

# BUILDING BRIDGES: DESIGNING A STRUCTURE THAT SUPPORTS WEIGHT

## LESSON OVERVIEW

Grade Levels: K-5

In the book *Iggy Peck, Architect* by Andrea Beaty, Iggy must build a bridge to save his teacher and classmates from an abandoned island. In this lesson participants use the engineering design process to build their own bridges. The students will watch a video about creating a sturdy bridge and then use the Engineering Design Process to create their own functional bridges.



## STANDARDS

NGSS 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.
NGSS 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.
NGSS 3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
NGSS 3-5-ETS1-2	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.
CCSS-ELA SL.1.2	Ask and answer questions about key details in a text read aloud or information presented orally or through other media
CCSS-ELA RI.1.1	Ask and answer questions about key details in a text.
CCSS-ELA RI.1.2	Identify the main topic and retell key details of a text.
CCSS-ELA RI.1.6	Distinguish between information provided by pictures or other illustrations and information provided by the words in a text.
CCSS-ELA RI.2.1	Ask and answer such questions as who, what, where, when, why, and how to demonstrate understanding of key details in a text.
CCSS-ELA RI.3.1	Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
CCSS-ELA RI.5.1	Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
CCSS-ELA RI.5.7	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
CCSS-ELA RI.5.9	Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
CCSS-ELA W.2.8	Recall information from experiences or gather information from provided sources to answer a question.

CCSS-ELA W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
CCSS-Math K.MD.A.1	Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
CCSS-Math 2.MD.A.1	Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

## OBJECTIVES

- Students will discuss how Iggy Peck used the engineering design process to plan, design, and test his inventions.
- Students will identify techniques in creating a sturdy bridge, both from the text and video.
- Students will design a bridge using the engineering design process.
- Students will discuss their designs with the class and explain how they crafted their bridge to hold Lila Greer and what techniques were used.

## MATERIALS

- *Engineering Design Process* handout
- Newspaper
- Masking tape
- Popsicle Sticks
- Colorful scraps of paper
- Glue
- Rulers
- Other miscellaneous materials (i.e. sequins, pipe cleaners, pom poms)
- Camera to take pics and send them to us
- Computers/mobile devices for videos
- Bin/tub (1 foot in width)
- Full can or bottle to test the prototype



## PROCEDURES

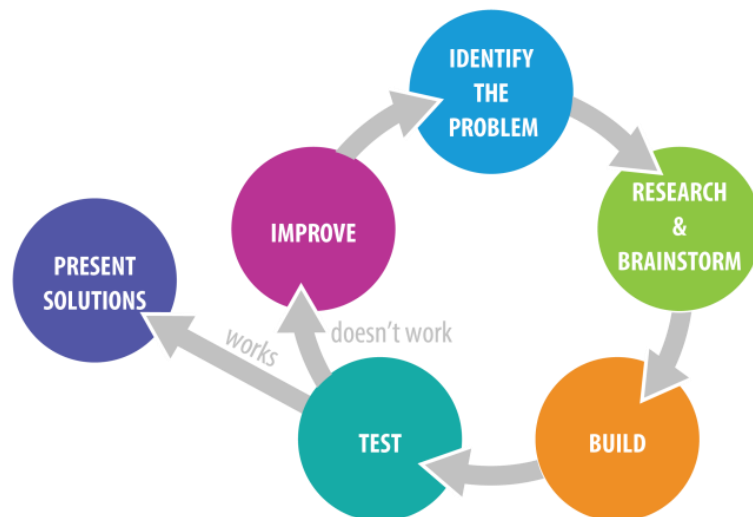
- STEP 1:** Read the book *Iggy Peck, Architect* by Andrea Beaty and then ask the following questions and have discussions.
- What is an architect?
  - What are some jobs an architect might do?
  - What kinds of buildings did Iggy build?
  - What is something useful you would like to build?
- STEP 2:** Watch a video with NIU SWE as they build bridges out of paper.  
Building Bridges with the NIU Society of Women Engineers <https://youtu.be/-CgGWXtJuyE>
- STEP 3:** Discuss techniques they used in the video and how the techniques could be used in their own bridges.
- STEP 4:** Discuss how wide the river is to determine how long the bridge should be and how much weight the bridge should support.
- STEP 5:** Go through the engineering design process and discuss how each step relates to the story.
- STEP 6:** Review examples of bridges with the class and analyze bridges in terms of what parts help provide support and strength. How does the bridge design allow the bridge to hold so much weight? Also discuss aesthetics of bridges to consider how to make the bridge visually pleasing to the community.
- STEP 7:** Have the students work in groups to brainstorm and build their bridge prototypes.

**STEP 8:** Have students test their prototypes with the can or bottle, and let students improve their prototypes and retest if their prototype is unsuccessful.

**STEP 9:** Have the participants present their solutions to the group and explain how their design held up the can or bottle. Older students can cite information that helped them arrive at this solution.

## ENGINEERING DESIGN PROCESS

IDENTIFY THE PROBLEM	What is the problem, and why is it important?
RESEARCH AND BRAINSTORM	<i>Research:</i> What has been done to solve this problem? Who is affected by this problem? What current solutions are available? <i>Brainstorm:</i> What sort of things can be used to solve this problem? How can current solutions be improved? What materials will you need? Create concept designs.
BUILD	Decide upon your best design, gather your materials, and build your prototype.
TEST	Test your prototype to determine its challenges, problems, and level of effectiveness.
IMPROVE	If the prototype does not work, repeat the process by identifying problems with the prototype design, conducting more research and brainstorming possible improvements, modifying or rebuilding the prototype, and performing additional testing until a solid solution is found.
PRESENT SOLUTIONS	Once an effective solution is discovered, present your work to others. Possible forms of presentation include a project board or multimedia presentation at a meeting or conference, documentation made accessible to those who can benefit from the work, and electronic communication of the solution via email, social media, blogs, websites, digital signs, videos, etc.



## RUBRIC

	Target (3)	Meets (2)	Partially Meets (1)	Does Not Meet (0)
BRIDGE DESIGN	Does a great job showing an understanding of design for a purpose.	Does an okay job with showing an understanding of designing for a purpose.	Tries but has great difficulty showing an understanding of the design process.	Does not show an understanding of design.
USE OF MATERIALS	Inventively chooses materials that are interesting and support the project's purpose.	Appropriately chooses materials to support the project's purpose.	Chooses materials but some work against the purpose of the project.	Does not choose appropriate materials.
COLLABORATION	Works well with others and discusses ideas in a fair, respectful, encouraging way and is considerate of the feelings of others.	Works okay with others and discusses ideas in a fair, respectful way, but may not have been encouraging. Considers the feelings of others.	Works with others, but did not contribute a fair share of work OR was discouraging and did not consider the feelings of everyone.	Did not work well with others and/or discusses ideas in an unfair, disrespectful way.
REQUIREMENTS	Meets all of the requirements for the project.	Meets most of the requirements for the project.	Meets some of the requirements for the project.	Does not meet the requirements for the project.
DEMONSTRATION OF KNOWLEDGE OF CONTENT IN DISCUSSIONS AND ACTIVITIES	Does a great job showing an understanding of the content covered in class.	Does an okay job with showing an understanding of the content covered in class.	Tries but has a difficult time showing an understanding of the content covered in class.	Does not show an understanding of the content covered in class.
Total				/15