

Appendix E

Descriptions of Science Items at Each Benchmark

Exhibit E.1: Descriptions of Science Items at Each International Benchmark



Items at Low International Benchmark (400)

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Life Science

- S01_02 Recognizes that a human inherits traits from both parents.
- S02_02 Recognizes the function of nerves in transmitting visual messages to the brain.
- S03_03 Recognizes that traits are transferred to offspring through the sperm and egg.
- S07_01 Identifies the circulatory system using a list of its components.

Chemistry

- S02_04 From its physical description, identifies a heterogeneous powder as a mixture (requires knowledge of scientific terminology).

Physics

- S03_01 Identifies the diagram depicting the correct arrangement of batteries in a flashlight.
- S07_06 Given the definition of work, identifies a diagram that shows that work being done.
- S09_08 Recognizes that evaporation is the process that takes place when clothes dry.

Earth Science

- S03_11 Demonstrates knowledge of relative distance to explain why Jupiter, although bigger than Earth's moon, appears smaller when viewed from Earth.

Environmental Science

- S14_06 Predicts a long-term effect of cutting down trees on the environment.

Items at Intermediate International Benchmark (475)

Life Science

- S03_14 Demonstrates knowledge of contagious diseases by explaining why some people catch colds and others do not.
- S06_09 Recognizes a characteristic that is found only in mammals.
- S09_01 Recognizes that gills have the same function the lung.
- S11_01 Recognizes which cells destroy bacteria that enter the body.

Chemistry

- S02_09 Applies knowledge of the need of oxygen for burning to a practical situation to identify that fanning a fire provides more oxygen.

Physics

- S02_03 Identifies the apparent position of reflected image in a mirror on a diagram representing three dimensions.
- S02_08 Recognizes that a compressed spring has more stored energy than an uncompressed one.
- S02_10 Recognizes the necessity of reflected light for visibility of an object.
- S02_13 States why a nail becomes warmer when pulled out of a wooden board.
- S03_10 Extrapolates from data presented in a linear distance versus time graph.
- S04_06 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.
- S05_05 Applies knowledge that sound requires a medium to travel through by contrasting a situation on Earth to a situation on the Moon.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark (Continued...)



Items at Intermediate International Benchmark (475) – Continued

Earth Science

- S01_03 Locates a point when the temperature becomes colder from data presented in a time and temperature table.
- S02_06 Recognizes examples of fossil fuels.
- S05_07 Given a diagram of Earth's water cycle, recognizes the Sun as the source of energy for the water cycle.
- S09_11 Identifies the sun as a star.
- S11_10 Given a starting point, orders the processes involved in the water cycle.
- S13_02 Draws the position of the Moon relative the Sun and Earth during a solar eclipse.
- S13_06 Uses knowledge of gravity to recognize that objects fall towards the center of Earth.

Environmental Science

- S04_07A Describes a positive effect on farming of the presence of a dam upriver from the farm.
- S04_07B Describes a negative effect on farming of the presence of a dam upriver from the farm.
- S12_12 States how a volcanic eruption impacts the environment.
- S12_13 Identifies from a list of common materials that paper breaks down fastest.

Items at High International Benchmark (550)

Life Science

- S01_04 Determines characteristic used to sort animals into two groups as presented in a 3 x 2 table.
- S01_10 Identifies the diagram depicting an appropriate control for a given experimental setup (effect of soil conditions on plant growth).
- S02_07 From a list of organs, identifies the heart as the organ not situated in the abdomen.
- S02_14 Given that a community consists of mice, snakes, and wheat plants, explains what will happen to the mice and wheat plants if the snakes are killed.
- S03_02 Recognizes oxygen transport as the main function of red blood cells.
- S03_13 Describes the processes that take place in the human body to prevent it from overheating during exercise.
- S04_02 Demonstrates knowledge of the properties of lenses by explaining how eye glasses and contact lenses help some people see more clearly.
- S05_03 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.
- S06_07 Recognizes light absorption as the main function of chlorophyll.
- S06_10 Recognizes that comparing genes can determine whether two people are related.
- S06_13 Recognizes that cheese contains fat.
- S08_04 States one function of the uterus.
- S09_04 Recognizes that the joining of sperm and egg takes place during fertilization in animals.
- S11_02 Interprets graph showing a sudden drop in the size of a population of antelope and recognizes that loss of food supply is most likely to have caused this sudden drop.
- S11_04 States why exercise is important for good health.
- S12_02 Explains that an acquired characteristic such as the loss of a kidney cannot be passed onto the next generation.
- S12_03 Explains that camouflage helps snails avoid predators.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark (...Continued)



Items at High International Benchmark (550) – Continued

Life Science – Continued

- S13_08B States one effect the introduction of goats could have on animals and plants already living in an area.
- S14_08A Completes the food web of ocean ecosystem based on information given in a table that lists a number of species and how they obtain their energy.

Chemistry

- S03_04 Applies knowledge of the structure of matter to recognize that nothing remains of an object if all of its atoms are removed.
- S04_04 Given three diagrams depicting candles burning in open and closed jars, explains that the candles in the closed jars will be extinguished due to lack of oxygen.
- S05_02 Given a report of an experiment, distinguishes an observation from a prediction, conclusion, theory or hypothesis.
- S07_04 Interprets data in a table of physical properties to identify iron, water, and oxygen.
- S07_05 Identifies vinegar as an acidic solution.
- S12_04 Recognizes the graph that most likely shows the effect of temperature on the solubility of sugar in water.
- S12_05 Explains what causes a balloon to inflate when sodium bicarbonate in the balloon mixed with vinegar.
- S13_03 Using a four-step decision diagram showing the steps used to separate iron filings, cork, sand, and salt from a mixture, identifies which component is separated by magnetism, floating/sinking, filtering, and evaporation.

Physics

- S01_05 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.
- S01_07 Demonstrates knowledge of polarity of magnets by labeling poles on a diagram of a magnet cut into three pieces.
- S01_16 Identifies the ray diagram that shows the path of light reflected from a vertical mirror.
- S04_05 Given a three-dimensional diagram depicting an object placed at an angle to a mirror plane, draws the apparent position the reflected image.
- S04_12A Draws the compass needle under the influence of a magnet and labels the poles of the compass needle.
- S04_12B Explains why a compass needle was drawn in a particular orientation under the influence of a magnet.
- S05_04 Completes a brief table showing the relation between voltage and current.
- S05_06 Based on a diagram demonstrating an investigation of thermal conductivity, identifies that metal conducts heat faster than glass, wood, or plastic.
- S05_11 Interprets data presented in a non-linear distance vs. time graph.
- S05_13 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.
- S05_14 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.
- S06_02 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.
- S06_03 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.
- S08_08 Identifies conduction is the process by which heat is transferred along a metal rod.
- S09_09 Explains why lightning is seen before thunder is heard.
- S09_10 Recognizes that a helium balloon rises because the density of helium is less than the density of air.
- S12_14 Recognizes the gas molecules move faster when temperature increases.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark (Continued...)



Items at High International Benchmark (550) – Continued

Earth Science

- S01_12 Recognizes that fossil fuels were formed from the remains of living things.
- S02_12 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.
- S03_05 Recognizes a definition of sedimentary rock.
- S04_11 Recognizes that Earthquakes and volcanic activity occur along the boundaries of tectonic plates.
- S06_01 Recognizes the definition of an Earth year (time it takes Earth to revolve once around the Sun).
- S06_06 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.
- S08_10A Interprets a contour map to recognize a topographical representation of a mountain top.
- S12_10 Recognizes the main difference between planets and moons.
- S12_11 Given a diagram showing whether conditions at different elevations on a mountain, identifies the most likely location of a jungle.

Environmental Science

- S02_05 Recognizes the relationship between global warming and the increase in carbon dioxide levels in the atmosphere.
- S02_11 Recognizes that overgrazing leads to soil erosion.
- S03_07 States one reason why a hole in Earth's ozone layer may be harmful to people.
- S04_08 States two reasons why some people do not have enough drinking water, even though the surface of Earth has more water than land.
- S06_11 Predicts one effect a new dam could have on wildlife.
- S09_13 Recognizes that using public transportation can help reduce air pollution.
- S11_11 Recognizes what soil change is due to a natural cause rather than human activity.
- S13_04 Distinguishes renewable from non-renewable energy sources.

Items at Advanced International Benchmark (625)

Life Science

- S01_09 Applies knowledge of sexual reproduction process to draw a conclusion about how to control insect populations.
- S01_15 Demonstrates knowledge of structure/function by describing one advantage of having two ears.
- S05_10 Recognizes the hierarchy of organization in living organisms (cell, tissue, organ, and organism).
- S07_02 States one structure that is found in plant cells but not in animal cells.
- S07_03 Given that chlorophyll is needed for photosynthesis, states two other factors that are needed.
- S08_01 Identifies food source as a criterion for classifying animals into two groups.
- S08_02 Recognizes that organisms that are producers use energy from the sun to make food.
- S09_03 Explains that photosynthesis takes place when light is shone on a plant and/or recognizes that the gas given off is oxygen.
- S09_05 Recognizes that fossils found in the oldest layers of sedimentary rock are formed from organisms that lived in the sea.
- S10_01 Recognizes that leafy vegetables are a good source of minerals.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark (...Continued)



Items at Advanced International Benchmark (625) – Continued

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Life Science – Continued

- S10_03 Recognizes that chemical elements recycle back into the environment when animals/plants die.
- S11_03 Compares two diagrams showing a pair of eyes and recognizes light as the environmental condition that causes the difference and recognizes that more light results in smaller pupils.
- S12_06 Recognizes that vaccines provide the body with long-term immunity.
- S13_07 Chooses plants or animals as the likely first inhabitants of an island and explains why.
- S13_08A States one effect the introduction of cats could have on animals and plants already living in an area.
- S13_09A Interprets two bar charts showing the distribution of beak depths of two species of birds and describes how the beak depths compare.
- S13_09B Using the information from two bar charts showing the distribution of beak depths of two species of birds, relates the size of seeds they eat to beak depth.
- S14_09 From diagrams showing organisms that live in the intertidal zone, selects one organisms, identifies and explains how a physical feature or behavior that helps it to survive low tide.
- S14_10 States two conditions that are found at the bottom of the ocean that make it difficult for most organisms to live there.

Chemistry

- S01_01 Recognizes that the nucleus of most atoms is composed of protons and neutrons.
- S01_11 Recognizes that both burning coal and exploding fireworks release energy.
- S03_12 Recognizes that an ion is formed when a neutral atom gains an electron.
- S04_01 Distinguishes between mixtures and a pure substance (sugar).
- S05_01 From a list of gases, identifies oxygen as the gas that causes rust formation.
- S06_04 Recognizes that when sugar is dissolved in water, the sugar molecules continue to exist, but in solution.
- S06_05 Recognizes a phase change as not involving a chemical change.
- S06_12 Recognizes that electrical conductivity has been used as a criterion to classifying materials into two groups.
- S08_05 Recognizes which diagram best represents the structure of water molecules.
- S09_06 Recognizes that water should be added to a saline solution to make it half as concentrated, and determines the amount.
- S09_07 Explains why litmus paper does not change color in a mixture of the right proportion of hydrochloric acid and sodium hydroxide.
- S10_07 Calculates the density of a metal in a block given the block's mass and length of its size.
- S10_10A Compares the previously computed density of a block of metal to the densities of different metals presented in a table and infers what the metal is and explains their answer.
- S11_06 Identifies a property of metals and describe how this property can be used to determine whether an unknown substance is a metal or nonmetal.
- S13_01 Identifies which of oxygen, hydrogen, and water are elements.
- S14_02 Based on an incomplete table comparing pure water and salt water, explains that addition of salt increases the density.

Physics

- S04_03 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).

Items at Advanced International Benchmark (625) – Continued

Physics – Continued

- S07_07 Recognizes that mass is conserved during thermal expansion.
- S07_08 Recognizes plucking a guitar string harder causes the volume to increase but does not effect the pitch.
- S08_07 Interprets a circuit diagram recognizes that the current flows through two bulbs is the same.
- S10_08 Describes water displacement as a procedure to find the volume of an irregularly shaped object.
- S10_09A Explains why scientists do repeated measurements.
- S10_09B Describes how scientists use the combined results from five trials to obtain a mean value.
- S11_09 Recognizes that the force of gravity acts on a person regardless of position and movement.
- S12_08 Recognizes that railway tracks are laid down with gaps between lengths to allow expansion on hot days.
- S12_09 Predicts the effect of removing air on the propagation of sound.
- S13_05 Describes that a spectrum can be seen when sunlight passes through by a glass prism.
- S14_03 Recognizes that particles of a liquid are slower and closer together than particles of a gas.
- S14_04 Recognizes that an iron nail becomes magnetized when current flows through a wire coiled around the nail.

Earth Science

- S01_06 From a list of rock types, identifies limestone as the type involved in the formation of underground caves.
- S07_09 Relates the tilt of Earth's axis as it orbits the Sun to the seasons.
- S08_09 Recognizes what is a cause of tides.
- S08_10B Draws the path and direction of a river on a contour map from a mountain to a bay.
- S09_12 Given a table showing information about Venus and Mercury, recognizes that the higher average surface temperature on Venus is due to the greenhouse effect.
- S10_04 Interprets a map of the world showing latitude and recognizes to areas of similar average yearly temperature.
- S10_05 Relates the phases of the Moon to its motion around Earth.
- S11_12 Describes changes in atmospheric conditions that occur with increasing elevation.
- S14_01 Recognizes the percentage of total water on Earth that is fresh water.
- S14_05A Identifies and explains a physical process that can cause weathering of rocks.

Environmental Science

- S03_06 From a list of renewable and non-renewable energy sources, identifies coal as a non-renewable energy source.
- S05_09 States that sulfur dioxide produced by burning coal combines with water vapor in the atmosphere to form acid rain.
- S06_14A Describe how science and technology can be used to address oil spills in the oceans.
- S07_11 Interprets the data in a table to describe the effect of the amount fertilizer on the yield of rice.
- S07_12 States one reason why the human population increased rapidly over the last 200 years.
- S08_11A Based on demographic and other information about two countries, predicts how their population will change over time.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark (...Continued)



Items at Advanced International Benchmark (625) – Continued

Environmental Science – Continued

- S08_11B Given a table showing the demographic, grain production, oil consumption about two countries, predicts how a change in population in each country will affect the land use over the next 10 years.
- S08_11C Given a table showing the demographic, grain production, oil consumption about two countries, predicts how a change in population in each country will affect the pollution over the next 10 year.
- S10_06 States one renewable energy source and describes one way it can be used.
- S11_13 Recognizes that the increase in algal growth in a lake is most likely due to fertilizer runoff.

Items Above the Advanced International Benchmark (625)

Life Science

- S04_10 Recognizes that cats are more closely related to whales than birds or reptiles.
- S05_08 From a list of animals, identifies fish as having been on Earth for the longest period of time.
- S05_12 Provides a partial explanation of why the heart beats faster during exercise that includes physiological needs (e.g., oxygen, carbon dioxide removal) or the role of the circulatory system (increased blood flow).
- S08_03 Given that seeds can germinate in the light and dark, states two conditions needed for germination of seeds.
- S10_02 Recognizes that the absorption of food into the blood stream mainly takes place in the small intestine.
- S12_01 Recognizes that the purpose of cellular respiration is to provide energy for cell activities.
- S13_10 Compares two graphs showing different overlap between the distribution of beak size for two species and infers less overlap is the most favorable situation for both species to survive due to reduced competition for food.
- S14_08B Based on a completed food web, predicts and explains what is most likely happen to a population of sharks when tuna are over-fished.

Chemistry

- S01_14 Recognizes that a compound results from a reaction between chlorine gas and sodium metal.
- S03_08 Identifies a chemical change from examples of physical and chemical changes.
- S08_06 States one thing that could be observed that shows energy has been released during a chemical reaction.
- S10_10B Compares a given density of a metal crown to the densities of different metals shown in a table and infers the composition of the crown.
- S11_05 Recognizes the concept map that best represents the particulate structure of matter going from molecules to atoms to subatomic particles (protons, neutrons, and electrons).

Physics

- S01_08 Identifies the diagram that shows the most appropriate thermometer scale for accurately measuring a given range of temperatures.
- S04_09 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.
- S06_08 Applies the principle of conservation of mass during phase change to explain why the mass of water remains unchanged after it is frozen.
- S11_07 Recognizes a sequence of energy conversion that takes place in a battery-operated flashlight.
- S11_08 Interprets a diagram showing air and water in a sphere attached to a U-tube and explains that how heating the air can cause the water level in the open tube to rise.
- S12_07 Recognizes that when traveling from a mountain top to a valley, a closed empty plastic bottle collapses because the air pressure is higher in the valley is higher than on the mountain top.

Exhibit E.1: Descriptions of Science Items at Each International Benchmark

**Items Above the Advanced International Benchmark (625) – Continued****Earth Science**

- S02_01 Applies knowledge of the effect of weathering over time to interpret diagrams and draw conclusion about the relative age of two mountain systems based on shape.
- S03_09 Identifies the order of abundance in Earth's atmosphere of nitrogen, oxygen, and carbon dioxide.
- S07_10 Recognizes that most fresh water on Earth is located in the polar ice caps.
- S14_05B Identifies and explains a chemical process that can cause weathering of rocks.

Environmental Science

- S01_13 Recognizes that gases from burning fossil fuels are a principal cause of acid rain.
- S06_14B Describes how science and technology can be used to address global warming due to increased levels of carbon dioxide in the atmosphere.
- S09_02 Describes a procedure that includes evaporation and condensation that can be used to obtain drinking water from sea water.
- S14_07 Recognizes the graph that shows the increasing rate of human population growth over the last 200 years.

Exhibit E.2: Descriptions of Science Items at Each International Benchmark



Low International Benchmark (400) Items

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Life Science

- S01_09 Identifies a food in a list of edible and inedible plants.
- S02_02 Recognizes that washing hands of germs prevents illness.
- S02_05 Recalls information that air enters the lungs.
- S02_06 Interprets a diagram and identifies roots as plant part responsible for water uptake.
- S02_10 Identifies an animal that does not lay eggs in a list of familiar animals.
- S03_04 Communicates an effect of environmental change (temperature) on aquatic life.
- S03_06 Identifies the herbivore in a list of familiar animals.
- S03_11 Interprets a diagram and reasons from everyday experience to identify teeth used for grinding.
- S04_01 From a diagram showing insects and young insect forms, recognizes that the butterfly is correctly paired with its larvae.
- S07_04 Recognizes from diagrams of animals which is most likely to live in a desert.
- S08_02 Recognizes which foot structure belongs to a bird that lives in a pond.
- S08_05 Recognizes that tadpoles hatch from frogs' eggs.
- S09_01 Given a diagram, recognizes insects by presence of six legs.
- S11_07 Recognizes that birds sit on their eggs to keep the eggs warm.
- S12_01 Recognizes wolves as a predator.
- S12_02 Recognizes that fat layers help keeping a walrus warm.
- S12_03 Recognizes that wings are common to bird, bats, and butterflies.

Physical Science

- S01_01 Recalls information about attraction of iron to magnets.
- S01_05 From a diagram of floating objects, identifies the heaviest object.
- S02_01 Recognizes that water changes into vapor during boiling.
- S02_09 Recognizes physical conditions required causing rainbows (sunlight, rain).
- S03_05 Recognizes that the weight of an object does not change depending on its orientation on a scale.
- S07_06 Recognizes that iron nails rust.
- S09_05 Given diagrams showing a lightbulb connected to a battery, recognizes in which one the bulb will light.
- S10_08 Recognizes that sugar dissolves in water.
- S11_08 Recognizes that an iron nail can complete an electrical circuit and allow a bulb to blow.

Earth Science

- S01_10 Recalls knowledge of Earth's annual revolution around sun.
- S02_11 Interprets a diagram of the Earth's layers and identifies the center as the hottest.
- S03_02 Recalls knowledge that the sun is the hottest celestial body in the solar system.
- S03_08 Identifies oxygen as gas needed for breathing.

Items at Low International Benchmark (400) – Continued**Earth Science – Continued**

- S05_09A States the names of two seasons.
- S06_07 Explains why people should not drink water directly from oceans and seas.

Items at Intermediate International Benchmark (475)**Life Science**

- S01_07 Recognizes that excess food is stored as fat.
- S04_03 Given four diagrams, recognizes types of plants that usually found in a tropical rain forest.
- S06_01 Recognizes that snakes shed their outer covering as they grow larger.
- S06_03 Recognizes from diagrams of bird which is most likely to eat mammals.
- S07_01 Recognizes that trees make their own food using sunlight.
- S07_05 Recognizes from a picture of two types of seed that they are scattered by wind.
- S09_02 States one thing that can happen to human body if it is not protected from the sun.
- S09_03 Recognizes a group consisting only of living things.
- S09_06 Given a diagram of six organisms, classifies them into those that give birth and those that lay eggs.
- S10_03 In a diagram of a pond community, recognizes that tadpoles get their food from plants.
- S10_07 Recognizes that larvae found in a bag of rice likely come from eggs laid by insects.
- S13_07A Combines information from a plan of a garden and a diagram showing plants and their light requirements, explains why roses would not grow well under an oak tree.
- S14_05 Recognizes that a person's hair type can be predicted by his/her parents' hair type.
- S14_06 Interprets from a food chain that snakes eat voles.

Physical Science

- S01_03 Recalls knowledge that plant matter (apple core) will decay.
- S03_01 Recognizes that air is contained inside soap bubbles.
- S03_10 Recognizes that copper is a good heat conductor.
- S04_08A Given that a material (solid, liquid, or gas) is put into a larger container, recognizes the state of the material from the shape it takes in the larger container.
- S05_05A States one way water in ice form is used by humans.
- S05_05B States one way water in liquid form is used by humans.
- S08_07 Recognizes that salt water is a mixture.
- S08_08 From a list of common materials, indicates which of them will burn.
- S09_07A States one object that is made out of metal.
- S12_07 States two things that electricity can be used for in daily life.
- S13_01 Recognizes that all objects have mass.
- S13_04 Recognizes that a candle in the largest sealed container will be the last to go out.
- S14_02B Given from a diagram showing the color of a white shirt appears to be under different colored light bulbs, infers its color under blue light.

Exhibit E.2: Descriptions of Science Items at Each International Benchmark (...Continued)



Items at Intermediate International Benchmark (475) – Continued

Earth Science

- S01_02 Recalls information about the saltiness of ocean water.
- S01_06 Recalls fact to identify that water covers most of Earth's surface.
- S01_08 Recalls fact about location of fossils in rocks.
- S01_11 Interprets textual description and diagrams of rock abrasion observations to identify the hardest rock.
- S04_09 Given diagrams showing rocks of different shapes and sizes, recognizes which rock has been carried furthest down the river.
- S05_09B States one difference between two previously named seasons.
- S06_08 States one different between the Sun and the Moon.
- S07_11 States two different things human use wood for.
- S13_02 Recognizes that the minerals needed to make things come from rocks.
- S14_08 Orders diagrams showing ribbons on holes by decreasing wind strength.

Items at High International Benchmark (550)

Life Science

- S01_04 Recognizes that sensory messages are interpreted in the brain.
- S03_03 Recognizes that exercise causes an increase in breathing and pulse rates.
- S05_03 Using knowledge of teeth, identifies and explains which of two skulls shows an animal that ate plants and which shows an animal that ate meat.
- S06_04A States one physical feature or behavior of fish that distinguishes them from sea mammals.
- S10_05 Recognizes that plants are living things and gives a reason.
- S11_01 Recognizes from a list of animals that humans have a young form that looks most like the adult form.
- S11_03 From pictures of animals, pairs each animal with its distinguishing biological characteristics (skeleton, milk production, number of legs).
- S12_04 States one thing can cause the temperature of the human body to be higher than normal.
- S13_05B States one thing plants need in addition to light and water in order to grow well.
- S13_08 Infers from a picture of plants and its seed, how the seeds are spread.
- S14_04 Recognizes that the teeth of monkeys are most like the teeth of humans.

Physical Science

- S05_06 From a diagram showing a metal ruler heated at one end, recognizes the direction of heat transfer starting from the heated end.
- S05_07 From a diagram showing a person blowing into water using a straw, explains why bubbles rise to the top.
- S06_05 Recognizes that the hotter the water the more sugar will dissolve.
- S06_06A Describes how a liquid can be turned into a gas.
- S06_06B Describes how a liquid can be turned into a solid.
- S07_07 From a diagram showing three powders, recognizes those likely to be mixtures.
- S07_08 Given a set of diagrams, recognizes that ice melts most slowly in the closed container.

Items at High International Benchmark (550) – Continued

Physical Science – Continued

- S10_10 Describes one difference between solids and liquids.
- S11_05 Recognizes that metal spoon in hot soup feels hotter than a wooden spoon in hot soup, because metal conducts heat better than wood.
- S11_09 Recognizes that gravity causes an object to fall to the ground.
- S14_01C From an investigation of the effect of different colored light on the apparent color of a shirt, infers the color of an unknown light bulb.
- S14_02A Describes the results of an investigation involving white shirt seen under different colored light bulbs.

Earth Science

- S02_07 Interprets pictorial diagram and identifies angle/length of shadow cast by sunlight.
- S07_09 Explains that early morning moisture can be due to condensation.
- S09_09 From a diagram showing a variety of landscape features, recognizes the best location for growing crops.
- S10_04 Explains that when moist air becomes very cold, water in the air condenses or freezes.
- S12_10 Identifies the Earth, Moon, and Sun from a diagram.

Items at Advanced International Benchmark (625)

Life Science

- S04_02 States one thing human body does to cool down during exercise.
- S04_04 Describes one physical change, other than growing taller and becoming heavier, that takes place in children's bodies as they become adults.
- S05_01 Recognizes a group of animals that are all mammals.
- S05_04 Recognizes that the energy needed to heal a cut comes from food.
- S06_02 States two reasons why humans need a skeleton.
- S06_04B States one physical feature or behavior of sea mammals that distinguishes them from fish.
- S07_02 Explains that the last surviving member of a species of a turtle cannot reproduce and gives a reason.
- S08_01 Recognizes from a list of foods that cheese is the best source of calcium.
- S08_04 Recognizes that differences in light brightness cause eyes in one picture to look different from the eyes in a second picture.
- S10_01 Recognizes that flowers are yellow because the flowers of the parent plant are yellow.
- S10_06 States two ways a cold can be transmitted.
- S11_02 Recognizes that if the only remaining Siberian Tigers are female, they will not be able to reproduce, and will die out.
- S12_11 Describes two human activities that can lead to the extinction of animals.
- S13_07B Combines information from a plan of a garden and a diagram showing plants and their light requirements, to complete a table listing plants that would grow well in different areas of the garden.
- S13_09 Explains why some insects are important for flowering plants.

Physical Science

- S03_07 Distinguishes between renewable and non-renewable energy sources.

Exhibit E.2: Descriptions of Science Items at Each International Benchmark (...Continued)



Items at Advanced International Benchmark (625) – Continued

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2003

Physical Science – Continued

- S04_05 Interprets information from a table of physical properties of three materials to identify wood, rock, and iron.
- S04_07 Recognizes from four diagrams the two diagrams that show two magnets repelling each other.
- S08_10 From a diagram showing two magnets on carts with the magnet poles marked, describes what happens to the carts when they are moved close together and let go.
- S10_11 Recognizes that magnetism and not gravity can make objects repel each other.
- S11_04 Recognizes that fine salt dissolves faster in water than coarse salt and explains why.
- S11_06 Names one thing that shows that sunlight being made up of different colors.
- S12_05 From a table showing the results of an experiment, identifies what was being studied in the experiment.
- S12_06 Recognizes the diagram that best shows how ice flows in water.
- S12_08 Recognizes that heat needs to be supplied for melting and boiling but not for freezing.
- S13_03 Identifies the two things wrong with a diagram showing the shadow of a man and the location of the sun.
- S14_01A Describes the results of an investigation involving red shirt seen under different colored light bulbs.
- S14_01B From an investigation of the effect of different colored light on the apparent color of a shirt, concludes that the shirt looks different under different lights.

Earth Science

- S02_03 Applies knowledge of Earth's features to interpret a diagram and indicate the direction of river flow from mountains to sea.
- S03_09 Recognizes that metals are found in rocks.
- S05_08 Recognizes that the Moon can be seen because it reflects the light from the Sun.
- S07_10 Recognizes that fossils are evidence that land was once discovered by the sea.
- S08_03 Describes two things people can do to avoid wasting water.
- S09_08 Interprets table of temperature and cloud cover data to predict location where it snowed.
- S11_11 Recognizes a soil change due to natural causes.
- S12_09 Recognizes that soil rich in decaying plants and animals makes plants grow.
- S13_06 From a plan of a house and garden showing North, South, East, and West, identifies the side of the house that receives the most sun in the morning and explains why.

Items Above the Advanced International Benchmark (625)

Life Science

- S02_04 Recognizes that a person's adult height is affected by the height of their parents.
- S05_02 Predicts whether different types of plants can reproduce and justify answer.
- S07_03 Evaluates and explains best experimental setup for investigating effect of salt on seaweed.
- S09_04 Describes functions of the skin.
- S10_02 Recognizes from a picture of an animal that lives in a hot desert that its large ears help it lose heat.
- S13_05A Explains why plants need light to grow.
- S14_07 Evaluates and supports argument for the need for a balanced diet.

Exhibit E.2: Descriptions of Science Items at Each International Benchmark

SCIENCE
Grade 4**Items Above the Advanced International Benchmark (625) – Continued****Physical Science**

- S04_06 Applies knowledge that water expands when it freezes to a practical problem.
- S04_08B Explains predicted volume and shape of solid, liquid and gas when transferred to different containers.
- S08_09 Determines changes in temperature when a hot object is put into cold water.
- S09_07B Gives an example of a property and use of metal object.
- S10_09 Identifies rusting as an example of a chemical change that produces different materials.
- S14_03 Predicts and explains color of blue shirt under blue light.

Earth Science

- S08_11 Relates day and night on Earth to rotation on its axis.
- S09_10 Recognizes that a full moon occurs about once a month.
- S11_10 Describes activities that require air.