

## Engineering Design Process

Explorers will be introduced to one of the standards used in engineering, called a design process.

### CATEGORY

- Engineering (could be adapted for other fields, such as robotics, graphics design, inventing, game design, etc.)
- Design Process

### OBJECTIVES

By the end of this session, participants will be able to:

- Understand the steps in the design process.
- Identify a way to protect and track ideas and inventions.
- Learn a tool that will be invaluable as they record and track their ideas over time and as they observe how their ideas change and become a real product or invention.

### SUPPLIES

- Simple composition-style notebook
- Pen, pencil
- Computer with Internet access
- Supplies for Activity 3, to be determined based on selected projects

### RESOURCES

*Reminder: Any time you use an outside source, be sure you follow the content owner's or website's permission requirements and guidelines.*

The following are suggested resources that Advisors may find helpful in planning this session:

- [VEX Robotics](#)
- *Boys' Life* magazine, "[Robotics](#)"
- *Boys' Life* magazine, "[Overview of the engineering design process](#)"

**ADVISOR NOTE:** Text in italics should be read aloud to participants. As you engage your post in activities each week, please include comments, discussions, and feedback to the group relating to **Character, Leadership, and Ethics**. These are important attributes that make a difference in the success of youth in the workplace and in life.

### ACTIVITY 1

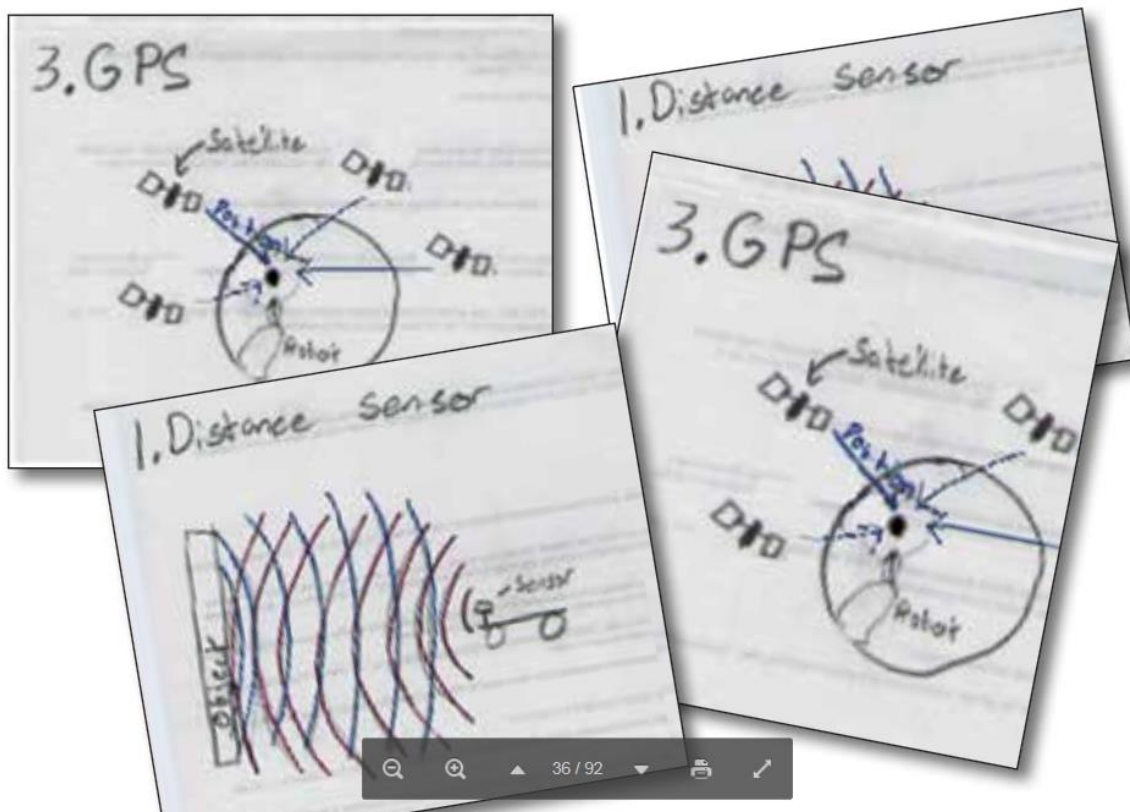
#### The Design Notebook

(The following is adapted from the *Robotics* merit badge pamphlet by permission of the Boy Scouts of America. Illustration by Christopher Hideg.)

*Say: As you begin working through the engineering design process, you'll need many tools. One of the most important tools to help you get started is the design notebook. The design notebook is a tool that you use to record your ideas. Make sure you document your designs, thoughts, and inventions so you can*

protect your ideas. The notebook is also where you'll document your questions and ideas as you go through the process of creating solutions and resolving problems. It's a useful tool to keep track as your product or idea continues to evolve. You will be amazed looking back through it to see the different solutions you tried and to see the change from your starting point to your final solution.

You should draw several pictures of your designs as you develop them. Using a notebook with graph paper will allow you to draw pictures of your designs to scale. Have the squares represent a measurement scale (i.e., one square equals 1 inch or 1 centimeter). A drawing to scale on graph paper will give you more information about the final design size and the placement of parts than a free drawing.



Here are some of the elements Explorers may want to include in their design notebooks.

### Robot Engineering Notebook

Put your name in your robot engineering notebook, and include these sections:

- **Robot.** Describe the type of robot you want to build (flying, underwater, boat, land, tank drive, wheeled, etc.).
- **Task.** Describe in detail the task the robot will accomplish.
- **Several Possible Design Ideas.** Discuss with your counselor several possible ideas for your robot design before building it.
- **Tests.** Describe the tests and the designs that did not work that lead to the final robot design.

- **Pseudo Code.** Prepare a detailed flowchart of the step-by-step commands the robot must complete to accomplish the task.
- **Software Code.** Include the code or flowchart you used.
- **Code Modifications.** Include any changes you make to the pseudo code or the actual code so that the robot completes the task better.
- **Final Robot Design.** Include a description or picture of what you decided to build.
- **Potential for Improvements.** Describe how you can improve your robot for the next design version.

## ACTIVITY 2

### Overview of the Engineering Design Process

Tell Explorers: *Today we'll be examining the design process that an engineer uses to turn an idea into a reality. The term for an engineer's process is the design cycle: a series of steps that begin with identifying a problem and then move to understanding the limitations, analyzing and researching past experiences, brainstorming and evaluating possible solutions, selecting an approach, building a product, testing it, refining it, and repeating the cycle.*

Review with participants the article ["Overview of the engineering design process"](#) from Boys' Life magazine.

Discuss as a group each step in the design cycle, and allow participants to provide feedback or ask questions.

## ACTIVITY 3

### Hands-on Project

**NOTE:** This could be a two- or three-session project to fit the goals and needs of your post. Guide the participants as needed throughout their projects.

For this activity, Explorers will take what they have learned and will begin applying the design process to a project. The project could be creating a robotic design to solve a problem, or it could be a similar situation that you feel is a good fit for participants.

Another option would be to choose to just take one or two areas of the design process and apply them to a project.

Be sure to have Explorers make drawings and take notes in their design notebooks to track and record how their problem and solution evolve to create the finished product.

## ADVISOR NOTE

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Some sample questions are below. They are designed to help the participants apply what they have learned to their own interests. You are welcome to use these questions or develop your own questions that relate to your post or specific focus area.

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## REFLECTION

### Focusing Questions

- *What new things did you learn?*
- *Which element of the design process was easiest for you?*
- *Which part of the design process was the most challenging for you?*
- *Is protecting your ideas important? Why or why not?*

### Analysis Questions

- *What are some challenges you expect with the design process? How might you overcome them?*
- *What are some challenges specifically with the design notebook? How might you get beyond those challenges?*

### Generalization Questions

- *Are there areas related to today's topic that you'd like to learn more about?*
- *What subjects in school do you believe will be helpful in order to be better at this skill or process?*

## ADVISOR/OFFICER REVIEW

After the meeting, address the following points:

- Identify what was successful in the meeting.
- Identify what needed improvement.

Schedule a planning meeting for the officer and advisor to prepare for the next post meeting or activity.

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