Shapes in Engineering

Teach 1	Names of student(s) teaching:
Teach date: Teach time: Teach length: 45-50 minutes	Title of lesson: Shapes in the Engineering Design Process Source (Kit, Lesson, Page #):

Concept statement/Main idea:
The students will be introduced to the techniques of solving an engineering problem such as brainstorming and thinking outside the box. After a discussion on the effects that a shape has on building buildings the students will design their own structures to support at least one textbook.

Standards for the lesson:
Utilize the engineering design process to create efficient structures.

Objectives	Evaluation
Write objectives in SWBAT form	Write at least one question to match the objective you listed or describe what you will look at to be sure that students can do this.
SWBAT **describe** the steps of the engineering design process.	What are the steps in the engineering design process? Answer: 1. Find the need. 2. Define the problem. 3. Brainstorm to come up with ideas. 4. Select the most promising design. 5. Plan and manage the project. 6. Build-test-refine the design.
SWBAT **assimilate** new information on shapes and force to create structures.	Why is understanding force important to engineering? Answers may vary, however steer students towards the idea that force allows engineers to consider different variables like the material they will use and the amount of

	mass their structure will need to hold when designing.
	List the shapes in order from greatest to least according to their strength. (rectangle, triangle, Column,) Answer: Triangle, column, rectangle

Engagement

Estimated time: 5 minutes

Description of activity: Create a discussion that introduces the importance of shapes and the process of engineering design.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
The teacher will first cover the steps of the engineering design process. The teacher will then lead a discussion by asking the essential question of "What makes a building strong?" along with "What occurs when I apply a force to a structure?"	The students will discuss their ideas with the class. They will reach the conclusion that shape is important to structure.	Students will gear towards the idea that the materials used are what make the building strong; it is up to you to steer them towards the shapes used in the design. Yes, materials are important but what if all the materials are the same then what makes the building strong? If they still don't reach this conclusion then give examples. Why can the Olympics stadium hold so many people all at once? Why are the pyramids still standing to this day?

Resources needed:

Powerpoint
Engineering Design Video

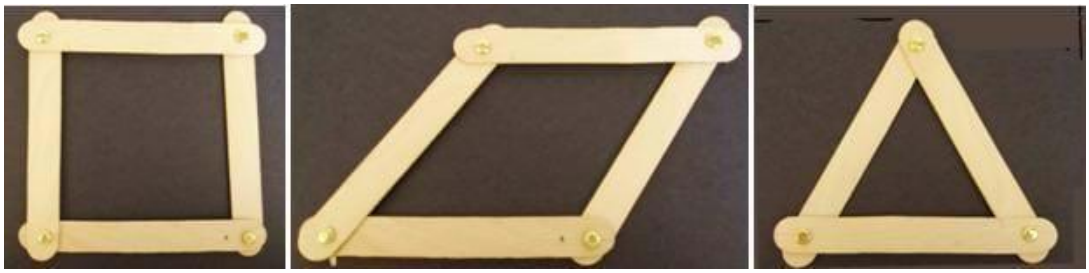
Safety considerations:

Exploration

Estimated time: 20 minutes
Description of activity:

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
The teacher will first make a visual demonstration on how shapes react to a force acting on it. The teacher will then supply materials and give instructions on the Shapes activity. The teacher will repeat the instructions to ensure the students do not have doubts over what they are doing.	The students will utilize the first 5 steps of the engineering design process to create a structure that can support the force applied by one textbook.	Do you think your structure will support the mass of one textbook? What things are you considering while building your structure? Would this structure also work for 3 textbooks ?

Resources needed:



(For class demonstration by teacher)

- 7+ popsicle sticks
- 7+ large brads
- Power Point

- Make a column also
- 10 sheets of copy paper (okay if has printing on it, such as paper from recycle bin)
- Roll of masking tape
- 20 drinking straws
- 20 paper clips
- 2-3 pre-weighed hardcover books (give each group similarly weighted books)
- Scissors (for each group)
- A small scale for weighing textbooks (to be shared among the class)

Activity Demo Video
Explore Worksheet

Safety considerations:

Explanation

Estimated time: 10 minutes
Description of activity: The students will explain the reasoning behind their design.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
The teacher will ask students questions about their final design. The teacher will also ask about their thought process.	The students will present their structure to the class and explain their thought process. Lastly, they will test and express at least one way to refine their structure.	Why do you think your structure succeeded/ failed? What could you tweak to make it better? Were you surprised to see your results?

Resources needed:
Students' structures
Safety considerations:

Elaboration

Estimated time: 10 minutes
Description of activity: Students will relate their structures to the buildings we see today and we saw earlier in the year.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
The teacher will ask the students to recall the pictures seen during the engage. The teacher will then ask the students to relate this to the stadiums/venues used during the Olympics. Talk about today's buildings.	The students will connect the explore activity and their use of the engineering design process to relate to the buildings they see now.	Have the students think of other shapes that appear in structures. What about arches and domes? Or more simple shapes like octagons and hexagons? Which shape do they think is the strongest? How is the structure different from today's buildings? If you were an engineer in today's time what shape would your masterpiece building be? Why are the Pyramids and the Greek Parthenon still standing today?

Resources needed:
Visual aid of today's buildings versus famous architectural buildings. (Power Point)

Safety considerations:

Evaluation

Estimated time: 5 minutes
Description of activity: Students will complete a short quiz and turn it in once completed.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
The teacher will pass out the quiz and pick up the evaluations once all papers are all turned over or the time has run out.	The students will use the material learned in this lesson and apply it to solve the questions on the quiz.	

Resources needed:

Evaluation Quiz

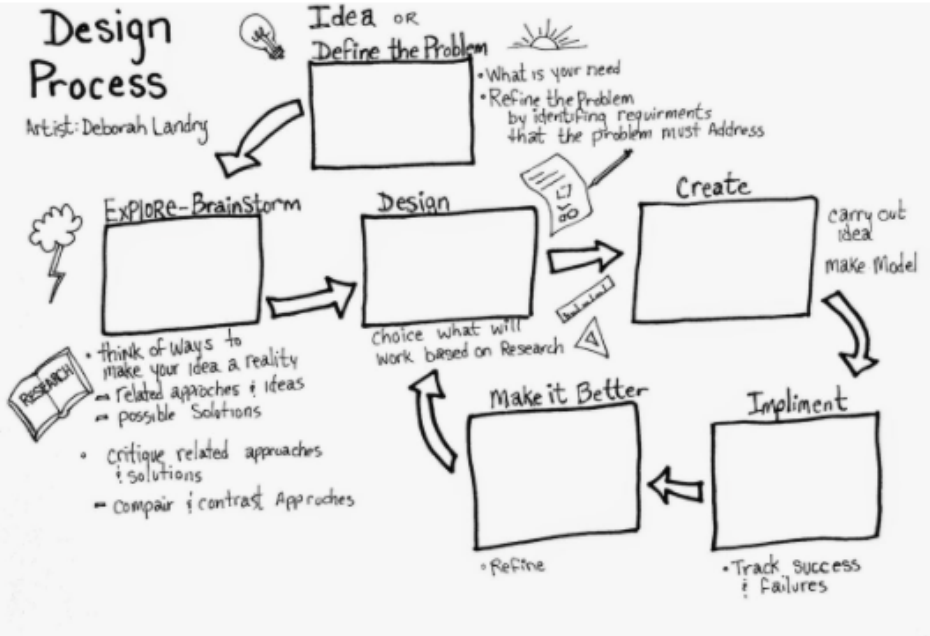
KEY

Safety considerations:

Name:_____

Engineering Design Process: Shapes

Instructions: Keeping the Engineering Design Process in mind, create a shape with the given materials that can hold the weight of one textbook. After you have created your design and been given approval by the lead engineer, your teacher, you may begin the building process.



Draw out the design process for your shape below. List what materials you will be using to construct your design.

After testing your design answer the following questions: What changes would you make to make your shape be able to hold more textbooks? Do you think there's a direct relationship between how the structure is built and how many books it can hold?

Name: **Date:**

Shapes in the Engineering Design Process Quiz

1. Is the engineering process important? Explain.

2. List the steps of the engineering process.

3. How does force affect the engineering process?

4. How does shape affect the engineering process? Which shapes are best to use when building ?

Name: **Date:**

Shapes in the Engineering Design Process Quiz

KEY

1. Is the engineering process important? Explain.

   The engineering process is very important because it promotes creativity and helps the engineer organize their thoughts.

2. List the steps of the engineering process.

   Find the need.

   Define the problem.

   Brainstorm to come up with ideas.

   Select the most promising design.

   Plan and manage the project.

   Build-test-refine the design.

3. How does force affect the engineering process?

   When creating a structure engineers must know how much force will be applied to their structure to be able to plan and design ahead. Force= Mass x acceleration.

4. How does shape affect the engineering process? Which shapes are best to use when building?

Some shapes are stronger than others and that's why they can tolerate more force than others. Specific shapes work best in different engineering scenarios. Using different geometric shapes, structures are used to support in different ways.

Columns and triangles are two of the strongest geometric shapes and therefore are preferred when building.