

UNIT 4

Initial Design

UNIT OVERVIEW

UNIT NUMBER: 4

DURATION: 10 hours

SUMMARY

In this unit, students will begin the design process. You will introduce the design process with a short activity, and then the students will go through the first three steps of designing their robot: identifying the problem/requirements, brainstorming, and planning.

INSTRUCTIONS

1. Use the PBS Paper Table Challenge as an entry event and present the driving question to the students.
2. Discuss Knows and Need to Knows.
3. Divide the students into groups and start them on their robot design challenge.
4. Groups will present their designs to the class at the end of the week and the students will give feedback on each others' ideas.
5. As a class, decide on a "final" plan.
6. Students will complete Self & Peer Evaluations.

LEARNING RESOURCES

[PBS Design Process Paper Table Challenge Teacher Guide](#)
[Paper Table Challenge Sheet](#)
[Science Buddies: Engineering Design Process](#)



ASSESSMENTS:

1. Weekly Engineering Notebook
2. Weekly Self & Peer Evaluation
3. Design Presentation

TOOLS & MATERIALS

Paper Table Challenge

1. Newspaper
2. Masking tape

STANDARDS ADDRESSED:

Full course standards alignments can be found [here](#).

ENTRY EVENT



Use newspaper and masking tape to build a table that will hold a textbook!

Use this Paper Table activity from PBS to introduce the design process. In groups, students must use newspaper and masking tape to build a table that will support a textbook without collapsing or falling over.

After the activity, discuss the design process. The design process consists of five stages:

1. Identify a problem
2. Brainstorm ideas
3. Design and plan a solution
4. Build a prototype
5. Test the prototype

The stages are a cycle. Once the team has built and tested their design, they will inevitably need to make changes. These changes then become the problems they address for the next cycle of the design process. They will brainstorm ideas for how to solve these problems, design a solution, build it, test it, and repeat. There are always improvements to be made! This cycle continues until the end of the *FIRST*Tech Challenge season.

If you would like more guidance on facilitating a discussion about the design process with your students, check out this [discussion guide](#) from PBS.



DRIVING QUESTION

How can we as engineers design a robot to compete in the *FIRST*Tech Challenge?

Complete knows and need to knows again. Many of the questions may be the same as the previous unit, but it can't hurt to reassess what we know and don't know!

KNOWS

As a class, make a list of what you currently know related to the project. Ask yourselves questions such as:

1. What do we know about the driving question?
2. What do we know about *FIRST*[®] Tech Challenge?
3. What do we know about building a robot?
4. What do we know about programming?
5. What do we know about this year's game?
6. And more!

NEED-TO-KNOWS

Now make a list of what you need to know to complete the project. Ask yourselves questions such as:

1. What do we *not* know about the driving question?
2. What do we *not* know about *FIRST*Tech Challenge?
3. What do we *not* know about building a robot?
4. What do we *not* know about programming?
5. What do we *not* know about this year's game?
6. And more!

This list will help as you design and build your robot. Think about how you can learn the things on this list. Where can you go? What resources can you access? Who can you talk to?

DESIGN CHALLENGE

1. Divide students into groups of 3-4.
2. Instruct the students that they have one week to create a robot design by following the first three steps of the design process.
 1. Identify a problem (much of this work was done in the previous unit)
 2. Brainstorm ideas
 3. Design and plan a solution
3. Remind them to continually document their process in the Engineering Notebook!

**HINT:**

Much of the work for identifying a problem and some of the brainstorming was done in the previous unit when students researched the *FIRST* Tech Challenge game.

PRESENTATIONS & CRITICAL FRIENDS

1. At the end of the week, have each group present their plans to the rest of the class.
2. After each presentation, have students perform "Critical Friends." Critical friends is a way for students to give feedback on others' ideas in a constructive way. It works like this:
 1. Students ask the presenting group clarifying questions to make sure they fully understood the presentation.
 2. After step 1, the presenting group can no longer speak, but only listen.
 3. Students then share what they like about the ideas presented.
 4. Then students may raise concerns or questions they have about the ideas. This is done by asking "I wonder" questions. For instance:
 1. I wonder if having 4 wheels will provide the power needed to climb hills?
 2. I wonder if the robot is tall enough to reach the bar?
 5. Now the presenting group may speak again and talk about ways they could improve their design based on the class' "I wonder" questions.
 6. Finally, the class may suggest other ideas by saying "I have..."
 7. This video provides an overview of the Critical Friends protocol.
3. After all of the groups have presented, facilitate a team-wide discussion on what design to use for the robot. It is perfectly acceptable to mix and match ideas from different groups.

**HINT:**

Help the team decide on a decision-making process they will use throughout the season.

1. How will they make decisions?
2. Are there designated leaders?
3. Will they use a majority vote?

This will help avoid conflict later in the process.
