will both be less. (2) Infiltration and runoff will both be greater. (3) Infiltration will be less and runoff will be greater. (4) Infiltration will be greater and runoff will be less. |
| Which conditions on Earth’s surface will allow for the greatest amount of water to seep into the ground? | (1) gentle slope and permeable (2) gentle slope and impermeable (3) steep slope and permeable (4) steep slope and impermeable |
| When snow cover on the land melts, the water will most likely become surface runoff if the land surface is | (1) frozen (2) porous (3) grass covered (4) unconsolidated gravel |
| Flash flooding is most likely to occur when heavy rain falls on | (1) deforested landscapes with clay soils (2) deforested landscapes with sandy soils (3) forested landscapes with clay soils (4) forested landscapes with sandy soils |
| A portion of a land surface was recently paved with asphalt and concrete. Describe the change in the amount of runoff and infiltration that will occur. | Describe the soil permeability and the land surface slope that allow the most infiltration of rainwater and the least runoff. |

4. I can identify different types of weathering.

| Rock fragments that are tumbled and carried over long distances by a stream will most likely become | (1) less dense, harder, and smaller (2) less rounded, jagged, and larger and smaller (3) more dense, angular, and smaller (4) more rounded, smoother, and smaller |
| Describe the most likely changes in the size and shape of individual particles of sediment as they are transported downstream by rivers. | Size: ___________________________ Shape: __________________ |
| Slightly acidic groundwater has been seeping through cracks and openings in limestone bedrock producing caves. State whether the type of weathering that produces these caves is mainly chemical or physical, and identify one characteristic of limestone that allows this type of weathering to occur. | Type of weathering: ___________________________ Characteristic of Limestone: __________________ |
5. I can identify factors that affect the rate of weathering.

The photograph shows a small waterfall located on the Tug Hill Plateau.

Compared to the bedrock layers above and below the rock ledge shown at the waterfall, the characteristic that is primarily responsible for the existence of the rock ledge is its greater
(1) resistance to weathering  (3) thickness
(2) abundance of fossils      (4) age

A cross section of Niagara Falls is shown below.

Which two rock units appear to be most resistant to weathering and erosion?
(1) Lockport dolostone and Whirlpool sandstone
(2) Rochester shale and Albion sandstone and shale
(3) Clinton limestone and shale and Queenston shale
(4) Thorold sandstone and Queenston shale

Which change in the climate of New York State would most likely cause the greatest increase in chemical weathering of local bedrock?
(1) lower humidity in winter  (3) lower temperature in winter
(2) greater precipitation in summer  (4) higher atmospheric pressure in summer
6. I can describe the formation of soil.

Particles of soil often differ greatly from the underlying bedrock in color, mineral composition, and organic content. Which conclusion about these soil particles is best made from this evidence?

(1) They are transported sediments.  
(2) They are residual sediments. 
(3) They are soluble in water.  
(4) They are uniformly large-grained

The formation of soil is primarily the result of

(1) stream erosion and mass movement  
(2) stream deposition and runoff  
(3) precipitation and wind erosion  
(4) weathering and biological activity

7. I can describe the erosional/depositional effect of rivers/streams.

The block diagram below represents a landscape that was produced by a meandering stream. One landscape feature is labeled X. Letters A, B, C, and D represent locations on the stream banks.

The landscape feature labeled X is best described as

(1) a flood plain  
(2) a sand bar  
(3) a delta  
(4) an escarpment

The diagram represents a meandering stream flowing into the ocean. Points A and B represent locations along the stream banks. Letter C indicates a triangular-shaped depositional feature where the stream enters the ocean.

Identify the triangular-shaped depositional feature indicated by letter C.

Which cross section best represents the valley shape where a rapidly flowing stream is cutting into the bedrock in a mountainous area?

(1)  
(2)  
(3)  
(4)
The map below shows a portion of the Hudson River and three tributaries: Catskill Creek, Fishkill Creek, and Wallkill River.

The greatest discharge of the Hudson River is generally observed near
(1) Albany     (3) Poughkeepsie
(2) Kingston   (4) Ossining

The topographic map below shows a portion of the Cayuta Creek that is located in New York State. Points A, B, C, and D represent locations on Earth’s surface.

Which point on the map most likely represents a location within the flood plain associated with Cayuta Creek?
(1) A (3) C
(2) B (4) D
8. I can determine where the velocity is the fastest and the most erosion occurs in a meandering stream.

The block diagram below represents a landscape that was produced by a meandering stream. One landscape feature is labeled X. Letters A, B, C, and D represent locations on the stream banks.

![Block Diagram]

Erosion is most likely greatest at locations (1) A and B (2) B and C (3) C and D (4) D and A

The cross section below represents a portion of a meandering stream. Points X and Y represent two positions on opposite sides of the stream.

![Cross Section]

Based on the cross section, which map of a meandering stream best shows the positions of points X and Y?

(1) ![Map 1] (2) ![Map 2] (3) ![Map 3] (4) ![Map 4]

On the map to the right, place an X at the location between the bridges where the greatest amount of deposition is most likely occurring.
The diagram represents a meandering stream flowing into the ocean. Points A and B represent locations along the streambanks. Letter C indicates a triangular-shaped depositional feature where the stream enters the ocean.

The top of the box represents the stream surface between points A and B. In the box, draw a line from point A to point B to represent a cross-sectional view of the shape of the bottom of the stream channel.

**9.** I can read the Relationship of Transported Particle Size to Water Velocity in the ESRT.

Record the minimum velocity this stream needs to transport a 2.0-cm-diameter particle.

What is the approximate minimum stream velocity needed to keep a particle in motion that has a diameter of 10 centimeters?

- (1) 110 cm/s
- (2) 190 cm/s
- (3) 325 cm/s
- (4) 425 cm/s

**10.** I can determine which size particles settles first and why when a stream flows into a big body of water.

Which cross section best represents the pattern of sediments deposited on the bottom of a lake as the velocity of the stream entering the lake steadily decreased?

- (1)  
- (2)  
- (3)  
- (4)  

Sediment is deposited in a river delta because the

- (1) velocity of the river decreases
- (2) force of gravity decreases
- (3) volume of the river increases
- (4) gradient of the river increases
Each of the rock particles below has the same density and volume. Which particle will most likely settle at the fastest rate in moving water?

A river's current carries sediments into the ocean. Which sediment size will most likely be deposited in deeper water farthest from the shore?

(1) pebble
(2) sand
(3) silt
(4) clay

The cross-sectional diagram below shows the stream entering the lake. On the diagram, indicated the expected pattern of deposition of the three particles by placing the letters A, B and C in the appropriate boxes along the lake bottom.

<table>
<thead>
<tr>
<th>Data Table</th>
<th>Direction of stream flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle</td>
<td>Particle Diameter (cm)</td>
</tr>
<tr>
<td>A</td>
<td>0.5</td>
</tr>
<tr>
<td>B</td>
<td>1.0</td>
</tr>
<tr>
<td>C</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Explain why the particles are deposited after the stream enters the lake.

___11. I can describe the erosional/depositional effect of glaciers.

The map shows a retreating valley glacier and the features that have formed because of the advance and retreat of the glacier.

Describe one piece of evidence likely to be found on the exposed bedrock surfaces that could indicate the direction this glacier moved.

Describe one difference between the arrangement of sediment in the moraines and the arrangement of sediment in the outwash plain.

Describe the most likely shape of the valley being formed due to erosion by this glacier.
The cross section below shows layers of sediments deposited in a region of Wisconsin that has experienced several periods of glaciation. Descriptions of the sediments in layers A through F are included.

Which two layers of sediments were probably deposited directly by glaciers?

(1) A and D  (2) B and F  (3) C and E  (4) D and E

Which agent of erosion most likely formed the drumlins and finger lakes in New York State?

(1) running water  (2) moving ice  (3) wave action  (4) mass movement

The diagram below, which shows the edge of a continental glacier that is receding. R indicates elongated hills. The ridge of sediments from X to Y represents a landscape feature.

The elongated hills labeled R are most useful in determining the

(1) age of the glacier  (2) direction the glacier has moved  (3) thickness of the glacier  (4) rate at which the glacier is melting

Which feature will most likely form when the partially buried ice block melts?

(1) drumlin  (2) moraine  (3) kettle lake  (4) finger lake
The ridge of sediments from X to Y can best be described as
(1) sorted and deposited by ice
(2) sorted and deposited by meltwater
(3) unsorted and deposited by ice
(4) unsorted and deposited by meltwater

12. I can describe the erosional/depositional effect of ocean waves.

The narrow, sandy, barrier islands in the ocean along the south coast of Long Island were deposited by
(1) wind
(2) streams
(3) glacial ice
(4) wave action

The arrows on the diagram show the directions in which sediment is being transported along the shoreline. A barrier beach has formed, creating a lagoon (a shallow body of water in which sediments are being deposited). A groin has recently been constructed. Groins are wall-like structures built into the water perpendicular to the shoreline to trap beach sand.

The groin structure will change the pattern of deposition along the shoreline, initially causing the beach to become
(1) wider on both sides of the groin
(2) narrower on both sides of the groin
(3) wider on the western side of the groin
(4) wider on the eastern side of the groin

13. I can describe the erosional/depositional effect of mass movement.

Pieces of bedrock material that are broken from a cliff and deposited by a landslide at the base of the cliff are best described as
(1) rounded and sorted
(2) rounded and unsorted
(3) angular and sorted
(4) angular and unsorted

A landslide is an example of
(1) river deposition
(2) glacial scouring
(3) mass movement
(4) chemical weathering

Which erosional force acts alone to produce avalanches and landslides?
(1) sea waves
(2) winds
(3) running water
(4) gravity
14. I can describe the erosional/depositional effect of wind.

Which change is most likely to occur in a landscape if its climate changes from humid to arid?
(1) Wind will become a more important agent of erosion.
(2) Surface features will become more rounded.
(3) Chemical weathering will increase.
(4) Vegetation will increase.

The photograph below shows farm buildings partially buried in silt.

Which erosional agent most likely piled the silt against the buildings?
(1) mass movement (3) ocean waves
(2) wind (4) glacial ice

The diagram below shows sand particles being moved by wind?

At which Earth surface locations is this process usually the most dominant type of erosion?
(1) glaciers and moraines (3) deserts and beaches
(2) deltas and floodplains (4) mountain peaks and escarpments

Which diagram represents a side view of a sand dune most commonly formed as a result of the prevailing wind direction shown?

The natural sandblasting (abrasion) of surface bedrock in a desert region is the result of
(1) wind erosion (3) mass movement
(2) wave erosion (4) chemical precipitation
1. I can differentiate between seismic waves.

Base your answer to the question on the diagram below, which shows models of two types of earthquake waves.

Model A best represents the motion of earthquake waves called
(1) P-waves (compressional waves) that travel faster than S-waves (shear waves) shown in model B
(2) P-waves (compressional waves) that travel slower than S-waves (shear waves) shown in model B
(3) S-waves (shear waves) that travel faster than P-waves (compressional waves) shown in model B
(4) S-waves (shear waves) that travel slower than P-waves (compressional waves) shown in model B

2. I can explain how Earth’s interior can be inferred from seismic data.

A seismic station recorded the P-waves, but no S-waves, from an earthquake because S-waves were
(1) absorbed by Earth’s outer core
(2) transmitted only through liquids
(3) weak and detected only at nearby locations
(4) not produced by this earthquake

The cross section represents the pattern of seismic wave movement away from an earthquake. Point W represents a location at the boundary between two layers of Earth’s interior. Points X, Y, and Z represent seismic stations on Earth’s surface.

Which statement best explains why no S-waves were received directly from this earthquake at some seismic stations?
(1) An interior Earth layer absorbs S-waves.
(2) Earth’s mantle reflects S-waves.
(3) S-waves travel slower than P-waves.
(4) S-waves travel only on Earth’s surface
Which evidence recorded at seismic stations following an earthquake supports the inference that Earth’s interior changes from solid rock to molten iron and nickel at the mantle-core boundary?
(1) P-waves arrive earlier than S-waves.
(2) P-waves and S-waves are both recorded at all stations.
(3) Only S-waves are recorded at all stations.
(4) Only P-waves are recorded on the opposite side of Earth

### 3. I can calculate the difference in arrival times between p- and s-waves.

How long after receiving the first P-wave from an earthquake centered 4000 kilometers away does a seismic station receive its first S-wave from the same earthquake?
(1) 1 minute
(2) 5 minutes 35 seconds
(3) 7 minutes
(4) 12 minutes 40 seconds

Seismic station A is 5000 kilometers from the epicenter. What is the difference between the arrival time of the first P-wave and the arrival time of the first S-wave recorded at this station?
(1) 2 minutes 20 seconds
(2) 6 minutes 40 seconds
(3) 8 minutes 20 seconds
(4) 15 minutes 00 second

What is the approximate P-wave travel time from an earthquake if the P-wave arrives at the seismic station 8 minutes before the S-wave?
(1) 4 minutes 20 seconds
(2) 6 minutes 30 seconds
(3) 10 minutes 0 seconds
(4) 11 minutes 20 seconds

### 4. I can determine the distance to the epicenter based on the difference between the arrival of the p- and s-waves.

A seismograph station records a difference in arrival time between the S- and P-wave of 4 minutes. About how far away is the earthquake epicenter?
(1) 1,000 km
(2) 5,200 km
(3) 2,600 km
(4) 1,900 km

### 5. I can calculate the time of the earthquake.

A seismic P-wave is recorded at 2:25 p.m. at a seismic station located 7600 kilometers from the epicenter of an earthquake. At what time did the earthquake occur?
(1) 2:05 p.m.
(2) 2:11 p.m.
(3) 2:14 p.m.
(4) 2:36 p.m.

A P-wave reaches a seismograph station 2,600 kilometers from an earthquake epicenter at 12:10 p.m. What time did the earthquake occur?
(1) 12:01 p.m.
(2) 12:15 p.m.
(3) 12:19 p.m.
(4) 12:05 p.m.

### 6. I can read the Inferred Properties of Earth’s Interior diagram in the ESRT.

What is the range of pressure in Earth’s interior where rock with a density range of 9.9 to 12.2 g/cm³ is found?
(1) 0.2 to 1.4 million atmospheres
(2) 0.8 to 2.3 million atmospheres
(3) 1.4 to 3.1 million atmospheres
(4) 2.3 to 3.5 million atmospheres

At which depth below Earth’s surface is the boundary between Earth’s outer core and stiffer mantle located?
(1) 700 km
(2) 2000 km
(3) 2900 km
(4) 5100 km

The composition of some meteorites supports the inference that the Earth’s core is composed of
(1) magnesium and potassium
(2) silicon and oxygen
(3) iron and nickel
(4) aluminum and calcium

A strong earthquake that occurs on the ocean floor could result in the formation of
(1) a tsunami
(2) a delta
(3) an El Niño event
(4) an ocean current
<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. I can discuss safety precautions for earthquakes.</td>
<td>Identify one safety precaution that residents of a coastal community could undertake in response to the tsunami warning. List one action that a homeowner could take to prepare the home or family for the next earthquake.</td>
</tr>
<tr>
<td>8. I can provide evidence of continental drift/plate tectonic theory.</td>
<td>Earth’s magnetic field has reversed itself several times during the past. This pattern of magnetic reversal is best preserved in (1) metamorphic bedrock in mountain ranges (2) bedrock with fossils containing radioactive carbon-14 (3) layers of sedimentary bedrock of the Grand Canyon (4) igneous bedrock of the oceanic crust. The map below shows the continents of Africa and South America, the ocean between them, and the ocean ridge and transform faults. Locations A and D are on the continents. Locations B and C are on the ocean floor. Which graph best shows the relative age of the ocean-floor bedrock from location B to location C? Igneous rock along oceanic ridges is younger than the igneous rock farther from the ridges. This evidence supports the theory that (1) the ocean floor is stable (2) volcanoes one existed on both sides of the oceanic ridges (3) the ocean floor is spreading (4) oceanic ridges are areas of subsidence. Which statement best supports the theory of continental drift? (1) Areas of shallow-water seas tend to accumulate sediment, which gradually sinks. (2) Basaltic rock is found to be progressively younger at increasing distances from a mid-ocean ridge. (3) Marine fossils are often found in deep-well drill cores. (4) The present continents appear to fit together as pieces of a larger landmass.</td>
</tr>
</tbody>
</table>
The cross section below represents a pattern of magnetic field reversals preserved in the igneous bedrock of the oceanic crust east of the Mid-Atlantic ridge.

Which cross section best represents the magnetic field pattern west of the Mid-Atlantic ridge?

(1) [Cross Section]

(2) [Cross Section]

(3) [Cross Section]

(4) [Cross Section]

Which world map shows the locations where most earthquakes and volcanoes occur on Earth?

(1) [World Map]

(2) [World Map]

(3) [World Map]

(4) [World Map]
9. I can state the differences between the continental and oceanic crusts.

Compared to Earth’s oceanic crust, Earth’s continental crust is
(1) thinner and more dense  (3) thicker and more dense
(2) thinner and less dense  (4) thicker and less dense

Compared to the oceanic crust, the continental crust is
(1) less dense and more basaltic  (3) more dense and more granitic
(2) less dense and more felsic  (4) more dense and more mafic

10. I can explain the current theory of why tectonic plates move.

The convection currents responsible for moving tectonic plates occur in which Earth layer?
(1) crust  (3) stiffer mantle
(2) rigid mantle  (4) asthenosphere

The primary cause of convection currents in the Earth's mantle is believed to be the
(1) rotation of the Earth  (3) occurrence of earthquakes
(2) subsidence of the crust  (4) differences in densities of earth materials

Earth’s internal heat is the primary source of energy that
(1) warms the lower troposphere
(2) melts glacial ice at lower altitudes
(3) moves the lithospheric plates
(4) pollutes deep groundwater with radioactivity

Use the map of a portion of the East African Rift system shown below to answer the question. Point X represents a location on Earth’s surface within a rift valley on the Ethiopian Dome.

On the cross section to the right, draw two curved arrows, one on each side of the dashed line, to show the direction of movement of the convection currents within the asthenosphere that caused the formation of the dome and the rift valley near location X.
11. I can use Tectonic Plates diagram in ESRT to discuss changes in the Earth’s crust.

<table>
<thead>
<tr>
<th><strong>Crustal formation, which may cause the widening of an ocean, is most likely occurring at the boundary between the:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) African Plate and the Eurasian Plate</td>
</tr>
<tr>
<td>(2) Pacific Plate and the Philippine Plate</td>
</tr>
<tr>
<td>(3) Indian-Australian Plate and the Antarctic Plate</td>
</tr>
<tr>
<td>(4) South American Plate and the North American Plate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Which two features are commonly found at divergent plate boundaries?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) mid-ocean ridges and rift valleys</td>
</tr>
<tr>
<td>(2) ocean trenches and subduction zones</td>
</tr>
<tr>
<td>(3) wide valleys and deltas</td>
</tr>
<tr>
<td>(4) hot spots and island arcs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Which geologic feature is composed of the youngest crustal bedrock?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Peru-Chile Trench</td>
</tr>
<tr>
<td>(2) Mid-Atlantic Ridge</td>
</tr>
<tr>
<td>(3) Adirondack Mountains</td>
</tr>
<tr>
<td>(4) San Andreas Fault</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>At which plate boundary is one lithospheric plate sliding under another?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Pacific Plate and Indian-Australian Plate</td>
</tr>
<tr>
<td>(2) Nazca Plate and Antarctic Plate</td>
</tr>
<tr>
<td>(3) Nazca Plate and Pacific Plate</td>
</tr>
<tr>
<td>(4) Indian-Australian Plate and Antarctic Plate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Which block diagram best shows a transform fault?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>(2)</td>
</tr>
<tr>
<td>(3)</td>
</tr>
<tr>
<td>(4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Which type of tectonic plate boundary is found between the South American Plate and the Scotia Plate?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) transform</td>
</tr>
<tr>
<td>(2) convergent</td>
</tr>
<tr>
<td>(3) divergent</td>
</tr>
<tr>
<td>(4) complex or uncertain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>The Aleutian Islands extend westward from southern Alaska to form the northern boundary of the Pacific Ocean. These volcanic islands were formed by the nearby:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) subduction of a continental plate</td>
</tr>
<tr>
<td>(2) subduction of an oceanic plate</td>
</tr>
<tr>
<td>(3) divergence of a continental plate</td>
</tr>
<tr>
<td>(4) divergence of an oceanic plate</td>
</tr>
</tbody>
</table>
12. I can identify hot spots and describe how they infer plate movement.

Which mantle hot spot is located closest to a mid-ocean ridge?
(1) Canary Islands   (3) Hawaii
(2) Easter Island    (4) Tasman

The map below shows the major islands in the Galapagos Island chain. These islands were formed by volcanic eruptions as the tectonic plate passed over the Galapagos Hot Spot. The age of the volcanic bedrock on certain islands is shown in millions of years (my).

![Map of Galapagos Island Chain]

Based on the age of the bedrock of the Galapagos Islands, in which direction does the tectonic plate containing the islands appear to be moving away from the Galapagos Hot Spot?

Identify the tectonic feature responsible for the formation of the Hawaiian Islands.

Identify one feature in the mantle beneath Iceland that causes larger amounts of magma formation in Iceland than at most other locations along the rest of the Mid-Atlantic Ridge rift.
1. I can use the Average Chemical Composition of Earth’s Crust, Hydrosphere, and Troposphere Table in ESRT.

Which two elements make up the greatest percentages by mass in Earth’s crust?  
1) oxygen and potassium  
2) oxygen and silicon  
3) aluminum and potassium  
4) aluminum and silicon

In which two Earth regions is oxygen the second most abundant element by volume?  
1) crust and hydrosphere  
2) hydrosphere and troposphere  
3) troposphere and core  
4) core and crust

2. I can state the reason why minerals have the properties they have.

The table below lists some information about the minerals graphite and diamond.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Composition</th>
<th>Depth of Formation</th>
<th>Hardness</th>
<th>Electrical Conductor</th>
</tr>
</thead>
<tbody>
<tr>
<td>graphite</td>
<td>carbon</td>
<td>shallow</td>
<td>1</td>
<td>good</td>
</tr>
<tr>
<td>diamond</td>
<td>carbon</td>
<td>very deep</td>
<td>10</td>
<td>poor</td>
</tr>
</tbody>
</table>

Some properties of diamond are different from those of graphite because diamond  
1) has a different arrangement of atoms  
2) forms larger crystals  
3) has a different composition  
4) is older in geologic age

The diagram below shows how a sample of the mineral mica breaks when hit with a rock hammer.

The mineral breaks in smooth, flat surfaces it  
1) is very dense  
2) is very hard  
3) contains large amounts of iron  
4) has a regular arrangement of atoms

3. I can use Properties of Common Minerals table in ESRT to identify minerals.

The minerals talc, muscovite mica, quartz, and olivine are similar because they  
1) have the same hardness  
2) are the same color  
3) contain silicon and oxygen  
4) break along cleavage planes

Which two properties are most useful in distinguishing between galena and halite?  
1) cleavage and color  
2) luster and color  
3) hardness and streak  
4) streak and cleavage

The graph below shows the hardness of four minerals.

Which mineral is hard enough to scratch calcite but is not hard enough to scratch amphibole?  
1) muscovite mica  
2) fluorite  
3) olivine  
4) graphite
Use the mineral chart lists below for the following 3 questions. The chart lists some properties of five minerals that are the major sources of the same metallic element that is used by many industries.

<table>
<thead>
<tr>
<th>Mineral Name</th>
<th>Composition</th>
<th>Density (g/cm³)</th>
<th>Hardness</th>
<th>Streak</th>
<th>Nonmetallic Luster</th>
<th>Common Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>brucite</td>
<td>Mg(OH)₂</td>
<td>2.4</td>
<td>2.5-3</td>
<td>white</td>
<td>glassy to waxy</td>
<td>white</td>
</tr>
<tr>
<td>carnallite</td>
<td>KMgCl₂•6H₂O</td>
<td>1.6</td>
<td>2.5</td>
<td>white</td>
<td>greasy</td>
<td>white</td>
</tr>
<tr>
<td>dolomite</td>
<td>CaMg(CO₃)₂</td>
<td>2.8</td>
<td>3.5-4</td>
<td>white</td>
<td>glassy to waxy</td>
<td>shades of pink</td>
</tr>
<tr>
<td>magnesite</td>
<td>MgCO₃</td>
<td>3.1</td>
<td>3.5-4.5</td>
<td>white</td>
<td>glassy</td>
<td>white</td>
</tr>
<tr>
<td>olivine</td>
<td>(Fe,Mg)₂SiO₄</td>
<td>3.3</td>
<td>6.5</td>
<td>white</td>
<td>glassy</td>
<td>green</td>
</tr>
</tbody>
</table>

Which two minerals have compositions that are most similar to calcite?
(1) brucite and carnallite  
(2) carnallite and dolomite  
(3) dolomite and magnesite  
(4) magnesite and olivine

Which mineral might scratch the mineral fluorite, but would not scratch the mineral amphibole?
(1) brucite  
(2) magnesite  
(3) carnallite  
(4) olivine

Which mineral has a different common color from its color in powdered form?
(1) brucite  
(2) carnallite  
(3) magnesite  
(4) olivine

I can read the Bowen’s Reaction Series diagram.

The diagram of Bowen’s Reaction Series below indicates the relative temperatures at which specific minerals crystallize as magma cools.

![Bowen's Reaction Series Diagram]

Which statement is best supported by Bowen’s Reaction Series?
(1) Most minerals crystallize at the same temperature.  
(2) Most felsic minerals usually crystallize before most mafic minerals.  
(3) Muscovite mica and quartz are the last minerals to crystallize as magma cools.  
(4) Biotite mica is the first mineral to crystallize as magma cools.
5. I can use the Rock Cycle in Earth’s Crust diagram to state how the 3 rock types are formed.

Which rock was subjected to intense heat and pressure but did not solidify from magma?  
(1) sandstone  (3) gabbro  
(2) schist  (4) rhyolite

Which processes lead directly to the formation of igneous rock?  
(1) weathering and erosion  (3) heat and pressure  
(2) compaction and cementation  (4) melting and solidification

Which two processes lead directly to the formation of both breccia and conglomerate?  
(1) melting and solidification  (3) compaction and cementation  
(2) heat and pressure  (4) evaporation and precipitation

6. I can use the Scheme for Igneous Rock identification chart in the ESRT.

Which texture best describes an igneous rock that formed deep underground?  
(1) glassy  (3) fine grained  
(2) vesicular  (4) coarse grained

Obsidian’s glassy texture indicates that it formed  
(1) slowly, deep below Earth’s surface  
(2) slowly, on Earth’s surface  
(3) quickly, deep below Earth’s surface  
(4) quickly, on Earth’s surface

The table shows the approximate mineral percent composition of an igneous rock. The photograph shows the true-scale crystal sizes in this igneous rock.

<table>
<thead>
<tr>
<th>Mineral Name</th>
<th>Percentage of Mineral Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>plagioclase feldspar</td>
<td>55%</td>
</tr>
<tr>
<td>biotite</td>
<td>15%</td>
</tr>
<tr>
<td>amphibole</td>
<td>30%</td>
</tr>
</tbody>
</table>

Identify two elements that are commonly found in all three minerals in the data table.

Identify this igneous rock. ____________________________

Identify two processes that formed this rock.
7. I can use the Scheme for Sedimentary Rock Identification chart in the ESRT.

Most of the sediment that is compacted and later forms shale bedrock is
(1) clay (3) sand
(2) silt (4) pebbles

What are the rock name and map symbol used to represent the sedimentary rock that has a grain size of 0.006 to 0.2 centimeters?

- Rock name: Siltstone
  - Map symbol: [Diagram]

- Rock name: Sandstone
  - Map symbol: [Diagram]

Limestone is composed mostly of what mineral? _________________

Which rock is composed of the mineral halite that formed when seawater evaporated?
(1) limestone (3) rock gypsum
(2) dolostone (4) rock salt

This rock should be classified as
(1) an intrusive igneous rock
(2) a bioclastic sedimentary rock
(3) an extrusive igneous rock
(4) a clastic sedimentary rock

8. I can use the Scheme for Metamorphic Rock Identification chart in the ESRT.

The diagram below indicates physical changes that accompany the conversion of shale to gneiss.

- Shale
  - Clastic texture
  - Slatey cleavage

- Slate
  - Obvious foliation

- Schist
  - Banding

Which geologic process is occurring to cause this conversion?
(1) sedimentary layering (3) metamorphism
(2) intrusion of magma (4) weathering

Which rock would be the best source of the mineral garnet?
(1) basalt (3) schist
(2) limestone (4) slate
The photograph below shows an igneous rock with mineral crystals ranging in size from 2 to 6 millimeters. The rock is composed of 58% plagioclase feldspar, 26% amphibole, and 16% biotite.

What is the name of this rock?
(1) diorite
(2) andesite
(3) gabbro
(4) pumice

Base your answers to questions on the passage below.

Dimension Stone: Granite

Dimension stone is any rock mined and cut for specific purposes, such as kitchen countertops, monuments, and the curbing along city streets. Examples of rock mined for use as dimension stone include limestone, marble, sandstone, and slate. The most important dimension stone is granite; however, not all dimension stone sold as granite is actually granite. Two examples of such rock sold as “granite” are syenite and anorthosite. Syenite is a crystalline, light-colored rock composed primarily of potassium feldspar, plagioclase feldspar, biotite, and amphibole, while anorthosite is composed almost entirely of plagioclase feldspar. Like actual granite, both syenite and anorthosite have large, interlocking crystals.

Explain why syenite is classified as a plutonic igneous rock.

State one reason why anorthosite is likely to be white to gray in color.

The igneous rock gabbro is sometimes sold as “black granite.” Compared to the density and composition of granite, describe how the density and composition of gabbro are different.

Identify one dimension stone mentioned in the passage that is composed primarily of calcite.

A student on a field trip in New York State collected a sample of metamorphic bedrock containing bands of coarse-grained crystals of plagioclase feldspar, pyroxene, quartz, and mica.

List two of the chemical elements found in plagioclase feldspar.

Describe two physical properties of pyroxene.

Identify the metamorphic rock found by the student.  

58
1. I can identify landscapes and the factors that affect them.

The photograph below shows a steep-sided rock formation that is over 100 meters high. This landscape feature is located in an arid region. What would happen to this landscape feature if the climate became more humid?

(1) less weathering and erosion, producing a more rounded landscape feature
(2) less weathering and erosion, producing a more angular landscape feature
(3) more weathering and erosion, producing a more rounded landscape feature
(4) more weathering and erosion, producing a more angular landscape feature

The Catskills of New York State are best described as a plateau, while the Adirondacks are best described as mountains. Which factor is most responsible for the difference in landscape classification of these two regions?

(1) climate variations
(2) bedrock structure
(3) vegetation type
(4) bedrock age

Which two factors have the most influence on the development of landscape features?

(1) bedrock age and weathering rates
(2) bedrock structure and climate variations
(3) rate of deposition and thickness of the bedrock
(4) rate of erosion and fossils in the bedrock

2. I can read both the Generalized Landscape Regions of New York State and Generalized Bedrock Geology of New York State to bedrock types associated with landscapes.

Which chart best describes the landscape category and the general bedrock structure, type, and composition of New York State’s Catskills?

<table>
<thead>
<tr>
<th>Landscape Category</th>
<th>Bedrock Structure</th>
<th>Bedrock Type</th>
<th>Bedrock Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>plateau</td>
<td>horizontal</td>
<td>sedimentary</td>
<td>limestone, shale, sandstone</td>
</tr>
<tr>
<td>mountain</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which types of surface bedrock are most likely found near Jamestown, New York?

(1) slate and marble
(2) quartzite and granite
(3) shale and sandstone
(4) schist and gneiss

New York State bedrock of which age contains salt, gypsum, and hematite?

(1) Cambrian
(2) Devonian
(3) Silurian
(4) Devonian
Use the map below to answer the question.

In New York State, the Marcellus shale is generally found in which type of landscape region?
(1) plain  (3) mountains
(2) plateau  (4) lowlands

In which landscape region are New York State’s Finger Lakes primarily located?
(1) Adirondack Mountains  (3) Atlantic Coastal Plain
(2) Allegheny Plateau  (4) Erie-Ontario Lowlands

Which two cities are located in the Interior Lowlands?
(1) Elmira and Binghamton  (3) Massena and Old Forge
(2) Riverhead and New York City  (4) Buffalo and Watertown

I can identify drainage patterns dependent on landscapes.

The map below shows a stream drainage pattern where the streams radiate outward from the center.

Which landscape feature would produce this stream drainage pattern?
(1) steep cliff  (3) volcanic mountain
(2) glacial kettle lake  (4) flat plain

The maps show the locations of major watersheds in New York State. Letters A through K represent individual watersheds.

In which major watershed is the Susquehanna River located?
(1) F  (3) I
(2) H  (4) J

The Genesee River in watershed A generally flows in which direction?
(1) north  (3) east
(2) south  (4) west
Over which two landscape regions do the streams in watershed D flow?

(1) Tug Hill Plateau and the Catskills
(2) Tug Hill Plateau and Erie-Ontario Lowlands
(3) Adirondack Mountains and Champlain Lowlands
(4) Adirondack Mountains and St. Lawrence Lowlands

4. I can read the Geologic History of New York State chart in the ESRT to correctly place events on a geologic time line.

The map below shows the inferred shape of the North American landmass in the past. The location of Florida is labeled.

Which event was occurring on Earth when Florida was located at the equator?

(1) The dome-like uplift of the Adirondack region began.
(2) The earliest dinosaurs appeared on Earth.
(3) Oceanic oxygen began to enter the atmosphere.
(4) Earth’s first coral reefs were forming.

The extinction of which group of animals 65.5 million years ago is thought to have been due to an impact event and global climate change?

(1) ammonoids
(2) brachiopods
(3) trilobites
(4) placoderm fish

The map below shows the current location of New York State in North America.

Approximately how many million years ago (mya) was this New York State region located at the equator?

(1) 59 mya
(2) 119 mya
(3) 359 mya
(4) 458 mya

Which group of organisms survived mass extinctions that marked the ends of both the Paleozoic Era and the Mesozoic Era?

(1) ammonoids
(2) graptolites
(3) eurypterids
(4) gastropods

During which geologic epoch do scientists infer that the earliest grasses first appeared on Earth?

(1) Holocene
(2) Pleistocene
(3) Oligocene
(4) Eocene

Which event is inferred to have contributed to the significant global climate change that may have caused the mass extinctions of organisms at the end of the Late Cretaceous Epoch?

(1) the Big Bang
(2) an asteroid impact
(3) formation of Pangaea
(4) shifting of Earth’s magnetic poles
The timeline below represents time on Earth from the beginning of the Paleozoic Era (A) to the present (B).

Which numbered position best represents the time when humans first appeared in the fossil record?
(1) 1   (3) 3
(2) 2   (4) 4

5. I can determine the relative ages of rock layers based on the principle of superposition, intrusions, faults and/or folds.

The bedrock cross section below contains rock formations A, B, C, and D. The rock formations have not been overturned.

Which sequence represents the relative ages of these rock formations, from oldest to youngest?
(1) B → A → C → D
(2) B → D → C → A
(3) D → C → A → B
(4) D → B → A → C

The geologic cross section below shows rock layers that have not been overturned.

The fault is older than the
(1) slate   (3) unconformity
(2) marble   (4) shale

The cross section below represents surface bedrock where faulting has occurred along line AB.

Key to Rock Age
O — Ordovician
C — Cambrian
When could this faulting have occurred?
(1) before the Ordovician rocks were deposited
(2) during the Ordovician period
(3) before the Cambrian rocks were deposited
(4) during the Cambrian period

6. I can explain and identify an unconformity.

The geologic cross section below includes an unconformity and an igneous intrusion.

**Key**

- **Igneous rock**
- **Contact metamorphism**

Which two events produced the geologic unconformity in the rock record?
(1) intrusion of magma, followed by contact metamorphism
(2) intrusion of magma, followed by erosion of rock layers
(3) erosion of rock layers, followed by deposition of more sediments
(4) erosion of rock layers, followed by intrusion of magma

The photograph below shows rock layers separated by unconformity XY. Which sequence of events most likely produced this unconformity?
(1) uplift and erosion of bedrock, followed by subsidence and more deposition
(2) intrusion of magma into preexisting rock, causing contact metamorphism
(3) eruption of a volcano, spreading lava over horizontal sedimentary rock layers
(4) separation of one rock layer, by movement along a plate boundary

The cross section below represents several rock units within Earth’s crust. Letter A represents Earth’s surface. Letters B, C, and D indicate boundaries between rock units. One of the unconformities is labeled.

**Key**

- **Igneous rock**
- **Contact metamorphism**

Which lettered boundary is most likely another unconformity?
(1) A  (3) C
(2) B  (4) D
7. I can correlate rock layers based on volcanic eruptions.

A volcanic ash layer between sedimentary rock layers is used by geologists to
(1) determine Earth’s absolute age
(2) predict global warming
(3) locate an earthquake epicenter
(4) correlate widely separated rock formations

The map below shows the distribution of ash across the United States as a result of the May 18, 1980 volcanic eruption of Mount St. Helens.

Volcanic ash deposits such as these are usually excellent geologic time markers because they
(1) occur at regular time intervals
(2) spread over a large area in a short amount of time
(3) represent a time gap in the rock record
(4) contain index fossils from different time periods

The cross sections below represent three bedrock outcrops found several kilometers apart.

Which statement best explains why the volcanic ash layers are useful for correlating the relative ages of the bedrock in the three outcrops?
(1) The ash was deposited over a large area when a volcano erupted.
(2) There are no fossils found within the volcanic ash.
(3) The volcanic eruptions that produced the ash layer occurred over a long period of geologic time.
(4) The volcanic ash is found between many different layers of bedrock.
8. I can correlate rocks layers based on index fossils.

The diagram below represents the placoderm fish *Bothriolepis*, an index fossil found in New York State.

The surface bedrock at which location is most likely to contain this fossil?

(1) Ithaca  (3) Albany  
(2) Old Forge  (4) New York City

The cross sections below represent three outcrops, labeled I, II, and III, containing some New York State index fossils. The rock layers have *not* been overturned.

When the rock layers in the three outcrops are correlated, the oldest layer is the

(1) shale layer in outcrop I  (3) limestone layer in outcrop III  
(2) siltstone layer in outcrop II  (4) conglomerate layer in outcrop III

Four rock outcrops, labeled 1, 2, 3, and 4, found within the same plateau, are represented below. Index fossils found in some of the rock layers are shown. The rock layers have *not* been overturned.

Which rock layer is the youngest?

(1) sandstone in outcrop 1  (3) conglomerate in outcrop 3  
(2) breccia in outcrop 2  (4) sandstone in outcrop 4
The rock columns below represent four widely separated locations, W, X, Y, and Z. Numbers 1, 2, 3, and 4 represent fossils. The rock layers have not been overturned.

Which numbered fossil best represents an index fossil?
(1) 1  (2) 2  (3) 3  (4) 4

The cross sections below represent three geologic columns, I, II, and III, exposed at three different locations. The rock layers have not been overturned. Letters A through E represent different fossils.

Which rock layer is the youngest?
(1) green shale containing fossil B in column I
(2) glacial soil containing fossil E in column III
(3) brown sandstone containing fossil C in column II
(4) gray limestone containing fossil D in column I
9. I can identify metamorphic rocks located at contact zones on a rock diagram.

Use the geologic cross section shown below to answer the question.

State the name of the metamorphic rock at location A.

Base the block diagram shows bedrock units A through F and boundary XX’.

The rock that formed in the contact metamorphic zone between rock unit E and rock unit D is (rocks #8)
(1) hornfels  (3) schist
(2) marble    (4) anthracite coal

The cross section below represents a portion of Earth’s crust. Letters A through D are locations within the rock units.

At which location is quartzite most likely found?
(1) A   (3) C
(2) B   (4) D
10. I can determine the absolute age of a rock layer.

Radioactive decay of 40K atoms in an igneous rock has resulted in a ratio of 25 percent 40K atoms to 75 percent 40Ar and 40Ca atoms. How many years old is this rock?

- 0.3 x 10^9 y
- 1.3 x 10^9 y
- 2.6 x 10^9 y
- 3.9 x 10^9 y

The graph below shows the rate of decay of the radioactive isotope carbon-14 (14C).

![Graph of Decay of Carbon-14](image)

Complete the flow chart in your answer booklet by filling in the boxes to indicate the percentage of carbon-14 remaining and the time that has passed at the end of each half-life.

Identify the decay product formed by the disintegration of carbon-14.

Explain why carbon-14 cannot be used to accurately determine the age of organic remains that are 1,000,000 years old.

State the name of the radioactive isotope that has a half-life that is approximately the same as the estimated time of the origin of Earth.

Base your answers to the following on the information below.

A scientist found the bone of a mastodont. In the lab, the scientist found that 12.5% of the original radioactive C-14 still remained in the bone.

Identify the element formed when carbon-14 (14C) undergoes radioactive decay.

Explain why 14C was used to date the mastodont bone.

How old is the mastodont bone?
11. I can tie in several concepts for rock layer diagrams.

The diagram represents an igneous intrusion that solidified between some layers of sedimentary rock. Letter X represents an index fossil in a sedimentary rock layer. The rock layers have not been overturned.

Describe the evidence represented in the diagram that indicates that the shale layer and the limestone layer are older than the igneous intrusion.

The limestone layer is composed mostly of what mineral? ________________

Describe one characteristic of fossil X that makes it a good index fossil.

The igneous intrusion contains the radioactive isotope potassium-40, which is used in radioactive dating to determine the age of rocks. State one property of potassium-40 that allows it to be useful in the radioactive dating of rocks.

The cross section represents a portion of Earth’s crust. Letters A, B, C, and D indicate sedimentary rock layers that were originally formed from deposits in a sea. The rock layers have not been overturned.

Identify the name of the contact metamorphic rock formed at the boundary of the igneous rock and rock layer B.

Describe one piece of evidence that suggests that rock layer C formed in a deeper sea environment than did rock layer A.

Describe one piece of evidence represented in the cross section that indicates Earth’s crust has moved at this location.

Identify the mineral composition of rock layer D. ________________