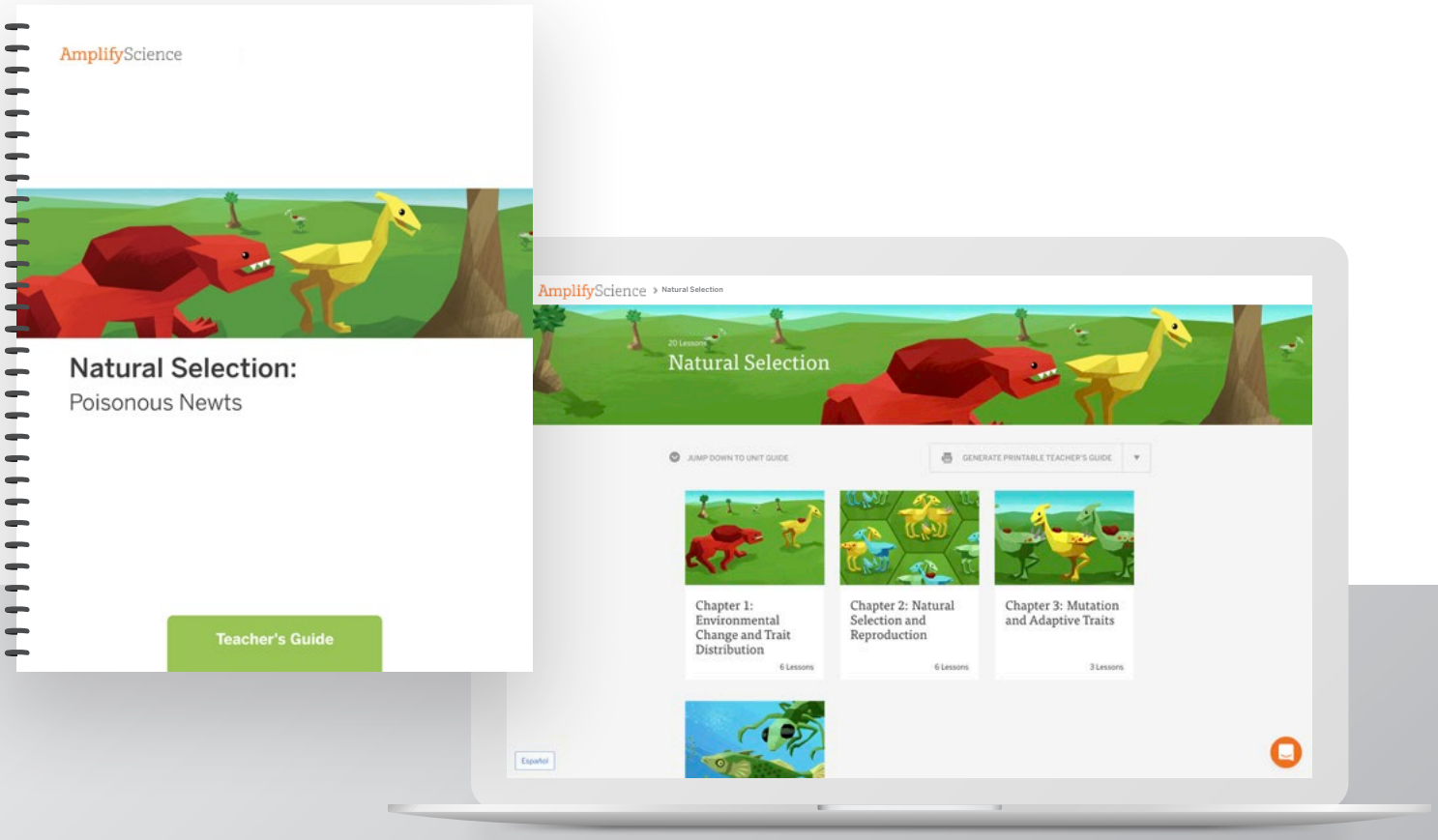
Amplify Science

Grade 8

UNIT GUIDE

Natural Selection



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Amplify.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Welcome to Natural Selection

Natural selection is a powerful process. It produces amazing adaptations and helps us understand much of what we observe in the natural world. However, natural selection is often misunderstood, and is frequently misconstrued as a process that simply grants a species any trait that it might need for survival. Because natural selection is difficult to observe, the strategies and activities that most curricula use to teach the topic end up leading to and reinforcing these misconceptions. In contrast, Amplify Science takes a very intentional approach to using terminology, activities, and digital models that help break down misconceptions and build deeper and more scientifically accurate understandings of natural selection and its limitations.

> Unlike a typical curriculum, Amplify Science anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of biologists. Their job is to investigate what caused the rough-skinned newts of Oregon State Park to become so poisonous. Working together, students learn about the mechanisms of natural selection, and uncover how the population of newts changed over time. The unit concludes with a Science Seminar, in which students use what they have learned to analyze evidence and participate in a discussion about whether the changing traits of the stickleback fish are designed to help it better escape predators or better catch prey.

Unit Type: Core

Student Role: Biologists

Phenomenon: The newt population in Oregon State Park has become more poisonous over time.

Core Concept: Understanding mechanisms by which the distribution of traits in a population change in response to changes in factors in the environment

Target Performance Expectations:

- LS3-1: Gene, Protein, Trait, and Mutations
- LS4-4: Genetic Variation in Populations
- LS4-5: Artificial Selection and Genetic Engineering
- LS4-6: Natural Selection
- ESS3-4: Human Population

Related Performance Expectations:

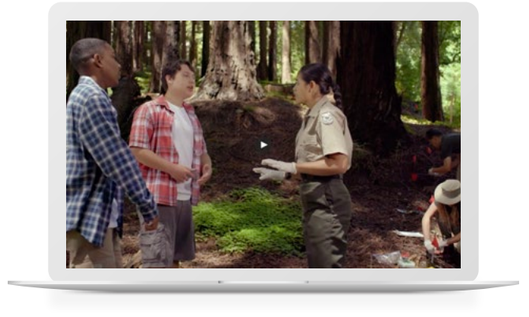
- LS2-4: Changes Affect Populations

Students figure out the unit phenomenon through the use of a variety of resources.

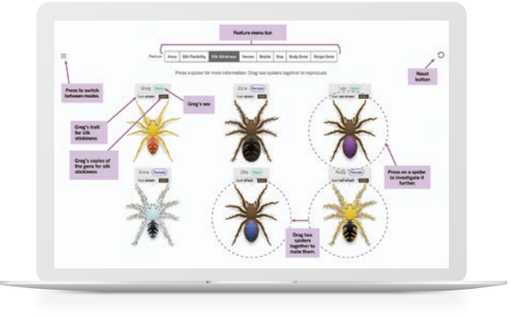
Student Investigation Notebook

Hands-On Kit

Videos



Digital Tools



About technology in this unit:
All Amplify Science lessons were designed with device sharing in mind, and never assume that every student has a separate device.

In grade 8, student-facing technology includes Practice Tools and digital Simulations. When the use of a digital tool is called for in a lesson, teachers have several implementation options:

If limited student devices are available—teachers can have students do activities in pairs or small groups.

If no student devices are available—teachers can project the digital tool to the class and either "drive" the digital tool themself or invite students to "drive" by using their device.

If internet access is unavailable—teachers can "pre-load" the digital tool on their device for use offline.

Chapter 1:
The storyline begins

What students investigate:

What caused this newt population to become more poisonous?

What students figure out:

There is variation in poisonousness among individuals in the newt population. Because of the presence of predators (snakes), the more poisonous traits were adaptive. Over time, the newts with higher poisonous-level traits became more common in the newt population.

How they figure it out:

- Exploring variations in populations and testing when traits will become common in the Sim
- Using a physical model of variations in a population
- Analyzing histogram evidence about the newt population
- Correcting alternate conceptions represented in a short comic strip
- Creating visual models of their own ideas

KEY

- CLASS
- HANDS-ON
- HOMEWORK
- MODELING
- READING
- SIM
- STUDENT-TO-STUDENT DISCUSSION
- TEACHER
- TEACHER-LED DISCUSSION
- WARM-UP
- WRITING

DAY 1 | LESSON 1.1

Pre-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2

The Mystery of the Poisonous Newts

- Warm-Up (10 min)
- Video: The Mystery of the Poisonous Newts (10 min)
- Observing Traits (20 min)
- Reflection (5 min)
- Homework

DAY 3 | LESSON 1.3

Exploring Variation and Distribution in Populations

- Warm-Up (5 min)
- Exploring Variation and Distribution in the Sim (20 min)
- Video: Histograms (5 min)
- Defining Variation, Distribution, and Generation (5 min)
- Building Histograms (10 min)
- Homework

On-the-Fly Assessment
Optional Flextension: *Sunflower Seed Traits*

DAY 4 | LESSON 1.4

Investigating Changes in Trait Distribution

- Warm-Up (7 min)
- Observing Fur Traits and Temperature in the Sim (10 min)
- Modeling Changes to the Distribution of Traits (18 min)
- Testing Predictions in the Sim (10 min)
- Homework

On-the-Fly Assessment

DAY 5 | LESSON 1.5

Adaptive Traits

- Warm-Up (5 min)
- Investigating Adaptive Traits in the Sim (25 min)
- Modeling Trait Distribution in Thornpalms (15 min)
- Homework

On-the-Fly Assessment

DAY 6 | LESSON 1.6

Explaining Changes in Trait Distribution

- Warm-Up (10 min)
- Write and Share: Changes in Populations (20 min)
- Explaining Changes in the Newt Population (15 min)
- Homework: Reading "Meet a Scientist Who Studies Variation in Monkey Populations"
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 2:
The storyline builds

What students investigate:

How did the trait for increased poison level become more common in the newt population?

What they figure out:

Poisonousness became more common in the newt population because newts with higher levels of poison were likely to survive longer than newts without these traits. Surviving longer means the newts had more chances to reproduce. Because more poisonous newts could survive longer and create more poisonous newt offspring, highly poisonous newts became more common in the population.

How they figure it out:

- Investigating reproduction and traits using physical models
- Investigating how adaptive traits affect survival and reproduction in the Sim
- Reading articles about scientists' research on poisonousness as an adaptive trait
- Correcting the explanations in two more short comic strips
- Creating visual models to represent their explanations

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DAY 7 | LESSON 2.1

Reproduction and Traits

- Warm-Up (10 min)
- Reproduction in the Sim (15 min)
- Traits Over Generations (20 min)
- Reading "Glowing Jellies" (5 min)
- Reflection (10 min)

DAY 8 | LESSON 2.2

Survival and Reproduction

- Warm-Up (5 min)
- Observing Genes, Protein Molecules and Traits (15 min)
- Observing Reproduction in the Sim (20 min)
- Responding to Sherman (20 min)
- Introducing Homework (5 min)
- Homework

Optional Flextension: *Claw Traits Over Generations*

DAY 9 | LESSON 2.3

"The Deadly Dare"

- Warm-Up (10 min)
- Reading "The Deadly Dare" (25 min)
- Discussing Annotations (10 min)
- Homework

On-the-Fly Assessment

DAY 10 | LESSON 2.4

Reasoning About the Newt Mystery

- Warm-Up (5 min)
- Rereading "The Deadly Dare" (20 min)
- Reasoning About the Rough-Skinned Newts (18 min)
- Introducing the Homework (2 min)
- Homework

On-the-Fly Assessment

DAY 11 | LESSON 2.5

Critical Juncture Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

Critical Juncture Assessment

DAY 12 | LESSON 2.6

Reviewing Key Ideas About Natural Selection

- Warm-Up (5 min)
- Preparing for the Lesson (2 min)
- Investigating Adaptive Traits (17 min)
- Reviewing the Remaining Activities (2 min)
- Understanding Reproduction and Adaptive Traits (17 min)
- Self-Assessment (Optional)
- Family Homework Experience (Optional)

Self-Assessment

Chapter 3:
The storyline goes deeper

What students investigate:

How did a poison-level trait that wasn't always present in the newt population become the most common trait?

What they figure out:

A trait for extreme poisonousness was introduced into the newt population as the result of a mutation. Because the newts' predator, the garter snake, had some individuals with high poison resistance, the newts with the extreme poison were able to survive longer and reproduce more than other newts, passing on the trait for extreme poison to future generations. As this cycle of surviving and reproducing repeated over many generations, the trait for extreme poison became more common in the population.

How they figure it out:

- Reading an article about mutations and how they can cause new traits to appear in populations
- Investigation mutations in the Sim
- Correct misconceptions in another short comic strip
- Constructing a final visual model and writing a final explanation of what made the newts become so poisonous

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DAY 13 | LESSON 3.1

Introductions to Mutations

- Warm-Up (7 min)
- Reading "Mutations" Article Set (25 min)
- Discussing Annotations (10 min)
- Introducing the Homework (3 min)
- Homework

On-the-Fly Assessment

DAY 14 | LESSON 3.2

Mutations in a Population

- Warm-Up (5 min)
- Rereading "Mutations" Article Set (20 min)
- Investigating Mutant Fur Traits in the Sim (15 min)
- Reflection (5 min)
- Homework

On-the-Fly Assessment

DAY 15 | LESSON 3.3

Wrapping Up the Mystery

- Warm-Up (5 min)
- Write and Share: Discussing Mutations (20 min)
- Preparing a Final Model (20 min)
- Homework
- Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 4:
Application to a new storyline

What students investigate:

Stickleback are small fish with protective spines on their back. They appeared in a lake in Alaska where they had never lived before, and after several generations, the population's traits changed. The stickleback now had less armor and swam faster. Was this because these new traits allowed the fish to better escape predators, or to better catch prey?

What they figure out:

Scientists must communicate how their claims and evidence are supported with reasoning in a convincing scientific argument. In order to convince its reader, a written scientific argument needs to state a claim, describe specific evidence, and explain how the evidence supports the claim. A claim can sometimes be supported more effectively if you consider the combination of several different pieces of evidence.

How they figure it out:

- Reviewing available evidence to make an argument
- Reading an article about points in Earth's history where the environment changed so quickly and dramatically that most populations were not able to adapt
- Engaging in oral argumentation in a student-led discourse routine called a Science Seminar
- Writing final arguments

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DAY 16 | LESSON 4.1

Examining Evidence About Sticklebacks

- Warm-Up (5 min)
- Introducing Sticklebacks (10 min)
- Examining Evidence About Sticklebacks (20 min)
- Discussing Evidence and Claims (20 min)

DAY 17 | LESSON 4.2

Science Seminar

- Warm-Up (5 min)
- Preparing for the Science Seminar (15 min)
- Introducing the Science Seminar (5 min)
- Participating in the Science Seminar (20 min)
- Homework

On-the-Fly Assessment

DAY 18 | LESSON 4.3

Writing a Scientific Argument

- Warm-Up (10 min)
- Using the Reasoning Tool (10 min)
- Preparing to Write (10 min)
- Writing a Scientific Argument (15 min)
- Homework
- Self-Assessment (Optional)

Self-Assessment

DAY 19 | LESSON 4.4

End-of-Unit Assessment

- Multiple-Choice Questions (25 min)
- Written-Response Question #1 (10 min)
- Written-Response Question #2 (10 min)

End-of-Unit Assessment

DAY 20 | LESSON 4.5

Extinctions and Human Impacts

- Warm-Up (5 min)
- Reading "The Limits of Natural Selection" (20 min)
- Investigating Climate Change in the Sim (20 min)
- Reflection (10 min)

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Natural Selection Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding about the mechanisms by which the distribution of traits in a population change in response to changes in factors in the environment.

Progress Build Level 1:
Adaptive traits become more common while traits that are non-adaptive become less common in a population over many generations.

Progress Build Level 2:
Individuals with adaptive traits are more likely to live longer and pass on those traits to their offspring.

Progress Build Level 3:
Mutations can sometimes introduce new traits into a population.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief**.

Below are a few examples of strategies embedded in this unit.

For English learners:

Additional sentence starters (Example from Lesson 1.3)
English learners may benefit from the support of sentence starters in order to participate more fully in the partner discussions. You could write the following prompts on the board or distribute them on paper to students you think would benefit from having them.

- I notice ...
- I observe ...
- I think that this is _____, and my evidence is _____.

For students needing more support:

More teacher modeling with evidence cards (Example from Lesson 4.1)
Students who need more support could benefit from more teacher modeling before and during the Stickleback Evidence card-sort analysis. You can read 1–2 cards aloud with a small group of students and annotate the cards as you think aloud about what you are noticing or what is important. Students can annotate along with you. This type of modeling helps to prepare students to do the same task more independently.

For students ready for a challenge:

Considering and addressing refutational evidence (Example from Lesson 2.4)
Sophisticated argumentation includes not only supporting a claim with the strongest, most convincing evidence available, but also explaining why some evidence eliminates other possible claims. It can be quite challenging to consider both support and refutation at the same time but if some or all of your students are ready for the challenge you may want to ask them to explain, orally or in writing, how to refute the claims that they are not supporting.

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Natural Selection 3-D Coverage

SEPs
Science and Engineering Practices

DCIs
Disciplinary Core Ideas

CCCs
Cross-Cutting Concepts

Unit Level

Students analyze and interpret data from a digital model, engage in hands-on activities, and obtain information from texts to figure out what can cause a shift in the pattern of traits in a population of newts as they become more poisonous over time in response to changes in their environment (patterns). Students also construct explanations and visual models showing how a specific trait can be adaptive in a certain environment, which will cause it to be passed down through sexual reproduction and become more common over time, while other traits that are non-adaptive will become less common (cause and effect).

Chapter Level

Chapter 1: Environmental Change and Trait Distribution

Students learn about adaptive and non-adaptive traits and variation in a population by using a digital model and analyzing patterns in data (patterns). They construct visual models showing why the distribution of these traits can change over time (cause and effect) and analyze evidence to support the argument that the newt population became more poisonous because of a change in the environment.

Chapter 2: Natural Selection and Reproduction

Students obtain information from the digital model, a physical model, and articles about what can cause a trait to become more common in a population over time (cause and effect). Students analyze and interpret data about the newt population in order to write explanations.

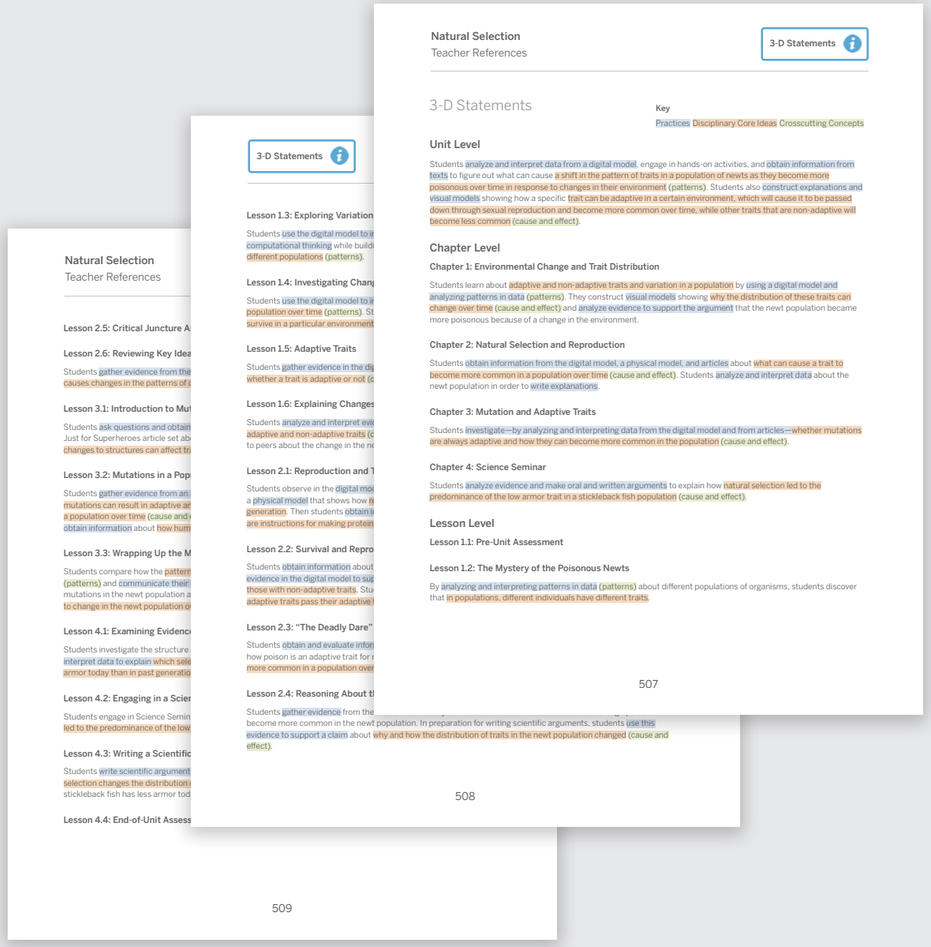
Chapter 3: Mutation and Adaptive Traits

Students investigate—by analyzing and interpreting data from the digital model and from articles—whether mutations are always adaptive and how they can become more common in the population (cause and effect).

Chapter 4: Science Seminar

Students analyze evidence and make oral and written arguments to explain how natural selection led to the predominance of the low armor trait in a stickleback fish population (cause and effect).

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.



Notes

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For more information on Amplify Science, visit **amplify.com/science**.

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