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# Benchmarks Tested on Grade 8 Science FCAT

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<th>Sunshine State Standards Benchmark</th>
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<tbody>
<tr>
<td><strong>STRAND A: THE NATURE OF MATTER</strong></td>
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</table>
| **SC.A.1.3.1** The student identifies various ways in which substances differ (e.g., mass, volume, shape, density, texture, and reaction to temperature and light). AA; MC, GR, SR  
*Also covers A.1.3.2, A.1.3.6* |
| **SC.A.1.3.2** The student understands the difference between weight and mass. *Covered as A.1.3.1* |
| **SC.A.1.3.3** The student knows that temperature measures the average energy of motion of the particles that make up the substance. CS; MC |
| **SC.A.1.3.4** The student knows that atoms in solids are close together and do not move around easily; in liquids, atoms tend to move farther apart; in gas, atoms are quite far apart and move around freely. CS; MC |
| **SC.A.1.3.5** The student knows the difference between a physical change in a substance (i.e., altering the shape, form, volume, or density) and a chemical change (i.e., producing new substances with different characteristics). CS; MC |
| **SC.A.1.3.6** The student knows that equal volumes of different substances may have different masses. *Covered as A.1.3.1* |
| **SC.A.2.3.1** The student describes and compares the properties of particles and waves. CS; MC |
| **SC.A.2.3.2** The student knows the general properties of the atom (a massive nucleus of neutral neutrons and positive protons surrounded by a cloud of negative electrons) and accepts that single atoms are not visible. CS; MC |
| **SC.A.2.3.3** The student knows that radiation, light, and heat are forms of energy used to cook food, treat diseases, and provide energy. *Covered as B.1.3.1* |
| **STRAND B: ENERGY** |
| **SC.B.1.3.1** The student identifies forms of energy and explains that they can be measured and compared. AA; MC, GR, SR, ER  
*Also covers A.2.3.3, B.1.3.2, B.1.3.3* |
| **SC.B.1.3.2** The student knows that energy cannot be created or destroyed, but only changed from one form to another. *Covered as B.1.3.1* |
| **SC.B.1.3.3** The student knows the various forms in which energy comes to Earth from the sun (e.g., visible light, infrared, and microwave). *Covered as B.1.3.1* |
| **SC.B.1.3.4** The student knows that energy conversions are never 100% efficient (i.e., some energy is transformed to heat and is unavailable for further useful work). CS; MC, GR |
| **SC.B.1.3.5** The student knows the processes by which thermal energy tends to flow from a system of higher temperature to a system of lower temperature. CS; MC |
| SC.B.1.3.6 | The student knows the properties of waves (e.g., frequency, wavelength, and amplitude); that each wave consists of a number of crests and troughs; and the effects of different media on waves. AA; MC, GR, SR
|            | **Also covers C.1.3.2** |
| SC.B.2.3.1 | The student knows that most events in the universe (e.g., weather changes, moving cars, and the transfer of a nervous impulse in the human body) involve some form of energy transfer and that these changes almost always increase the total disorder of the system and its surroundings, reducing the amount of useful energy. AA; MC |
| SC.B.2.3.2 | The student knows that most of the energy used today is derived from burning stored energy collected by organisms millions of years ago (i.e., nonrenewable fossil fuels). **Covered as G.2.3.1** |

**STRAND C: FORCE AND MOTION**

| SC.C.1.3.1 | The student knows that the motion of an object can be described by its position, direction of motion, and speed. CS; MC, GR |
| SC.C.1.3.2 | The student knows that vibrations in materials set up wave disturbances that spread away from the source (e.g., sound and earthquake waves). **Covered as B.1.3.6** |
| SC.C.2.3.1 | The student knows that many forces (e.g., gravitational, electrical, and magnetic) act at a distance (i.e., without contact). CS; MC |
| SC.C.2.3.2 | The student knows common contact forces. **Covered as C.2.3.6** |
| SC.C.2.3.3 | The student knows that if more than one force acts on an object, then the forces can reinforce or cancel each other, depending on their direction and magnitude. **Covered as C.2.3.6** |
| SC.C.2.3.4 | The student knows that simple machines can be used to change the direction or size of a force. CS; MC, GR |
| SC.C.2.3.5 | The student understands that an object in motion will continue at a constant speed and in a straight line until acted upon by a force and that an object at rest will remain at rest until acted upon by a force. **Covered as C.2.3.6** |
| SC.C.2.3.6 | The student explains and shows the ways in which a net force (i.e., the sum of all acting forces) can act on an object (e.g., speeding up an object traveling in the same direction as the net force, slowing down an object traveling in the direction opposite of the net force). AA; MC, GR, SR
|            | **Also covers C.2.3.2, C.2.3.3, C.2.3.5** |
| SC.C.2.3.7 | The student knows that gravity is a universal force that every mass exerts on every other mass. CS; MC |

**STRAND D: PROCESSES THAT SHAPE THE EARTH**

| SCD.1.3.1 | The student knows that mechanical and chemical activities shape and reshape the Earth’s land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers. CS; MC |
| SCD.1.3.2 | The student knows that over the whole Earth, organisms are growing, dying, and decaying as new organisms are produced by the old ones. **Covered as D.1.3.4** |
| SC.D.1.3.3 | The student knows how conditions that exist in one system influence the conditions that exist in other systems. CS; MC |
| SC.D.1.3.4 | The student knows the ways in which plants and animals reshape the landscape (e.g., bacteria, fungi, worms, rodents, and other organisms add organic matter to the soil, increasing soil fertility, encouraging plant growth, and strengthening resistance to erosion). AA; MC  
  Also covers D.1.3.2 |
| SC.D.1.3.5 | The student understands concepts of time and size relating to the interaction of Earth’s processes (e.g., lightning striking in a split second as opposed to the shifting of the Earth’s plates altering the landscape, distance between atoms measured in Angstrom units as opposed to distance between stars measured in light-years). CS; MC, GR |
| SC.D.2.3.1 | The student understands that quality of life is relevant to personal experience. Not covered |
| SC.D.2.3.2 | The student knows the positive and negative consequences of human action on the Earth’s systems. Covered as G.2.3.4 |

**STRAND E: EARTH AND SPACE**

| SC.E.1.3.1 | The student understands the vast size of our Solar System and the relationship of the planets and their satellites. AA; MC, GR, SR  
  Also covers E.1.3.2 |
| SC.E.1.3.2 | The student knows that available data from various satellite probes show the similarities and differences among planets and their moons in the Solar System. Covered as E.1.3.1 |
| SC.E.1.3.3 | The student understands that our sun is one of many stars in our galaxy. Covered as E.2.3.1 |
| SC.E.1.3.4 | The student knows that stars appear to be made of similar chemical elements, although they differ in age, size, temperature, and distance. CS; MC |
| SC.E.2.3.1 | The student knows that thousands of other galaxies appear to have the same elements, forces, and forms of energy found in our Solar System. CS; MC  
  Also covers E.1.3.3 |

**STRAND F: PROCESSES OF LIFE**

| SC.F.1.3.1 | The student understands that living things are composed of major systems that function in reproduction, growth, maintenance, and regulation. AA; MC, SR |
| SC.F.1.3.2 | The student knows that the structural basis of most organisms is the cell and most organisms are single cells, while some, including humans, are multicellular. CS; MC |
| SC.F.1.3.3 | The student knows that in multicellular organisms cells grow and divide to make more cells in order to form and repair various organs and tissues. CS; MC |
| SC.F.1.3.4 | The student knows that the levels of structural organization for function in living things include cells, tissues, organs, systems, and organisms. CS; MC |
| SC.F.1.3.5 | The student explains how the life functions of organisms are related to what occurs within the cell. CS; MC |
| SC.F.1.3.6 | The student knows that the cells with similar functions have similar structures, whereas those with different structures have different functions. CS; MC |
| SC.F.1.3.7 | The student knows that behavior is a response to the environment and influences growth, development, maintenance, and reproduction. CS; MC |
| SC.F.2.3.1 | The student knows the patterns and advantages of sexual and asexual reproduction in plants and animals. CS; MC |
| SC.F.2.3.2 | The student knows that the variation in each species is due to the exchange and interaction of genetic information as it is passed from parent to offspring. AA; MC, SR |
| SC.F.2.3.3 | The student knows that generally organisms in a population live long enough to reproduce because they have survival characteristics. CS; MC |
| SC.F.2.3.4 | The student knows that the fossil record provides evidence that changes in the kinds of plants and animals in the environment have been occurring over time. CS; MC |

**STRAND G: HOW LIVING THINGS INTERACT WITH THEIR ENVIRONMENT**

| SC.G.1.3.1 | The student knows that viruses depend on other living things. *Covered as G.1.3.4* |
| SC.G.1.3.2 | The student knows that biological adaptations include changes in structures, behaviors, or physiology that enhance reproductive success in a particular environment. CS; MC |
| SC.G.1.3.3 | The student understands that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships. CS; MC |
| SC.G.1.3.4 | The student knows that the interactions of organisms with each other and with the nonliving parts of their environments result in the flow of energy and the cycling of matter throughout the system. AA; MC, SR *Also covers G.1.3.1, G.1.3.5* |
| SC.G.1.3.5 | The student knows that life is maintained by a continuous input of energy from the sun and by the recycling of the atoms that make up the molecules of living organisms. *Covered as G.1.3.4* |
| SC.G.2.3.1 | The student knows that some resources are renewable and others are nonrenewable. CS; MC *Also covers B.2.3.2* |
| SC.G.2.3.2 | The student knows that all biotic and abiotic factors are interrelated and that if one factor is changed or removed, it impacts the availability of other resources within the system. CS; MC, GR |
| SC.G.2.3.3 | The student knows that a brief change in the limited resources of an ecosystem may alter the size of a population or the average size of individual organisms and that long-term change may result in the elimination of animal and plant populations inhabiting the Earth. CS; MC, GR |
| SC.G.2.3.4 | The student understands that humans are a part of an ecosystem and their activities may deliberately or inadvertently alter the equilibrium in ecosystems. AA; MC, SR  
Also covers D.2.3.2 |
| STRAND H: THE NATURE OF SCIENCE |
| SC.H.1.3.1 | The student knows that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way. AA; MC, SR |
| SC.H.1.3.2 | The student knows that the study of the events that led scientists to discoveries can provide information about the inquiry process and its effects. CS; MC |
| SC.H.1.3.3 | The student knows that science disciplines differ from one another in topic, techniques, and outcomes, but that they share a common purpose, philosophy, and enterprise. CS; MC |
| SC.H.1.3.4 | The student knows that accurate record keeping, openness, and replication are essential to maintaining an investigator’s credibility with other scientists and society. AA; MC, SR  
Also covers H.1.3.7 |
| SC.H.1.3.5 | The student knows that a change in one or more variables may alter the outcome of an investigation. AA; MC, GR, SR, ER |
| SC.H.1.3.6 | The student recognizes the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations. Not covered |
| SC.H.1.3.7 | The student knows that when similar investigations give different results, the scientific challenge is to verify whether the differences are significant by further study. Covered as H.1.3.4 |
| SC.H.2.3.1 | The student recognizes that patterns exist within and across systems. CS; MC |
| SC.H.3.3.1 | The student knows that science ethics demand that scientists must not knowingly subject coworkers, students, the neighborhood, or the community to health or property risks. CS; MC  
Also covers H.3.3.2, H.3.3.3 |
| SC.H.3.3.2 | The student knows that special care must be taken in using animals in scientific research. Covered as H.3.3.1 |
| SC.H.3.3.3 | The student knows that in research involving human subjects, the ethics of science require that potential subjects be fully informed about the risks and benefits associated with the research and of their right to refuse to participate. Covered as H.3.3.1 |
| SC.H.3.3.4 | The student knows that technological design should require taking into account constraints such as natural laws, the properties of the materials used, and economic, political, social, ethical, and aesthetic values. CS; MC  
Also covers H.3.3.6, H.3.3.7 |
| SC.H.3.3.5 | The student understands that contributions to the advancement of science, mathematics, and technology have been made by different kinds of people, in different cultures, at different times, and are an intrinsic part of the development of human culture. *Not covered* |
| SC.H.3.3.6 | The student knows that no matter who does science and mathematics or invents things, or when or where they do it, the knowledge and technology that result can eventually become available to everyone. *Covered as H.3.3.4* |
| SC.H.3.3.7 | The student knows that computers speed up and extend people’s ability to collect, sort, and analyze data; prepare research reports; and share data and ideas with others. *Covered as H.3.3.4* |
Student Recording Chart

**Directions** Mark an × by each question from the Pretest and Posttest that you answered incorrectly. If there are one or two ×s marked for a benchmark, write Yes in the Need Practice? box. Then complete the practice pages for that benchmark.

### Strand A: The Nature of Matter

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### Strand C: Force and Motion

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### Strand D: Processes that Shape the Earth

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**Test Questions**

**Need Practice?**

**Practice Pages**
### Strand G: How Living Things Interact with Their Environment

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### Strand H: The Nature of Science

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How to Complete the Response Grids

Science test questions that have the gridded response symbol require you to fill in the grid to the right of the question. Sometimes there is more than one way to complete the response grid. In this section, you will learn the different ways the grids can be filled in.

**Parts of a Response Grid**

Response grids have the following:

- Answer boxes
- Fraction bar
- Decimal point
- Number bubbles

**Directions**

1. Read the question and work the problem. For gridded response questions, your answer will always be a number.
2. Once you have your answer, write it in the answer boxes.
   - Write your answer with the first digit in the left box OR with the last digit in the right box.
   - Use only one digit or symbol in each box. Do NOT leave a blank answer box in the middle of an answer.
   - If your answer is a decimal or fraction, be sure to include the decimal point or the fraction bar in the correct answer box.
3. Under each answer box, fill in the correct bubble for the number you wrote.
   - Fill in one bubble for each answer box. Do NOT fill in a bubble under an unused answer box.
   - Each bubble must be filled in completely.
   - You MUST correctly fill in the bubbles for your answer in order to receive credit.

Examples

Whole Number

95 − 15 =

Decimal

Show the decimal equivalent of \( \frac{8}{100} \).
Fraction

NOTE: You cannot have a mixed number as an answer. If you have a mixed number, you must convert your answer to an improper fraction or a decimal number. For example, if you fill in $17\frac{1}{2}$, it would be read as $\frac{171}{2}$. This is not a correct answer, and you will not receive credit.

INCORRECT

$17\frac{1}{2}$

CORRECT

$17\frac{1}{2}$

OR

$17.5$
Decimal or Fraction

Many answers may be shown as either a decimal or a fraction.
Taking the FCAT Science Test

Hints for Taking the FCAT Science Test

✔ There are four kinds of questions on the FCAT Science Test. These are: multiple choice, gridded response, short response, and extended response. Learn how to recognize and answer these different types of questions.

✔ Read each question and answer choice carefully.

✔ Make sure that when choosing an answer choice, your answer is the one that is correct.

✔ If you come to a question that seems too difficult, move on to the next question. You can come back to the question later.

✔ When answering multiple choice and gridded response questions, make sure you have completely and correctly filled in the bubbles. Avoid any stray marks, and if you accidentally make one, be sure to erase it.

✔ After answering a question, double-check to make sure that your answer choice answers the question.

✔ Get a good night’s sleep the night before test day. On test day, just relax and do your best.
How to Answer "Read, Inquire, Explain" Questions

You can receive full or partial credit for your answers to short response and extended response questions. Even if you do not feel that you can find the complete answer for these types of questions, you should write as much as you can and show all your work. This way, you may receive credit for a portion that is correct.

When you see this symbol next to a question, it signals a short response question. For these types of questions, you should use about five minutes to write your answers.

You will receive 2 points for an answer that is completely correct and 1 point for an answer that is partially correct.

When you see this symbol next to a question, it signals an extended response question. The answers for these questions will be longer than those for short response. You will see questions with a Part A and a Part B. You should use about 10–15 minutes to answer extended response questions.

You will receive 4 points for an answer that is completely correct and 1, 2, or 3 points for an answer that is partially correct.

When you see this symbol next to a question, it signals a gridded response question. For this type of question you will need to fill in a grid. There is more than one correct way to record your answer on the grid. You MUST write your numerical answer in the answer boxes and then fill in the correct bubbles for all of the digits and symbols.

You will receive 1 point for a correct answer. There are no partial points for incomplete gridded response questions.
FCAT Science Reference Sheet

Equations

\[
\text{Acceleration (} a \text{)} = \frac{\text{change in velocity (m/s)}}{\text{time taken for this change (s)}} \quad a = v_f - v_i
\]

\[
\text{Average speed (} \bar{v} \text{)} = \frac{\text{distance}}{\text{time}} \quad \bar{v} = \frac{d}{t}
\]

\[
\text{Density (} D \text{)} = \frac{\text{mass (g)}}{\text{volume (cm}^3\text{)}} \quad D = \frac{m}{\bar{V}}
\]

\[
\text{Percent efficiency (} e \text{)} = \frac{\text{Work out (J)}}{\text{Work in (J)}} \times 100 \quad \%e = \frac{\text{Work}_{\text{out}}}{\text{Work}_{\text{in}}} \times 100
\]

\[
\text{Force in newtons (} F \text{)} = \text{mass (kg)} \times \text{acceleration (m/s}^2\text{)} \quad F = ma
\]

\[
\text{Frequency in hertz (} f \text{)} = \frac{\text{number of events (waves)}}{\text{time (s)}} \quad f = \frac{n \text{ of events}}{t}
\]

\[
\text{Momentum (} p \text{)} = \text{mass (kg)} \times \text{velocity (m/s}^2\text{)} \quad p = mv
\]

\[
\text{Wavelength (} \lambda \text{)} = \frac{\text{velocity (m/s)}}{\text{frequency (Hz)}} \quad \lambda = \frac{v}{f}
\]

\[
\text{Work (} W \text{)} = \text{Force (N)} \times \text{distance (m)} \quad W = Fd
\]

Units of Measure

\[
\begin{align*}
\text{cm} &= \text{centimeter} & \text{Hz} &= \text{hertz} & \text{kg} &= \text{kilogram} & \text{N} &= \text{newton} \\
g &= \text{gram} & J &= \text{joule (newton-meter)} & m &= \text{meter} & s &= \text{second}
\end{align*}
\]
Using a Calculator

This is a diagram of a generic calculator and its parts.

### Helpful Hints for Using a Calculator on the FCAT Science Test

1. Decide if you need a calculator to solve the problem by reading the question very carefully.
2. Always clear your calculator by pressing the clear key before starting a new problem.
3. If you see an **E** in the display, clear the error before you begin.
4. If you see an **M** in the display, clear the memory before you begin.
5. If you get an answer that does not match an answer choice or seems unreasonable, check your work and re-enter the problem into the calculator.
6. Remember to enter your problem into the calculator using the correct order of operations. The calculator will NOT do this automatically.
7. Take your time when using the calculator. Make sure you are pressing the correct keys.
8. Always check your answer and your work before writing or selecting your final answer.
### Periodic Table of the Elements

(based on $^{12}_6$C = 12.0000)

<table>
<thead>
<tr>
<th>Group</th>
<th>Period</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1</td>
<td>H, He, Li, Be, B, C, N, O, F, Ne</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Na, Mg, Al, Si, P, S, Cl, Ar</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Xe</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Cs, Ba, La, Hf, Ta, W, Os, Ir, Pt, Au</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Fr, Ra, Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr</td>
</tr>
</tbody>
</table>

#### Transition Metals
- Period 3: Li, Be, B, C, N, O, F, Ne
- Period 4: Na, Mg, Al, Si, P, S, Cl, Ar
- Period 5: K, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn
- Period 6: Rb, Sr, Y, Zr, Nb, Mo, Tc, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Te, I, Xe
- Period 7: Cs, Ba, La, Hf, Ta, W, Os, Ir, Pt, Au, Hg, Tl, Pb, Bi, Po, At, Rn

#### Inner Transition Metals
- Lanthanide Series
- Actinide Series

#### Actinide Series
- Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr

#### Metals vs. Nonmetals
- Metals: upper right corner
- Nonmetals: lower left corner
Michaela is conducting an experiment on the speed of toy cars on different surfaces. For each trial, she uses a ramp covered in a different substance. Michaela uses a different type of car for each trial to make sure it is free from any materials from the previous trial. Michaela measures the distance traveled and time of each car. Which of the following is a change Michaela should make in her investigation in order to achieve more valid results?

A. Michaela should measure the force each car exerts on each surface.
B. Michaela should measure the direction in which the cars are traveling.
C. Michaela should use the same material for each trial of her investigation.
D. Michaela should use the same type of car for each trial of her investigation.

Which of the following describes how fossils aid scientific research?

F. Fossils show what fuels have been present on Earth over time.
G. Fossils show how organisms on Earth have changed over time.
H. Fossils show how the makeup of the solar system has changed over time.
I. Fossils show how the human population has changed over the last century.

Observe the diagram below. Which container of water has molecules with the greatest average kinetic energy?

A. A
B. B
C. C
D. D
Christina has three substances. Each substance is a cube with a volume of 6 milliliters. She is going to place all three substances in a tub of water and wants to know which will float. Substance A has a mass of 4 grams, substance B has a mass of 8 grams, and substance C has a mass of 10 grams.

**Part A** Which substance will float?

**Part B** Explain how you know which substance will float.

In a car, 75 percent of the chemical energy of gasoline is lost as thermal energy. If the gasoline contains 1,000 kilojoules of energy, how much of that energy is used to actually move the car? Record your answer in kilojoules.

Gridded Response
Pretest

Which of the following is responsible for the formation of sinkholes and caves?

F. eroding soil on Earth’s surface
G. ice that builds up on Earth’s surface
H. deposition that has built up at the mouth of a river
I. flowing groundwater that dissolves rock, such as limestone

The table below shows the distance of each planet from the Sun. How much further is Uranus from the Sun than Jupiter is? Record your answer to the nearest whole astronomical unit (AU).

<table>
<thead>
<tr>
<th>Planet</th>
<th>Distance from Sun (AU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>0.387</td>
</tr>
<tr>
<td>Venus</td>
<td>0.723</td>
</tr>
<tr>
<td>Earth</td>
<td>1.000</td>
</tr>
<tr>
<td>Mars</td>
<td>1.524</td>
</tr>
<tr>
<td>Jupiter</td>
<td>5.203</td>
</tr>
<tr>
<td>Saturn</td>
<td>9.523</td>
</tr>
<tr>
<td>Uranus</td>
<td>19.208</td>
</tr>
<tr>
<td>Neptune</td>
<td>30.087</td>
</tr>
<tr>
<td>Pluto (average)</td>
<td>39.746</td>
</tr>
</tbody>
</table>

Go on
The following diagram shows an energy pyramid. Where is the greatest amount of energy found?

A. at the top level  
B. at the middle level  
C. at the producer level  
D. at the carnivore level

The human population is growing at an extraordinary rate. Describe the effect this growth has on Earth’s natural resources.
A bicyclist is riding north at a speed of 15 kilometers per hour (km/h). The wind is blowing toward the north at 10 km/h. What is the bicyclist’s speed with respect to the ground?

- F. 5 km/h
- G. 15 km/h
- H. 25 km/h
- I. 50 km/h

Prior to the 15th century, most people believed that Earth was the center of the universe. In the 1600s, the telescope came into use for astronomical observations. Explain the results of telescope use.
A scientist testing the effects of a new medicine that will treat anemia, a blood disorder, uses a sample size of 15 patients for a study. All of the patients are from the same large city, are of varying ages, and are male.

Which of the following is an accurate statement regarding this investigation?

A. Using a sample size of 15 people is too small. The investigation will not be a reliable and valid test of the medicine.

B. Using a sample of people of the same gender always allows the scientist to obtain the most accurate data for the study.

C. Using varying ages of people will add necessary data to this study, causing the investigation’s results to be informative and useful.

D. Using a sample from the same city is necessary to allow the scientist to control for all other factors that may have an effect on the medicine’s effectiveness.

Observe the following diagram showing a wave. How many wavelengths are shown in the diagram? Record your answer as a whole number.
The following diagram shows an amoeba and a plant. Which of the following identifies the primary difference between the two organisms?

- F. The amoeba has organs.
- G. The amoeba contains only one cell.
- H. The amoeba can produce its own food.
- I. The amoeba cannot conduct respiration.

Observe the diagram below. Which of the following describes the process these organs go through when working together?

- A. The organs work together to extract nutrients from food.
- B. The organs work together to move oxygen to needed areas.
- C. The organs work together to move blood throughout the body.
- D. The organs work together to regulate hormone levels in the body.
Aline is watching the weather to prepare for her trip to a beach in a warm climate. She notices that a low-pressure system is going to bring in cold air and rain, just for the night. What type of weather conditions will likely happen in the morning?

F. drizzly and cold
G. overcast and foggy
H. chance of thunderstorms
I. cloudy and slightly warm

The following table shows some characteristics of stars. Which of the following correctly describes how one factor affects the other?

<table>
<thead>
<tr>
<th>Main Sequence Star Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>bluest</td>
</tr>
<tr>
<td>bluish</td>
</tr>
<tr>
<td>blue-white</td>
</tr>
<tr>
<td>white</td>
</tr>
<tr>
<td>yellow-white</td>
</tr>
<tr>
<td>orange</td>
</tr>
<tr>
<td>red</td>
</tr>
</tbody>
</table>

A. As the mass increases, the diameter decreases.
B. As the color becomes more red, the temperature increases.
C. As the temperature increases, the size of the star increases.
D. As the mass of the star increases, the temperature decreases.
Pretest

18 Consider burning paper and making a pie. Why would these actions be classified as chemical changes?
F. They change densities.
G. They create new substances.
H. They change the state of matter.
I. They are actually physical changes.

19 A phylogenic tree shows the evolutionary relationships between organisms. The following diagram shows a section of a phylogenic tree. Which of the following organisms are most closely related?

A. dog and kangaroo
B. horse and rabbit
C. pigeon and duck
D. turtle and penguin

20 Observe the following diagram of an airplane flying east at a speed of 300 kilometers per hour (km/h). There is a wind blowing eastward at 40 km/h.

What is the airplane’s speed, in kilometers per hour, with respect to the ground?
What happens to the electrical energy used by a refrigerator to cool the inside of the refrigerator?

F. The total amount of energy decreases.
G. Some energy is lost as thermal energy.
H. The energy is used in full without any loss.
I. Energy increases during the transformation.

The gene for curly hair is dominant and the gene for straight hair is recessive. Two individuals, who are hybrids with both genes each, have offspring. What is the percent chance the offspring will have straight hair?

A. zero percent
B. 25 percent
C. 50 percent
D. 75 percent

Which of the following describes the energy transformations that occur when a lamp is plugged in and turned on?

F. Electromagnetic energy is converted to kinetic energy.
G. Electrical energy is converted to light and thermal energy.
H. Chemical energy is converted to thermal and mechanical energy.
I. Mechanical energy is converted to electrical and chemical energy.
24 Which of the following describes the nature of light?

A. Light has only wavelike properties.
B. Light has only particle-like properties.
C. Light has properties of both particles and waves.
D. All light consists of many different colored particles.

25 The diagram below shows a runner and the course he runs. He completes the course in 10 seconds. What is his average speed in meters per second?

26 The following diagram shows a convection current in an oven. Which of the following describes what is occurring in the oven?

F. The coils warm the air in the oven, causing the cooler air to be moved into the back of the oven.
G. The coils warm the oven, creating currents of warm air moving around the oven in all directions.
H. The coils heat the air near the bottom, the warm air rises, and the cooler air sinks to the bottom where it is warmed.
I. The coils heat the air, causing the cooler air in the oven to rise to the top and the warmer air to circulate around the oven.
Which of the following is a renewable resource currently being used by countries around the world?

A. coal  
B. fusion  
C. natural gas  
D. sunlight

Tamika is conducting an investigation on the effect of different types of soil on the growth of Bermuda grass. Which of the following describes the methodology she should use in her investigation?

F. Tamika should repeat her investigation several times for reliability of her results.  
G. Tamika should check the growth of her plants once a month and record her findings.  
H. Tamika should keep each plant in a separate room so that they are not influenced by one another.  
I. Tamika should provide each plant with enough fertilizer to keep it growing at the same rate as the other plants.

Biologists study living organisms. Chemists study matter. Which of the following explains how these two unique disciplines are similar?

A. Chemists often need to study biology to understand how nonorganic molecules function.  
B. Chemists and biologists often use similar tools and techniques, so they share each other’s technologies.  
C. Biologists often disagree with the findings of chemists because they are at odds with the way living things work.  
D. Chemists and biologists work in isolation from one another, so they do not have much contact with each other’s studies.
A rock is dropped into a still pond. Waves radiate from the center and move out across the water. The diagram below shows the wave crests as they would appear from above. How many complete wavelengths are shown in the diagram?

- F. 1
- G. 5
- H. 10
- I. 12

The following table shows the characteristics of the parts of an atom. Based on the information, which of the following describes the interactions between these particles?

<table>
<thead>
<tr>
<th>Particle</th>
<th>Mass (atomic mass units)</th>
<th>Charge</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electron</td>
<td>1/1836</td>
<td>–</td>
<td>Electron cloud</td>
</tr>
<tr>
<td>Proton</td>
<td>1</td>
<td>+</td>
<td>Nucleus</td>
</tr>
<tr>
<td>Neutron</td>
<td>1</td>
<td>Neutral</td>
<td>Nucleus</td>
</tr>
</tbody>
</table>

- A. Electrons are attracted to the nucleus.
- B. Neutrons help balance the charge of an ion.
- C. The electron cloud is lighter than the nucleus.
- D. Protons always have the same mass as neutrons.

Which of the following is true about a person’s weight on the moon versus his or her weight on Earth?

- F. The Moon orbits Earth at great speed, making one only feel lighter.
- G. The Moon is denser than Earth, therefore making one’s weight higher than it would be on Earth.
- H. One’s mass would be the same on the Moon and on Earth, therefore the weight would be the same on both.
- I. The Moon has less mass than Earth and therefore less gravity, which makes one’s weight less on the Moon.
Blood is pumped through the heart and then transported to all parts of the body. At what level does the aorta, the largest artery in the body, carry oxygen-rich blood to the body from the heart?

A. cell  
B. organ  
C. organ system  
D. tissue

The following graphic shows a duck’s feet. Which of the following explains how the structure of the feet enables the duck to survive in its environment?

F. The number of toes on the foot enables the duck to capture prey.  
G. The webbing on the feet enables the duck to move through water.  
H. The shape of the foot enables the duck to walk to find sources of water.  
I. The presence of claws on the feet enables the duck to glide through the air.

The water that you drink today has probably been around since before the most recent Ice Age. Which of the following describes why this is so?

A. Water is constantly being reused as it moves through the nitrogen cycle.  
B. Conservation efforts to recycle water have long been in effect around the world.  
C. Water is constantly being cycled through Earth’s atmosphere and bodies of water.  
D. The water we drink today was once part of the polar ice caps, which have since melted.
Justin wants to make candy canes for his family. He knows that one step is to dissolve sugar in water so that he will get a syrup. Justin wants to know the most effective way to perform this step, so he is testing how temperature affects the rate at which sugar dissolves in water.

**Part A** Name two variables that Justin will need to control.

**Part B** Describe what will happen if these variables are not controlled.

__________________________
__________________________
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__________________________
__________________________
__________________________
__________________________
__________________________
__________________________
__________________________
Tyra has four samples of metal, all with the same volume, but with different masses. Tyra also knows the densities, in grams per cubic centimeter (g/cm³), of certain metals. Which of Tyra’s samples is copper (Cu)? **SC.A.1.3.1**

<table>
<thead>
<tr>
<th>Metal</th>
<th>Density (g/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>2.6</td>
</tr>
<tr>
<td>Brass</td>
<td>8.5</td>
</tr>
<tr>
<td>Copper</td>
<td>8.9</td>
</tr>
<tr>
<td>Iron</td>
<td>7.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Samples</th>
<th>Volume (cubic centimeter)</th>
<th>Mass (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td>12</td>
<td>106.8</td>
</tr>
<tr>
<td>Sample B</td>
<td>12</td>
<td>86.4</td>
</tr>
<tr>
<td>Sample C</td>
<td>12</td>
<td>1.348</td>
</tr>
<tr>
<td>Sample D</td>
<td>12</td>
<td>0.742</td>
</tr>
</tbody>
</table>

Ethanol (grain alcohol) has a density of 0.789 grams per centimeter cubed. How many cubic centimeters of ethanol must be poured into a graduated cylinder to equal 30.3 grams? **SC.A.1.3.1**

Solids, liquids, and gases have very different properties. Explain what happens to the density, volume, mass, and shape of an ice cube put in a glass jar and left out in the Sun. **SC.A.1.3.1**
Which of the following procedures increases the average kinetic energy of the molecules in a beaker of water? **SC.A.1.3.3**

- F. Heating water from 0°C to 100°C.
- G. Cooling steam at 100°C to ice at 0°C.
- H. Changing ice at 0°C to liquid water at 0°C.
- I. Changing liquid water at 100°C to steam at 100°C.

Molecules in a gas are in constant motion and are spread very far apart. Which description fits the molecular arrangement and motion of a solid? **SC.A.1.3.4**

- A. tightly packed molecules that do not move
- B. loosely packed molecules that move randomly
- C. tightly packed molecules that compress over time
- D. tightly packed molecules that vibrate in fixed areas

Eliza mixes batter for a cake and puts it in the oven. What kind of change does the cake undergo as it bakes? **SC.A.1.3.5**

- F. biological
- G. chemical
- H. electrical
- I. physical
Benchmark Practice

Strand A: Nature of Matter

7 When a beam of white light shines through a prism at a wall, bands of colors appear on the wall. Why does the light exit the prism differently than it enters it? SC.A.2.3.1

A. The prism changes the frequency of the light.
B. The prism reflects the light at different speeds.
C. The prism splits the light into waves and particles.
D. The prism splits the light into its different wavelengths.

8 Which of the following is NOT a property of electromagnetic waves? SC.A.2.3.1

F. amplitude
G. charge
H. frequency
I. wavelength

9 What is the difference in the number of neutrons for the following elements? SC.A.2.3.2

<table>
<thead>
<tr>
<th>Element</th>
<th>Protons</th>
<th>Neutrons</th>
<th>Mass Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>11</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Fe</td>
<td>26</td>
<td>56</td>
<td>82</td>
</tr>
</tbody>
</table>

A. 6
B. 12
C. 18
D. 30
A rock falls from a ledge to the ground. What energy conversion occurs during this process? **SC.B.1.3.1**

- F. Potential energy is converted into kinetic energy.
- G. Kinetic energy is converted into potential energy.
- H. Thermal energy is converted into mechanical energy.
- I. Chemical energy is converted into mechanical energy.

A generator makes 3.45 kilojoules (kJ) of energy during each minute of operation. Of this energy, 2.23 kJ are converted to thermal energy by friction and electrical resistance. How many kilojoules are available as electrical energy? **SC.B.1.3.1**

Using the figure below, describe the two main energy transfers. **SC.B.1.3.1**
The diagram below shows the various processes that take place as an electric streetcar moves up a hill. SC.B.1.3.1

Part A Fill each box in the diagram with one of the given energy terms that correctly identifies the type of energy occurring for each specific step. Use each term only once.

- electrical
- kinetic
- mechanical
- potential

Part B Describe the various steps shown in the diagram that cause the transfer of energy. Be sure to include references to the power lines, the streetcar’s motor, and the hill.
The information given in the table below gives the input and output energies for several types of engines. Which of these engines converts energy most efficiently? SC.B.1.3.4

<table>
<thead>
<tr>
<th>Engine</th>
<th>Input Energy (kJ)</th>
<th>Work Performed (kJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>270</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>550</td>
<td>85</td>
</tr>
<tr>
<td>3</td>
<td>330</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>120</td>
<td>45</td>
</tr>
</tbody>
</table>

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

A steam engine only converts 20 percent of its input energy into useful work. How many kilojoules of work does this engine do if its input energy is 300 kilojoules? SC.B.1.3.4

When you sit indoors near a window on a sunny day, your skin gets warm. How does this happen? SC.B.1.3.5

F. The Sun’s energy reaches your skin as radiation.  
G. Heat from the Sun reaches your skin by conduction.  
H. The Sun’s energy is conducted to your skin by the glass.  
I. Heat from the room is reflected from the window onto your skin.
In the figure below, what is the amplitude of the wave in meters? 

**SC.B.1.3.6**

A. 0.25 m  
B. 0.50 m  
C. 2.00 m  
D. 4.00 m

Andrea observes waves moving in a pond. She counts 21 waves passing a given point in 14 seconds. What is the frequency of the waves in hertz (Hz)?  

**SC.B.1.3.6**

The string of a violin is held down at the point shown in the figure. How will this affect the frequency and pitch of the sound waves made if the string is vibrated?  

**SC.B.1.3.6**
20. In the figure below, energy from the falling water is used to power the mill. Which of the following correctly describes the loss of energy between the falling water and the mill? **SC.B.2.3.1**

- F. Friction causes mechanical energy to convert into light energy.
- G. Friction causes mechanical energy to convert into thermal energy.
- H. Friction causes mechanical energy to convert into chemical energy.
- I. Friction causes mechanical energy to convert into electrical energy.

21. Which of the following correctly describes the process of water freezing? **SC.B.2.3.1**

- A. The ordered liquid water molecules become more disordered as they become ice.
- B. The disordered liquid water molecules become more ordered as they become ice.
- C. The ordered liquid water molecules become more ordered as they become ice.
- D. The disordered liquid water molecules become more disordered as they become ice.
Benchmark Practice

Strand C: Force and Motion

22. A train travels at a constant speed of 125 kilometers per hour. How many minutes does it take the train to travel 25 kilometers? **SC.C.1.3.1**

- F. 10 minutes
- G. 12 minutes
- H. 15 minutes
- I. 20 minutes

23. Which of the following statements correctly describes the force between two magnets? **SC.C.2.3.1**

- A. The force increases as the charge of the magnets increases.
- B. The force increases as the distance between the magnets increases.
- C. The force increases as the distance between similar poles of the two magnets decreases.
- D. The force increases as the distance between opposite poles of the two magnets increases.

24. Assume that the ramp shown in the figure below has a frictionless surface. How much work, in newton-meters, is done in raising the crate to the top of the ramp? **SC.C.2.3.4**

[Diagram of a ramp with dimensions: 1.5 meters height, 4.1 meters length, and a crate of 500 newtons]
An automobile is moving forward. If all of the forces on the automobile are balanced by equal and opposite forces, what must be true about the motion of the automobile? SC.C.2.3.6

F. The automobile increases speed in the forward direction.
G. The automobile decreases speed in the forward direction.
H. The automobile continues to move forward at constant speed.
I. The automobile gradually changes direction while maintaining its speed.

A speedboat traveling east at a constant speed of 25 kilometers per hour (km/h) encounters a current directed south at a constant speed of 5 km/h. Which segment of the figure below indicates the overall direction in which the speedboat travels with respect to the shore? SC.C.2.3.6

A. 1
B. 2
C. 3
D. 4
A boat is driven forward by a force of 4550 newtons (N). If the water provides a resisting force equal to 4360 N, what is the net forward force, in newtons, acting on the boat? SC.C.2.3.6

A stone falling from a cliff increases speed until it reaches constant velocity, or terminal velocity. What does the stone’s motion tell you about the forces acting on the stone? SC.C.2.3.6
The figure below shows several forces (in newtons) acting on a cart. Describe the motion, if any, of the cart in terms of net force and acceleration. **SC.C.2.3.6**

- Force applied to cart = 75 N
- Downhill force of gravity on cart = 125 N
- Friction acting on cart = 35 N

Which of the following statements correctly describes the results of gravitational force on a satellite orbiting Earth? **SC.C.2.3.7**

- F. The satellite moves in a path along Earth’s equator.
- G. The satellite moves in a path between Earth’s poles.
- H. The satellite follows a closed, curved path around Earth.
- I. The satellite moves farther outward from Earth into space.
Suppose Earth’s moon had twice its current mass. Which of the following statements would be true? **SC.C.2.3.7**

A. The Moon would change orbit so as to maintain the same gravitational force.

B. The gravitational force between Earth and the Moon would be half what it is now.

C. The gravitational force between Earth and the Moon would be twice what it is now.

D. The gravitational force between Earth and the Moon would be the same as it is now.

The table below lists the masses and distances of several asteroids that orbit the Sun. For which asteroid is the gravitational force between the Sun and asteroid strongest? **SC.C.2.3.7**

<table>
<thead>
<tr>
<th>Asteroid</th>
<th>Asteroid mass (kg)</th>
<th>Sun mass (kg)</th>
<th>Mean asteroid distance from Sun (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psyche</td>
<td>$2 \times 10^{19}$</td>
<td>$2.0 \times 10^{30}$</td>
<td>$4.37 \times 10^{8}$</td>
</tr>
<tr>
<td>Ida</td>
<td>$4 \times 10^{16}$</td>
<td>$2.0 \times 10^{30}$</td>
<td>$4.28 \times 10^{8}$</td>
</tr>
<tr>
<td>Pallas</td>
<td>$3.2 \times 10^{20}$</td>
<td>$2.0 \times 10^{30}$</td>
<td>$4.15 \times 10^{8}$</td>
</tr>
<tr>
<td>Ceres</td>
<td>$8.8 \times 10^{20}$</td>
<td>$2.0 \times 10^{30}$</td>
<td>$4.14 \times 10^{8}$</td>
</tr>
</tbody>
</table>

F. Psyche
G. Ida
H. Pallas
I. Ceres
Erosion is a process in which material is worn away from the surface of Earth. What is the most common cause of erosion? **SC.D.1.3.1**

A. time
B. water
C. wildlife
D. wind

There are many ways Earth has been shaped and reshaped over millions of years. Which of the following has NOT changed Earth’s shape over time? **SC.D.1.3.1**

F. earthquakes
G. ecosystems
H. glaciers
I. tides

A high-pressure system moves over a city that has poor air quality due to pollution. The weather reporter states that the high-pressure system will stay in the city for at least one week. How will this system affect the pollution in the city? **SC.D.1.3.3**

A. It will not affect the pollution at all.
B. It will trap the pollution over the city.
C. It will reduce the pollution, then increase it.
D. It will blow the pollution away from the city.
Benchmark Practice

Strand D: Processes that Shape the Earth

36. Scientists believe the continents are constantly shifting because of convection currents from within Earth’s crust. If this is true, and if the transfer of heat continues, which of the following can be expected to occur over time? **SC.D.1.3.3**
   - F. Volcanic activity will increase.
   - G. The Earth’s outer shell will get softer.
   - H. The Earth’s crust will become less stable.
   - I. The continents will continue to move around.

37. The California coastal climate is cool and wet, while the climate behind the mountain range is hot and dry. Using the illustration below, which of the following correctly describes why the climates are different? **SC.D.1.3.3**
   - A. The mountain rock emits heat energy that evaporates the wet, cool air.
   - B. The hot, dry air gives off too much energy for the wet air to withstand.
   - C. The wet air evaporates before reaching the other side of the mountains.
   - D. The wet air is blocked by the mountains, and cannot move anywhere else.

38. Farmers use compost to help fertilize their soil, allowing their crops to grow healthy and strong. What do these farmers primarily depend on in order for this process to work? **SC.D.1.3.4**
   - F. producers
   - G. decomposers
   - H. fertilizer distribution
   - I. soil nutrient reproduction
Benchmark Practice

Strand D: Processes that Shape the Earth

Multiple Choice

39 In an area where erosion is a problem, scientists are deciding which tree they should plant to help prevent soil erosion from heavy rains. They need a tree that will grow 18-centimeter roots within the first three years. According to the data in the graph below, which tree should they plant? SC.D.1.3.4

- A. Tree F
- B. Tree G
- C. Tree H
- D. Tree I

40 In a grassland area, the cattle are allowed to graze wherever they want. Many of the cattle graze on the bank of a small stream. What is an effect of the grazing? SC.D.1.3.4

- F. Soil erosion will widen the stream.
- G. Weathering will narrow the stream.
- H. Less sand and soil will fill the stream.
- I. More plants will grow along the stream bank.

Multiple Choice

41 Forest fires are dangerous to all living organisms, but sometimes they can be beneficial. Which of the following is a benefit of a forest fire? SC.D.1.3.4

- A. It emits gases that are very beneficial to the atmosphere.
- B. It clears old growth, recycling essential nutrients back into the soil.
- C. It kills off poisonous and harmful plants that hikers might encounter.
- D. It eliminates animal populations that are dangerous or overpopulated.
Benchmark Practice

**Strand D: Processes that Shape the Earth**

**42** Which of the following events could NOT occur during a human lifetime?  
SC.D.1.3.5  
F. formation of a valley  
G. erosion of a riverbank  
H. growth and death of a tree  
I. movement of the tectonic plates

**43** Which of the following units of measure is used to determine the distance between atoms? SC.D.1.3.5  
A. angstrom  
B. hertz  
C. light year  
D. nanometer

**44** A light-year measures the distance a light beam can travel in one year. One light-year is equal to 9 500 000 000 000 kilometers. Why do scientists use light-years to measure distances in the universe? SC.D.1.3.5  
F. Light-years are the most accurate form of measurement for universal purposes.  
G. Light-years are the only practical unit for measuring the vast distances of space.  
H. Light-years tell us about the temperature, distance, and age of other celestial bodies.  
I. Light-years measure the age of celestial bodies by determining how bright the light is.
A storm moves east at 56 kilometers per hour (km/h), but the rough waves it produces move ahead at 110 km/h. The projected path of the storm has it hitting a coast 375 kilometers away. Assuming the storm’s speed remains constant, how many hours ahead of the storm will the waves be reaching the shore? SC.D.1.3.5

According to the diagram below, a river deposits sediments over five years. The five years shown are average river deposits for the designated time period. If all factors remain constant, how much sediment (in centimeters) would the river deposit over a period of 100 years? SC.D.1.3.5

<table>
<thead>
<tr>
<th>Year</th>
<th>Sediment (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>5</td>
</tr>
<tr>
<td>1998</td>
<td>2</td>
</tr>
<tr>
<td>1997</td>
<td>4</td>
</tr>
<tr>
<td>1996</td>
<td>6</td>
</tr>
<tr>
<td>1995</td>
<td>3</td>
</tr>
</tbody>
</table>
All planets orbit the Sun and rotate on their axes. Based on the information in the table below, how long would a day on Pluto be?

**Data on Pluto**

<table>
<thead>
<tr>
<th>Rotation Time</th>
<th>Orbit Time (around Sun)</th>
<th>Distance from the Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4 Earth days</td>
<td>248 years</td>
<td>3.7 miles</td>
</tr>
</tbody>
</table>

A. 24 hours  
B. 153.6 hours  
C. 3.2 days  
D. 248 years

The Moon is in a synchronous orbit with Earth. What is a result of this type of orbit?

F. We always see the same side of the Moon.  
G. The Moon comes closer to Earth each year.  
H. The Moon rotates over the course of a week.  
I. The Moon moves further from Earth each year.

Astronomers measure distances between the Sun and other objects in the solar system in astronomical units (AU). One astronomical unit is the distance between the Sun and Earth. Using the table below, in AU, how many times farther from the Sun is Pluto than Jupiter?
Asteroids are rocky fragments that orbit the Sun in an asteroid belt between Mars and Jupiter. **SC.E.1.3.1**

What do scientists think the origins of these fragments are?

Describe the planetary arrangement of our solar system, including the major differences between the inner and outer planets. **SC.E.1.3.1**
Stars are born in great clouds of interstellar dust and gas. As these dusts and gases collapse, they become more dense. What describes these initial clouds of dust and gas? **SC.E.1.3.4**

A. eclipses  
B. meteoroids  
C. nebulae  
D. protostars

Most stars are main-sequence stars that develop over time, eventually becoming white dwarf stars. However, some types of stars have a special final stage in which they become black holes. Which kind of stars become black holes? **SC.E.2.3.1**

F. high-mass stars  
G. low-mass stars  
H. planetary nebulae  
I. protostars
Benchmark Practice

Strand F: Processes of Life

54 In which of the following tissues of a tree does photosynthesis occur?

SC.F.1.3.1

A. root cap
B. blade of the leaf
C. cambium of the bark
D. sapwood of the trunk

55 Mark drinks a large glass of orange juice with his breakfast. This adds potassium to his blood in a short period of time. Which of the following systems is primarily responsible for regulating the amount of potassium in Mark’s blood?

SC.F.1.3.1

F. circulatory
G. excretory
H. reproductive
I. respiratory

56 Carbon dioxide and water are the byproducts of complete combustion. Carbon monoxide (CO) is formed during incomplete combustion, or combustion that takes place in an oxygen-poor environment. Like oxygen (O₂), CO will combine with the hemoglobin in a person’s blood and is less likely to release itself from the hemoglobin than O₂. Explain the effect of CO exposure on the human body.

SC.F.1.3.1

_________________________

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Sex cells are formed in the testes and ovaries—parts of the reproductive systems in men and women. Both testes and ovaries also produce hormones, making them parts of what other system? **SC.F.1.3.1**

A. endocrine  
B. excretory  
C. nervous  
D. respiratory

**57**

Sara finds a cross-section of a tree trunk from a nearby timber-cutting operation. While counting the rings, Sara notices that the ring that corresponds to ten years ago is very narrow and dark. She researches newspaper weather reports for that period. Based on the tree-ring evidence, which of the following reports is she likely to discover? **SC.F.1.3.1**

F. Ten years ago, the summer was very humid.  
G. Ten years ago, several hurricanes came through the area.  
H. Ten years ago, there was an abundance of rain and sunshine.  
I. Ten years ago, the weather was unseasonably cold, overcast, and dry.

**58**

Plants capture energy from sunlight using chemical properties of chlorophyll and other light-absorbing pigments. Explain why chlorophyll makes plant leaves appear green. **SC.F.1.3.1**

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**59**

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Benchmark Practice
Strand F: Processes of Life

60   Bacteria and protists are primarily unicellular organisms. How do bacteria and unicellular protists differ? **SC.F.1.3.2**
A. Bacteria have a complex intracellular structures like ribosomes.
B. Bacteria lack a definite nucleus and have no nuclear membrane.
C. Protists have a single chromosome in a nuclear region, but no nuclear membrane.
D. Protists lack organized intracellular structures like mitochondria and chloroplasts.

61   How are human red blood cells different from all other human cells? **SC.F.1.3.2**
F. They have no nuclei or chromosomes.
G. They travel through the circulatory system.
H. They are a primary component of the immune system.
I. They reproduce themselves by mitosis every seven days.

62   Victor was born with a liver defect. When he was five, he received a liver transplant, but the doctors needed to transplant only one-third of an adult liver. What process will make it possible for this liver section to grow as Victor grows into an adult? **SC.F.1.3.3**
A. conjugation
B. fusion
C. meiosis
D. mitosis
One of the simplest types of animal is the sponge. The sponge has a multicellular structure and specialized cells for digestion, water circulation, reproduction, and external covering. Which of the following does the sponge lack? **SC.F.1.3.4**

- F. sperm and eggs
- G. tissues and organs
- H. a supporting skeleton
- I. genes and chromosomes

An hour after Enea ate breakfast, her body began to break down the food into glucose, fatty acids, and amino acids. These nutrients were then absorbed into her bloodstream. The graph below shows a normal, gradual rise in blood sugar after a meal and then a gradual return to a concentration of about 100 milligrams (mg) of glucose per 100 mL of blood.

If by five hours after eating, Enea’s blood sugar has not returned to normal, what might be the problem? **SC.F.1.3.5**

- A. Enea’s liver might not be producing enough glycogen.
- B. Enea’s gall bladder might not be producing enough bile.
- C. Enea’s pancreas might not be producing enough insulin.
- D. Enea’s stomach might not be producing enough hydrochloric acid.
Benchmark Practice

Strand F: Processes of Life

65. The diagram below shows human red blood cells and white blood cells. Why do these cells have different shapes?  SC.F.1.3.6

   F. They reproduce using different forms of mitosis.  
   G. They each are generated in different parts of the body.  
   H. They travel in different parts of the circulatory system.  
   I. Their shapes help them perform different functions in the body.

66. Whooping cranes regularly migrate from a wildlife refuge in Canada to another refuge in Texas. Whooping crane eggs hatched and raised in captivity were recently “taught” to migrate from Wisconsin to Florida by following an ultra-light airplane that looks like an adult whooping crane. Of what is this an example?  SC.F.1.3.7

   A. camouflage  
   B. geotropism  
   C. learned behavior  
   D. mutation

67. Protists, like paramecia, usually reproduce by mitosis—creating two daughter cells that each has a copy of the parent’s chromosomes. Sometimes paramecia reproduce sexually. In this case, the equivalent of meiosis occurs in the nuclear material so that half the chromosomes of each paramecia are exchanged through a bridge between the cells. What is the advantage of sexual reproduction if an organism is capable of reproducing asexually?  SC.F.2.3.1

   F. It decreases mutation in the species.  
   G. It increases the size of the population.  
   H. It increases genetic diversity in the species.  
   I. It deletes damaged genetic material from the organism.
In one species of the sweet-pea plant, the gene for solid green leaves is dominant, while the gene for bi-colored leaves is recessive. Jane crosses two plants with solid green leaves. She then plants the seeds of the first generation in order to make more plants. Of the resulting offspring plants, three have solid green leaves and one has bi-colored leaves. What does this tell Jane about the parent pea plants? **SC.F.2.3.2**

A. One parent had one copy of the recessive gene.
B. Both parents had one copy of the recessive gene.
C. One parent had two copies of the recessive gene.
D. Both parents had two copies of the recessive gene.

Two organisms of the same species differ in only a single trait. They are crossbred to analyze how the trait will be distributed. What is this procedure called? **SC.F.2.3.2**

F. completeness cross
G. dihedral cross
H. monohybrid cross
I. selection cross

Kate raises fruits and vegetables for a nearby farmers’ market. One day she decides to cross her purple eggplants with white eggplants. Her first generation produced four purple eggplants. Her second generation produced three purple eggplants and one white eggplant. Which of the following is a correct conclusion? **SC.F.2.3.2**

A. White is the dominant color in eggplants.
B. Purple is the recessive color in eggplants.
C. Purple is the dominant color in eggplants.
D. Purple is incompletely dominant in eggplants.
Gabriel’s father raises American Quarter Horses, specializing in the golden palomino: a golden yellow horse with a white mane and tail. Gabriel helps his father by keeping breeding records. He tries to produce foals of golden color by mating a brown (CC) horse with a white horse (cc), causing the palomino color. **SC.F.2.3.2**

Use a Punnett square to show why a brown (CC) horse and a white (cc) horse cannot produce a white foal.

Ranchers often crossbreed cattle to produce offspring with hybrid vigor, meaning the offspring are more likely than either parent to demonstrate a desirable trait. Explain some of the possible advantages of crossbreeding for a cattle rancher. **SC.F.2.3.2**
The Manx mutation in cats produces offspring with either stumpy tails or no tails at all. The Manx mutation can occur in any breed of cat, but a breed of Manx cat was developed. The Manx gene being dominant, if two Manx cats are bred together, the kittens that inherit two copies of the Manx gene will die before birth. Which of the following describes this mutation?  

- F. homozygous lethal  
- G. heterozygous lethal  
- H. homozygous neutral  
- I. heterozygous advantageous

Which of the following is the correct term for the process by which an advantageous genetic mutation spreads throughout a species?  

- A. dominance  
- B. genetic drift  
- C. monohybrid crossing  
- D. natural selection

Trilobite fossils found in rock layers show that they were once abundant on Earth, but no living trilobite has ever been found. Which of the following is a correct assessment of why this occurs?  

- F. Trilobites still exist, but scientists have not found any living ones.  
- G. Animals and plants can change over time, including becoming extinct.  
- H. Trilobite fossils have been misidentified; they are really fossils of an existing animal.  
- I. The fossils are not remnants of animals; they are really art objects created by early humans.
Benchmark Practice

Strand G: How Living Things Interact with Their Environment

76 Multiple Choice

In the Galapagos Islands, iguanas breathe air but spend hours in and under coastal waters feeding on algae. These iguanas have a gland that removes salt from their blood and allows them to sneeze it out through their nostrils. Why is this adaptation necessary for the iguana? SC.G.1.3.2

A. It rains frequently in this environment and salt is scarce.
B. In this environment, fresh water is scarce and their diet is high in salt.
C. The iguanas have to compete with other coast-dwelling animals for algae.
D. It is difficult for cold-blooded iguanas to keep warm in this environment.

77 Multiple Choice

Based on the five major characteristics that classify organisms, which of the following kingdoms do NOT have a nucleus in their cell structure? SC.G.1.3.3

F. Eubacteria, Fungi
G. Eubacteria, Protista
H. Archaebacteria, Protista
I. Archaebacteria, Eubacteria

78 Multiple Choice

Viruses have a core of DNA contained within a protein envelope. The virus inserts its DNA into a host such as a human. Why must the virus get inside the host cell? SC.G.1.3.4

A. The virus helps the host animal process nutrients.
B. The virus creates products that the host cell needs.
C. The virus is reproducing sexually with the host cell.
D. The virus needs the host cell to make copies of itself.
Living organisms on Earth exchange oxygen and carbon dioxide. This process is called the carbon cycle. What is the abiotic factor that creates the energy that drives this cycle? **SC.G.1.3.4**

- F. lightning
- G. rainfall
- H. sunlight
- I. wind

The larval form of certain species of flies, like the common housefly, is called a maggot. Maggots feed almost exclusively on dead tissue of animals and plants. Explain why maggots are an important part of ecosystems. **SC.G.1.3.4**
Helium is an inert gas used in lighter-than-air crafts like blimps because it is nonflammable. It is formed deep underground over millions of years as a by-product of the formation of natural gas. Almost all of the world’s helium is found in deep deposits of natural gas within 250 miles of Amarillo, Texas. Helium can be considered what type of natural resource? SC.G.2.3.1

A. a fossil fuel  
B. a renewable resource  
C. a part of the carbon cycle  
D. a nonrenewable resource

Waterways can become contaminated with mercury. Mercury is an extremely harmful element when ingested because it can damage the nervous system, lungs, kidneys, and reproductive system of wildlife and humans. If bodies of water within Everglades National Park became contaminated with mercury, which of the following will NOT be a possible effect? SC.G.2.3.2

F. Animals that eat fish caught in the park might suffer neurological damage.
G. Fewer fish hatchlings might mature causing a decline in the fish population within the park.
H. Fewer songbird and wetland bird eggs might hatch, causing a decline in bird populations within the park.
I. Animals who feed on mercury-contaminated animals will have offspring that are immune to the effects of mercury.
Benchmark Practice

Strand G: How Living Things Interact with Their Environment

Multiple Choice

83 In Indonesia, a volcanic eruption destroyed a large island, but also created a smaller one from the cooled lava rock. A century later, this island is now a tropical rain forest. Which of the following explains how the process occurred? **SC.G.2.3.2**

A. The lava rock provided the perfect amount of nutrients for tropical forest plants to grow.
B. The people of Indonesia wanted to rebuild the island, so they planted the ecosystem over a period of years.
C. The plants that grew on the rock were not blocked from sunlight, and therefore grew quickly from the Sun’s energy.
D. Through ecological succession, organisms that survived the eruption reproduced offspring and thus created the rain forest ecosystem.

84 Roberto is studying bird species in the Everglades. His study is over a five-year period, but every year the amount of bird species declines. He also notices the swamp water level has declined. Which abiotic factor might contribute to these declines? **SC.G.2.3.2**

F. an increase in human population of the area
G. a decrease in the amount of food available to the birds
H. an increase in the bacteria population in the swamp water
I. a decrease in the average humidity and rainfall over the swamp

85 Many abiotic and biotic factors in an ecosystem affect one another constantly. Which of the following represents a chain of events from a biotic factor affecting an abiotic one? **SC.G.2.3.2**

A. The soil provides nutrients to the plants in the ecosystem.
B. The mosquito population declines, affecting bird population.
C. The trees provide materials from their leaves and stems for the soil.
D. An increase in sunlight provides energy for the plants to increase in population.
In an effort to get rid of mosquitoes, a city sprays its lake and wooded areas with insecticide. The insecticide also kills a large number of other insect species. Which of the following is true about the effect the insecticide will have on the organisms that live in the lake and wooded areas?  

SC.G.2.3.3

F. All plants will not be affected.
G. Only the insects will be affected by the insecticide.
H. Only animals that prey on the insects will be affected.
I. Plants and animals, as well as insects, will be affected.

Heavy hunting, predation, and severe habitat loss caused the Attwater’s prairie chicken to be listed as endangered in 1967. The table below shows the prairie chicken population during selected years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1937</td>
<td>8700</td>
</tr>
<tr>
<td>1972</td>
<td>1772</td>
</tr>
<tr>
<td>1988</td>
<td>926</td>
</tr>
<tr>
<td>1991</td>
<td>580</td>
</tr>
<tr>
<td>1993</td>
<td>456</td>
</tr>
<tr>
<td>1994</td>
<td>158</td>
</tr>
<tr>
<td>1995</td>
<td>68</td>
</tr>
<tr>
<td>1996</td>
<td>44</td>
</tr>
</tbody>
</table>

What was the difference in population from 1937 and the first population count after the animal was listed as endangered?  

SC.G.2.3.3
When fossil fuels are burned, carbon dioxide is released. Large-scale burning of fossil fuels may put too much carbon dioxide into the atmosphere and contribute to global warming. What would be one effect of global warming? **SC.G.2.3.4**

A. It could be too hot on Earth to support life.
B. Organisms will move to cooler areas and overpopulate them.
C. Agriculture could no longer be possible because of droughts.
D. It could cause gradual thawing of ice caps and increase ocean levels.

Which of the following is NOT a positive consequence of human action on Earth’s environment? **SC.G.2.3.4**

F. replanting of forests
G. declaring an ozone day
H. consuming less food and energy
I. protecting endangered organisms

The ozone layer helps protect Earth from the Sun’s harmful rays. Due to human interaction, the ozone layer developed a hole over Antarctica. What is a possible cause of the hole in the ozone layer? **SC.G.2.3.4**

A. emission of greenhouse gases
B. emission of certain chemicals
C. emission of smog in large cities
D. emission of airplane fuel pollution
A timber company clear-cut all of the trees on a hillside above a river. Without the tree roots to hold the soil, winter rains eroded the hill and washed tons of soil and decaying vegetation into the river. What effect might this have on living organisms in and around the river?

SC.G.2.3.4

Livestock like cows and chickens are routinely given antibiotics along with their feed. The antibiotics reduce infections among the animals, and cause the animals to grow faster and put on more weight. The antibiotics used are the same ones used by humans to fight disease. What effect does this practice have on antibiotic resistance in bacteria?

SC.G.2.3.4
Sir Humphrey Davy once said, “Nothing tends so much to the advancement of knowledge as the application of a new instrument.” Which of the following instruments is NOT an appropriate example of Sir Humphrey Davy’s statement? **SC.H.1.3.1**

- F. antibiotics
- G. a satellite
- H. a microscope
- I. a mixing stick

Benjamin Franklin’s famous kite experiment led to the study of electricity and its uses. As time passed, more scientific discoveries were made concerning electricity and its properties, leading to current technology and continuing research. Describe how Franklin’s experiment helped develop the importance of electricity today. **SC.H.1.3.1**

Marcus is completing a science experiment for class. He wants to see what effect water temperature has on plants. If his experiment contains one independent variable, which of the following would NOT be a constant in his experiment? **SC.H.1.3.2**

- A. the type of plant used
- B. the water temperature
- C. the room temperature
- D. the pot used for the plants
Miranda performed an experiment to determine what makes an object sink or float in water. She experimented with 10 different items and recorded the results. Which of the following is correct? **SC.H.1.3.2**

- **F.** The object’s shape is the only determining factor.
- **G.** The size of the object determines if it will sink or float.
- **H.** The mass and volume of an object determine if it will sink or float.
- **I.** Light-colored objects tend to float more easily than darker-colored objects.

When Julian compares his physics lab report to Kate’s biology report, he realizes that they are different. Julian also notices that the same method of experiment was used in both labs. Why would Julian and Kate use the same method for different subjects? **SC.H.1.3.3**

- **A.** Both subjects use common scientific principles.
- **B.** Biology and physics use the same type of instruments.
- **C.** They have the same teacher who uses identical methods.
- **D.** They were both doing a lab on the effect of light on an organism based on mass.

Two students prepare lab reports, one for a physics class and the other for a biology class. Which of the following items will both reports contain? **SC.H.1.3.3**

- **F.** mathematical equations
- **G.** the results of an investigation
- **H.** measurements of energy levels
- **I.** the scientific name of an organism
A scientist studying cold medicines hypothesizes that one particular medicine is more effective than the others in the study. He attempts the experiment several times. Each attempt produces a different result. What should he do next? **SC.H.1.3.4**

A. The scientist should give up since consistent results are not happening.
B. He should change the data in his experiment in order to get the results he expected.
C. He should determine whether the variation in his results are important through further investigation.
D. He should prevent other scientists from attempting the experiment until he gets the result he expected.

A researcher has conducted an experiment 20 times, making measurements each time. Of the measurements, 18 are close to what the researcher’s hypothesis predicted, while two are very different. In the final report, the researcher considers not presenting the two extreme values. Would this be appropriate? Explain your answer. **SC.H.1.3.4**

Elaine is studying the effect of sleep deprivation on motorists. The chart below shows the reaction times of the drivers she studied.

What is the independent variable in Elaine’s study? **SC.H.1.3.5**

F. the reaction time of each motorist
G. the stopping distance of each automobile
H. the type of vehicle each motorist is driving
I. the number of hours each motorist was awake
Amelia is conducting an experiment to determine the effect of ultraviolet light on the growth of sunflowers. The graph below shows the results of her experiment.

According to the graph, what was the greatest growth Amelia observed?

SC.H.1.3.5

Arash was experimenting with mold on bread. He used four types of bread: wheat, white, rye, and pumpernickel. Arash placed each slice of bread in a darkened room with a stable temperature. He also placed the same four types of bread in a lit room at the same temperature as the dark room. Identify the two variables and explain how Arash could isolate each one.  

SC.H.1.3.5

Many natural cycles allow life on Earth to continue. One of them is the carbon cycle, which is the balance of carbon between the soil, the atmosphere, the oceans, and plant and animal ecosystems. What are two major ways humans are affecting the carbon cycle?  

A. building ocean resorts and flying airplanes  
B. changing land use and burning fossil fuels  
C. building roads and using boats on the oceans  
D. depleting the fish population and burning fossil fuels  

SC.H.2.3.1
The chart shows the tide cycle for Tampa Bay, Florida, in January. Using the chart as a guide, what would be the approximate time of low tide in the morning of Saturday, January 29? **SC.H.2.3.1**

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Low Tide</th>
<th>High Tide</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 24</td>
<td>Monday</td>
<td>4:00 A.M.</td>
<td>10:23 A.M.</td>
</tr>
<tr>
<td>January 25</td>
<td>Tuesday</td>
<td>4:43 A.M.</td>
<td>11:05 A.M.</td>
</tr>
<tr>
<td>January 26</td>
<td>Wednesday</td>
<td>5:24 A.M.</td>
<td>11:44 A.M.</td>
</tr>
<tr>
<td>January 27</td>
<td>Thursday</td>
<td>6:03 A.M.</td>
<td>12:22 P.M.</td>
</tr>
<tr>
<td>January 28</td>
<td>Friday</td>
<td>6:43 A.M.</td>
<td>12:59 P.M.</td>
</tr>
<tr>
<td>January 29</td>
<td>Saturday</td>
<td>1:37 P.M.</td>
<td></td>
</tr>
</tbody>
</table>

F. 6:25 A.M.  
G. 6:43 A.M.  
H. 7:25 A.M.  
I. 7:43 A.M.

When a new medication or technology is developed, scientists and society must evaluate the product's safety. Which of the following is an ethical way science and society work together to help balance the risks and benefits of a new medication? **SC.H.3.3.1**

A. If the risks are high, the new medication should be sold for less money.
B. Scientists should not experiment with medications that could have side effects in humans.
C. New medications should be released to the public without testing to relieve suffering as quickly as possible.
D. Scientists must openly test the new medication on animals and on humans before making it available to everyone.

In 1906, the first radio station began broadcasting radio waves. What has been a result for society of radio broadcasting? **SC.H.3.3.1**

F. Communication between individuals has become simpler.
G. Information about world events is spread more quickly.
H. Important astronomical observations have become possible.
I. Prediction of future weather changes became more reliable.
A light shines on several different materials. The angle at which the light bends in each material is measured and then used to calculate the index of refraction.

What is the independent variable in this experiment?
A. the angle
B. the material
C. the index of refraction
D. the strength of the light

Which of the following terms is NOT a type of galaxy?
F. binary
G. elliptical
H. irregular
I. spiral

Each beaker contains a sample of 30 milliliters (mL) of water. How do the samples differ?
A. The volume of water in A is greater than in B.
B. The water molecules in B move faster than those in A.
C. The specific heat of the water in B is greater than in A.
D. The average kinetic energy of the molecules in A is greater than in B.
A researcher is investigating the flow of energy through a certain ecosystem. He estimates the amount of energy taken in by the organisms in each level.

Based on the data, what percent of the energy from each level is lost as thermal energy to the environment?

An airplane traveling west at 620 kilometers per hour (km/h) flies into the jet stream. The jet stream is a current of rapidly moving air in the atmosphere. The jet stream at this location is moving east at 90 km/h. How does the force exerted by the jet stream affect the motion of the airplane?

F. It slows its velocity to 530 km/h eastward.
G. It slows its velocity to 530 km/h westward.
H. It increases its velocity to 710 km/h westward.
I. It changes its direction from westward to eastward.

Sandy wants to find the density of a brick. The mass of the brick is 2200 grams (g). The length of the brick is 20 centimeters (cm), the height is 10 cm, and the width is 6 cm. Find the density of the brick and explain the procedure you used.
Sinkholes commonly form in Florida’s landscape. They are more likely to occur where limestone is close to the surface. Which process is primarily responsible for sinkholes?

A. chemical weathering  
B. earthquakes  
C. hurricanes  
D. volcanoes

Venus is sometimes called Earth’s twin. However, Venus moves through the solar system differently than Earth does. The table lists the periods of rotation and revolution for each planet in terms of Earth time.

<table>
<thead>
<tr>
<th></th>
<th>Venus</th>
<th>Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period of revolution</td>
<td>225</td>
<td>365</td>
</tr>
<tr>
<td>Period of rotation</td>
<td>5833</td>
<td>24</td>
</tr>
</tbody>
</table>

How many times does Venus travel around the Sun during one Earth year? (Express your answer rounded to the nearest hundredth.)

Nitrogen cycles between the biotic and abiotic factors in an ecosystem. Which of the following organisms is primarily responsible for changing nitrogen into a usable form?

F. flowers of clover plants  
G. grasses growing in rich soil  
H. cows feeding on grass and other plants  
I. bacteria on the roots of a soybean plant
In the atmosphere, carbon dioxide is responsible for preventing some energy from escaping into space. This keeps temperatures on Earth stable enough to maintain life. Some human activities are increasing the amount of carbon dioxide in the atmosphere. Name two such activities and explain how they impact the environment.

In 1977, scientists discovered hot vents in the ocean floor that release heated water filled with chemicals. Entire ecosystems with a variety of organisms surround the vents. Some organisms in these ecosystems use chemicals instead of sunlight to make food.

How do you think such a discovery changed what scientists believed about life on Earth?
A researcher is investigating the effects of radiation on fruits and vegetables. Why is it important for the researcher to keep accurate notes about the research?

A. Accurate notes are required by law.
B. Accurate notes will lead to expected results.
C. Accurate notes will allow other researchers to replicate the results.
D. Accurate notes will stop others from conducting the same experiments.

The speed of a wave is 72 centimeters per second. The wavelength of the wave is 12 centimeters. What is the frequency of the wave in hertz?

A paramecium and an oak tree are both living organisms. How is the structure of the oak tree different from the structure of the paramecium?

F. The oak tree does not have cells.
G. The oak tree has specialized cells.
H. The oak tree does not have organs.
I. The oak tree does not have systems.
Light travels at an approximate speed of 300 000 kilometers per second. Jupiter is located 779 000 000 kilometers from the Sun. How many minutes does it take for light to travel from the Sun to Jupiter? Round your answer to the nearest minute.

On an overnight field trip, a student looked up at the night sky and saw two stars that seemed to have about the same brightness. Her teacher told her that one of the stars is much farther from Earth than the other. What could the student conclude about the actual brightness of these stars?

A. The closer star is brighter than the more distant star.
B. The more distant star is brighter than the closer star.
C. One of the stars is made to seem darker by the atmosphere.
D. The stars are equally bright, but the closer star appears earlier in the night sky.

The respiratory system of the human body is represented in the diagram below.

What is the function of the bronchi, lungs, and alveoli?
F. They move blood to the cells of the body.
G. They store gases that may be used by the cells.
H. They bring oxygen to the blood and remove carbon dioxide.
I. They use oxygen to release energy stored in foods produced by plants.
Posttest

18. Earth’s plates move slowly across its surface. What will result when two plates carrying continental crust collide?
   A. Mountains will form.
   B. A valley will be created.
   C. All land faults on Earth will be affected.
   D. One plate will be subducted back into the mantle.

19. The human heart pumps blood throughout the body. As the heart beats, it pushes blood through the blood vessels that lead to cells. The heart achieves this pumping from the muscles in its walls. Unlike other muscles of the body, heart muscles are involuntary. What structural level controls the beating of the heart?
   F. cell
   G. organ
   H. organ system
   I. tissue

20. Why does the flower’s stem look broken as it enters the water?
   A. The light waves bend as they pass from water into air.
   B. The light waves are reflected from the surface of the water.
   C. The amplitude of the light waves decreases as they enter the water.
   D. The light waves are absorbed by the water and do not pass through to the other side.
Car engines operate by burning gasoline to release stored energy. In most engines, only one-third of that energy can be used to move the car. What happens to the rest of the energy? 

F. It is converted into electricity.
G. It is wasted as thermal energy.
H. It is used to recharge the car’s battery.
I. It is destroyed during the burning process.

A widow’s peak is a hairline that comes to a point in the center of the forehead. The allele for a widow’s peak (W) is dominant over the allele for a straight hairline (w). Two parents who are heterozygous for a widow’s peak have children.

Based on a complete Punnett square, what percentage of the children is likely to have a straight hairline?

A. 0%
B. 25%
C. 50%
D. 100%

A person jumps from an airplane with a parachute. Which form of energy is decreasing as the person falls to the ground?

F. chemical
G. kinetic
H. nuclear
I. potential
A car is accelerating to enter a highway. It starts at zero meters per second (m/s) and reaches a speed of 20 m/s in 8 seconds (s).

What is the car’s acceleration in meters per second squared?

Kayla fills a glass with ice water. She places the glass outside on a hot summer day. In which direction does thermal energy flow?
A. from the ice into the water
B. from the water into the ice
C. from the ice to the outside air
D. from the glass to the outside air

On a hot, humid afternoon, warm air is forced upward along a cold front. What is the likely outcome of this event?
F. a clear sky
G. a dense fog
H. a snow shower
I. a thunderstorm
Humans obtain resources from the environment. Which of these natural resources is renewable?

A. solar energy
B. nuclear energy
C. energy from coal
D. minerals used in industry

Thaddeus is studying how loud noise would affect the rate at which alligators hatch. He will test three sets of eggs, each with a different noise volume but the same type of noise. His hypothesis will predict at what noise level alligators hatch the fastest. What data should he include when writing his hypothesis?

F. the number of eggs
G. the type of noise that will be used
H. the possible gender of each alligator
I. the environmental conditions surrounding the eggs

Monica is researching how photosynthesis depends on environmental conditions. Sebastian is researching how the length of a star’s life is related to its mass. Both began their projects by asking a question, proposing a hypothesis, and making a prediction. Based on their predictions, both are gathering data in hopes of reaching a conclusion that will support their hypothesis. How can these two researchers follow similar methods to investigate completely different topics?

A. They are conducting their research in similar labs.
B. They are using the same tools in their investigations.
C. They will report their findings to the same scientific board.
D. They are basing their research on common scientific principles.
A student is investigating the mechanical advantage of a ramp. She exerts several different input forces and determines the output force. Mechanical advantage is equal to output force divided by input force. She uses this relationship to make a graph of her results. The slope of the resulting line represents the mechanical advantage of the ramp. The student then changes the length of the ramp and repeats her procedure.

**Part A** What is the independent and dependent variable in this investigation?

**Part B** What variables does the student need to control? If she does not control these variables, how will they affect her results?
Snapdragon plants exhibit incomplete dominance. Knowing this, a scientist crosses a snapdragon plant with red flowers and a snapdragon plant with white flowers. What is the expected color of the flowers of the offspring plants?

F. green
G. pink
H. red
I. white

Many sea turtles use parts of the Florida coastline for nesting each year. Females come ashore at night, during the high tide, to lay their eggs. Once the eggs are covered, the female returns to the ocean. When the eggs hatch, the young turtles follow the light of the moon to walk across the beach and into the ocean.

Today all sea turtles found in United States waters are endangered or threatened. One reason is that people have built condominiums, hotels, homes, and businesses along the beach. How might this construction lead to the endangerment of the turtles?

________________________________________________________________________________________
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________________________________________________________________________________________
Ian wants to test how food deprivation on hamsters affects their ability to find food at the end of a maze. Ian has three hamsters and an identical maze for each hamster. Two variables are the length of deprivation of food before the hamsters start the maze and the type of food at the end of the maze. Explain how these variables might affect the hamsters and their search for the food at the end of the maze.

Many discoveries in science have been based on a previous discovery or invention. Which of these is NOT an example of this?

A. The invention of kites led to the invention of the airplane.
B. The discovery of the lever led to the invention of the shovel.
C. The discovery of electricity led to the invention of the microscope.
D. The discovery of mold that could kill bacteria led to the development of antibiotics.

Scientists excavating a tar pit find the fossil of a camel that lived approximately 36,000 years ago. The camel’s skeleton indicates that the camel was about 5 meters tall. Modern camels are about 3 meters tall. What does the fossil reveal about camels?

F. Camels are now extinct.
G. Camels have not changed.
H. Camels have become smaller.
I. Camels can survive in the desert.
Posttest

36. The picture below shows the structure of a nail. Nails grow as new cells form in the nail matrix. Which of the following biological processes causes new nail cells to form?

A. ketosis  
B. meiosis  
C. mitosis  
D. osmosis

37. A solution of water, red blood cells, and salts is mixed to have the composition of human blood. Over several hours the red blood cells gradually darken in color. When oxygen is bubbled into the solution, the cells turn a bright red. What happens when the red blood cells turn dark red?

F. The cells are losing salt to the solution.  
G. The cells are losing oxygen to the solution.  
H. The cells are losing hemoglobin to the solution.  
I. The cells are losing carbon dioxide to the solution.

38. A citrus farmer learned that the overnight temperature would drop below freezing. He then told his workers to spray the oranges with water so the water would freeze and protect the fruit. How would the ice protect the oranges from the freezing temperatures?

A. As the water freezes, the oranges’ energy increases as a reaction to the ice.  
B. The freezing temperatures transfer thermal energy through the ice to the oranges.  
C. As the water freezes, thermal energy is transferred to the oranges to keep them warm.  
D. The farmer should have put heaters next to the orange trees instead of spraying water on them.