Lesson Overview

Students’ Initial Explanations

Students begin the Environments and Survival unit by being introduced to their role as biomimicry engineers. In this role, they will be learning about the traits of grove snails in order to inspire designs. Students explore the reference book, Biomimicry Handbook, which they will use throughout the unit. They examine bar graphs about two types of grove snails in the population—snails with yellow shells and snails with banded shells—and learn that the snails with yellow shells are not surviving as well in their environment. Students are also introduced to the Unit Question: Why are different organisms more likely or less likely to survive in an environment? At the end of the lesson, students write their initial explanations about the grove snail population. Students’ written explanations serve as a pre-unit assessment for formative purposes, designed to reveal students’ initial understanding of unit content—including unit-specific science concepts and the crosscutting concept of Systems and System Models—prior to instruction. As such, students’ explanations offer a baseline from which to measure growth of understanding over the course of the unit and can also provide the teacher with insight into students’ thinking. This three-dimensional assessment will allow the teacher to draw connections to students’ experiences and to watch for preconceptions that might get in the way of students’ understanding. The purpose of this lesson is to introduce the unit and allow students to demonstrate their current understanding of organisms’ needs for survival in their environment.

Anchor Phenomenon: Over the past 10 years, the snails with yellow shells have not survived as well as the snails with banded shells.

Students learn:

- Reflecting on what you understand and don’t understand allows you to prepare for learning new things.
- Engineers use science knowledge to design something to solve a problem.
- Biomimicry engineers get ideas for designs from organisms’ traits and how they work.
- Creativity and imagination are important to science.
Becoming Biomimicry Engineers

Students are introduced to their role as biomimicry engineers and explore the unit’s reference book, *Biomimicry Handbook*.

Instructional Guide

1. Introduce the unit.

   We’re about to begin a new science unit during which we’ll be learning about living things and how they stay alive. For the next few weeks, you will take on the role of engineers. You will work on many of the same problems that engineers do. Learning about living things and how they stay alive will help you solve these problems.

2. Project What is an engineer?

   **What is an engineer?**
   **What does an engineer do?**

   All the people in these photographs are engineers. What do you notice?
Based on these photographs, what do you think engineers do?

Engineers work on many different kinds of problems. An engineer is a person who uses science knowledge to design something in order to solve a problem.

3. Post the engineer vocabulary card. Hold up the engineer vocabulary card and then post it under the Vocabulary header on the classroom wall. Let students know that as they learn new words, you will post them here for reference.


   To: Biomimicry Engineers
   From: Dr. Jasmine Neel, Lead Engineer
   Subject: Grove Snail Biomimicry Project, Part 1

   Hello biomimicry engineers,

   We are excited that you are working with our engineering firm! We often get ideas for designs from studying organisms. We have been studying grove snails, and we need your help to learn more about them and to get ideas for designs. Here is a diagram that shows some of the parts of the body of a grove snail.

   Thank you!

   ![Grove Snail Diagram]

   In this unit, you will take on the role of engineers working for an engineering firm, or company. Let’s read our first message from Dr. Jasmine Neel, the lead engineer at the engineering firm.

   Read aloud the message.

5. Have students observe the image of the snail. Invite students to share what they notice about the grove snail’s body.

6. Hold up a copy of the unit’s reference book, Biomimicry Handbook. Let students know that this is a reference book that they will use throughout the unit in their work as engineers.

7. Point out the word biomimicry in the title. Let students know that it’s okay that this word is unfamiliar. They will learn more about biomimicry engineering today and throughout the unit.

8. Designate partners and distribute books. Distribute one copy of the book to each pair of students. Give students a couple of minutes to browse through the book and notice how it is organized.
9. Have students turn to the “What Is Biomimicry?” section on pages 4–5. Explain that you will read these introductory pages together. Partners should follow along as you read aloud. Discuss the text as needed.

10. Discuss design and biomimicry.

On page 4, we read that engineers design solutions to problems. Based on what we read, what do you think the word design means?

[To make something new that solves a problem.]

The engineers in the book are biomimicry engineers. What did you learn about what biomimicry is?

[Getting engineering ideas from observing organisms’ traits.]

11. Introduce the Partner Reading Guidelines. Let students know that they will now have a chance to explore the book with a partner. Point out the guidelines that you posted on the wall and review them with the class. If Partner Reading is an unfamiliar activity for your students, let them know that they can refer to the guidelines as they read.

12. Have students explore the rest of the book. Allow a few minutes for partners to explore the rest of the book at their own pace. You may want to suggest that students examine the photos on pages 14–15 and choose one of these examples to read about.

13. Students share. Invite students to share any interesting examples they read about, things they noticed, or questions they have that were prompted by the book.

Teacher Support

Rationale

Pedagogical Goals: Why Set Up a Fictional Context for the Unit?
An important aspect of the Amplify Science Elementary curriculum is to enable students to inhabit the role of a scientist or engineer—having students engage in doing science and engineering for an actual purpose. In each unit, we have created a fictional context that creates that purpose. The goal of the fictional context is not to fool students; it is to create an authentic purpose for students to learn and use a set of science concepts and practices. In every case, we make sure that though the context is fictional, the problem to be solved is the kind of problem that scientists and engineers actually need to solve. We recommend, especially for older students, that you make clear that the context for the unit is fictional, but the kind of problem that students will be solving is authentic.

Rationale

Pedagogical Goals: Inhabiting the Role of an Engineer
Inviting students to take on the role of engineers during this unit can help generate motivation and can also help students engage more fully in the practices of real engineers. Playing the role of biomimicry engineers making designs that are inspired by organisms’ traits gives students a real-world reason to learn the science concepts and practices of the unit. By thinking of themselves as engineers, students will have reason to consider and reflect on what real engineers do as part of their work.
Background

Science Note: What Is Biomimicry?
Engineers who get engineering ideas from organisms’ traits are known as biomimicry engineers. Biomimicry is an approach to engineering that seeks sustainable solutions to human challenges by emulating natural patterns, structures, and strategies. Engineers often use inspiration from nature when designing solutions to problems. Animals have special structures that help them navigate, deal with threats in their environments, and gain resources from their environments. These structures have evolved over millions of years and are often extremely efficient solutions to problems in the natural world.

Background

About the Book: Biomimicry Handbook
Biomimicry Handbook is the reference book for this unit and provides students with many examples of real scientists and engineers working on all kinds of biomimicry projects where they get inspiration for designs from the traits of organisms in the natural world. The introduction to the handbook provides a clear, illustrated example of adaptive and non-adaptive traits, an explanation of what biomimicry is, and discusses how designed objects are different from organisms. Students learn about self-healing plastic based on human skin, chainsaws based on beetle jaws, computer screens based on butterfly wings, and more fascinating examples of biomimicry. This book introduces the field of biomimicry, which students will explore throughout the unit in their role as biomimicry engineers. The book also serves to model how scientists and engineers use their knowledge of traits to design new things that solve problems.

Rationale

Literacy Note: Teaching Science Vocabulary in Context
To know a word is to know more than just its definition. Sophisticated word knowledge involves an understanding of how words relate to other words and how words are used in context. In this unit, students are introduced to a small number of conceptually important words. The vocabulary words for this unit were strategically selected to support students’ learning of science concepts and their understanding of the practices of science. Throughout the unit, words are usually introduced after students have had multiple opportunities to hear and see the words in context. Students will be exposed to unit vocabulary words many times, in many ways, to help them develop flexible word knowledge. In this lesson, students encounter several new words in the discussion and in print, which you will discuss in detail after students have had a chance to read the words in context.

Rationale

Literacy Note: Partner Reading
Throughout this unit, we suggest that students read the books with a partner. This allows students time to apply and practice the reading strategies they’re learning, keeps them focused on the task at hand, and provides opportunities for them to assist each other with reading. Of course, you can use any effective reading procedures you’ve already established with your class. Before reading this first book in the unit, you may need to provide instruction on how to read with a partner by using the Partner Reading Guidelines (provided in Digital Resources) or your own guidelines. Establishing procedures takes time at first, but will pay off in terms of student learning and management of the lessons. Over time, students gain practice working together and will need fewer reminders about reading together effectively.
Assessment

Pedagogical Goals: Understanding the Nature of Science
One goal set forth by the Next Generation Science Standards (NGSS) is for students to understand the nature of science as a discipline and how scientific knowledge develops over time. The NGSS calls out eight understandings about the nature of science that are woven throughout the Amplify Science curriculum. This unit gives students an opportunity to experience the understanding that Science Is a Human Endeavor. Specifically, the book Biomimicry Handbook, which is about scientists who study organisms to get ideas for solutions to design problems, illustrates the idea that creativity and imagination are important to science.

Instructional Suggestion

Nature of Science: Connecting to Engineering, Technology, and Applications of Science
Across each grade year and building cumulatively within grade spans, students experience the many ways that science, engineering, and technology share common attributes and also influence each other and society. This design unit provides an engaging context to highlight how knowledge of relevant scientific concepts and research findings is key to engineering, and tools and instruments developed through the engineering design process (e.g., rulers, thermometers, graduated cylinders, telescopes, microscopes) are used by scientists to gather data and help answer questions about the natural world. In this way, science and engineering drive each other forward—scientific discoveries about the natural world can often lead to new and improved technologies, and these technologies enable more scientific discoveries.

Point out to students that their work as engineers provides an example of how science and engineering move forward because scientists and engineers are guided by habits of mind, such as openness to new ideas, a focus on qualitative and quantitative data, and a critical eye in evaluating evidence. Science findings are frequently revised and/or reinterpreted based on new evidence leading us to very deep understanding of the world. Likewise, design ideas and solutions are continually refined and revised based on testing and evidence.

In the context of their work in this unit, help students make connections to the idea that engineers' work is determined by people's needs and wants, and people's lives and interactions are influenced by the technologies that engineers develop. As such, people's changing wants and needs drive the development of new and improved technologies. Through the engineering design process, engineers improve and develop new technologies to increase their benefits, to decrease known risks, and to meet societal demands. Point out how the designs and engineers that students read about are driven by and influence society, and how their own work as engineers relates to people's lives.
Becoming Biomimicry Engineers

Students are introduced to their role as biomimicry engineers and explore the unit’s reference book, *Biomimicry Handbook*.

**Instructional Guide**

1. Introduce the unit.

   Estamos comenzando una nueva unidad de ciencia durante la cual aprenderemos sobre seres vivientes y su supervivencia. Durante las próximas semanas, ustedes adoptarán el rol de ingenieros e ingenieras. Trabajarán en muchos de los mismos problemas en los que trabajan los ingenieros. Aprender sobre los seres vivientes y su supervivencia les ayudará a resolver estos problemas.

2. Project What is an engineer?

   **¿Qué es un/a ingeniero/a?**
   **¿Qué hace un/a ingeniero/a?**

   Todas las personas en estas fotografías son ingenieros. ¿Hay algo aquí que les llame la atención?
3. **Post the engineer vocabulary card.** Hold up the engineer vocabulary card and then post it under the Vocabulary header on the classroom wall. Let students know that as they learn new words, you will post them here for reference.

4. **Project Message Part 1.**

   Para: Ingenieros/as en biomimetismo  
   De: Dra. Jasmine Neel, Ingeniera Jefa  
   Asunto: Proyecto de biomimetismo del caracol regina, parte 1

   Hola, ingenieros/as en biomimetismo:  
   ¡Nos da mucho gusto que estén trabajando con nuestra firma de ingeniería! A menudo, al estudiar organismos obtenemos ideas para diseños. Hemos estado estudiando a los caracoles regina, y necesitamos su ayuda para aprender más acerca de ellos y obtener ideas para diseños. Este es un diagrama que muestra algunas de las partes del cuerpo de un caracol regina.
   ¡Gracias!

5. **Have students observe the image of the snail.** Invite students to share what they notice about the grove snail’s body.

6. **Hold up a copy of the unit’s reference book, Biomimicry Handbook.** Let students know that this is a reference book that they will use throughout the unit in their work as engineers.

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