# ASSESSABLE INDICATORS FROM THE KANSAS SCIENCE EDUCATION STANDARDS

**(Organized by Grade Span with Test Specification Notes)**

**August 2007**

# Key for Coding and Test Specification Abbreviations

**Standards Coding Scheme:**

S = Science standards
HS = High School

The code that precedes each assessable indicator is constructed as follows:

Subject **.** Grade Level **.** Standard Number **.** Benchmark Number **.** Indicator Number .

For Example, the code S.8.1.4.5 stands for the following: Science, Grade 8, Standard 1, Benchmark 4, Indicator 5.

**Item Types:**

MC = Multiple-choice items

**Miscellaneous**

TBD = To be determined
CA= Correct Answer
AC= Answer Choice
PB= Passage Based
NPB= Non Passage Based

**Grade 4:** Assessment questions are 60% process and 40% knowledge.
**Grade 7:** Assessment questions are 23% process, 60% knowledge, and 17% process and knowledge.
**High School:** Assessment questions are 7% process 93% knowledge.

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲S.4.1.1.1<br>The student asks questions that he/she can answer by investigating. | • MC<br>• PB or NPB<br>• Pictures and Diagrams<br>• Short passages<br>• Do not use proper names<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use terms or words that elementary students can relate to or have experienced in their school environment.<br>• Which is a good example of a question that can be investigated in science?<br>• Why can't her question be investigated using science?<br>• Asks questions like: Will the size of the opening of a container change the rate of evaporation of liquids? How much water will a sponge hold? | a. Change a question so it could be answered by a scientific investigation.<br>b. From a group of questions, choose the one that could (or could not) be studied scientifically.<br>c. Given a problem, state the question that could be studied scientifically or choose the correct form of the question.<br>d. Given a description of an investigation, identify the question being studied. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲S.4.1.1.2<br>The student plans and conducts a simple investigation. | • MC<br>• Use short passages<br>• Do not use proper names<br>• Mid Level Process questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Stay away from experimental design steps.<br>• She gathered her materials. What would her next step be?<br>• What materials should she collect to do the investigation?<br>• What is the best test for finding out something?<br>• Design a procedure to test of the wet strength of paper towels, to experiment with plant growth, or to find ways to prevent soil erosion. | a. Choose the best test to answer a question using descriptions or illustrations of the experimental set up.<br>b. Design a simple experiment to study a scientifically stated question (e.g., determine what will be tested, how it will be tested, including the sequences or stages of the investigation, or how to determine or measure the results).<br>c. Given a question under investigation, make a prediction of the outcome (i.e., assess the ability to form a hypothesis, but DO NOT use the term hypothesis.)<br>d. Given the details of a study choose which properties to observe or measure.<br>e. Given a question, choose the tools and/or materials needed for the investigation.<br>f. Identify flaws in a simple experimental design.<br>g. Given the details of a study identify features that should stay the same during the investigation (i.e., which parameters should be held constant.).<br>h. Recognize a “fair test” of a property or comparison of properties (i.e., tested under the same conditions, tested under controlled conditions, or compared to a standard value or control group).<br>i. Recognize that more than one trial increases the validity of the results of the investigation. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.1.1.3<br>The student employs appropriate equipment, tools, and safety procedures to gather data. | • MC<br>• Use short passages<br>• Do not use proper names<br>• Low Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Don't get too technical.<br>• Use appropriate METRIC tools including hand lens, meter stick, tape measure, measuring cups, balance, thermometer, spring scale, graduated cylinder, dropper, and stopwatch/clock.<br>• The best tool for measuring the vinegar would be…<br>• How can she safely collect data about the liquid?<br>• Use a balance to find the mass of the wet paper towel in grams; use a meter tape to measure the diameter of a rock; use the same size containers to compare evaporation rates of different liquids.<br>• Use appropriate precautions, procedures, and safety equipment when conducting investigations. | a. Choose the best tool to measure a given property.<br>b. Identify the property a given tool measures.<br>c. Identify tools that can be used to "extend" the senses in an investigation (e.g., sight, sound, temperature receptors extended with a microscope, amplifier, thermometer).<br>d. Identify safe or unsafe procedures when working with materials or tools that are poisonous, flammable, explosive, hot, or sharp.<br>e. DO NOT use the term mass or test for it. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.1.1.4<br>The student begins developing the abilities to communicate, critique, analyze his/her own investigations, and interprets the work of other students. | • MC<br>• Use pictures and graphs<br>• Use short passages<br>• Use major Kansas cities<br>• Do not use proper names<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Keep the vocabulary simple. Use words that fourth graders can read easily.<br>• Use pictures, graphs, written language.<br>• What would be the best way to show his findings?<br>• Using her graph, which city received the most rain?<br>• Describe investigations with pictures, graphs, written language, and oral presentations. | a. Choose the best prediction or conclusion based on the results of an investigation.<br>b. Draw conclusions from the results of a simple experiment.<br>c. Evaluate conclusions based on the results of a simple experiment.<br>d. Evaluate a description of a simple experiment for clarity and completeness.<br>e. Describe the flaw or omission in the description of an experiment.<br>f. Identify the missing information that would prevent someone else from repeating the experiment.<br>g. Choose the best way to display the results of an experiment (e.g., different graph formats or different scales within a single graph format).<br>h. Choose data set most likely to have been obtained from a given investigation (LIMIT TO a 3x4 or 4x3 data table).<br>i. Identify data or results that seem surprising, contradictory, or unlikely (i.e., extreme outliers). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.1.1<br>The student observes properties and measures those properties using appropriate tools. | • MC<br>• Short Passage<br>• Use only the following vocabulary:<br>• Size, Shape, Color, Weight, Temperature, or Volume<br>• Do not use proper names<br>• Low Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Tools: (Metric) Meter stick, tape measure, measuring cups, balance, thermometer, scale, graduated cylinder, dropper<br>• Do not use the term mass or test for it.<br>• A student observed the properties of a Popsicle placed in the sun. She noticed…<br>• Which measurement tool would best measure the weight of a football?<br>• Observe and record the size, shape, volume, color, and temperature of objects using balances, thermometers, and other metric measurement tools. | a. Understand that weight, size, color, shape, volume, and temperature can be the same for different objects and that weight, shape, volume, and temperature can be different for different samples of the same material.<br>b. Read the measurement of a physical property of an object on a tool (including reading the gradations/tic marks of a measuring tool at whole numbers. DO NOT ask to estimate values between scale markings/marked intervals).<br>c. Choose correct units of measurement associated with a specific property (DO NOT assess units of mass). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.1.2<br>The student describes and classifies objects by more than one property. | • MC<br>• Short Passage<br>• Use only the following vocabulary:<br>• Size, Shape, Color, Weight, Temperature, Volume<br>• Do not use proper names<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Do not use the term mass or test for it.<br>• Which properties best describe the rock?<br>• Which rock can be described as narrow, jagged, and spotted?<br>• Observe that an object can be hard, round, and rough; classify objects by two or more properties. | a. Describe common materials in terms of their properties.<br>b. Identify common materials given a description of their properties.<br>c. Classify materials or objects into groups based on their properties.<br>d. Rank materials or objects based on relative values of a common property. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.1.3<br>The student observes and records how one object interacts with another object. | • MC<br>• Short passages<br>• Do not use proper names<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use common objects as examples of interactions.<br>• …it shows an interaction because...<br>• What shows the interaction between the milk and the napkin?<br>• Mix baking soda and vinegar, or tea bag/food coloring and water, and record observations. | a. Describe how objects with different physical properties (temperature, hardness, texture) interact. (Examples of objects include boiling water and solid wax, salt and water; examples of interactions include they may make a noise, wear away, break apart, produce heat or light, or stick together.)<br>b. Identify evidence that a material has changed to a new material (e.g., color change, bubbles, smoke)<br>c. For clear-cut examples, distinguish between changes that create new materials (e.g., combustion) and changes that create a different form of the same material (e.g., changes of state). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.1.4<br>The student recognizes and describes the differences between solids, liquids, and gases. | • MC<br>• Pictures<br>• Short passages<br>• Do not use proper names<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use common items used at home or school by fourth graders.<br>What is the order of the states of matter pictures from left to right?<br>• Which is a liquid?<br>• Observes differences between a stick of butter and the butter melted, a chocolate bar and the chocolate melted, ice, melted ice, and evaporating water.<br>• Understands that a solid has a shape of its own and a liquid takes the shape of its container.<br>• Observe the differences between an inflated and deflated balloon. | a. Identify common materials as being solid, liquid, or gas.<br>b. Identify the state of a common material at an approximate temperature.<br>c. Describe the three states of matter in terms of whether their shape can change or whether their volume can change.<br>d. Know that temperature change is related to change in the state of matter. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.2.1<br>The student moves objects by pushing, pulling, throwing, spinning, dropping, and rolling and describes the motion. | • MC<br>• Short Passage<br>• Use only the following examples: push, pull, throw, spin, drop, or roll<br>• Do not use proper names<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Only use experiences that fourth graders have had.<br>• A student observed that a leaf fell to the ground. What did he observe?<br>• What best describes the motion of the ball?<br>• Spin or roll a variety of objects on various surfaces and explain what causes the objects to move. | a. Describe the motion of an object as not moving, motion at the same speed for a period of time, speeding up, slowing down, or changing direction.<br>b. Understand that a push or a pull causes an object to change its motion.<br>c. Understand that the change in the motion of an object is the result of both the amount of force applied and the direction of the force applied to the object.<br>d. Understand that heavier objects are harder to start moving or stop object (Specifications b, c, and d assess the general QUALITATIVE understanding of the second law of motion).<br>e. Recognize that the motion of an object on a surface is related to the shape and weight of the object and the smoothness of the surface (DO NOT assess the term *friction*.). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.3.1<br>The student identifies that the source of sound is vibrations. | • MC<br>• Short Passages<br>• Do not use proper names<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use instruments or objects "all" students (remember hearing impaired and physically impaired students) have experience with.<br>• A student felt the strings of a guitar when the guitar was strummed. What did she observe when sound was made?<br>• A student felt a table as it was being hit with a hammer. What did she feel?<br>• Explore various vibrating objects (tuning forks, rulers, tongue depressors, musical instruments, etc.) that produce sound. | a. Identify vibration as the type of motion that causes sound. Attribute visual evidence of vibrations to sound (e.g., rice in a tray that shakes when a drum is beat or a full glass of water that ripples and spills because of a loud sound).<br>b. Understand that sound is carried from the source to the ear by vibrations in the air or other material.<br>c. Know that changing the vibration of an object changes the sound produced by the object.<br>d. Know how to make the sound produced from an object louder or softer.<br>e. Know that vibrations in different materials will produce sounds with different qualities (i.e., pitch, volume, speed). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.4.1<br>The student demonstrates that magnets attract and repel. | • MC<br>• Pictures<br>• Short passages<br>• Do not use proper names<br>• Mild Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use bar magnets for pictures and/or drawings.<br>• A student observed what happened when she placed magnets in this position. She noticed the magnets…<br>• Explore the interactions between two magnets.<br>• Design a simple experiment with two magnets to show that they attract or repel. | a. Knows that all magnets have two poles: north and south.<br>b. Understand that like poles of magnets repel and unlike poles attract.<br>c. Predict whether two (or three) approaching magnets will attract or repel.<br>d. Understand that distance is related to the strength of magnetic attraction or repulsion between magnets. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.4.2<br>The student designs a simple experiment to determine whether various objects will be attracted to magnets. | • MC<br>• Short passages<br>• Do not use proper names<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Only use objects and/or situations that fourth graders have had experience with.<br>• A student wanted to know which objects were attracted to magnets. What might she do to test her question?<br>• Which object will a magnet attract?<br>• Design an experiment involving a group of objects to determine which are attracted to or repelled by the magnet. | a. Predict which objects will be attracted to a magnet based on the material from which the objects are made (e.g., iron nails, certain rocks, steel washers, thumbtacks, pins, steel paperclips.)<br>b. Use illustrations or descriptions of experimental situations such as sorting mixed objects in a box with a magnet or drawing a magnet through some sand to find lost objects. Be sure to include cases where objects are NOT attracted to the magnet. Use familiar objects like pencil erasers, glass, aluminum cans, or pennies. Be sure to identify the material of the object, not just the object.<br>c. Students know that magnets can attract things through solids, liquids, or gases. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.2.4.3<br>The student constructs a simple circuit. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Test only simple and simple series.<br>• Do not test the identification or distinction between parallel and series circuits.<br>• Which picture is an example of a simple circuit?<br>• Which circuit causes the bulb to light?<br>• What needs to be done to make this circuit light the bulb?<br>• Use a battery, and wire(s) to light a bulb(s). | a. Diagram a complete circuit by connecting electrical components. Include components such as source of electrical energy, wires to conduct, and bulb(s).<br>b. Explain how to make a complete circuit from an open circuit (i.e., Understand that a complete circuit provides an uninterrupted, circular path for the flow of electrical current.).<br>c. Identify a complete circuit from a group of choices.<br>d. Understand that a complete circuit must include a source of electrical energy (e.g., a battery).<br>e. DO NOT assess directionality of current. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.3.1.1<br>The student observes different organisms and compares and contrasts how similar functions are served by different structural characteristics. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• High Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use only animals and plants that fourth graders have experienced.<br>• A student was comparing a bird and a gerbil. He noticed…<br>• Compare the leaf structures of the bean seed and corn seed sprouts. How are they different?<br>• Compare the structures for movement of an insect to the structures for movement of a fish; compare the leaf structures of a sprouted bean seed to the leaf structures of a corn seed. | a. Sort or group organisms based on their structural characteristics (e.g., number of legs, body covering, leaves or needles).<br>b. Group familiar animals according to characteristics that are similar (e.g., lays eggs vs. live birth, breathes through lungs vs. gills, scales vs. feathers, four legs vs. two legs, wings vs. legs for primary locomotion).<br>c. Explain how an animal uses its particular type of body structures (e.g., webbed feet for moving in water, color pattern for hiding from predators).<br>d. Describe the functions of the primary structures of flowering plants/fruit trees (i.e., leaves make food, roots take in water and nutrients and anchor plant in place, stem or trunk provide support and transport water and nutrients through the plant, flowers and seeds are for reproduction.).<br>e. Know that plants and animals may use different structures to perform the same functions (e.g., for defense animals use different structures, such as claws, coloration, scales, spines, teeth).<br>f. Relate structures of animals to food source (e.g., beak shape in birds or teeth shape in mammals are related to obtaining and chewing specific kinds of food.) Distinctions between functions of structures MUST BE common and distinctive. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.3.1.2<br>The student compares basic needs of different organisms in their environment. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Only use animals and plants that fourth graders have experienced (in real life or through contact with familiar media, curriculum, and children's materials).<br>• Plants and animals both need _____ to live.<br>• Compare the basic needs of an animal to the basic needs of a plant. | a. Identify the basic needs of animals as air, water, and food/energy, habitat/living space/territory.<br>b. Relate the basic needs of a specific animal to a specific type of environment (i.e., freshwater, marine, desert, polar, forest, or meadow/grassland/prairie) in which those basic needs are met.<br>c. Identify the basic needs of plants as sunlight, air, and water and relate the basic needs of a specific plant to a specific type of environment (e.g., cactus, palm tree, fir tree). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.3.2.1<br>The student compares, contrasts, and asks questions about life cycles of various organisms. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Limit life cycles to those of humans, plants, butterflies, and frogs.<br>• Which is the correct order of the life cycle of an insect (butterfly)?<br>• What is the beginning stage of the life cycle of a plant?<br>• Plant a seed; observe and record its growth; observe and record the changes of an insect as it develops from birth to adult. | a. Know the environmental factors that affect the continuity of the life cycle of organisms.<br>b. Given labeled pictures, arrange in sequence the stages (or identify the missing, or next stage) in the life cycles of frogs or butterflies.<br>c. Know that some organisms go through metamorphosis during their life cycle and some do not (e.g., human babies have the same basic body form as adult humans; frogs do not).<br>d. Given labeled pictures, arrange in sequence the stages in the life cycles of plants. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.4.1.1<br>The student collects, observes properties, and classifies a variety of earth materials in his/her environment. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use earth materials that are FAMILIAR to fourth grade students.<br>• Fourth graders collected leaves from the playground. Which properties best describe the leaves?<br>• A student made groups of rocks based on the property of color. Which best shows how the student classified his rocks?<br>• Bring in samples of earth materials from his/her surroundings to observe color, texture, and other physical properties, and observe and classify rocks, soil, sand, and water. | a. Understand that earth materials are unprocessed objects or materials found naturally occurring in the earth including rocks and minerals (e.g., marble, limestone, flint, sandstone, quartz), metals from ores (i.e., gold, silver, copper), and oil, coal, water, soils, clay, silt, humus, sand, and fossils. DO NOT include living organisms and immediate or direct derivatives as examples of earth materials (e.g., wood, bones, nests, plant oils, etc.).<br>b. Group or sort earth materials based on observations or tests of the properties of those materials (e.g., color, shape, size, texture, reflectivity, transparency). Provide the materials or objects and the observed properties. Students then classify materials or objects based on the properties given.<br>c. Group or sort earth materials based on how the materials are useful (e.g., building materials, sources of fuel, used for growing plants).<br>d. Group or sort earth materials or objects based on more than one property.<br>e. DO NOT assess specific properties of types of soils (not state assessable in S.4.4.1.2). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.4.1.3<br>The student describes *properties* of water and process of the water cycle. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Observes a water drop using a hand lens to notice shape of the drop (surface tension) and that water is a transparent, odorless, colorless liquid.<br>• Makes a diagram of the water cycle to show processes of evaporation, condensation, and precipitation.<br>• *Relates the water cycle to observations of weather. Example: forms of precipitation*. | a. Do not test surface tension.<br>b. Test the properties of water (transparent, odorless, colorless).<br>c. Identifies the different physical states of water in the water cycle (i.e., solid, liquid, and gas).<br>d. The sun is the main source of energy that drives the water cycle.<br>e. Identify and describe the four main processes in the water cycle (i.e., evaporation, condensation, precipitation and collection/runoff) and locate where each occurs on a diagram of the water cycle.<br>f. Recognize evidence of different processes in the water cycle (e.g., clouds are evidence of condensation, puddles drying up are evidence of evaporation, streams and rivers are evidence of collection/runoff).<br>g. Understands how temperature affects the processes in the water cycle (e.g., warmer temperatures are usually associated with increased rates of evaporation, and colder temperatures with the formation of ice and with precipitation in the form of rain, snow, sleet, and hail).<br>h. Recognize the different forms of precipitation, including sleet, snow, hail, rain.<br>i. Most precipitation is eventually collected as runoff and ends up in lakes, oceans, or as groundwater. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.4.2.3<br>The student discusses that the sun provides light and heat (electromagnetic radiation) to maintain the temperature of the earth. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Do not use the term “electromagnetic radiation” on the test.<br>• Show why it seems cooler when the sun goes behind a cloud, and/or have the students investigate why it is cooler in the shade versus direct sunlight.<br>• Which child is playing in the **coolest** area?<br>• Four thermometers were placed in different locations around the school. The temperature from each was collected at 1:00pm. Where was the temperature warmest (highest)?<br>• Discuss why it seems cooler when the sun goes behind a cloud, and then investigate why it is cooler in the shade versus direct sunlight. | a. Understand that the Sun is the main source of energy for Earth, and Earth receives this energy in the form of light and heat. (DO NOT use the term *electromagnetic*.)<br>b. Explain what would happen on Earth (in terms of temperature and amount of light) if the amount of heat and light that Earth receives from the sun suddenly increased or decreased.<br>c. Explain why it is cooler in the shade than in sunlight and why it is darker and cooler at night than in daytime. (DO NOT include length of shadows.)<br>d. Choose the location with the highest or lowest temperature based on a picture of someone measuring temperatures at locations subjected to different intensities of sunlight (e.g., sun behind cloud, under shade of tree, at night). Example of scenario: Measure the temperature of jars of water after sitting in different exposures to sunlight. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.4.3.1<br>The student describes changes in the surface of the earth. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use examples from the environment in Kansas.<br>• What change shows erosion on a hill?<br>• There is a bare slope on the playground. When it rains the soil washes down the slope. What could be done to stop the erosion of the slope?<br>• Observe erosion at a study site. | a. Only assess changes caused by wind and water.<br>b. Understand that erosion is the removal of earth material from a location by natural forces.<br>c. Identify moving water and wind as the primary causes of erosion.<br>d. Understand the interaction between the type of erosion and the landform resulting from that erosion (e.g., river valley/canyon, sand dunes, riverbank, cliffs, shoreline erosion).<br>e. Describe the importance of slope and vegetation on the rate of erosion.<br>f. Describe ways that erosion can be an environmental problem.<br>g. Describe things that could be done to prevent erosion (e.g. planting, covering, and walls or other structures to retain soil). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.4.3.2<br>The student observes, describes, and records daily and seasonal weather changes. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Low Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use Kansas weather patterns.<br>• Do not use barometers, dew point, wind chill, humidity, atmospheric pressure, or wind sheer.<br>• What are the best tools to use when collecting data about rainfall and temperature?<br>• What is the best way to tell someone what the weather in Kansas is like in the winter?<br>• Record weather observations using simple instruments (metric rain gauge, Celsius thermometer, etc.). | a. Identify appropriate tools used to collect weather data. (i.e., rain gauge, thermometer, and weather vane or wind sock used to determine rainfall, temperature, and wind direction).<br>b. Describe daily changes in temperature.<br>c. Read and describe weather conditions based on data presented in simple weather maps that include temperature, wind speed, and type of precipitation. (DO NOT include fronts, pressure, isobars, etc.)<br>d. Describe seasonal changes in terms of both temperature and type of precipitation.<br>e. Understand why weather observations over time should be done under the same conditions if they are to be compared (e.g., time of day, location, type of equipment). |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.5.1.1<br>The student identifies a simple design problem (designs a plan, implements the plan, evaluates the results, makes changes to improve the product, and communicates the results). | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Low Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Only use technology that is understood by a fourth grade student in Kansas.<br>• A student designed an experiment to test what makes a whirlybird (helicopter) fall faster. Which would affect how fast the whirlybird falls?<br>• A student worked to design an airplane that flies the farthest. She made the first one out of notebook paper. It did not fly very far. She made the second airplane using heavy construction paper, paperclips for weight, and folded the plane differently. It flew a long way. How can she test what made the second plane fly farther than the first airplane?<br>• Try different kinds of tools for making the biggest bubbles or the longest lasting bubbles.<br>• Design and fly a paper airplane that makes one loop before landing. | a. Identifies and states a design problem. (e.g., Which of these questions was the investigation designed to solve? Which of these states a design problem?)<br>b. Chooses the best design from alternatives. (e.g., Which of these is the best design plan for a tree house ladder?)<br>c. Chooses the most appropriate material for a design. (e.g., Which material is the best/safest to use for the rungs of a tree house ladder?)<br>d. Explain the reason for a feature of a common design. (e.g., Why are door knobs on the edge of the door? Why do cups have handles, but glasses don't?)<br>e. Choose the most important characteristics for a material or part that is to perform a particular function in a design. (The most important properties of the material from which bicycle tires are made are…strength and flexibility.)<br>f. Evaluate the results of testing a design (identifying what did and did not work well).<br>g. Describe changes to a design to improve the product based on the results of testing.<br>h. Items should assess the design process as much as possible and the physical science aspects of the design as little as possible. |

# Grade 4

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.4.6.1.1<br>The student discusses the nutritional value of various foods and their contribution to health. | • MC<br>• Pictures<br>• Short Passages<br>• Do not use proper names<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Ask questions about the nutritional information found on food labels.<br>• Discuss healthy foods.<br>• Describe a healthy snack, breakfast, lunch, and supper.<br>• Which snack is the best healthy choice?<br>• The 4th grade class is planning a healthy snack for their reading party. Which is the healthiest choice?<br>• Read and compare nutrition information found on labels; discuss healthy foods; make a healthy snack. | a. Identify types of foods that make up a healthy diet and types of food that should be avoided in large amounts.<br>b. Choose the healthiest menu from a list of choices. Design a healthy menu from a list of foods.<br>c. Analyze the ingredients label of a food product and explain the relationship of the data for calories, fat, cholesterol, carbohydrates, and protein to personal health.<br>d. Choose the healthiest food from a group by comparing ingredients labels to determine the best food choice. (Provide the student with the criteria the decision should be based on to determine the "best.")<br>e. Relate appropriate calorie intake to activity level. (Everyone needs a basic amount of calories every day to maintain health.)<br>f. Know that some foods contain more calcium and iron than others and that these minerals are needed for healthy bodies (i.e., calcium for bones, iron for blood).<br>g. Know that good or bad nutrition choices have immediate effects (e.g., low energy level from skipping breakfast) and long-term effects (e.g., susceptibility to disease, obesity).<br>h. DO NOT assess knowledge of specific requirements of any specific nutrient such as vitamins or minerals. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7. 1.1.1<br>The student identifies questions that can be answered through scientific investigations. | • MC<br>• Short Passages<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Develop a scenario and have students identify the question being investigated.<br>• Which of the following cannot be answered through a scientific investigation?<br>• Explore properties and phenomena of various materials and generate testable questions to investigate. | a. Distinguish between testable and untestable questions. Testable questions address phenomena that are measurable, repeatable, and able to be proven or disproved using scientific methods. Untestable questions involve matters of opinion, preference, values, religious or philosophical beliefs.<br>b. Given a scenario with an unresolved problem, state a question that could be the basis of a scientific investigation to resolve the problem.<br>c. Given an experimental procedure, identify the question being tested.<br>d. Items SHOULD NOT test experimental design (see S.7.1.1.2) but should address testable or untestable questions. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.1.1.2<br>The student designs and conducts *scientific investigations* safely using appropriate tools, mathematics, *technology*, and techniques to gather, analyze, and interpret data. | • MC<br>• Short Passages<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Use different scenarios. Have students identify variables- independent & dependent, constants, experimental & control groups.<br>• Never mix meanings (e.g., Which is the **variable** being **controlled**?) when you are looking for constant as the correct choice.<br>• Scenarios: Paper towel absorption or strength, temperature and amount of sugar dissolved, temperature and the speed seltzer tablets dissolve, difference in rate at which water and land absorb heat, etc.<br>• Design and conduct an investigation on the question, "Which paper towel absorbs the most water?" (Materials include different kinds of paper towels, water, and a graduated cylinder. Components of the investigation may include background and hypothesis, identification of independent variable, dependent variable, constants, list of materials, procedures, collection and analysis of data, and conclusions).<br>• Given an investigative question, determine what to measure and how to measure.<br>• Display data collected from performing an investigation using tables, graphs, diagrams and other graphic organizers. | a. Identify a design of an investigation that will answer a stated scientific question.<br>b. Identify flaws in an experimental design (e.g., too many uncontrolled parameters, no control group, sample size too small, looking for data to support preconceived conclusions.)<br>c. Understand the term hypothesis, and, given a question, identify an appropriate hypothesis.<br>d. Arrange the basic steps in a scientific procedure (i.e., question – hypothesis – gather experimental data – draw conclusions).<br>e. Understand the relationship between sample size and validity of results.<br>f. Distinguish between dependent and independent variables.<br>g. Identify the parameters that should be constant in an experiment and explain why some parameters must usually be held constant.<br>h. Understand the purpose of control groups and know the types of studies in which they would be appropriate.<br>i. Choose the correct measuring tool or technology to measure a property or variable (e.g., graduated cylinder, meter stick, balance, spring scale, thermometer, stopwatch).<br>j. Identify the property (exclusive to the properties explicitly identified in the Grade 5-7 assessable indicators) or |

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| | variable a tool measures.<br>k. Read measurements on tools and instruments. (DO NOT test significant figures.)<br>l. Choose the correct observational tool (e.g., hand lens, microscope, telescope, audio or video recorder).<br>m. Identify safe or unsafe procedures when conducting investigations (e.g., appropriate clothing; correct handling of materials that are toxic, flammable, corrosive, explosive, radioactive, hot, or sharp). ONLY include equipment common to most middle school laboratories.<br>n. Choose an appropriate format (e.g., data table, diagrams, etc.) for collecting or recording data. Item ideas may include appropriate units of measure, column and row headings, and adequate space to record data for all samples.<br>o. Match units of measurement to properties. Use ONLY metric units except °F for weather temperatures. Use °C for all other temperature values (e.g., liquid, objects in a room, gas in a cylinder).<br>p. Calculate the mean (average) of a set of data. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.1.1.3<br>The student identifies the relationship between evidence and logical conclusions. | • MC<br>• Short passages<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • DON'T include questions about inductive/deductive reasoning.<br>• Provide data tables/graphs. Ask students to identify the logical conclusions.<br>• Check data to determine: Was the question addressed? Was the hypothesis supported/not supported? Did this design work? How could this experiment be improved? What other questions could be investigated?<br>• Look for patterns from the mean of multiple trials, such as the rate of dissolving relative to different temperatures.<br>• State relationships in data, such as variables, which vary directly or inversely. | a. Make predictions based on data in tables and graphs using analysis, extrapolation, and interpolation.<br>b. State relationships among variables (e.g., inverse, direct) or recognize lack of relationship.<br>c. Analyze data to find if a hypothesis was supported.<br>d. Suggest modifications to an experiment based on inconclusive data.<br>e. Identify relationships in, or conclusions based on, quantitative data.<br>f. DO NOT create items that just require reading or identifying one data point from a table or graph. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.1.1.4<br>The student communicates scientific procedures, results, and explanations. | • MC<br>• Short Passages<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Give a sample procedure. Could this experiment be repeated? How could this procedure be improved?<br>• You have just completed a scientific investigation. Which of the following is the best way to communicate your results?<br>• Present a report of an investigation so that others understand it and can replicate the design. | a. Identify the aspects of an experimental procedure that must be specified in order for another person to repeat the experiment. (e.g., Can this experiment be repeated given the information presented? Identify the detail missing from the report of the procedure or results that prevents the experiment from being repeatable.)<br>b. Given an experimental outline, describe the experiment in sufficient detail.<br>c. Choose the best graphic format for analyzing and displaying numerical data.<br>d. Choose the best method or format for reporting results of an experiment (e.g., graphical format, graphical organizers, numerical data displays). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.1.3.2<br>The student evaluates the work of others to determine evidence which scientifically supports or contradicts the results, identifying faulty reasoning or conclusions that go beyond the evidence and/or are not supported by data. | • MC<br>• Short Passages<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Given a scenario, is the stated conclusion supported by the data?<br>• Given a variety of data, have students identify which data is relevant for a particular conclusion.<br>• Explain how a reasonable conclusion is supported.<br>• Analyze evidence and data that supports or contradicts various theories (e.g., theory of continental drift, spontaneous generation, etc.).<br>• Recognize sources of conflict of interest and bias.<br>• Evaluate research based on the interest of parties conducting the research. | a. Distinguish between valid conclusions based on experimental data/evidence and unsupported opinions.<br>b. Explain why a report or claim may be unreliable or biased based on the extent or source of data.<br>c. Recognize missing data/evidence/information that is needed to verify a claim.<br>d. Identify and fix flaws or omissions in a scientific report. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.1.1<br>The student compares and classifies the states of matter; solids, liquids, gases, and plasma. | • MC<br>• Pictures<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Graph temperature/state of matter relationship using metrics, including degrees Celsius.<br>• Interpret a graph to determine the phase of matter of water at a certain temperature (point on the graph).<br>• Makes a diagram/model showing the various states of water demonstrating that the molecules of a solid has definite volume and shape, the molecules of a liquid have a definite volume but an indefinite shape, the molecules of a gas have an indefinite volume and indefinite shape. | a. Understand that matter is made of particles.<br>b. Identify substances as solids, liquids, or gases. (DO NOT include plasma.)<br>c. Predict the physical state of common materials at a specified temperature. Limit materials to water and common substances (e.g., milk, metal, rock).<br>d. Describe the properties of a phase (physical state) of matter in terms of shape and volume.<br>e. Know that particles of matter are constantly in motion and arranged differently in solids, liquids, and gases (includes models and graphical representation of arrangement of particles in different states of matter).<br>f. Understand that mass is conserved during physical changes, including phase changes.<br>g. Understand that all materials, including gases, are made of matter and know that matter has mass and takes up space.<br>h. Understand which properties can be used to classify and identify materials/substances in different states of matter (e.g., boiling and melting points, color, hardness, volume –definite vs. indefinite, temperature).<br>i. Recognize that the mass of a substance does not change as the substance undergoes phase changes.<br>j. When developing items, identify the object, NOT JUST the material/substance (e.g., copper spoon, iron shovel, wooden stick). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.2.1<br>The student understands the relationship of atoms to elements and elements to compounds. | • MC<br>• Diagram with atoms labeled.<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • What is matter made of? – atoms, elements, compounds<br>• If two atoms have a different number of electrons and protons they are two different _____.<br>• The student draws a diagram to show how different compounds are composed of elements in various combinations. | a. Understand the basic structure of an atom (proton and neutron located in the nucleus, electrons orbit the nucleus). DO NOT assess charges.<br>b. Understand that materials made of one kind of atom are elements and that, likewise, all atoms of an element have the same chemical properties. DO NOT include or assess isotopes.<br>c. Understand that compounds are chemical combinations of atoms of more than one element. DO NOT include molecules.<br>d. Understand that all the many compounds in the world are made of different combinations of a finite number of approximately 100 elements. DO NOT assess the number of elements except by comparing highly diverse approximations (e.g., approximately 100 elements, approximately 1,000 elements).<br>e. Understand that, when atoms combine, the compound formed has different properties than the original atoms. DO NOT assess chemical vs. physical change. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.2.2<br>The student measures and graphs the effects of temperature on matter. | • MC<br>• Diagram<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Which balloon represents matter at the warmest temperature? (Same number of atoms in each balloon.)<br>• Change water from solid to liquid to gas using heat. Measure and graph temperature changes. Observe changes in volume occupied. | a. Interpret a heating/cooling curve for water (may use other substances with documentation).<br>b. Measure temperature by reading a thermometer.<br>c. Compare the effect on temperature change of adding the same amount of heat to the same volume (or to different volumes) of the same substance (or to different substances).<br>d. Extrapolate/predict the state of matter of a substance from the temperature curve on a graph of the substance as it is heated over time.<br>e. Determine change in matter based on change in temperature (e.g., expansion and contraction).<br>f. Predict how adding heat affects the rate or extent of a particular chemical or physical change (e.g., dissolving, evaporating, decaying).<br>g. Understand that melting and boiling points are independent of mass, volume, or rate of heat change (Combining two volumes of water that are both at 0°C does not decrease the temperature of the combined volume. One liter of water boils at the same temperature as 10 liters of water.) |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.3.2<br>The student describes, measures, and represents data on a graph showing the motion of an object (position, direction of motion, speed). | • MC<br>• Diagram/graph<br>• Low Level Knowledge & Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • At which point on the graph is the speed the greatest?<br>• Trace the force, direction, and speed of a baseball, from leaving the pitcher's hand.<br>• Roll a marble down a ramp. Make adjustments to the board or to the marble's position in order to hit a target located on the floor. Measure and graph the results. | a. Interpret change of position on a two-dimensional grid.<br>b. Interpret linear distance vs. time graphs. (On graphs, represent **average** speeds as linear relationships between distance and time. DO NOT assess acceleration.)<br>c. Chose the graphical representation that matches a type of motion (e.g., moving, moving away/toward, moving fast/slowly).<br>d. Identify the time interval on a distance vs. time graph that corresponds to a given type of motion.<br>e. Graphically determine the effect on motion when a moving object changes from one surface to another or changes the media through which it travels (e.g., average speed of riding a bike on concrete then through sand). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.3.3<br>The student recognizes and describes Newton's Laws of Motion. | • MC<br>• For your info: Newton's Laws:<br>I. An object in motion stays in motion<br>II. Acceleration depends on mass and amount of force<br>III. Equal and opposite reactions<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • What happens to a book bag sitting on a car seat when the car stops suddenly?<br>• Use an illustration with a ping pong ball and two straws blowing on the ball. According to Newton's Laws of Motion which direction will the ball move? (Select the correct force – vector arrows.)<br>• What forces keep a satellite traveling in orbit around a planet rather than falling into the planet or flying off into space?<br>• Place a small object on a rolling toy vehicle, stop the vehicle abruptly, and observe the motion of the small object. Relate to personal experience – stopping rapidly in a car.<br>• Research safety equipment, such as seat belts and safety helmets, and the role they play related to inertia. | a. Understand Newton's first law (inertia) in the following ways:<br>i. Objects in motion tend to stay in motion.<br>ii. Objects at rest tend to stay at rest.<br>iii. Friction and air resistance account for most observed motions that appear to deviate from the first law.<br>iv. Predict motion on a frictionless surface.<br><br>b. Understand Newton's second law in the following ways (DO NOT assess F = ma):<br>i. A change in motion (i.e., speeding up, slowing down, changing direction) is the result of an unbalanced force.<br>ii. Know a change in mass and/or a change in force changes the motion of an object (qualitative understanding, NOT quantitative).<br>iii. Given change in force or mass, predict change in motion (qualitative).<br>iv. Determine net force (simplified quantitative analysis), with mass and force identified, acting on an object based on two force arrows in one |

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| | dimension (← ←) (→ →) (← →) (→ ←) or in two dimensions (e.g. ↑ →).<br><br>c. Understand Newton's third law (action-reaction) in the following ways:<br>i. Understand that for every action force there is an equal and opposite reaction force.<br>ii. Given one force of an action-reaction pair, identify the other.<br>iii. Relate the need for impact safety gear to Newton's Laws of Motion.<br>iv. DO NOT assess identification of laws of motion by name or label. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ 7.2.3.4<br>The student investigates and explains how simple machines multiply force at the expense of distance. | • MC<br>• Pictures<br>• Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| a. Investigates the load (force) that can be moved as the number of pulleys in a system is increased.<br><br>b. Investigates how bicycle gears work. | • Identify types of simple machines [i.e., pulleys, levers, inclined planes (including wedge and screw), wheel-and-axles].<br>• Understand that simple machines are used to reduce the force needed to move an object while increasing the distance over which that force is applied.<br>• Friction will reduce the output of simple machines, or increase the amount of force needed (e.g., frictional forces do not affect the force needed to lift a box vertically without a simple machine but do increase the force needed to slide a box up an inclined plane).<br>• The force needed to move an object can be reduced by combining two or more simple machines to create one machine.<br>• Understand that the force required to lift an object without a simple machine is equal to the weight of the object, but a simple machine can lift the object with a force less than its weight.<br>• Note: Use graphics where possible. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.4.2<br>The student understands that when work is done energy is transformed from one form to another, including mechanical, heat, light, sound, electrical, chemical, and nuclear energy, yet is conserved. | • MC<br>• Mid Level Knowledge Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • When energy is transformed from one form to another, does the amount of energy - increase, decrease, or stay the same?<br>• Sequence the transformation of energy through various real-life systems.<br>• Design an energy-transformation device using various forms of energy that will accomplish a simple task, such as popping a balloon.<br>• Describe the energy transformations through a telephone from the caller's voice to the listener's ear. | a. Identify mechanical, heat, light, sound, chemical, electrical, and nuclear as forms of energy and identify related energy source (e.g., sun, fossil fuel, wind, battery).<br>b. Describe or identify the possible transformations among the forms of energy in simple systems (e.g., flashlight, coal-burning electrical power plant, telephone).<br>c. Understand that energy is conserved in transformations.<br>d. DO NOT assess types of nuclear energy.<br>e. DO NOT assess or include potential or kinetic energy. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.4.3<br>The student observes and communicates how light (electromagnetic) energy interacts with matter: transmitted, reflected, refracted, and absorbed. | • MC<br>• Mid Level Knowledge Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Classify classroom objects as to how they interact with light: a window transmits; black objects absorbs; a projector lens refracts; smooth shiny objects reflect images. | a. Know that we see objects because they reflect or produce light (e.g., A leaf can be seen because it reflects light. The sun can be seen because it makes its own light.).<br>b. Distinguish among and describe examples and graphic representations of transmission, absorption, reflection, and refraction.<br>c. Predict the type of interaction that occurs when light encounters the surface of a given material (i.e., transmission, reflection, absorption, or refraction).<br>d. Understand that white light is made of many colors.<br>e. Understand that the color of an object is determined by the color of light reflected by the object.<br>f. Predict the angle of reflection given the angle of incidence.<br>g. DO NOT assess the term electromagnetic energy. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.2.4.4<br>The student understands that heat energy can be transferred from hot to cold by radiation, convection, and conduction. | • MC<br>• Mid Level Knowledge Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Which illustration best shows the transfer of heat by convection? | a. Identify the type of heat transfer in a process or simple system as radiation, convection, conduction or any combination of the three.<br>b. Describe the characteristics of transfer by radiation (through some materials and across empty space), convection (movement of material in liquids and gases), and conduction (through material by the collision of particles).<br>c. Compare the relative ability of materials to transfer heat by conduction, convection, or radiation.<br>d. Predict the net direction of heat transfer in a system given initial temperatures of substances.<br>e. Predict changes in temperature given initial temperatures of two objects of the same substance in a system (Objects can be different sizes.) |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.1.1<br>The student will understand the cell theory; that all organisms are composed of one or more cells, cells are the basic unit of life, and that cells come from other cells. | • MC<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Test Specification Notes (recommended)** |
| • Include an item on the Cell Theory – that all living things are made of one or more cells, cells are the basic unit of living things, and cells come from preexisting cells.<br>• Compare parts of cells and their function with parts of multi-cellular organisms and their functions. | a. Identify the cell as the basic unit of living organisms.<br>b. Know that some organisms consist of only one cell.<br>c. Recognize that each single-celled organism must perform all the following functions required for life:<br>i. Gas exchange<br>ii. Locomotion<br>iii. Intake of nutrients<br>iv. Disposal of waste<br>v. Stimulus response<br>vi. Reproduction<br>d. Understand that different cells have different functions in a multi-cellular organism. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.1.2<br>The student relates the structure of cells, organs, tissues, organ systems, and whole organisms to their functions. | • MC<br>• High Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Compare and contrast plant and animal cells.<br>• Describe the functions of the digestive and or circulatory systems.<br>• Sequence the structures of living things from the least complex to the most complex – cells, tissues, organs, organ systems, organism<br>• Identify human body organs and characteristics and relate their characteristics to function.<br>• Compare and contrast plant and animal cells. | a. Identify human body organs and their characteristics and relate characteristics to function (i.e., circulatory, respiratory, digestive, integumentary, immune, skeletal, and nervous).<br>b. DO NOT assess interactions between organ systems.<br>c. Compare and contrast plant and animal cells (i.e., cell wall, cell membrane, chloroplast, nucleus, and cytoplasm).<br>d. Understand that body cells of multi-cellular organisms reproduce for growth and repair of tissue. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.2.1<br>The student differentiates between asexual and sexual reproduction of organisms. | • MC<br>• Low Level Knowledge Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Which of the following is an example of regeneration?<br>• Which of the following can reproduce both sexually and asexually?<br>• Which of the following is an important trait of sexual reproduction?<br>• Which form of reproduction requires sex cells?<br>• Compare the propagation of new plants from cuttings (which skips a portion of the life cycle) with the process of producing a new plant from fertilization of an ovum.<br>• Observe and communicate the life cycle of an organism. | a. Compare asexual propagation of plants with sexual reproduction (e.g., pollination and fertilization of an ovum)<br>b. Recognize many single-celled organisms reproduce asexually.<br>c. Understand that the ability to reproduce is an essential requirement for the survival of every species.<br>d. AVOID using planaria on test questions; use plant cuttings as an example of regeneration. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.3.1<br>The student understands that internal and/or environmental conditions affect an organism's behavior and/or response in order to maintain and regulate stable internal conditions to survive in a continually changing environment. | • MC<br>• Mid Level Knowledge Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • A runner sweats to –<br>• Select a variable to alter the environment (e.g., temperature, light, moisture, gravity) and observe the effects on an organism (e.g., pillbug or earthworm).<br>• Evaluate the effects of environmental conditions on ones own behavior.<br>• Observe the response of the body when competing in a running event. (In order to maintain body temperature, various systems begin cooling through such processes as sweating and cooling the blood at the surface of the skin).<br>• Investigate the effects of various stimuli on plants and how they adapt their growth (e.g., phototropism, geotropism and thermotropism). | a. Describes/predicts the response of the human body (innate responses) when internal or environmental conditions change (e.g., In order to maintain body temperature during running a race or in a hot environment, various systems begin cooling through such processes as sweating and cooling the blood at the surface of the skin.).<br>b. Describes/predicts the effects of various stimuli on plants and how they adapt their growth (e.g., phototropism, geotropism, and thermotropism).<br>c. Describe plant and animal responses to seasonal changes (e.g., nocturnal, migration, hibernation, color change, fur length).<br>d. Understand that disease in an organism creates an imbalance in internal conditions. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.4.1<br>The student recognizes that all populations living together (biotic resources) and the physical factors (abiotic resources) with which they interact compose an ecosystem. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • In a food web diagram, remove a species and have students predict what will happen to the remaining population sizes.<br>• Have students identify biotic and abiotic factors in an ecosystem.<br>• Predict the possible affects of a drought on the various populations in an ecosystem.<br>• Create a classroom terrarium and identifies the interactions between the populations and physical conditions needed for survival.<br>• Participate in a field study examining the living and non-living parts of a community.<br>• Change variables such as wheat crop yield, mice, or a predator, and chart the possible outcomes. | a. Identify biotic and abiotic factors in an ecosystem.<br>b. Describe how biotic and abiotic factors in an ecosystem interact.<br>c. Understand how changes in abiotic or biotic factors affect populations of organisms (e.g., fire, flood, drought, parasite infestation, non-native species introduction).<br>d. DO NOT specifically address limiting factors (not state assessable per S.7.3.4.3). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.4.3<br>The student traces the energy flow from the sun (source of radiant energy) to producers (via photosynthesis – chemical energy) to consumers and decomposers in food webs. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Include the sun in all pictures of ecosystems related to food webs.<br>• Understand that radiant energy from the sun is changed into chemical energy by plants through the process of photosynthesis.<br>• Identify the role of various organisms as a producer, consumer, and/or decomposer in an ecosystem/food web.<br>• Explore populations at a stream, pond, field, forest floor, and/or rotting log.<br>• Identify the various food webs and observe that organisms in a system are classified by their function. | a. Understand that a food web shows how energy is transferred from organism to organism in an ecosystem.<br>b. Understand the importance of photosynthesis to all life.<br>c. Define the terms *producer, consumer,* and *decomposer* in terms of their role in a food web.<br>d. Understand that fungi and bacteria are true decomposer organisms that break down organic matter into the smallest compounds. DO NOT use earthworms, beetles, ants, etc. as examples of decomposers (either as correct or incorrect examples).<br>e. Understand that the amount of energy available for living organisms in and ecosystem decreases from producer to consumer.<br>f. Know that energy passes out of a food web through heat at every level of the food web (i.e., from cell functions and through decomposers breaking down organic matter).<br>g. Describe how a change in the population of one member of a food web affects populations of other members of the food web. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.5.2<br>The student understands that adaptations of organisms (changes in structure, function, or behavior that accumulate over successive generations) contribute to biological diversity. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • A bird with a long slender beak is most likely to eat …<br>• Adaptations are the traits resulting from genetic changes that lead to biological diversity over many generations.<br>• Compare characteristics of birds such as beaks, wings, and feet, with how a bird behaves in its environment. Relate characteristics and behaviors of a bird with its structures. | a. Understand that a species changes as the individual organisms best adapted to survive in the environment tend to survive and reproduce offspring with similar characteristics.<br>b. Relate biological diversity to environmental diversity.<br>c. Understand that organisms' adaptations are the result of random genetic variations.<br>d. Understand that natural selection requires genetic diversity of individuals in a population.<br>e. Understand that change through natural selection does NOT involve changes in an INDIVIDUAL member of a species during its lifetime.<br>f. Know that scientists learn how species have adapted (structure, function, or behavior) over time by studying the fossil record, genetic material, and characteristics of living species.<br>g. Identify the development of adaptations for survival in a given environment (e.g., development of fins for water, legs for land movement, wings for flying).<br>h. Use the terms adaptation, biological change over time, or natural selection. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.3.5.3<br>The student associates extinction of a species with environmental changes and insufficient adaptive characteristics. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • If the environment changes quickly and there is not enough time for individuals in a population to develop adaptive characteristics to survive, then the species will –––––––<br>• Why are the wooly mammoths gone from Kansas?<br>• Use various objects to model bird beaks, such as spoons, toothpicks, clothespins. Use "beaks" to "eat" several types of food, such as cereal, raisins, noodles. (When "food" sources change, those species that have not adapted die.) | a. Understand that a species becomes extinct if its environment changes faster than the process of natural selection allows the species to adapt to the change.<br>b. Know that natural selection is a relatively slow process but can be observed directly in species with very short life spans (e.g., insects, bacteria).<br>c. Explain that genetic diversity among the individual members of a species increases the chances of the species surviving environmental change.<br>d. Understand that extinction is a natural process, NOT just the result of human activity. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.4.1.1<br>The student identifies properties of the solid earth, the oceans and fresh water, and the atmosphere. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Know that the four major interacting Earth systems are the geosphere (crust , mantle, core), hydrosphere, atmosphere, and biosphere.<br>• Compare the properties of ocean (salt) water and fresh water.<br>• Compare the heating and cooling of water and land.<br>• Describe the composition of the atmosphere as consisting of nitrogen, oxygen, carbon dioxide, water vapor, other gases and particles.<br>• Measure sediment load in a nearby stream.<br>• Investigate water's major role in changing the solid surface of earth, such as the effect of oceans on climates and water as an erosion force. | a. Locate the relative position and properties of the crust, mantle, and core.<br>b. Understand that water is found on Earth's surface, beneath Earth's surface, and in Earth's atmosphere.<br>c. Distinguish between salt and fresh water and know the places where each is located.<br>d. Understanding that the primary gases found in the atmosphere are nitrogen, oxygen, water vapor, and carbon dioxide.<br>e. Know that ozone layer is part of the upper atmosphere. DO NOT assess the function of the ozone layer to absorb ultraviolet radiation.<br>f. Know that inside of Earth, temperature and pressure increase as depth increases.<br>g. Know that in Earth's atmosphere, temperature and pressure change as altitude increases. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.4.1.2<br>The student models earth's cycles, constructive and destructive processes, and weather systems. | • MC<br>• Mid Level Knowledge & Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Identify the missing part of the water cycle; evaporation, condensation, precipitation, runoff, infiltration (ground water), or transpiration (water from plants)<br>• Identify a naturally occurring event, such as a volcanic eruption, a hurricane, or a rainstorm, as a constructive or destructive force.<br>• Identify the temperature (warm or cold) and humidity (high or low) of air masses formed over polar or tropical and marine or continental areas.<br>• Illustrate global ocean and wind currents.<br>• Investigate weathering, erosion, and deposition. | a. Distinguish between constructive processes (e.g., any type of deposition, mountain building) and destructive processes (e.g., weathering and erosion, mass movement of material from high to low elevations).<br>b. Distinguish between specific examples of fast and slow processes that shape Earth's surface. (The relative time frame may need to be stated to determine speed of process.)<br>c. Describe the processes and rock types involved in the rock cycle (i.e., Sedimentation and compaction form sedimentary rocks; heat and pressure form metamorphic rocks; and melting and cooling form igneous rocks.).<br>d. Describe the processes and causes of weathering, erosion, and deposition.<br>e. Identify the major components of soil (i.e., organic matter, weathered rock, water, air).<br>f. Describe the processes that form soil.<br>g. Understand that Earth's climate has undergone dramatic global changes in climate in the past and cite evidence (e.g., fossils, landforms, glacial action, rock layers, ancient ocean beds). (See also S.7.4.2.1. for causes of global |

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| | climate changes.)<br>h. Describe the steps in the water cycle, including phase changes, and understand that the cycle is driven by solar energy (i.e., evaporation, condensation, precipitation, runoff, transpiration, glaciers, and fresh and salt water bodies). Only use transpiration in limited water cycles focused on plants as vital components.<br>i. Understand the effects of global ocean and wind currents.<br>j. Understand the effects of landforms and bodies of water on weather systems.<br>k. Explain how temperature and pressure differences cause wind patterns. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.4.2.1<br>The student understands that earth processes observed today (including movement of lithospheric plates and changes in atmospheric conditions) are similar to those that occurred in the past; earth history is also influenced by occasional catastrophes, such as the impact of a comet or asteroid. | • MC<br>• Pictures<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Plate tectonics – Lithospheric plates move (continental drift) because convection currents in the Earth's mantle cause sea-floor spreading. This also causes mountain building, volcanoes, and earthquakes. (Include diagrams.)<br>• Historically, rock types, fossil remains, and indicators of climatic change provide evidence for continental drift. (Use a map.) | a. Describe how Earth's crust is composed of large tectonic plates that are in constant motion because of convection currents in the mantle.<br>b. Describe how plate theory is related to continental drift. Identify evidence of continental drift.<br>c. Relate movement at plate boundaries to land forms (i.e., identify diverging plates with mid-ocean ridges and rift valleys, identify subduction boundaries with ocean trenches and coastal mountains, identify converging boundaries with mountains.<br>d. Relate volcanic activity, geothermal activity, and earthquakes to plate boundaries (e.g., Ring of Fire).<br>e. If occasional catastrophes are included in relation to climate change and mass extinction, they SHOULD BE LIMITED to those with total global consequences, such as massive volcanic eruptions and asteroid impacts, and NOT those resulting in regional disasters (e.g., tsunami, earthquake). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.4.3.1<br>The student compares and contrasts the characteristics of stars, planets, moons, comets, and asteroids. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Given a description of a star, planet, moon, comet, or asteroid, the student will identify the object.<br>o Star – a very large gaseous body usually made up of a high percentage of hydrogen that emits energy.<br>o Planet – a large, rocky or gaseous, spherically shaped object that circles a star.<br>o Moon – a smaller object that circles a planet.<br>o Asteroid – a smaller, irregular-shaped rocky object that circles a star.<br>o Comet – a smaller, irregular-shaped gaseous object that circles a star in a narrow elliptical orbit.<br>• Identify the sun as a star and compare its characteristics to those of other stars.<br>• Classify bright stars visible from Earth by color, temperature, age, apparent brightness, and distance from earth.<br>• Create a graphic organizer to visualize comparisons of planets. | a. Identify the sun as a star and know that it produces its own light.<br>b. Identify an object as a star, planet, moon, asteroid, or comet, based on its description.<br>c. Identify planets in our solar system and compare their characteristics (includes the use of data tables).<br>d. Understand that a star produces its own light, and planets and moons reflect light.<br>e. Know the relative sizes, distances, and motions of common objects in the sky. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.4.4.1<br>The student demonstrates and models object/space/time relationships that explain phenomena such as the day, the month, the year, seasons, phases of the moon, eclipses, and tides. | • MC<br>• High Level Knowledge & Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Rotation = one complete turn of Earth around its axis = one day  Also, understand the appearance of sunrise/sunset.<br>• Earth's revolution around the sun = one year.<br>• Seasons are caused by the tilt of a planet on its axis during its orbit around the sun.<br>• The gravitational pulls between the sun, Earth, and moon are mainly responsible for causing tides.<br>• Moon phases occur because the illuminated portion of the moon appears different as the angles between the sun, the moon, and Earth change as the moon orbits Earth. (Given a photo of a moon phase, identify the correct diagram showing the sun/Earth/moon positions.)<br>• Use an Earth/moon/sun model to demonstrate a day, a month, a year, and the seasons. | a. Know that one rotation of Earth on its axis equals 24 hours or 1 day.<br>b. Know that one revolution of Earth in its orbit around the sun equals 1 year or about 365 days.<br>c. Know that one revolution of the moon around Earth equals about one month.<br>d. Identify the correct order of moon phases and know the relative locations of Earth, the moon, and the sun during each phase.<br>e. Explain the relationship between gravitational forces and tides.<br>f. Recognize the positions of Earth, the moon, and the sun during solar and lunar eclipses.<br>g. Explain that the tilt of Earth's axis causes seasonal changes during its orbit around the sun.<br>h. Given an Earth-sun diagram, match the season to the hemisphere. Know that distance from the sun does not cause seasons on Earth. |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.6.1.1<br>The student identifies individual nutrition, exercise, and rest needs based on science and uses a scientific approach to thinking critically about personal health, lifestyle choices, risks, and benefits. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Given various scenarios, identify the major health risk of:<br>o Smoking<br>o Drug and alcohol use<br>o Poor eating habits<br>o Poor hygiene<br>o Lack of regular exercise<br>• Design, implement, and self-evaluate a personal nutrition and exercise program.<br>• Compare and contrast immediate benefits of eating junk food to long term benefits of a lifetime of healthy eating.<br>• Evaluate the risks and benefits of foods, medicines, and personal products.<br>• Evaluate and compare the nutritional and toxic properties of various natural and synthetic foods. | a. List the types of foods and nutrients (i.e., proteins, fats, carbohydrates/sugars, fiber, vitamins, minerals, water intake) in appropriate portions that make up a healthy diet.<br>b. Choose the healthiest menu (including vegetarian options) from a list of possibilities.<br>c. Identify environmental health hazards, including pollutants, household chemicals, and ultraviolet solar radiation.<br>d. Understand the benefits and risks of legal drugs, medicines, and substances and the dangers of illegal drugs. For example, identify the types of diseases people are more susceptible to if they smoke or use smokeless tobacco. Understand that nicotine is one of the most addictive drugs.<br>e. Understand that alcohol is an addictive drug. Alcohol reduces coordination.<br>f. Understand that the benefits of regular exercise include increased strength, muscle tone, stamina, weight control, mental alertness, bone strength, and a healthy cardiovascular system.<br>g. Describe the importance and characteristics of a healthy cardiovascular system.<br>h. Describe the benefits of aerobic exercise.<br>i. Understand the benefits of the proper amount of sleep (e.g., disease resistance, increased mental alertness, and stamina). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.6.2.1<br>The student investigates the effects of human activities on the environment and analyzes decisions based on the knowledge of benefits and risks. | • MC<br>• Mid Level Knowledge & Process Question |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Identify the benefits and risks of various scenarios:<br>o Stream channelization: The benefit is decreased local flooding; the risk is increased erosion & runoff.<br>o Burning fossil fuels: The benefit is a relatively inexpensive source of energy in the short term; the risk is long term environmental damage from global warming, acid rain, etc.<br>o Urban sprawl<br>o Overpopulation<br>o Soil erosion<br>• Investigate the effects of traffic volume on environmental quality (e.g., water and air quality, plant health).<br>• Evaluate the benefits of burning fossil fuels to meet energy needs against the risks of increased air pollution, etc. | a. Describe the greenhouse effect, identify $CO_2$ as the major greenhouse gas, and explain the concern over greenhouse gas buildup in the atmosphere.<br>b. Describe the benefit of the ozone layer and the hazards caused by a thinning ozone layer.<br>c. Describe the causes and effects of pollution resulting from human activities that harm the environment (e.g., various forms of soil, water, and air pollution, including pesticides, greenhouse gases, CFCs, acid rain from $SO_2$ emissions, thermal pollution).<br>d. Describe ways in which human activities benefit the environment or reduce the harm done to the environment (e.g., reforestation, habitat restoration, recycling, non-polluting energy sources).<br>e. Describe the effects of land management practices (e.g., introduction of non-native species, soil erosion from certain farming techniques, logging and mining practices, and overdrawing water from the water table).<br>f. Describe the role of humans in causing and preventing species extinction.<br>g. Compare and contrast renewable and non-renewable resources and relate rate of usage to future supplies.<br>h. Understand how personal choices and practices affect the environment (e.g., recycling, choice of fuels and transportation, energy conservation measures). |

# Grade 7

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.7.7.2.1<br>The student recognizes that new knowledge leads to new questions and new discoveries, replicates historic experiments to understand principles of science, and relates contributions of men and women to the fields of science. | • MC<br>• Mid Level Knowledge & Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Sequence of events to describe how one discovery led to another which led to the germ theory, or plate tectonics or evolution.<br>• Identify the contributions of Newton, Galileo, Darwin, Mendel, and Wegener. | a. Know that science began when humans began asking questions about their environment and that discovery and increased understanding motivate scientists today.<br>b. Know that the current body of scientific knowledge has developed over thousands of years and began in several ancient cultures.<br>c. Describe how scientific understanding usually progresses in small steps as old theories are added to and modified to account for new information.<br>d. Understand that sudden scientific breakthroughs that completely change our view of the world are very rare.<br>e. Describe the scientific community as being made up of men and women of diverse nationality, race, and ethnicity.<br>f. Understand that scientists check each other's results and conclusions and that scientists welcome these checks.<br>g. Match scientists with their contributions (i.e., Galileo with astronomy, Newton with laws of motion, Pasteur with germ theory, Wegener with plate theory, Mendel with genetics, Darwin with natural selection, Einstein with relativity, the Curies with radioactivity). Use the full names of scientists.<br>h. Understand that science has become more experimental and less philosophical since ancient times. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.1.1.2<br>The student actively engages in investigations, including developing questions, gathering and analyzing data, and designing and conducting research. | • MC<br>• Hypotheses in test questions should be written in "if/then" format.<br>• High Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Formulate a testable hypothesis.<br>• Utilize variables, such as independent, dependent, and variables that need to be controlled.<br>• Use methods for gathering data that are observable, measurable, and replicable.<br>• Analyze and evaluate the results in order to clarify the questions and hypotheses, and to refine methods for further research.<br>• Given a data table, identify the question being investigated.<br>• Given a hypothesis, choose the graph that supports the hypothesis.<br>• Given a data table, identify the conclusion that supports the data.<br>• Identify the independent and dependent variable given an experimental procedure and resulting data.<br>• Explain the need to control a variable during the course of an experiment. | a. Distinguish between testable and untestable questions. Testable questions address phenomena that are measurable, repeatable, and can be proven or disproved using scientific methods. Untestable questions involve matters of opinion, preference, values, or religious or philosophical beliefs to which the scientific method cannot be applied.<br>b. Recognize that a scientific method of investigation is not a rigid, inflexible sequence of steps. An investigation may loop several times from data analysis back to hypothesis before reaching final conclusions.<br>c. Given a scenario with an unresolved problem, state a question that could be the basis of a scientific investigation to resolve the problem.<br>d. Design a procedure to investigate a stated question.<br>e. Given an experimental procedure, identify the question being tested.<br>f. Explain the relationship between the sample size or the number of trials during an investigation and the validity of results.<br>g. Explain the purpose of a control group in an experimental design and identify investigations where a |

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| | control group is appropriate.<br>h. Choose an appropriate format (e.g., data table, diagrams, etc.) for collecting or recording data. Item ideas may include appropriate units of measure, column and row headings, appropriate table format, and adequate space to record data for all samples. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.1.1.3<br>The student actively engages in using technological tools and mathematics in their own scientific investigations. | • MC<br>• Mid Level Process Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Describe the use of a variety of technologies, such as, measuring instruments, calculators, and computers as an integral component of scientific investigations.<br>• Use common mathematical functions (linear, exponential, comparison to mean value, etc.) to analyze and describe data. (e.g., mean, median, mode, deviation from the mean, unit conversions.)<br>• Use statistical and graphing data analysis techniques.<br>• Recognize that the accuracy and precision of the data, and therefore the quality of the investigation, depends on the instruments used.<br>• Use equipment properly and safely (i.e., heat sources, glassware, and electrical devices).<br>• Choose the instrument needed to determine a given property (e.g., mass, time intervals, density, emission spectrum, etc.). | a. Relate precision in measurement tools and in reporting measurements to the scale and units used.<br>b. Choose the most appropriate graphing format (including scale) to display and analyze data.<br>c. Identify and utilize appropriate units of measure for properties.<br>d. DO NOT assess use of equipment that is not common to most high school laboratories. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2A.1.1<br>The student understands that atoms, the fundamental organizational unit of matter, are composed of subatomic particles. Chemists are primarily interested in the protons, electrons, and neutrons found in the atom. | • MC<br>• Diagram<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| | a. Identify the relative masses, charges, and locations of electrons, protons, and neutrons in an atom.<br>b. Know that the number of electrons equals the number of protons in a neutral atom and that the number of neutrons is not necessarily the same.<br>c. Understand that materials made of one kind of atom are elements.<br>d. Understand that the total size of an atom is determined by the number of electrons and by the strength of their electrostatic attraction to the nucleus.<br>e. Describe the Bohr model of the atom and relate the model to the energy levels of the electrons.<br>f. Understand that the electron clouds of the current atomic model represent the probabilities of finding electrons in various locations. |

# High School Physical Science

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.2A.2.1<br>The student understands chemists use kinetic and potential energy to explain the physical and chemical properties of matter on earth that may exist in any of these three states: solids, liquids, and gases. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| a. Elements and molecules may exist as gases, liquids or solids. Ionic compounds most commonly exist as solids<br>b. Intermolecular attraction (attraction between molecules) determines the state of the molecule. Examples of intermolecular attraction include hydrogen bonding, permanent dipole interaction, and induced dipole interaction. Gases have the weakest and solids have the greatest intermolecular attraction. The hydrogen bond is an intermolecular attraction responsible for the properties of water and many biological molecules. | a. Know that particles in all states of matter are in motion (even particles in a solid).<br>b. Relate models showing motion, spacing, and/or arrangement of particles to the physical state of a material.<br>c. Understand that temperature is a measure of the average kinetic energy of the particles of a material.<br>d. Understand that the strength of the forces between particles is related to the state of matter.<br>e. Understand that energy is absorbed or released during phase changes.<br>f. Understand that the polarity of water molecules is responsible for hydrogen bonding between molecules.<br>g. Understand that the unique properties of water are based on the molecular polarity of the water molecules (e.g. water is less dense as a solid than as a liquid, water is most dense at $4^{o}$ C)<br>h. Know that chemical potential energy is stored in chemical bonds.<br>i. The attractive forces in ionic bonds and in intermolecular bonds are related to the energy needed to change states of matter (e.g., relatively more energy is needed to boil water due to its molecules' polarity; more energy is needed to melt ionic solids due to the strong attraction between the ionic charges).<br>j. DO NOT address intramolecular forces. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2A.2.2<br>The student understands the periodic table lists elements according to increasing atomic number. This table organizes physical and chemical trends by groups, periods, and sub-categories. | • MC<br>• Periodic Table<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Elements in the same group share similar chemical properties because they have the same number of valence electrons.<br>• Periods indicate the energy level of the outermost (valence) electrons.<br>• Identify the regions of the periodic table occupied by metals, non-metals, noble gases, and transition elements.<br>• Describe the arrangement of elements in the periodic table.<br>• Recognize which elements have similar chemical properties.<br>• All questions MUST reference the periodic table OR electron configuration. | a. Know that the first periodic table was arranged to illustrate that properties of elements form a repeating (periodic) pattern as the atomic number of elements increases, and understand that it was later discovered that this pattern is explained by a repeating pattern of electron configurations.<br>b. Relate the information for an element in the periodic table to its atomic number, atomic mass, electron configuration, and the numbers of electrons, protons, and neutrons. |

# High School Physical Science

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.2A.2.3<br>The student understands chemical bonds result when valence electrons are transferred or shared between atoms. Breaking a chemical bond requires energy. Formation of a chemical bond releases energy. Ionic compounds result from atoms transferring electrons. Molecular compounds result from atoms sharing electrons.<br>For example, carbon atoms can bond to each other in chains, rings, and branching networks. Branched network and metallic solids also result from bonding. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • *Valence electrons (those farthest from the nucleus or highest energy electrons) determine the chemistry of the atom.*<br>• *Ionic compounds are composed of positively charged ions called cations and negatively charged ions called anions. Most cations are metals; most anions are non-metals.*<br>• *Molecules results when two or more nonmetals form covalent bonds by sharing one or more pairs of electrons.*<br>• *Identify groups of elements most likely to form ionic compounds.*<br>• *Identify elements most likely to form cations and elements most likely to form anions.* | a. Predict bond type and ionic charge based on electron configuration, position in the periodic table, or metallic/nonmetallic character.<br>b. Predict and diagram bond type, bond order, and chemical formula by applying the octet rule.<br>c. Construct and interpret electron dot-diagrams (Lewis structures).<br>d. Understand that polar bonds result from unequal sharing of electrons between bonded atoms.<br>e. Predict properties based on bond polarity (e.g., solubility, boiling point).<br>f. Reactions may absorb energy if the bonds formed in a reaction have greater potential energy than the bonds that were broken (endothermic reactions)<br>g. Reactions may release energy if the bonds formed in a reaction have less potential energy than the bonds that were broken (exothermic reactions). For example, respiration in biology<br>h. Energy may be needed to start a reaction; this energy is used to break bonds<br>(activation energy)<br>i. A catalyst may increase the rate of a chemical reaction by reducing the activation energy.<br><br>DO NOT USE ΔH |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2A.3.1<br>The student understands a chemical reaction occurs when one or more substances (reactants) react to form a different chemical substance(s) (products). There are different types of chemical reactions all of which demonstrate the Law of Conservation of Matter and Energy. | • MC<br>• Equations or equivalent provided<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Chemical reactions are written as chemical equations, which demonstrate the Law of Conservation of Mass through stoichiometric relationships. | a. Identify the products and reactants of a reaction.<br>b. Identify a balanced chemical equation, and provide ONE missing coefficient to balance a simple chemical equation.<br>c. Determine proportionate amounts of reactants required or products produced from chemical equations by applying relationships expressed by a balanced chemical equation.<br>d. Describe chemical processes at the molecular level (e.g., forming and breaking bonds).<br>e. Recognize that coefficients in chemical equations represent ratios of atoms (as opposed to masses of materials).<br>f. DO NOT assess identification of specific types of reactions (i.e., synthesis, decomposition, combustion, single and double replacement, acid/base, and oxidation/reduction). |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2B.1.1<br>The student understands Newton's Laws and variables of time, position, velocity, and acceleration can be used to describe the position and motion of particles. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • The kinematic variables of position, velocity, and acceleration can most concisely be described as vectors.<br>• Velocity describes how position changes and acceleration describes how velocity changes.<br>• From the definitions of velocity and acceleration, one can derive equations that relate the kinematic variables.<br>• Acceleration occurs when there is either a change in speed or a change in direction. In the case of uniform circular motion, the acceleration points towards the center of the circle. The magnitude of this acceleration can be constant, and is related to the speed of the object and the radius of the circle.<br>• In the absence of a net force, an object's velocity will not change.<br>• In the presence of a net force, an object will experience an acceleration, which is modeled mathematically by Newton's second law.<br>• The force that one object exerts on a second object has the same magnitude but opposite direction as the | a. Recognize that gravity is the force that accelerates falling objects.<br>b. Know that gravitational force between two objects increases with the masses of the objects and decreases with the distance between the objects. DO NOT assess quantitative calculations.<br>c. Describe weight as the measurement of the gravitational force between objects.<br>d. Describe mass as the measurement of the amount of matter in an object and the source of an object's inertia.<br>e. Understand that an object's mass is constant but its weight may change depending on location.<br>f. Identify friction and air resistance as the cause of apparent deviations from the first law of motion when observing the motion of objects on Earth.<br>g. Interpret graphs of distance vs. time and velocity vs. time (e.g., What does the slope represent? When was the velocity constant?).<br>h. Predict the change in motion of an object acted on by an unbalanced force.<br>i. Given one force of an action-reaction pair, identify the other. |

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| force that the second object exerts on the first.<br>• Identify speed and direction as the quantities that determine velocity.<br>• Given the forces acting on an object, qualitatively describe its motion (single object, could be multiple forces). Predict the general direction of motion (e.g., north, northeast…), but DO NOT require calculation of exact angles by vector analysis. | j. DO NOT assess identification of laws of motion by name or label.<br>k. DO NOT distinguish between speed and velocity or use together. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2B.2.2<br>The student understands the first law of thermodynamics states the total internal energy of a substance (the sum of all the kinetic and potential energies of its constituent molecules) will change only if heat is exchanged with the environment or work is done on or by the substance. In any physical interaction, the total energy in the universe is conserved. | • MC<br>• Diagram<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • There are different manifestations of energy. Kinetic energy is the energy an object possesses due to its motion. Gravitational potential energy is the energy due to the separation of masses. Electric potential energy is the energy due to the separation of charges. Kinetic and potential energy combined are known as mechanical energy.<br>• Heat is an exchange of internal (kinetic and/or potential) energy between systems due to a temperature difference. Examples of heat transfer include radiation from the sun, convection of hydrosphere/atmosphere/mantle, and conduction between water/land/air.<br>• A force that has a component parallel to the direction of motion of an object is said to do work on that object. The work done on an object may be positive or negative. When positive work is done on an object, it increases the object's energy. Negative work decreases the object's energy. | a. Identify the form of energy in an example as being mechanical (potential and kinetic), heat, light, sound, chemical, electrical, or nuclear.<br>b. Trace energy transfers and transformations through a system (e.g., trace energy from a commercial power source to a household appliance).<br>c. Distinguish between heat and temperature in terms of particle motion (i.e., heat is the total kinetic energy of the particles; temperature, in Kelvins, is proportional to the average kinetic energy of the particles).<br>d. Understand that energy is conserved in a closed system and that energy transfers and transformations do not change the amount of energy.<br>e. Compare quantities of work done, given force and distance data.<br>f. Compare quantities of power generated, given time and work or time, distance, and force data. |

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| • There is a relationship between energy and power. Power is the rate at which work is done, or the rate at which the energy of some system changes.<br>• Recognize kinetic and potential energy.<br>• EXCLUDE questions about heat unless focused on convection, conduction, and radiation.<br>• Emphasize conceptual understanding instead of calculations. | |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2B.3.2<br>The student understands waves have energy and can transfer energy when they interact with matter. | • MC<br>• Diagram of waves<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Waves are traveling disturbances, which transport energy without the bulk motion of matter. In transverse waves, the disturbance is perpendicular to the direction of travel. In longitudinal waves, the disturbance is parallel to the direction of travel.<br>• There are many different types of waves. Examples are water waves, sound waves, and electromagnetic waves. Visible light, radio waves, and X-rays are all examples of electromagnetic waves. Periodic waves can also be described in terms of their wavelength, frequency, period, and amplitude.<br>• All waves can be described in terms of their velocities. The velocity of most types of waves depends on the medium in which they are traveling. There is a relationship between the speed, wavelength, and frequency of a periodic wave. The frequency of sound waves is related to the pitch we perceive. Different wavelengths of visible light correspond to different colors.<br>• Understand that waves can exhibit constructive and destructive interference.<br>• Diffraction is the bending of a wave around an obstacle or an edge. When this happens, different | a. Explain the Doppler Effect and predict the difference between the pitch emitted and the pitch perceived when the source and observer are in motion relative to one another.<br>b. Predict the relative speed of light and sound through various media.<br>c. DO NOT assess refraction quantitatively (as calculated by Snell's Law). |

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| intensities (i.e., diffraction patterns) of the wave are observed due to the wave interfering with itself.<br>• When light reflects from a surface, the angle of incidence is equal to the angle of reflection. When light propagates from one transparent medium to another, it bends (refracts) at the interface. Predict the path of rays passing through concave and convex lenses and reflected from concave and convex mirrors. | |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.2B.3.5<br>The student understands electromagnetic waves result when a charged particle is accelerated or decelerated. | • MC<br>• Diagram of the electromagnetic spectrum<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Electromagnetic waves include radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. The energy of electromagnetic waves is carried in packets and has a magnitude that is inversely proportional to the wavelength.<br>• Understand that an accelerating charged particle produces an electromagnetic wave.<br>• Some particles, such as protons and electrons, have a physical property known as charge. There are two types of charge, positive and negative. Two charged particles or objects exert a force on each other, which is attractive between unlike charges and repulsive between like charges.<br>• This force increases with the magnitude of the charges and decreases with the distance between the charges. | a. Understand that moving charges generate magnetic fields.<br>b. Understand that the relative motion of a magnetic field to an electrical conductor induces an electric current in the conductor. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.4.1.2<br>The student understands the theory of Plate Tectonics explains that internal energy drives the Earth's ever changing structure. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Movable continental and oceanic plates make up Earth's surface; the hot, convecting mantle is the energy source for plate movement.<br>• Convection circulation in the mantle is driven by the outward transfer of Earth's internal heat.<br>• Identify convection currents in the mantle as the cause of movement in Earth's tectonic plates. | a. Describe evidence supporting the theory of continental drift (e.g., jigsaw puzzle fit of continents and matching rock formations, locating similar fossils where coastlines appear to have drifted apart, magnetic striping of ocean floors at mid-oceanic ridges).<br>b. Explain volcanic and seismic activity in terms of plate boundaries. Interpret a map showing plate boundaries and volcanoes and earthquakes.<br>c. Identify the three kinds of plate boundaries and match each to the resulting landforms (i.e., mid-ocean ridges and rift valleys at divergent plate boundaries; mountains at convergent plate boundaries—note differences depending on whether the plates are both continental or one is oceanic and one continental; slip [transform] boundaries displace surface features). |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.4.3.2<br>The student understands the relationship between the earth, moon, and sun explains the seasons, tides, and moon phases. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • The angle of incidence of solar energy striking Earth's surface affects the amount of heat energy absorbed at Earth's surface.<br>• The gravitational relationship between Earth, the moon, and the sun causes tides.<br>• Identify the moon as having the greatest effect on the tides of Earth's oceans.<br>• Explain why the lunar eclipses occur only at the time of a full moon and solar eclipses only occur at the time of a new moon. | a. Explain that seasonal temperature variation at a given latitude results from Earth's axis being tilted with respect to the plane of its orbit, and that this relationship is the result of three factors:<br>i. Changes in the angle of incidence changes the area over which the rays are spread.<br>ii. Changes in the angle of incidence changes the amount of energy-absorbing atmosphere through which the rays must pass.<br>iii. Changes in the inclination of a hemisphere toward or away from the sun changes the hours of sunlight per day.<br>b. Recognize that distance from the sun is NOT a factor in the cycle of seasons.<br>c. Understand that the gravitational attraction of the moon and, to a lesser extent, the sun cause ocean tides, and be able to locate areas of high and low tides on an Earth-moon-sun diagram.<br>d. Arrange phases of the moon in the order of occurrence.<br>e. Given an Earth-moon-sun diagram, identify the phase of the moon.<br>f. Given a phase of the moon, identify the Earth-moon-sun diagram that would result in that phase. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.4.4.1<br>The student understands stellar evolution. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Condensation of gases, due to gravity, is a foundation for the formation of stars.<br>• The life cycle of the star begins with the nebula, which contains mostly hydrogen and helium. Heavier elements were, and continue to be, made by the nuclear fusion reactions in stars or formed during supernovae.<br>• The Hertzsprung-Russell (H-R) diagram is one method used to classify stars. The Sun is a main sequence star.<br>• Stars are classified by their color, temperature, age, apparent brightness, and distance from Earth.<br>• Understand that star color is related to star temperature (i.e., long wavelength [red] are cooler; short wavelength [blue] are hotter). | a. Understand that atoms of elements more massive than hydrogen are formed by fusion reactions in stars or during supernovae of stars.<br>b. Understand that fusion reactions in stars release large amounts of energy, including solar energy striking Earth.<br>c. Explain that changes during the evolution of a star are caused by shifts in the balance between gravitational collapse and nuclear fusion.<br>d. Explain that increasing gravitational forces, caused by the increasing density of stellar matter, can cause stars to collapse to form neutron stars or black holes.<br>e. Given a Hertzsprung-Russell diagram:<br>i. Supply missing axis labels (i.e., temperature, luminosity).<br>ii. Indicate the group to which Earth's sun belongs.<br>iii. Locate and describe the basic characteristics of the main sequence group, giants, and dwarfs. |

# High School Physical Science

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.5.1.1<br>The student understands technology is the application of scientific knowledge for functional purposes. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Technology is driven by the need to meet human needs and solve human problems.<br>• Engineering is the practical application of science to commerce or industry.<br>• Medicine is a practical application of science to human health.<br>• All technological advances contain a potential for both gains and risks for society.<br>• Technology is the application of science knowledge to meet human needs. | a. Given a group of human endeavors, select the one that is best classified as technology, as opposed to science, art, philosophy, etc.<br>b. Given a field of science, identify a common technological application resulting from discoveries in that field.<br>c. Given a field of technological application, identify the scientific discoveries that made it possible.<br>d. Given a technological advance, identify related benefits and hazards or risks. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.1.2<br>The student understands cell functions involve specific chemical reactions. | • MC<br>• Photosynthesis equation provided<br>• Can connect to chemistry indicators<br>• Low and Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Food molecules taken into cells provide the chemicals needed to synthesize other molecules.<br>• Enzymes catalyze both breakdown and synthesis in the cell.<br>• Identify the reactants and products of photosynthesis. | a. Describe the mechanism by which cell membranes regulate concentrations of compounds inside the cell, and distinguish between active and passive transport.<br>b. Explain that enzymes catalyze reactions in organisms by providing reaction sites that accept only the reacting molecules.<br>c. Identify water and carbon dioxide as the reactants and carbohydrates and oxygen as the products of the series of reactions known as photosynthesis. Know that the same substances are involved in the series of reactions known as respiration, with reactants and products reversed.<br>d. Describe the transfer and transformation of energy in photosynthesis and respiration reactions (i.e., light energy to chemical energy through photosynthesis, then to chemical energy stored in ATP, then primarily to heat and mechanical energy through respiration).<br>e. Identify the monomers from which organic polymers are synthesized (i.e., polysaccharides from monosaccharides, proteins from amino acids, and nucleic acids from nucleotides). |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.2.1<br>The student understands living organisms contain DNA or RNA as their genetic material, which provides the instructions that specify the characteristics of organisms. | • MC<br>• All Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Nucleotides, with associated nitrogen bases (adenine, thymine, guanine, cytosine and uracil) make up DNA and RNA molecules.<br>• Sequences of nucleotides that either determine or contribute to a genetic trait are called genes.<br>• The sequence of the nucleotide bases within genes is not dictated by any known chemical or physical law.<br>• DNA is replicated by using a template process that usually results in identical copies.<br>• DNA and associated proteins supercoil during cellular replication to become structured as chromosomes. | a. Explain how DNA, nucleotides, genes, and chromosomes are related.<br>b. Identify the part of the cell where chromosomes are located.<br>c. Explain that coded genetic information in the form of nucleotide sequences determines the sequence of amino acids in protein synthesis.<br>d. Explain how the information for protein synthesis is copied to RNA, and explain the roles of mRNA and tRNA in protein synthesis (i.e., m(messenger)RNA carries information needed for protein construction from the nucleus to the ribosomes; t(transfer)RNA places specific amino acids in a peptide chain at the ribosome).<br>e. Understand that chromosomes are formed when DNA and associated proteins supercoil.<br>f. Recognize that the DNA in every cell of an organism is the same and that cells differentiate by expressing different parts of the DNA.<br>g. Identify the nitrogen base pairings in DNA (A to T and C to G). |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.2.3<br>The student understands hereditary information is contained in genes, located in the chromosomes of each cell. | • MC<br>• F1 Punnett square illustrating incomplete dominance<br>• F2 diagram<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • An inherited trait of an individual can be determined by one gene or by many genes (a polygenic trait), and a single gene can influence more than one trait.<br>• The expression of traits is determined by a complex interaction of genes and the environment.<br>• Alleles, which are different forms of a gene, may be dominant, recessive, or co-dominant. | a. Understand that traits inherited by offspring from parents are coded in DNA.<br>b. Explain dominant and recessive traits in terms of expression of dominant and recessive alleles.<br>c. Understand that sexual reproduction involves genetic recombination, resulting in variation, while asexual reproduction does not.<br>d. Understand that an organism's genetic makeup (genotype) determines probabilities of how particular alleles will be expressed.<br>e. Understand that an organism's phenotype is the actual trait of that organism resulting from the expression of the genotype and the interaction with the environment.<br>f. Understand that offspring of parents may not necessarily express traits in the exact proportion predicted by the parents' genetic material (i.e., phenotypic ratios can vary from predicted genotypic ratios).<br>g. Understand that mutations are permanent changes in genetic code, which may benefit, but are more likely to harm, an organism. Recognize that the location of a mutation in the genetic code and the timing of the occurrence of the mutation determine its significance in affecting a trait.<br>h. Construct a Punnett square given dominant-recessive information of parents. |

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| | i. Use a Punnett square to predict traits of offspring.<br>j. Given the traits of offspring, make generalizations about the traits of their parents.<br>k. DO NOT assess pedigrees. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.3.3.1<br>The student understands biological evolution, descent with modification, is a scientific explanation for the history of the diversification of organisms from common ancestors. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Evidence for biological evolution includes homologous skeletal and organ structures (e.g., similar bone structures in bat wings and primate hands), the fossil record, and comparing DNA.<br>• Understands that rock layers of the same time period may contain similar fossils, regardless of the location of the rock layers (e.g. the more recent fossils are found above older fossils in undisturbed layers of rock)<br>• Species with short life cycles can be used to directly observe evolution (e.g., bacteria developing resistance to multiple antibiotics).<br>• Uses a cladogram to interpret a proposed phylogeny DO NOT include Hardy-Weinberg | a. The presence of the same materials and processes of heredity (DNA, replication, transcription, translation, etc.) is used as evidence for the common ancestry of modern organisms.<br>b. Patterns of diversification and extinction of organisms are documented in the fossil record. Evidence indicates that simple, bacteria-like life may have existed billions of years ago.<br>c. The distribution of fossil and modern organisms is related to geological and ecological changes (i.e. plate tectonics, migration). There are observable similarities and differences among fossils and living organisms.<br>d. d. The frequency of heritable traits may change over a period of generations within a population of organisms, usually when resource availability and environmental conditions change as a consequence of extinctions, geologic events, and/or changes in climate. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.3.3.3<br>The student understands biological evolution is used to explain the earth's present day biodiversity: the number, variety and variability of organisms. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Separate populations within a species may become sufficiently different enough that new species develop. This process is called speciation.<br>• Changes in inherited traits accumulate in populations.<br>• Historically only a small percentage of species have survived to modern times. | • Understands processes involved in speciation, such as geographic and temporal reproductive isolation (e.g., Darwin's finches, 13- and 17-year cicada cycles).<br>• Understands that speciation can result from genetic variation, from genetic drift, and from genetic mutation. (Note: items should not address natural selection; natural selection is covered in S.HS.3.3.4.)<br>• Understands that most mutations are harmful to an organism, however, some mutations have been beneficial<br>• Recognizes that most of the species that have ever existed on Earth are now extinct. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.3.4<br>The student understands organisms vary widely within and between populations. Variation allows for natural selection to occur. | • MC<br>• High Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Heritable variation exists in every species.<br>• New heritable traits result from new combinations of genes and from mutations or changes in the reproductive cells.<br>• Variation of organisms within and among species increases the likelihood that some members will survive under changing environmental conditions. | a. Describe the process of natural selection as the process whereby those individuals of a species best adapted to survive are the ones most likely to survive and reproduce, thereby passing their beneficial traits on to their offspring.<br>b. Understand that natural selection is typically a slow process in terms of the number of generations needed to cause adaptations.<br>c. Understand that extinction of a species can occur when the process of natural selection is too slow to produce an adaptation needed to counteract a threatening environmental change.<br>d. Recognize that many species that have lived on Earth are now extinct.<br>e. Recognize that extinction is a natural event not always related to human activity.<br>f. Compare the Lamarckian concept of acquired traits with the current theory of natural selection.<br>g. Understand that mutations are more likely to harm than to help an organism and rarely lead to a useful adaptation in a population.<br>h. Understand that each of the many thousands of species represents a unique adaptation to a particular environmental niche.<br>i. Compare artificial and natural selection. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.4.1<br>The student understands atoms and molecules on the earth cycle among the living and nonliving components of the biosphere. | • MC<br>• Illustration/diagram of carbon cycle<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • The essential chemical elements for life circulate in the biosphere in characteristic paths known as biogeochemical cycles (i.e., cycles for water, nitrogen, carbon, oxygen).<br>• Identify a biochemical cycle illustrated in a diagram.<br>• Explain how burning fossil fuels affects the composition of the atmosphere.<br>• Describe the process that absorbs carbon from the atmosphere and cycles it into living systems. | a. Identify the chemical forms carbon takes in the carbon cycle, know where each form exists, and describe the processes (i.e., respiration, photosynthesis, combustion) that cause carbon to change form (i.e., carbon, carbohydrates, carbon dioxide).<br>b. Describe the forms of oxygen compounds and the processes in the oxygen cycle and understand how the oxygen cycle and carbon cycles are interwoven.<br>c. Identify the forms and location of nitrogen compounds (atmospheric nitrogen [$N_2$], ammonia [$NH_3$], nitrate, and nitrite) in the nitrogen cycle and explain the role of bacteria in the process.<br>d. Diagram the water cycle including the processes of evaporation, condensation, precipitation, runoff, transpiration, respiration, and photosynthesis.<br>e. Explain the mechanism whereby solar energy drives the water cycle.<br>f. Recognize that matter is cycled in biogeochemical cycles, whereas energy is not cycled. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.4.3<br>The student understands the distribution and abundance of organisms and populations in ecosystems are limited by the carrying capacity. | • MC<br>• Picture/diagram of a fish tank<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • The carrying capacity is determined by the availability of matter and energy, and the ability of the ecosystem to recycle materials.<br>• Living organisms produce more offspring than environmental resources can support, resulting in a competition for resources.<br>• Given a diagram of fluctuating essential resources, recognize it as an illustration of carrying capacity. | a. Distinguish between resources that establish carrying capacity (i.e., matter and energy) and other environmental factors that affect population size (e.g., predators, introduction of exotic species, disease).<br>b. Predict the effect on the carrying capacity of changing the supply of one of the resources.<br>c. Interpret graphs of species population vs. time in terms of carrying capacity. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.5.2<br>The student understands the sun is the primary source of energy for life through the process of photosynthesis. | • MC<br>• Formula for photosynthesis<br>• Food web illustration<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Plants and other photosynthetic organisms use energy to make organic compounds (primarily glucose) from carbon dioxide and water ($CO_2$ and $H_2O$) through a series of biochemical reactions.<br>• The energy in these compounds is used to assemble larger molecules with biological activity, including proteins, DNA, carbohydrates, and fats.<br>• These molecules serve as sources of energy for the plants themselves and for many other organisms through food webs.<br>• Chemosynthetic organisms, unlike photosynthetic organisms, do not depend on solar energy as the energy source for life functions. | a. Understand that electromagnetic energy from the sun is the original source of energy for most types of organisms on Earth and for the energy stored in combustible fuels.<br>b. Explain that the basic difference between most plants and most animals is that plants use light energy to produce their own food for energy and animals extract chemical energy stored in food materials originally synthesized by plants.<br>c. Describe the roles of producers, consumers, and decomposers in a food web.<br>d. Understand that fungi and bacteria are true decomposer organisms that break down organic matter into the smallest compounds. DO NOT use earthworms, beetles, ants, etc. as examples of decomposers (either as correct or incorrect examples).<br>e. Trace the path of energy through a food web.<br>f. Given several organisms, construct a food web.<br>g. Explain why only about 10% of the energy at a given trophic level of a food web is available to the next trophic level.<br>h. Describe how a change in the population of one type of organism in a food web affects populations of other types of organisms in the food web.<br>i. Understand that most energy leaving a food web eventually becomes heat energy lost to the environment. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.3.5.3<br>The student understands food molecules contain biochemical energy, which is then available for cellular respiration. | • MC<br>• Concept: ATP<br>• Glucose breaking down into carbon dioxide and water (show two way chemical reaction)<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Energy is released when the food molecules are broken down into simpler compounds.<br>• Energy is transferred to adenosine triphosphate (ATP) through cellular respiration.<br>• Most biochemical reactions, fueled by ATP, are catalyzed by enzymes.<br>• Understand that ATP powers all chemical reactions in a cell. | a. Understand that energy released during the series of reactions that take place during respiration is stored in the chemical bonds of ATP molecules.<br>b. Know that ATP is produced in mitochondria.<br>c. Understand that larger food molecules (i.e., complex carbohydrates, fats, and proteins) are broken down during digestion into basic subunits (i.e., simple sugars, fatty acids, or amino acids) that can be used directly for cellular respiration or quickly converted by the body into sources of energy. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS. 3.6.1<br>The student understands animals have behavioral responses to internal changes and to external stimuli. | • MC<br>• Mid Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Responses to external stimuli can result from interactions with the organism's own species and others, as well as environmental changes.<br>• These responses can be innate and/or learned.<br>• Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change.<br>• Recognize basic animal instincts, such as searching for food, reproduction, caring for young, as examples of innate behavior. | a. Identify a particular animal behavior as being primarily learned or primarily innate.<br>b. Recognize that behaviors are a result of the interaction of genetic and environmental influences.<br>c. Describe instinctive reactions to seasonal change (e.g., hibernation, migration, color change).<br>d. Given an external stimulus (e.g., temperature change, competition, predator, population pressure, disease) identify a behavioral response (e.g., migration, aggression, camouflage, food storage, mating display). |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.3.7.2<br>The student understands that homeostasis is the dynamic regulation and balance of an organism's internal environment to maintain conditions suitable for survival. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • The systems of an organism interact with one another to maintain homeostasis. | a. Recognize that organisms maintain homeostasis in different ways (e.g., humans sweating, dogs panting, reptiles resting in sunlight, humans adjusting to altitude by producing more red blood cells).<br>b. Describe and predict how transport of substances across membranes is related to maintaining homeostasis (e.g., red blood cells in pure water vs. salt solution).<br>c. Body temperature and heart rate are related to maintaining homeostasis.<br>d. Organisms may have specialized structures designed to monitor and maintain homeostasis (including buffers). |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specifications |
|---|---|
| ▲ S.HS.3.7.3<br>The student understands that living things change following a specific pattern of developmental stages called life cycles. | • MC<br>• Diagram<br>• Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| | **a.** Compare and contrast the life cycles of different organisms (both plants and animals), including those that go through metamorphosis and periods of dormancy.<br>**b.** Recognize that all organisms go through life cycle stages.<br>**c.** Recognize that certain species alternate sexual and asexual stages in their typical life cycle. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.4.2.1<br>The student understands geological time is used to understand the earth's past. | • MC<br>• Diagrams of geologic time scale, each showing different proportional size of 4 eras<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Radioactive dating and relative dating (i.e., stratigraphy, fossils) are used to estimate the time rocks were formed.<br>• Earth changes can be short term (during a human's lifetime), such as earthquakes and volcanic eruptions, or long term (over a geological time scale), such as mountain building and plate movements.<br>• The Earth's atmosphere has changed over time. For example, the dramatic changes in Earth's atmosphere (i.e., introduction of $O_2$), was caused by the emergence of life on Earth.<br>• Relate geologic evidence to a record of Earth's history.<br>• Explain the presence of sedimentary rock in Kansas.<br>• Given a choice of diagrams of geologic time scales, choose the one with the correct proportions. | a. Recognize that the current accepted age of Earth is about 4.5 billion years.<br>b. Understand that geologic time periods are based on major geologic and paleontologic events (e.g., mass extinctions, glaciation, climatic changes).<br>c. Explain and apply the principle of superposition in establishing relative ages of rock strata.<br>d. Understand that radioactive dating has made it possible to assign reference dates to specific rock layers in strata. |

# High School Life Science Assessment

| Assessable Indicator | Official Test Specification |
|---|---|
| ▲ S.HS.6.3.1<br>The student understands natural resources from the lithosphere and ecosystems are required to sustain human populations. | • MC<br>• Low Level Knowledge Questions |
| **Recommended Test Specifications or Instructional Examples** | **Additional Test Specification Notes** |
| • Understand that the processes of ecosystems required to sustain human populations include maintenance of the atmosphere, generation of soils, control of the hydrologic cycle, and recycling of nutrients. Humans are altering many of these processes, and the changes may be detrimental, beneficial, or both to ecosystem function.<br>• Natural systems can reuse waste, but this capacity is limited. Recycling and environmentally sound decisions improve the quality of human life. | a. Explain how human activities (e.g., power production, livestock operations, controlled burning) can change the relative abundance of atmospheric gases (e.g., $CO_2$, $H_2O$, $CH_4$, $H_2S$, $SO_2$, $O_3$), relate these changes to consequences, and explain the mechanisms that cause the consequences.<br>b. Explain how human activities (e.g., use of pesticides and herbicides, fertilizers, livestock operations, landfills, irrigation practices, urbanization, removing forest cover) affect the abundance and quality of fresh water.<br>c. Explain how human activities affect the availability and quality of soil and soil nutrients (e.g., stream and river management, farming practices, ranching practices, and mining practices).<br>d. Explain how changing vegetation cover can affect localized climate conditions.<br>e. Explain the concept of sustainable yield as it relates to forest products, fisheries, soil nutrients, etc.<br>f. Distinguish among resources that are renewable, renewable through very slow processes (e.g., soils), and nonrenewable. |