Strands: 6.4.3 and 6.4.4

**Emphasis:** In 1850, there were 13 species of fish in Utah lake. Now there are four species of fish.

**Standard 6.4.3** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.

**Standard 6.4.4** Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

**Anticipated Time Required:**
LE 1 - One to two 50 minute class period
LE 2 - Two to three 50 minute class periods
LE 3 - Two to three 50 minute class periods
LE 4 - Three to four 50 minute class periods
Optional Extension - Twelve to fifteen 50 minute class periods

**Dominant CCC:** Stability and Change
**Dominant SEP:** Developing and Using Models

**Management Strategies to support equitable access to content:**
- Build an inclusive and fair classroom community that encourages and respects diverse thinking and discussion by keeping close proximity and listening to student conversations. Emphasize the everyone’s contributions by paying attention to students’ ideas that you can highlight in front of the whole class.
- Encourage students to take risks, and embrace mistakes as learning opportunities by making it the norm that students’ ask questions and challenge each other’s ideas and viewpoints in a respectful manner.
- Give students time to think about and discuss ideas, predictions, findings, etc.
- Actively manage participation levels of students.

**Shopping list:**
- 8.5 X 11 white or colored paper
- Sticky/Post-it notes
- Black markers
- Highlighters (optional)
- Colored pencils (optional)

**Additional materials for the optional extension:**
- Clear 2 liter soda bottle for each student or group
- Pea gravel
- Activated charcoal
- Rich topsoil (not potting soil)
- Plants or seeds
- Sphagnum moss (optional)
## 6.4.3 and 6.4.4 Ecosystem Interactions Storyline Overview

**Anchor Phenomenon:** In 1850, there were 13 species of fish in Utah Lake. Now there are four species of fish.

**Student Performance Expectation:**

**6.4.3:** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.

**6.4.4:** Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

**Evidence statements:**


<table>
<thead>
<tr>
<th>Dominant DCI</th>
<th>Dominant CCC</th>
<th>Dominant SEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS2.B: Cycle of Matter and Energy Transfer in Ecosystems</td>
<td>Cause and effect</td>
<td>Developing and using models</td>
</tr>
<tr>
<td>● Food webs are models that demonstrate how matter and energy is transferred between producers, consumers and decomposers as the three groups interact within an ecosystem.</td>
<td>Matter and energy</td>
<td>Arguing from evidence</td>
</tr>
<tr>
<td>LS2.C: Ecosystem Dynamics, Functioning and Resilience</td>
<td>Systems and system models</td>
<td></td>
</tr>
<tr>
<td>● Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations</td>
<td>Stability and change</td>
<td></td>
</tr>
</tbody>
</table>

### Science Experiences

<table>
<thead>
<tr>
<th>CCC/SEP</th>
<th>What are students doing? (This should match your SEP!)</th>
<th>What specific understandings should students get from this experience? (What pieces of the performance expectation does the experience provide?)</th>
<th>New questions students have to propel us to the next science experience</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Introduction to fish populations in Utah Lake</td>
<td>Gather: Students use data to gather information about the fish populations in Utah Lake.</td>
<td>Some species of fish (including trout) have decreased to the point of extinction, while the populations of other species have increased.</td>
<td>Why would some populations shrink and others grow? What is causing these changes?</td>
<td>Formative: Student questions and predictions should be used to plan for instruction throughout the rest of the unit.</td>
</tr>
<tr>
<td>CCC: Patterns</td>
<td>Reason: Students generate questions to investigate and categorize the questions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEP: Analyzing and interpreting data</td>
<td>Communicate: Students predict the causes of the population changes they observed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2: Food webs</td>
<td><strong>Gather:</strong> Students learn about the different parts of a food web.</td>
<td><strong>Producers</strong> can use energy from the sun, consumers must eat another organism to obtain energy, decomposers get energy from eating dead/decaying matter.</td>
<td><strong>How are populations of the producers in Utah Lake changing?</strong> How are populations of the trout and carp’s predators changing?</td>
<td>Formative: Students ability to identify parts of a food web and generate possible investigation questions should be used to assess their understanding of how the components of the system interact with each other.</td>
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</tr>
<tr>
<td><strong>CCC:</strong> Cause and effect</td>
<td><strong>Reason:</strong> Starting with a familiar food web, students determine the role of each organism and then do the same for less familiar food webs.</td>
<td><strong>Communicate:</strong> Students generate additional investigation questions using the food web terms they have learned.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEP:</strong> Developing and using models</td>
<td><strong>Gather:</strong> Students learn about the different parts of a food web.</td>
<td><strong>Producers</strong> can use energy from the sun, consumers must eat another organism to obtain energy, decomposers get energy from eating dead/decaying matter.</td>
<td><strong>How are populations of the producers in Utah Lake changing?</strong> How are populations of the trout and carp’s predators changing?</td>
<td>Formative: Students ability to identify parts of a food web and generate possible investigation questions should be used to assess their understanding of how the components of the system interact with each other.</td>
</tr>
<tr>
<td>3: What do the arrows mean?</td>
<td><strong>Gather:</strong> Students use food web models to identify factors that all food webs have in common.</td>
<td>Energy flows through all food webs, and the energy flow is represented by arrows. Arrows should point from the sun to the plants to the herbivores, etc.</td>
<td><strong>Did the energy flow in the Utah Lake ecosystem change?</strong> Is there not enough energy for the trout?</td>
<td>Formative: Students should be able to identify parts of the food web model that represent energy and matter.</td>
</tr>
<tr>
<td><strong>CCC:</strong> Energy and matter</td>
<td><strong>Reason:</strong> Students predict what the arrows in a food web represent.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEP:</strong> Developing and using models</td>
<td><strong>Communicate:</strong> Students share and justify their predictions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4: Take my advice</td>
<td><strong>Gather:</strong> Students analyze population data for trout, carp and humans and read information about human impacts on Utah Lake.</td>
<td>Several factors, including overfishing and invasive species, have played a role in the decline of the trout population. Human choices (to fish, to introduce carp) are responsible for the changes to the ecosystem.</td>
<td><strong>Why did people make those choices?</strong> What would have happened if we hadn’t introduced carp or overfished the trout?</td>
<td>Formative: Initial student explanations should be used to assess their understanding of the changes in the ecosystem before they complete the summative assessment. Summative: Evidence should be used to support written explanation of how and why the ecosystem changed.</td>
</tr>
<tr>
<td><strong>CCC:</strong> Cause and effect; stability and change</td>
<td><strong>Reason:</strong> Students construct explanations, supported by evidence, for the decline in the trout population in Utah Lake.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEP:</strong> Analyzing and interpreting data; argue from evidence</td>
<td><strong>Communicate:</strong> Students share their explanations with each other and make revisions, then use their revised ideas to construct a final written explanation.</td>
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</tbody>
</table>
### 6.4.3 & 4 Learning Episode 1

#### Student Science Performance

<table>
<thead>
<tr>
<th>Topic:</th>
<th>Title:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactions Between Organisms and Environment in an Ecosystem</td>
<td>Introduction to fish populations in Utah Lake</td>
</tr>
</tbody>
</table>

#### Overarching Performance Expectations (Standard):

**6.4.3:** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.

**6.4.4:** Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

#### Lesson Performance Expectations:

Students will analyze data to identify patterns in the population sizes of native and introduced fish in Utah Lake, and generate questions about the causes of the changes in population size.

**CCC:** Patterns

**SEP:** Analyzing and interpreting data

**Students Will... To Construct Meaning**

*Engage with a phenomenon:* In 1850, there were *13* species of fish in Utah Lake. Now there are *four* species of fish.

*Gather:*

Student prompt:

Use the fish population data to identify at least two patterns.

Write at least three questions that could help us investigate what caused these patterns (one question per sticky note).

*Reason:*

Student prompt:

Listen to questions that are similar to yours, and hold your question up when you hear a similar question. Be prepared to describe similarities and differences in your questions.

**Teacher Will... To Support Students**

Teacher gives students initial Native/Carp data table. Instruct students to keep the data table for future reference.

Students work with partners or small groups to look for patterns and formulate questions.

Provide sticky notes for student questions.

**Management Strategy:** Walk around the room and listen to student conversations, paying attention to students’ ideas that you can highlight in front of the whole class. Prepare students ahead of time that you would like them to share their questions.

Sort the students’ questions into categories. Possible strategies you could use:

- Model sorting the questions by asking the students to post their sticky notes on the board. As you sort them into groups, narrate the thinking that motivates your decisions.
- While partners/groups still have their questions in front of them, have one group read their question to the class and then ask, “Who else wrote a similar question?” Ask students to group the similar questions together on the board.

Categories of questions may include:

- Questions about what the fish eat
- Questions about other animals in the lake
Communicate:
Student prompt:
Predict the cause of the change in the fish population that you explored. Record your prediction in your lab book.

Consider facilitating a short small group or whole group discussion to allow students to share their predictions.

Assessment of Student Learning
Formative: Students’ predictions and questions are the basis for assessment. At this point, student responses should not be graded, but should be used to assess their prior knowledge of ecosystem interactions and identify misconceptions that may need to be addressed in future lessons.

Students can begin to construct an explanation that predicts patterns of interactions among organisms in an ecosystem. Students who got it will see patterns and make predictions that are based on the data in the table. Students whose patterns and predictions do not need scaffolding to get them on track.

Student questions and predictions can be used to assess their prior knowledge of ecosystem interactions and identify misconceptions that may need to be addressed in future lessons. For example, student questions/predictions may indicate that the student understands that the fish’s food source, as well as the fish’s predators, or temperature of the water could be causing a change in the fish’s population size.
### 6.4.3 & 4 Learning Episode 2

**Student Science Performance**

<table>
<thead>
<tr>
<th>Topic: Interactions Between Organisms and Environment in an Ecosystem</th>
<th>Title: Food Webs</th>
</tr>
</thead>
</table>

**Overarching Performance Expectations (Standard):**

6.4.3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.

6.4.4: Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

**Lesson Performance Expectations:**

Identify patterns to develop a model that identifies key food web roles and explains that there are consistent interactions among organisms in an food web.

- **CCC:** Cause and effect
- **SEP:** Developing and Using Models

### Students Will... To Construct Meaning

*Engage with a phenomenon: Models of food webs all include arrows.*

**Gather:**
As we discuss the parts of a food web, record the part, its role in the food web, and an example.

**Student prompt:**
Use the vocabulary we’ve just learned to label the plover food web from earlier in the year.

**Reason:**
Using the two aquatic ecosystem models as examples, label your freshwater ecosystem. Then circle one food chain within the freshwater ecosystem.

### Teacher Will... To Support Students

Direct instruction: Teach students basic food web vocab (producer, consumer, decomposer, predator/predation, food web, food chain). Consider providing a graphic organizer where they can organize the parts of the food web with definitions and examples that will be useful to them later.

Allow students time to determine the roles of the organisms in the plover food web. As students work, walk around the room and look for places where they are struggling. If needed, facilitate a short discussion to make sure the students have correct answers on their plover food webs.

Give students a food web and written description of two ecosystems: an estuary and oceanic ecosystem.

Students will also need a blank freshwater food chain diagram with description to label; distribute now or allow students to pick it up after they have completed the estuary and oceanic food webs. Note that the freshwater ecosystem reading contains a lot of information. Scaffolding may be needed for struggling readers and ELL students.

Instruct students on how you would like them to label the parts...
Communicate:
On sticky notes, write down 3 more questions about the original fish data sheet using the vocabulary words producer and consumer.

of the estuary and oceanic food webs. When they finish, they should have labeled all organisms with their role (for example, the seal is a consumer). Options for facilitating this activity may depend on how well students are prepared to complete the task on their own:

- I do, we do, you do: Select either the estuary or oceanic food web to demonstrate how to determine the role of each organism, work as a class to complete the other one together, and then let students do the fresh water web individually
- Partners: Allow students to work in partners to complete the estuary and oceanic webs before completing the fresh water web individually
- Hint cards: Work through the estuary or oceanic web as a class, and then ask students to do the other on their own, with the option to check “hint cards” which you have set up around the room. If a student gets stuck, he can go to where a hint card is, silently read it to himself, and then return to the web. Examples of hints:
  - Plankton get energy from the sun
  - Worms eat dead animals
  - Crabs cannot use energy from the sun
  - There are ____ decomposers in the food web
Students then complete the fresh water web individually with no hints. This strategy can be useful because students can use the hints instead of interrupting as you work with students who need more direct instruction
- Level up/fast finishers: ask students who need an extra challenge to identify the herbivores, carnivores and omnivores in the food webs, or to add in arrows that are missing from the estuary and oceanic food web diagrams (for example, there are no arrows going to the decomposers in the oceanic food web; students should recognize that the decomposers can eat any of the organisms in the web)

When students finish, ask them to circle one food chain within the food web. Observe their work; if needed, facilitate a short class discussion to make sure everyone recognizes that several intertwined food chains make a food web.

Instruct the students on how you would like them to develop their new questions (individually or in partners). Allow students to determine where their new questions should be categorized on the board; the class may determine that a new category or two are needed. If students have answered any questions, any time you revisit the question board, you can ask students to offer answers they’ve encountered.
Assessment of Student Learning

A properly-labeled aquatic food web is important for this lesson - note students’ answers to formatively assess understanding of food web relationships. Asking questions about why a student labeled the food web the way she did can also be used as an assessment of student understanding. Circle one food chain in their food web and use the words producer and consumer to explain why their food chain is a food chain, and not a food web.

Example of labeled food web (note that the student may not have every arrow represented in the reading, but should be able to trace a few different pathways from the heron or fish back to the sun). The food chain circled in this example is: sun → algae → mayfly → frog → heron.
An estuary is a place where a river meets the ocean. The river contains fresh water, meaning that it is not salty. The water in the ocean is salty. Sometimes the water in the estuary is more salty from the ocean water, and sometimes there is more fresh water from the river. The organisms that live in the estuary must be able to survive in different types of water. In an estuary, there are worms and shrimp that eat decaying matter in the water. The shrimp also eat plankton. Small insects, called stonefly larva, eat plants growing around the water.
Oceanic Food Web

All of the organisms in an oceanic food web must be able to survive in the salty water that is in the ocean. If an animal dies without being eaten by something else, it will sink to the ocean floor and be eaten by decomposers.

Oceanic food web url:
Plants and algae that live in fresh water get energy from the sun. Some animals that live in the water, like shrimp, will eat decaying matter. Other animals in or near the water, like the trout and frogs, eat insects and shrimp. The carp can eat insects and shrimp too, but it mostly eats plants and algae growing in the water. Herons and other birds may not live in the water, but they can catch and eat many of the animals living in the water, including frogs and fish. Mayflies and dragonflies are both insects that change in appearance as they grow. Young mayflies eat algae. When the mayflies turn into adults, they live for such a short time that they don’t eat anything at all. In fact, as adults, they don’t even have a functional mouth! When dragonflies are young, they are called nymphs. Both the nymphs and the adult dragonflies eat other insects. The nymphs live in the water and will eat any insects or small animals they can catch. Sometimes they even eat small fish! The adults can eat mosquitoes, butterflies, or even smaller dragonflies.
### 6.4.3 & 4 Learning Episode 3

**Student Science Performance 3**

<table>
<thead>
<tr>
<th>Topic: Energy in a Food Web</th>
<th>Title: What do the arrows mean?</th>
</tr>
</thead>
</table>

#### Overarching Performance Expectations (Standard):

6.4.3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.

6.4.4: Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

#### Lesson Performance Expectations:

Individually, students will use models to construct sound predictions concerning energy and matter. Predictions will be refined through effective communication with others. A separate model will be developed with the evidence based findings.

- **CCC:** Energy and matter
- **SEP:** Developing and using models

#### Students Will. . . To Construct Meaning

*Engage with a phenomenon: All food chains/webs contain arrows.*

*Gather:* What do all the food webs we looked at during the last lesson have in common?

Ask students, “What do the arrows in a food web mean?”

*Reason:* Predict what the arrows in a food web mean and be prepared to explain your reasons for your prediction. Record your prediction and your reasoning in your lab book.

*Communicate:* Share your prediction and reasoning during the Inside-Outside Circle activity. You can revise your prediction after listening to your peers’ ideas, but make sure you also revise your reasoning.

With your group, discuss your predictions and reasoning. Formulate your final conclusions about what the arrows represent.

#### Teacher Will. . . To Support Students

To introduce the idea of arrows, ask students to pull out the four food webs they used during the last lesson, and determine what they have in common. Students should recognize that all the food webs contain arrows and the sun.

When students say the arrows show “what eats what,” ask them if that definition works for the arrow that goes from the sun to the vegetation.

Allow students time to record their prediction. Encourage them to look at their food webs and use the information in the food webs and text to support their predictions.

*Inside-Outside Circle Strategy:* Students make an inside and outside circle so they can pair up and share their predictions.

Use small group discussions/whole group discussion to tease out concept that arrows represent energy. Some groups will need some scaffolding to come to the correct
Using the freshwater food web sheet from the previous learning episode, students circle matter, label arrows as energy, and be prepared explain the difference between the two.

In your science notebook, make a table and write down two producers and two consumers from each food web.

Assessment of Student Learning
Use students’ initial predictions about what the arrows represent to formatively assess their understanding and to help determine how much time needs to be spent learning about/discussing energy flow through the ecosystem. Common misconceptions include: “the arrows represent what eats what” or “the arrows show that ____ eats ____.” Students will rarely come up with the correct answer (arrows represent the movement of energy) on their first try.

Use student ideas during the Inside-Outside Circle and small group discussions to formatively assess their understanding of the concepts of energy and matter, and how these are represented in models of food webs/chains. By the end of the lesson, students should understand that energy flows through the ecosystem and is represented by arrows. The matter is contained in the organisms (and abiotic factors, such as water) in the ecosystem.

Ten Coins in a Hat
Students are placed in groups of five, and each student is given two “coins” (slips of paper, tokens, etc.). When a student shares an idea with the group, she must place one of her “coins” in the middle of the table. Once a student has used both of her coins, she can’t share again until everyone else has used both of their coins.

Walk around the room to observe students’ level of participation. Make certain students have equity within their groups. Intervene, if necessary, and ask questions of the quieter students to increase their involvement in the group discussion. Depending on the students in the class, consider providing a discussion format, such as Ten Coins in a Hat (described below) to allow all students to participate.

As students work on this, walk around the room and make note of their work. If students are struggling with the concept of matter, consider stopping the class and facilitating a short discussion to review what matter is and how it compares to energy before allowing the students to finish circling matter and labeling energy.
Table example for science notebook

<table>
<thead>
<tr>
<th>Producers</th>
<th>Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>pond weed</td>
<td>heron</td>
</tr>
<tr>
<td>phytoplankton</td>
<td>shrimp</td>
</tr>
</tbody>
</table>

Example of food chain with matter/energy labeled (note that although every arrow represents the movement of energy, not every arrow in the food web below has been labeled; it is important for students to recognize that the sun is the energy source for the food web, that plants can use energy from the sun, and then the energy can be used by other organisms in the food web):
### Student Science Performance 4

<table>
<thead>
<tr>
<th>Topic: Human impacts on ecosystems</th>
<th>Title: Take My Advice</th>
</tr>
</thead>
</table>

### Overarching Performance Expectations (Standard):
6.4.3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Emphasize food webs and the role of producers, consumers, and decomposers in various ecosystems.
6.4.4: Construct an argument supported by evidence that the stability of populations is affected by changes to an ecosystem. Emphasize how changes to living and nonliving components in an ecosystem affect populations in that ecosystem.

### Lesson Performance Expectations:
Students will analyze data to identify patterns in the populations of trout, humans and carp. They will use evidence to construct an explanation for the decline in the trout population of Utah Lake, and communicate their explanations and offer advice to a past policy-maker in a letter.

**CCC:** Cause and effect; stability and change

**SEP:** Analyzing and interpreting data

<table>
<thead>
<tr>
<th><strong>Students Will. . . To Construct Meaning</strong></th>
<th><strong>Teacher Will. . . To Support Students</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engage with a phenomenon:</strong> In 1875, there were approximately 580,000 trout in Utah Lake; by 1825, there were none.</td>
<td>Provide students with the human population data and allow them time to graph the carp and trout data. Students may need some direct instruction to get started; the human population numbers are on the left axis and the carp and trout population numbers are on the right axis. This could also be a good time to talk about scale and proportion; students should understand that two different scales are needed because the carp population is so much larger than the human population. As students work on their graphs, circulate through the room and check on their progress. Encourage students to ask their neighbors for a hint on how to construct the graph if they are stuck. Remind students to finish the key. Consider facilitating a short class discussion to allow students to explain the patterns in the data. Distribute the readings about humans and Utah Lake (or hand readings to students as they finish their graphs). You could give each student both readings, or give each student only one reading, and then later pair students who got different readings together (during the CCCR) so they can teach their partner the information they learned.</td>
</tr>
</tbody>
</table>

**Gather:**
Student prompt:
Review the fish population data and compare it with the human population data. On the graph of the human population, add the trout and carp populations.

Read the information about humans and Utah Lake.

E. Harward & B. Breinholt
**Reason:**

Student prompt:
Reflect on everything we’ve learned, including information about food webs. What do you think caused the decline in the trout population? You will be using the consider-contribute-consult-revise strategy to construct an explanation to this question.

**Consider:** Consider the question, “What caused the decline in the trout population?” Record your best ideas about the question in your lab book. You should record your ideas about how and why the trout population declined, and should include evidence that supports your ideas. You can use both words and pictures to record your ideas.

**Contribute and Consult:** Share your ideas with your partner. Read what you wrote, word for word. If you used pictures, explain the pictures to your partner. Answer your partner’s questions. If your partner gives you feedback that you have questions about, ask her. Record the feedback in your lab book. When it is not your turn to share, show your partner you are listening. As your partner explains her ideas, ask any questions that might help you understand her ideas better. When she finishes, provide feedback that your partner could use to revise and improve her ideas. To do this, ask yourself the following questions:

- “Was everything correct?”
- “Was everything clear?”
- “Would an example, more evidence, or a diagram help?”

**Revise:** After you have consulted with your partner, revise your ideas. Decide which pieces of your partner’s feedback is useful and will improve your explanation. You can make revisions by drawing a line through items you don’t want to include, and adding items that will help improve and clarify your ideas.

During the class discussion, you can make further revisions to your ideas.

Review each step of the CCCR strategy with students before they start it. Set time limits for each step of the CCCR. Students do not need to write in complete sentences/paragraphs, but should represent their ideas and the evidence to support them in any way they would like. They will be using the ideas to construct a written argument, in the form of a letter, at the end of the lesson.

Before students start the contribute-consult step, consider modeling what the partner discussion should look and sound like. You may also want to provide sentence stems to facilitate student engagement. As students work, it is important for you to circulate through the class and listen to their ideas. Make note of student ideas that will be useful in facilitating the class discussion, and consider giving individual students a heads-up that you will be asking them to share a particular idea during the discussion.


After students have time to complete the CCCR and have revised their ideas, facilitate a class discussion. Students should understand that the decline in the trout population does not have only one cause. Overfishing by humans reduced the population. Changes to the food web caused by the introduction of the carp also contributed to a decline in the trout population. Allow students to share their ideas and drive the discussion, but use questions to guide the discussion in a way that helps students see the various causes of the decline in the trout population. Encourage students to revise their ideas during the class discussion.
Communicate:
Student prompt: You will be using your ideas about what caused the decline in the trout population to write a letter to one of the following people:

- A. Milton Musser (head of the fishing commission when carp were introduced to the lake)
- Brigham Young (governor of the Utah Territory who brought the settlers to the area)
- John S. Higbee (helped establish the first settlement of European Americans near Utah Lake)

All of these people lived in the 1800’s and made decisions that affected Utah Lake. A short biography has been prepared for each person. Read through them, and decide who you would like to write your letter to. Your letter needs to include the following:

- A comparison of the Utah Lake they knew (in the 1800’s) and the Utah Lake that exists now
- An explanation of why the Utah Lake ecosystem is so different now
- Advice about what choices they should make concerning Utah Lake, and why they should follow your advice

Explain the letter-writing activity to the students, and provide the bios for students to determine who they would like to write to. Also provide a grading rubric and/or list of expectations for the letter. Review the requirements before students start their letters. Consider reviewing the decisions each man made that affected the lake, so students know where to focus their advice.

Consider allowing students to share their letters. Some ideas:

- Have one or two students read their letters to the class every day until everyone has had a chance to share, or read a letter or two yourself to the class each day
- Allow students to read their letters in small groups, and instruct each group to select one letter from the group that they want to read for the class
- Hang the letters in a place where students can read them and allow time/structure for students to read the letters

Assessment of Student Learning
Formative: Student graphs and the patterns they identify, as well as their ability to construct and support an explanation during the CCCR activity should be used as formative assessments. Students should already have constructed reasonable explanations with evidence before they are expected to assimilate those ideas into their letter. Examples of student products are below.

Sample graph:
Patterns identified could include: as the human population gets larger, the trout population gets smaller, or as the carp population gets larger from 1935 to 1955, the trout population gets smaller, etc.

Sample CCCR ideas and evidence:

My idea is that the carp populations are caused the trout population to get smaller and then go extinct. Some evidence for this is that from 1875 to 1955, the trout population went from 580,000 to 0. At the same time, the carp population went from 0 to 7,200,000. We read that the carp eat the plants. If there are carp eating all the plants, there won’t be enough food for the insects that the trout eat. On our food web, it shows that the mayflies eat the plants and the trout eat the mayflies. Without any plants, the trout won’t have mayflies to eat. Also, the carp can eat the insects too, so the trout won’t have as much food.

I think that people fishing is what caused the trout to disappear from Utah Lake. Even though it said in the reading that the Native Americans fished in the Lake, there weren’t very many of them, so they didn’t take as many fish. When the settlers came, the population got really big and it said that they were catching thousands of fish. The graph also shows that when the human population got bigger, the trout population got smaller. This shows that when there are more people, they will take more fish from the lake and the trout can go extinct.

Summative assessment:
Letters can be assessed using the following rubric as a guide:

<table>
<thead>
<tr>
<th>Surpasses proficiency</th>
<th>Your letter meets the requirements for proficiency, and includes additional informations. For example:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Your letter includes more than two factors that have caused changes in the lake ecosystem</td>
</tr>
<tr>
<td></td>
<td>• Your letter includes predictions about what the lake would be like today if the person had followed your advice, including evidence to support your prediction</td>
</tr>
<tr>
<td></td>
<td>• Your letter includes predictions about the conditions of the lake in the future if the person does not follow your advice, including evidence to support your prediction</td>
</tr>
<tr>
<td></td>
<td>• Your letter outlines a solution for restoring the lake that we will have to implement</td>
</tr>
<tr>
<td>Level</td>
<td>Requirements</td>
</tr>
<tr>
<td>-------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| Proficient | - Your letter describes the similarities and differences in conditions of the lake in the 1850’s and now (this could include describing parts of the food web that are the same or different or how the area around the lake looks the same or different)  
- Your letter explains how and why the ecosystem of the lake changed  
- Your letter includes at least two factors that have caused changes in the lake ecosystem  
- Your letter includes advice about decisions that the person makes about the lake (for example, advice given to Brigham Young might focus on his decision to send settlers to the area to fish, advice given to A. Milton Musser might focus on his decision to put carp into the lake, advice given to John S. Higbee might focus on his decision to catch fish from the lake)  
- The advice you give includes an explanation that is supported by evidence (you include an explanation of why the person you are writing to should follow your advice) |
| Approaching proficiency | Your letter contains all elements required to meet proficiency, but some of the information is incorrect or incomplete. For example, only one factor that caused a change in the lake ecosystem is included. |
| Below proficiency | Your letter is missing elements required to meet proficiency; elements that are included may be incorrect or incomplete. |

Student samples:

Proficient (high):

E. Harward & B. Breinholt
Mr. Young,

In school we learned about you. We are in the future and learned about that you sent people to live by Utah Lake and get the fish to eat. This was not a good choice because it took the trout out of the lake and now in the future there are no more trout.

The food web is different now because there are carp and they eat different food than the trout. The carp eat all of the plants but the trout were eating the insects.

I will give you the advice to tell people that they should not fish in Utah Lake. When you sent the settlers to live by the lake and catch the fish maybe you didn't know they would catch all the fish. But that's what happened, so you shouldn't send them to catch the fish. I think you did some good things, like making roads, but telling more people to live by Utah Lake was not a smart choice. You should listen to my advice because I am in the future so I know what happened. I know you are busy because you are the governor. So thanks for reading this.
Humans and Utah Lake


Using large nets, pioneer fishermen caught thousands of pounds of Bonneville cutthroat trout, June sucker, Utah sucker, and chub. In 1848, fishing companies were organized to collect fish for desperate settlers who were without provisions. That year, frost killed early sprouting crops. Then came the crickets. Swarms of crickets destroyed many crops, and hundreds of the valley’s early residents stared starvation in the face. Were it not for the plentiful fish in Utah Lake, hundreds of settlers would have suffered severely. Several families were fortunate to have friends who were also skilled fishermen. More crickets and other insects would destroy pioneer crops in years to come. They gobbled up wheat, corn, oats, barley, clover, grass – even clothing. At times like these, when all the crops were eaten by insects, the only thing left to do was fish. Motivated by hunger, settlers fished frequently and recklessly. Soon, laws were written to control the number of fish being taken from the lake. But these laws were ignored by many locals, who used nets to fish night and day.

Humans and Utah Lake


Very often, change is good. But in the 1880s, when carp were introduced to Utah Lake, the results weren’t good at all. The intent was to replace the dwindling number of trout and to provide locals with a hardy fish that was also a very popular dish in other areas of the world. Yet, the newly integrated carp had long-lasting, negative impacts on the lake’s native fish population. The carp’s aggressive foraging habits eventually destroyed the pondweed on the surface and the plant life on the lake floor. This directly impacted the native fish population.

E. Harward & B. Breinholt
A. Milton Musser

Amos Milton Musser was born in 1830 in Pennsylvania. He traveled to the Utah Territory in 1851. Musser worked on many different projects throughout his life. He brought the telephone to Salt Lake, and helped promote railroad building across areas that would become part of Utah. Before Utah became a state, Musser was the fish and game commissioner for the territory. While he was in this position, he helped make the decision to introduce fish into many different lakes and rivers in Utah. In 1883, he helped make the decision to stock Utah Lake with carp.

Brigham Young

Brigham Young was born in 1801 in Vermont. He helped bring the first settlers to Utah in 1847, and became the first governor of the Utah Territory before Utah became a state. While he was governor, he helped many more settlers come to the area. By 1860, there were 40,000 new settlers in the territory. Young directed the building of roads, bridges, schools, and a mail service. He also directed irrigation projects that helped move water from lakes and rivers so that the settlers could use it to grow crops. Young wanted to use the fish from Utah Lake to help feed the settlers. In 1849, he sent a team to Utah Lake with instructions to find the best places to catch fish. Young was the governor from 1851-1858.

John S. Higbee

In 1849, John S. Higbee brought the first group of Mormon settlers to the Utah Lake area. Two years earlier, Higbee had visited Utah Lake with a few other settlers to see how easy it might be to catch fish in the lake. They fished in a place that does not usually have many fish, and only caught a few trout. When Higbee returned with a group to settle the area, they observed the Native Americans catching fish from the lake, and learned where and when to catch fish. There were so many fish that they could even catch them by hand. In June of 1849, the Native Americans and settlers caught thousands of fish from the lake. The fish they caught were a mixture of different species.
Human, Carp and Trout Populations

The graph below shows the population of humans living in Utah County, near Utah Lake. The graph shows the population of humans from 1855 to 1955. Remember that before 1847, there were only Native Americans and various mountain men and trappers living in the area, and the human population was relatively small. The first large settlements of European Americans began in 1847.

Use the fish population data to add carp and trout populations to the graph. Then identify at least one pattern in the population sizes.

![Graph of Fish and Human Population Size]

Describe at least one pattern in the data:
Consider: What do you think caused the decline in the trout population in Utah Lake? As you think about this, reflect on what you know about the other species (including humans) in the area and food webs. You can use pictures and/or words to record your ideas below. Don’t forget to include your evidence!
Now that you have a better understanding of the role that humans played in the decline of the trout population in Utah Lake, what advice would you give to the early settlers in the area? Do you think they understood how their decisions would affect the lake? How would you explain to them how their choices impacted the lake?

You will be writing a letter to A. Milton Musser, Brigham Young, or John S. Higbee. You will be telling him about the changes to the lake and giving him some advice. Before you turn in your letter, make sure it has:

- The similarities and differences in the lake from the 1800’s and the lake now
- Explanation of how and why the lake ecosystem changed
- Advice about the choices the recipient made about the lake
- Evidence to convince him to follow your advice

E. Harward & B. Breinholt