Appendix 15D: Grade 8 Science Item Descriptions Developed During the TIMSS 2019 Benchmarking

Items at Low International Benchmark (400)	
Biology	
S11_04	Describes one characteristic of mammals that is advantageous for survival in cold weather (1 of 2 points)
S01_01	States one reason why male penguins' incubation behavior helps their eggs survive (1 of 2 points)
S13_01B	Uses a food web to identify which organisms eat only plants
Chemistry	
S10_10	Identifies the form of wood that will burn fastest based on its size (1 of 2 points)
Physics	
S11_15	Recognizes whether an electromagnet would attract objects made of various materials
Earth Science	
S10_15	States what must be removed from clean ocean water in order for a person to be able drink it

Items at Intermediate International Benchmark (475)	
Biology	
S12_03	Matches 4 of 5 organism groups to defining biological characteristics (1 of 2 points)
S09_04	Justifies an advantage of hollow bones for birds
S14_01	Evaluates a diagram to identify an advantage of a fish's field of vision
S06_04A	Identifies one way that plant and animal cells are similar (1 of 2 points)

S13_04	Recognizes the functions of 2 of 4 tissues found in the human stomach (1 of 2 points)
S06_02	States one substance plants obtain from their environment and use in photosynthesis (1 of 2 points)
S09_03	Recognizes characteristics inherited by rabbits in a given context
S05_03B	Reasons how a crocodile's angle of vision helps it to survive in the environment
S14_05	Identifies the rock layer containing the oldest fossils and justifies the choice
S10_05	Places four organisms in a model of an energy pyramid
S13_01A	Uses a food web to identify which organisms are producers
S08_01	Identifies the best description of the advantages to bird and crocodile in the symbiotic relationship formed when a bird picks food from around a crocodile's teeth
S05_02	Analyzes information about an ecosystem and explains the effect of introducing a new population
S04_04	Explains how reducing the number of vehicles in a city center affects air quality
S07_01A	Recognizes the agent that causes influenza
S14_02	Identifies diseases associated with 4 of 4 human behaviors
Chemistry	
S07_05Z	From a list of symbols and formulas, recognizes which are elements and which are compounds
S01_07	Applies knowledge of concentration to explain why one solution is paler than another solution
S12_09	Explains that volume is one factor that can be used to identify the solution with a higher concentration of solute (1 of 2 points)
S07_07	Recognizes an everyday occurrence that is an example of a chemical change
S03_01	Recognizes a chemical process that involves the absorption of light

Physics	
S14_12	Identifies the glass of ice cubes that will melt faster based on the ice cubes' size (1 of 2 points)
S03_09	Recognizes the type of energy change that occurs as a child slides down a slide
S10_13	Recognizes 5 of 5 materials as conductors or insulators based on a graph showing the electric current in circuits containing the materials
S12_13B	Identifies a statement describing the movement of a motorbike in a chronophotograph
S02_12	Recognizes why a vehicle has a different weight on Mars than it does on Earth
Earth Science	
S01_12	Recognizes the reason for cold temperatures outside an airplane in flight
S13_15	Synthesizes information in rainfall and temperature graphs to match 2 of 4 animals with the climate where they live (1 of 2 points)
S04_13	Identifies 5 or 6 of 7 activities as examples of reducing, reusing, or recycling (1 of 2 points)
S14_15	Interprets a diagram to identify the position of the Moon in orbit during a specific phase of the Moon

Items at High International Benchmark (550)	
Biology	
S04_01	Applies knowledge of mammals to identify how echidna differ from most mammals
S04_02	Identifies examples of animals belonging to 4 of 4 groups of organisms
S10_06	States one biological difference between fish and mammals (1 of 2 points)
S12_03	Matches 5 of 5 organism groups to defining biological characteristics (2 of 2 points)
S08_02	Identifies the body systems to which 4 of 4 organs belong

S09_02	Recognizes 2 of 3 major organs in a diagram (1 of 2 points)
S14_04	Explains why the percentage of oxygen differs in inhaled and exhaled air or why the percentage of nitrogen is the same in inhaled and exhaled air (1 of 2 points)
S11_04	Describes two characteristics of mammals that are advantageous for survival in cold weather (2 of 2 points)
S13_03	Predicts how heart rate changes in response to exercise, based on a set of given conditions
S04_03	Recognizes where new cells come from as an organism grows
S10_01	Identifies the functions of 5 of 5 human cell types (2 of 2 points)
S10_01	Identifies the functions of 4 of 5 human cell types (1 of 2 points)
S13_02	Explains how a fossil can be classified as plant or animal, based on its cellular structure
S01_02	Recognizes an organism that is made up of cells with cell walls
S08_03	Identifies an implication of removing a plant cell's chloroplasts
S09_01	Recognizes what happens to an animal's cells as it grows
S08_05	Identifies where DNA is located in a human body cell
S10_02	Identifies acquired characteristics of a pet bird
S06_03	Recognizes why rabbits inherit traits that their parents do not have
S14_03	Interprets a diagram to identify the source of DNA responsible for a plant's flower petal color
S12_05	Identifies the statement about python and boa evolution that is best supported by given information
S11_03	Identifies the conclusion best supported by a diagram of rock layers with embedded fossils
S01_03	Recognizes how decomposers get their energy
S02_03	Explains how roof gardens in cities help reduce the amount of carbon dioxide in the air

S12_01	States the part of tomato plant that releases the most water
S02_04	Recognizes an explanation for why the mass of leaves removed from a tree decreases over time
S01_04	Given a food chain, explains which organism competes most with humans in a farming community
S01_05Z	For pairs of animals, distinguishes between predatory and competitive relationships
S08_06	Uses information in a table to explain why the abundance of one specie in an ecosystem changed between two given years (1 of 2 points)
S04_05	Interprets a food web to identify a predator/prey relationship
S02_01	Recognizes the relationship that occurs when insects that feed on nectar pollinate flowering plants
S03_06A	Evaluates data from a table to draw a conclusion about the reason for a change in population of a species
S07_04	Explains how flooding leads to a shortage of drinking water or the spread of disease (1 of 2 points)
S11_02	Explains why it is unlikely for someone to get sick with the measles a second time
S03_05	Selects and classifies 3 of 4 foods from a list that comprise a balanced diet (1 of 2 points)
S05_01	Recognizes which food is the best source of carbohydrates
S11_01	Recognizes a list of food that comprises a healthy, balanced meal
Chemistry	
S02_06	Identifies the subatomic particle that is locates outside of an atom's nucleus
S11_06	Identifies the number of atoms of each element in nitric acid
S03_02	Recognizes a model of a carbon dioxide molecule
S08_10	Identifies an explanation of how carbon dioxide can extinguish a fire
S12_07	Recognizes a chemical property

S10_08	Identifies a necessary property for a liquid in a thermometer
S04_08B	States one variable to hold constant when investigating reactivity of different types of steel with water (1 of 2 points)
S07_10	Explains the effect of temperature on diffusion in the context of an investigation
S11_07	Uses data in a table to order set-ups according to the rate at which a solute will dissolve in water
S05_07	Recognizes a property that is common to both acids and bases
S05_08	Recognizes which process makes bronze dark and dull over time
S13_11	Explains whether a reaction between two solutions in a given context can occur a second time
S08_08	Interprets a diagram to identify the number of hydrogen atoms present before a chemical reaction
Physics	
S08_12	States that the amount of a substance present in its liquid form and present in its solid form is the same (1 of 2 points)
S02_11	Recognizes steps that should be taken to ensure an experiment will show whether iron or copper is the better conductor of heat
S09_05	Relates knowledge of heat transfer to recognize a graph that shows how two substances eventually reach temperature equilibrium
S13_07	Recognizes whether a red object will absorb or reflect different colors of light
S02_13	Applies knowledge of sound transmission to explain whether a ringing cell phone in a vacuum can be heard outside the vacuum chamber
S06_07	Recognizes which graph represents a musical note with given specifications for volume and pitch
S01_09B	Explains that in a parallel arrangement of two bulbs, one bulb failing does not affect the other bulb
S08_14	Recognizes for 5 statements about magnets whether they are true or false
S01_10	Recognizes the best explanation of why two bar magnets repel each other
S04_12	States the force represented by an arrow in a diagram of a falling object

S05_06	Recognizes and explains which substance will float on water using a table of densities
S05_10	Given the densities of two objects and three liquids, and diagrams showing the objects floating or sinking in the liquids, identifies each liquid
S10_11	Explains how deploying a parachute slows a skydiver's fall
S13_06	Relates knowledge of density to indicate the order in which three liquids will settle after being poured in a beaker
S06_08	Recognizes a free-body diagram that has a total force acting towards the right
Earth Science	
S13_14	Recognizes sources of fresh and salt water in a diagram
S02_16	Interprets a diagram to identify the natural resource that is formed during the process depicted
S06_01	Recognizes the process in the water cycle indicated in a diagram of an ecosystem
S02_15	Identifies evidence that the Earth is becoming warmer over time
S06_13A	Relates information in temperature graphs and maps to recognize climatic attributes of two cities
S11_11A	Interprets information in a climate graph to determine the warmest and driest month of the year
S13_13	Identifies how the melting of permafrost can affect the Earth's climate
S13_15	Synthesizes information in rainfall and temperature graphs to match 4 of 4 animals with the climates where they live (2 of 2 points)
S05_13	Uses a graph of average monthly temperature to identify the city most likely to be located at the equator
S09_13	Identifies a disadvantage of using solar energy
S04_14	Recognizes the best explanation for why a river floods more often after a forest is cleared
S01_11B	Synthesizes information from tables about revolution times around and distances from the Sun to infer relative distances of planets from the Sun
S12_14	Identifies the best explanation for why Saturn is visible from Earth

S01_11A	Uses information in a table with characteristics of planets to identify the planet with the shortest day length
S04_15	Recognizes a description of how the Sun produces its own light

Items at Advanced International Benchmark (625)	
Biology	
S02_05A	Classifies 7 of 7 animals as mammals or nonmammals
S10_06	States two biological differences between fish and mammals (2 of 2 points)
S14_04	Explains why the percentage of oxygen differs in inhaled and exhaled air and why the percentage of nitrogen is the same in inhaled and exhaled air (2 of 2 points)
S07_02	Interprets a diagram to identify what happens to biceps and triceps when an elbow bends
S02_02	Recognizes where DNA replication takes place in an animal cell
S06_04A	Identifies two ways that plant and animal cells are similar (2 of 2 points)
S06_04B	States one way that plant and animal cells are different (1 of 2 points)
S13_04	Recognizes the functions of 4 of 4 tissues found in the human stomach (2 of 2 points)
S10_04	Identifies an explanation for why plants in a tank with woodlice grow faster than plants in a tank without woodlice
S10_03	Identifies the tube containing two substances bacteria need for cellular respiration
S12_06	Identifies how fermentation differs from typical cellular respiration
S05_04	States one similarity between the life cycles of a bird and a frog
S07_03	Recognizes a human characteristic that is acquired
S01_01	States two reasons why male penguins' incubation behavior helps their eggs survive (2 of 2 points)

S05_03A	Justifies a statement about crocodiles' adaptation to their environment, based on given facts
S03_04	Applies knowledge about the theory of evolution to identify the best conclusion supported by a diagram of limbs from different animals
S08_04	Identifies where the largest energy transfer occurs in an energy pyramid
S11_05	Recognizes an example of a symbiotic relationship between two organisms
S03_06B	Selects and evaluates data from a table to draw a conclusion about the likely reason for a change in population of a species
S14_06	States two ways that planting trees is beneficial for the environment
S12_02	Identifies a human activity that can increase the amount of nutrients in a pond
S14_07	Recognizes the function of white blood cells in the human immune system
S03_05	Selects and classifies 4 of 4 foods from a list that comprise a balanced diet (2 of 2 points)
Chemistry	
S04_07	States the subatomic particle that is not included in a diagram of an atom
S06_11	Recognizes what happens to the atoms in an object pounded flat
S09_08	Recognizes whether 4 of 5 substances are elements, compounds, or mixtures (1 of 2 points)
S02_07	Uses a portion of the periodic table to order four elements from the smallest atomic number to the largest atomic number
S14_08	Uses atomic numbers to identify the position of 4 of 4 elements in a portion of the periodic table
S10_09	Identifies a similarity between two elements in the same group of the periodic table
S04_08A	Explains how measuring the amount of rust on discs made from different types of steel will show which type of steel is more reactive with water
S07_06	Identifies an element as a metal or a nonmetal, based on a list of physical properties and predicts one additional property
S14_09	Compares/contrasts substances in a table to identify the property used to sort them into two groups

S03_03	Applies knowledge of density to identify and explain which liquid will leave a dropper first after a mixture separates
S12_08	Identifies pieces of equipment that could be used to separate and collect substances from 4 of 4 mixtures
S12_09	Applies knowledge of concentration to identify the cup of tea with the higher concentration of sugar (2 of 2 points)
S09_11	Explains whether a reaction took place after a pH indicator is added to a solution based on information provided about the indicator
S09_10	Identifies and explains whether a described change is physical or chemical
S06_10	Recognizes which model best illustrates the results of a chemical reaction
S12_10	Identifies the statement that best describes what occurs when iron sulfide is formed
Physics	
S02_10	Recognizes a diagram of what happens to gas molecules inside a balloon when the balloon expands
S06_09	Explains the difference between a solid and air in terms of particle spacing in context
S11_13	Draws a conclusion about the states of substances in two pistons, based on the different amounts of compression that occurred
S05_09	Recognizes why gases are easier to compress than solids and liquids
S12_11	Recognizes what happens to water molecules in an ice cube when the ice cube melts
S14_11	Interprets a temperature graph to identify the process happening in a given section of the graph
S08_12	Applies the law of conservation of mass to compare the mass of a substance before and after a state change (2 of 2 points)
S01_08	Recognizes an everyday process that is an example of a physical change
S06_05	Recognizes how the mass of a metal ball will change as it cools down
S11_14	Recognizes the type of energy transformation that occurs when a car begins to move from rest
S10_12	Recognizes an experimental design that will determine whether an aluminum, iron, or ceramic bar conducts heat the fastest

S09_07	Recognizes an explanation for why a ball appears a certain color in a given context
S04_11	Uses a diagram to determine a position where an observer's shadow would not fall on a monument
S03_07	Recognizes which property of sound allows animals to navigate and find food
S14_13	Identifies a description of the relationship between sounds made by the longest and shortest bars on a xylophone
S01_09A	States one reason why a bulb in a diagram of an electrical circuit does not light
S08_13	Identifies the components that must be included in a circuit that will turn a bell on and off
S13_08	Indicates whether parts of a light bulb are electrical conductors or insulators
S01_09C	Recognizes a correct statement about battery life and bulb brightness in two given electrical circuits
S07_09	Recognizes how to increase the strength of an electromagnet
S08_11	States the two measurements needed to calculate average speed in an everyday context
S12_13A	Identifies the movement of a motorbike in a chronophotograph and explains how the chronophotograph reveals the motorbike's movement
S03_10	Identifies and explains which of three methods will require the smallest force to move a heavy box onto a truck
S12_12	Explains why a person slides down a waterslide faster when the water is turned on
S07_11	Applies knowledge about the relationship between depth and water pressure to recognize a conclusion about the pressure at different depths
Earth Science	
S05_12	States one condition below Earth's crust that can be inferred from volcanic eruptions
S03_11	Recognizes a major source of water for desalinization plants
S09_12	Recognizes the gas that makes up most of Earth's atmosphere
S02_14	Recognizes why a balloon gets bigger as its height above the ground increases

S09_14A	Recognizes the process that forms rock layers
S14_14	Recognizes climatic conditions that cause rock to erode the fastest
S03_13	Uses a diagram of a mountain range on the ocean and a given wind direction to recognize which location will have the greatest rainfall
S07_12	Recognizes the source of energy for the water cycle
S04_13	Identifies 7 of 7 activities as examples of reducing, reusing, or recycling (2 of 2 points)
S06_12	Describes one geographic factor to consider when selecting a safe location for a nuclear power plant
S07_13	Explains one way trees protect soil from erosion
S13_12	Recognizes a negative effect that fertilizer can have on the environment
S08_17	Recognizes the main cause of water level changes in a harbor over the course of 24 hours
S07_14	Justifies a claim that the Moon travels around the Sun

Items Above Advanced International Benchmark (625)

Biology	
S02_05B	States the biological characteristic used to distinguish vertebrates from invertebrates
S09_02	Recognizes 3 of 3 major organs in a diagram (2 of 2 points)
S06_04B	States two ways that plant and animal cells are different (2 of 2 points)
S06_02	States two substances plants obtain from their environment and use in photosynthesis (2 of 2 points)
S05_05	Identifies an explanation for disappearance of a trait over generations
S04_06	Identifies where the carbon in wood comes from

S08_06	Uses information in a table to explain why the abundance of two species in an ecosystem changed between two given years (2 of 2 points)
S03_06C	Predicts which species would best survive in a given environment, using information in a table, and provides a supporting explanation
S07_04	Explains how flooding leads to a shortage of drinking water and the spread of disease (2 of 2 points)
S07_01B	Explains how influenza can be spread rapidly around the world
Chemistry	
S13_10	Recognizes a true statement about neutral atoms
S09_08	Recognizes whether each of five substances is an element, a compound, or a mixture (2 of 2 points)
S04_08B	States two variables to hold constant when investigating reactivity of different types of steel with water (2 of 2 points)
S08_07	Evaluates whether a series of steps will separate a mixture of salt, sand, and iron
S02_08	Interprets information in a table to determine if 3 of 3 solutions are acidic, basic, or neutral
S02_09	Recognizes the reason for a temperature increase when an acid and base are combined
S04_09	Identifies and explains the solution that should be combined with an acidic solution to neutralize it
S11_08	Recognizes a property of a basic solution
S14_10	Predicts the color of flowers that are produced when peat moss is added to soil with a given pH
S13_09	Explains how painting a metal prevents rust from forming
S10_10	Identifies the form of wood that will burn fastest based on its surface area (2 of 2 points)
Physics	
S07_08	Recognizes the property of a gas in a dented ping pong ball that stays constant if the ball is heated
S09_09	Explains how a substance can be in two different states in a container at one time in a given context

S14_12	Identifies the glass of ice cubes that will melt faster based on the ice cubes' surface area (2 of 2 points)
S10_14	Recognizes the position in a diagram where a thrown stone has the greatest kinetic energy
S03_08	Recognizes how the temperature of water changes over time when heated
S04_10	Interprets a graph to identify the description of how heat is transferred between a substance and its surroundings
S06_06	Uses a diagram to explain one way to increase the strength of an electromagnet
S09_06	Explains why a vehicle with tires is more likely to sink in the mud than a vehicle with treads
Earth Science	
S14_16	Recognizes the diagram that best represents the structure of the Earth
S11_10	Recognizes the relative composition of gases in Earth's atmosphere
S09_14B	Given a diagram, explains a process that shaped a rock formation in the ocean
S11_09	Recognizes how oil is formed on Earth
S06_13B	Synthesizes information in temperature graphs and maps to recognize an explanation for the difference in seasonal climates of two cities at similar latitudes
S10_16	Identifies best explanation for why temperatures are hotter in a city center than in a meadow
S11_11B	Evaluates a conclusion about climate data, based on one week of weather observations
S08_16	Explains why oil, gas, and coal are nonrenewable resources
S08_15	Evaluates what kind of area would benefit most from a desalination plant
S05_14	Identifies an explanation for why a constellation visible one night is no longer visible six months later