FUTURE U.

Design Challenge: Philly Vertical Lift Chinook

Materials Store:

- Nose-hook propellers (similar to this)
- Popsicle sticks
- Rubber bands: small and large
- Paperclips
- Cardboard or cardstock cut in 8 ½ by 11 sheets
- Pennies
- Masking tape
- Timer
- Devices with internet access

Example Team Roster	
Finance manager	
Materials manager	
Engineer	
Engineer 2	
Mechanic	
Helicopter pilot	

Overview

In this challenge, students will create helicopters designed to fly into the air and hover. After competing to see which design can stay up for the longest amount of time and which design can carry the most weight, students will discuss how they could change their helicopters to make them even more powerful.

Educator Prep

- Review the Introduction Video.
- Review the other pages included in this activity packet.
- Complete the classroom setup below prior to the session.

Classroom Setup

1. Select an area outside where students will be able to complete their helicopter flying trials without risking helicopters landing on roofs, in trees, or in other places they can't reach.
2. Set up and review the **Materials Store**. Ensure there is enough of each item for each team:
3. Set up the Teams Tables with each of the following items:
    - Team Roles + Salaries sheet
    - Role Handouts
    - Engineering Planning Guide
4. Divide students into teams of five people. Each person will have a specific role. If some teams have six people, a second engineer can be added.

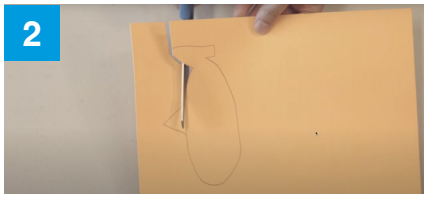
Student Introduction

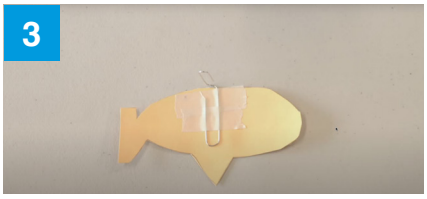
In this activity, you will work in teams to create your own helicopter! You will watch a video that explains how to use your materials to build a helicopter. You will then collaborate with your group members to apply the ideas presented in the video *and* your own ideas to design and build a helicopter of your own.

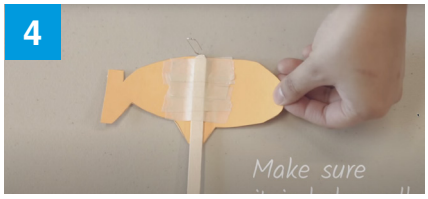
As you build, keep these two goals in mind:

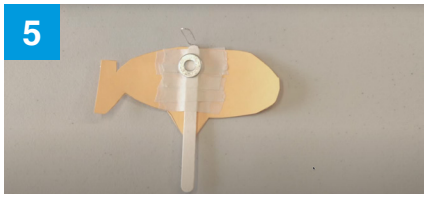
1. Will your helicopter be able to stay up the air longer than all the rest?
2. Will your helicopter be able to carry more weight than the others?

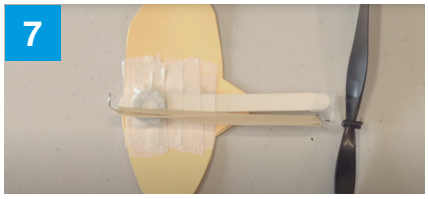
Each team member will have a role to play as you experiment with different ways to build your helicopter. Once you have had 15 minutes to plan with your team and perform your roles, the helicopter design challenge will begin!

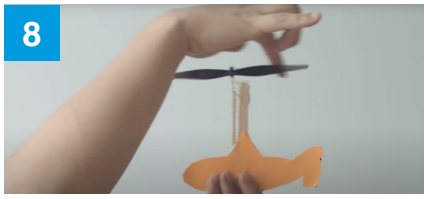












Team Roles + Salaries

Finance Manager: $3,250

Responsible for the budget

Materials Manager: $3,000

Responsible for the purchasing and inventory of the supplies

Engineer: $3,500

Leads the group through completing the Engineering Design Planning Guide

Mechanic: $3,000

Builds the helicopter

Helicopter pilot: $3,000

Tests the helicopter, reports issues, and suggests modifications

Materials Manager: Cost Sheet

Items	Cost
Propeller	$8,000
Craft stick	$5,000
Large rubber band	$4,500
Small rubber band	$3,000
Cardstock	$5,000 per sheet
Paperclip	$2,000
Scissors	$1,000
Pennies	$1,000 per penny
Masking tape	$4,000 for unlimited supply
Device with internet access	FREE

Finance Manager: Budget Sheet

Items	Starting Budget: $55,000
Finance manager salary	$3,250
Materials manager salary	$3,000
Engineer 1 salary	$3,500
Engineer 2 salary	
Mechanic salary	$3,000
Helicopter pilot salary	$3,000
Propeller	$8,000
Craft stick	$5,000
Large rubber band	$4,500
Small rubber band	$3,000
Cardstock	$5,000/sheet
Paperclip	$2,000
Scissors	$1,000
Pennies	$2,000/penny
Masking tape	$4,000 for unlimited supply
Device with internet access	FREE
Ending Balance:	**$_____**

Engineer Instruction

In this activity, you will be challenged to turn potential energy (or stored energy) into kinetic energy (or thrust and lift) to propel the helicopter into the air and keep it up there!

Thrust is the force that gets the helicopter moving. Lift is the force that helps the helicopter rise up from your hand. Today you and your team will focus on creating a helicopter with the most possible potential energy so it can transform into the thrust and lift needed to keep your helicopter in the air.

Your role is to lead your team through completing the Engineering Design Planning Guide. With your team members, you will watch the *Build a Helicopter* video available at youtu.be/DwHyk4V2w5Y. You will then work with your team to decide which ideas from the video you want to try and which ideas you want to modify.

Two may win this challenge: the team whose helicopter stays in the air the longest *and* the team whose helicopter is able to carry the most weight for at least three seconds. (Unless, of course, one team succeeds at both!)

You may use any of the materials available to you as long as they are within your budget.

Mechanic Instructions

Work with your teammates to build and carry out a design that will enable your helicopter to stay in the air longer than others *or* carry more weight than others (for at least three seconds)!

Lead your team in watching the *Build a Helicopter* video available at youtu.be/DwHyk4V2w5Y. Then decide with your team members which ideas your team wants to try and which ideas you'd like to change. Remember: There are many different ways to tackle this challenge, and the ideas in this video are only some of them!

It is your job to help construct the helicopter, analyze its performance during the test flight(s), and repair, enhance, and tweak the design as needed until it is ready to compete.

Helicopter Pilot Instructions

Work with your teammates to build a design that you believe will enable your helicopter to stay in the air longer than others *or* carry the most weight.

It is your job to help test your design(s), provide feedback on the trial(s), and hold and release the helicopter during the final competition.

As the pilot, be sure to remind your teammates that it is important to consider where the passengers (i.e., pennies) should sit and how the helicopter should take off!

Engineering Design Planning Guide | Page 1

Directions: Follow the steps below to prepare for the helicopter design challenge. Make notes as you discuss your answers together.

- **Ask:** What is the problem we are trying to solve?

_____

_____

- **Imagine:** How can we solve this problem? Brainstorm solutions.

_____

_____

- **Plan:** Select one or two solutions you think will work best and explain how they will solve the problem.

_____

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- **Create:** Design and build your prototype.

- **Test:** What worked? What didn't work?

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- **Improve:** How could you make your design better? Make these changes.

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- **Share:** Be ready to discuss what you have learned!

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Scoring/Judging Guide

Each group of students is unique. In addition to which helicopter stayed in the air for the longest amount of time *and* which helicopter could carry the most weight for three seconds, you may also choose other ways to judge your groups based on their grade level, your learning focus areas, and the resources available.

Additional judging criteria may include the following:

___ correctly completed Math on the Budget sheet

___ highest flight

___ most original design

___ least amount of money spent

___ completion of the Engineering Design Planning Guide

___ _____

___ _____

___ _____

Once you have selected multiple judging criteria, assign one point to each item above to see which group(s) have the highest number of points.

Final Discussion Question Guide

Directions: Conclude with a discussion to wrap up the session:

- **Ask:** What role(s) did potential and kinetic energy play during the competition?

- **Recap:** The designs with the most potential energy had the most success. When a helicopter takes off and then hovers in the air, the propeller must provide enough thrust to overcome the helicopter's weight. The heavier the helicopter, the more potential energy is needed to lift it off the ground and keep it off the ground.

- **Ask:**
  - Which of your design decisions were most effective? Least effective? Why?
  - Which helicopter release method worked best? Why?
  - How could you optimize your design in order to make your helicopter even more powerful?

- **Discuss** as a full group.

- **Explain:** Recap and help students understand that in addition to helping their helicopter store as much potential energy as possible, the students also had to make other important design decisions. When designing the body of the helicopter, they had to think about balance and make sure that the weight of the helicopter was distributed in the right places so that it could fly straight up. Another important factor they had to consider was timing. Ideally, their propeller needed to start creating lift before the helicopter was released.