

Structure and Function: Exploring Design Teacher Resources

Related Documents

See “Files” section in the LMS.

Preface

Students will discover the design process and how engineers influence their lives. Then, in small groups, the students will design, build, and test a structure out of available materials to withstand a force. The students will also use the design process to sketch, build, test, and reflect on a new paintbrush design.

Transfer

Students will be able to independently use their learning to ...

1. Evaluate a problem in a novel situation.
2. Apply a step by step design process to solve a problem.
3. Identify the structure and function of real world objects.

Understandings

Students will understand that ...

1. The design process is a step by step method used to guide people in developing solutions to problems.
2. Engineers and designers create new products or improve existing products and technology to meet human needs and wants.
3. Engineers ask questions, make observations, and gather information about a situation people want to change.
4. The shape of an object can help it perform as needed to solve a given problem.
5. Products may be analyzed by comparing objects designed to solve the same problem.
6. Engineers keep and organize all of their work in an engineering notebook.
7. Engineers share their work and get feedback from others during the design process.

Knowledge

It is expected that students will:

- List products created by engineers and designers that were created to meet a human need or want.
- State questions engineers may ask when gathering information about a situation people want to change.
- Identify the differences between a new object and an improved object.

Skills

It is expected that students will:

- Follow a step by step method to solve a problem.
- Examine how other people have tried to solve a design problem.
- Gather information about a situation people want to change.
- Describe how the shape of a structure helps it function as needed to meet a human need or want.
- Brainstorm possible solutions and select one solution to develop, taking into account strengths and weaknesses of each design.
- Build and test a physical model of an improved object or tool designed to meet a human need or want.
- Collect and analyze data from two models and compare the strengths and weaknesses of how each performed.
- Organize and maintain an engineering notebook to document work.
- Share findings and conclusions with others.

Essential Questions

Students will keep considering:

1. How do you know something has been designed by a person or team of people?
2. Why should a step by step process be followed to solve a problem?
3. Why is the shape of an object important?
4. Why is the structure of an object important?
5. Why is the function of an object important?

Day-by-Day Plans

Time: 10 instructional hours

NOTE: *In preparation for teaching this module, it is strongly recommended that the teacher read the Structure and Function: Exploring Design Teacher Resources document, including the Understandings, Knowledge, and Skills addressed in the module. Detailed instructions are provided in the Teacher Notes for each activity, project, or problem.*

Part 1: Structure and Function

40 minutes

- Detailed instructions may be found in the document entitled Activity 1.1 What are Structure and Function? Teacher Notes.
- This activity may be taught over a series of class periods as determined by the teacher and is estimated to take 40 minutes to complete.
- As described in the Activity 1.1 Teacher Notes, students will participate in a large group discussion. The teacher will guide the students in identifying products around them that were designed by an engineer and prompt students to ask questions about a product that an engineer might have asked when he or she designed the item. Students will also determine the structure and function of a particular item.
- Student work may be recorded in the module-specific Launch Log as students work through the activities, project, and problem. If the Launch Logs were not purchased, the teacher may access the document entitled Structure and Function Launch Log in the “files” section of the LMS and print as needed.

- Students will complete the corresponding section in their Launch Logs under the heading Activity 1.1 What are Structure and Function?

Part 2: Build a Beanstalk

120 minutes

- Detailed instructions may be found in the document entitled Activity 1.2 Build a Beanstalk Teacher Notes.
- This activity may be taught over a series of class periods as determined by the teacher and is estimated to take 120 minutes to complete.
- Students will complete the corresponding section in their Launch Logs under the heading Activity 1.2 Build a Beanstalk. As an alternative to drawing the beanstalks on the provided handout, the students may use the tablet application Autodesk® SketchBook® Express.
- In this activity students will listen to the familiar story of *Jack and the Beanstalk* and retell key parts of the story as a group. The book includes an audio CD and sequencing cards which may be used to tell the story. The story is told both as a story and as a song.
- As part of an introduction to the design process, the students will model a beanstalk using pipe cleaners with a goal of creating the tallest model possible.
- The teacher will guide the students in a discussion to identify the model they created as an improvement (innovation) rather than a new object (invention).
- Students will consider the structure and function of the beanstalk in the story.

Part 3: Straw, Wood, and Bricks

90 minutes

- Detailed instructions may be found in the document entitled Activity 1.3 Straw, Wood, and Bricks Teacher Notes.
- This activity may be taught over a series of class periods as determined by the teacher and is estimated to take 90 minutes to complete.
- In this activity the teacher will read the fable *The Three Little Pigs* and then prompt and support the students to retell the story and include key details. The book includes an audio CD and sequencing cards which may be used to tell the story. The story is told both as a story and as a song.
- The students will answer questions about the characters, major events in the story, and identify the materials used by each of the pigs in constructing their houses. The students will relate the steps in the story to the design process.
- Students will consider the structure and function of the houses in the story.

Part 4: Design a House

150 minutes

- Detailed instructions may be found in the document entitled Project 1.4 Design a House Teacher Notes.
- This project may be taught over a series of class periods as determined by the teacher and is estimated to take 90 minutes to complete.
- In this project students will model a house for one of the three little pigs. The students will be assigned a specific material to use that represents either straw, wood, or bricks.

- The teacher will guide and support the students as they use the design process to create and test their models. The students will compare data from two models and identify strengths and weaknesses of how each performed. Students will also relate the structure to the intended function.
- At the conclusion of the project, the teacher will lead the class or small groups in a discussion about the “wolves” in their region, including earthquakes, hurricanes, and blizzards.

Part 5: Paintbrush Design

200 minutes

- Detailed instructions may be found in the document entitled Problem 1.5 Paintbrush Design Challenge Teacher Notes.
- This problem may be taught over a series of class periods as determined by the teacher and is estimated to take 200 minutes to complete.
- Students will complete the corresponding pages in their Launch Logs handouts entitled Paintbrush Design.
- In this design challenge, students will follow the design process to sketch, build, test, and reflect on a new paintbrush design.
- With teacher support, students will compare physical models of paintbrush tool designs and describe the differences in material choice, shape, and size. The students will use technology to document their final design solutions and suggest improvements.
- At the conclusion of the module, the students complete the Structure and Function Check for Understanding.

National and State Standards Alignment

Common Core English Language Arts

- RL.K.1 With prompting and support, ask and answer questions about key details in a text.
- RL.K.2 With prompting and support, retell familiar stories, including key details.
- RL.K.3 With prompting and support, identify characters, settings, and major events in a story.
- SL.K.1 Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.
- SL.K.1a Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion).
- SL.K.1b Continue a conversation through multiple exchanges.

Common Core Mathematics

- K.MD.A.1 Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
- K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.
- MP.2 Reason abstractly and quantitatively.
- MP.4 Model with mathematics.

- MP.5 Use appropriate tools strategically.

Next Generation Science Standards

- K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.