Natural Selection Unit

Lesson 5: Explaining Changes in Loberg Lake Stickleback

Grade: 9–10 General Biology

Length of lesson: 90 minutes

Placement of lesson: Lesson 5 of 6

Unit Overarching Goal

Populations of organisms change over time (evolve) as a consequence of natural selection and adaptation due to the interaction of four factors: (1) the potential for a population (species) to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Unit Central Question

What causes populations of organisms to change over time?

Lesson 5 Main Learning Goal

A change in population is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Lesson 5 Focus Questions

What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?

Ideal student response

The stickleback population in Loberg Lake, Alaska, changed over time due to natural selection. Over time, as more individuals are born with traits that help them survive and reproduce, the population will change. In any population, more individuals are born than can survive and reproduce. In Loberg Lake, female stickleback produce many eggs, but not all survive. This is because, in a population, there is competition for limited resources. This competition could be for food, habitat, or survival from being eaten. In Loberg Lake, predators will eat some of the fish and there is competition for food. All individuals in a population have the same traits, but there are different versions of the trait in different individuals in a population. Loberg Lake stickleback show variations in the amount of armor and length of spines. The amount of armor and length of spines do not change in an individual during its lifetime. Some of the differences in a trait will help an individual survive longer and/or produce more offspring. Individuals without spines are less likely to be eaten by predators in freshwater lakes, so they are more likely to survive, reproduce, and pass on their traits. Because of natural selection, the stickleback population in Loberg Lake changed from being made up of mostly individuals with spines and armor to being made up of mostly individuals with no spines or armor.

Science Content Storyline

Knowledge of Darwin's four factors of natural selection coupled with data that were gathered and observed in previous lessons can be used to thoughtfully explain how the Loberg Lake fish population changed over time. Certain data can provide evidence for a claim concerning the fish population, and the four factors of natural selection can be used to strengthen the overall argument by supporting a line of reasoning that links the evidence to the claim.

Materials

- 4 sentence strips: 1 of Darwin's 4 principles should be written on each sentence strip
- tape for posting sentence strips

Time (min)	Phase of Lesson	How the science content storyline develops
10	**Revisit the Unit Central Question and Link to Prior Learning:** What causes populations of organisms to change over time? **Lesson Focus Questions:** What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?	
60	**Explaining Changes in Loberg Lake Stickleback** <u>Activity Setup</u> Students review Darwin's four principles of natural selection. The teacher summarizes the science ideas of Lessons 2–4 and introduces the Explanation Tool. <u>Activity</u> In groups, students develop a Darwinian explanation for what has happened to the stickleback population in Loberg Lake using the Explanation Tool. <u>Activity Follow-up</u> Students use the Consider-Contribute-Consult-Revise (CCCR) strategy with partners from different groups to improve their explanations.	● Adult stickleback produce more offspring than can survive and reproduce. ● Armor and spines are heritable traits. ● A given trait is fixed during the lifetime of an individual stickleback. ● Some heritable traits are more advantageous than others. ● Stickleback offspring look similar to parents, but traits among parents and offspring can vary.
15	**Summarize and Link:** The teacher facilitates a discussion about the second focus question, helping students predict what will happen to the population of stickleback in another 25 years. The teacher then summarizes the lesson and links to the next lesson.	

Lesson 5: Explaining Changes in Loberg Lake Stickleback

Phase of Lesson: *Lesson Focus Question*

Main Learning Goal: A change in population is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Focus Question: What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?

Unit Overarching Goal

Populations of organisms change over generational time (evolve) as a consequence of natural selection and adaptation due to the interaction of four factors: (1) the potential for a population (species) to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms thatare better able to survive and reproduce in that environment.

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Time: 10 Minutes

STeLLA Strategies

- Strategy 2: Ask questions to probe student ideas and predictions
- Strategy 3: Ask questions to challenge student thinking
- Strategy B: Set the purpose with a focus question

Science Ideas

- Adult stickleback produce more offspring than can survive and reproduce.
- Armor and spines are heritable traits.
- Stickleback offspring look similar to parents, but traits among parents and offspring can vary.
- A given trait is fixed during the lifetime of an individual stickleback. (The trait cannot be willfully changed by the individual to make the trait advantageous.)
- Some heritable traits are more advantageous than others in a particular environment.

Common Student Ideas

- Changes in the environment cannot lead to changes in the traits of populations living in that environment.
- Natural selection leads to perfection.
- Natural selection and evolution are equivalent terms.

Lesson 5: Explaining Changes in the Loberg Lake Stickleback Population

Introduction

Over the past several lessons, you have looked at observations and data that will help you answer the question: “What caused the population of stickleback in Loberg Lake, Alaska, to change over time?” In this lesson, you will construct a scientific explanation that answers this question.

Process and Procedure

1. Write the focus questions for the lesson in the box below. Write your best ideas about the questions under the box.

Implementation	Notes
Unit Central Question and Link to Prior Learning ● Remind students that the overarching goal of this series of lessons is to answer the unit central question, "What causes populations of organisms to change over time?" Let them know that today they will begin to answer this question using the stickleback population of Loberg Lake, Alaska. ● Ask students to review Darwin's four principles. In groups of three to four, have students discuss the four principles, making sure that everyone in the group has an understanding of each principle. As groups discuss the four principles, circulate through the room asking probe and challenge questions as needed. ● Ask individuals to describe one of Darwin's principles. As each principle is shared with the class, post the appropriate sentence strip on the board. These sentence strips will be the science principles students will use as they write their scientific explanation. ● **STEP 1:** Introduce the lesson focus questions: "What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?" ● Write the lesson focus questions on the board so you and the students can refer to it throughout the lesson. ● Ask students to write the focus questions in the box and their best ideas underneath it. They will have an opportunity to add to their ideas throughout this lesson, so limit the amount of time they spend on this step.	

Lesson 5: Explaining Changes in Loberg Lake Stickleback

Phase of Lesson: Explaining Changes in the Loberg Lake Stickleback Population

Main Learning Goal: A change in population is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Focus Question: What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?

Unit Overarching Goal

Populations of organisms change over generational time (evolve) as a consequence of natural selection and adaptation due to the interaction of four factors: (1) the potential for a population (species) to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms thatare better able to survive and reproduce in that environment.

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Time: 60 Minutes

STeLLA Strategies

- Strategy 2: Ask questions to probe student ideas and predictions
- Strategy 3: Ask questions to challenge student thinking
- Strategy 4: Engage students in communicating in scientific ways
- Strategy 7: Engage student in constructing explanations and arguments
- Strategy 9: Engage students in making connections by synthesizing and summarizing key science ideas

Science Ideas

- Adult sticklebacks produce more offspring than can survive and reproduce.
- Armor and spines are heritable traits.
- Stickleback offspring look similar to parents, but traits among parents and offspring can vary.
- A given trait is fixed during the lifetime of an individual stickleback. (The trait cannot be willfully changed by the individual to make the trait advantageous.)
- Some heritable traits are more advantageous than others in a particular environment.

Common Student Ideas

- Changes in the environment cannot lead to changes in the traits of populations living in that environment.
- Natural selection leads to perfection.
- Natural selection and evolution are equivalent terms.

2. Read the following information about how to write a scientific explanation. As you read, underline key ideas. Make notes in the margins about ideas and questions that you have about how you will write your scientific explanation.

Scientific Explanations

What Is a Scientific Explanation?

Scientists work to explain the natural world. Their explanations begin with a question they have or a problem they are trying to solve. Scientists collect and analyze data to see if the data will help them answer the question or solve the problem. The data that help answer the question and solve the problem become the evidence that they will use in their scientific explanations. In their scientific explanations, they use evidence and reasoning about what they are investigating in order to support their claims. Their claims are the answer to the question they are investigating or the problem they are trying to solve. Your explanations in science should include evidence, reasoning, and claims. As part of becoming proficient in science, you will learn to support your claims with evidence. This evidence may be from data that you have collected or that someone else has collected. You may also use evidence from reports and summaries from scientists or even from other students. This evidence will provide you with what you need to support your claims in science.

When you write a scientific explanation, you will use reasoning. Reasoning links your evidence to your claim. This makes your explanation stronger and more convincing. Your reasoning should be logical and explain why the data you are using are evidence that supports your claim. As you learn more about a science concept, you will want to use scientific principles in your reasoning. These scientific principles are the accepted understandings in science that you will learn about in your science classes. When you use scientific principles to support your explanation, you will add to the logical connections you make. This creates a stronger scientific explanation.

The Explanation Tool (figure 1) provides you with a way to organize the important parts of a scientific explanation—your claim, evidence, and reasoning. This organization will help other people make sense of your work. Notice that the Explanation Tool in figure 1 has five basic parts.

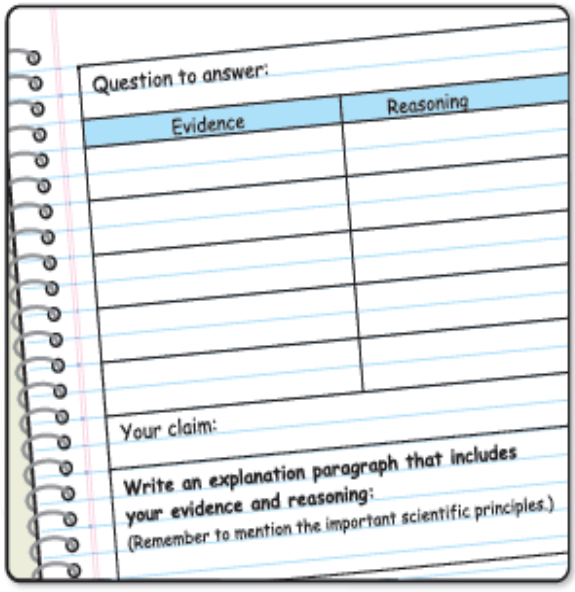

Figure 1: Explanation template. This explanation template can help you write a scientific explanation from a claim, evidence, and reasoning.

Implementation	Notes
Activity Setup ● Draw students' attention to the introductory paragraph in their student notebook. Share with students that they have looked at observations and data that will help answer today's first focus question: "What causes a population of organisms to change over time?" Ask several students to share an example of observations and data they've explored. Share that in this lesson they will construct a scientific explanation that answers this question. ● **STEP 2:** Have students read about how to write a scientific explanation. Encourage students to use appropriate literacy strategies to support them as they read.	

3. Follow your teacher's instructions to read about the parts of a scientific explanation. As you read and discuss your part, underline or make notes in the margin so you can share these ideas with your group.

Parts of a Scientific Explanation

1) The first part of the Explanation Tool is **the question that you are trying to answer or the problem you want to solve**. Doing science involves answering questions about the world around you. Testable questions in science are those that you can answer by investigations. The questions that you ask help you decide what data you will collect.

Stop and Think

What is the question you will answer in your scientific explanation?

2) **The evidence that you gather.** This part of the template includes the data you have collected that will help you answer the question. You may collect a lot of data in an investigation. But some of that data will not help you answer your question. Data become evidence when they help answer your question. Do not list individual data points but, rather, choose the data that will count as evidence. Then write a summary of your evidence. This evidence may come from a number of sources, like your investigation, observations you make, or investigations that others have done.

3) **The relevant science ideas and concepts.** In this part, add science ideas that justify why each piece of evidence helps support your answer to the question. This is your reasoning: a justification that logically links the answer to your question to the evidence. These statements show why the data count as evidence to help you answer the question. When you can, base your reasoning on appropriate science ideas.

4) **Your claim or claims.** Your claim is the response to the question you are trying to answer. You will state your claim in one or two sentences. Your claim should make a statement that answers the question or addresses the original problem. This may be in the form of a statement of a trend, a behavior, or a generality that your evidence supports.

5) **Your scientific explanation.** This is the most important work you will do—creating your scientific explanation. As you get better at writing scientific explanations, you may complete only this part of the template. The other parts of the tool are to help you with this final step. Your explanation will likely be a short paragraph. There are two goals to writing a strong scientific explanation. The first goal is to write a logical explanation that includes a claim that is supported with your evidence and reasoning. Connect each piece of evidence and reasoning to your claim. The second goal is to use appropriate scientific principles in your reasoning when you can. In using a scientific principle, you show how the evidence supports your claim.

Stop and Think

How will you explain your part of the Explanation Tool to the rest of your group?

Implementation	Notes
• **STEP 3:** Use a jigsaw technique to explore the parts of a scientific explanation. Have students number off 1–5. They will read the section that corresponds to their number. Designate a different place in the room for each expert group to gather as they explore their part. • As expert groups explore their part, circulate among groups asking probe and challenge questions as necessary to ensure each group understands the purpose and key features of their part. • Have students reorganize in groups that have one person who read each number and share their part of a scientific explanation. Encourage others in the group to make notes of the purpose and key features of each part in their notebook. • Once all experts have shared their part with their group, draw the class back together and ask several individuals to share the purpose and key features of each part of a scientific explanation. Use probe and challenge questions to make sure students understand all parts of a scientific explanation. • As you discuss reasoning, refer students to the four factors of natural selection that they learned about in Lesson 3. ***Teacher Note:*** Reasoning is the most difficult part of writing a strong scientific explanation. The first important part of reasoning is the logical way in which students present their arguments. Students should develop a logical argument to justify *why* the data they are using support their claims. The second part of reasoning is using appropriate scientific principles. A strong scientific explanation uses appropriate scientific principles to justify that the evidence supports the claim.	

4. Working as a group, use the Explanation Tool template on the next page to write a scientific explanation that answers the question.

1) Begin by writing the question.
2) Then add evidence from the data and observations you examined in previous lessons.
3) Then add the science ideas. These science ideas will help you justify why your evidence supports your claim.
4) Write your claim in complete sentences.
5) Write your explanation.

Make sure that each member of the group has a complete explanation and is ready to share.

Focus on Student Thinking

- As groups work on their explanations, circulate among groups asking probe and challenge questions. The purpose is to have students think critically about the data that count as evidence for their claim. Secondly, teacher questions should support students as they develop a logical reason that ties their evidence to the claim. This should include the accurate use of Darwin's four factors of natural selection. Following is example dialog between a teacher and a student:
  - S: I think the stickleback in the aquarium is good evidence.
  - T: Say more about why you think this will be good evidence. **(Probe)**
  - S: Well, in a couple of years there were more fish than the aquarium could hold.
  - T: Can you point to the data you calculated that show your idea? **(Probe)**
  - S: Here (pointing). After three years, there would be 125,000 fish in the aquarium. And the aquarium could never hold that many fish.
  - T: This is good thinking! Can you link these data with one of the science ideas? **(Challenge)**
  - S: Adult stickleback produce more offspring than can survive and reproduce.

Implementation	Notes
Activity ● **STEP 4:** Have students work in their table groups to write a scientific explanation that answers the first focus question, "What causes a population of organisms to change over time?" Emphasize that, while they are working as a group to develop a scientific explanation, each member of the group will need to complete the Explanation Tool template to be able to share the group's explanation with others in the class. ● Remind students that the sentence strips with Darwin's four principles are the science ideas they will use as reasoning to show why their evidence supports their claim. Refer to **Focus on Student Thinking** in the SE key to see how a teacher can support students in this part of the lesson.	

Explanation Tool

Question	
Evidence from data and observations (e.g., patterns or trends specific to your investigation)	**Science ideas and concepts (e.g., patterns or trends that are generalizable across many situations; may include science vocabulary).**
Claim (Your claim should answer the question.)	
Scientific Explanation (Be sure to Include the claim, evidence, and reasoning in your explanation. Reasoning includes science concepts and linking words used to connect your ideas in the paragraph.)	

Implementation	Notes

5. Scientists consult with other scientists to get feedback on their explanations. They use this feedback to revise their explanations to make sure they have strong evidence, science ideas, and reasoning. Like scientists, you will get feedback on your explanations. To do this, follow the steps below.

   Work with a partner from a different group to complete the steps in the chart. One of you will be Student A and the other will be Student B. *Contribute* your explanation to a discussion with your partner. Then switch roles and complete the steps again.

	Student A	Student B
Contribute	■ This is a *partner* step. ■ **Contribute** your ideas to a discussion with your partner by doing the following: • If you used words to record your ideas, read the sentences aloud, word for word. Do not add any additional explanation. • If you used sketches to record your ideas, explain the sketches carefully, including the labels. ■ Answer any questions your partner might have. ■ Watch your partner for signs of confusion. ■ Take turns so that each partner has an opportunity to contribute.	■ This is a *partner* step. ■ Listen quietly as your partner reads or explains his or her work. ■ Ask any questions that would help you understand your partner's work. ■ Think about the feedback you could give your partner. If you are having trouble thinking of feedback, ask yourself the following questions: • "Was everything correct?" • "Was everything clear in the answer?" • "Would an example help?"

   Next, *consult* with your partner to get feedback on your explanation. Follow the steps in the chart below. After Student A has consulted Student B, switch roles and repeat the consult steps.

	Student A	Student B
Consult	■ This is a *partner* step. ■ **Consult** your partner to get feedback on your answer. ■ Listen to the feedback from your partner. ■ Ask questions that would help you understand your partner's feedback. ■ Carefully consider the feedback that your partner gives. ■ Take turns so that each partner has an opportunity to receive feedback.	■ This is a *partner* step. ■ Offer advice to your partner to help improve his or her work. ■ Answer any questions your partner might have.

   Return to your group to *revise* your explanation. Share the feedback from your partner with your group. After all members of your group have shared their feedback, revise your group's explanation following the steps in the chart below.

Revise	■ **Revise** your work based on any problems you discovered on your own during the contribute and consult steps. ■ Decide which advice is useful and would improve your answer. Include any ideas that your partner had that you thought were good. ■ Use a different-colored pen or pencil for your revisions. ■ For any feedback that did not lead to a revision, describe why you chose not to make any changes.

Implementation	Notes
Activity Follow-up ● **STEP 5:** Draw students' attention to the introductory paragraph in their student notebook. Share with students that, like scientists, they will consult with one another to get feedback. They will use this feedback to revise their explanations to make sure they have strong evidence, science ideas, and reasoning. ● Share that they will use a method called Consider-Contribute-Consult- Revise (CCCR) to give and get feedback. ● Note that the first step in CCCR is Consider. In this step they will consider a question or problem and record their best ideas in their science notebook. Point out that they have already completed this step by writing their scientific explanation to answer the question, "What causes a population of organisms to change over time?" ● Students should join in pairs for the Contribute step of the method. Depending on your class, you may assign partners or allow students to select a partner from another group. Have students stand facing each other to complete this step. Each pair should designate one student as Student A and the other as Student B. ● Have students read aloud to each other what they wrote. They should simply read what they have in their science notebooks without embellishing or explaining their ideas further. If students were working to make a sketch, they should explain the parts of the sketch and any labels. Students should not exchange science notebooks during this step. Reading aloud helps students process what they have written. Many students will begin the process of revision in their heads as they hear themselves read their answer aloud. ○ Here is an example Contribute prompt: "Read your answer aloud exactly as you wrote it. Do not add any explanation or say, 'What I meant was ….'" ● Once Student A has read their explanation to Student B, the pair should switch roles and repeat the Contribute process.	

Explanation Tool

Question	
What caused the population of sticklebacks in Loberg Lake, Alaska to change over time?	
Evidence from data and observations	**Science ideas or concepts or principles**
Female sticklebacks produce many eggs, but not all survive. Predators will eat some of the fish and there is competition for food. Some fish won't compete as well as others and die.	In a population, more individuals are born than can survive and reproduce.
Individual sticklebacks in Loberg Lake with stickles take longer to reproduce and are eaten more often by predators, so they are less likely to survive, reproduce, and pass on their stickle traits.	In a population, there is competition for limited resources. This competition could be for food, habitat, or survival from being eaten.
The population of sticklebacks in Loberg Lake show variations in the amount of armor and length of stickles. The amount of armor and length of stickles do not change in an individual during their lifetime.	All individuals in a population have the same traits, but there are different versions of the trait in different individuals in a population.
Over 13 generations of time, the stickleback population in Loberg Lake changed from being made up of mostly individuals with stickles and armor to being made up of mostly individuals with no stickles or armor.	Some of the differences in a trait will help an individual survive longer and/or produce more offspring.
Claim *(Your claim should answer the question.)*	
The stickleback population in Loberg Lake, Alaska changed over time due to natural selection.	
Explanation *(Make sure to link your claim, evidence, and science ideas.)*	
The stickleback population in Loberg Lake, Alaska changed over time due to natural selection. Over time, as more individuals are born with traits that help them survive and reproduce, the population will change. In any population, more individuals are born than can survive and reproduce. In Loberg Lake, female sticklebacks produce many eggs, but not all survive. This is because in a population, there is competition for limited resources. This competition could be for food, habitat, or survival from being eaten. In Loberg Lake, predators will eat some of the fish and there is competition for food. All individuals in a population have the same traits, but there are different versions of the trait in different individuals in a population. Loberg Lake sticklebacks show variations in the amount of armor and length of stickles. The amount of armor and length of stickles do not change in an individual during their lifetime. Some of the differences in a trait will help an individual survive longer and/or produce more offspring. Individuals without stickles reproduce earlier in their lives and are less likely to be eaten by predators, so they are more likely to survive, reproduce, and pass on their traits. Because of natural selection, over 13 generations of time, the stickleback population in Loberg Lake changed from being made up of mostly individuals with stickles and armor to being made up of mostly individuals with no stickles or armor.	

Implementation	Notes
● In the Consult step, Student A will ask Student B for advice on his or her answers. Provide examples and prompts as well as nonexamples to help them. Nonexamples, or feedback that is not helpful, include, "I like the color of pen you used" and "Nice job." Questions that students can use as prompts can help them provide better feedback. Examples follow: ○ "Was the claim a complete sentence that answers the question and is supported by evidence and reasoning?" ○ "Was enough evidence included?" ○ "Did the reasoning justify why the evidence supports the claim?" ○ "Did the reasoning show how the evidence follows logically from science ideas?" Students should ask themselves these prompts to help them think about what valuable feedback they can give. Although it is OK to disagree, the focus should be on improving answers and understanding. ○ Here is an example Consult prompt: "Consult with your partner to get feedback on how to improve your answer." ● Once Student A has received feedback from Student B, the pair should switch roles and repeat the Consult process. ● For the Revise step, students should return to their group to revise their group's explanation. Each member of the group should share the feedback she or he received, then the group should work together to revise their explanation. Tell them that the goal is to have the most complete, correct information they can in their answers. ● Have them use a different-colored pen or pencil for revisions as this will help them, and you, keep track of their learning. Emphasize that they do not have to take all the advice that their partners gave them if they do not feel it was helpful advice. They should either make a change based on the feedback or write why they chose not to take the advice. ○ Here is an example Revise prompt: "Work together to revise your explanation. Use a different-colored pen or pencil for your revisions. Think about what you noticed about your answer and consider all the feedback you got. If you choose not to take a piece of advice from your partner, explain why you chose not to." **Refer to the SE key to see a sample completed Explanation Tool.**	

Lesson 5: Explaining Changes in Loberg Lake Stickleback

Phase of Lesson: *Lesson Focus Question*

Main Learning Goal: A change in population is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.

Focus Question: What causes a population of organisms to change over time? How can an explanation of what happened to the population help people predict what might happen in the future?

Unit Overarching Goal

Populations of organisms change over generational time (evolve) as a consequence of natural selection and adaptation due to the interaction of four factors: (1) the potential for a population (species) to increase in number, (2) variations in traits inherited from organisms' parents, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms thatare better able to survive and reproduce in that environment.

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Time: 15 Minutes

STeLLA Strategies

- ❖ Strategy 1: Ask questions to elicit student ideas and predictions.
- ❖ Strategy 2: Ask questions to probe student ideas and predictions
- ❖ Strategy 3: Ask questions to challenge student thinking
- ❖ Strategy 4: Engage students in communicating in scientific ways
- ❖ Strategy H: Highlight key science ideas and focus question throughout
- ❖ Strategy I: Summarize key science ideas

Science Ideas

- Adult stickleback produce more offspring than can survive and reproduce.
- Armor and spines are heritable traits.
- Stickleback offspring look similar to parents, but traits among parents and offspring can vary.
- A given trait is fixed during the lifetime of an individual stickleback. (The trait cannot be willfully changed by the individual to make the trait advantageous.)
- Some heritable traits are more advantageous than others in a particular environment.

Common Student Ideas

- Changes in the environment cannot lead to changes in the traits of populations living in that environment.
- Natural selection leads to perfection.
- Natural selection and evolution are equivalent terms.

Summarize and Link

6. Look back at the focus questions for the lesson. Your scientific explanation answered the first question about a specific population, the stickleback fish in Loberg Lake. Think about how your explanation could help you predict future changes to the stickleback. In the space below write your best ideas about what will happen to the stickleback population of Loberg Lake in another 25 years. Be prepared to share your ideas with the class.

Implementation	Notes
Summarize and Link to Next Lesson ● **STEP 6:** Direct students' attention to the focus questions. Highlight that their explanation answered the first of the two questions. Have students write their best ideas about how the population of stickleback in Loberg Lake might change in another 25 years. Ask them to use the ideas from their explanation to make a prediction. ● Once students have finished writing their predictions, ask them to share their ideas with the entire group. Use STeLLA Strategy 1: Ask questions to elicit student ideas and predictions to get a variety of ideas out. Make it clear to students that you are not going to tell which ideas about how the population will change over the next 25 years are right or wrong at this point. Chart students' predictions on the board. ● Once students have shared their ideas, have groups evaluate each of the predictions in light of the explanation they just completed. They should consider how their evidence, science ideas, and reasoning supports or does not support each prediction. ● Ask students to share their group's thinking with the class. Ask probe and challenge questions to make student thinking visible and grounded in the evidence and science ideas. ● Use a notation system (+, ✓, –) to denote the strength of each prediction based on reasoning using evidence and science ideas. ● Highlight comments in the discussion to make sure that students focus on ○ reproduction and not just survival, and ○ if the environment does not change in Loberg Lake, the population will not change as rapidly. ● Invite students to revisit their predictions and make revisions in another color ink. ● After students revisit their predictions and make revisions, share with students that in this lesson they wrote a scientific explanation using evidence, science ideas, and reasoning to support their claim about how the population of stickleback in Loberg Lake changed over time. They used their understanding of natural selection to make predictions about how the population of stickleback will change in the next 25 years. ● Share that in the next lesson they will use and apply their understanding to different populations of organisms. They'll work together to understand changes over time in a population of finches on the Galapagos Islands and analyze evidence and information to help evaluate claims as to the cause of the changes.	