Grade Two

Students in grade two continue to explore phenomena related to life sciences, physical sciences, and Earth and space sciences and reinforce their ability to identify patterns in their observations. They use those patterns to develop models, to find relationships between cause and effect in systems, and to begin developing ideas about how matter cycles in systems. Grade two also places special emphasis on planning and conducting investigations, developing models and the role of evidence in developing scientific arguments and explanations. The instructional segments build in complexity in terms of both disciplinary content and the application of science and engineering practices and crosscutting concepts.

Table 4 summarizes the PEs included in each instructional segment and the crosscutting concepts that students may use as a tool to make sense of the core ideas. Where necessary, PEs that integrate science ideas with engineering design are accompanied by one of the three PEs from the K-2 engineering design system. The engineering design PE has been chosen to best match the suggested integration. The PEs that suggest an explicit integration with engineering are indicated with an asterisk (*).

Table 4: Instructional Segments in Grade Two

Instructional Segment	Highlighted SEP	Highlighted CCC	PEs addressed	DCI addressed
Instructional Segment 1: Identifying and locating features of the geosphere and biosphere	• Designing solutions • Developing and using models	• Patterns • Energy and Matter	2-ESS2-2 2-ESS2-3	ESS2.B: plate tectonics and large-scale systems interactions ESS2.C: the roles of water in Earth's surface processes
	Brief Summary			
	Water is present on the Earth's surface as liquid and solid. As water moves on the surface of Earth, it shapes Earth's surface.			
Instructional Segment 2: How landforms change	• Obtaining, evaluating, and communicating information • Designing solutions	• Stability and Change	2-ESS1-1 2-ESS2-1* K-2-ETS1-2	ESS1.C: the history of planet Earth ESS2.A: Earth materials and systems
	Brief Summary			
	Earth's surface has been shaped by geological events that occur on different time scales.			
Instructional Segment 3: Matter and its properties	• Analyzing and interpreting data • Planning and carrying out investigations	• Patterns • Energy and Matter	2-PS1-1 2-PS1-2* K-2-ETS1-3 2-PS1-3 2-PS1-4	PS1.A: Structures and properties of matter PS1.B: Chemical reactions ETS1.C: Optimizing the design solution
	Brief Summary			

	Different materials can be solid or liquids depending on temperature. The change from solid to liquid (or vice versa) can be reversed, but not for all materials.			
Instructional Segment 4: Biodiversity	**Highlighted SEP**	**Highlighted CCC**	**PEs addressed**	**DCI addressed**
	• Designing solutions • Analyzing and interpreting data • Planning and carrying out investigations	• Patterns • Cause and Effect	2-LS2-1 2-LS4-1 2-LS2-2* K-2-ETS1-1	LS2.A: Interdependent relationships in ecosystems LS4.D: Biodiversity and humans ETS1.B: Developing possible solutions
	Brief Summary			
	Plant and animals depend on the availability of resources in their ecosystem to grow. The diversity of plants and animals in different habitats also depends on the availability of these resources.			

Grade Two-Instructional Segment 1: Identifying and locating features of the geosphere and biosphere

In second grade, students continue developing their understanding of Earth's systems by acquiring the capacity to draw maps representing characteristic features of familiar areas. In later grades, they move to more complex mapping of regions and interpreting existing maps. This capacity of observing, reproducing, and creating maps will allow students in subsequent grades to make sense of patterns on Earth's surface and begin to develop their understanding of plate tectonics as the unifying theory that explains past and current movements of rocks on Earth's surface.

Grade Two-Instructional Segment 1: Identifying and locating features of the geosphere and biosphere
How can we represent the land around us? *What are the different kinds of land and bodies of water?* *Where can we find water on Earth?* *Where can we find ice on Earth?*
Highlighted Crosscutting Concepts: Patterns, Energy and Matter

Highlighted Science and Engineering Practices:

- *Develop solutions*
- *Developing and using models*

CA NGSS Performance Expectations:

Students who demonstrate understanding can:

2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be solid or liquid.
[Note: no clarification statement or assessment boundary is included in this PE.]

2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
[Assessment Boundary: Assessment does not include quantitative scaling in models.]

Background for Teachers

One of the major features of Earth is the presence of abundant amounts of liquid water. Water has unique physical and chemical properties that are central to the processes occurring on Earth. These properties include water's ability to absorb, store, and release large amounts of energy as it changes state. These properties fundamentally affect Earth's systems. For example, the expansion of water as it freezes contributes to breaking of rocks and rock erosion, and the ability of water to store energy as heat contributes to keeping coastal area temperatures within moderate ranges.

Water is found everywhere on Earth's surface in different forms depending on temperature and pressures. Gravity is the force that moves water in different states through Earth's surface, interior, and atmosphere. This movement contributes to shaping the land, transports sediments, and dissolves Earth's materials. At this grade level, however, students explore only the liquid and solid states of water and recognize the presence of water on maps. This instructional segment is closely linked to instructional segment 2 in this grade level.

Description of the Instructional Segment

In this instructional segment, students develop their ability to make and use map-based models to record or interpret information about geographic features. They begin by observing their surroundings, for example the classroom or schoolyard, and use that information to draw a “treasure hunt” map. Students use a map made by another student to find an object. This treasure hunt activity motivates and engages students. Students then collaborate in gathering information about a particular location, paying attention to collecting and recording accurate data. They locate information on maps provided by the teacher and make their own maps.

Students move from observing and representing small spaces or designed spaces to creating models of larger spaces, such as the entire school or a park, including developing and interpreting ways to indicate variations in topography. Students are not expected to construct detailed topographic maps, but they need to develop their own ways of representing hills and valleys before being introduced to maps that include topological contours and learning to interpret them. They then use the map of their town, a local park or region, or their entire state with the intent of obtaining information about geographic and environmental features in their region. The teacher leads the students to ask questions about the geographic features or observed patterns and to analyze and relate features of their maps so patterns can emerge and claims can be supported with evidence. For example, students may develop questions and, based on their observations, relate the pattern of areas with more plants to physical features such as shade or availability of water. The may relate the presence of particular birds to

ELA ELD Connection
Pose a unifying question, such as “What are the different kinds of land and bodies of water?” Students gather information about different landforms or bodies of water by watching related videos (or the teacher can read aloud texts and provide informational texts that students read). Next, the students create a booklet labeling the different landforms and bodies of water on each page, starting with the lower land or water levels on the first page, adding the taller landforms for the next additional pages. At the end, the booklet should include a variety of drawings (e.g., ocean page, desert page, forest page, hill page, plateau page, mountain page). Different bodies of water can be included, such as a lake, river, or ice caps on some of the mountains.

particular plant or water features to answer these questions.

Students are then asked to gather and use information to identify and represent where certain kinds of lands and bodies of water are found on Earth and the locations of dominant geographic features such as mountain ranges, glaciers, ice caps, oceans, major rivers and lakes. The intent is not for students to memorize these locations but to analyze and interpret patterns found in them, such as how different bodies of water are connected to each other.

Students then ask questions and design investigations to develop an understanding of the conditions under which water freezes (temperature and salinity variation) and the time it takes for a given amount of ice to melt at different external temperatures. After they have made investigations, the students can apply this understanding to interpret and explain where certain ice features are found on maps provided by the teacher and what this tells us about temperature ranges in those regions. The idea of the difference in regional average temperatures and of a cycle of temperature changes and range over the year is introduced through discussions and analysis of temperature maps available from online sources—and students' own experiences with temperature changes. Students analyze and argue from evidence about the relationships between major features found on temperature maps and geographic maps of the same area.

Mathematics Connection
When talking about very low temperatures, below freezing or negative numbers such as "negative 10 degrees, (-10°)", it would be helpful for students to see a vertical thermometer enlarged, with benchmark temperatures marked on it. Students will not encounter negative numbers in mathematics until grade six and may have to count degree marks to calculate a change in temperature that spans negative numbers.

Many young students in California have not experienced very low temperatures.

Grade Two-Instructional Segment 2: How landforms change

In order to reconstruct and understand events occurring in Earth's past and current history, Earth scientists observe and use structure, sequence, and properties of rocks and sediments. Interaction of these Earth's materials with water and wind causes them to erode, change, or be transported to different locations.

Grade Two-Instructional Segment 2: How landforms change

What natural processes cause changes in landforms?
What are the causes of quick change?
What processes result in slow changes?

Highlighted Crosscutting Concepts: Stability and Change

Highlighted Science and Engineering Practices:

- *Obtaining, evaluating, and communicating information*
- *Designing solutions*

CA NGSS Performance Expectations:

Students who demonstrate understanding can:

2-ESS1-1. Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
[Clarification Statement: Examples of events and timescales could include volcanic explosions and earthquakes, which happen quickly, and erosion of rocks, which occurs slowly.] [Assessment Boundary: Assessment does not include quantitative measurements of timescales.]

2-ESS2-1. Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.*
[Clarification Statement: Examples of solutions could include different designs of dikes and windbreaks to hold back wind and water and different designs for using shrubs, grass, and trees to hold back the land.]

K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a practice or disciplinary core idea.

Background for Teachers

Instruction and learning in this instructional segment should focus on the processes of wind and water erosion and catastrophic natural events, such as earthquakes and volcano eruptions. Students, especially students who live in earthquake-prone regions, may raise questions about the changes to the continents and mountain uplift due to plate tectonics. Students will not be formally introduced to plate tectonics until middle school, but their questions will need to be accommodated and discussed in the context of the instructional segment.

What types of changes are considered to be quick or slow relative to the timescale in the Earth systems? A quick change could be defined as the sudden (within minutes or hours) eruption of a volcano with explosions of gases, ash, lapilli (the small rocks falling out of the air during a volcanic eruption), and lava, though it may then take several weeks before the volcano's activity subsides. A slow change might be the erosion of a stream valley by the stream. This understanding supports students to deepen their ability to use the crosscutting concept of ***stability and change*** to characterize observations of events with greater details.

Mathematics Connection
Students could create a relative time scale of Earth's history comparing the entire history to a 12- hour period, or a calendar year; noting that humans have existed for a very short time during Earth's existence. When introducing the timeline project, the timeline could be compared to a number line.

Description of the Instructional Segment

In this instructional segment, students gather information about landforms that display different and interesting shapes (where possible, use local examples) and also engage in classroom experiments that investigate the impact of moving water on different types of soil and rocks. These activities generate observations regarding which type of soil is subject to a more rapid change as water moves through. For example, in a small amount of time slow-moving water may not significantly change the rocky bottom of a river, but the change is more observable when the bottom of the river is sandy.

To investigate different situations or events, students analyze data and engage in argumentation to develop explanations of how wind or water (or a combination of the two) could be responsible for the way the land is shaped. The location of the land affected by wind or water can be close to the students' community first and then move to a larger scale with videos and visual online resources provided to present examples of water erosion, silting of flooded regions or river delta formation, and wind-driven shaping of sandstone.

> **ELA ELD Connection**
> Using a cause/effect template or note-taking guide, students investigate and record the natural process that cause changes in landforms, cause and effect of wind and/or water on the shape of land forms. Details should answer such as questions as what, where, when, why, and how the changes impact landforms.

To understand and fully appreciate science, students must be able to read, write, speak and listen about science concepts and practices. To support literacy in science, this instructional segment includes a research and writing project. Students begin by gathering information from multiple sources (e.g., reading from textbook or magazine articles appropriate to their grade level, collecting pictures, and using selected online and video materials) regarding the processes and timescales in which water and wind shape the land. They write informative texts in which they synthesize information from several sources to provide evidence and reasoning to support the claim some events happen quickly (e.g., flood, hurricane, mudslide), while others occur over extended time (e.g., erosion of rocks by repeated freezing and thawing of water). They investigate evidence from maps that show occurrences of other sudden natural catastrophic events, such as volcanic eruptions and earthquakes, and discuss how these events have changed the land quickly in certain locations in the past. As part of their writing project, students are also encouraged to argue to support claims about the risks of various types of such catastrophic events in their region and to develop suggestions about what can be done to minimize damage in such an event.

Engineering Connection

Students then analyze a local problem caused by wind or water (e.g., flooding, erosion, crop damage, landslide) and design a possible solution to slow or prevent the problem. Students make models of the scenario to test their ideas and collect data about the impact of their solution on the problem. For example, after observing erosion around rainspouts on the school grounds, students could construct barriers that stop water from running down a slope. Students can use heavy paper (card stock or large file cards) and structural support materials (craft sticks, twigs, blocks, clay) to create a wind barrier to protect a "sand dune" (a small mound of sand). The effectiveness of the barriers can be tested by observing what happens when a fan blows "wind" across the sand dune. By analyzing and sharing their data, students compare different engineering design solutions to the problem to evaluate the solutions' strengths and weaknesses and their overall effectiveness in slowing or preventing this problem.

Grade Two-Instructional Segment 3: Matter and its properties

This instructional segment develops students' ideas and language about matter and its conservation, a concept that will be further developed and deepened in subsequent grades. The focus is chiefly on solids and liquids, as it is difficult for students at this level to visualize a gas as scientists do or to see it as something rather than nothing. The instructional segment also begins to develop students' language and ideas around classifying materials by their properties and noting that different materials have different uses because the use requires particular properties. These uses are related to the function of the materials, which is based on their structure.

Grade Two-Instructional Segment 3: Matter and its properties
How can we describe different types of matter? *What properties are important and useful to consider?*

How are materials similar and different from one another, and how do the properties of the materials relate to their use?
Highlighted Crosscutting Concepts: Patterns, Energy and Matter
Highlighted Science and Engineering Practices: • *Analyzing and interpreting data* • *Planning and carrying out investigations*
CA NGSS Performance Expectations: Students who demonstrate understanding can: 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.] 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.] K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. 2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.] 2-PS1-4. Construct an argument with evidence that some changes in matter, caused by mixing, heating, or cooling can be reversed and some cannot. [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 heating paper.] *The performance expectations marked with an asterisk integrate traditional science content with

engineering through a practice or disciplinary core idea.

Background for Teachers

The activities in this instructional segment deal chiefly with large scale changes in matter and begins to develop the idea that some changes are easily reversed. For example, ice can be melted and refrozen or salt can be dissolved in water and recovered by evaporation. Other changes cannot be reversed, for example, cooking an egg, baking a cake, or burning a piece of paper or wood in a fire. These original materials cannot be recovered

The instructional segment also takes a first step toward the idea of substructure within matter at a scale too small to see. The intent of this instructional segment is not for the students to understand the existence of atoms or molecules, rather it simply develops the idea that some objects can be put together with only a few different types of elemental objects in multiple different ways to make many distinct types of objects. These elemental objects could be blocks that interconnect to each other or other small objects that can be used to build bigger objects. The purposes of the instructional segment are to 1) focus students' attention on things and phenomena that seem unremarkable because they are part of their everyday experience and to 2) lead students to ask questions about the how and why of these familiar things as they organize the patterns they observe.

Description of the Instructional Segment

This instructional segment focuses on physical science concepts about matter and its observable properties, and it links to instructional segment 1

ELA ELD Connection
Teacher can read aloud, or have students read, informational texts related to solids and liquids, for example, *What is a Liquid?* or *What is a Solid*? by Jennifer Boothroyd. Students collect examples of everyday situations (using or drawing pictures) of how matter changes and identify which changes can, or cannot, be reversed.

as students generalize their understanding of freezing and thawing of water to other reversible and non-reversible changes of matter.

The teacher directs students to observe of everyday objects (clothing, cooking utensils, toys, houses) and the different materials they are made of and then asks questions such as “What properties does the material have?” “Why are those properties important to the way we use this object?” and “Would a jacket made out of paper keep you dry in the rain.” The questions prompt students to ask further questions about materials. Over time, they begin to analyze and classify materials based on observable properties such as solid or liquid, texture, hardness, absorbency, and flexibility.

The notion of persistence (or stability) and change in matter is then extended as students investigate conditions under which objects mixed or fastened together can or cannot be separated back into their original components. Students also observe changes in properties of matter occur in many everyday situations (cooking an egg, mixing substances that react but do not give off gases, melting and attempting to solidify a variety of substances such as water, cooking oil, ice-cream, or butter). These changes do not change the amount of matter (as measured by weight).

Through multiple experiences with matter changes, students develop understanding that some changes can be reversed and others cannot. They are able to relate this idea to the evidence about the melting and freezing of water and the erosion of rocks in instructional segments 1 and 2. In second grade, students are expected to students to recognize matter changes its properties under various conditions, including sometimes when it is brought into contact with other matter, and only a limited number of these changes can be reversed. In later grades, they will learn about the characteristics of physical and chemical changes.

Engineering Connection

The two examples of connections to engineering provided below offer students opportunities to explore the different types of matter (materials) and their properties. The examples lead students to understand that different materials are used to meet different purposes.

Students are given a supply of small objects such as connecting or building blocks or some of the same materials they used in previous lessons. They are asked to reflect on and provide evidence that many different structures or objects can be made from the same set of components and an object made up of smaller parts can sometimes be taken apart and the parts used to build something quite different. The teacher should emphasize that 1) to make or build something we need a certain amount of particular types of matter; 2) things we no longer use do not disappear but must be disposed of; and 3) the materials in them may be recycled for other uses. These ideas are introduced through teacher and student questions, classroom activities, read alouds, students' informational text, and discussions of examples supported with visual materials.

Applying what they have learned about the properties of different materials, small groups of students undertake projects in which they design an object intended for a particular function. For example, students can design a cage or enclosure for a small animal. The design process starts by students defining the problem to be solved (e.g., keeping a hamster safe in the classroom), considering the constraints (How big can it be? What will the hamster need inside the cage?), and making a list of the desired properties of the object (It has to be hard enough the hamster cannot bite through it.) and the materials and tools they will need to use in order to build it. The students might assess each material's individual properties and how they work together in concert to meet the needs specified for the product. Each group of students constructs a prototype and then evaluates the strengths and weaknesses of their own and other groups' designs, focusing on the appropriateness of the materials used. After this analysis, students can develop a joint design for the entire class that includes the best ideas from the initial designs. Working collaboratively, the students can draw or construct a model of the final design.

Grade Two-Instructional Segment 4: Biodiversity

In this instructional segment, students build on their experiences from kindergarten and first grade about needs of plants and animals to make observations and develop maps that describe the variety and abundance of plants and animals that occupy different habitats. These earlier experiences laid the groundwork for investigating the needs of plants and how these needs are met in different habitats.

Grade Two-Instructional Segment 4: Biodiversity
What do plants need to grow? What more do they need to thrive as a population? *What regions have greater diversity and abundance of plants and animals, what conditions promote such diversity and/or abundance?* *How can we record and analyze information about what grows where?* *What do plants need to grow? How many types of living things live in a place?*
Highlighted Crosscutting Concepts: Patterns, Cause and Effect
Highlighted Science and Engineering Practices: • *Designing solutions* • *Analyzing and interpreting data* • *Planning and carrying out investigations*
CA NGSS Performance Expectations: Students who demonstrate understanding can: 2-LS2-1. Plan and conduct an investigation to determine if plants need sunlight and water to grow. [Assessment Boundary: Assessment is limited to testing one variable at a time.] 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats. [Clarification Statement: Emphasis is on the diversity of living things in each of a variety of different habitats.] [Assessment Boundary: Assessment does not include specific animal and plant names in specific habitats.] 2-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.* [Note: there is no clarification statement or assessment boundary for this PE.]

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

*The performance expectations marked with an asterisk integrate traditional science content with engineering through a practice or disciplinary core idea.

Background for Teachers

Ecosystems are composed of multiple parts, including biological components (plants and animals) and physical components (e.g., water, light, soil, air). Living organisms within an ecosystem will survive and grow only if their needs are met. Different ecosystems provide different resources to plants and animals, and the variety of organisms in certain habitats depends on the availability and abundance of these resources. Animals can move around in a habitat, while plants cannot. This lack of mobility creates a dependence of plants on animals for pollination or to move seeds around. The crosscutting concepts of ***patterns*** and ***cause and effect*** are used by students in combination as they organize their observations into patterns to identify the effects and to subsequently investigate the causes of the patterns.

ELA ELD Connection
To connect to Unit 1 and help them recall information, students create an If/Then poem or text about a plant in different habitats. For example, *If* a plant lives in the desert where there is not much water - then it needs long roots to get water, often has few leaves or a protective coating on the stem, and remains dormant during times with little water.

Description of the Instructional Segment

Students plan and conduct investigations and gather evidence to develop a model they can use to support an argument that plants need air, water, and sunlight (or a light similar to that provided by the sun) to grow. Based on this fundamental understanding, students then examine and compare the variety and abundance of plants and other life forms in different habitats. They can also apply their learning from instructional segment 1 to create maps from observable environments and compare the diversity of living things present in different habitats around their school or in a nearby park. Students compare these observations and develop arguments about the bodies of water and the landforms present and their relationship to the abundance and variety of life forms present in different locations.

Engineering Connection

Students further use their maps and models to support an argument that plants' survival and abundance as a species also depends on their ability to pollinate and spread their seeds. Many plants depend on the animals present in their environment for these functions. Students deepen their understanding of this idea by making a model of how the structure of the plant and the pollinator are related to how this function occurs for particular examples of plant/pollinator pairings. Students obtain information about problems related to plant pollination or seed dispersal in agriculture and design a simple device that can be used to mimic the function of natural pollinator or seed dispersal to solve a problem for a particular plant. Students can compare their solutions by testing their devices to see how well they pollinate or disperse seeds. Using the evidence from their tests, they can engage in argument to compare and contrast the characteristics of different devices.

The following vignette is an example of how teaching and learning focused on the disciplinary core idea LS4.D Biodiversity and Humans and the PE 2-LS4-1 Biological Evolution: Unity and Diversity might look in a second-grade classroom.

Grade 2 Vignette

Biodiversity in Changing Environments

Introduction

In this series of lessons, Mr. B takes his students outside the classroom to observe animals and plants in their habitats. He augments the students' observations with informational texts and class discussions on animals and plants and their habitats. His goal is that students will understand concepts such as diversity and abundance and the impacts of human activities on habitats.

Day 1 – Biodiversity in Changing Environments

Mr. B decided to use materials from three California Environmental Education Initiative (EEI) units, *Cycle of Life*, *Flowering Plants in Our Changing Environment*, and *Open Wide! Look Inside!* as the foundation for a series of lessons about biodiversity in changing environments. His students have already begun to learn about what plants need to grow and what they get from the ecosystems where they live. He posts word cards on the wall to introduce students to several domain-specific words that they will use as they study what plants need from the habitats where they live: *moisture*, *nutrient*, *pollinate*, *soil*, *temperature*, *water*, and *ecosystem*. He decides to focus on the word *ecosystem* because it represents a crucial concept in the life sciences. He asks students if they have heard this word before and what they think it means. Building on the students' suggestions, Mr. B explains that an *ecosystem* is made up of living and nonliving things that are found together and that affect each other.

Mr. B begins a class discussion by asking students to consider the school garden they planted and list some of the things that the plants in their garden need to survive. He expands on this discussion by having the class brainstorm a list of some of the things that plants living in a forest ecosystem need to grow and survive. Then, working in groups of three, the students read and discuss two sets of informational text, *Would Blackberries Grow…?* and *What a Joshua Tree Needs from the Desert.* The class as a whole than reviews the basic things plants need from the habitats where they live.

Day 2 – Plants and Animals Near Our School

The students take their science journals and pencils with them on a walk outside. With Mr. B leading the way and a parent volunteer following along, the students visit green areas on the campus, in a nearby park, in the local neighborhood, or at a nature center. Before they start their walk, Mr. B tells the students that they need to make firsthand observations and collect data during this field trip. Once they are outside, he asks the students to point out different plants and animals and make notes or simple drawings in their science journals. Before they go back to their classroom, he guides the students in a discussion about the variety and abundance of plants and other life forms they observed in the different habitats along the way. After their field trip, the students draw simple maps of the areas they visited and identify or draw some of the organisms they observed in the different habitats. Mr. B asks the students to recall information from their field trip and their maps and use it as the basis for answering the question, "Do the plants and animals we observed live in all of the areas we visited or just some of the areas?" This question helps students begin to recognize that many different kinds of living things are found in a given area and that they exist in different places on land and in water.

Days 3-4 – Humans Change Habitats

In order for students to relate their developing ideas about the diversity (variety) of life to the natural world, Mr. B calls their attention to the California *Habitats* wall map. Working together, the class identifies the nine major habitat types in California. The teacher calls on different students to identify animals and plants illustrated on the map, assisting them as needed to read the names of the different organisms. He introduces students to the idea that there are many different kinds of living things in the world and mentions the word *diversity*, explaining that it means the variety of living things. Mr. B then facilitates a brief discussion about the diversity of California's ecosystems, plants, and animals.

Once the students have this basic background information about different habitats, they are ready to start an investigation. Mr. B tells the students that they are going to investigate how humans change the habitats where plants and animals live. He begins the process by asking students several focused questions: “How can human activities change the habitats where plants and animals live?” “How do these changes affect the survival of the plants and animals that live there?” “What might happen to the variety of living things around the school or in the nearby park if we change those habitats?”

Mr. B tells the class that they are going to take another walk to the places they visited before and continue collecting data. He explains that during this second field trip the class is going to investigate two types of areas, some that have been “disturbed” by humans and others that are in a more natural condition. As they visit these sites, the students make notes or simple drawings in their science journals about the condition of the habitats and abundance of plants and animals.

Upon their return to the classroom, the students work in pairs using the notes from their field trip to summarize their observations about the effects of human activities on the variety and abundance of plants and animals. The students participate in a “round robin” discussion as Mr. B lists their ideas about the relationship between human activities and the variety of living things. As a strategy for reinforcing the crosscutting concept ***cause and effect***, he guides the students through a discussion of what they observed on their field trips regarding how human activities have changed the local environment.

Day 5 – Improving a Local Habitat

Mr. B challenges the students to come up with ideas about what they as a class or as individual students might do to decrease the effects of human activities on plants and animals. He then acts as the recorder as the students share their ideas about how to decrease the effects of human activities.

In order to assess their understanding of these concepts, Mr. B tells the students that they are going to share what they learned through their research by creating informational posters. He tells them that they should include four different items on the posters: two drawings based on their science journals, one showing a natural habitat and another showing the effects of human activities; a brief written description about their scientific observations regarding these two habitats; and their ideas about decreasing the effects of human activities. Excited by what they have learned, the students ask if they can display their posters in the hall outside the classroom so that the **information** can be shared with other students and their parents.

Because the students want to do something to lessen the effects of human activities on their environment, Mr. B collaborates with the school's expanded learning program on a recycling project. During expanded learning time, students create signs to glue to recycling boxes and place the recycling boxes around the expanded learning space. They encourage other students in the expanded learning program to recycle used paper. At the end of week, the students empty the boxes in the school's recycling containers.

(Note: EEI Curriculum Units: *Flowering Plants in Our Changing Environment* and *Cycle of Life and Open Wide! Look Inside!* are comprised of a total of 10 lessons and a variety of supporting materials that can be integrated together to support instruction in this instructional segment.*)*

Performance Expectations		
2-LS4-1. Biological Evolution: Unity and Diversity Make observations of plants and animals to compare the diversity of life in different habitats.		
Science and engineering practices	**Disciplinary core ideas**	**Cross cutting concepts**
Planning and Carrying Out Investigations Make observations (firsthand or from media) to collect data which can be used to make comparisons.	**LS4.D Biodiversity and Humans** There are many different kinds of living things in any area, and they exist in different places on land and in water.	**Cause and Effect** Events have causes that generate observable patterns.
California's Environmental Principles and Concepts		
Principle II: The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies. **Concept a.** Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.		
Connections to the CA CCSS for ELA/Literacy: W.2.7, W.2.8		

Vignette Debrief

The CA NGSS require that students engage in science and engineering practices to develop deeper understanding of the disciplinary core ideas and crosscutting concepts. The lessons give students multiple opportunities to engage with the core ideas in life sciences related to the diversity of plants and animals in different habitats, helping them to move towards mastery of the three components (SEPs, DCIs, CCCs) described in the CA NGSS performance expectations.

In this vignette, the teacher selected one PE but in the lessons described above he only engaged students in selected portions of this PE. Full mastery of this PE will be achieved through subsequent instructional segments.

Students were engaged in a number of science practices with a focus on the science and engineering practice of **planning and carrying out investigations**. Life sciences lend themselves well to the developing students' abilities to make firsthand observations and collect data to use in making comparisons.

Students observed the diversity of plants and animals that lived near the school. They also collected evidence about human-caused changes to a natural habitat. Students then created informational posters to share what they learned about the diversity of life in different habitats and the effects of human activities on those habitats.

The field trips and subsequent class discussions helped students begin to recognize that events have causes that generate observable patterns, reinforcing the crosscutting concepts of ***cause and effect*** and ***patterns.*** In addition, these experiences provided a context within which the students could begin developing an understanding of California Environmental Principle II Concept a, Direct *and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems*.

CA NGSS Connections to English Language Arts

Students used the text in "*Would Blackberries Grow…?"* and "*What a Joshua Tree Needs from the Desert"* as the sources for a shared research project, connecting to the CA CCSS for ELA/Literacy Standard (W.2.7). In addition, they used their science journals to make notes and gather information about the diversity of plants and animals living nearby and human disturbances they observed. Students also used this information to answer questions during a round-robin discussion, corresponding to CA CCSS for ELA/Literacy Standard 2 (W.2.8), as well as creating an informational poster.

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W.2.7 Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations).

W.2.8 Recall information from experiences or gather information from provided sources to answer a question.

Resources for the Vignette

- California Education and the Environment Initiative. 2011. *Cycle of Life.* Sacramento: Office of Education and the Environment.
- California Education and the Environment Initiative. 2011. *Flowering Plants in Our Changing Environment.* Sacramento: Office of Education and the Environment.
- California Education and the Environment Initiative. 2011. *Open Wide! Look Inside!* Sacramento: Office of Education and the Environment.

Science Literacy and English Learners

The vignette below presents an example of how teaching and learning may look in an early learning classroom (kindergarten through second grade) when the CA NGSS are implemented in tandem with the CA CCSS for ELA/Literacy and the CA ELD Standards. The purpose is to illustrate how a teacher engages students in three-dimensional learning by providing them with experiences and opportunities to develop and use the Science and Engineering Practices and the Crosscutting Concepts to understand the Disciplinary Core Ideas associated with the topic in the instructional segment. An additional purpose is to provide examples of how language and literacy development are cultivated through interactive and engaging science literacy learning tasks. The vignette includes scaffolding approaches for English learner (EL) children. It is important to note that the vignette focuses on only a limited number of performance expectations. It should not be viewed as showing all instruction necessary to prepare students to fully achieve the CA NGSS performance expectations or complete the instructional segment. Neither does it indicate that the performance expectations (PEs) should be taught one at a time. Three PEs are featured in this vignette: K-LS1-1, K-ESS2-2, and K-ESS2-2. These PEs are also featured in the vignettes for instructional segments 2 and 3 in kindergarten. Together, these three vignettes present different ways to approach instruction on similar content.

The vignette uses specific themes, but it is not meant to imply that this is the only way in which students are able to achieve the indicated PEs and learning target. Rather, the vignette highlights examples of teaching practices, lesson organization, and possible students' responses. Science instruction should take into account that student understanding builds over time and is extended by revisiting topics and concepts throughout the course of the year. In addition, some topics or concepts require different pedagogical and scaffolding approaches, depending on individual student needs. Finally, while the vignette provides several illustrations of sound instructional practices, it does not include everything that educators need to consider when designing and facilitating learning tasks. All learning environments should follow research-based guidelines.

K–2 Grade Span Vignette: Integrated Science, ELA, and ELD

Caring About and Protecting the Environment

Background

Mrs. J's Kindergarten classroom is a place where children can wonder about the world and actively engage in inquiry about it through observing, questioning, exploring, communicating, and working with others. Currently, the children are learning about how people can choose to care about and protect the environment. Mrs. J's goal is to immerse her young students in interactive learning tasks where they can explore new ideas about the environment and environmental issues, discuss their questions and thinking, and work collaboratively to problem solve. She doesn't merely want her students to learn about environmental protection and conservation; she wants them to be able to practice it by developing the knowledge and skills needed for lifelong environmental stewardship.

Mrs. J integrates environmental awareness throughout—every day, all year long. For example, the words and photographs on the alphabet cards the children use to learn their letter names represent the natural environment (*L* is for *Leaf*, *O* is for *Ocean*, *R* is for *Rainbow*, etc.). This allows her not only to support the children in their foundational skills development and to build their vocabulary knowledge, but also to engage the children in conversations about the natural world and environmental issues related to the words.

Currently, the class is learning about water and water conservation: why animals, plants, and people need clean, fresh water to survive; the effects of the current California drought; and how people can choose to protect and conserve fresh water. The two big ideas that guide lesson planning for the learning segment are:

Children can choose to care about nature and conserve natural resources.
Children can engage other people to care about and protect the environment.

Mrs. J's students live in a culturally and linguistically rich urban neighborhood. Roughly half of the children in the class speak African-American English with their families at home, and several children are bilingual and proficient in both Spanish and English. The remaining students are English learners (EL), most of whom were born in the United States. Most of the EL children are at the Expanding level of English language proficiency, and they have a solid grasp of conversational, or everyday, English. Three of the EL children are new to the U.S. and are at the early Emerging level of English language proficiency. Most of the children in the class have socio-economically disadvantaged backgrounds and have limited access to academic English in their home environments. Mrs. J knows that each of her students is capable of thriving with an intellectually rich science curriculum and that she needs to both cultivate their curiosity about the world and support their deeper learning with appropriate types and levels of scaffolding.

Lesson Context

At this point in the learning segment, the children have been learning about water for about a week. They have been listening to and discussing the ideas in many informational texts that Mrs. J has been reading aloud to them, and they have been exploring water during science investigation lessons and at the science observation station. Last week, the children started learning about different marine and freshwater aquatic ecosystems in California (*estuaries, salt marshes, lakes, ponds, rivers, wetlands)*, and they viewed short media pieces about some of the ecosystems. As they were learning about these ecosystems, the class started a large butcher paper mural representing them, along with labels and questions they had written on sticky notes. As they progress through this learning segment, they will add details and additional questions.

The class has also started building a scientific vocabulary wall with these and other words, including *conserve, protect, natural resource, pollute, reduce,* and *recycle.* The words are accompanied by pictures and illustrations, along with student-friendly explanations (for example, *reduce* – *use less; protect* – *keep safe*). Mrs. J would like the children to feel comfortable using these words in their conversations and when they write daily about the topic, so she has explicitly taught some of the words to the children and supports them to use the words frequently in meaningful ways (for example, when they sing songs or chant poems or when they are making observations).[1] Mrs. J also models how to use the words several times each day. For example, when the class washes their hands before snack time, she says, "Let's be sure to turn off the faucet while we soap up our hands so we don't use more than we need to. That way, we're *conserving* water. Let's all say that together. We're *conserving* water." She then encourages students to say, "I am conserving water," when they turn off the faucet to soap up their hands.

By focusing intentionally on both content knowledge and language, Mrs. J is supporting the children to build both their science conceptual understandings and their awareness of how language works in science. The children will draw upon all of this

[1] See the ELA/ELD Framework, Chapter 3, Kindergarten designated ELD vignette for an idea how to teach vocabulary explicitly.

integrated knowledge to write a letter about water conservation to the editor of the local newspaper. The following learning target and NGSS performance expectations guide Mrs. J's lesson planning.

Learning Target: We will inform others about how we can care about and protect the environment.

CA NGSS Performance Expectations:

- **K-LS1-1 From Molecules to Organisms: Structures and Processes:** Use observations to describe patterns of what plants and animals (including humans) need to survive.
- **K-ESS2-2 Earth's Systems:** Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
- **K-ESS3-3 Earth and Human Activity:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

Lesson Excerpts

Mrs. J begins today's lesson by inviting the children to sit in a big circle. She shows them a large, clear bucket containing five gallons of water and asks them to think about all the different ways they and their families use water in their daily lives. She provides an example: drinking a glass of water when she's thirsty. Before she has the children share their ideas with a partner, she gives them about ten seconds to think quietly about as many ideas as they can (at least three). This provides a valuable opportunity for the children to prepare a response. She checks in with each of the children who are ELs at Emerging levels of English language proficiency to make sure they understand the question and supports them to prepare a response. She then prompts all students to use a language frame to tell their ideas to their partner: “My family uses water to ____.”

After the children have shared with their partners, Mrs. J asks them to share some of their ideas with the whole class. She then asks them to help her sort the activities by the ones for which they need water in order to survive, or stay alive (drinking, watering the garden), and the ones for which it is nice to have water but not really necessary for survival (swimming, making popsicles). She writes the children’s ideas on a T-chart that is big enough for the whole class to see, and the class decides together by voting (thumbs up, thumbs down) in which category each activity belongs. The children discuss whether taking a shower or brushing their teeth are activities for which they need water in order to survive. In the end, the class decides that water is necessary for brushing teeth (because they need their teeth to eat food so they can stay alive) but not for swimming (because they don’t have to swim in order to live).

Inquiry Activator: Where’s the Water on Earth?

Mrs. J then returns the children’s attention to the bucket of water, next to which she places a globe.

> Mrs. J: Children: Today we’re going to be thinking and talking about how much water is on the planet and where it is stored. We’re also going to talk about why it’s important for everyone to conserve and protect fresh water, or the water we need in order to survive, or live. You all said we use water to do a lot of things in our daily lives. Where do you suppose the water we use for drinking, cooking, brushing our teeth, and many other uses, comes from? And why do you think that? You can use our water mural for ideas.

The children think for a moment and then discuss their thinking with their partner as Mrs. J. listens in, making sure that each child has a chance to share. She also encourages them to ask their partner clarification questions and to respond to their partner's ideas.

> Chanel: I think … I think the water we use for brushing our teeth comes from … comes from … I don't know.
>
> Ana: (Pointing to the water mural.) Do you think it come from the lake? Or from the ocean, maybe?
>
> Chanel: From the lake! I think it comes from the lake 'cuz the water in the ocean, it's too salty.
>
> Ana: Yeah, I think if you drink the water from the ocean, you get sick. And maybe the water come from that. (Pointing to the mural.)
>
> Chanel: That's a pond. I don't want to drink water from there. It has fish and stuff. Yuck!
>
> Ana: The lake has fish in it too, right? I wonder if that's where we get our water to drink. How do they get the fish out?

Mrs. J tells the children that she heard some very interesting ideas with good reasons to justify them and also some great questions that they'll be investigating. She clarifies that the water we drink is fresh water and not the salt water from oceans, which would make us sick. Then, she asks them to look at the large bucket of water and the globe.

> Mrs. J: (Points to the bucket.) This represents all the water on our planet Earth, including the water that is in the atmosphere, glaciers, ice caps, lakes, rivers, oceans, groundwater and streams. So, if this is all the water there is on the planet, how much of it do you think is available for us to use for drinking, cooking,

and other things we said we need water for in order to survive?

Jesse: (Placing his hand in the middle of the bucket.) Like, up to here?

Sadie: No, I think it's more, 'cuz we have to use a lot of water at my house.

Ricardo: (Pointing to the Pacific Ocean on the globe.) But… but, look the ocean. Is big!

Mrs. J: That's a great observation, Ricardo. Yes, a lot of the planet is covered in ocean, and we can see that on the globe. All of you are doing some great science thinking. Let's find out how much of the water on the planet is in the oceans and how much is available for us to use for our survival needs. Ricardo, can you help me?

Mrs. J invites Ricardo to help her demonstrate where the earth's water is located. She asks Ricardo to take out 25 tablespoons of water from the bucket and place it in a large, clear jar labeled "fresh water" as everyone counts to 25. She takes the jar over to the mural so that she can point to the bodies of water as she explains what the bucket and jar represent.

Mrs. J: The water in this jar represents all the fresh water on Earth. Fresh water is in the air, glaciers, rivers, ponds, lakes, and groundwater. Let's say those words together as I point to them. All the remaining water in the bucket, or the water that's left in there, represents all the salt water on Earth, which is mostly in the oceans.

Jasmine: There's a lot in that bucket. That's a lot of salty water.

Lawrence: Can we drink it?

Jasmine: No! You can't drink salty water! I went to the ocean one time, and I got water in my mouth. It didn't taste good. I don't think you can drink salty water.

Lawrence: But, can you make it not salty? Can you get the salt out?

Mrs. J: Jasmine is right, it's not healthy to drink salt water, and Lawrence, your question is one we could investigate. Should we put that on our water inquiry chart?

After placing the question on the chart, Mrs. J invites another child to help her take out 8 tablespoons from the freshwater supply and place it in the jar labeled "ground water." She tells the children that this represents all the ground water on Earth. She shows them and explains an illustration of ground water in a book and tells them that in the area where they live, a lot of the drinking water they use is ground water, and more so because of the drought.

Solange: But, how do we get it, if it's in the ground? How do they get it to the kitchen?

Jesse: And the bathroom!

Mrs. J: Hmm… That's another good question I bet we can investigate.

Solange: Put it on the inquiry chart!

After posting the question to the chart, Mrs. J invites another child to use an eyedropper to transfer 25 drops from of the freshwater supply to a very small jar labeled "rivers and lakes." She tells the children that this water represents all the water in rivers and lakes on Earth. All the water contained in ground water, rivers, and lakes from the world's "fresh water" has been removed. The "fresh water" container now represents all the water contained in the atmosphere (clouds, rain, snow, etc.) and all the water on the planet that is frozen (polar ice caps and glaciers). She asks the children to observe the containers and how much water is in each container and to discuss their thinking in groups of three. After a few minutes of discussion, she asks each triad to write down at least one of their questions on a sticky note and to place the question on the “water inquiry chart” before going to their tables and writing and drawing one thing they learned about water that day. As the children are writing, Mrs. J encourages the children to talk about their ideas at their tables, ask and answer one another’s questions, and include any questions they are wondering about.

Using Science Informational Texts: How Dirty is the Water?

The next day, to respond to some of the questions the children have had about where people get their drinking water and to reinforce the importance of freshwater conservation, Mrs. J shows the children a short and engaging video about why it’s important to turn off the water while brushing one’s teeth (Sesame Street: Water Conservation). In their table groups, the children briefly discuss what they learned from the video and generate other ways they can conserve water at home and at school.

Mrs. J asks the children to join her so that she can read to them several pages from a complex science informational text about water protection and conservation. She asks the children to be thinking about all the things they’ve been learning about and wondering about as she reads aloud. As she reads, she stops several times to explain new terms and concepts and to have the children turn and talk about strategic questions she poses. On one page, she draws the children’s attention to a circle graph representing all the water that is available on Earth. The graph shows that 97% of the earth’s water is ocean water and less than 1% of the Earth’s water is usable for people (for drinking, sanitation, cooking, growing crops) and for wildlife that need fresh water. On another page, Mrs. J reads that all the water that exists on Earth right now is all that is available and, even though this water is recycled over and over again, it is impossible to make more.

When Mrs. J gets to a page with a photograph of a polluted river with dead fish floating at the top, she asks the children to discuss with a partner what they think happened. To make sure her three EL students at the Emerging level of English language proficiency (ELP) are able to engage in the conversations, she has paired each of them with an English-proficient partner who speaks the same primary language. After the children have had a chance to discuss their ideas, she calls on a few of them to share. She calls on Hernán, one of the EL children at the Emerging level of ELP. At first, he is hesitant to respond, but then his partner, Victor, prompts him to respond in Spanish.

Hernán: *Se mueren. Los peces se mueren porque el agua está bien sucia.*

Victor: He says, the fish die because the water is very dirty.

Hernán: (Nodding, then repeating) The fish die. Water is very dirty.

Mrs. J: (Expanding on Hernán’s response.) Yes, the water does look very dirty. It has a lot of greasy stuff and garbage in it (looking closely at the photograph and then showing it to the children). Let’s read the caption underneath the photograph. It says that some harmful chemicals were dumped into it. Hernán, tell me more about what you’re thinking.

Hernán: *Podemos… Podemos limpiar el río. Podemos limpiar el agua, y así, los animales, los peces pueden vivir.* The fish can live. And the river, we can also swim there. We can … we can clean the water.

Alicia: Yeah! We can clean it! Let’s clean up the water so the fishes can survive!

Mrs. J: Do you think we can do that? Can we clean up the water? Can we protect the animals that live in water?

All of the children: Yeah!

Mrs. J: Okay! Well, let's see if we can find a way to do that. Let's read on to see what else we can learn from this book.

Later in the book, the children learn that, in some places in the world, people do not have access to clean water. In some places, aquifers have been contaminated, and water is scarce.

Alicia: How come the people don't have clean water to drink?

Mrs. J reads the text, pointing to the illustration of an aquifer.

Some of our drinking water comes from under the ground in pools of water, called aquifers. People drill down into the ground, through soil and rock, to get the water, which we call ground water. Unfortunately, the ground water can become dirty, or contaminated, with things that shouldn't be in it, such as the chemicals in products people use to clean their houses. Some farms use chemicals on their crops, and that can get into the ground water, too.

Mrs. J: Let's think about that for a minute. It says that people drill through the ground to get water for drinking and to use for other things. But sometimes, things that are not safe for animals, plants, or people, like poisons in some chemicals, get into the aquifer, and they *pollute* the ground water. That can make people and animals sick if we drink the water. But, the aquifer is so far down in the ground, under the rocks and soil. How do you think the water gets polluted?

Mrs. J gives the children a few moments to think about this question, and then she asks them to discuss it in triads. She places an illustration in the book, which shows a model of how an aquifer can become polluted, under the document reader, and she tells them that they should refer to the illustration as they explain their thinking. She listens carefully as the children discuss their ideas. Many of the children struggle to explain how the toxins in some chemicals might get from someone's house or lawn all the way down into the groundwater, and Mrs. J encourages them to refer to the illustration. After a couple of minutes, Mrs. J strategically calls on one student, Inés, to explain what she and her partner, Rafael, discussed.

Inés: My partner say that maybe the bad stuff, the chem-, the chem-

Rafael: Chemicals. That's pollution!

Inés: Oh, yeah! He say the chemicals get into the ground, the ground water because maybe people they put it in the street, they pour it there, and it can all go down into the ground.

After hearing other children's explanations, Mrs. J realizes that the concept of groundwater and how it can become polluted is quite complex for young learners and that the book alone is insufficient to help them understand this process. She decides that later that week, the children will build a classroom model of an aquifer so that they can observe its structure and how it works, as well as what happens when it becomes polluted. (The children will also build their own aquifers and take home a kit so they can recreate it at home in order to teach their families about aquifers.)

Hands-on Investigation: How Do We Clean the Water?

Mrs. J reminds the children about how much they've already learned about bodies of water and aquatic ecosystems (referring to the mural), how much of the water on Earth is fresh water (referring to the bucket and jars, which are now displayed on a counter), and how fresh water can become polluted or scarce due to drought. She tells the children that they are going to go outside and work together on a Clean Water Challenge.

She takes the children to the grassy area of the school grounds. Parent volunteers have worked with the school staff to create an outdoor space that allows for science exploration and learning, including a vegetable garden and a large grassy area surrounded by bushes and trees, which is ideal for observing nature and conducting messy science investigations. She reminds the children that when they go outside, they are to handle plants and animals gently and with respect. Because it is a wide-open space, she knows the children will want to run around and that if she allows them to do so, they will be more engaged in the science investigation she has planned for them to do afterward. She asks the children to pretend they are a body of water. They can flow gently, like the water flowing down a gentle stream, they can flow quickly, like the water rushing down a river, or they can be like any body of water they prefer. She asks them to try out as many different bodies of water as they can, but before they do, she provides an example, inviting the children say "I'm flowing like a rushing river!" and run briskly with her to the other side of the yard.

After several minutes, Mrs. J asks the children to gather around her in a circle. She shows them the materials for the Clean Water Challenge, which they will use to attempt to *clean* a sample of water: an empty plastic cup, a plastic cup filled with *dirty* water (water with safe organic debris, such as orange peels or blades of grass), as well as tools they might use to clean the water, such as paper towels, cotton balls, coffee filter, sponges, pieces of nylon (or other fabric), sand, gravel, and rubber bands. She tells them that she wants them to share ideas and discuss with each other what might work to clean the water before they start using the materials. She also reminds them that scientists test many ideas before finding one that will work, so, since they're kid scientists, they should try out many different ways of cleaning the water (there is plenty of dirty water in the bucket she has brought outside). She groups the children strategically into teams of three, and the children collect their materials and begin the challenge. As the children work together, Mrs. J moves from team to team, listening to their discussions and prompting them to share their ideas before they start testing them. Solange, Hernán, and Rafael are working as a team.

Solange: I know, I know! Let's use the cotton. I think we can scoop up the dirty stuff with it.

Hernán: Yeah, we can do it. Y… we can use this (pointing to the coffee filter).

Solange: That's a coffee filter. Okay, so we could use the coffee filter. But how?

Hernán: You can … You can put the water in. Here (miming how he would pour the water through the coffee filter).

Rafael: Yeah, we could pour the dirty water through the coffee filter and into the clean cup. But will the water get clean?

Solange: Let's do it!

Mrs. J: Have you shared lots of different ideas first? Have you talked about all of the materials you have? You can test out many different ways of cleaning the water, and it's a good idea to talk about lots of ideas before you start testing them.

Rafael: I wonder if the water can go through the sponge. Maybe that would just keep it there.

Solange: I think, I think it would get stuck. So, we talked about the cotton balls, the coffee filter, and the sponge. What's the sand for?

As the teams share ideas and then test them out, Mrs. J encourages them to explain their thinking to one another and to continue to ask questions about what is working best to clean the water. Through trial and error, most of the children figure out they need to build a filter rather than add items to the water to *clean* it. Once the teams have tried out many different ways of cleaning the water, Mrs. J asks a few students to help her pass out the children's science journals and pencils, and she asks them to discuss with one another which way or ways worked best, showing what they discuss through drawings with labels. The teams then work together to write a brief explanation of their design solution, with evidence from their investigation. Once the children have recorded their notes, Mrs. J facilitates a whole group discussion, and take notes on a large piece of chart paper she has brought outside, which she will post in the classroom afterward. At the end of the discussion, the children conclude that it is easier to keep water clean than to have to clean it up once it is dirty.

Writing an Argument: Why Should We Protect and Conserve Water?

Later that week, and after many discussions, book readings, videos, and hands–on experiences—including building both the class model and individual models of aquifers—the children have much to say about why people should protect and conserve water. Mrs. J asks the children if they would like to write a letter to the newspaper so that they can share their ideas with a lot of people. The children decide that this is a way for them to help others know how to make choices that will help both the natural environment and their communities.

Mrs. J guides the children to co-construct the argument, prompting them to provide evidence to justify their claims. During the joint construction of the text, she asks the children to tell her what to write, first by having them brainstorm all of the different ideas they could use, and then grouping the ideas together. Mrs. J. writes the ideas on a chart, and then shows the children how she groups them together by circling each word or group of words with a different color marker. Next, she asks the children to tell her what to write, using the ideas from the brainstorm and all of the ideas they have in their heads. She does not write what they say verbatim, but rather, supports them to rephrase and extend their thinking, as needed.

Henry: We could say, please don't get the groundwater dirty 'cuz we want to drink clean water, not dirty water.

Mrs. J: That's a great idea, Henry! Hmm… I'm thinking that there's another way of saying 'get the water dirty.' Maybe we could use one of the words from our 'kid scientist' word wall.

Henry: Pollute! We could say, please don't pollute the groundwater 'cuz we don't want to drink dirty water. We want to drink clean water.

Mrs. J: Can anyone say more about why we don't want to drink polluted ground water?

Rafael: We don't want to drink the polluted ground water because when it's dirty like that, it can make us sick. That's what the book said.

Celeste: And, don't get the chemicals in there.

Mrs. J: Can you say more about that?

Celeste: Please don't get the chemicals in the water because that can make the fishes sick, and they can't survive. The polluted water can make people sick, too. And it's really, really hard to clean the water when it's polluted!

Solange: And if the river is polluted, we should clean it up 'cuz that's not fair to the animals that live there. They could die, and then the river is sick, too.

All of the students have ideas to add to the letter and solutions to this environmental problem, such as "Turn off the water when you brush your teeth so you don't waste it," "Use the bath water to water the plants because it's good to reuse water;" and "Do not put chemicals into the ocean or rivers because then the fish get sick, and sometimes we eat the fish, and we don't want to get sick."

After the class has completed their letter to the editor, which Mrs. J will type up and e-mail to the local newspaper, the children work on creating a class book focused on teaching younger students about protecting the environment. They decide to call the book *We Can Protect Water*. Each child makes a small poster with illustrations, labels, and writing, which will then be gathered into a book that the children can read together in the library corner and later share with their families at the monthly family science nights.

Teacher Reflection and Next Steps

When Mrs. J meets with the kindergarten teaching team for their weekly grade-level planning time, the teachers share their reflections about the learning segment and examine student work together. They use their observation notes and the children's science journals and big book pages to make strategic decisions about the teaching and learning tasks they will modify or add to the learning segment, as well as how they will plan scaffolding approaches for individual students. They also discuss the types of activities they will plan for the next monthly family science night, during which the students will teach their families what they've been learning about in science that month.

Based on their observations of student language use and analysis of written work, the teachers also discuss how they will design or adjust their designated ELD lessons moving forward. They use the CA ELD Standards to plan focused language development lessons for designated ELD, differentiated by the children's English language proficiency levels. These lessons build into and from the science teaching and learning tasks. For the EL children at the Emerging level, the teachers have noticed that the children are gaining confidence with using everyday English, but they are not yet using some of the new domain-specific vocabulary (e.g., pollute, protect) needed to discuss the science ideas. Although she has taught these words explicitly to the whole class, Mrs. J feels that these children would benefit from some additional practice using them orally, so she plans structured conversations where the children can use the new words as they discuss the illustrations in the books the class has been reading, using strategies such as sentence starters or conversation prompts that explicitly ask students to use the target words. For the EL children at the Expanding level, Mrs. J and the other teachers plan to try out a technique they read about called *sentence unpacking*, where they discuss all of the meanings in the long, information–dense sentences that are in the science informational texts they read aloud to the children[2]. The teachers record their agreements in their Team Meeting Record Sheet so that they can reflect on how the activities they planned have worked out when they meet again the following week.

Sources:

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Clymire, Olga. (1997). A Child's Place in the Environment: Respecting Living Things. California Department of Education. http://www.acpe.lake.k12.ca.us/download/unit1/Unit1_00_Preface-Introduction.pdf

Early Childhood Environmental Education Programs: Guidelines for Excellence (Washington, D.C.: North American Association for Environmental Education, 2010). http://resources.spaces3.com/c518d93d-d91c-4358-ae5e-b09d493af3f4.pdf

Excellence in Environmental Education: Guidelines for Learning (K–12) (Washington, D.C.: North American Association for Environmental Education, 2010). http://resources.spaces3.com/89c197bf-e630-42b0-ad9a-91f0bc55c72d.pdf

The Globe Program: A Worldwide Science and Education Program: https://www.globe.gov/

The Groundwater Foundation: http://www.groundwater.org/kids/trythis.html

Natural Wildlife Federation. (2011). Water, Water, Everywhere? http://www.nwf.org/pdf/Schoolyard%20Habitats/WaterWaterEverywhere-NWF2011.pdf

Project Wet Foundation: http://www.discoverwater.org

Sesame Street: Water Conservation https://www.youtube.com/watch?v=gtcZbN0Z08c

United States Environmental Protection Agency. Thirsten Builds an Aquifer.

[2] An example of sentence unpacking can be found in the first grade designated ELD vignette in the ELA/ELD Framework.

http://water.epa.gov/learn/kids/drinkingwater/upload/2005_03_10_kids_activity_grades_k-3_aquiferinacup.pdf

The Water Project.
http://thewaterproject.org/resources/water_pollution_filtration_experiments

Water.org: http://water.org/news/lesson-plans/

Performance Expectations:

K-ESS2-2 Earth's Systems: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.

K-ESS3-3 Earth and Human Activity: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

K-LS1-1 From Molecules to Organisms: Structures and Processes
Use observations to describe patterns of what plants and animals (including humans) need to survive.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. ▪ Ask questions based on observations to find more information about the designed world. (K-ESS3-2) **Developing and Using Models** Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing, physical replica, diorama, dramatization, storyboard) that represent concrete events or design solutions. ▪ Use a model to represent relationships in the natural world. (K-ESS3-1) **Analyzing and Interpreting Data** Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions. **Obtaining, Evaluating, and**	**ESS2.E: Biology** Plants and animals can change their environment. (K-ESS2-2) **ESS3.C: Human Impacts on Earth Systems** Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (secondary to K-ESS2-2) **ETS1.B: Developing Possible Solutions** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people. (secondary to K-ESS3-3) **ETS1.A: Defining and Delimiting an Engineering**	**Systems and System Models** Systems in the natural and designed world have parts that work together. (K-ESS2-2) **Cause and Effect** Events have causes that generate observable patterns. (K-ESS3-2),(K-ESS3-3) **Patterns** Patterns in the natural world can be observed, used to describe phenomena, and used as evidence. **Cause and Effect** Events have causes that generate observable patterns. (K-ESS3-2),(K-ESS3-3) **Systems and System Models** Systems in the natural and designed world have parts that work together. (K-ESS3-1)

Communicating Information Obtaining, evaluating, and communicating information in K–2 builds on prior experiences and uses observations and texts to communicate new information. ▪ Read grade-appropriate texts and/or use media to obtain scientific information to describe patterns in the natural world. (K-ESS3-2) ▪ Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. (K-ESS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in K–2 builds on prior experiences and progresses to comparing ideas and representations about the natural and designed world(s). ▪ Construct an argument with evidence to support a claim. (K-ESS2-2) **---** ***Connections to Nature of Science*** **Science Knowledge is Based on Empirical Evidence** Scientists look for patterns and order when making observations about the world. (K-ESS2-1)	**Problem** Asking questions, making observations, and gathering information are helpful in thinking about problems. (secondary to K-ESS3-2) **ETS1.A: Defining and Delimiting Engineering Problems** ▪ A situation that people want to change or create can be approached as a problem to be solved through engineering. (K–2-ETS1-1) ▪ Asking questions, making observations, and gathering information are helpful in thinking about problems. (K–2-ETS1-1) ▪ Before beginning to design a solution, it is important to clearly understand the problem. (K–2-ETS1-1) **ETS1.C: Optimizing the Design Solution** Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K–2-ETS1-3)	**--------------------------------------** Connections to Engineering, Technology, and Applications of Science **Interdependence of Science, Engineering, and Technology** People encounter questions about the natural world every day. (K-ESS3-2) **Influence of Engineering, Technology, and Science on Society and the Natural World** People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

California's Environmental Principles and Concepts
Principle I: The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. **Concept b.** The goods produced by natural systems are essential to human life and to the functioning of our economies and cultures. **Concept c.** The quality, quantity and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems. **Principle IV:** The long-term functioning and health of terrestrial, freshwater, coastal and marine ecosystems are influenced by their relationships with human societies. **Concept a.** Direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

CA CCSS for ELA/Literacy and CA ELD Standards	
CA CCSS for ELA/Literacy: **W.K.1** - Use a combination of drawing, dictating, and writing to compose opinion pieces in which they tell a reader the topic… and state an opinion or preference about the topic…; **W.K.7** - Participate	**CA ELD Standards (Expanding):** **ELD.PI.K.2 -** Collaborate with the teacher and peers on joint composing projects of informational and literary texts that include some writing…; **ELD.PI.K.5** – Demonstrate active listening to read-

in shared research and writing projects…; **SL.K.1** – Participate in collaborative conversations with diverse partners, follow agreed-upon rules, and continue a conversation through multiple exchanges …	alouds and oral presentations by asking and answering questions with oral sentence frames and occasional prompting and support; **ELD.PII.4** - Expand noun phrases in a growing number of ways (e.g., adding a newly learned adjective to a noun) in order to enrich the meaning of sentences and add details about idea …