

Instructional Teacher Guide - Bridge Activity



Figure 1: The Golden Gate Bridge in San Francisco, California.

Disclaimer

This activity guide is a general guideline of the engineering design process, intended to serve as a reference for teachers. The teacher is responsible to incorporate and comply with the New Generation Science Standards of design for 3rd to 8th grade students in their lesson plans.

Teacher preparation

For additional information about engineering concepts to aid the understanding of this activity visit the link below. In addition, It is recommended to watch the instructional teacher guide videos provided in the same link:

<http://research.engr.oregonstate.edu/pigroup/engineering-design-toolkit>

Materials

- One Engineering Design Toolkit containing all materials needed for this activity.



Figure 2: Engineering Design Toolkit

Constraints

The students are expected to finish activity within a 45-50 minute time frame. (Note: Every engineering design step has a recommended time limit shown in the engineering design process section of this document.)

Learning outcomes - The student must...

1. Show an understanding of the problem.
2. Show an understanding of the solution and the purpose of the solution.
3. Be able to plan/design the solution.
4. Be able to implement their plan to the solution with the materials provided.
5. Be able to test the solution.
6. Be able to understand why the solution does not work.

7. Show an understanding of the engineering design process steps.

Note: The learning outcomes are general guidelines of the engineering design process, intended to serve as a reference for teachers. The teacher is responsible to incorporate and comply with the New Generation Science Standards of design for 3rd to 8th grade students in their lesson plans.

Source: <http://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf>

Introducing the activity

To introduce the activity follow the following procedure:

Note: This procedure was only created with the intent to serve as a reference on how to structure and teach this activity. Teachers have the full flexibility of teaching this activity based on their teaching style.

1. Setup the materials for students before session starts as shown in Figure 3.



Figure 3: Engineering Design Toolkit materials setup for the Bridge activity

2. Introduce the Engineering design process to students.

- ***Definition - Engineering design process:***
The engineering design process is a series of steps that engineering teams use to guide them as they solve problems. The design process requires that

engineers repeat the steps as many times as needed, making improvements along the way.

Sources: <https://www.teachengineering.org/engrdesignprocess.php>



Figure 4: Engineering Design Process

Source: <http://shop.dowlingmagnets.com/p/engineering-design-process-magnets>

3. Introduce the activity's problem description to the students.

Problem Description

Sam is driving a monster truck to his friends house when he encounters a river. He has hired your team of engineers to design and build a 3ft bridge that will allow Sam to cross the river safely. Your task is to use the the materials provided and the engineering

design process to successfully build a bridge that does not collapse when Sam's monster truck crosses your bridge. Remember his safety is in your hands.

4. Instruct the students to follow the Engineering design process steps.

- **Step 1: Ask** (*Duration = 5 minutes*)
 - Questions
 - What is the problem that Sam is facing? (**Learning outcome 1**)

- **Step 2: Imagine and plan** (*Duration = 10 minutes*)
 - Questions
 - What does Sam need to be able to get to the other side of the river? Why does Sam need a bridge to be built? (**Learning outcome 2**)
 - How can we make/build a bridge? (**Learning outcome 3**)
 - Mission
 - Have the students draw out their designs of the bridge on paper as a team.

- **Step 3: Create** (*Duration = 20 minutes*)
 - Questions
 - Using the materials provided at hand, how will you make the bridge? (**Learning outcome 4**)
 - Mission
 - Show the students the possible designs diagram then let them create the bridge.

- **Step 4: Test** (*duration of 5 minutes*)
 - Questions
 - How can we test if the bridge works? To check if the bridge works, we should test if the car crosses the bridge successfully. (**Learning outcome 5**)
 - Mission
 - Have the students test their bridge designs by controlling the car to move from one end to the other. If the car reaches the other end then the bridge is a success.

- **Step 5: Improve** (*Duration = 5 minutes*)
 - Debriefing through the following questions
 - For the bridges that collapsed, Why did the bridge collapse? How can we re-make the bridge to improve it? (**Learning outcome 6**)
 - What have you learned ? (**Learning outcome 7**)

Adjusting difficulty (Optional)

New Problem descriptions

Sam is driving a monster truck to his friends house, which is at the top of a cliff. He has hired your team of engineers to design and build a bridge that will allow Sam to drive his truck to the top of the container the materials come in as shown in Figure 5. Your task is to use the the materials provided and the engineering design process to successfully build a bridge that does not collapse when Sam's monster truck crosses your bridge. Remember, his safety is in your hands.

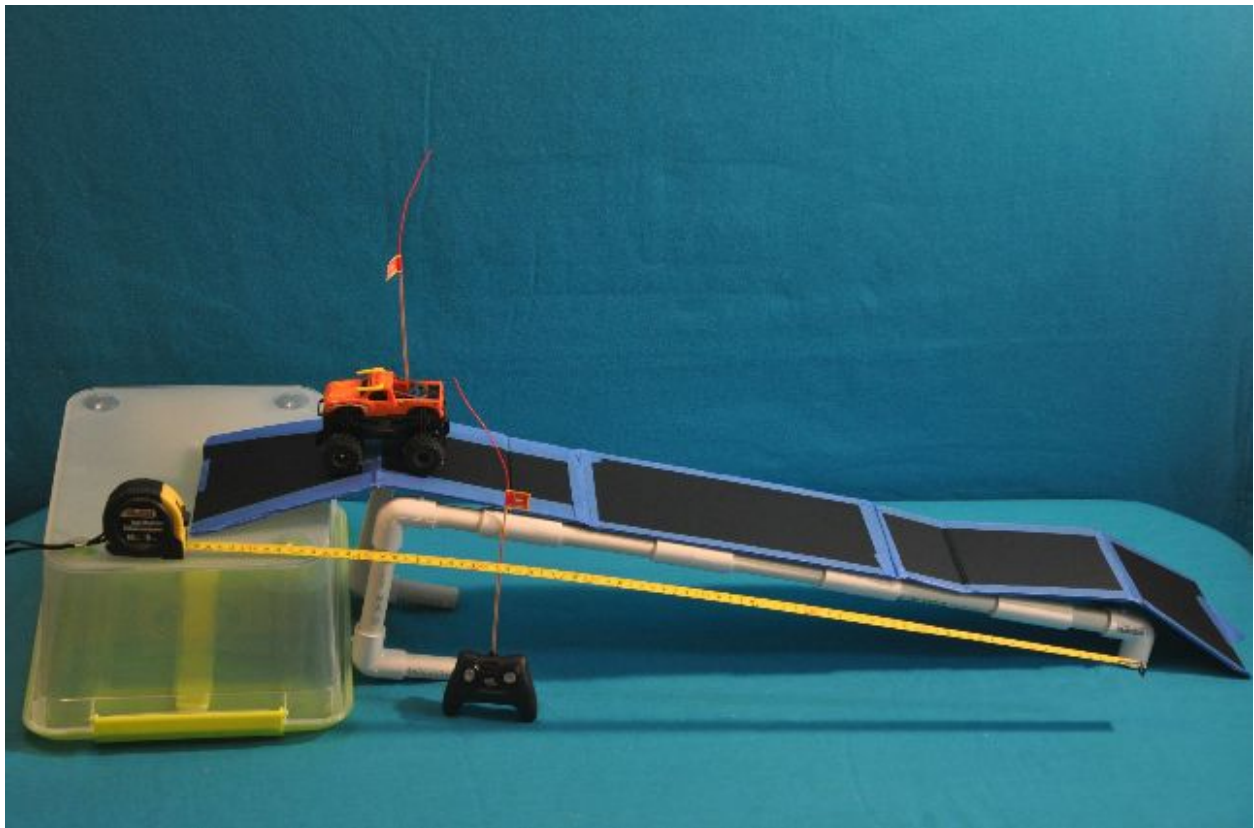


Figure 5: Engineering Design Process