

**Descriptions of Science Items
at Each Benchmark**

APPENDIX





Lower Quarter Benchmark Items

Earth Science

- B01 Interprets a diagram of the Earth's layers and identifies the center as the hottest.
- F05 Recognizes that there is less oxygen at high altitudes.
- H03 Recognizes that the moon is visible because of reflected sunlight.

Life Science

- B04 Recognizes that exercise causes an increase in breathing and pulse rates.
- C08 Recognizes the function of nerves in transmitting visual messages to the brain.
- D06 Recognizes the flower as the part of the plant from which seeds develop.
- E08 Recognizes that a human inherits traits from both parents.
- F03 Recognizes that sensory messages are interpreted in the brain.
- G09 Recognizes that traits are transferred to offspring through the sperm and egg.
- H02 Recognizes that vitamins are needed by the human body for normal functioning.
- X02A Demonstrates understanding of ecosystems by describing one role of trees in a rainforest.

Physics

- A10 Recognizes the necessity of reflected light for visibility of an object.
- B06 Recognizes that white surfaces reflect more light than colored surfaces.
- G07 Identifies the diagram depicting the correct arrangement of batteries in a flashlight.
- J04 Recognizes the relationship between surface area and evaporation rate.
- K19 Identifies the ray diagram that shows the path of light reflected from a vertical mirror.

Chemistry

- A09 Applies knowledge of the need of oxygen for burning to a practical situation to identify that fanning a fire provides more oxygen.
- C10 From its physical description, identifies a heterogeneous powder as a mixture (requires knowledge of scientific terminology).

Median Benchmark Items

Earth Science

- E09 Locates point when the temperature becomes colder from data presented in a time and temperature table.
- I16 Given a diagram of the Earth's water cycle, recognizes the Sun as the source of energy for the water cycle.
- J01 Recognizes that plates that make up Earth's surface have been moving for millions of years.
- J09 Extracts information from a table of planetary conditions to describe a condition hostile to human life.
- O14 Demonstrates knowledge of relative distance to explain why Jupiter, although bigger than Earth's moon, appears smaller when viewed from Earth.

Life Science


- A07 From a list of organs, identifies the heart as the organ not situated in the abdomen.
- D05 Recognizes that nerves carry sensory messages to the brain (requires knowledge of scientific terms).
- F01 Recognizes that feeding milk to its young is a defining characteristic of mammals.
- G08 Recognizes oxygen transport as the main function of red blood cells.
- H01 Distinguishes between bodily functions that are carried out by the blood and those that are not.
- L02 Recognizes that seedlings growing in a forest have large leaves to gather light for photosynthesis.
- L05 Recognizes that wolves place their scent on trees to mark their territory.
- R03D Applies knowledge of ecosystems to state one unwanted outcome of introducing a new species into a lake. (Partial credit)
- X02B Demonstrates understanding of ecosystems by describing one role of the Sun in a rainforest.

Physics

- A08 Recognizes that a compressed spring has more stored energy than an uncompressed one.
- C09 Identifies the apparent position of reflected image in a mirror on a diagram representing three dimensions.
- C12 Recognizes examples of fossil fuels.
- D02 Applies knowledge of magnetic properties to interpret diagram and identify substance based on its attraction to a magnet.
- D04 Recognizes that a given sequence of energy changes applies to gasoline burning to power a car.
- F02 Recognizes that a person feels cooler when wearing light-colored clothing because it reflects more radiation.
- I14 Applies knowledge that sound requires a medium to travel through by contrasting a situation on the Earth to a situation on the Moon.
- J08 From a list of radiation types, identifies ultraviolet as the form of solar energy that causes damage to the skin.
- L01 Identifies the diagram that shows the forces acting on a wheel that will result in rotation.
- M15 Applies knowledge of circular motion to identify the diagram that shows that an object will move in a straight line when released from a circular path.
- N01 Applies concept of electrical circuits and knowledge of conductors to identify diagrams that show a complete circuit.
- N09 Applies knowledge of levers to identify the diagram that shows the best way to balance two buckets of unequal weight.

Chemistry

- F06 Recognizes that painting iron prevents exposure to oxygen and moisture.
- M13 Given three diagrams depicting candles burning in open and closed jars, explains that the candles in the closed jars will be extinguished due to a lack of air. (Partial credit)



Environmental and Resource Issues

**Median
Benchmark Items
continued**

- A11 Recognizes that overgrazing leads to soil erosion.
- F04 Recognizes that soil erosion is more likely in barren sloping areas.
- P05D Provides one reason for why famine occurs. (Partial credit)
- W01A Describes a positive effect on farming of the presence of a dam upriver from the farm.

Scientific Inquiry and the Nature of Science

- O13 Extrapolates from data presented in a linear distance versus time graph.

Upper Quarter Benchmark Items

Earth Science

- A12 Applies knowledge of the effect of topography on river flow to identify the change in river shape and speed as it flows from a mountain to a plain.
- G11 Recognizes a definition of sedimentary rock.
- K15 Recognizes that fossil fuels were formed from the remains of living things.
- Q11 Recognizes the definition of an Earth year (time it takes the Earth to revolve once around the Sun).
- Q16 Applies knowledge of the relative distances of the Sun and Moon from Earth to explain why light from the Moon reaches Earth in less time.
- Z02 Demonstrates some knowledge of Earth's water cycle by drawing a diagram showing how water from the sea can fall as rain on land (includes three of four required steps: evaporation, condensation, transportation, precipitation). (Partial credit)

Life Science

- E10 Determines characteristic used to sort animals into two groups as presented in a 3 x 2 table.
- I12 Applies knowledge of the processes of photosynthesis and respiration to identify gases used up and given off by plants and animals in a forest ecosystem pictured in a diagram.
- J02 Recognizes that an external skeleton is a feature shared by all insects.
- K12 Applies knowledge of sexual reproduction process to draw a conclusion about how to control insect populations.
- L08 Applies knowledge of energy flow to complete a food web diagram.
- N03 Recognizes that bacteria are involved in converting milk to yogurt.
- N05 Demonstrates knowledge that plants need minerals, which can be obtained from bone meal used as fertilizer.
- O16 Describes the processes that take place in the human body to prevent it from overheating during exercise.
- O17 Demonstrates knowledge of contagious diseases by explaining why some people catch colds and others do not.

- Q17 Recognizes light absorption as the main function of chlorophyll.
- Y01 Provides a partial explanation of why the heart beats faster during exercise that includes physiological needs (eg., oxygen, carbon dioxide removal) or the role of the circulatory system (increased blood flow). (Partial credit)

Physics

- B02 Applies knowledge of energy conversion in a practical context to identify that an engine converts much of the chemical energy derived from burning gasoline to heat.
- E11 Applies scientific principle of the effect of distance on shadow size and interprets diagram to solve a quantitative problem involving the change in shadow size when the distance of the light source is increased.
- I13 Completes a brief table showing the relation between voltage and current.
- I15 Based on a diagram demonstrating an investigation of thermal conductivity, identifies that metal conducts heat faster than glass, wood, or plastic.
- M14 Given a three-dimensional diagram depicting an object placed at an angle to a mirror plane, draws the apparent position the reflected image.
- P01 Determines the speed of a car from data presented in a linear distance vs. time graph.
- Q13 Recognizes that the height of an alcohol column in a thermometer rises with increasing temperature because the alcohol expands more than the glass when heated.

Chemistry

- G10 Applies knowledge of the structure of matter to recognize that nothing remains of an object if all of its atoms are removed.
- H06 Recognizes that burning wood releases energy.
- J03 Identifies that sugars are compounds composed of molecules that are made up of atoms.
- K14 Recognizes that both burning coal and exploding fireworks release energy.

Chemistry continued

- M13 Given three diagrams depicting candles burning in open and closed jars, applies knowledge of burning to explain that the candle flame in the closed jar with the least amount of oxygen available will go out first.
- N07 From a list of chemical and physical changes, identifies rusting as a chemical reaction.
- Z01D Describes one consequence of applying a shorter galvanization process to produce steel beams. (Partial credit)

Environmental and Resource Issues

- C11 Recognizes the relationship between global warming and the increase in carbon dioxide levels in the atmosphere.
- G12 From a list of renewable and non-renewable energy sources, identifies coal as a non-renewable energy source.
- L07 Recognizes that insecticides become less effective over time because certain insects pass their resistance to the insecticide to their offspring.
- O10 States one reason why a hole in Earth's ozone layer may be harmful to people.
- W02D States two reasons why some people do not have enough drinking water, even though the surface of Earth has more water than land.

Scientific Inquiry and the Nature of Science

- I11 Given a report of an experiment, distinguishes an observation from a prediction, conclusion, theory or hypothesis.
- I20 Interprets data presented in a non-linear distance vs. time graph.
- K13 Identifies the diagram depicting an appropriate control for a given experimental setup (effect of soil conditions on plant growth).
- M12 Applies knowledge of experimental controls and interprets diagrams to identify variables to be controlled and varied in a described experiment (effect of height of ramp on speed of cart).
- N04 Identifies an appropriate conclusion from observations of evaporating liquids.

Top 10% Benchmark Items

Earth Science

- B05 Applies knowledge of patterns of prevailing winds and precipitation around a mountain to identify a dry region on a diagram of elevation and temperature.
- C07 Applies knowledge of the effect of weathering over time to interpret diagram and draw conclusion about the relative age of two mountain systems based on shape.
- D03 Interprets a contour map and identifies direction of river flow from higher to lower elevation.
- E12 From a list of rock types, identifies limestone as the type involved in the formation of underground caves.
- H04 Applies knowledge of soil composition and interprets diagram to identify the soil layer containing the most organic material.
- Z02 Demonstrates understanding of Earth's water cycle by drawing a diagram showing how water from the sea can fall as rain on land (includes all of four required steps: evaporation, condensation, transportation, precipitation).

Life Science

- I19 Recognizes the hierarchy of organization in living organisms (cell, tissue, organ, organism).
- K18 Demonstrates knowledge of structure/function by describing one advantage of having two ears.
- L03 Applies knowledge of the structure/function of animal characteristics to identify features belonging to animals that are preyed on by other animals.
- M11 Demonstrates knowledge of the properties of lenses by explaining how eye glasses and contact lenses help some people see more clearly.
- N06 Recognizes the definition of a tissue (group of cells with similar structure and function).
- N08 Recognizes that the ability to regulate body temperature explains why mammals are found in very cold regions of the world but lizards are not.

**Top 10%
Benchmark Items
continued**

Life Science continued

- P03 Applies knowledge of tree growth to explain why a nail placed in the trunk of a tree remained at the same level from the ground despite the increased height of the tree.
- P04 Recognizes that the rate of metabolism decreases during hibernation.
- P06 Names a digestive substance found in the stomach and describes its function.
- R03D Applies knowledge of ecosystems to state two unwanted outcomes of introducing a new species into a lake.

Physics

- D01 Identifies the ray diagram depicting light passing through a magnifying glass.
- J05 Applies knowledge of gravitational force by recognizing that gravity acts on a rocket at rest, while ascending, and when returning to Earth.
- L04 Given data on fuel consumption and work accomplished, determines and explains which of two machines is more efficient.
- N10 Applies knowledge of light reflection to explain why a white reflector shines more light toward a wall than a black reflector.
- Q12 Demonstrates an understanding that the surface of a liquid remains horizontal by drawing the level of the liquid on a frame-of-reference diagram depicting a tilted U-shaped container.
- Y02 Applies knowledge of phase change and the boiling point of water to explain that the temperature of water does not exceed its boiling point despite the addition of heat.
- Z03 Applies knowledge of gas pressure and thermal expansion to a practical situation to explain the effect of heat on the volume of a balloon.

Chemistry

- I10 From a list of gases, identifies oxygen as the gas that causes rust formation.
- K17 Recognizes that a compound results from a reaction between chlorine gas and sodium metal.
- M10 Distinguishes between mixtures and a pure substance (sugar).

Chemistry continued

**Top 10%
Benchmark Items
continued**

- O15 Recognizes that an ion is formed when a neutral atom gains an electron.
- Q14 Recognizes that when sugar is dissolved in water, the sugar molecules continue to exist, but in solution.
- Q15 Recognizes a phase change as not involving a chemical change.
- Z01A Applies knowledge of rusting in a practical context to explain why steel beams must be galvanized.

Environmental and Resource Issues

- P05D Provides two reasons for why famine occurs.
- R06 Recognizes that rising ocean levels could result from global warming.

Scientific Inquiry and the Nature of Science

- P07 Recognizes that repeated scientific measurements enable scientists to estimate experimental error.

Items Above the Top 10% Benchmark

Earth Science

- J06 Recognizes that the tilt of the Earth's axis is an important factor in explaining why the seasons occur.
- O12 Identifies the order of abundance in the Earth's atmosphere of nitrogen, oxygen, and carbon dioxide.
- R04 Demonstrates knowledge of how atmospheric conditions vary at different altitudes in a practical context.

Life Science

- I17 From a list of animals, identifies fish as having been on Earth for the longest period of time.
- J07 Recognizes that the best reason for including protein in a healthy diet is that it is the main source of raw materials for cell growth and repair.
- N02 Applies understanding of the interrelationships of organisms in a food web to explain what will most likely happen to a robin population when the corn crop fails.
- Y01 Provides an explanation of why the heart beats faster during exercise that includes physiological needs (eg., oxygen, carbon dioxide removal) and the role of the circulatory system (increased blood flow).

Physics

- B03 Uses mass and volume data presented in a table to determine which of four objects has the greatest density.
- E07 Recognizes that the nucleus of most atoms is composed of protons and neutrons.
- H05 Recognizes that energy stored in food comes from the sun.
- K10 Demonstrates knowledge of polarity of magnets by labeling poles on a diagram of a magnet cut into three pieces.
- P02 Demonstrates knowledge of light properties by providing an explanation for the same amount of light from a given source reaching surfaces at different distances.

Physics continued

**Items Above the
Top 10% Benchmark
continued**

- Q18 Applies the principle of conservation of mass during phase change to explain why the mass of water remains unchanged after it is frozen.
- R02 Applies knowledge of the relationship between absorption and reflection of light and the appearance of color to identify why a red object appears black in green light.
- X01 Applies knowledge of energy conversion to a practical situation to explain why the electrical energy used by a lamp is more than the amount of light energy produced.

Chemistry

- L06 Applies knowledge of the process of filtration and the difference between solutions and mixtures to identify a separable mixture.
- O11 Identifies a chemical change from examples of physical and chemical changes.
- R05 Applies knowledge of the need for oxygen or air for burning to a practical situation to explain why increased surface area increases the rate of combustion.
- Z01D Describes two consequences of applying a shorter galvanization process to produce steel beams.

Environmental and Resource Issues

- I18 States that sulfur dioxide produced by burning coal combines with water vapor in the atmosphere to form acid rain.
- K16 Recognizes that gases from burning fossil fuels are a principal cause of acid rain.
- W01B Describes a negative effect on farming of the presence of a dam upriver from the farm.

Scientific Inquiry and the Nature of Science

- K11 Identifies the diagram that shows the most appropriate thermometer scale for accurately measuring a given range of temperatures.
- R01 Demonstrates knowledge of experimentation by recognizing a tentative statement that is based on observations as a hypothesis.

**Items Above the
Top 10% Benchmark
continued**

Scientific Inquiry and the Nature of Science continued

- W03 Given a table of results from an investigation of how the length of a spring changes as different masses are hung from it, describes the relationship between mass and length.
- X03 Describes a complete procedure for investigating how long it takes the heart rate to return to normal after exercising.
- X03 Describes a partial procedure for investigating how long it takes the heart rate to return to normal after exercising. (Partial credit)
- Y03 From a description of an experiment investigating the effect of dissolved salt on the freezing point of water, states the problem under investigation or a conclusion based on prior knowledge.