Grade Two Instructional Segment 4: Biodiversity in Landscapes

Ecosystems include 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.

GRADE TWO INSTRUCTIONAL SEGMENT 4: BIODIVERSITY IN LANDSCAPES

Guiding Questions

- How can we determine what plants need to grow?
- How do plants depend on animals?
- How many types of living things live in a place? How can we tell?

Performance Expectations

Students who demonstrate understanding can do the following:

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-LS2-2. Develop a simple model that mimics the function of an animal in dispersing seeds or pollinating plants.*

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.*]

The bundle of performance expectations above focuses on the following elements from the NRC document *A Framework for K–12 Science Education*:

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Crosscutting Concepts
[SEP-2] Developing and Using Models [SEP-3] Planning and Carrying Out Investigations	LS2.A: Interdependent Relationships in Ecosystems LS4.D: Biodiversity and Humans ETS1.B: Developing Possible Solutions	[CCC-1] Patterns [CCC-2] Cause and Effect: Mechanism and Explanation [CCC-6] Structure and Function

Highlighted California 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.

CA CCSS for ELA/Literacy Connections: W.2.3, 4, 7, 8, 10

CA ELD Standards Connections: ELD.PI.2.2, 6, ELD.PII.2.6

This instructional segment builds directly on activities and understandings from kindergarten and grade one. In kindergarten, students noticed patterns in the needs of living things. Here in grade two, they revisit the same DCI using a more sophisticated implementation of the SEPs. Rather than just noticing patterns in what they see and know, they now must **plan and conduct an investigation [SEP-3]** to gather and **analyze [SEP-4]** systematic evidence about the needs of plants (2-LS2-1). In grade one, they performed an engineering task to mimic the **structure/function [CCC-6]** relationships of plants or animals, and now they revisit the same CCC and SEP and use them to gain a deeper understanding of DCIs about how plants depend on animals to help them reproduce—both for pollination and seed dispersal (2-LS2-2).

Exploring the local schoolyard provides students valuable context to help them meet the performance expectations in this instructional segment. Students can begin by visiting their schoolyard and describing the physical conditions in different sections of the school. Which have the most sunlight and which receive the most water? These observations can motivate questions like, How much sunlight or water do plants need to survive? They can then **plan an investigation [SEP-3]** to answer that question (testing just one factor at a time; 2-LS2-1). In grade two, the emphasis of this investigation is on answering a question and students do not need to know any of the vocabulary related to investigational design. Students should start with living plants for this task rather than seeds since seeds can germinate and grow in the absence of light until they run out of the energy stored in the seed. Because every plant, like every person, is a unique individual that may have a different growth rate, teachers can explicitly emphasize the value of making many observations to answer this question. If one plant fails to grow, it may be due to a weakness in that specific plant. If almost all the plants that experience similar growing conditions fail to grow, students can be more confident in the strength of the evidence.

Students are now ready to put together their observations about the needs of plants, the fact that different locations have different physical conditions (including the amount of water and light), and the differences in material properties at each location. Can students expect different plants and animals to survive in different locations? The following vignette allows them to explore this question. In grade two, however, they will not explain the links between biodiversity and physical conditions. Instead, they will **ask questions [SEP-1]** and start to notice **patterns [CCC-1]** in where things live and what conditions are like there.

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Performance Expectations

Students who demonstrate understanding can do the following:

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.*]

Highlighted Science and Engineering Practices	Highlighted Disciplinary Core Ideas	Highlighted Crosscutting Concepts
[SEP-3] Planning and Carrying Out Investigations	LS4.D Biodiversity and Humans	[CCC-2] Cause and Effect: Mechanism and Explanation

Highlighted California 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.

CA CCSS Math Connections: 2.MD.10

CA CCSS for ELA/Literacy Connections: W.2.7, W.2.8

CA ELD Standards Connections: ELD.I.2.1, 9; 12

Introduction

In this series of lessons, Mr. B takes his students outside the classroom to observe animals (mostly insects) 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 for students to understand concepts such as diversity and abundance and the impacts of human activities on habitats.

Day 1–2: Plants and Animals Near Our School

Students conduct an investigation by collecting data about this diversity of plants and animals on their schoolyard or in the surrounding neighborhood.

Day 3: Different Needs of Various Plants in an Ecosystem

Students obtain information from texts about the factors that affect diversity in a particular place.

Day 4–5: Mapping Habitats

Students identify patterns in the diversity of different sections of their field area and make maps of different habitats. They then compare their map to a map of California's habitats.

Day 6: Documenting Human Changes to Habitats

Students return to the field to compare areas that are more natural with those that are affected by human activities. Students identify specific cause and effect relationships in their observations.

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Day 7: Improving a Local Habitat

Students communicate ideas for reducing human impacts on their local habitat and put them into action.

Day 1–2: Plants and Animals Near Our School

Anchoring phenomenon: Different numbers of organisms and types of organisms live in different locations on the schoolyard.

Students in Mr. B's class were going to **investigate [SEP-3]** living things in a few different areas around the schoolyard, in a nearby park, in the local neighborhood, or at a nature center. Mr. B asked them, "Since the whole class is going, we will certainly find people everywhere we go. But do you think we will find anything else that is alive on the schoolyard?" A few students shook their heads no at first, but then someone mentioned the trees, the weeds, and even tiny ants. Mr. B agreed that most of the animals they would encounter are small such as insects, which meant that students would need to look very carefully. He also asked them if they thought some places would have more living things than others. They generally agreed that the playground would have fewer living things than the school garden, but they disagreed about how much life there would be in the plants by the front office. Mr. B told them that he wanted them to find out which places had the most life. A student asked, "Do we have to count all the creatures? There could be a thousand ants, but that's just one type of thing." Mr. B said that both the number of different types of things and the number of things could be interesting and that they should track both **quantities [CCC-3]**. Students complained that it will take them all day to count all the blades of grass on the entire soccer field, so Mr. B suggested that they focus on a small section of each location and shows them how they can take the ends off of a cardboard box so that it creates a little fence around an area (field biologists use a device called a *quadrat* box to accomplish the same task). If every group of students had the same size box, they could all look at the same size area and then compare their results.

The students took their science notebooks and pencils with them on a walk outside. With Mr. B leading the way and a parent volunteer following along, the students visited green areas on the campus, in a nearby park, in the local neighborhood, (or at a nature center). At each location, they placed their quadrat box down and counted the number of organisms and the number of different types of plants and animals. Since students could not identify many different species by name, Mr. B told them to just draw a picture and label it with a few descriptive words like "brown bug." At each location, Mr. B also had students describe the area in as much detail as possible in their science notebooks. What materials did they see? What did it feel like to sit at this location? They took a photograph of each location to supplement their descriptions.

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When students returned to their classroom, Mr. B had students compile all their data into a table on the board. For each location, each group wrote up the number of different types of living things and the total number of individual organisms they had recorded. Mr. B asked the students to **analyze their data [SEP-4]** by sorting the locations based on the two numbers they collected. The middle of the playground was the lowest on both counts (though everyone was surprised that they had found a number of different organisms there, too!). The school garden had the most types of living things, but a grassy section by the front yard of the school had more individual organisms. Mr. B asked students to look at their field notes and see if they could find evidence about why some sites had more life than others. Mr. B asked students to record some possible explanations in their science notebooks, labeling them with **"Possible Interpretations of Our Data" [SEP-4]**. Students wrote down several observations: "There is no place for plants to grow on the playground because the ground is too hard," "The garden has a lot because we water it all the time," and, "I think the school waters the plants by the front office and it is also shadier than the hot garden." For each interpretation, Mr. B instructed students to write out complete sentences below that clearly stated the evidence they were using to help them make this **claim [SEP-7]**. As Mr. B circulated around, he spotted one particularly interesting entry and wrote it on the board: "I think that there are more animals at the sidewalk because there are more plants there." Mr. B asked students if they could test this idea. He asked them to return to their notebooks and tally up the number of plants and animals. Did locations with more plants have more animals? If so, why might that be? Mr. B was laying the foundation for concepts of interdependent relationships in ecosystems. What affects how much life there is at a particular location? Mr. B instructed each student to write one **question [SEP-1]** of their own in their science notebook about the data the class had collected.

Day 3: Different Needs of Various Plants in an Ecosystem

Students had ended the previous day with a question about what affected the amount of life in a particular location. Students could come up with many ideas about important factors, so Mr. B decided to give the students a word to describe all of these factors together: *ecosystem*. He asked students if they had heard this word before and what they think it means. Building on the students' suggestions, Mr. B explained that an *ecosystem* is made of living and nonliving things that are found together and that affect each other.

Everyday phenomenon: Blackberry plants and Joshua trees grow in different places with different physical conditions.

Since students had experience in the school garden, Mr. B decided to focus on that ecosystem. He asked students to list some of the things that the plants in their garden need to survive. As students brought up different plant needs, Mr. B posted a word card (available at http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link6) on the wall to reinforce each of these several domain-specific terms that students will use to describe what plants need from the habitats where they live: *moisture*, *nutrients*, *pollination*, *soil*, *suitable temperatures*, *water*. As he

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introduced each new term, he asked a student to describe one of their observations from the previous day's notebook entries using the new word. He expanded 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 discussed two sets of informational text, *Would Blackberries Grow...?* and *What a Joshua Tree Needs from the Desert* (available at http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link7). Mr. B asked students to compare (**evaluating information [SEP-8]**) the specific needs of blackberries and Joshua trees using the new words they had learned. Could students identify plants from their schoolyard field trip that have different needs or can survive in different conditions?

Days 4–5: Mapping Habitats

Investigative phenomenon: Different numbers of organisms and types of organisms live in different locations on the schoolyard (returning to investigate the anchoring phenomenon).

The following day, Mr. B had students walk their field trip route a second time, this time to make a map of areas with similar conditions and similar living things. They needed to identify **patterns [CCC-1]** in the ecosystems. The grass of the school playing field was similar to the small patch of grass between the sidewalk and the road in front of the school, so students decided to mark both of those spaces green and added a new category to their map legend called "grassy." The sidewalk, the playground, and the road all had hard ground and only a few weeds growing in cracks, so they colored those spaces grey and added the legend item "pavement." Landscaped garden areas received a different category, while various "wild patches" of weeds were a different one—even though both have lots of plant life, the types of plants were clearly different.

Investigative phenomenon: Different regions of California have different plants and animals.

When they returned to the classroom, Mr. B showed them a wall map of California's *Habitats* (available at http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link8). In grade two, students were just beginning to examine maps of California and beyond and could identify essential map elements on the wall map (CA History-Social Science Standards 2.2.2). Like on their own map, areas with similar conditions and similar plants and animal life are grouped together using the same symbols. Mr. B called on different students and asked them to describe the differences they see between two different habitats on the map. "What might make them have different plants and animals?" he asks. The answer always has the same general pattern—the two regions had different amounts and types of the things needed by plants and animals to survive. These differences in conditions led to a wide variety of living things, a concept called

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diversity. Students recorded the diversity of living things during day 1 when they counted the number of different types of organisms. Mr. B used the habitat map to emphasize diversity in California's ecosystems, plants, and animals.

Day 6: Documenting Human Changes to Habitats

Investigative phenomenon: Areas affected by humans have different organisms than areas not affected by humans.

Students returned to their field trip route one more time, this time looking for places where humans have influenced plant and animal life. He asked students, "In what ways can humans 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 humans change the conditions again?"

During this field trip, the class investigated two types of areas: ones that had been disturbed by humans and others that were in a more natural condition. As they visited these sites, the students made notes and simple drawings in their science notebooks about the condition of the habitats, the evidence for human activity, and the abundance of plants and animals.

Upon their return to the classroom, the students worked in pairs using the notes from their field trip to summarize their observations. To help draw their attention to specific **cause and effect [CCC-2]** relationships, Mr. B created a two-column chart. He labeled one column "cause" and the other "effect." Students shared ideas based on their observations about the changes that had occurred in the different habitats they investigated as they tried to place their observations into the correct column of cause or effect. Mr. B circulated around the class, helping students distinguish between the causes and effects and making sure that students were able to articulate both a cause and a matched effect for every row.

Day 7: Improving a Local Habitat

Investigative phenomenon: How do we decrease the effects of humans on plants and animals?

Mr. B challenged 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 acted as the recorder as the students shared their ideas about how to decrease the effects of human activities.

To assess their understanding of these concepts, Mr. B told the students that they were going to **communicate [SEP-8]** what they learned through their research by creating informational posters. He told them that they should include three different items on the posters: a drawing from their science notebook showing a natural habitat, a drawing from their science notebook showing the effects of human activities, and a description of how humans could decrease

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their impact. Excited by what they had learned, the students asked if they could display their posters in the hall outside the classroom to share with other students and their parents.

Student posters focused a lot on trash in the natural environment, with much of the litter being recyclable. Mr. B helped students collaborate with the school's expanded learning program on a recycling project. During expanded learning time, students created signs to glue to recycling boxes and placed the recycling boxes around the expanded learning space. They encouraged other students in the expanded learning program to recycle used paper. At the end of week, the students emptied the boxes in the school's recycling containers.

Vignette Debrief

This vignette is anchored in a phenomenon that students experience every day. As they walk to and from school, they may see different trees, shrubs, birds, squirrels, or other animals and plants. Students go on a field trip around the school and neighborhood to observe different types of organisms that live in various locations. Most importantly, students communicate their ideas for reducing human impacts on their local habitats and put them into action through a recycling project.

SEPs. Students were engaged in a number of science practices with a focus on the SEP of **planning and carrying out investigations [SEP-3]**. Each time they went out to collect data, they were motivated by a specific question. And each time they returned, they always had a specific activity designed to help them analyze and interpret their data. Sometimes the analysis used some mathematical thinking (days 1–2) during which students were making quantitative comparisons and sorting them. Students **communicated their understanding [SEP-8]** on the final day as an informational poster.

DCIs. This lesson highlights the concept of biodiversity, and how humans can influence that biodiversity (LS4.D).

CCCs. On days 4–5, the map itself was a form of analysis as students noticed patterns and created categories while they were still in the field. On day 6, students described the pattern and interpreted their observations in terms of **cause and effect [CCC-2]**.

EP&Cs. The vignette also demonstrates the utility of getting outside into the schoolyard and surrounding community to make observations. Urban habitats are the ones most familiar to many students, and it is the goal of the CA NGSS that all students understand the world around them. Part of the goal is so that they will be better stewards of that world and seek to make it better. Since habitats close to schoolyards are almost certainly affected by humans, this lesson also provides a forum to for students to develop 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.* The lesson ends with students not only suggesting ways to minimize human impacts, but with them pursuing a specific solution. This lesson sequence does not go into great depth about the design process, but developing systems to solve problems is an example of engineering.

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CA CCSS Connections to English Language Arts and Mathematics. 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 notebooks 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 W.2.8, as well as creating an informational poster. After students conduct an investigation of the schoolyard, they compile their data in a table (CA CCSSM 2.MD.10). They identify patterns in the diversity of different sections of their field area and make maps of different habitats. They then compare their map to a map of California's habitats.

Resources:

California Education and the Environment Initiative. 2011. *Cycle of Life*. Sacramento: Office of Education and the Environment. http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link9

California Education and the Environment Initiative. 2011. *Flowering Plants in Our Changing Environment*. Sacramento: Office of Education and the Environment. http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link10

California Education and the Environment Initiative. 2011. *Open Wide! Look Inside!* Sacramento: Office of Education and the Environment. http://www.cde.ca.gov/ci/sc/cf/ch3.asp#link11

Engineering Connection: Design a Seed

Animals can move around in a habitat, while plants cannot. Due to this lack of mobility, plants depend on animals to pollinate them or to move seeds around. Students can directly observe these relationships by watching bees visit flowers or by looking at seeds stuck to their clothing after they walk through a patch of weeds. Students can dissect seeds and flowers that they or their teacher collected from the schoolyard or around the community. They can closely inspect the specific structures of the flower that are involved in pollination or parts of the seed that allow it to stick to an animal's fur or a person's clothing. Using simple materials provided by their teacher, students can create physical **models [SEP-2]** that mimic the behavior of pollinators or seeds (2-LS2-2). 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 [SEP-7]** to compare and contrast the characteristics of different devices.

(A detailed snapshot of this engineering design challenge appears in chapter 11 of this framework on instructional strategies.)