

Science and Technology/Engineering

Instructional Guidelines: 1st & 2nd Grade

The 2016 [Massachusetts Science and Technology/Engineering \(STE\) Curriculum Framework](#) articulates statewide guidelines for STE learning, teaching, and assessment. Science and engineering are a natural focus for young children who are beginning to develop their own understandings of the world and how it works. By introducing children to science and engineering at a young age, we support their curiosity, promote their understanding, and give them the tools they need to investigate, design, observe, and draw evidence-based conclusions about the world. Children who are able to think critically, solve problems, and base their ideas on evidence at an early age will have a strong foundation as they engage with a world that is increasingly rooted in science and engineering.

Purpose: The intention of this document is to provide additional guidance around the instruction and content of the grades 1 and 2 STE standards. The information provided in this document is **not an exhaustive list** of instructional guidance and should be used to purposefully plan, align, and strengthen learning for all students. The document is not intended to be prescriptive or a curriculum guide, but rather a bank of ideas to which educators and curriculum planners can refer within the context of their own curriculum and teaching practices. This document may be updated as necessary.

Science and Engineering Practices: The science and engineering practices are the behaviors or skills students should be practicing in the classroom on a regular basis as a means to exploring and explaining natural [phenomena](#). The science and engineering practices include the skills necessary to engage in scientific inquiry and engineering design. It is necessary for students to use and develop them over time within the context of grade appropriate science disciplinary knowledge. The eight science and engineering practices are listed below.

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Construct and engage in argument with evidence
- Obtaining, evaluating, and communicating information

Multiple practices (such as data analysis, modeling, and reasoning) should be used with the content of a particular standard, even if that practice is not listed in the standard. Some additional examples of integration of science practices in lesson, are included as part of this guide. Helpful resources to learn more about the science and engineering practices: [Science and Engineering Practices Matrix](#), [Next Generation Science Standards -NGSS@NSTA](#), [Instructional Leadership for Science Practices](#), [Boston Public Schools Science Department – Practices PD Series \(virtual\)](#), [STEM Teaching Tools](#).

Strand Maps/Learning Progressions: See the [strand maps](#), [Standards Navigation tool](#) or [disciplinary core idea \(DCI\) progression matrix](#) for additional information on the conceptual relationship between standards within and across grades that allow for targeted pre-assessment, contextualization, and/or identification of boundaries for any particular standard that is being taught. This can be an efficient way to visualize how elementary and middle school standards lead to high school standards.

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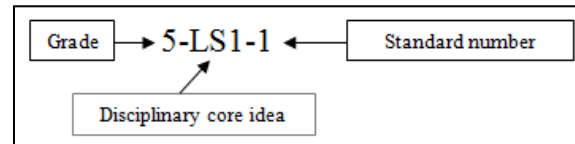
Features and Design: The document is arranged by science domain (Earth and Space, Life, Physical, and Technology/Engineering), then by grade level. The STE standards are structured to have the science and engineering practices imbedded into them. The sample standard below **bolds** the practice.

2-LS2-3(MA). **Develop and use models** to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live.

Clarification Statement: Animals need food, water, air, shelter, and favorable temperature; plants need sufficient light, water, minerals, favorable temperature and animals or other mechanisms to disperse seeds.

Labeling/Coding of the Standards:

The Massachusetts STE standards are labeled using the NGSS system, as shown in Figure 1:



The first component of each label indicates the grade. The next component specifies the discipline and core idea (domain). Finally, the number at the end of each label indicates the standard within the related set.

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Earth and Space Science (ESS)

1st Grade: ESS1. Earth's Place in the Universe

MA Standard	What students will be expected to do:	Supportive practices: Educators could...
<p>1-ESS1-1. Use observations of the Sun, moon, and stars to describe that each appears to rise in one part of the sky, appears to move across the sky, and appears to set.</p>	<ul style="list-style-type: none"> • Make observations and model/draw position of the sun/moon and stars in the sky at different times of the day (morning, noon, and night) • Organize data from observations (using table or chart) that shows which objects are visible at different times of the day • Use data from observations to identify and describe patterns (e.g. which objects are visible during the day and at night; which objects change positions in the sky and which do not; if objects move, what direction do they move in the sky?) • Use identified patterns to make predictions about when (what time of day) and where (location in the sky) you will see the sun, moon and stars • Model movement of sun, moon and earth through active movement or drawings • Use observations to describe similarities and differences in the motions of the sun, moon, and stars, in relation to Earth. 	<ul style="list-style-type: none"> • Create opportunities to build background knowledge about stars, moon and Sun for students by watching a video or by going outside to make and record observations (choose a day when the moon is visible at daytime, some students may be surprised to see both the sun and moon out at the same time) • Provide opportunities for students to make observations and ask questions of the position of sun/moon at different times during the school day (at the beginning of the school day, during recess, and at the end of the school day) • Provide options that will help students decide how to organize their data (e.g. graphical displays) • Provide opportunities for students to trace their shadows at different points in the school day • Have students create a model of (e.g. labeled drawing, use students to act out) Earth's rotation and the sun's reflection using a globe and flashlight (as the sun). Discuss what time of day it would be at the same point on the globe with every 90-degree rotation of the globe • Use video clips to model movement of the earth around the sun, have students make observations and ask questions

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<p>1-ESS1-2. Analyze provided data to identify relationships among seasonal patterns of change including relative sunrise and sunset time changes, seasonal temperatures and rainfall or snowfall patterns, and seasonal changes to the environment.</p> <p>Clarification Statement: Examples of seasonal changes to the environment can include foliage changes, bird migration, and differences in the amount of insect activity.</p>	<ul style="list-style-type: none"> • Ask questions based on observations about seasonal patterns • Use observations to identify seasonal patterns from sunrise and sunset data and use this information to predict future patterns • Construct an explanation describing/relating changes to sunlight at dinner time in winter vs. summer • Analyze seasonal data on temperature and rainfall to describe patterns over time • Obtain and communicate data about daily weather changes/patterns • Use observations to construct explanations of how seasonal changes influence clothing, activities, events/holidays 	<ul style="list-style-type: none"> • Help children record or access the monthly temperature and weather. • Read grade appropriate books about seasons to provide context for students • Support student to use resources for finding patterns in information about sunrise/sunset data across seasons • Take outdoor walks in each of the seasons, encouraging students to record what clothing they are wearing to be comfortable, and observations they make about their surroundings • Provide opportunities for students to monitor daily weather with a weather notebook/journal- precipitation, sunrise/sunset, moonrise/moonset, temperature, etc. • At the start of the unit, support students to work in groups to create 4 models (murals/posters) of the seasons, each with a similar setting and similar organisms. At the end of the unit revisit their models and consider ways that they could be revised with students' new knowledge of the seasons
<p>2nd Grade: ESS2. Earth's Systems</p>		
<p>MA Standard</p>	<p>What students will be expected to do:</p>	<p>Supportive practices: Educators could...</p>
<p>2-ESS2-1. Investigate and compare the effectiveness of multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*</p> <p>Clarification Statement: Solutions to be compared could include different designs of dikes and windbreaks to hold back wind and water, and different designs for using shrubs, grass, and trees</p>	<ul style="list-style-type: none"> • Create a model of a landscape with various materials (sand, soil, gravel, etc.) in order to make observations of the effects of water (stream) or wind (fan) on the landscape. • Investigate and compare different designs of dams, dikes, windbreaks, etc., and the use of shrubs, grass, trees, etc., to test their effectiveness for holding back land 	<ul style="list-style-type: none"> • Provide opportunities for students to use a stream table and vary the amount of water, sand etc. for each of the investigations. Include small model "homes" (e.g., board game pieces or other small objects) and challenge students to design a system that would protect the homes from the stream in the table • Use video clips to demonstrate wind and water erosion

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<p>to hold back the land. Solutions can be generated or provided.</p> <p>(*) standard has an engineering design application</p>	<ul style="list-style-type: none"> • Make an argument that supports or refutes design effectiveness 	<ul style="list-style-type: none"> • Show pictures/video of different types of barriers used to slow beach erosion and facilitate a discussion among students about the effectiveness of each structures. For example: why can't the same type of barrier be used in each location? Encourage students to use evidence from the pictures or videos to support their claim • Provide students with photographs of various human designed landscapes, and encourage students to explain how the human design reduces erosion damage to the landscape • Unit related to this standard: The Effects of Wind and Water Movement on Earth's Landscape (DESE Model Curriculum Unit)
<p>2-ESS2-2. Map the shapes and types of landforms and bodies of water in an area.</p> <p>Clarification Statement: Examples of types of landforms can include hills, valleys, riverbanks, and dunes. Examples of water bodies can include streams, ponds, bays, and rivers. Quantitative scaling in models or contour mapping is not expected.</p>	<ul style="list-style-type: none"> • Develop a map of landforms and bodies of water • Make observations about various shapes and types of landforms in a particular area • Create a model, with various materials, of a famous landform or body of water close to where students live, graphically • Obtain and communicate information from various informational sources about various types of landforms and bodies of water in an area 	<ul style="list-style-type: none"> • Display posters or maps (for example: road maps, theme park maps, hiking maps, museum maps, evacuation map) of various landforms to identify features • Provide students with the opportunity to create 3-D maps of various landforms (around the school or in their neighborhood), using materials such as clay, crumpled paper, or paper mâché, and encourage students to label their map with appropriate landforms or water bodies • Take a walk outside or use videos/web cams to observe some landforms or bodies of water in their local area
<p>2-ESS2-3. Use examples obtained from informational sources to explain that water is found in the ocean, rivers and streams, lakes and ponds, and may be solid or liquid</p>	<ul style="list-style-type: none"> • Develop a model about where water is found on earth • Make observations about where water can be found that is liquid or solid • Use grade-appropriate books, media, and other informational sources to conduct research and evaluate where water is typically located on Earth 	<ul style="list-style-type: none"> • Provide students with opportunities to watch videos or read books to ask questions about different water sources • Use Google Earth to view a variety of places on earth, have students make observations and locate and label types of water sources found on the map

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	<ul style="list-style-type: none"> • Construct an explanation describing the different forms water is available on Earth 	<ul style="list-style-type: none"> • Provide a template for students to record water source titles (pond, river, etc.) and define each term when doing a social studies lesson on different places around the world • Provide informational texts and online resources about water for students to conduct research, and provide a template for students to organize their notes into “fresh water”, “frozen water” and “salt water” and record which bodies of water fall into each category
<p>2-ESS2-4 (MA). Observe how blowing wind and flowing water can move Earth materials from one place to another and change the shape of a landform.</p> <p>Clarification Statement: Examples of types of landforms can include hills, valleys, riverbanks, and dunes.</p>	<ul style="list-style-type: none"> • Make observations and ask questions about how wind and water can move/change the shape of land • Investigate how blowing wind and flowing water can change landforms • Construct explanations for how different types of landscaping features can reduce the damage caused by weather (landscaping features may include sloping landscape, plantings, sand dunes, rock walls, sea walls, wetlands, and drainage) 	<ul style="list-style-type: none"> • Provide students with materials, such as a sand, to conduct an investigation about how wind (fan) or water can change the shape of the land • Take students on a walk to observe the land surrounding their school, look for evidence of how water or wind has changed the shape of the land or moved materials and document with a camera or student drawings • Provide informational texts and online resources for students to observe how wind or water can move earth’s materials • Unit related to this standard: The Effects of Wind and Water Movement on Earth’s Landscape (DESE Model Curriculum Unit)

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Life Science (LS)

1st Grade: LS1. From Molecules to Organisms: Structures and Processes

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>1-LS1-1. Use evidence to explain that (a) different animals use their body parts and senses in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air, and (b) plants have roots, stems, leaves, flowers, and fruits that are used to take in water, air, and other nutrients, and produce food for the plant.</p> <p>Clarification Statement: Descriptions are not expected to include mechanisms such as the process of photosynthesis.</p>	<ul style="list-style-type: none"> • Communicate information using evidence from observations (firsthand or from media) about patterns of features in plants and animals, including: <ul style="list-style-type: none"> ○ Key differences between different types of plants and animals ○ Young plants and animals of the same type have similar, but not identical features ○ Adult plants and animals (i.e., parents) of the same have similar, but not identical features ○ Patterns of similarities and differences in features between parents and offspring • Use or develop a model that explains how the shape/structure of a part of a plant (or animal) allows it to do its job/function. • Plan and conduct an investigation collaboratively to produce data that can be used to support an explanation of how the senses work 	<ul style="list-style-type: none"> • Provide models (e.g., diagrams or descriptive drawings) of different plants with similar features and ask students to make observations, compare, or group the models • Support students in designing an investigation that will help explain the value of one of the senses • Provide structure for group discussion with example questions and ways to respond. • Provide informational texts and online resources for students to observe and ask questions about how animals use their body parts to sense, and about the function of parts of plants • Units related to this standard: <ul style="list-style-type: none"> ○ Why is our corn changing? (NextGen Storylines) ○ Why are there different plants growing in different places? (NextGen Storylines)
<p>1-LS1-2. Obtain information to compare ways in which the behavior of different animal parents and their offspring help the offspring to survive.</p> <p>Clarification Statement: Examples of behaviors could include the signals that offspring make (such as crying, cheeping, and other vocalizations) and the responses of the parents (such as feeding, comforting, and protecting the offspring).</p>	<ul style="list-style-type: none"> • Use grade-appropriate books and other reliable media to obtain scientific information about animals and their offspring • Make observations and ask questions about animal parents and their offspring • Compare patterns of behavior that animal parents use to help offspring survive • Construct explanations for behaviors of animal parents that help offspring survive (e.g., 	<ul style="list-style-type: none"> • Use an anchor chart to collect and display students' notices and wonderings from texts, video, or other media • Provide list of behaviors that students can use to sort/match with different animals, then use table to identify which animal parents have similar behaviors and which have different behaviors in how they help their offspring survive

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	<p>keeping offspring safe from predators by circling the young, feeding offspring, playing with offspring, teaching offspring how to hunt or get food, etc.)</p>	<ul style="list-style-type: none"> Support students to write/draw explanations about different behaviors animals use to help their offspring survive
1st Grade: LS3. Heredity: Inheritance and Variation of Traits		
MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>1-LS3-1. Use information from observations (first-hand and from media) to identify similarities and differences among individual plants or animals of the same kind.</p> <p>Clarification Statement: Examples of observations could include that leaves from the same kind of plant are the same shape but can differ in size. Inheritance, animals that undergo metamorphosis, or hybrids are not expected.</p>	<ul style="list-style-type: none"> Ask questions based on observations (firsthand or from media) to find more information about patterns of features in plants and animals Collect data that can be used to make comparisons about the similarities and differences between plants and animals of the same kind Use evidence to construct an explanation about the idea that young plants and animals are like, but not exactly like, their parents 	<ul style="list-style-type: none"> Provide pictures or watch a video of a particular plant or animal and make observations and make predictions of young and adult. <ul style="list-style-type: none"> Young plants and animals of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity) Adult plants and animals (i.e., parents) of the same type have similar, but not identical features (e.g., size and shape of body parts, color and/or type of any hair, leaf shape, stem rigidity) Support students' predictions based on observations about similarities and differences among individual plants or animals of the same kind Provide informational texts and online resources for students to find patterns of similarities and differences in features between parents and offspring Provide a data table for students to collect data about features in plants and animals. (e.g., features that distinguish dogs versus those that distinguish fish, oak trees vs. bean plants)

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2nd Grade: LS2. Ecosystems: Interactions, Energy, and Dynamics

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>2-LS2-3 (MA). Develop and use models to compare how plants and animals depend on their surroundings and other living things to meet their needs in the places they live.</p> <p>Clarification Statement: Animals need food, water, air, shelter, and favorable temperature; plants need sufficient light, water, minerals, favorable temperature, and animals or other mechanisms to disperse seeds.</p>	<ul style="list-style-type: none"> • Use observations (firsthand or from media) to describe patterns and/or relationships between organisms in a particular place • Compare the needs of plants and animals • Use models (e.g., diagrams) to show how different plants disperse seeds and/or pollinate • Develop or use a model to show how animals that live in a particular place have their food needs met (e.g., food chain, food web) • Construct an explanation using pictures and/or words for how plants and animals depend on their habitats, including living and non-living factors (e.g., weather, water), to meet their needs 	<ul style="list-style-type: none"> • Provide students with videos, pictures, or texts and collect student observations about the relationships of plants and animals with their habitat • Support students in organizing their observations into patterns before students try to explain what they have observed • Support students in creating explanations about how plants and animals depend on their habitats, including living and non-living factors (e.g., weather, water), to meet their needs • Units related to this standard: <ul style="list-style-type: none"> ○ Why is our corn changing? (NextGen Storylines) ○ Why are there different plants growing in different places? (NextGen Storylines)

2nd Grade: LS4. Biological Evolution: Unity and Diversity

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>2-LS4-1. Use texts, media, or local environments to observe and compare (a) different kinds of living things in an area, and (b) differences in the kinds of living things living in different types of areas.</p> <p>Clarification Statement: Examples of areas to compare can include temperate forest, desert, tropical rainforest, grassland, arctic, and aquatic. Specific animal and plant names in specific areas are not expected.</p>	<ul style="list-style-type: none"> • Use grade-appropriate books and other media to obtain scientific information about local environments and the different types of living things that live there • Collect data from first-hand observations about the variety of plants and animals in a given area • Create models displaying various habitats and the diversity of living things found within them • Compare and contrast the attributes of living things found in various habitats 	<ul style="list-style-type: none"> • Take a walk outside in school yard or nearby place or use videos/web cams park to make observations • Create a table students can use to organize information/data from their observation • Have students sketch/draw habitats they observe (after lifting a rock, or observing a hole in the ground, nest, etc.) • Unit related to this standard: Why are there different plants growing in different places? (NextGen Storylines)

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Physical Science (PS)

1st Grade: PS4. Waves and Their Applications in Technologies for Information Transfer

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>1-PS4-1. Demonstrate that vibrating materials can make sound and that sound can make materials vibrate.</p> <p>Clarification Statement: Examples of vibrating materials that make sound could include tuning forks, a stretched string or rubber band, and a drum head. Examples of how sound can make materials vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.</p>	<ul style="list-style-type: none"> • Use observations as evidence to develop questions about the relationship between vibrating materials and sound • Develop and/or use a model (a picture) to represent vibrating objects • Collaboratively plan an investigation, including: <ul style="list-style-type: none"> ○ The materials to be used ○ How the materials will be made to vibrate to make sound ○ How resulting sounds will be observed and described ○ What sounds will be used to make materials vibrate ○ How it will be determined that a material is vibrating • Collect and analyze data such as: <ul style="list-style-type: none"> ○ Observations that sounds can cause materials to vibrate ○ Observations that vibrating materials can cause sounds • Construct an argument that supports or refutes ideas about the relationship between vibrating materials and sound 	<ul style="list-style-type: none"> • Provide students with videos, pictures, or texts and collect student observations and ask questions about vibrating materials and sound (e.g., slow motion videos of speakers or sound makers to record observations of sounds and their vibrations) • Collect student questions about sound and vibrations and support them to plan investigations about those questions • Provide students with materials to conduct investigations and collect data (e.g., use musical instruments or speakers for investigations related to vibrations and sound) • Make or generate sounds in the classroom, then lead students on a “vibration hunt” • Provide partial drawings or shapes for students to start with when creating their models/pictures of their observations (what they see and feel) of vibrating and sound making objects • Support students to develop claims and explanations using evidence they collected
<p>1-PS4-3. Conduct an investigation to determine the effect of placing materials that allow light to pass through them, allow only some light through them, block all the light, or redirect light when put in the path of a beam of light.</p>	<ul style="list-style-type: none"> • Ask questions based on observations to find out more information about the phenomenon of light • Make a claim using evidence to support or refute student ideas about putting objects made of different materials in the path of a beam of light 	<ul style="list-style-type: none"> • Collect student questions about light and shadows and use those to develop investigations • Support light investigations with the different materials listed below: <ul style="list-style-type: none"> ○ A material that allows all light through, resulting in the background lighting up

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<p>Clarification Statement: Effects can include some or all light passing through, creation of a shadow, and redirecting light. Quantitative measures are not expected.</p>	<ul style="list-style-type: none"> • Plan and carry out an investigation to produce data about what happens when objects made of different materials (that allow light to pass through them in different ways) are placed in the path of a beam of light • Use observations to describe or draw (with support) the materials to be placed in the beam of light, including: <ul style="list-style-type: none"> ○ A material that allows all light through (e.g., clear plastic, clear glass) ○ A material that allows only some light through (e.g., clouded plastic, wax paper) ○ A material that blocks all of the light (e.g., cardboard, wood) ○ A material that changes the direction of the light (e.g., mirror, aluminum foil) • Collect data and/or organize data to represent observations of the effect of placing objects made of different materials in a beam of light 	<ul style="list-style-type: none"> ○ A material that allows only some light through, resulting in the background lighting up, but looking darker than when the material allows all light through ○ A material that blocks all of the light, resulting in a shadow. ○ A material that changes the direction of the light, lighting up the surrounding space in a different direction • Show students examples of different light phenomena using pictures and videos • Offer many opportunities for students to investigate how light interacts with individual materials and combined materials • Provide students with a graphic organizer or table for collecting and organizing data • Make sentence frames and stems available to support student when writing to explain • Units related to this standard: <ul style="list-style-type: none"> ○ How does light help me see things and communicate with others? (NextGen Storylines) ○ Light and Shadows (DESE Model Curriculum Unit)
<p>1-PS4-4. Use tools and materials to design and build a device that uses light or sound to send a signal over a distance.*</p> <p>Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string “telephones,” and a pattern of drumbeats. Technological details for how communication devices work is not expected.</p> <p>(*) standard has an engineering design application</p>	<ul style="list-style-type: none"> • Generate design solutions for a problem involving people communicating over long distances. • Draw or build a device that sends a signal over a long-distance using light or sound • Compare multiple devices to assess which device sends a signal over a distance • Evaluate potential solutions, and explain whether the device: <ul style="list-style-type: none"> ○ Has the expected or required features of the design solution 	<ul style="list-style-type: none"> • Make a variety of materials available to students for constructing various types of devices (e.g., for sound, a cup telephone, sound makers; for light, flashlights, cards with different shapes/colors,) • Provide an organizational table for comparing devices that use sound or light • Provide opportunities for students to measure sound or light detection from a variety of distances (near and far) • Provide opportunities for students to describe specific features of their design solution:

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	<ul style="list-style-type: none"> ○ Provides a solution to the problem involving people communicating over a distance by using light or sound ● Use various texts or media to explain why it is helpful to communicate over long distances 	<ul style="list-style-type: none"> ○ The device is able to send or receive information over a given distance ○ The device must use light or sound to communicate ○ The device is only made from the materials provided ● Units related to this standard: <ul style="list-style-type: none"> ○ How does light help me see things and communicate with others? (NextGen Storylines) ○ Light and Shadows (DESE Model Curriculum Unit)
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2nd Grade: PS1. Matter and Its Interactions

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>2-PS1-1. Describe and classify different kinds of materials by observable properties of color, flexibility, hardness, texture, and absorbency.</p>	<ul style="list-style-type: none"> ● Construct an explanation that different kinds of matter have different properties ● Make observations, collect, and record data on the properties of the materials ● Organize or create a chart classifying different kinds of materials by their observable properties. ● Obtain and communicate the properties of matter of the materials and their classification 	<ul style="list-style-type: none"> ● Provide students with a variety of different types of everyday objects to make observations, ask questions and classify (pictures can be substituted for objects) ● Provide a table for students to use for sorting objects and identifying properties of those objects ● Provide graphic organizers for students to communicate information about properties of materials ● Unit related to this standard: Investigating Material Properties (DESE Model Curriculum Unit)
<p>2-PS1-2. Test different materials and analyze the data obtained to determine which materials have the properties that are best suited for an intended purpose.*</p> <p>Clarification Statement: Examples of properties could include, color, flexibility, hardness, texture,</p>	<ul style="list-style-type: none"> ● Conduct an investigation to determine which materials have the properties that are best suited for a specific purpose ● Analyze the given data from tests of different materials to organize those materials by their properties (e.g., strength, flexibility, hardness, texture, ability to absorb) 	<ul style="list-style-type: none"> ● Have students name a material and engage them in a discussion by asking why they think the manufacturer of each object decided to make it out of that particular material, and make note of the properties of materials mentioned and how they connect the properties to how the material is used (e.g.,

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<p>and absorbency. Data should focus on qualitative and relative observations.</p> <p>(*) standard has an engineering design application</p>	<ul style="list-style-type: none"> • Construct an explanation describing the relationships between properties of materials and some potential uses (e.g., hardness is good for breaking objects or supporting objects; roughness is good for keeping objects in place; flexibility is good to keep a materials from breaking, but not good for keeping materials rigidly in place) • Use observed data to describe patterns and relationships between materials and their properties (e.g., metal is strong, paper is absorbent, rocks are hard, sandpaper is rough, etc.) • Make an argument supported by evidence for which properties allow a material to be well suited for a given intended use (e.g., ability to absorb for cleaning up spills, strength for building material, hardness for breaking a nut) • Make a claim that support or refute their ideas about which properties of materials allow the object or tool to be best suited for the given intended purpose relative to the other given objects/tools 	<p>students could support the idea that hardness allows a wooden shelf to be better suited for supporting materials placed on it than a sponge would be, based on the patterns relating property to a purpose; students could refute an idea that a thin piece of glass is better suited to be a shelf than a wooden plank because it is harder than the wood by using data from tests of hardness and strength to give evidence that the glass is less strong than the wood)</p> <ul style="list-style-type: none"> • Provide students with materials to plan and conduct investigations and data tables to help them organize their data • Support students to make explanations by using graphic organizers and sentence stems • Unit related to this standard: Investigating Material Properties (DESE Model Curriculum Unit)
<p>2-PS1-3. Analyze a variety of evidence to conclude that when a chunk of material is cut or broken into pieces, each piece is still the same material and, however small each piece is, has weight. Show that the material properties of a small set of pieces do not change when the pieces are used to build larger objects.</p> <p>Clarification Statement: Materials should be pure substances or microscopic mixtures that appear contiguous at observable scales. Examples of pieces could include blocks, building bricks, and other assorted small objects.</p>	<ul style="list-style-type: none"> • Carry out an investigation using large pieces of materials that can be broken into smaller pieces/shapes (i.e. sugar cubes, paper, playdough, building block set pieces, etc.) • Make and compare observations of the material properties before and after breaking them down into pieces • Use evidence from observations to construct an explanation that when a chunk of material is cut or broken into pieces, each piece is still the same material and, however small each piece is, has weight • Use evidence to support an argument that: 	<ul style="list-style-type: none"> • Provide opportunities for students to make observations and predictions before investigations • Support students to plan and carry out investigations (e.g., put a cube of sugar in a jar and shake to break up into smaller pieces and make observations of the sugar before and after; use blocks to build a structure then break that structure apart into the individual pieces and make observations about the disassembled pieces; use paper or blocks to build larger objects) • Provide science tools for students to weigh and record the mass of the large chunk of

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	<ul style="list-style-type: none"> ○ The material properties of a small set of pieces do not change when the pieces are used to build larger objects ○ Many different objects can be built from the same set of pieces ○ Compared to the original object, the new object or objects can have different characteristics, even though they were made of the same set of pieces 	<p>materials before and after breaking them down into pieces</p> <ul style="list-style-type: none"> ● Support students to make explanations by using graphic organizers (e.g., claim, evidence, reasoning format) and sentence frames to help students construct an argument
<p>2-PS1-4. Construct an argument with evidence that some changes to materials caused by heating or cooling can be reversed and some cannot.</p> <p>Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and burning paper.</p>	<ul style="list-style-type: none"> ● Make and compare observations of the materials before and after changes to materials ● Use evidence to support an argument that some changes caused by heating or cooling can be reversed and some cannot. Evidence they could use: <ul style="list-style-type: none"> ○ The change in the material after heating (e.g., ice becomes water, an egg becomes solid, solid chocolate becomes liquid). ○ Whether the change in the material after heating is reversible (e.g., water becomes ice again, a cooked egg remains a solid, liquid chocolate becomes solid but can be a different shape). ○ The change in the material after cooling (e.g., when frozen, water becomes ice, a plant leaf dies) ○ Whether the change in the material after cooling is reversible (e.g., ice becomes water again, a plant leaf does not return to normal) 	<ul style="list-style-type: none"> ● Support students to make explanations by using graphic organizers (e.g., claim, evidence, reasoning format) and sentence frames to help students construct an explanation and argument ● Provide informational texts, online resources, and demos for students to observe and ask questions about changes caused by heating and cooling (e.g., Popcorn in an air popper would be an irreversible change. Show students the kernels and have them observe. Place them in the air popper. Have students make claims whether the popcorn could get back to the kernel’s original form, observe broken crayons and then melt them. Do you still have a crayon?) ● Encourage students to come up with some examples on their own and investigate to see if a change occurs and/or if the change is reversible ● Provide a table or chart for sorting whether the change can be reversible or irreversible (water, bread, butter, eggs, toothpaste) and have them provide evidence to support their placement in the table/chart

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2nd Grade: PS3. Energy

MA Standard	What students will be expected to do...	Supportive practices: Educators could...
<p>2-PS3-1 (MA). Design and conduct an experiment to show the effects of friction on the relative temperature and speed of objects that rub against each other.</p> <p>Clarification Statement: Examples could include an object sliding on rough vs. smooth surfaces. Observations of temperature and speed should be qualitative.</p>	<ul style="list-style-type: none"> • Use observations to ask questions about various situations involving forces and friction • Make predictions about how they think temperature and speed of objects affect friction and compare them to results of an investigation • Collect and analyze data from the investigation • Construct an explanation supported with evidence <ul style="list-style-type: none"> ○ When two objects rub against each other, this interaction is called friction ○ Friction between two surfaces can warm both of them (e.g., rubbing hands together) 	<ul style="list-style-type: none"> • Provide students with videos, pictures, or texts and collect student observations about effects of friction on the relative temperature and speed of objects that rub against each other • Support students in organizing their observations or data collected into patterns before students try to explain what they have observed/investigated • Have students generate a list of examples or possible investigations of friction in the classroom (e.g., a marble would travel on different surfaces, use the slide or other parts of the playground, move around the room on different surfaces, hold a thermometer, rub their hands together for 30 seconds and take the temperature) • Provide materials for students to conduct investigations

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Technology/Engineering (ETS)

1st Grade: ETS1. Engineering Design

MA Standard	What Students will be expected to do...	Supportive practices: Educators could...
<p>1.K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool.*</p> <p>(*) standard has an engineering design application</p>	<ul style="list-style-type: none"> • Generate and ask questions to gather information about a situation that people want to change and why they want that situation to change that can be solved by developing or improving an object or tool • Record observations of areas such as the school (classroom, lunchroom, hallway, playground) to identify situations people want to change and record quantitative or qualitative data related to their findings. • Collect and record quantitative or qualitative data related to their findings • Describe the features for a tool or object that would solve the problem, based on scientific information, materials available, and potential related benefits to people and other living things • Use the information they have gathered (including the answers to their questions, observations they have made, and scientific information) to describe the situation people want to change in terms of a simple problem that can be solved with the development of a new or improved object or tool. • Communicate design ideas in oral or written forms using models, drawings, etc. 	<ul style="list-style-type: none"> • Engage students in the engineering design process by displaying the design process (poster, drawing, etc.) in the classroom and using the process as they develop questions and make observations about a situation they want to change • Support students to focus their questions, observations, and information gathering on a specific situation that people want to change, why they want it to change, and the desired outcome of changing the situation • Provide students with question sentence starters and support students' generation of questions before and after observing the situation • Take a walk around the school or interview others to find out what situations people would like to improve and use the information to propose an improvement • Support students to obtain information using various texts and other media that will be useful in developing or improving an object or tool. • Provide students with examples about situations people wanted to change that was solved by improving an object or tool to support them in making observation and asking questions • Provide graphic organizers or table to support students in organizing their observations or

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		<p>data collected into patterns before students try to explain what they have observed/investigated</p> <ul style="list-style-type: none"> • Units related to this standard: <ul style="list-style-type: none"> ○ How does light help me see things and communicate with others? (NextGen Storylines) ○ Why are there different plants growing in different places? (NextGen Storylines)
<p>1.K-2-ETS1-2. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.</p>	<ul style="list-style-type: none"> • Generate and ask questions to gather information about a design problem • Make observations and provide possible solutions for a design problem • Use sketches, drawings, or physical models to convey possible solutions to design problem • Use a model (simple sketch, drawing, or physical model/prototype) to communicate how the object could solve the problem • Ask questions based on models of solutions (e.g., to compare solutions, to clarify how a solution works) 	<ul style="list-style-type: none"> • Engage students in the engineering design process with a focus on design and modeling (drawing) possible solutions, refining them, or choosing a model that best meets the solution • Support students to obtain information using various texts and other media that will be useful in developing a drawing to represent a solution • Provide students with examples of design problems and some possible solutions to support them in making observation and asking questions to develop their own solutions • Provide students with graphic organizers or partial models to support them in developing a plan for a solution • Help students understand how to use a model by drawing an everyday object (e.g., pencil sharpener, stapler, scissors) as a model, including: <ul style="list-style-type: none"> ○ Label parts that perform a specific task ○ The relationships between the components of the object ○ Have students compare the drawings/models of an object to the actual object and discuss what would be confusing to someone who has never

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		<p>used the object represented in the model</p> <ul style="list-style-type: none"> • Units related to this standard: <ul style="list-style-type: none"> ○ How does light help me see things and communicate with others? (NextGen Storylines) ○ Why are there different plants growing in different places? (NextGen Storylines) ○ Light and Shadows (DESE Model Curriculum Unit)
2nd Grade: ETS1. Engineering Design		
MA Standard	What Students will be expected to do..	Supportive practices: Educators could...
<p>2.K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strengths and weaknesses of how each object performs.*</p> <p>Clarification Statement: Data can include observations and be either qualitative or quantitative. Examples can include how different objects insulate cold water or how different types of grocery bags perform.</p> <p>(*) standard has an engineering design application</p>	<ul style="list-style-type: none"> • Describe quantitative or qualitative attributes of the different solutions and display the data using simple graphs • Organize data in order to find patterns in the data, and use those patterns to compare: <ul style="list-style-type: none"> ○ how each of the objects performed, relative to the other object ○ how each of the objects performed, relative to the intended performance ○ how design features (e.g. shape, thickness) of objects relate to their performance and function ○ Use the patterns they found in the data to describe: <ul style="list-style-type: none"> ○ how each object solves (or does not solve) the problem ○ strengths and weaknesses of each design ○ which object is better suited to the desired function if both solve the problem ○ Evaluate different ways of observing and/or measuring the success of the objects (e.g., refining the test, deciding which way to test is best) 	<ul style="list-style-type: none"> • Engage students in the engineering design process with a focus on testing and evaluating the design problem. • Display (poster, drawing, etc.) and engage students in the design process for students to develop the necessary skills to engage in the process • Provide materials for students to conduct investigations and collect data • Provide multiple opportunities for students to collect data with a variety of data collection tools (e.g., measurement tools, surveys) • Provide a variety of ways (e.g., picture graph, bar graph, table) to show data from a test, and allow students to choose representation that fits data best • Bundle with mathematics standards 1.MD.4, 2.MD.9, 2.MD.10 when asking students to collect and represent data • Support student ideas for solutions or changes drawn from data • Units related to this standard:

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		<ul style="list-style-type: none">○ How does light help me see things and communicate with others? (NextGen Storylines)○ Why are there different plants growing in different places? (NextGen Storylines)○ Investigating Material Properties (DESE Model Curriculum Unit)
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