ENVIRONMENTAL LITERACY CURRICULUM CONNECTIONS

The Lawrence Hall of Science
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Amplify Science

The Next Generation Science Standards (NGSS) are based on the premise that the purpose of learning science is to help students understand the natural world, solve problems, improve their lives and communities, and make the world a better place. Environmental literacy is an essential part of science and is deeply embedded throughout NGSS. We think environmental literacy should be deeply embedded throughout your science curriculum, too! This resource will help you identify the units in your curriculum that emphasize environmental concepts and that provide opportunities where outdoor learning experiences are part of regular classroom routines.

What is environmental literacy and how is it connected to science teaching and learning?

In this document, environmental literacy is represented by three interconnected categories:

1) **Connection to nature**: having a sense of wonder and curiosity, enjoying the physical, social and emotional benefits of being outdoors, making observations and asking questions, building our relationship with the natural world;
2) **Understanding natural systems**: figuring out how nature works by carrying out investigations, collecting and analyzing data, constructing explanations, arguing based on evidence; and
3) **Community engagement**: communicating ideas, applying knowledge to positive community actions, understanding the socio-political and historical context for longstanding environmental inequities.

Within NGSS, Performance Expectations (PE) at every grade level ask students to **connect to nature**, **understand natural systems** and **apply** that knowledge. For example:

Kindergarten (K-ESS3-3) Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
5th Grade (5-ESS3-1) Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.
Middle School (MS-LS2-4) Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Emphasizing environmental literacy supports students to develop skills that make them well-rounded, effective leaders in their human and ecological communities.

WHY DOES IT MATTER?

Environmental literacy leads to more equitable, inclusive, and culturally relevant learning experiences.

- Experiences in the local community with local partners are authentic, place-based and relevant to the lives of learners.
- Community leaders, community-based organizations, and environmental educators can help us understand environmental injustices and ensure that local issues and assets are part of student learning.
- Learning outdoors can be safer, healthier, more engaging than learning indoors.

How to use this tool

This teaching tool allows teachers, site leaders and instructional leaders, to complement their classroom instructional materials with local and easily accessible, real-world opportunities for their students to more fully understand the world around them.

Schoolyard Connections | **Field Trip Connections** | **EP&C/Environmental Literacy Connections**

- Select the appropriate curriculum document(s): FOSS Grades K-8; Amplify Science Grades K-8; SEPUP Grades 6-8; and, Ocean Sciences Sequence, Grades 6-8.
  - Read the environmental literacy curriculum connections (of select modules) organized by grade level and unit, describing meaningful outdoor learning activities for a schoolyard or local field trip destination
    - District office / school sites / or team of teachers may customize this tool, adding location ideas for outdoor learning when teaching the different units and lessons for each school, TK-8, in their district.

CONNECTING ENVIRONMENTAL LITERACY TO SCIENCE CURRICULUM

Districts don't always have the expertise to effectively, systematically use the outdoors as a classroom from Grades TK-12. We need partners who know the landscape, the natural and human history of the community, and know how to engage students in the world around them.

Environmental literacy curriculum connections in this document:

- support students to better understand natural systems,
- connect students to place, their schoolyard, their community, state and federal national parks; and
- encourage students to understand and create solutions to improve their communities.

Environmental Literacy Curriculum Connections funded by

CALIFORNIA ENVIRONMENTAL LITERACY INITIATIVE

Ten Strands
Connecting Education, Environment, and Community

NEEDS OF PLANTS AND ANIMALS

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students take on the role of scientists in order to figure out why no monarch caterpillars live in the fictional Mariposa Grove in an area that was converted from a field to a community vegetable garden. They investigate how plants and animals get what they need to live and grow, and then they make a new plan for the garden that will provide for the needs of monarch caterpillars and produce vegetables for humans. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
Extend the Lesson 1.3 opportunity to make observations around the school by having students visit an area of your schoolyard, school garden, or a nearby community garden repeatedly throughout the unit. Have them observe and record changes over time and/or look for examples of plants or animals getting what they need to live and grow. In particular, **after Chapter 2** you might have them observe roots, and **after Chapter 3** you might have them observe leaves, which both help plants get what they need. **LOCATION IDEA:**	Organize a field trip to a local botanical garden or farm. Do the field trip near the beginning of the unit, e.g. **after Lesson 1.3**, and have students hone their scientific observation skills by using their senses to observe different kinds of plants and animals at the garden or farm. Alternatively, do the field trip at the **end of Chapter 3** and use the field trip as an opportunity for students to apply what they have figured out about the needs of plants and animals by looking for evidence of plants and animals getting what they need to grow (e.g. evidence of animals eating plants or evidence of plants getting sunlight.) **LOCATION IDEA:**	These extensions provide students with opportunities to build observation and analysis skills, and to deepen understanding of plant and animal needs and how people depend on, influence, and make decisions about natural resources. **EP&C** Principles I, II, and V.
After students design and discuss their plans for the Mariposa Grove community garden in **Lessons 4.3 and 4.4**, have them plant plants in your own schoolyard or school garden. If in California, consider planting milkweed; if not in California, identify a native plant species that is part of a local animal's diet and have students plant that species. Alternatively, plant a fruit or vegetable that students may harvest and taste. Regardless of what students plant, have them make and record observations as it sprouts and grows. **LOCATION IDEA:**	Organize a field trip to a local farm where students may observe the produce that is being grown and hear from the farmers about how they choose what to grow and how they take care of their crops. **LOCATION IDEA:**	

SUNLIGHT AND WEATHER

Schoolyard Connection	Field Trip Connections	Why does this support environmental literacy and NGSS?

As weather scientists, students figure out how sunlight warms different surfaces in order to explain why students at two fictional elementary schools, Woodland and Carver Elementary, experience different temperatures during their morning and afternoon recesses. They also explore different types of weather and severe weather, and investigate ways to prepare for severe weather, which helps them evaluate why one of the school's playgrounds floods after severe rain, and what the school could do to prevent future flooding.

Throughout the unit, have students repeat the weather observations they make in **Lesson 1.2** each day. Consider recording the weather on a class chart so that students can observe patterns in the local weather over time.

LOCATION IDEA:

After students compare the temperature of surfaces in the sun and in the shade outside in **Lesson 2.3**, extend their understanding of the warming effect of sunlight on different surfaces by having them compare the temperature of schoolyard surfaces made of different materials, e.g. soil, woodchips, turf, pavement, and sand.

LOCATION IDEA:

At the **end of Chapter 3**, have students design and build miniature structures (e.g. tents, canopies) to reduce the warming effect of sunlight on an area of the schoolyard. Then take students outside with their structures and with thermometers to test them. If possible, have them set their structures out in the morning, then test the temperature beneath their structures and on a nearby exposed area of ground multiple times throughout the day to make comparisons.

LOCATION IDEA:

Reach out to a nearby regional, state, or national park to find out if they offer field trips or ranger-led programs focused on weather or preparing for and responding to severe weather. If the former, take students on a field trip to expand their understanding of weather **during Chapter 1**; if the latter, take them on a field trip to expand their understanding of severe weather in **Chapter 5**.

LOCATION IDEA:

These extensions provide students with opportunities to engage in observation and design, and to deepen understanding of the types and consequences of weather and the effect of sunlight on Earth's surface.

ANIMAL AND PLANT DEFENSES

GRADE 1

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Working in their role as marine scientists, students figure out how plants and animals defend themselves, then apply their understanding of plant and animal defense structures to explain to aquarium visitors how a sea turtle or other sea animals at the aquarium could defend themselves from ocean predators once they are released back into the wild. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
In conjunction with **Lesson 1.3**, or anytime after that, have students find and observe organisms' (e.g. isopods, ants, earthworms) structures in your schoolyard or school garden. Encourage them to consider the function of the structures they observe. See the BEETLES activity, Structures and Behaviors, at http://beetlesproject.org/resources/for-field-instructors/structures-and-behaviors-2/ for ideas about how to lead this activity. **LOCATION IDEA:**	**After Chapter 2 or Chapter 3**, take students on a field trip to a local wildlife center, farm, zoo, or aquarium to observe animal defense structures. If you go after **Chapter 3** and there are offspring, encourage students to compare the structures of parents and offspring. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation skills, and to deepen understanding of plant and animal structures, parents and offspring, and structure-function relationships, as well as how people depend on natural systems (e.g. for food). **EP&C** Principle I.
In your schoolyard or school garden, plant the seeds of a quick-growing plant such as radishes and have students observe the plants' structures over time. If possible, stagger when you plant the seeds so that students can observe and compare multiple stages at once. Time this extension for students to make observations **during Chapter 3** when they are focused on similarities and differences between parents and offspring. **LOCATION IDEA:**		

SPINNING EARTH

GRADE 1

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
As sky scientists, students figure out that the sun follows the same pattern in the sky every day because Earth spins. They also figure out that Earth's spin is responsible for the daily cycle of daytime and nighttime, and for it being daytime on one side of Earth when it is nighttime on the other. With this understanding, students can explain why a boy living in one place sees different things in the sky than his grandma who lives in a faraway place. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Chapter 4, once students have figured out that the sun makes the same pattern in the sky each day, have them predict what will happen to their shadows throughout the day. Then have them draw each other's shadows at different times of day to check their predictions. **LOCATION IDEA:**		These extensions provide students with opportunities to investigate and observe patterns in and effects of the apparent movement of the sun.
Each month throughout the year, consider taking a picture of the horizon on the schoolyard just before the school day begins, attempting to include the sun in your pictures. Then, when you are teaching **Chapter 5** of this unit, in which students are investigating seasons, show them the photographs from throughout the year and take them out to the schoolyard at the beginning of the day to compare how the sky looks at different times of year. If you teach the unit near the beginning of the year, you might have students partake in taking pictures and observing the sky each month. **LOCATION IDEA:**		

LIGHT AND SOUND

GRADE 1

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students take on the dual role of light engineers and sound engineers for a puppet-show company as they investigate cause-and-effect relationships and learn about the nature of light and sound. They apply what they learn to designing shadow scenery and sound effects for a puppet show.		
At the **end of Chapter 2**, have students explore shadows in the schoolyard. Encourage them to find shadows and identify what is causing them (i.e. what is blocking sunlight from reaching the surface they're observing.) Then, **after Chapter 3**, challenge students to find shadows that are different shades, and to figure out why certain shadows are darker than others (i.e. to correlate the darker shadows to more opaque objects blocking the light). A variety of objects might cause interesting shadows on the schoolyard, e.g. play structures, plants, tables and benches, fences, etc. **LOCATION IDEA:**	Lead the shadow schoolyard extension in an area farther afield from school. Both natural and urban areas could provide a wealth of interesting shadows to explore. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation skills, and to deepen understanding of light and sound, and cause-and-effect relationships.
After Lesson 4.1, when students shift their focus from light to sound, take students outside to sit silently and observe the sounds around them and try to identify what the source of each sound is. To structure the activity, you could have students create sound maps by giving each student a blank piece of paper and have them draw an "X" in the middle to mark the spot they are sitting and then draw representations of the sounds they hear around them. **LOCATION IDEA:**		

PLANT AND ANIMAL RELATIONSHIPS

GRADE 2

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
In their role as plant scientists, students figure out that plants depend on water and light to grow, and on animals for pollination and seed dispersal. They apply what they figure out to explain why there are no new chalta trees growing in the fictional Bengal Tiger Reserve. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
Extend students' **Lesson 1.3** experience with their sample study sites, revisiting the sites regularly throughout the unit to observe, record, and analyze changes. See the Flextension Compilation in the Unit Guide's Printable Resources for information on how to lead this extension. **LOCATION IDEA:**	At the conclusion of the unit, take students on a field trip to a botanical garden or to a local park with a variety of plants. Have them observe the seeds of different plants and hypothesize about how the seeds are dispersed based on their structure. You might also challenge them to find a seed that they think would be dispersed the farthest by wind, and then test their ideas. **LOCATION IDEA:**	These extensions provide students with opportunities to investigate and analyze data, and to deepen understanding of plants' needs and plant and animal relationships, as well as how people depend on natural systems (e.g. for food). **EP&C** Principle I.
In **Lesson 1.6**, instead of planting the radish seeds in containers inside, plant the radish seeds outside. Have students investigate what happens to the radish plants under different conditions (more/less water, light/no light). If possible, expand the investigation to other plants in a school garden as well. Later, in **Chapter 2**, you might have students explore what happens if the plants are transplanted to be really close together versus what happens when they have a lot of space to grow. **LOCATION IDEA:**		

CHANGING LANDFORMS

GRADE 2

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students take on the role of geologists to investigate landforms and erosion. They figure out that wind and water can change the shape of land, sometimes slowly as an accumulation of many tiny changes, and sometimes quickly. They use what they figure out to explain how a cliff near the fictional Oceanside Recreation Center is changing slowly while another nearby cliff collapsed overnight. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Lesson 4.2, when students model how landforms erode quickly, and just after a rain, take students on a walk around the schoolyard (or a nearby park) to look for and record evidence of erosion (e.g. small channels caused by flowing water, sediment collecting at the base of slopes). If there is no rain in the forecast, you could have students look for evidence of erosion near sprinklers or other water sources, and/or provide them with cups of water to pour and observe erosion in action. **LOCATION IDEA:**	**After Chapter 1**, take a field trip to a beach and have students observe grains of sand, copying the procedures they used to observe and make sense of sand samples in the classroom in **Lessons 1.3 and 1.5**. **LOCATION IDEA:** After reading "Making Models of Streams" take students on a field trip to a nearby park where they can explore a stream. See the BEETLES activity, Stream Detectives, at http://beetlesproject.org/resources/for-field-instructors/stream-detectives/ for information on how to lead this activity. **LOCATION IDEA:**	These extensions provide students with opportunities to investigate, analyze data, and engage in argument, and to deepen understanding of erosion, as well as how natural systems can change in ways that people benefit from and can influence. **EP&C** Principle III.

INHERITANCE AND TRAITS

GRADE 3

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?

Students play the role of wildlife biologists working in Graystone National Park. They study two wolf packs and are challenged to figure out why Wolf 44, an adopted wolf, has certain traits. Students observe variation between and within different species, investigate inherited traits and those that result from the environment, and explain how Wolf 44 acquired certain traits.

If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.

After students read Blue Whales and Buttercups in **Lesson 1.2**, take them to a school garden or local park and have them observe the traits of different organisms. You might have students choose two similar organisms to compare, then discuss as a class or in larger groups which students' pair of organisms are most closely related. See the BEETLES activity, Related and Different at http://beetlesproject.org/resources/for-field-instructors/related-and-different/ for information about how to lead this activity.

LOCATION IDEA:

Near the **end of Chapter 1**, provide students with more opportunities to consider variation within a species by taking them to a school garden or a local park where they can observe and compare the traits of many individuals of one species.

LOCATION IDEA:

Conduct either of the schoolyard/garden extensions while on a field trip to a botanical garden or natural space with abundant plants and/or animals.

LOCATION IDEA:

ENVIRONMENTS AND SURVIVAL

GRADE 3

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
In their role as biomimicry engineers, students figure out how the traits of an organism affect its likelihood of survival in a particular environment and explain how the traits of grove snails affect their survival in different environments. They also apply their understanding of traits to design effective solutions to the problem of invasive plant removal using the structural traits of giraffes as inspiration. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Chapter 2, take students to a school garden or local park and have them make and record observations of an organism of their choosing, focusing in particular on the traits of the organism that might help it survive in its environment. See the BEETLES activity, Interview an Organism at http://beetlesproject.org/resources/for-field-instructors/interview-an-organism/ for information about how to lead this activity. **LOCATION IDEA:**	**During Chapters 1 or 2**, take a field trip to a wildlife center or natural space with abundant wildlife, such as an intertidal area along the coast. **During Chapter 1** students could focus on what animals need to survive in their particular environment and how they meet their needs. **During Chapter 2**, they could observe animals' traits and consider how those traits might help the animals survive in their environment. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation skills, and to deepen understanding of organisms' needs and adaptive traits. Depending on the areas in which students observe organisms, they may also develop understanding of how people influence natural systems, as they may notice unnatural aspects of the environment in which their chosen organism lives and how those aspects affect the organism. **EP&C** Principle II.

WEATHER AND CLIMATE

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?

Students take on the role of meteorologists to figure out weather and climate patterns in order to determine which of three fictional islands would have the most suitable weather for an orangutan reserve.

If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.

In addition to collecting temperature and precipitation data and recording a general description of cloud cover as part of the daily local weather data collection routine that begins in **Lesson 1.4**, you could have students do a more extensive observation of the clouds. You could teach them some of the basic cloud types, and how those can be used to predict the weather, than give them opportunities to go outside and practice interpreting the clouds and making predictions about the weather. You could then have them compare their predictions to the weather that actually occurs.

LOCATION IDEA:

Near the **end of Chapter 3**, once students have developed an understanding of climate, lead them in exploring microclimates on the schoolyard. Have them look for the hottest and coolest parts of the schoolyard, measure the temperature in those locations and then record the temperature and any features of those areas that they think might contribute to their temperatures. You might also have them notice and compare any plants or animals they find in those areas. Alternatively, you could pre-identify two different microclimates in your neighborhood (e.g. a hot area on black pavement in the schoolyard versus a cooler area in a local park) and have students explore and record data for those areas.

LOCATION IDEA:

After Chapter 3, organize a field trip to a local botanical garden, especially if there is one where plants are organized by region or climatic zones (desert, tropical, etc.). Encourage students to observe differences between plants from different climate zones, and look for patterns. Point out ways that the garden models different climates by controlling watering (taking the place of precipitation) and (in greenhouses) temperatures.

LOCATION IDEA:

These extensions provide students with opportunities to build observation and analysis skills, and to deepen understanding of patterns in weather and climate, as well as how people depend on and influence natural systems.

EP&C
Principles I and II.

VISION AND LIGHT

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Working as conservation biologists, students investigate vision, light, and information processing to figure out why the installation of new highway lights in the rain forest has caused a decrease in a population of Tokay geckos.		
During Chapter 1, as students investigate how animals use their senses to get information about their environment, have students find and observe organisms' structures in your schoolyard or school garden. Encourage them to consider the function of the structures they observe. See the BEETLES activity, Structures and Behaviors, at http://beetlesproject.org/resources/for-field-instructors/structures-and-behaviors-2/ for ideas about how to lead this activity. **LOCATION IDEA:**	**In Chapter 1**, when students investigate animal and plant structures and functions, take a field trip to a local botanical garden or wildlife center to observe the external structures of plants and animals and consider how those structures might help the animals survive or reproduce. **LOCATION IDEA:**	
In conjunction with observing animal and plant structures in **Lesson 1.4**, you could extend students' investigations of plant structures by taking them to a school garden or an area of the schoolyard with plants. You could have students identify different structures of the plants (branches, roots, leaves, seeds) and further discuss the function of each. If it is possible to observe multiple types of plants, they could compare them and consider how the different plants' structures might function similarly or differently. **LOCATION IDEA:**	**At the conclusion of the unit**, you might take students to a natural space, such as a regional park, to continue investigating how our senses help us understand our environment. You could lead activities such as scavenger hunts or memory games focused on particular senses. Alternatively, **during Chapter 4**, if it is possible to arrange an overnight field trip, you could lead students in exploring how their vision is affected by the amount of light during the day versus at night. For example, you could have them explore an area, perhaps challenging them to find as many camouflaged objects as possible during the day, and then do the same activity at night and discuss why it is more challenging in the dark. **LOCATION IDEA:**	
In Chapter 5, instead of or in addition to doing the Smell, Hearing, and Touch Investigations in the classroom, you could lead students outside to conduct the investigations. They could make use of the local surroundings for their investigations. For example, they might use plants with strong scents in a Smell Investigation or natural surfaces with interesting textures (e.g. tree bark) in a Touch Investigation. **LOCATION IDEA:**		

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
In the role of geologists, students figure out how patterns of rock formations and fossils can reveal the history of environments in a place. They apply their understanding to help the director of the fictional Desert Rocks National Park explain how and when a particular fossil formed and how it came to be in its current location, as well as what the environment of the park was like in the past and why its rocky outcrops have so many visible layers. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Lesson 4.1, when students read Rocky Wonders, and ideally after a rain, take students on a walk around the schoolyard (or a nearby park) to look for and record evidence of erosion (e.g. small channels caused by flowing water, sediment collecting at the base of slopes, small sediments getting picked up by wind, roots causing cracks in pavement). If there is no rain in the forecast, you could have students look for evidence of erosion near sprinklers or other water sources, and/or provide them with cups of water to pour and observe erosion in action. **LOCATION IDEA:**	At the **end of Chapter 3**, if possible, take students on a field trip to a location with exposed rock layers or fossils. Have them use *Fossil Hunter's Handbook* and/or other reference guides to identify the rock types and/or fossils, and make inferences about the past environments of the place. Alternatively, take students on a field trip to a beach, lake, floodplain, delta, or river, and have them discuss and draw/write about how rock could be forming in that location; or, take them to a location where they can observe and identify rocks and make inferences about the environments in which those rocks formed. **LOCATION IDEA:** **In Chapter 4** after conducting investigations with the Erosion Model, take students on a field trip to a nearby park where they can explore a stream. See the BEETLES activity, Stream Detectives, at http://beetlesproject.org/resources/for-field-instructors/stream-detectives/ for information on how to lead this activity. **LOCATION IDEA:**	These extensions provide students with opportunities to engage in investigation and argumentation, and to deepen understanding of the formation and erosion of rock, as well as how natural systems change in ways that people benefit from and can influence. **EP&C** Principle III.

PATTERNS OF EARTH AND SKY

GRADE 5

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students work as astronomers to figure out how Earth's spin and orbit around the sun cause daily, monthly, and yearly patterns in the apparent movement of the sun and other stars. They apply this understanding to help a team of archaeologists at the fictional Museum of Archaeology explain what an ancient artifact of the sky depicted and what might be on a missing piece of the artifact.		
In conjunction with **Lesson 2.3**, you could lead the Investigating How Shadows Change activity and/or Shadow Patterns Flextension included in the unit and/or lead an activity to measure and observe changes in shadows of other natural or manmade items on the schoolyard (e.g. trees or play structures). **LOCATION IDEA:**	If possible, anytime **after Chapter 2**, do an overnight field trip in a location with little light pollution so that students can star gaze. You might have them observe and record the time that particular constellations (or the moon) appear to rise, and/or the rate at which constellations appear to cross the sky (using simple hand measurements for which you may find a guide online). You might also download an app that enables you to measure light pollution and make and compare measurements in areas with different light pollution levels. This could be done near the **end of Chapter 1**, in conjunction with the Lost in Light video students watch in **Lesson 1.6**. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation and analysis skills, and to deepen understanding of patterns of Earth and sky and how people influence natural systems. **EP&C** Principle II.
In Chapter 4, in conjunction with using the Sim to investigate questions, you could encourage students to come up with questions that they could investigate by observing the sky outside (e.g. How does the time the moon appears to rise change from day to day? When are shadows the longest / shortest?) **LOCATION IDEA:**		

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students take on the role of water resource engineers to investigate what is causing a water shortage on one side of a fictional island and figure out that different parts of the Earth system interact to create a rain shadow on that side of the island, and that population growth has compounded the problem. They consider design solutions to the water shortage, including using chemical reactions to treat and reuse wastewater. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Chapter 1, lead students in exploring what happens to water around the school—can it flow into the ground to eventually become groundwater or does it flow over the surface? Why? If it flows over the surface, where does it end up and what might happen to it while it flows? **LOCATION IDEA:**	After students read *Water Shortages, Water Solutions* in **Chapter 1**, or during **Chapter 5** when students are focused on wastewater treatment, take students on a field trip to test the water quality of a local water resource, and if applicable, make inferences about pollution sources. You might look into the possibility of doing this work in partnership with a local water quality organization. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation and analysis skills, and to deepen understanding of Earth system interactions and the movement of water, as well as how people depend on, influence, and make decisions about natural systems, and how there are no permanent boundaries between human and natural systems. **EP&C** Principles I, II, IV, and V.
After reading *How the Earth System Explains Dinosaur Extinction* in **Lesson 4.4**, lead students on a walk around the schoolyard or neighborhood and have them identify as many Earth system interactions as they can. **LOCATION IDEA:**	**During Chapter 5**, visit a local water treatment center to learn about the complex process through which water is treated. **LOCATION IDEA:**	

ECOSYSTEM RESTORATION

GRADE 5

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Working as ecologists, students figure out how organisms in an ecosystem get the matter and energy they need to survive. They apply their understanding of plants, animals, decomposers, and the environment in which they live to determine why the organisms in a part of the Costa Rican rainforest ecosystem aren't growing or thriving. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
Near the **end of Chapter 2**, take students to a school garden or other area of the schoolyard where they may find a live animal (e.g. an isopod) to observe and reflect on how the animal uses matter and energy from food. See the BEETLES activity, Food, Build, Do, Waste, at http://beetlesproject.org/resources/for-field-instructors/food-build-waste/ for information about how to lead this activity. **LOCATION IDEA:**	To supplement the Food Web Model activity students do in **Lesson 1.7**, take students on a field trip to a natural space, e.g. a regional park, ideally one with native plants where tracks and/or other signs of animals are evident, in order to look for evidence of what lives in that ecosystem and create a model of interactions in the ecosystem. See the BEETLES activity, What Lives Here? at http://beetlesproject.org/resources/for-field-instructors/what-lives-here/ for information about how to lead this activity. **LOCATION IDEA:**	These extensions provide students with opportunities to engage in investigation, analysis, modeling, and argumentation, and to deepen understanding of interactions and flows of matter and energy in an ecosystem, as well as how people depend on and influence natural systems. **EP&C** Principles I and II.
If you have a school garden with a compost bin, begin an investigation of the compost during **Chapter 3**. You might have students make, record, and compare observations of decomposing material in the compost at various stages of decomposition; compare the soil that results from compost to the soil samples included in the Ecosystem Restoration kit; and/or find and observe decomposers, perhaps using the Food, Build, Do, Waste activity mentioned above. **LOCATION IDEA:**	In **Chapter 3**, when students are investigating decomposers, perhaps in conjunction with reading *Walk in the Woods*, take students on a field trip to a nearby natural space where they could find decaying leaves and logs to investigate. See the BEETLES activity, Decomposition Mission, at http://beetlesproject.org/resources/for-field-instructors/decomposition-mission/ for information on how to lead this activity. For a further exploration of decomposition, see the BEETLES activity, The Case of the Disappearing Log at http://beetlesproject.org/resources/for-field-instructors/case-disappearing-log/ **LOCATION IDEA:**	
	At the conclusion of the unit, give students an opportunity to visit and learn about and/or participate in a local restoration project with an environmental organization. **LOCATION IDEA:**	

WEATHER PATTERNS (Earth Science; Grade 6 in the Integrated Model)

GRADE 6

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students play the role of student forensic meteorologists as they figure out how water vapor, temperature, energy transfer, and wind influence local weather patterns in a fictional town called Galetown. They use what they have learned to explain what may have caused rainstorms in Galetown to be unusually severe in recent years. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
Throughout the unit, you could have students conduct and record weather measurements on the schoolyard. Students could just take the temperature and record qualitative observations, or if your school has a weather station or other tools, students could use those. You could also have students make weather measurement tools, though note that some DIY tools lack accuracy and precision so this could affect their data. **LOCATION IDEA:**		These extensions provide students with opportunities to engage in observation and analysis, and to deepen understanding of weather patterns, as well as how people depend on natural systems. **EP&C** Principle I.
In conjunction with reading "What Are Clouds?" in **Lessons 1.4 and 1.5**, you could take students outside to observe clouds. You could teach them some of the basic cloud types, and how those can be used to predict the weather, then give them opportunities to go outside and practice identifying the clouds and predicting the weather. You could then have them compare predictions to the weather that actually occurs. **LOCATION IDEA:**		

EARTH'S CHANGING CLIMATE ENGINEERING INTERNSHIP (Earth Science; Grade 6 in the Integrated Model) GRADE 6

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students act as civil engineering interns to design a plan to modify a city's roofs in order to reduce the city's impact on climate change. These plans must meet three design criteria: 1) reducing impact on the climate; 2) preserving the city's historic character; and 3) minimizing costs. Students figure out the cause-and-effect mechanisms involved as changes to albedo and changes to combustion of fossil fuels affect climate. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
In Day 1, give students additional time to explore and compare the albedos of other surfaces on the schoolyard or in a school garden. **LOCATION IDEA:**		These extensions provide students with opportunities to investigate and design solutions, and to deepen understanding of climate change and how people depend on, influence, and make decisions about natural systems. **EP&C** Principles I, II, and V.
If you have access to additional solar panels, cables, motors and fan blades, and/or small LED lights, instead of demonstrating how the solar panel functions in Day 2, have students explore how the solar panels work outside. You could encourage them to explore the effects of changing the angle or direction the solar panels face, then discuss what this means for the best locations/orientations for solar panels to be installed in a city. **LOCATION IDEA:**		
Expand on students' ideas from Day 10's brainstorm of solutions to reduce their city's climate impact through outdoor investigations and activities. For example, if students focused on solutions to home energy usage, they could design and test a solar water heater or passive solar home models. If they focused on landscaping, they might walk around the schoolyard or neighborhood to evaluate the landscaping and then plan (and if possible, execute) changes to create more climate-friendly landscaping. **LOCATION IDEA:**		

OCEAN, ATMOSPHERE, AND CLIMATE (Earth Science; Grade 6 in the Integrated Model)

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
As student climatologists, students figure out how ocean currents behave and what effect they have on the climate of different locations around the world, specifically the air temperature of various locations. They investigate energy transfers between the sun, Earth's surface, atmosphere, and ocean. They apply their understanding of these energy transfers to determine the cause of significantly colder air temperatures in New Zealand during the El Niño climate event. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
To deepen students' understanding of latitudinal temperature differences, supplement **Lesson 1.4**'s activities by taking students outside to measure the local temperature and compare it to current temperatures at other latitudes. Repeat this measurement and comparison several times to support students' understanding that the pattern of higher temperatures near the equator stands. If you have a weather station, you might collect other weather data as well. **LOCATION IDEA:**	Near the **end of Chapter 2**, when students are figuring out how ocean currents affect air temperatures, if you are near the ocean, gather weather data by the coast and then gather weather data 20-30 miles inland for comparison. While by the ocean, have students make observations about the movement of the water and compare tides, waves, and rip currents to ocean currents. **LOCATION IDEA:** In conjunction with reading about ocean currents and pollution in **Lesson 2.1**, or with the Warm Up about the Great Pacific Garbage Patch in **Lesson 2.3**, if you are near the ocean, do a beach clean up and/or citizen science project around ocean plastic pollution. Alternatively, if you live inland, you might have students consider how pollutants near them could eventually end up in the ocean and then do a clean-up project near a local water resource. **LOCATION IDEA:**	These extensions provide students with opportunities to collect and analyze data, and to deepen understanding of patterns in climate, as well as how they influence natural systems. **EP&C** Principle II.

GEOLOGY ON MARS (Earth Science; Grade 7 in the Integrated Model)

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
In their role as student planetary geologists, students investigate geologic processes to figure out whether a particular channel on Mars was caused by flowing water or flowing lava. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
After Chapter 2, and ideally after a rain, take students on a walk around the schoolyard (or a nearby park) to look for and record evidence of geologic processes (e.g. small channels caused by flowing water, larger surrounding landforms shaped by geological processes). **LOCATION IDEA:**	After observing the Flowing Water Model in **Lesson 2.2**, take students on a field trip to a natural area such as a regional park where they can explore a stream. In particular, have them look for evidence of how the stream has shaped the land. **LOCATION IDEA:**	These extensions provide students with opportunities to collect and analyze data, and to deepen understanding of patterns in climate, as well as how they influence natural systems. **EP&C** Principle II.

ROCK TRANSFORMATIONS (Earth Science; Grade 7 in the Integrated Model)

GRADE 7

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students take on the role of student geologists to investigate how rock forms and transforms and apply what they figure out to determine why two rock samples, one from the Great Plains and one from the Rocky Mountains, look very different but are composed of a surprisingly similar mix of minerals. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
	If you live near a beach, supplement the **Lesson 1.4** article that students read for homework, "Rocks on the Beach" with a field trip to observe, compare, and make inferences about the sand grains or rocks on the beach. **LOCATION IDEA:**	
	At the end of the unit, you might take students on a field trip to a park with landforms made of sedimentary or igneous rocks. Have students observe the rocks and apply what they learned through the unit to make and support claims about how they formed. You might support students with a rock identification chart or guide. **LOCATION IDEA:**	

POPULATIONS AND RESOURCES (Life Science; Grade 7 in the Integrated Model)

GRADE 7

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
In the role of student ecologists, students investigate reproduction, predation, food webs, and indirect effects to figure out the cause of an alarming increase in the moon jelly population in the fictional Glacier Sea. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
In **Chapters 2 or 3**, in an area of the schoolyard or in a school garden, have students identify organisms that live in that area and brainstorm the ways those organisms could affect each other directly or (**during Chapter 3**) indirectly. **LOCATION IDEA:**	To extend students' investigation of connections in ecosystems in **Chapters 2 and 3**, take students on a field trip to a natural space such as a regional park, ideally one with native plants where tracks and/or other signs of animals are evident, in order to look for evidence of what lives in that ecosystem and create a model of direct and/or indirect interactions between parts of the ecosystem. See the BEETLES activity, What Lives Here? at http://beetlesproject.org/resources/for-field-instructors/what-lives-here/ for information about how to lead this activity. **LOCATION IDEA:**	These extensions provide students with opportunities to engage in investigation, modeling, and argumentation, and to deepen understanding of food webs and other interactions in ecosystems, and, if students include themselves in their models, how people depend on and influence natural systems. **EP&C** Principles I and II.

MATTER AND ENERGY IN ECOSYSTEMS (Life Science; Grade 7 in the Integrated Model) GRADE 7

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
Students work as student ecologists to figure out how the organisms in an ecosystem get the resources they need to release energy, and how carbon cycles through an ecosystem as photosynthesis and cellular respiration take place. They apply what they learn to determine why a biodome—an enclosed ecosystem that was meant to be self-sustaining—failed. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
To support the understanding of photosynthesis that students develop in **Lessons 1.3 and 1.4**, have students conduct investigations of plants. You might have students investigate plant growth in dark conditions inside vs. light conditions outside on the schoolyard or in a school garden. Or, have students collect green leaves from a variety of plants and investigate their pigments, using rubbing alcohol to extract the pigments and chromatography to separate them. Or, you could have students closely observe leaves outside, and then if you have access to microscopes, observe leaf cross sections under microscopes to better understand the structures that enable gas exchange. **LOCATION IDEA:**		These extensions provide students with opportunities to engage in investigation, analysis, modeling, and argumentation, and to deepen understanding of how organisms get the resources they need and of flows of matter and energy in an ecosystem, as well as how people depend on and influence natural systems. **EP&C** Principles I and II.
At the **end of Chapter 2**, in an area of the schoolyard or in a school garden, have students identify ecosystem components (both biotic and abiotic matter). Then have students identify evidence of interactions between those components, create models to show how matter and energy flow between them, and/or collect data on particular components (e.g. species counts or animals, plant growth over time, etc.). **LOCATION IDEA:**		

LIGHT WAVES (Physical Science; Grade 8 in the Integrated Model)

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?

As student spectroscopists, students gain a deeper understanding of how light interacts with materials and how these interactions affect our world, from the colors we see to changes caused by light from the sun, such as warmth, growth, and damage. They use what they figure out about light to explain the causes of Australia's high skin cancer rate.

If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.

To extend students' investigations of how light can make materials change in **Lesson 1.2**, have them explore the effect of sunlight on sunprint paper. Have students choose found objects to place on the sunprint paper (e.g. fallen leaves, flowers, classroom objects) and expose the paper to the sun for a few minutes, then remove the objects and observe how the paper changed. Dunk the paper in water to set the image (and/or add some hydrogen peroxide to deepen the color contrast). Note that this process is shown in the first part of the Sun Paper Demo video in **Lesson 2.1**. You could revisit sunprint paper in Lesson 2.1—in addition to or instead of watching the Sun Paper Demo video, you could have students explore the effect of different types of light on the sunprint paper. Or, at the **end of Chapter 3**, once students have explained why Australia has such a high skin cancer rate, you could have students explore how well different sunscreens protect people's skin by putting pieces of sunprint paper under plastic wrap, smearing different sunscreens on the plastic wrap, then observing the effects when they're exposed to sunlight.

LOCATION IDEA:

At the **end of Chapter 3**, once students have developed an understanding of the effects of light on materials and how light can be absorbed, transmitted, or reflected, take students outside to observe evidence of these different interactions with light (e.g. the schoolyard surface being warm from absorbing light, metal reflecting light, etc.).

LOCATION IDEA:

NATURAL SELECTION (Life Science; Grade 8 in the Integrated Model)

Schoolyard Connections	Field Trip Connections	Why does this support environmental literacy and NGSS?
As student biologists, students figure out the mechanisms of natural selection, investigating variation in populations, survival and reproduction, and mutation. They apply their understanding of natural selection to explain what caused rough-skinned newts to develop higher poison levels. **If using Amplify Science California, see "Opportunities for Unit Extensions" in the Unit Guide for more environmental and/or outdoor learning suggestions.**		
To support students' investigation of adaptive traits in **Lesson 1.5**, take students to a school garden or area of the schoolyard where they may make and record observations of an organism of their choosing, focusing in particular on the traits of the organism that might help it survive in its environment. See the BEETLES activity, Interview an Organism at http://beetlesproject.org/resources/for-field-instructors/interview-an-organism/ for information about how to lead this activity. **LOCATION IDEA:**	To supplement students' observations of different traits within a population in **Lesson 1.2** and/or their exploration of variation and distribution of traits in **Lesson 1.3**, take them to a botanical garden, park, or farm where they may observe the traits of several organisms in a population. You might have them identify traits and then create histograms to show the distribution of traits in the population. **LOCATION IDEA:** Near the **end of Chapter 1**, take a field trip to a wildlife center or natural space with abundant wildlife, such as an intertidal area along the coast and have students do the BEETLES Interview an Organism activity there to support their understanding of adaptive traits. **LOCATION IDEA:**	These extensions provide students with opportunities to build observation and analysis skills, and to deepen understanding of adaptations and variation in populations.