

# Environments and Survival: Snails, Robots, and Biomimicry

How can learning about how grove snails survive help engineers design effective solutions to problems?

Why are snails with yellow shells not surviving well?

What makes organisms in a population more likely to survive or less likely to survive? (1.2–1.4)

- Investigate organisms' survival needs (1.2)
- Make inferences about organisms' likelihood to survive in different environments (1.2)
- Read *Earthworms Underground* (1.3)
- Discuss how traits can help organisms survive (1.3)
- Use Concept Mapping routine to discuss relationships among concepts (1.3)
- Use the Survival Mode to investigate how environment affects an organism's likelihood of survival (1.4)
- Use the Data Tool to graph population change in the Survival Model, then analyze the data (1.4)
- Think-Pair-Share about the Survival Model (1.4)

- When it's easy for organisms to meet their needs in their environment, they are likely to survive. (1.4)
- When it's hard for organisms to meet their needs in their environment, they are not likely to survive. (1.4)

- Use data about grove snails' environment to make inferences about their likelihood of survival (1.5)
- Shared write an explanation to answer the Chapter 1 Question (1.5)

In a specific snail population, the snails with yellow shells are less likely to survive because it is harder for them to avoid song thrush birds in their environment. Organisms are more likely to survive if they can meet their needs in their environment, and avoiding predators is one of those needs. The snails with yellow shells are less able to avoid being eaten by the birds, so they are less likely to survive.

The problem students work to solve

Chapter 1 Question

Investigation Question

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 1 Question

The problem students work to solve

Chapter 2 Question

Investigation Question

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 2 Question

# Environments and Survival: Snails, Robots, and Biomimicry

How can learning about how grove snails survive help engineers design effective solutions to problems?

Why are the snails with banded shells more likely to survive than the snails with yellow shells?

Why are some organisms in a population more likely to survive than others in their environment? (2.1–2.5)

- Observe images of animal populations for variation in traits (2.1)
- Use the Hummingbird Model to investigate how trait variation affects animals' ability to meet their survival needs (2.1)
- Use the Data Tool to analyze Hummingbird Model data (2.1)
- Read *Mystery Mouths* and discuss examples of structure and function (2.2)
- Observe fossils and make inferences about how traits helped the organisms survive (2.3)
- Revisit the Survival Model to investigate how organisms' traits, which can vary among a population, can affect their survival in an env't (2.4)
- Read about adaptive and non-adaptive traits in *Biomimicry Handbook* (2.4)
- Reflect on how traits can inspire biomimicry designs (2.4)
- Use the Modeling Tool to model how traits affect likelihood of survival (2.5)
- Use Concept Mapping routine to discuss relationships among concepts (2.5)

- Organisms in a population can have different traits. (2.1)
- An organism's traits can make it easier or harder for the organism to meet its needs in its environment. (2.3)
- In a population, organisms with adaptive traits are more likely to survive in their environment. (2.5)
- In a population, organisms with non-adaptive traits are less likely to survive in their environment. (2.5)

- Analyze grove snail data to make inferences about how traits affect their likelihood of survival (2.6)
- Write an explanation to answer the Chapter 2 Question (2.6)

Snails with banded shells are more likely to survive because their shells blend in with the environment. The snails live in an environment with brown grass, so it's harder for birds to see snails with banded shells. Another reason snails with banded shells are more likely to survive is that banded shells are stronger than yellow shells. Since birds need to crack the shell in order to eat the snail, snails with the stronger banded shells are more likely to survive.

**The problem students work to solve**

Lessons 2.7–2.8

Investigation Question

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 2 Question

# Environments and Survival: Snails, Robots, and Biomimicry

How can learning about how grove snails survive help engineers design effective solutions to problems?

Note: Lessons 2.7–2.8 provide a mid-unit opportunity for students to focus on biomimicry and engage with the Science and engineering practice of Designing Solutions, in particular using science ideas about how grove snails survive to help them to plan designs and inspire solutions to problems.

How can organisms' traits help engineers make successful designs? (2.7 - 2.8)

- Read about how adaptive traits inspire biomimicry designs in *Biomimicry Handbook* (2.7)
- Discuss guidelines for biomimicry designs (2.7)
- Brainstorm ways to apply ideas about grove snails' adaptive traits to an engineering problem (2.7)

- Organisms' traits can inspire engineers to create designs that solve problems. (2.7)

- Plan biomimicry designs in pairs (2.7)
- Share and revise biomimicry designs (2.8)

Students can identify a problem they can work to solve using inspiration from grove snails' adaptive traits. They can plan a design, evaluate their design according to design guidelines, share it and revise it based on feedback, and write to explain how their design meets the design guidelines.

# Environments and Survival: Snails, Robots, and Biomimicry

## The problem students work to solve

Chapter 3 Question

Investigation Question

Evidence sources and reflection opportunities

Key concepts

Application of key concepts to the problem

Explanation that students can make to answer the Chapter 3 Question

How can learning about how grove snails survive help engineers design effective solutions to problems?

Why were snails with yellow shells more likely to survive in their environment 10 years ago?

How can organisms have traits that are adaptive at one time and non-adaptive at another time? (3.1–3.4)

- Use the Survival Model to investigate how traits affect animal survival when an environment changes (3.1)
- Discuss examples of environment change, and brainstorm how environmental changes can affect how likely an organism is to survive in that environment (3.1)
- Read *Environment News* (3.2)
- Discuss how environmental changes in *Environment News* affected which traits were adaptive for the organisms in the text (3.2)
- Discuss examples of organisms with adaptive traits that become non-adaptive after an environmental change in *Biomimicry Handbook* and *Environment News* (3.3)
- Use the Modeling Tool to develop a model of organism survival during environmental change (3.3)
- Use Concept Mapping routine to discuss relationships among concepts (3.3)

- When an environment changes, traits that were adaptive might now be non-adaptive. (3.4)
- When the environment changes, that doesn't mean that organisms can decide to change their traits to survive. (3.4)

- Analyze grove snail data to make inferences about how traits affect their likelihood of survival (2.6)
- Write an explanation to answer the Chapter 2 Question (2.6)

Snails with yellow shells were more likely to survive in the past because their yellow color was an adaptive trait in their former environment. That area used to be sandy, so the snails with yellow shells blended in against the yellow sand. When the environment changed from sandy to brown grass, the yellow color became a non-adaptive trait; it is easier for birds to see the yellow snails against the brown grass.

# Environments and Survival: Snails, Robots, and Biomimicry

How can learning about how grove snails survive help engineers design effective solutions to problems?

How can engineers use what they learn from organisms' traits to design solutions?

How do engineers learn, plan, make, and test their designs? (4.1–4.5)

- Read about the work of biomimicry engineers in *Cockroach Models* (4.1)
- Reflect on how the engineers in *Cockroach Models* used the design cycle in their work (4.1)
- Watch a video to introduce the design challenge of developing RoboGrazer necks (robot necks inspired by giraffe necks) (4.2)
- Read about the structure of giraffe necks (4.2)
- Plan initial RoboGrazer neck designs using constrained materials (4.2)
- Make and test RoboGrazer neck designs (4.3)
- Provide and receive feedback on initial designs (4.3)
- Revise and re-test designs (4.3)

Students can use the design cycle to design solutions to human problems based on organisms' structures. Through reading and observation, they can gather evidence about how the structure of a specific animal body part functions. Then, using what they've learned about the animal, they can use constrained materials to plan designs, make them and test them against design guidelines, and revise them to better meet the criteria.

The problem students work to solve

Chapter 4 Question

Investigation Question

Evidence sources and reflection opportunities

Practice that students can do in response to the Chapter 4 Question