Lesson 4.2
Planning Designs
Lesson Overview

In this lesson, students start a new design challenge. To begin, students receive a message from Dr. Neel about their next assignment as biomimicry engineers—they will assist the engineering firm in designing a new robot that will solve a problem. Students are introduced to the criteria they will work to meet for the robots they will help design. Students learn that the designs they will create should incorporate structures similar to those of a giraffe neck and mouth. Students read about the structures of a giraffe neck for inspiration for their biomimicry designs. Next, students are briefly introduced to the procedure for neck testing, which they will conduct in the next lesson. They are then introduced to the materials they will use to make the test versions of their robot necks, and they begin planning their designs. The purpose of this lesson is for students to learn about the giraffe structures that will inspire their designs and to begin planning their first test versions of their robot necks.

**Design Problem:** Design a robot that can remove and grind up invasive plants.

**Students learn:**

- Giraffe necks have structures that help them reach food in many places.
- Invasive plants can change the environment, which can make it hard for other plants or animals to survive there.
- Engineers design solutions to problems that can arise when the environment changes.
Partners read the introduction and Part 1 of an article in order to learn about the structures in a giraffe neck.

### Instructional Guide

1. **Introduce the activity.** Let students know that they will learn more about giraffe necks by reading a short article. Then, they will review some materials and design a plan for their test versions of the robot neck. Remind students that in a later lesson, they will begin working on their designs for the robot mouth and teeth.

2. **Project notebook pages 62–63, *Giraffe Structures for Getting Food***. Explain that students will read and learn about the structures of giraffes that help them get food. Explain that they will only read the introduction and Part 1: Giraffe Necks at this time.

3. **Prompt students to think in terms of structure and function as they read.**

   - Focus students on the diagram on page 62. Point out the diagram of the giraffe neck and encourage students to look at this diagram as they read Part 1. It explains important information about giraffe necks.

4. **Have partners read.** Circulate as partners read, offering support as necessary. Remind students they should only read to the end of Part 1: Giraffe Necks, on page 63.

5. **Partners discuss how the article relates to the design challenge.** Prompt partner discussion with the following questions.

   - How does the structure of a giraffe’s neck help it get food? Describe the functions of the different parts of the neck you read about.
     
     [It’s long, so it can reach a lot of plants. It’s thicker at the bottom, which makes it strong. This is important because the head and neck are heavy. It’s also strong because of the muscles that support the neck. It has a hump of muscle that helps it balance its neck and hold its head up.]
After partners discuss, invite students to share their ideas with the class. Remind students that they should get inspiration from giraffe necks for their robot designs.

Teacher Support

Background

Science Note: About Structures and Giraffe Necks
When considering the giraffe neck, students may analyze the structure and function of the entire neck and/or the structure and function of the component parts of the neck. Both are useful ways of thinking that can help students with their design task. The neck as a whole has a long, flexible yet strong structure that allows the giraffe to reach both low plants and high plants. The bones of the neck are long and thicker near the bottom than the top in order to support a lot of weight. The structure of the muscles, which wrap the bones, help balance the neck and hold it up. The ligaments have structure that connects the bones and keeps the neck stable.
Partners read the introduction and Part 1 of an article in order to learn about the structures in a giraffe neck.

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3. **Prompt students to think in terms of structure and function as they read.**

   Cuando lean la introducción y la Parte 1 del artículo, piensen en cómo lo que aprendan sobre la estructura del cuello les ayudará a diseñar sus cuellos de robot.

   • **Focus students on the diagram on page 62.** Point out the diagram of the giraffe neck and encourage students to look at this diagram as they read Part 1. It explains important information about giraffe necks.

4. **Have partners read.** Circulate as partners read, offering support as necessary. Remind students they should only read to the end of Part 1: Giraffe Necks, on page 63.

5. **Partners discuss how the article relates to the design challenge.** Prompt partner discussion with the following questions.

   ¿Cómo ayuda la estructura del cuello de la jirafa a que obtenga alimento? Describe las funciones de las distintas partes del cuello sobre las que leíste.

   [Es largo, para poder alcanzar muchas plantas. Es más grueso en la parte inferior, lo que lo hace fuerte. Esto es importante, porque la cabeza y el cuello son pesados. También es fuerte debido a los músculos que apoyan el cuello. Tiene un montículo de músculo que le ayuda a equilibrar el cuello y a afirmar la cabeza levantada].
After partners discuss, invite students to share their ideas with the class. Remind students that they should get inspiration from giraffe necks for their robot designs.

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