

# GO WITH THE FLOW

Fifth-grade students write about the flow of energy and matter through an ecosystem.

By Tracy Hodgson-Drysdale and Holly Rosa

How can catching grasshoppers in an outdoor classroom lead to meaningful science writing? We, a professor and a science teacher, decided to put our heads together to create a science writing unit that called for students to think more deeply about ecosystems and to produce science writing that reflected their learning. Writing reports would require students to build up their content knowledge, which would in turn prepare them to write explanations of food webs.

Energy and Matter is one of seven Crosscutting Concepts in the *Next Generation Science Standards*, and in fifth grade, students learn about the flow of energy and matter through an ecosystem (5-LS2 Ecosystems: Interactions, Energy, and Dynamics). In prior grades, students learned about individual organisms and their needs for survival, and this unit extends that knowledge to learning about the relationships among organisms in a system. Students worked in heterogeneous cognitive groups of four to observe, question, and manipulate models of ecosystems to explore the Crosscutting Concept of Systems and System Models. We wanted students to learn both concepts and language through an experiential approach to provide them with a strong understanding of the concepts in everyday language first and then later in academic language. The use of experiential learning through an outdoor classroom and field trips along with the creation of physical and conceptual models would lead students to a broader understanding of ecosystems and the transfer of energy, and it would prepare students to choose an ecosystem and conduct in-depth research on it.

## Literacy Goals

We are also interested in teaching writing across content areas and teaching students to make conscious language choices when they write (Halliday and Martin 1993). Language, content, and genres (or text types) are taught using the Teaching and Learning Cycle (TLC) throughout a unit by analyzing high-quality science texts with students and then writing together as a class before having students work independently (Rothery 1996). This approach supports English language learners (ELLs) and students with special education needs by differentiating the teaching of language, content, and writing through an iterative process throughout the unit.

One of our goals was to teach students to write explanations of the flow of energy in an ecosystem. Students would first need to develop knowledge of the various characteristics of an ecosystem. Their knowledge would be enhanced by writing reports with the characteristics as subtopics. Students would then be prepared to explain the phenomenon of energy flow in a system. Students were already familiar with report writing from previous grades,



but explanation writing would be new to them and would be the summative assessment of this topic.

## An Introduction to Ecosystems: The Outdoor Classroom

As a preassessment of their knowledge of ecosystems, students were asked to explain energy flow in a food chain in writing. Their work showed a basic understanding of the needs of living things and some misconceptions, such as the direction of the flow of energy.

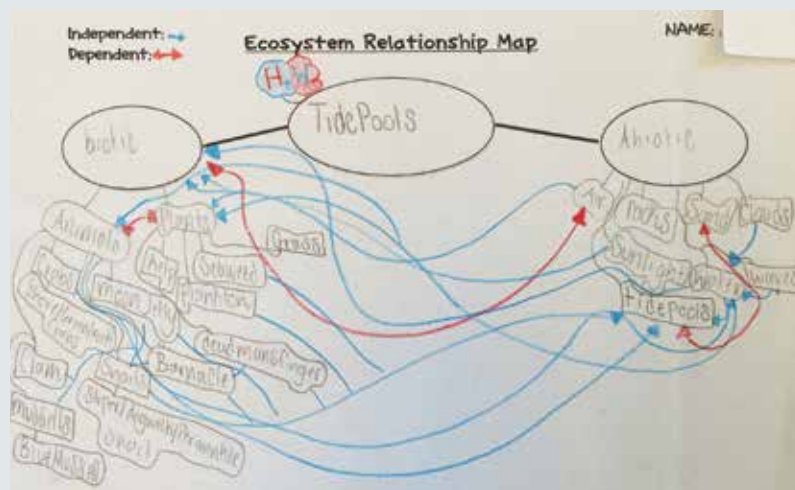
To begin the unit, we discussed the characteristics that make something *living* and how it functions in its environment, a conceptual model students build on over the course of the unit through a series of experiences and scientific discussions. Students participated in a living/non-living scavenger hunt in the school's outdoor classroom, which is a meadow ecosystem. Students began to learn to use field guides to facilitate the process of identifying unknown organisms. Then they built soda bottle models of a meadow ecosystem to begin understanding the parts of a system and how it functions. They drew diagrams of the model and wrote observations in their science journals to help them understand the movement of matter in an ecosystem over time. For example, seeds grew into plants and the introduction of animals decreased the plant matter (see NGSS Performance Expectation 5-LS2-1). The models enabled students to observe the growth of plants and animals gathered from the outdoor classroom (including grasshoppers, pill bugs, and earthworms), and they began to understand the concept of an ecosystem. To teach students about safety, students were reminded to wash their hands before and after each activity involving the collection of plants and animals. For a full description of the soda bottle ecosystem lesson see the online lesson plan (see NSTA Connection).

## Beyond the Classroom: Field Trips

The class participated in two field trips that helped students broaden and apply their understanding of being scientists in the field through making connections, building background knowledge, and applying knowledge to new situations. For safety in the field, students were asked to wash their hands before and after visiting the tide pools and the forest ecosystem. All of the organisms were safe

**FIGURE 1.**

Tide pool map.



PHOTOGRAPHS COURTESY OF THE AUTHORS

for students to pick up with their bare hands, but for the safety of the organisms they were kept in a bucket of ocean or pond water during the identification process and then released after being identified. For more field trip safety tips, see NSTA Connection.

The first field trip was to the local Harbor Islands tide pool ecosystem and the second was to the Wakefield Estate's successional woodland, a local forest ecosystem. A ranger from Harbor Islands visited the classroom to discuss tide pool ecosystems and provide a preview of the field trip along with safety instructions. When students visited the Harbor Islands, they observed and explored tide pool ecosystems and collected samples of organisms, which they checked off in a field guide and then released. Students were familiar with the purpose of using field guides to identify and compare the structure of organisms. They then discussed with their peers the different structures and how they are used to survive in a tide pool ecosystem. While collecting samples in the field, students asked many questions, such as, "How do barnacles and snails stay on the rocks when the water is so rough?" This began a discussion of the survival of small organisms in tide pools, and they made the connection that barnacles and snails anchor themselves to rocks as a survival mechanism.

During the field trip to the forest ecosystem, students participated in three distinct activities and wrote observations in their science journals. They took a nature walk to observe the ecosystem; observed and identified pond organisms such as frogs and crayfish with a field guide; and walked along a "decomposer trail" where they observed the effects of different types of decomposers, such as pill

bugs breaking down fallen trees. Students were initially confused as to why an organism would eat dead matter. They understood that the dead matter was the organism's

food source, which they used to produce their own energy. Through their observations of decomposers, they developed the understanding that the decomposer's role in the system is to recycle matter. This helped students understand more deeply how each individual organism is vital to maintaining balance in an ecosystem.



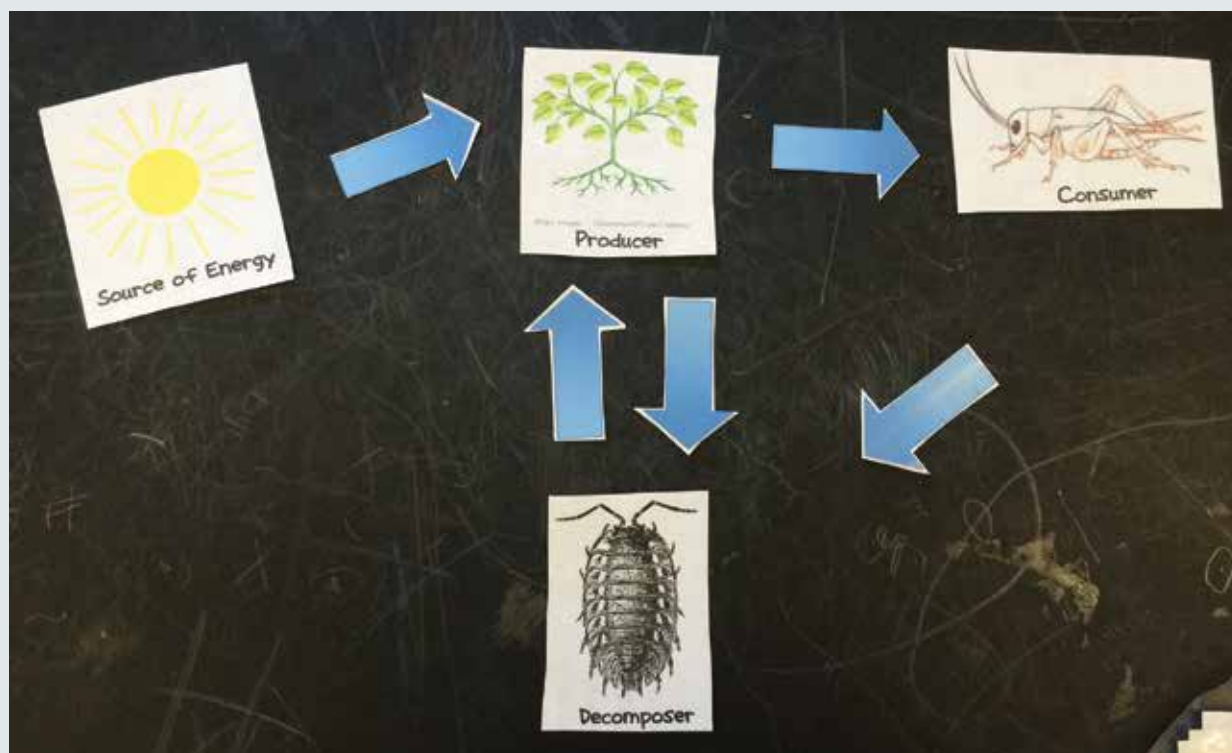
We identified organisms found on the field trip with a field guide.

## Back to the Classroom

"We saw crabs and periwinkles!" "We saw dead man's fingers!" These were some of the enthusiastic comments from students following the trip to the Harbor Islands. Students were watching a slideshow on the projector of the tide pools they had observed as they engaged in a discussion classifying their observations as *living* or *nonliving*. Together, the class created a relationship map of the meadow ecosystem and as a class as we discussed dependent relationships. A relationship map makes the ecosystem relationships visual. During the tide pool exploration students became familiar with living and non-living things in the ecosystem, and when they went back to the classroom, they continued their discussion of how they depend on each other. A relationship

**FIGURE 2.**

Food chain model showing the concept of energy flow in a meadow ecosystem.





### Students make observations on a field trip.

map shows which living and non-living things are connected by a survival need in an ecosystem. A single arrow shows a dependent relationship (only one thing is benefiting) and a double arrow shows an interdependent relationship (both things are benefiting). This helps develop students' understanding of how matter flows through the ecosystem. During the discussion, students were able to identify the needs of individual organisms and applied their thinking to the needs of a population of organisms. Students then extended this understanding by creating a relationship map of the tide pool ecosystem for homework (Figure 1, p. 33).

The following class, students applied their new knowledge of organisms in an ecosystem. Working in groups, students used teacher-created food chain cards to construct a model of energy flow and drew the final models in their science journals (Jadrich and Bruxvoort 2011). They organized the cards in order of what is consumed by what and then added arrows in to show the concept of energy flow (Figure 2, p. 34). Students discussed in groups the concept of energy flow and how animals use food to make energy to help clarify a misconception that energy flows in the direction of what was consumed. They were able to apply their knowledge of food chains to practice the skill of constructing a conceptual model of a food web as a class. They were then able to understand the foundational concept that the Sun is the main source of energy and that energy flows from producers to consumers to decomposers. Once students had an

understanding of the model of a food chain, they could manipulate it by thinking about what would happen to an ecosystem if a population of organisms disappeared and they drew conclusions such as, "If there were no plants, the grasshopper and other herbivores would die because they would have nothing to eat."

To review these concepts and deepen their knowledge of the flow of energy, students filled in a food chain graphic organizer (Figure 3). Ms. Rosa reminded them to use sentence starters such as, "Energy flows from \_\_\_\_\_" and "The main source of energy is \_\_\_\_\_," and one student suggested they could use, "Energy *transfers* from \_\_\_\_\_." The sentence starters helped students understand how to use academic language and kept them focused on the big idea. They also scaffolded the writing for ELLs and students on IEPs, allowing them to work more independently.

## Writing From Experience

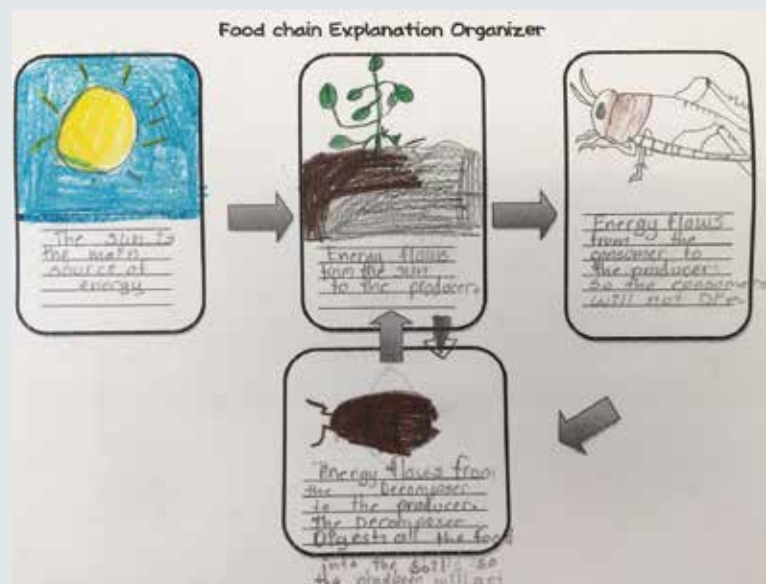
Students individually selected an ecosystem to research, and they each produced their own written report at the end of the unit. However, they were paired by topic to



Keywords: Food Chains  
and Food Webs  
[www.scilinks.org](http://www.scilinks.org)  
Enter code: SC150202

**FIGURE 3.**

A student's written and visual explanation of a meadow food chain.



conduct the research, take notes, and fill in the report graphic organizer to facilitate the process of gathering information using books and a variety of websites as resources. Ms. Rosa created note-taking pages on each subtopic of the reports to help students put content into their own words and carefully select quotes. The information was then transferred to a graphic organizer that showed them all seven subtopics: Geographic Location, Weather/Climate, Living, Non-Living, Adaptations, Food Chain or Food Web, and Interesting Facts (Brisk 2014). She guided students through the process of filling in the graphic organizer by creating a large version of it on chart paper and entering the information from the meadow ecosystem with the class. These subtop-

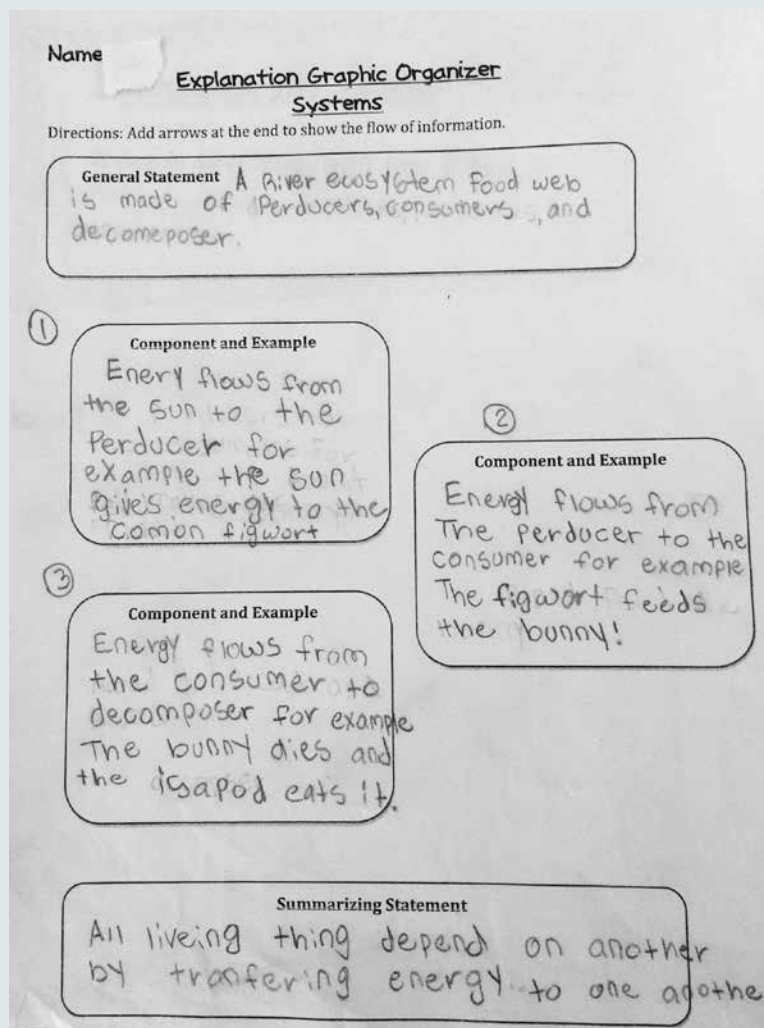
ics were the basis for the summative report rubric (see NSTA Connection). Ms. Rosa assessed students' work and gave them feedback as they gathered information. Reading the students' notes and writing throughout the unit helped her to see misconceptions they had so that she could address them. For example, as Ms. Rosa read through students' research notes on rainfall averages she realized that they were having difficulty distinguishing between the concepts of climate and weather. She was then able to explain and model using the terms correctly in a joint writing session on desert ecosystems.

Prior to the desert ecosystems writing lesson, we brainstormed several opening statements for reports and agreed on "The \_\_\_\_\_ ecosystem is a community with independent and dependent relationships." Ms. Rosa then wrote a sample of the first paragraph of the report with the whole class on chart paper to guide them through the process, using the desert ecosystem as a topic (Rothery 1996). She showed students her notes on the desert ecosystem on chart paper and engaged them in writing the first subtopic paragraph on climate, explaining the process of transforming the notes into sentences as they wrote. This process enabled her to determine students' level of comprehension of the writing based on their engagement and to provide additional small-group and individualized instruction for ELLs and students on IEPs as needed while students completed their individual writing over the following three classes.

Next, Ms. Rosa taught students to write explanations of food webs (Disciplinary Core Idea LS2.A, Interdependent Relationships in Ecosystems). To begin, she read aloud the book *Rotters* (Townsend 2005) and had students complete the Frayer model for *decomposer* (the model is a schoolwide initiative). As she read the book, they analyzed the text together, noticing how the author had explained the concepts (Rothery 1996). Before writing, she had students brainstorm a list of vocabulary to describe food webs. They suggested *energy*, *flows*, *producers*, *consumers*, and *decomposers*. First, she taught students to use an explanation graphic organizer (Brisk 2014) (Figure 4). Then, as she led them in a joint construction of the desert food

**FIGURE 4.**

**Student sample of explanation graphic organizer.**



web explanation, students offered ideas. One ELL student said, “I think your second sentence should be that energy flows from the consumer to the decomposer.” The teacher answered, “That is beautiful, but first we need to be more specific. What are some consumers?” Students offered multiple answers, such as “Squirrels,” “Snakes,” and “Bats.” They wrote, “Some consumers in the desert are squirrels, snakes, and bats. Energy flows from the consumer to the decomposer.” She kept track of sentence starters that students could use on separate chart paper.

Before students finalized and typed their reports and explanations, they received a checklist to help them review their work. Students who finished early created food web model posters with pictures and sentences (Figure 5). Students’ final texts were assessed for their use of the language of science and knowledge of the content of ecosystems using the explanation rubric based on the explanation graphic organizer (see NSTA Connection).

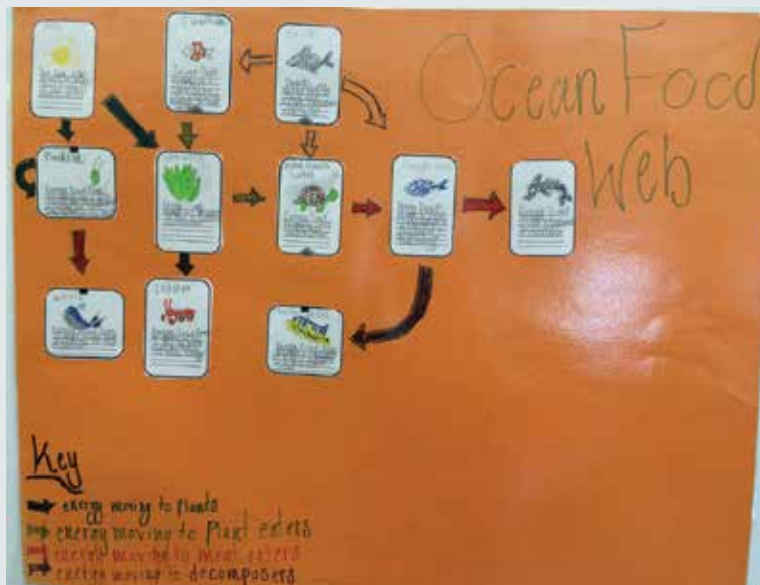
## The Big Idea

Throughout the unit, students explored two of the big ideas of science: the interdependent relationships in an ecosystem, and the cycling of matter and transfer of energy through a system. Students built on their knowledge of the survival needs of organisms to understand the relationships necessary to the functioning of an entire ecosystem. The layering of different types of models combined with the explicit teaching of language and writing made the abstract concepts of ecosystems more concrete, and students were able to explain the scientific phenomena with greater clarity. The field trips provided rich opportunities for students to experience a variety of ecosystems, which honed their observation skills and inspired questions that brought about new learning. The learning throughout the unit allowed students’ view of the natural world to evolve from an everyday perspective to a scientific perspective, and their new knowledge and language enabled them to begin to explain the complex relationship of energy flow through systems in nature. ■

**Tracy Hodgson-Drysdale** ([tracy@lrn2read.com](mailto:tracy@lrn2read.com)) is an assistant professor of TESOL and bilingualism at Lesley University in Cambridge, Massachusetts. **Holly Rosa** is a science specialist at the Russell School in Boston Public Schools in Boston, Massachusetts.

**FIGURE 5.**

A student model of an ocean food web showing energy flow.



### References

- Brisk, M.E. 2014. *Engaging students in academic literacies: Genre-based pedagogy for K-5 classrooms*. New York: Routledge.
- Halliday, M.A.K., and J.R. Martin. 1993. *Writing science: Literary and discursive power*. Pittsburg: University of Pittsburg Press.
- Jadrich, J., and C. Bruxvoort. 2011. *Learning & teaching scientific inquiry: Research and applications*. Arlington, VA: NSTA Press.
- National Governors Association Center for Best Practices and Council of Chief State School Officers (NGAC and CCSO). 2010. *Common core state standards*. Washington, DC: NGAC and CCSO.
- NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states*. Washington, DC: National Academies Press. [www.nextgenscience.org/next-generation-science-standards](http://www.nextgenscience.org/next-generation-science-standards).
- Rothery, J. 1996. Making changes: Developing an educational linguistics. In *Literacy in Society*, eds. R. Hasan and G. Williams, 86–123. New York: Addison Wesley Longman Limited.

### Resources

- Benoit, P. 2011. *Deserts*. New York: Scholastic.
- Townsend, J. 2005. *Rotifers!: Decomposition*. Chicago: Raintree Fusion.

### NSTA Connection

Download field trip safety tips, the rubrics, examples of student work, and a full description of the soda bottle ecosystem lesson at [www.nsta.org/SC1502](http://www.nsta.org/SC1502).

## Connecting to the *Next Generation Science Standards* (NGSS Lead States 2013)

### 5-LS2 Ecosystems: Interactions, Energy, and Dynamics

[www.nextgenscience.org/5ls2-ecosystems-interactions-energy-dynamics](http://www.nextgenscience.org/5ls2-ecosystems-interactions-energy-dynamics)

<b>Performance Expectation</b> <i>The materials/lessons/activities outlined in this article are just one step toward reaching the Performance Expectations listed below. Additional supporting materials/lessons/activities will be required.</i>	<b>Connections to Classroom Activity</b>
5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.	Students build and manipulate multiple models to observe the changes in matter and the relationships in various ecosystems.
<b>Science and Engineering Practices</b> Asking questions (for science) and defining problems (for engineering) <ul style="list-style-type: none"> <li>• Developing and using models</li> <li>• Constructing explanations (for science) and designing solutions (for engineering)</li> <li>• Obtaining, evaluating, and communicating information</li> </ul>	Students <ul style="list-style-type: none"> <li>• Ask questions about relationships in a variety of ecosystems</li> <li>• Build a model of a meadow ecosystem in the classroom; observe and record the dynamics</li> <li>• Construct an oral and written explanation of the flow of energy in food chain and web</li> <li>• Conduct research on ecosystems using books and the internet</li> <li>• Communicate information about a specific ecosystem in a written report that included a scientific explanation of an ecosystem</li> </ul>
<b>Disciplinary Core Idea</b> LS2.A: Interdependent Relationships in Ecosystems <ul style="list-style-type: none"> <li>• The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as “decomposers.” Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.</li> </ul>	Students create a relationship map of the meadow and tide pool ecosystems make interdependent and dependent relationships visual.
<b>Crosscutting Concept</b>	
Energy and Matter	Students traced the flow into, out of, and within an ecosystem to understand the possibilities and limitations of the system and the effect on individual organisms.

## Connecting to the *Common Core State Standards* (NGAC and CCSSO 2010)

### English Language Arts/Reading: Informational Text/Integration of Knowledge and Ideas

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably

[www.corestandards.org/ELA-Literacy/RI/5](http://www.corestandards.org/ELA-Literacy/RI/5)

### English Language Arts/Writing/Text Types and Purposes

W.5.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

W.5.2.A Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

W.5.2.B Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.

[www.corestandards.org/ELA-Literacy/W/5](http://www.corestandards.org/ELA-Literacy/W/5)

### English Language Arts/Writing/Research to Build and Present Knowledge

W.5.8 Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.

[www.corestandards.org/ELA-Literacy/W/5](http://www.corestandards.org/ELA-Literacy/W/5)