

Engineering Process

- Define
- Gather
- Generate
- Analyze
- Test

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ENGINEERING PROCESS

ABOUT THIS PLAN:

In this plan we will watch videos on Engineering by [Crash Course Kids](#), the videos cover the Engineering Process and are about 10 minutes in length. After watching the videos, we will work through the engineering process and create our own invention/solution to a problem.

MATERIALS NEEDED:

1. Notebook or binder to keep all worksheets, drawings, test results, notes, etc.
2. Computer or laptop to watch Crash Course videos on YouTube and accessing websites for articles.
3. Optional: [Google Sketch Up](#), if you will create a 3D model of your product. If you are a teacher or homeschooler, you can obtain a FREE one-year license
4. Optional: 3D printer to print a prototype.
5. Materials to build a prototype and materials to build the actual product. You will have a better idea of what you need during the design process.

GRADE LEVEL

This plan designed for upper elementary/ middle school, however the plan can be adjusted for older students.

OBJECTIVES/TEACHING GUIDE:

1. What is an Engineer?
2. Different types of Engineers
3. The Engineering Process
4. Define a problem
5. Research
6. Brainstorm solutions
7. Choose best solution (or a couple)
8. Create prototype
9. Test and redesign

WHERE TO FIND US:

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www.teacherspayteachers.com/Store/Kid2Kid-Tutorials

LESSON PLAN:

VIDEOS: CLICK ON BLUE TITLES TO WATCH VIDEOS.

1. [What's an Engineer?](#)
2. [The Engineering Process](#)
3. [Defining a Problem](#)
4. [Project Success: Defining the Problem](#) – this video recommended for older students.
5. [Defining Success](#)
6. [Got Some Solutions](#)
7. [Let's Fly](#)
8. [A Case of "What-ifs"](#)
9. [Engineering Games](#)
10. [Bowled Over](#)
11. [Try Trials](#)
12. [Succeed by Failing](#)
13. [Fixing Failure Points](#)
14. [Designing a Trial](#)
15. [Testing and Trials](#)
16. [The Robot Challenge](#)
17. [Architecture Adventure](#)
18. [Let's Build a City](#)

READINGS:

1. ["Engineering Design Process"](#) – this is for older students (upper middle school/high school)
2. Suggested reading ["Engineering Design Project Guide"](#) by Science Buddies.

ACTIVITIES:

I do not specify the number of days it will take to watch the videos, do the reading, or work on the projects. The timeline is something the parent/teacher should set.

Purchase a notebook or place worksheets and blank paper in a 3 ring binder. This will be your "Engineering Notebook". You will keep all your ideas, notes, designs, research and tests results in this book. You can use the cover page I created (under Worksheets) for the Notebook or create your own.

YOUNGER STUDENTS: ELEMENTARY AND LOWER MIDDLE SCHOOL

1. Watch all Crash Course Videos
2. Complete worksheet [Engineering Process – Defining/ Choosing the Problem](#)
3. Have students research and gather information on how to build the project they selected and supplies they will need.
4. Complete worksheet [Engineering Process – Specification/Criteria](#). Consider size, shape, weight, distance, strength, materials, etc.
5. Design the product by making a drawing (this could be to scale), creating a 3D model sketch, or a prototype (this should be made from cheap material like cardboard). *We used graph paper to draw a model then we made a 3D sketch using Google Sketchup. We plan on 3D printing our design, if we take this route we will post pictures on social media.*
6. If you did not create a prototype, create one now.
 - a. Gather all required materials, you can use the [Materials List](#) (you may have to assist younger students with calculation).
 - b. Watch videos corresponding to the project you picked. The ones from PBS have written instructions.
7. It is now time to test your prototype. You can use the [Testing results](#) worksheet to keep track of the tests.
 - a. Does the product work?
 - b. What changes, if any need to be made?
 - c. Fill out the [Solutions check list](#) to ensure all the criteria's have been met.
8. If the product work's, then success. If it does not work make any needed adjustments and go back to step 7.

OLDER STUDENTS: UPPER MIDDLE SCHOOL AND HIGH SCHOOL

1. Watch video 4 and read up to page 8 of the "Engineering Design Process"
2. Complete worksheet [Engineering Process – Defining the Problem](#)
3. Begin research, refer to [Engineering Process – Gather Information](#)
4. Complete worksheet [Engineering Process – Specification/Criteria](#). Consider size, shape, weight, distance, strength, material, etc.
5. Begin to brainstorm solutions. Write or draw ideas in your Notebook. Be sure to keep your criteria's in mind.
6. Fill out, or create a [Solutions check list](#).
7. Design the product by making a drawing (this could be to scale), creating a 3D model sketch, or creating a prototype. *We used graph paper to draw a model then we made a 3D sketch using Google Sketchup. We plan on 3D printing our design, if we take this route we will post pictures on social media.*

8. If you did not create a prototype, create one now. A prototype should be created with cheaper materials.
 - a. Gather all required materials, you can use the [Materials List](#) to keep track of everything you will need and the cost.
9. It is now time to test your prototype. You can use the [Testing results](#) worksheet to keep track of the tests.
 - a. Does the product work?
 - b. Have all the criteria's been met?
 - c. Does it solve the problems/need?
 - d. What changes, if any are needed?
10. If the product work's, then success. Now create the actual product. Use the [Materials List](#) to keep track of materials and cost.
11. If it does not work make any needed adjustments and go back to step 8.

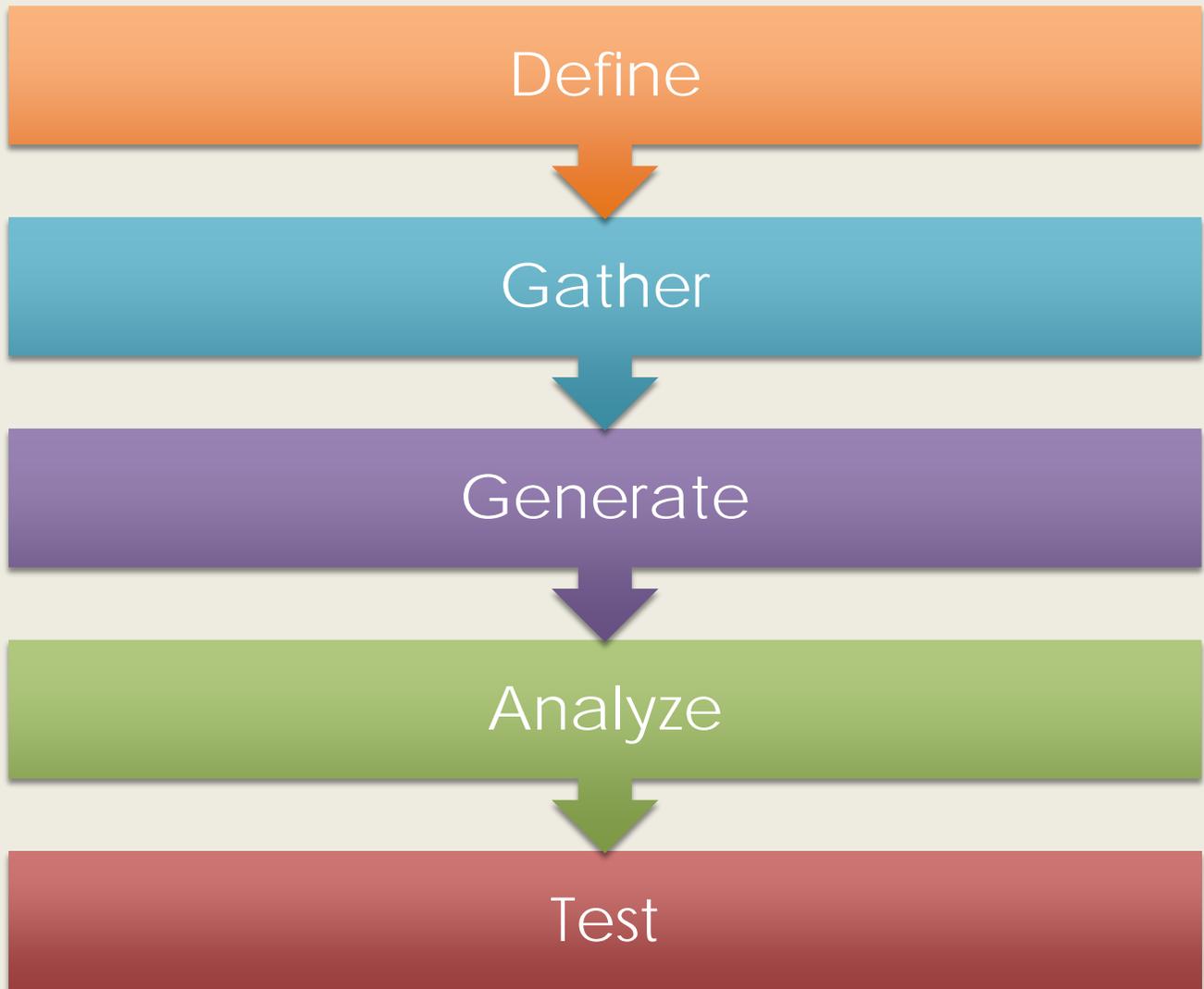
MORE LESSON PLANS:

1. PREVIOUS LESSON PLANS
 - a. [Archeology and Early Humans](#)
2. OTHER LESSON PLANS
 - a. [Math Lessons](#)

WORKSHEETS:

1. Cover Page for Notebook
2. Defining/Choosing the Problem
3. Defining the Problem
4. Specification/Criteria
5. Gathering Information
6. Solutions Checklist
7. Materials List

MY FIRST ENGINEERING NOTEBOOK



This book belongs to: _____

ENGINEERING PROCESS – DEFINING/ CHOOSING THE PROBLEM

1. Choose one project:

- a. Design a rubber-band gun that can shoot a rubber band 2 feet without breaking the rubber band. (Challenge: see how far you shoot the rubber band). Picture of our [Rubber Band Gun and materials list](#).
- b. Design a vehicle that can move (forwards, backwards, and side to side) using a magnet. [Our Magnet Car](#) video.
- c. Design a stomp rocket that shoots a marshmallow 4 feet in the air. (Challenge: see how far you shoot the marshmallow). [Our Stomp Rocket](#) video.
- d. Design a building that can survive an earthquake. ([PBS Design Squad](#))
- e. Design and build an emergency shelter that can fit one person and is sturdy and easy to build. ([PBS Design Squad](#))

2. **WHO** can benefit from the projects listed above?

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

3. Choose a project and explain **WHY** you chose it.

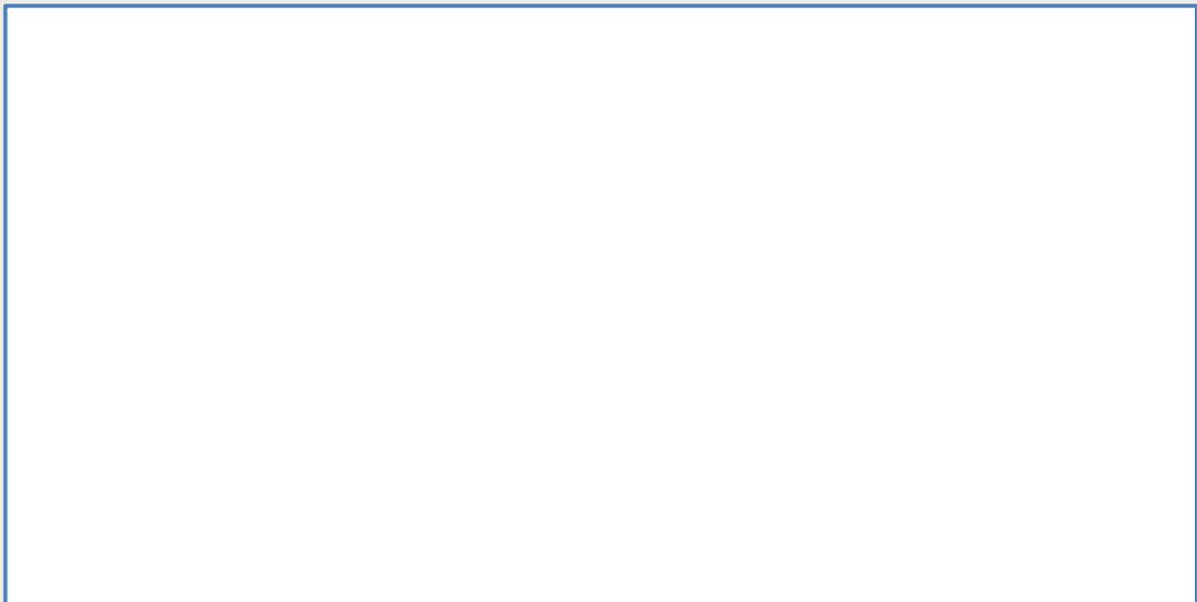
ENGINEERING PROCESS – DEFINING THE PROBLEM

1. Brainstorm some ideas about **WHAT** is needed or something that can be improved.

“Engineering design activity always occurs in response to a human need. Before you can develop a problem definition statement for a design problem, you need to recognize the need for a new product, system, or machine.” (Seyyed Khandani, 2005, p. 8).

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

2. **WHO** has the problem?



3. Explain **WHY** this problem needs to be solved.



4. Select one idea from question 1 and define the problem.



ENGINEERING PROCESS – SPECIFICATION/CRITERIA

Write out the specification/criteria for your product (the problem you chose in “Define the Problem” Worksheet).

Criteria 1: _____

Criteria 2: _____

Criteria 3: _____

Criteria 4: _____

Criteria 5: _____

Criteria 6: _____

Criteria 7: _____

Criteria 8: _____

Criteria 9: _____

ENGINEERING PROCESS – GATHER INFORMATION

Do research and gather information. Keep track of your resources for future use. Think about the following when gathering information:

1. Is there an existing solution?
2. Is the current solution working?
3. How can the current solution be improved?
4. What will people pay for the product?
5. Are there any regulations (government, environment, design)?
6. Cost of building the product

RESEARCH TRACKING

Keep track of the sites and resources you used for your research. This will allow you to refer back to them when needed.

Research Tracking					
Source Type	Author	Name of Web Page/Company	URL	Date Retrieved	Notes
Website	Zack	Kid2Kid Tutorials	www.kid2kiddtutorials.com	8/19/2016	This is an example

MATERIALS LIST

Materials List						
Quantity	Material	Unit Price	Total			
3	pvc pipe	\$ 0.50	\$ 1.50			

TESTING RESULTS

Go through the products criteria's and ensure that all are met. Ensure the product is functional.

Testing Checklist						
Test	Met requirement	Has not met requirements	Notes			
Criteria 1	Yes					

PICTURE OF OUR RUBBER BAND GUN



What you need:

Plastic Tube, Duct tape, knife, scissors, clothes pins

Plastic Tube: cut a tube 8 inches long.

Make two slits on one side of the tube (two slits on the same side, one on top and one on bottom). The slits are to hold the rubber band in place.

Duct tape the clothes pin to the other side of the tube. One on top and one on bottom. Make sure the longer end of the clothes pin is on the outside (that will be the trigger).

REFERENCES

Course, C. (n.d.). *YouTube*. Retrieved from Crash Course:
<https://www.youtube.com/user/crashcoursekids/playlists>

PBS Kids Design Squad Global. (2016). Retrieved from PBS Kids: <http://pbskids.org/designsquad/build/>

Seyyed Khandani, P. (2005, August). *Engineering Design Process*. Retrieved August 15, 2016, from Saylor:
<http://www.saylor.org/site/wp-content/uploads/2012/09/ME101-4.1-Engineering-Design-Process.pdf>