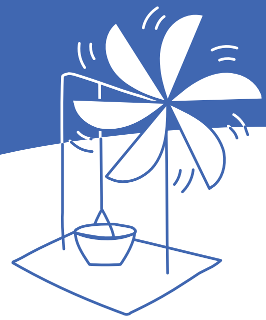
Wind Lift Overview

THINKING AHEAD
What happens when you change the shape, angle or size of your blades?

Download Documents and get your supplies at **teachergeek.com**

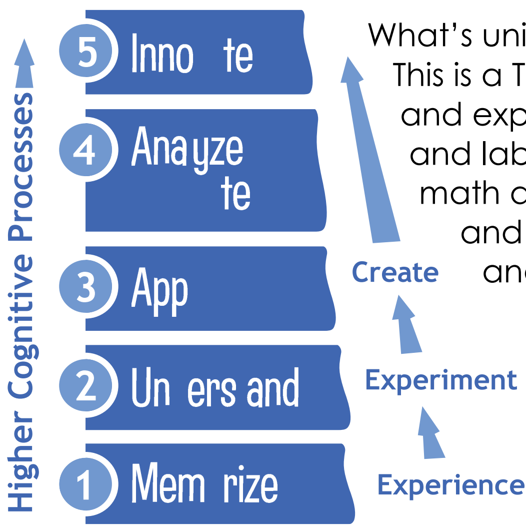


Wind Lift Overview

Recommended Age level:
Activity Age Level: 8-18
Lab Age Level: 8-18 (grades 3-12)
Recommended Group Size: 1-3 students/Wind Lift

Overview

Engineer a Wind Lift that can lift the heaviest loads or lift heavy loads quickly. Start by building the example Wind Lift in the "Build Guide".
Learn about forces and concepts like torque by completing the optional Wind Lift Labs.
Then, design and build your own Wind Lift to compete in Engineering Challenges.

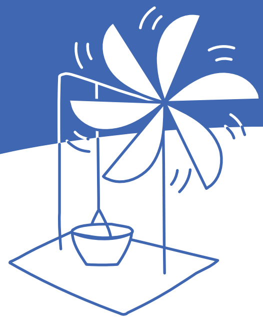


Adapted from Bloom's Taxonomy

What's unique about this, and other TeacherGeek activities? This is a True STEM/Engineering activity; It allows kids to tinker and experiment, grow understanding through experimentation and labs, isolate variables and utilize the scientific method, apply math and science concepts, create their own unique designs, and become innovators. Every project turns out different, and evolves with their understanding.

When you create a project using TeacherGeek, the data works (it's usable). This allows kids to apply the math and science, see the results, and experience "I-get-it" moments (understanding *why* they need the math/science and *what* it does).

Make It Your Own: The documents for this activity are available in PDF and Microsoft Word format. If you wish to edit a document, simply download the Microsoft Word format.



Wind Lift Overview

Standards

Next Generation Science Standards:

Forces & Interactions

- K-PS2-1: Plan & conduct an investigation to compare the effects of different strengths or different directions of pushes & pulls on the motion of an object.
- K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.

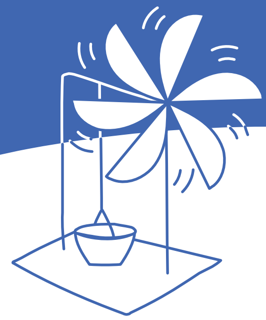
Engineering Design

- K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Concepts & Vocabulary

When you push a friend on a swing, you are using a force. Pushing moves something in the direction of the push. The harder the push, the further the item goes. Pulling something has a similar action. The harder you pull, the faster something moves along.

- Energy: is the ability to do work.
- Potential Energy: an object held in a position (that is at rest) has potential energy.
- Kinetic Energy: an object in motion.
- Revolution: is the movement of one object around the center of another.
- RPM: revolutions per minute.
- Torque: is a twisting force to cause rotation - think of it as how strong the Wind Lift is during each revolution.
- Pitch: is the angle amount the blade is rotated about its axis (skewer).



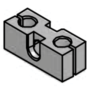
Wind Lift Overview

TeacherGeek

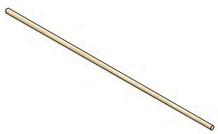
TeacherGeek Components

For One Wind Lift

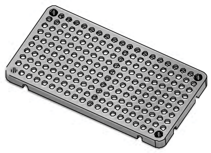
Below is the list of “ingredients” you’ll need for each Wind Lift build.



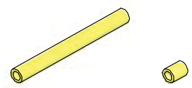
x4 **Perpendicular Blocks**



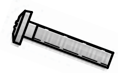
x4 300mm (12") **Dowels**



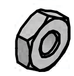
x1 **Hole Plate**



x1 100mm (3") **Slide Stop**



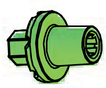
x2 ⅝" or 1" #10 **Screw**



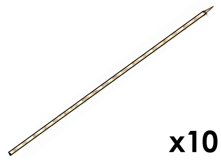
x2 #10 **Nut**

x1 ⅝" #6 **Screw**

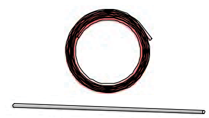
x1 **Mini Hub Cover**



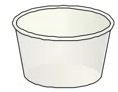
x1 **Mini Hub Base**



x10 150mm (10") **Skewers**



x1 **Wire** Roll or 4.5" section



x1 **Portion Cup**

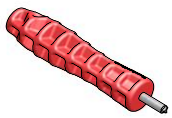
TeacherGeek Tools You'll Need

Easy to Share in Groups

Perfect for sharing in groups of 3 and 4!

Time to break out those tools and start building! Remember to be kind and share with others.

Multi-Cutter
SKU 1823-81



Reamer
SKU 1823-87

Screwdriver
SKU 1823-90

Pliers
SKU 1823-86

Materials You Supply

Go on your own scavenger hunt to find these items. Try lifting all kinds of things!

Tape

String
450mm (1.5ft)

Materials to lift
What else could you try?

Recycling Materials
(for blades)

Wind Lift Overview

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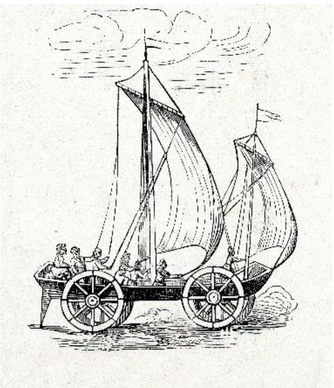
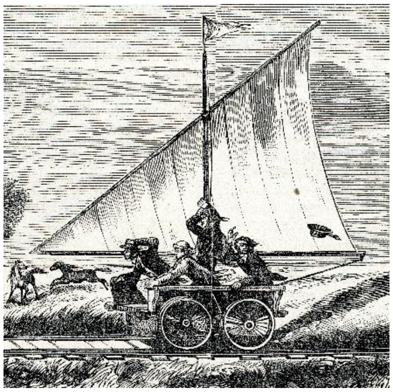
Background

When you think of sailing, you probably think of a boat that is propelled by the wind, like the one over here.

Did you know that sailing isn't just for the water? Cars can also be powered by wind. As shown below, people have been "sailing on land" for centuries.



Sail driven Dutch Cart 17 century

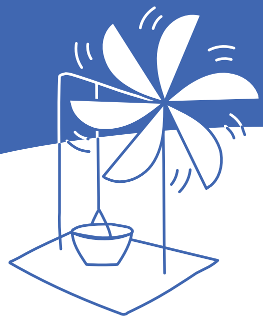


Sail driven vehicle on Kansas Pacific Railway (ca. 1890)

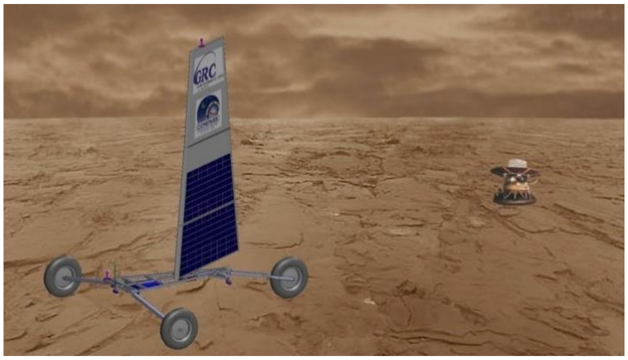
Brooklyn Sail Car

Land Sail Car: A vehicle with wheels that uses a sail and is powered by the wind. Sail Cars, also known as land yachts, were once a mode of transportation. Now, they are mainly used for recreation and fun.

Here's what today's Sail Cars look like. The "Greenbird" is a Sail Car that can go 126 miles per hour. That's faster than most gas powered cars!



Wind Lift Overview



NASA is thinking about using a Sail Car to traverse the surface of the planet Venus.

Zephyr Land Sailing Rover
Image from NASA John Glenn Research Center

Resources

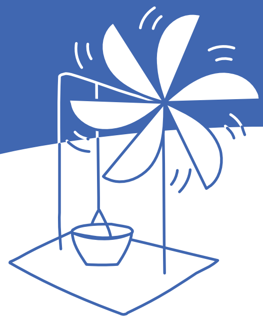
There are "a ton" of resources to help you complete this activity. Pick and choose the ones that will work for you. They are available as links below, or at **teachergeek.com/learn**.

Wind Lift Documents

- Classroom Overview - This is it (you're reading it).
- Wind Lift Build Guide - Required
- Labs
  - **Wind Lift Build Guide**
    - During this step you will make the *Example Wind Lift*.
  - **Energy Lab** - Optional
    - Students investigate potential and kinetic energy using their Wind Lift.
  - **Blade Angle Lab** - Optional
    - Students investigate how blade angle or pitch affects their Wind Lift.
  - **Blade Area Lab** - Optional
    - Students investigate how blade area affects their Wind Lift.
- Wind Lift Engineering Challenges - Optional
  - **Heavy Lift Challenge**
    - Lift the most weight in 20 seconds
  - **Speed Lift Challenge**
    - Lift the same weight the fastest

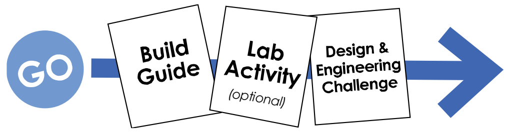
Wind Lift Videos

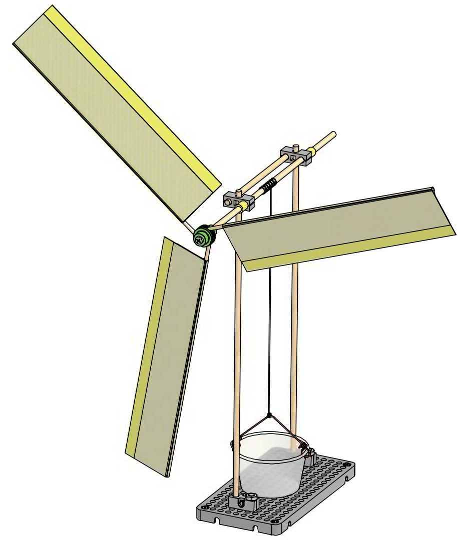
- Energy 101: Wind Turbine—Youtube Video



Wind Lift Overview

Procedure





There are many optional Labs for Wind Lifts, download them

You get to choose which Labs (if any) you would like to do. After you've finished, you can download the Wind Lift Engineering Challenges and Engineering Notebook sheets to take your designs to the next level. Documents are available as links below or at **teachergeek.com/learn**.

1

Build Guide — Required

During this step you will create the example Wind Lift.
The Wind Lift can be kept together and used in the labs or taken apart at the end of the activity to be used during other class sessions.

Download the Wind Lift Build Guide

2

Lab Activities — Optional

Energy Lab

This Lab allows students to experience potential and kinetic energy forces that happen when the bucket is lifted and lowered. Students will learn energy vocabulary, identify energies of their Wind Lift, and explain their findings.

Instructions:

- Discuss the following concepts with your students.
  Ask them to provide describe, define, and/or give examples for each:
  - Object in motion
  - Object at rest
- Distribute Lab sheets. Explain the lab procedure and let them get to work.

Blade Angle Lab

This Lab allows students to experiment with blade pitch and forces that lift the bucket; graphing their Wind Lift's lifting output and learning how blade size relates to torque forces applied.

Instructions:

- Discuss the following concepts with your students. Ask them to provide describe, define, and/or give examples for each:
  - Angle
  - Hypothesis
- Distribute Lab sheets. Explain the lab procedure and let them get to work.

Blade Area Lab

This Lab allows students to experiment with blade area and how that effects forces that lift the bucket; calculating blade area and recording how their Wind Lift performs.

Instructions:

- Discuss the following concepts with your students.
  Ask them to provide describe, define, and/or give examples for each:
  - Area
  - Blade Pitch
  - Hypothesis
- Distribute Lab sheets. Explain the lab procedure and let them get to work.
- If students finish early, you may wish to start the Engineering Challenges.

Download the Wind Lift Labs

3 Engineering Challenges

The following challenges are optional.
It's an Engineering Challenge; immersing students in the Engineering Design process.
Learn more about the Engineering Design Process on the next page.

Download the Engineering Notebook Sheets

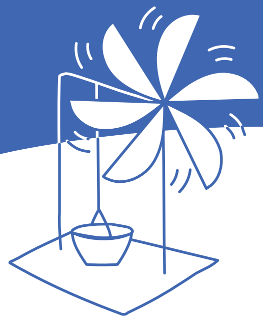
Heavy Lift Challenge

The challenge is simple: design and build Wind Lift blades to lift as many pennies as possible in 20 seconds. Compete for the title of "Strongest Wind Lift".

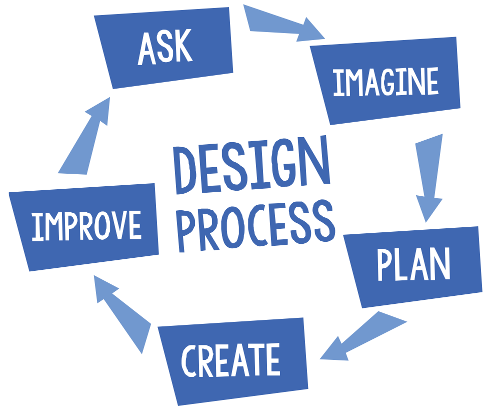
Speed Lift Challenge

On your mark, get set, go! Design and build Wind Lift blades to lift 10 pennies the fastest. Compete against the clock or other Wind Lifts.

Download the Wind Lift Engineering Challenges



Wind Lift Overview



The Design & Engineering Process

Do you have a challenge to solve? Is there something you want to invent, fix or improve? You do? Excellent… the **Engineering Design Process** is exactly what you need.

Inventing, fixing, improving… these are really ways to create a solution to a problem. A problem can be as complicated as creating a way to live on Mars, or as simple as stopping a door from squeaking. You are reading this because you have a problem to solve: to create the strongest or the fastest Wind Lift. The Design Process will help you solve it. Here's how it works:

ASK

What is the problem (what needs to be solved/made better)?

The Design Process helps you solve a problem. Therefore you need to start the Design Process by identifying a problem. In this activity, your problem is either to create a Wind Lift that lifts the most or the fastest.

After constructing your first Wind Lift and going through the initial Design Process, your problem may change. Your next problem might be to make the Wind Lift raise the bucket to the top or lift it faster.

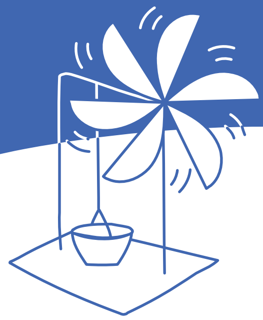
There is no perfect design, so there is no end to the Design Process. You can always identify a new problem (a way to make your Wind Lift better) and go through the Design Process again.

Research: How have others solved, or attempted to solve this problem?

If you are going to solve the problem, you better know what you are doing. After identifying the problem, look at how others have solved, or tried to solve it. Look around your class, search the library and internet, or ask other people.

What are the constraints (things your design cannot, or must, do or be)?

It would be great if you could solve this problem any way you want, with anything you want. The truth is… you can't! You have these things called "constraints" which limit what your design can do, can't do, must be, or can't be (How confusing is that?). Constraints could be resources like time or materials. They could also be rules, such as the size or material of the blades. You need to identify the constraints to your problem before you can solve it.



IMAGINE

Brainstorm, sketch and describe possible solutions (different ideas that might solve the problem).

This is a fun part. You can brainstorm, or use another process, to come up with as many possible solutions to your problem as possible. Consider your problem, constraints and research while generating possible solutions. Do not judge, or pick, your best solution at this point. Just write as many down as you can. Note: wacky/unique ideas sometimes lead to wonderful new design solutions. Be super creative, and original.

Choose the best solution. Circle it. Why do you think it is best?

Ok - now it's time to judge. Pick what you think will be the best solution to your problem. Make sure it fits the constraints. It's ok to feel sorry for all the possible solutions that didn't get picked. They were good ideas too…

PLAN

Draw the solution you choose. Include the details you will need to create it.

Neatly sketch the design you choose (the one you are going to build).
The sketch should include details and descriptions about how it will work, or be built.

CREATE

Build the solution you planned.

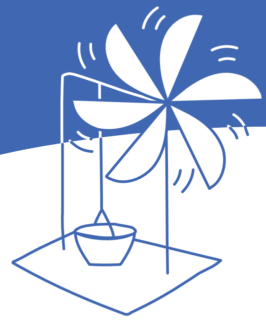
Is this the step you have been waiting for? You finally get to build the solution to your problem (the new design). Have fun! Take the time to make it properly.

Test it.

Test your solution (new design). How does it work? Does it go fast down the track?
Make small adjustments to optimize it (to try and make this design solution work best).

Make observations. Record results.

Pay close attention while testing your solution. Write down what happened (it tipped over, the bucket didn't raise to the top, it didn't spin, it took ___ seconds for the bucket to get to the top). You will use this information to make your Wind Lift even better.



Wind Lift Overview

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IMPROVE

Did you solve the problem?

Look at the test results. Reflect on your observations.
Did your solution solve the problem as you had planned?

Yes? Great! Identify a new problem (a way to make your design even better).

There is no perfect design (yep... your design can still be improved).
Identify another problem that will make your Wind Lift even better.
Grab another Engineering Notebook Sheet and try to solve it.

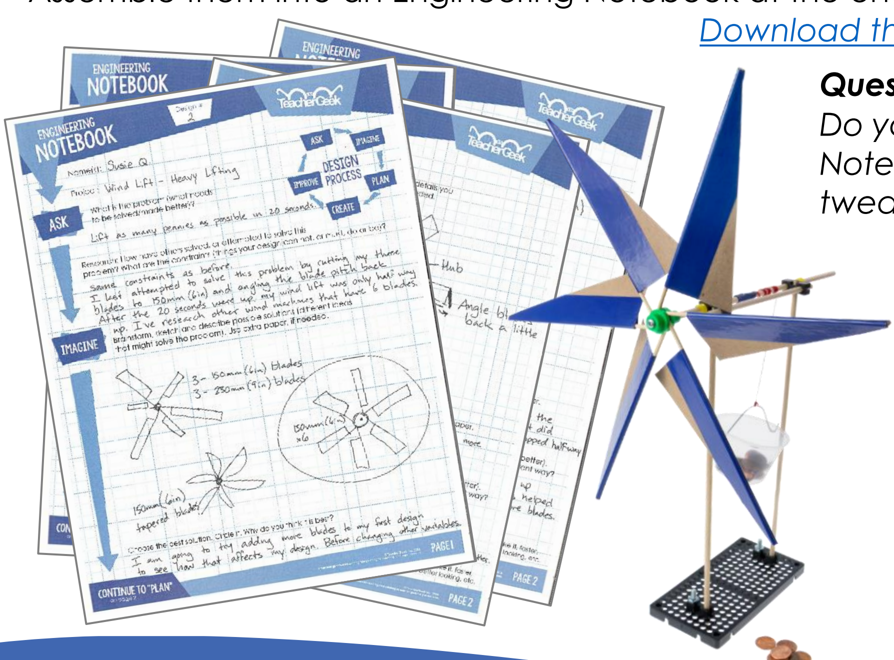
No? That's OK. What did you learn that can help solve it in a new/different way?

You learn more from failures than you do from successes. The best solutions come from/after failures (ideas that didn't work). Most inventions do not work the first time around the Design Process. Learn from what didn't work. Grab another Engineering Notebook Sheet and try to solve the problem a different way.

Engineering Notebook

Fill in a TeacherGeek Engineering Notebook Sheet (front and back)
every time you go around the Design Process. Keep your Notebook Sheets.
Assemble them into an Engineering Notebook at the end of the project.

[Download the Engineering Notebook Sheets]



Question
Do you need to fill out a new Engineering Notebook Sheet for small changes or tweaks to an existing design?

Nope… just record what you did on the current Notebook Sheet.