Environments and Survival Coherence Flowchart

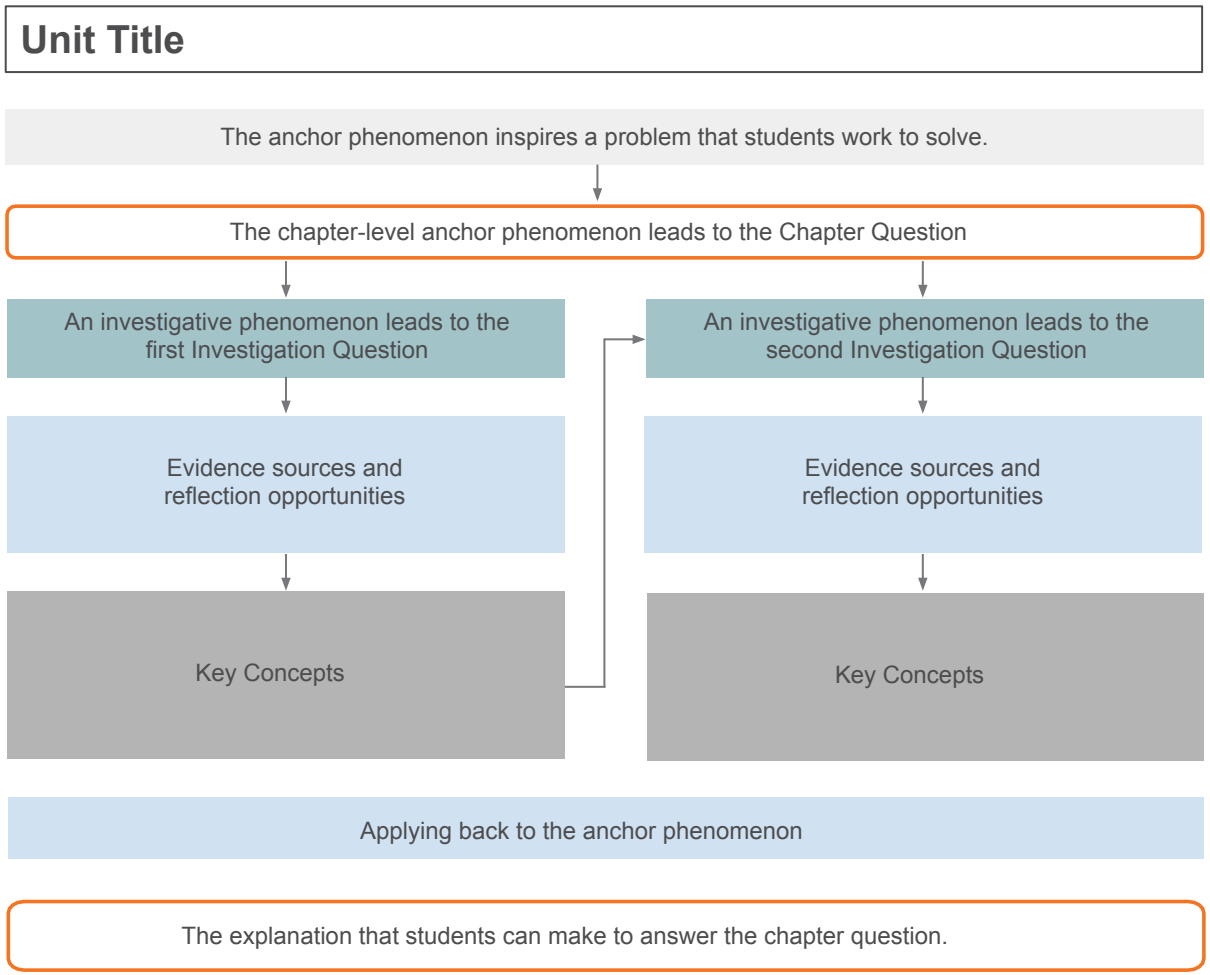
The storyline of the unit

In each Amplify Science unit, students figure out a phenomenon by asking questions, gathering evidence, and coming up with an explanation of how the phenomenon works. The Coherence Flowchart visually represents the storyline of the unit, showing the coherent flow of questions based on phenomena, evidence, and ideas that support students as they build complex explanations of the unit's anchor phenomenon. The Coherence Flowchart on the following pages (one chapter per page) can be used to see the connections between the phenomena and questions that drive students' experiences, the evidence they gather, the ideas they figure out, and the new questions that those ideas generate. The diagram to the right explains the structure of a chapter in the Coherence Flowchart.

In some units a design problem drives the investigations of the unit or of specific lessons. In these cases the design problem will be noted in place of the phenomenon.

Note: The Coherence Flowchart is a tool for teachers and is not meant to be distributed to students.

Typical structure of one chapter in a Coherence Flowchart



Instruction is framed by questions about the unit's anchor phenomenon and the related problem students are solving. Chapter Questions then guide students in figuring out the phenomenon, piece by piece. Within each chapter, investigative phenomena lead to Investigation Questions that focus students on a manageable piece of content that will help them figure out the Chapter Question. Each phenomenon leads to a question which motivates activities, and each activity provides specific evidence related to the Investigation Question. Students synthesize the understanding constructed over multiple activities, and this understanding is formalized through key concepts. Often a key concept leads students to an additional investigative phenomenon and Investigation Question students need to pursue to answer the Chapter Question. At the end of the chapter, students' new understanding is applied back to the unit's anchor phenomenon and leads students to a new Chapter Question or a final explanation.

AmplifyScience

Environments and Survival: Snails, Robots, and Biomimicry

Unit Design Problem

Problem students work to solve

We want to use what we learn about grove snails to design effective solutions to problems.
How can learning about how grove snails survive help engineers design effective solutions to problems?

Chapter-level Anchor Phenomenon
Chapter 1 Question

The number of snails with yellow shells now is smaller than it was 10 years ago.
Why are snails with yellow shells not surviving well?

Investigative Phenomenon
Investigation Question

Organisms in a population with particular traits increase in number over time while others decrease.
What makes organisms in a population more likely to survive or less likely to survive? (1.2—1.4)

Evidence sources and reflection opportunities

- 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)

Key concepts

- 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)

Application of key concepts to the problem

- 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)

Explanation that students can make to answer the Chapter 1 Question

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.

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Unit Design Problem

Problem students work to solve

We want to use what we learn about grove snails to design effective solutions to problems.
How can learning about how grove snails survive help engineers design effective solutions to problems?

Chapter-level Anchor Phenomenon
Chapter 2 Question

The snails with yellow shells are not surviving as well as other snails.
Why are the snails with banded shells more likely to survive than the snails with yellow shells?

Investigative Phenomenon
Investigation Question

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

Evidence sources and reflection opportunities

- 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)

Key concepts

- 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)

Application of key concepts to the problem

- 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)

Explanation that students can make to answer the Chapter 2 Question

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.

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Unit Design Problem

Problem students work to solve

We want to use what we learn about grove snails to design effective solutions to problems.
How can learning about how grove snails survive help engineers design effective solutions to problems?

Lessons 2.7–2.8

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.

Design Problem
Investigation Question

We want to use what we know about organisms' traits to make successful designs.
How can organisms' traits help engineers make successful designs? (2.7 - 2.8)

Evidence sources and reflection opportunities

- 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)

Key concepts

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

Application of key concepts to the problem

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

Explanation that students can make to answer the Chapter 2 Question

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

Unit Design Problem

Problem students work to solve

We want to use what we learn about grove snails to design effective solutions to problems.
How can learning about how grove snails survive help engineers design effective solutions to problems?

Chapter-level Anchor Phenomenon
Chapter 3 Question

The number of snails with yellow shells was increasing before 10 years ago, when it started decreasing.
Why were snails with yellow shells more likely to survive in their environment 10 years ago?

Investigative Phenomenon
Investigation Question

Organisms in a population with particular traits can increase over some periods of time and decrease over others.
How can organisms have traits that are adaptive at one time and non-adaptive at another time? (3.1–3.4)

Evidence sources and reflection opportunities

- 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)

Key concepts

- 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)

Application of key concepts to the problem

- Analyze grove snail data to make inferences about how environment change affected grove snails that had yellow shells (3.4)
- Write an explanation to answer the Chapter 3 Question (3.4)

Explanation that students can make to answer the Chapter 3 Question

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.

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Unit Design Problem

Another problem students work to solve

We want to use what we learn about giraffe traits to design a robot that can pull up and grind up invasive plants.
How can we use what we learn about giraffes traits to design a robot that can pull up invasive plants and grind them up?

Chapter-level Design Problem
Chapter 4 Question

We want to get ideas from giraffe's traits that will inspire us to make a robot that will solve a problem.
How can engineers use what they learn from organisms' traits to design solutions?

Investigative Phenomenon
Investigation Question

Engineers learn and use what they learn to plan, make, and test their designs.
How do engineers learn, plan, make, and test their designs? (4.1–4.5)

Evidence sources and reflection opportunities

- 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)

Practice that students can do in response to Chapter 4 Question

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.