

Structure and Function - Tools

Lesson Overview

Our world is filled with technology, from the simple to the complex. By definition, technology is the application of scientific knowledge to solve a problem or a need. Tools are a perfect example of technology. In this lesson, students will analyze the structure and function of a variety of tools. They will investigate how tools convert energy from one form to another to perform an intended task.

Objectives

- Analyze a variety of tools, ranging from simple to complex
- Describe the correlation between the structure and function of tools
- Identify where force would be applied and where the intended task would be performed

Standards (NGSS and Common Core)

For state specific standards visit edu.zspace.com

Next Generation Science Standards

- Physical Science - Energy
 - 4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- Engineering Design
 - 3-5-ETS1 Define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost.
 - 3-5-ETS2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
 - 3-5-ETS3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Common Core Connections

- Language Arts
 - RI.5.7 Draw on information from multiple print or digital resources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
 - RI.5.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

Grade level: 3rd - 5th

Lesson Time: 150 Minutes

Key Terms:

Energy
Engineering Design Process
Force
Technology
Tools

Resources:

Answer Key
Structure and Function -
Tools worksheet

Materials needed:

Supplies for engineering
design project (variety of
materials to choose from)

- W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Differentiation (Δ)

- Group students heterogeneously to allow students with a strong command of English to assist others
- Allow students to provide answers that are handwritten, typed, or verbal
- Give students a variety of presentation styles to choose from (using charts/graphs, PowerPoint, making 3D presentations, creating videos/movies, making posters)

Introduction

The teacher will start the discussion by asking students to name several examples of technology. Students will share their ideas. The teacher will then ask the students to think about whether these examples of technology have similar structures and functions. Because some of these items will have different structures and functions, the teacher will ask the students what all of these items have in common to classify them as technology. The class will work together to come up with an agreed-upon definition of technology. The teacher will explain that they will be investigating the structure and function of one kind of technology: tools.

Activity

Structure and Function - Tools

This section will be completed in Studio.

Scene 1

Tools are a great example of technology. Tools are machines that have fixed or moving parts that use energy to perform a particular action. Tools can be big or small, simple or complex. Every tool has a specific function and was invented to solve a specific problem or need. Let's take a closer look at a few examples...

Scene 2

Let's start with a couple of simple tools that have a similar function. Here is an Allen wrench and a screwdriver.

- Look for similarities and differences in their structures. Use the Straight Ruler to measure their lengths.
- Add a note to the part of the tool where force would be applied by hand.
- Add a note to the part of the tool that performs the intended task.
- Take a screenshot.

Scene 3

Here is another pair of tools with a similar function, but a little more complex in design: a clamp and locking pliers.

- Look for similarities and differences in their structures.
- Add a note to the part of the tool where force would be applied by hand.
- Add a note to the part of the tool that performs the intended task.
- Take a screenshot.

Scene 4

Here is another tool that is a little more complex than the ones before. This is a scissor car jack.

- Add a note to the part of the tool where force would be applied by hand.
- Add a note to the part of the tool that performs the intended task.
- Take a screenshot.

Scene 5

Here is a very complex tool: the miter saw.

- Add a note to the part of the tool where force would be applied by hand.
- Add a note to the part of the tool that performs the intended task.
- Take a screenshot.

After viewing the Studio tour, students will each choose one item of technology from the classroom and complete the Structure and Function - Tools worksheet.

Δ Students could bring in an item of technology from home instead. For example, from the kitchen, students could bring in a can opener, a whisk, or a cheese grater. From the bathroom, students could bring in a hair brush, a toothbrush, tweezers, or a nail file.

Create a New Tool Engineering Project

Students will work in small groups to identify a real-world problem or need requiring a new tool. Students will work through the Engineering Design Process together to design and create a new tool that solves this issue.

ASK: Students will identify a real-world problem/need and its criteria and constraints.

IMAGINE: Students will research previous solutions and brainstorm new ideas.

PLAN: Students will design a new tool and draw a detailed sketch with labels and dimensions.

CREATE: Students will build a prototype of their new tool using materials of their choice.

IMPROVE: Students will test their prototype and make improvements if necessary.

Finally, students will make group presentations to the class about their new tool. They will describe the real-world problem/need that the tool addresses and explain how their new tool helps to solve this issue.

Closing

After listening to the group presentations, students will share what they liked about each group's new tools.

Questions for Discussion

1. How does the structure of tools relate to their function? Give an example.

Answers will vary. Sample Answer: The size and shape of tools directly relates to their specific function. For example, a long screwdriver is useful to tighten or loosen screws in places that have narrow openings. An Allen wrench has a similar function, but it has a bent shape to allow for shorter, cramped spaces.

2. How do tools convert energy from one form to another? Give an example.

Answers will vary. Sample Answer: Tools have one part where force is applied and one part that performs the intended task. For example, in the scissor car jack, a person must apply force by hand to the jackscrew in a circular motion while the top bracket does the work to raise the car off the ground.

3. Based on your research, is technology only large, complex machines like computers and airplanes?

Answers will vary. Sample Answer: No, technology can also be very small and simple in design.

4. What is the definition of technology?

Answers will vary. Sample Answer: Technology is the application of scientific knowledge to solve a problem or a need.

Δ Investigate Further

Follow-up Activity: Students could complete other Studio lessons that emphasize the relationship between structure and function of other forms of technology, such as Structure and Function - Transportation.

Follow-up Activity: Students could complete other Studio lessons that emphasize the relationship between structure and function of animals, such as Animal Defenses or Insect Characteristics.

Extension Activity: Students could go on a field trip to an offsite location, such as a car repair shop, dentist office, or veterinarian clinic, and learn about the structure and function of the specific tools that are used daily.

Answer Key

Activity Questions Provided in Studio

1. Allen wrench and screwdriver: Look for similarities and differences in their structures. Measure the lengths of each tool. For each tool, note where a force would be applied by hand and which part of the tool performs the intended task. Take a screenshot.

Answers will vary. Screenshot: The students should display the lengths of both tools using the Straight Ruler. For the Allen wrench, students should add a note showing that force is applied to one side of the Allen wrench and another note showing that the opposite side performs the task of screwing/rotating an object. For the screwdriver, students should add a note that force is applied to the handle and another note showing that the tip performs the task.

2. Clamp and locking pliers: For each tool, note where a force would be applied by hand and which part of the tool performs the intended task. Take a screenshot.

Answers will vary. Screenshot: For the clamp, students should add a note showing that force is applied to the T-pin and another note showing that the jaw performs the task of holding an object tightly. For the locking pliers, students should add a note that force is applied to the handle and another note showing that the jaws perform the task.

3. Scissor car jack: For each tool, note where a force would be applied by hand and which part of the tool performs the intended task. Take a screenshot.

Answers will vary. Screenshot: Students should add a note that force is applied to the blue handle and another note showing that the arms and top bracket performs the task of lifting heavy objects.

4. Miter saw: For each tool, note where a force would be applied by hand and which part of the tool performs the intended task. Take a screenshot.

Answers will vary. Screenshot: Students should add a note that force is applied to the handle and another note showing that the blade performs the task of cutting an object.

Name _____ Date _____

Structure and Function - Tools

Complete this worksheet after you view the *Structure and Function-Tools* tour in Studio.

Name of Tool:
Describe its structure (shape and size)
What problem or need does it solve?
To which part of the tool is force applied? How?
Which part of the tool performs the intended task? How?
How could you change the structure of the tool to improve its function (increased efficiency or quality of product)?
Draw a detailed sketch of the tool and label all parts. Draw an arrow to which part of the tool force is applied and to which part performs the intended task.