### SCIENCE AND ENGINEERING PRACTICES

**PERFORMANCE EXPECTATIONS**

**PERFORMANCE INDICATOR**

**S.1A.3: PLAN AND CARRY OUT INVESTIGATIONS**

<table>
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<td><strong>3.S.1A.3 4.S.1A.3</strong></td>
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<td><strong>5.S.1A.3</strong></td>
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<td><strong>6.S.1A.3 7.S.1A.3 8.S.1A.3</strong></td>
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<td><strong>H.B.1A.3 H.C.1A.3 H.P.1A.3 H.E.1A.3</strong></td>
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SPECIFIC CHANGES PER GRADE

- In grades K-2, performance expectations include conducting structured scientific investigations with teacher guidance.
  - In this context, structured scientific investigations mean investigations that are guided by the teacher but still conducted by students in order to answer a scientifically testable question that can be answered through objective investigation, experimentation, and observation.
- In kindergarten, students make qualitative observations and use non-standard measurements as sources of data.
- Starting in grade 1, performance expectations expand to include making qualitative measurements using appropriate tools. Students should no longer be making non-standard measurements.
- Starting in grade 3, performance expectations expand to planning and carrying out scientific investigations.
  - In this context, scientific investigations and questions serve to distinguish from structured investigations. Students are now expected to plan and carry out (without as much direct teacher guidance) investigations designed to answer scientifically testable questions.
- Starting in grade 3, performance expectations expand to include formulating scientific questions.
- Starting in grade 3, performance expectations expand to include identifying variables.
- Starting in grade 3, performance expectations expand to include selecting the appropriate tools they will use to carry out scientific investigations.
- Starting in grade 5, performance expectations expand to include formulating testable hypotheses.
  - In this context, the term testable hypothesis serves to distinguish the expectation from predicting possible outcomes. Students formulate testable hypotheses not only as prediction of possible outcomes but also as proposed explanations for possible that can then be tested through experimentation and investigation.
- Starting in grade 9, performance expectations expand to include formulating scientific questions and testable hypotheses based on credible scientific information.
  - In this context, credible scientific information refers to sources of information that have been evaluated and are considered scientifically valid and accurate.

DEFINING CHARACTERISTICS

Scientists and engineers investigate the world with two goals - to answer questions and to develop and test designs, theories, and explanations about how the world works. This includes engaging in careful observation and description of natural phenomena as well as the ability to design experimental inquiries to test a hypothesis and answer a question. Investigations generate data that is then analyzed. To do this, scientists and engineers need to carefully identify parameters to be controlled during an investigation, what tools will be necessary to conduct measurements, and what variables are to be tested and measured to generate the evidence necessary to determine the conclusions of the investigation.
In science, the goal of carrying out investigations is to acquire data that can be used to refine theories and ideas about natural phenomena. In engineering, investigations provide data that can be used to test the effectiveness of and refine designs and solutions.

**Investigations can be designed to:**
- Generate data (observations/measurements) that can be used to generate a hypothesis.
- Test an existing hypothesis.
- Isolate variables to determine how they impact a phenomenon.
- Test design solutions.

**Reproducible Data**

Scientific investigations generate consistent, reproducible data and observations.
- Procedures are clear and complete.
- Tools and materials are appropriate to the task.
- Precision (how close you are to the target) and accuracy (how often do you hit the same area) are attended to.
- Outside variables are controlled as much as possible.

**Importance of Sample Size**

Reliability in the outcome of the investigation comes from having a sufficient body of data to serve as evidence. Scientific claims cannot be argued with only a single or limited body of data to serve as evidence. When multiple trials produce consistent, reproducible results, then it is possible to use that data as evidence to support claims and, ultimately, construct explanations.

It is essential for students to know that for an investigation to be scientifically valid, replication within the procedures is important to verify the results and produce valid conclusions. Scientists want to report true results; therefore, they conduct repeated trials so that patterns or trends in the data can be determined. The more data that is collected through replication, the more reliable the results. Without replication, errors in procedures or data collection may not be detected.

While gathering data during an experiment:
- Data needs to be gathered more than one time under the same conditions and with the same measurement tools.
- Repetition ensures that the experiment is valid and that the data is reliable. Validity indicates how close the investigation is to being accurate and dependable. As a result of validity, other investigations repeated the same way should produce similar results.
- When possible, measurements should be taken several times, and then the results averaged.
- Each set of repeated data is called a trial.

An investigation may involve a sample, or a portion of the total number, as a type of estimation.
- The sample is used to take a representative portion of the objects or population for research.
- A poorly chosen sample size can be unrepresentative of the whole.
• Careful observations made from a proper sample size or manipulating variables within that sample size result in information and conclusions that might apply to the whole population.

The “lifecycle” of data

Investigation leading to data collection → data interpreted and evaluated to be used as evidence → evidence used to develop and refine models, arguments, and theories → new questions generated, cycle repeats.

The goals for this practice are for students to formulate questions that can lead towards the framing of a hypothesis that can be tested, to decide what and how much data is necessary, what tools are needed, and how the measurements will be recorded, to plan and conduct investigations, to identify independent and dependent variables, as well as what parameters need to be controlled, and to evaluate the effectiveness of the investigation’s design.

Scientific Tools

Students need to know that different tools are needed to collect different kinds of data. Students should be able to use tools from previous grade levels that are appropriate to the content of their current grade level.

|   | 1. A magnifier, or hand lens, is a science tool that can be used to see details of objects that are too small to be seen clearly with unaided eyes.  
  | o A magnifier should be held between the eye and the object being viewed.  
  | o The magnifier should be moved back and forth until the object looks clear.  
  | o Magnifiers can be used to observe physical properties of objects.  
  | Eyedroppers are short tubes fitted with rubber bulbs at the top of the tube that are used to measure liquids by drops when gathering specific data.  
  | o Squeeze the bulb before inserting it into the liquid to obtain some of the liquid.  
  | o Eyedroppers can be used to add small amounts of liquids.  
  | A thermometer is a tool that measures temperature.  
  | o When using a thermometer, make sure not to place the bulb of the thermometer on the bottom or sides of the container or touch the bulb when taking air temperature.  
  | o When reading the temperature on a thermometer, it should be vertical and at eye level with the top of the liquid in the glass tube.  
  | 2. Standard English units should be used where appropriate when making measurements of objects. For example, rulers should measure to the nearest whole inch; time can be measured in hours to the nearest half hour.  
  | o A ruler is a measurement tool that can be used to measure the length, width, or height of an object or the distance between two objects.  
  | o When using a ruler, make sure to begin measuring from the zero (0) mark, not necessarily the edge of the ruler.  
  | 1. Ruler is a measurement tool that can be used to measure the length, width, or height of an object or the distance between two objects. |
A thermometer measures temperature in degrees Fahrenheit (°F) and Celsius (°C) to the nearest degree.

NOTE: Fahrenheit will be used to measure weather data only. All other temperature readings will be taken using the Celsius scale. Use only thermometers with colored alcohol in them (such as red or blue), NEVER mercury thermometers (silver liquid in them).

A rain gauge is a tool that measures the amount of rainfall.
- To collect rainfall accurately, the rain gauge must be in an open area.
- To read the rain gauge, hold it at eye level.
- A rain gauge measures the amount of rainfall in inches (in).

A balance is a tool that measures the mass of an object compared to a known mass. Mass is the amount of matter, or material, in an object.
- When using a pan or bucket balance, be sure the balance pointer begins at zero (is level).
- Place the object being measured on one side.
- Place the known masses on the opposite side until the balance is level and the pointer is again at zero.
- When the balance is level, the mass of the object is equal to the total of the known masses.
- A balance measures the mass of an object in grams (g).

A measuring cup is a tool that measures volume.
- To read the measuring cup, place the cup on a level surface.
- When using the measuring cup to measure volume of a solid, be sure the top surface of the solid is level.
- A measuring cup measures volume in fluid ounces (oz), parts of a cup (c), milliliters (mL), or liters (L).

A beaker is a tool that measures liquid volume.
- To read the volume of a liquid in a beaker, place the tool on a level surface.
- When using a beaker to measure the volume of a granular (powdered) solid, be sure the top surface of the solid is level.
- Choose the appropriate size beaker for the measurement task—use small beakers for measuring small amounts, and large beakers for large amounts.
- A beaker measures the volume in metric units such as milliliters (mL) or liters (L).

3 A meter tape, or meter stick, is a measurement tool that can be used to measure the length, width, or height of an object or the distance between two objects.
- When using a meter tape, or stick, make sure to begin measuring from the zero (0) mark, not necessarily the edge of the tool.
- A meter tape, or stick, measures in metric units such as centimeters (cm) or meters (m).

Forceps/tweezers are tools that grasp or pick up small materials.

A graduated cylinder is a tool that measures volume of liquids.
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<td><strong>To read the graduated cylinder, place the tool on a level surface.</strong>&lt;br&gt;<strong>Choose the right size graduated cylinder for the measurement task—use small graduated cylinder for measuring small amounts, and large graduated cylinder for large amounts.</strong>&lt;br&gt;<strong>The graduated marks are in metric units such as milliliters (mL).</strong>&lt;br&gt;&lt;br&gt;A graduated syringe is a tool that measures volume of liquids.&lt;br&gt;<strong>Place the end of the syringe in the liquid and then pull the plunger out to draw in the appropriate amount of liquid.</strong>&lt;br&gt;<strong>A graduated syringe measures in metric units such as milliliters (mL).</strong>&lt;br&gt;&lt;br&gt;It is also essential for students to use tools such as rulers (measuring to millimeters), pan balances (measuring in grams), or measuring cups (measuring in parts of a cup).&lt;br&gt;&lt;br&gt;A tuning fork is a tool that produces vibrations when struck appropriately.&lt;br&gt;<strong>Use the rubber mallet or rubber surface to strike the tuning fork.</strong>&lt;br&gt;&lt;br&gt;A compass is a tool that is used to determine the cardinal directions of North, South, East, and West when using a wind vane to identify wind direction.&lt;br&gt;&lt;br&gt;An anemometer is a weather instrument used to determine wind speed.&lt;br&gt;<strong>An anemometer should be vertical and needs to be able to spin without obstruction.</strong>&lt;br&gt;<strong>An anemometer measures wind speed in miles per hour (mph).</strong>&lt;br&gt;&lt;br&gt;A mirror (plane/flat) is a tool that reflects light toward a given direction.&lt;br&gt;&lt;br&gt;A prism is a tool that breaks light into the colors of the spectrum.&lt;br&gt;<strong>To use a prism appropriately, the light has to enter the prism at the correct angle to the surface in order to separate the white light.</strong>&lt;br&gt;&lt;br&gt;It is also essential for students to use tools such as rain gauges (measuring in inches), and beakers or graduated cylinders (measuring to milliliters or liters). Other units of measurement that students should be familiar with are kilograms (mass) or kilometers (distance).&lt;br&gt;&lt;br&gt;A timing device is an instrument used to measure time.&lt;br&gt;<strong>An example of a timing device is a stop watch or clock with a second hand.</strong>&lt;br&gt;<strong>Time is measured in seconds (s), minutes (min), hours (hr), and days.</strong>&lt;br&gt;&lt;br&gt;A 10x magnifier is a tool that is used to enlarge objects or see details.&lt;br&gt;<strong>Objects seen through a 10x magnifier look ten times larger than they do with the unaided eye.</strong>&lt;br&gt;&lt;br&gt;It is also essential for students to use tools such as graduated cylinders and syringes (measuring in milliliters).&lt;br&gt;&lt;br&gt;A spring scale is a tool used to measure the weight of an object or the force on an object.</td>
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o Some spring scales have a slider that moves in response to the weight/force of an object. The measurement is read on one of two scales located on either side of the slider.
o Some spring scales have a spring that is visible through a clear plastic tube with two scales labeled on either side of the tube.
o Before an object is attached to the spring scale, make sure the marker is on the zero (0) by adjusting the slider or knob usually found on the top of the scale.
o A spring scale measures weight or force in newtons (N).

A digital balance is a tool used to measure the mass of an object.

A barometer is an instrument used to measure air pressure or a change in pressure readings.
o Many of the barometers have qualitative descriptions of weather conditions associated with air pressure but this alone should not be used to forecast weather.
o To read your barometer, first tap the glass lightly, but firmly, to ensure that the reading pointer attached to the linkage mechanism inside the barometer is not sticking.
o The other pointer that is found on most instruments is the set pointer and is usually made of brass.
o The set pointer can be turned by means of the knob at the center of the glass so that it covers the reading pointer. If the reading pointer has moved between readings then it can be determined that the pressure is now lower or higher and by how much.
o A barometer scale is measured in millimeters or inches of mercury or millibars (mb).

A sling psychrometer is a tool used to measure relative humidity.
o A sling psychrometer is made of two thermometers—a wet bulb and a dry bulb—held together by a handle.
o The wet bulb thermometer is covered with a piece of cloth and moistened.
o The two thermometers are then moved through the air. After a period of time the temperature of each thermometer is recorded. A relative humidity chart is used to determine the relative humidity percent.

It is also essential for students to use tools such as graduated cylinders (measuring at the meniscus to milliliters), graduated syringes (measuring to milliliters), anemometers (measuring in miles per hour), compasses, 10x magnifiers, or timing devices (measuring in minutes or seconds) to gather data.

NOTE: All temperature readings during investigations will be taken using the Celsius scale unless the data refers to weather when the Fahrenheit scale is used.

A microscope is a tool that is used to magnify the features of an object. A compound microscope has two or more lenses. Other parts of a compound microscope are:
Eyepiece—contains the 10X magnifying lens
Coarse adjustment knob/focus—focuses the image under low power
Fine adjustment knob/focus—focuses the image under high power
Objective lenses—two or three separate lenses that contain varying powers of magnifying lenses
Stage and stage clips—supports and hold the microscope slide in place while viewing
Diaphragm—controls the amount of light available
Light source—a mirror, external or internal light source that shines light through the object
being viewed
Arm—supports the body tube which connects the eyepiece to the set of objective lenses
Base—supports the microscope

It is essential for students to use the microscope safely and accurately.
When looking through a microscope, the lighted area is the field of view.
Adjust the diaphragm until an adequate amount of light is available.
  o To make the field of view brighter, open the diaphragm.
  o To make the field of view darker, close the diaphragm.
To view an object under the microscope, first focus on the lowest power objective lens.
Then change to the highest power objective lens if necessary.
When focusing the image under low power objective, use the coarse adjustment knob.
Use only the fine adjustment knob to sharpen the focus when using the high power
objective.
To calculate the magnification of objects seen through a microscope, multiply the
magnification of the eyepiece times the magnification of the objective lens being used.
Objects on the slide move in the opposite direction when being viewed through the
eyepiece (for example, if the slide is moved to the left, the object being viewed appears to
move to the right).

It is essential for students to use care when handling the microscope.
A microscope should be held and carried with one hand under the base and one hand on
the arm.

Some microscopes may have a mirror as the light source. Care should be taken not to aim
the mirror directly at the Sun.

It is also essential for students to use tools such as magnifiers (hand lenses), 10X
magnifiers, or beam balances (measuring to centigrams) to gather data.

| 8 | Convex lenses are tools used to bend, or refract, light causing objects to be magnified.
   | A plane mirror is a tool used to reflect light.
   | A color filter is a tool that blocks certain wavelengths of light and transmits others.
   | A prism is a tool that breaks light into the colors of the spectrum.
   |  o To use a prism appropriately, the light has to enter the prism at the correct angle to the
     surface in order to separate the white light.
   | A coiled metal spring is a tool used to model waves. |
| High School | Use appropriately and identify the following laboratory apparatuses and materials:
   | Balances (electronic)
   | pH indicator paper
<p>| pH buffer solution |</p>
<table>
<thead>
<tr>
<th>Beakers (50mL, 100 mL, 250mL)</th>
<th>Chemicals &amp; other consumable materials depending on planned laboratory investigations</th>
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<tbody>
<tr>
<td>Prepared slides of normal cells, human cheek cells, onion root cells, bacteria, protists, fungi, sickle cell blood, whitefish blastula, etc.</td>
<td>Erlenmeyer flasks Pipettes / droppers</td>
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<tr>
<td>Evaporating dishes</td>
<td>Petri dishes</td>
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<tr>
<td>Ring stand, ring clamp, and test tube clamp</td>
<td>spatulas, scissors, Funnels Stoppers – rubber, cork</td>
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<tr>
<td>Graduated cylinders (10 mL &amp; 100 mL)</td>
<td>Hand lenses (magnifiers) Test tubes, clamp, holder, and rack</td>
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<tr>
<td>Test tube brushes</td>
<td>Measuring tools (metric rulers, meter stick, meter tapes, stop watch or timer)</td>
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<tr>
<td>Microscopes (compound &amp; dissecting)</td>
<td>Microscope slides &amp; cover slips, light source, lens paper</td>
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<tr>
<td>Lab aprons, safety goggles, gloves</td>
<td>Tongs (crucible, beaker)</td>
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<tr>
<td>Watch glasses, spot plate</td>
<td>Wire gauze with ceramic centers</td>
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<tr>
<td>Centrifuge</td>
<td>Water bath</td>
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<tr>
<td>Gel electrophoresis supplies (tray, chamber, &amp; power supply)</td>
<td>Dialysis tubing, Parafilm, chromatography paper</td>
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<tr>
<td>Mortar and Pestle</td>
<td>Balances electronic Pipettes / droppers pH paper / pH meters</td>
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<tr>
<td>Burners (Bunsen), flint strikers</td>
<td>Chemical scoop (scapula) Stirring rods</td>
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<td>Conductivity apparatus (light bulb)</td>
<td>Stoppers – rubber, cork Erlenmeyer flasks Test tubes, holder, and rack</td>
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<tr>
<td>Evaporating dishes</td>
<td>Test tube brushes Filter paper Thermometers (alcohol, digital) Forceps</td>
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<tr>
<td>Funnels</td>
<td>Tongs (crucible, beaker) Watch glasses</td>
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Graduated cylinders
Wire gauze with ceramic centers
Hot plates
Wood splints
Litmus paper
Ammeters and voltmeters (or multimeters)
Motion carts (or toy cars)
Compasses
Motors, simple electric
Diffraction grating
Protractors
Dry cells (or other voltage source)
Resistors
Electrosopes
Coiled or large metal springs
Flashlights
Spectroscope
Generators (hand-held)
Spring scales
Hand lenses (magnifiers)
Switches (knife)
Lenses (convex and concave)
Timers
Light bulb and holders
Tuning forks
Magnets
Weights
Mirrors, plane rectangular
Wire, insulated copper

Use the identified laboratory apparatuses in an investigation safely and accurately with
- Associated technology, such as computers, calculators and other devices, for data
collection, graphing, and analyzing data; and
- Appropriate techniques that are useful for understanding biological concepts, such as
  Using a microscope appropriately
- Associated technology, such as probeware and meters to gather data; and
- Appropriate techniques that are useful for understanding chemistry and physics concepts,
such as measuring, heating, filtering, timing, setting up circuits, electrostatics, or wave
  behavior.
Planning an investigation
1. Develop a testable question.
2. Predict possible outcomes.
3. Identify appropriate tools, instruments, materials, and procedures.
4. Identify possible variables that affect what you are questioning and narrow it down to the ONE you want to test. This will help you refine your question.
5. Identify controls that you will keep constant during the investigation. These will come from the list of possible variables that you choose NOT to test.

Carrying out an investigation
1. Make qualitative and quantitative observations.
2. Take measurements.
3. Structuring and organizing data (data table/chart).

Importance of Safety

It is vitally important that students use necessary and appropriate safety procedures when conducting any scientific investigation.

Suggested safety procedures (including but not limited to):

- All students and parents must sign a science course safety contract. A lab safety contract is recommended to notify parents/guardians that classroom science investigations will be hands-on and proper safety procedures will be expected. These contracts should be signed by the student and the parents or guardians and kept on file to protect the student, teacher, school, and school district. In the event of a serious laboratory safety violation or accident, follow your school or district policy for documentation.
- Conduct pre-lab safety overview. Students should be able to describe and practice all of the safety procedures associated with the activities they conduct.
- Review ALL safety considerations and possible risks prior to starting an investigation.
- Use all appropriate personal safety equipment (goggles, aprons, gloves, shields, etc…) and take all appropriate safety precautions (close-toed shoes, long pants, long hair tied back, etc…)
- Follow all safety guidelines for equipment and materials/chemicals.
- Monitor environment for possible disruptions, hazards, and safety violations. Address any problems immediately and appropriately.
- Discontinue lab if the environment becomes unsafe/overly disruptive.
- NEVER assign potentially hazardous tasks as homework.
- Lab safety rules may be posted in the classroom and/or laboratory where students can view them.
- Materials Safety Data Sheets (MSDS) should be reviewed, if necessary. Special Biological Precautions: Use only nonpathogenic varieties of bacteria. Seal all petri dishes with tape. Kill all cultures before disposing of them. Wear gloves when working with bacteria and other specimens. Consult your district policy before allowing students to collect any human specimen (i.e. cheek cells or blood).
The role of prior knowledge

Prior knowledge plays an important role in how students formulate questions and generate hypotheses. In some cases, students will have prior knowledge about a particular scientific concept. Otherwise, the acquisition of prior knowledge will need to be built into the learning experience for students to have the framework to plan and carry out investigations. Some investigations may require little prior knowledge to design and conduct while others may require a great deal of background information.

EVIDENCE OF MASTERY

Students who show evidence of mastery in this practice will be able to:

- Plan scientific investigations following the appropriate grade-level criteria defined by the performance indicator. Scientific investigations answer scientifically testable questions using reproducible results from robust data sets.
- Generate testable scientific questions.
- Predict possible outcomes to an investigation or experiment.
- Generate testable hypotheses that not only predict possible outcomes, but also propose an explanation for the possible outcome (beginning at 5th grade).
- Identify materials and procedures needed to carry out an investigation.
- Identify the variables that are part of an investigations (beginning at 3rd grade).
- Use appropriate lab equipment, technology, and techniques to collect both qualitative and quantitative data.
- Record and represent data in the appropriate form.
- Use appropriate lab safety procedures.

CONNECTIONS WITH OTHER SCIENCE AND ENGINEERING PRACTICES

- Ask Questions (S.1A.1)
  - Investigations serve as the mechanisms by which evidence is acquired in an effort to construct answers to questions as well as test proposed solutions to problems.
- Analyze and Interpret Data (S.1A.4) and Use Mathematics and Computational Thinking (S.1A.5)
  - Evidence acquired through investigations and tests is analyzed and interpreted through the application of mathematics and computational thinking in order to look for patterns, trends, relationships, anomalies, etc...
- Engage in Argument from Evidence (S.1A.7) and Construct Explanations (S.1A.6)
  - Investigations provide the evidence that is used to support claims in the argumentation processes as well as to construct explanations of processes and phenomena in science. Tests of proposed design solutions provide evidence needed to identify and refine viable solutions to problems.
- Develop and Use Models (S.1A.2) and Obtain, Evaluate, and Communicate Information (S.1A.8)
  - Information and models can provide information to help students plan scientifically accurate investigations by providing important content prior knowledge. Investigations can also provide evidence needed to develop models.
• Construct Devices or Design Solutions (S.1B.1)
  o Whereas scientists plan and carry out investigations, engineers conduct tests on proposed designs for possible solutions in order to gather the data needed to analyze the efficacy of the design or solution.

PERFORMANCE TASK EXAMPLES

The following are selected examples of performance tasks aligned with sample grade band content standards and performance indicators. The purpose of these examples is to illustrate what a performance task would look like that meets the performance expectations of both a given content performance indicator and the science and engineering performance indicator. Examples of performance tasks that do not meet the criteria of the science and engineering performance indicator are also provided for comparison. This list does not provide examples for every grade level.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Subject</th>
<th>Example</th>
<th>Non-Example</th>
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<tbody>
<tr>
<td>K</td>
<td>Life Science</td>
<td>Students predict the needs of plants and then conduct structured investigations to determine which environmental factors are necessary for plants to live and grow. Students make non-standard measurements and qualitative observations. Observations and data are recorded in a graphic organizer, journal, and/or class chart.</td>
<td>Teacher describes and demonstrates what plants need to live and grow. Class conducts a group investigation to verify this information.</td>
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<tr>
<td>1-2</td>
<td>Earth Science</td>
<td>After generating questions about shadows, students conduct an investigation as to how shadows change as the position of a light source changes. Students make both qualitative and quantitative measures of the change in position. Data is organized.</td>
<td>Students make non-standard qualitative observations about shadows without taking quantitative measurements.</td>
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<td>3-4</td>
<td>Physical Science</td>
<td>Based on prior knowledge and student generated questions, students use provided materials to plan and conduct investigations that test how different variables affect the properties of sound (including pitch and volume). Both qualitative and quantitative data are recorded and organized in an appropriate format. Quantitative measures are made using smart technology.</td>
<td>Based on teacher-provided questions, students conduct a scripted investigation about the variables that affect pitch and volume to confirm anticipated outcomes.</td>
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<tr>
<td>5</td>
<td>Physical Science</td>
<td>Students are provided with materials and plan and conduct a controlled scientific investigation to test the effects of balanced and unbalanced forces on motion. Students identify experimental and control variables and record and organize qualitative and quantitative data.</td>
<td>Students conduct a scripted investigation to verify the variables that affect motion.</td>
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| 7     | Chemistry   | Students use sodium bicarbonate tablets, film canisters, and water to conduct a controlled investigation. | Students conduct a scripted investigation to confirm an
| High School Earth Science | Based on credible scientific information, students formulate scientific questions and develop a testable hypothesis on the different variables that affect the rate of weathering. Students plan and conduct a scientific investigation to test those variables, using appropriate materials, equipment, and technologies to accumulate and communicate qualitative and quantitative data. | Students conduct a series of scripted experiments to prove the expected outcomes on the variables that affect the rate of weathering. |