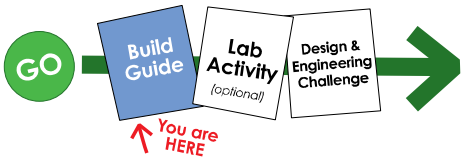
Build Guide & Labs
Wind Lift

TeacherGeek LS

Wind is an *amazing* energy source! Use the power of the wind to lift objects. This Build Guide and Lab activities will help you create your own Wind Lift.

LEARN stuff LS

This is the LS (learn stuff) Build Guide. To do this activity "just for fun" download the JFF documents at **teachergeek.com/learn**

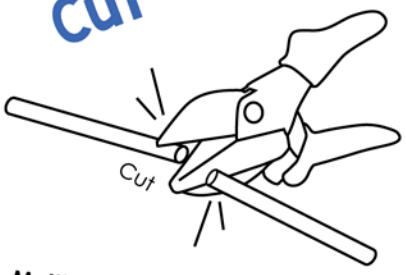


This packet includes the Build Guide and the Labs. Download the Challenge documents at **teachergeek.com/learn**

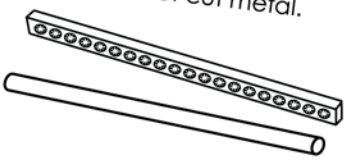
TeacherGeek Build Guide

What do you need to know
to make something out of TeacherGeek?

Cut

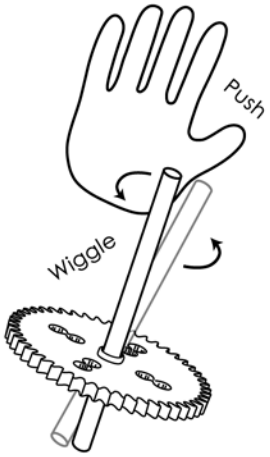


Multi-Cutters cut wood & plastic (like **dowels** and **connector strips**). They do not cut metal.

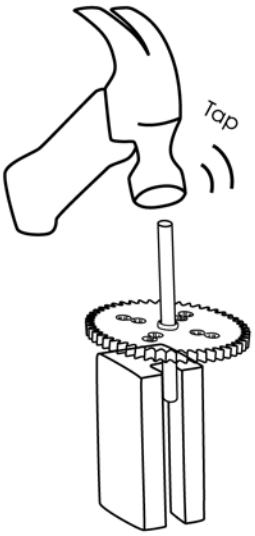


Push, Wiggle,

Push, wiggle or tap **dowels** into holes.



Tap



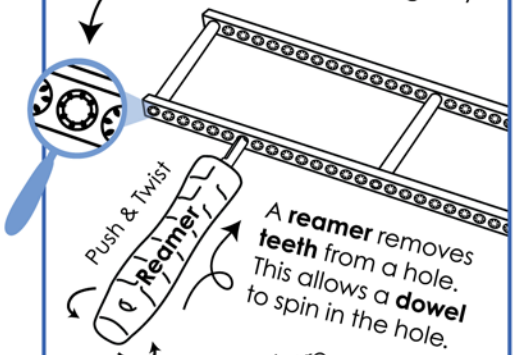
Use a **hammer** and **slider block** to tap **dowels** farther thru holes.

Quick Tip!

Use a crayon, or soap on the end of a Dowel to make building easier.

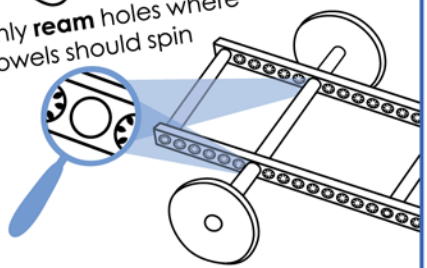
Ream

Most parts have holes with **teeth**. The **teeth** hold **dowels** (keep dowels from falling out).



A **reamer** removes **teeth** from a hole. This allows a **dowel** to spin in the hole.

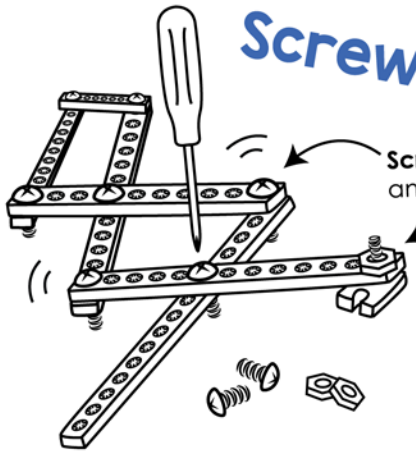
Only **ream** holes where dowels should spin



Never **ream pulleys**, **gears**, **wheels**, or any hole a **dowel** stays stuck into.

Screws & Nuts

Do not **ream** holes you will put **screws** into.



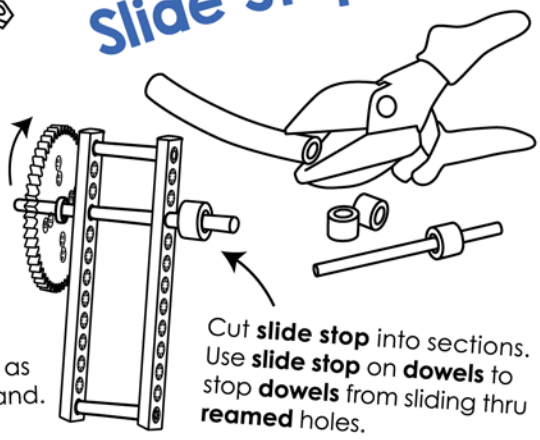
Screws (without nuts) can connect parts, and allow them to rotate.

Screws (with a nut) can connect parts, and keep them from rotating.

Stop Clip

Press a **stop clip** onto a **dowel** to keep it from sliding or use it as a hook for a string / rubber band. It takes little force to get it on.

Slide Stop



Cut **slide stop** into sections. Use **slide stop** on **dowels** to stop **dowels** from sliding thru **reamed** holes.

More resources available at teachergeek.com.
Adult supervision required for children 12 and under.

Wind Lift Build Guide

TeacherGeek LS

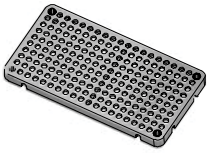
TeacherGeek Components

For One Wind Lift

Here are the TeacherGeek materials you'll need to build each Wind Lift.
Available as single: *SKU 1823-14* or 10 pack: *SKU 1823-15*. Both include extra parts for your own innovative creations!

x4
Perpendicular Blocks

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



x1
Hole Plate

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

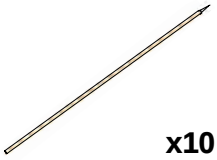
x2
⅝" or 1" #10 **Screw**

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

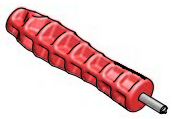
TeacherGeek Tools You'll Need

Easy to Share in Groups

Tools can be shared between classes and groups.

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

Here are some non-TeacherGeek materials that you will need.

Tape

String
450mm (1.5ft)

100 or more **Pennies** to lift
What else could you try?

Recycling Materials
(for blades)

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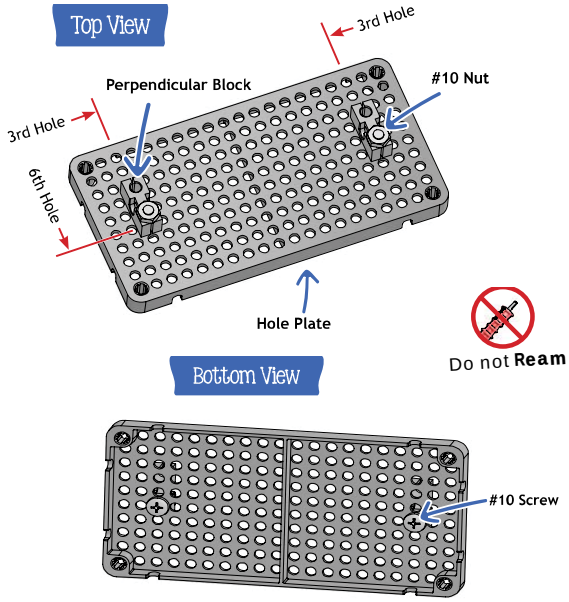
Let's Get Started

1. Attach two **perpendicular blocks** to the **hole plate** using two **#10 screws** and **#10 nuts**.

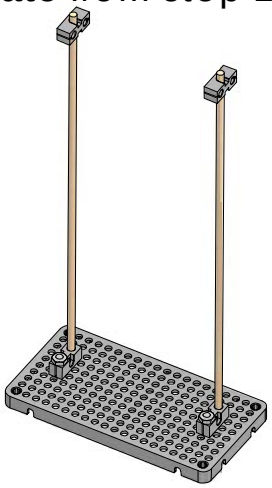


Do not **Ream**

2. Tap two **dowels** into the middle hole of two **perpendicular blocks**.

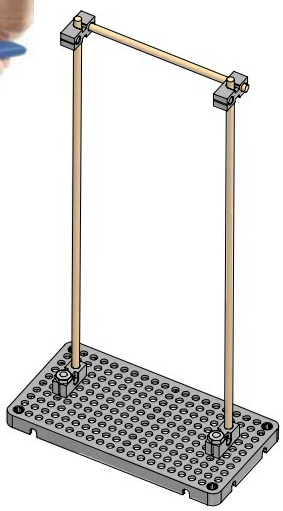
Do not **Ream**

3. Push the **dowels** from Step 2 thru the **perpendicular blocks** and **hole plate** from Step 1.



Do not **Ream**

4. Cut a **dowel** to 13cm (6"). Insert it into the uprights as shown.



Do not **Ream**

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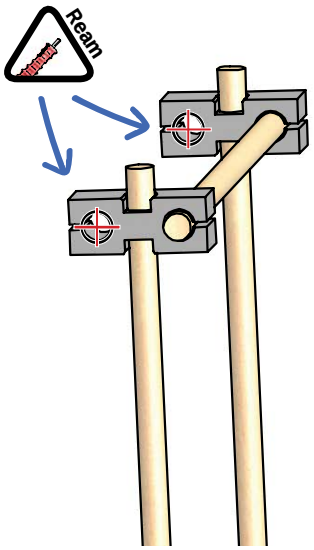
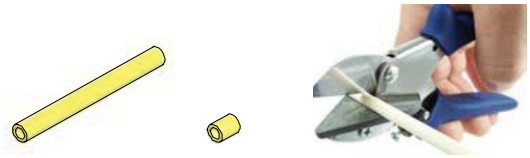
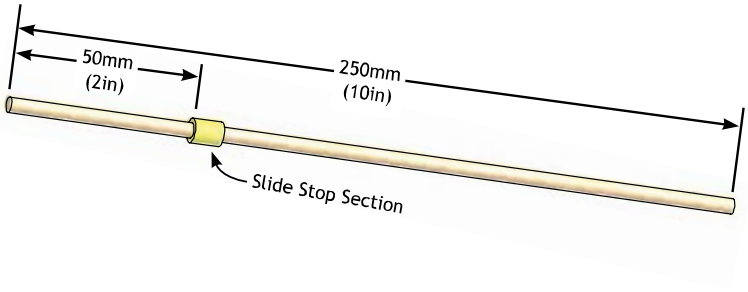
5 **Ream** the two holes marked with the ⊕ symbol.

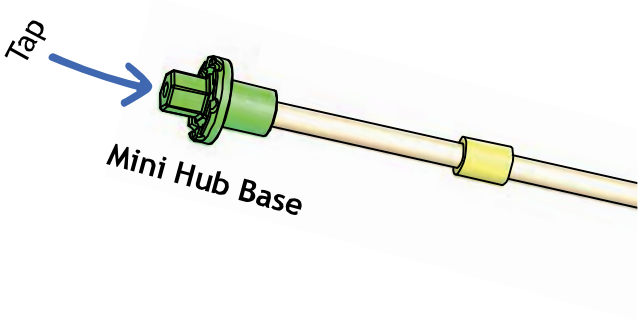


6 Cut a **dowel** to 250mm (10″) and a **slide stop** to 6mm (¼″). Then slide the **slide stop** 5mm (2″) up the **dowel**.

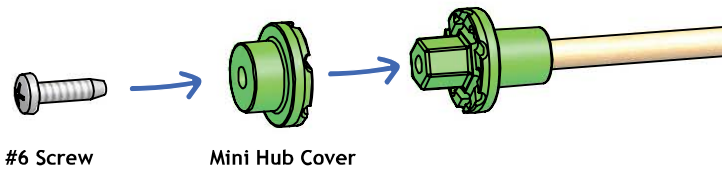


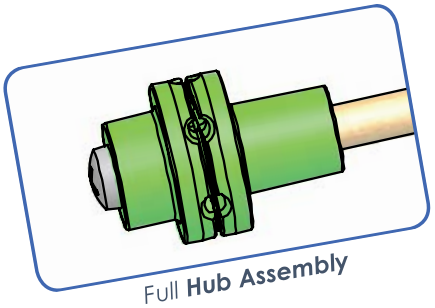


7 Insert the **dowel** from Step 6 into the **mini hub base**.



8 Attach the **mini hub cover** to the **mini hub base** using a **#6 screw**.





Full **Hub Assembly**

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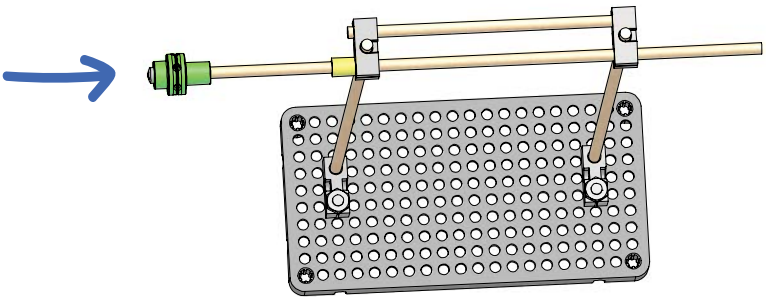
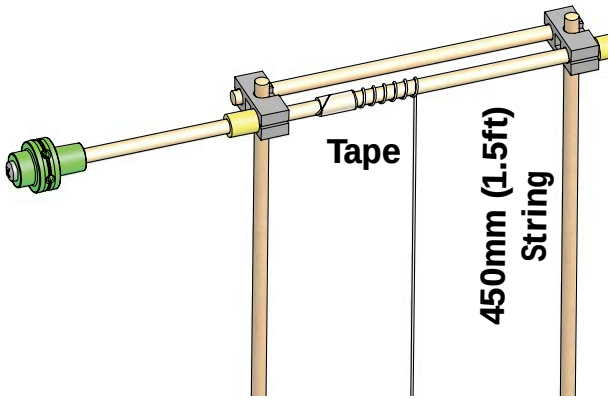
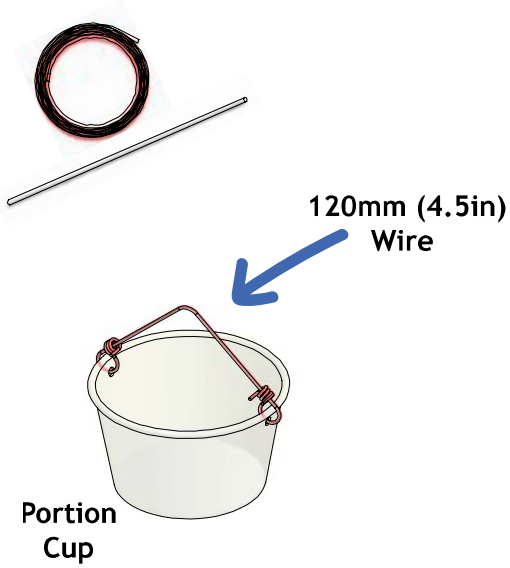
9 Insert **hub assembly** from Step 8 into the **reamed** holes of Step 5.



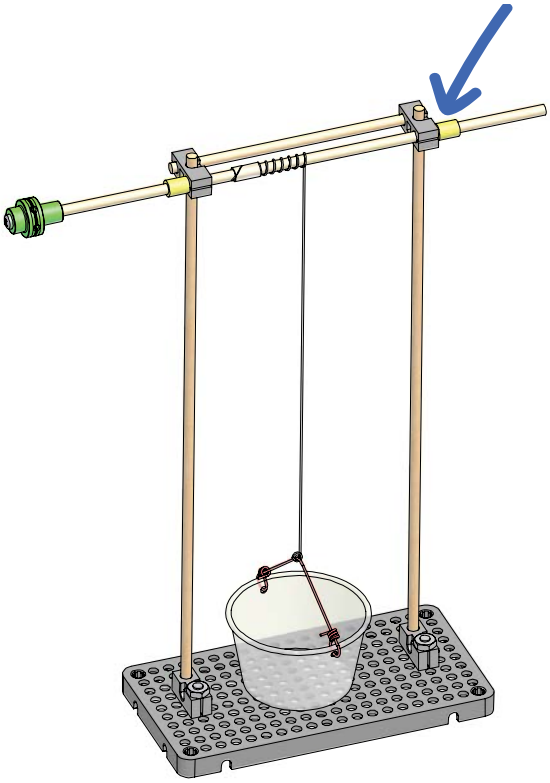
10 Tape a 45cm (1.5ft) **string** onto the **dowel** with the **hub assembly**.



11 Punch two holes on opposite sides of a **portion cup** and attach a 120mm (4¼") **wire** thru the **portion cup** holes to create a handle.



12 Attach the **string** from Step 10 to the **wire** handle from Step 11 and secure a **slide stop** to the back end of the **dowel**.



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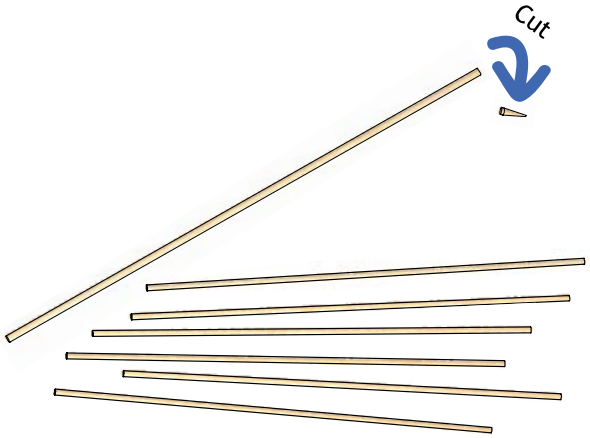
Blade Designs

It's now time to make your blades. Make the example blades shown below. Experiment with them, use them to complete the lab (optional), and then change them into your own unique design.

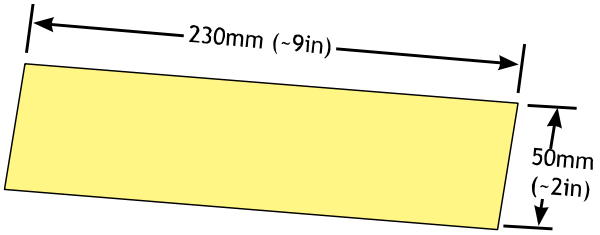
13 Cut the points off the **skewers**.



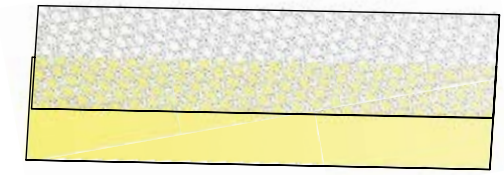
14 Find materials for your **blades** like recycled materials, poster board, card board, plastic, etc.

You will also need **tape**

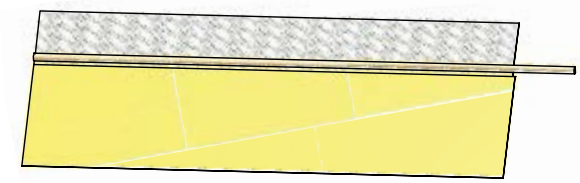
15 Attach the **blade** material (cardboard, card stock, cereal box material) to the skewers using tape.



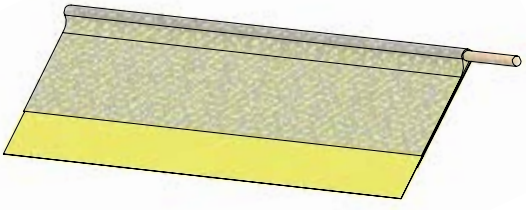
*a. Cut a section of **blade***



*b. Place the **tape** half over the edge of the **blade** material.*



*c. Face sticky side up and place a **skewer** at the edge of the **blade** material, overhanging to one side.*



*d. Fold the **tape** over the **skewer** to secure to the **blade** material.*

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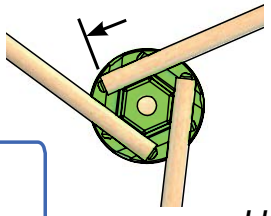
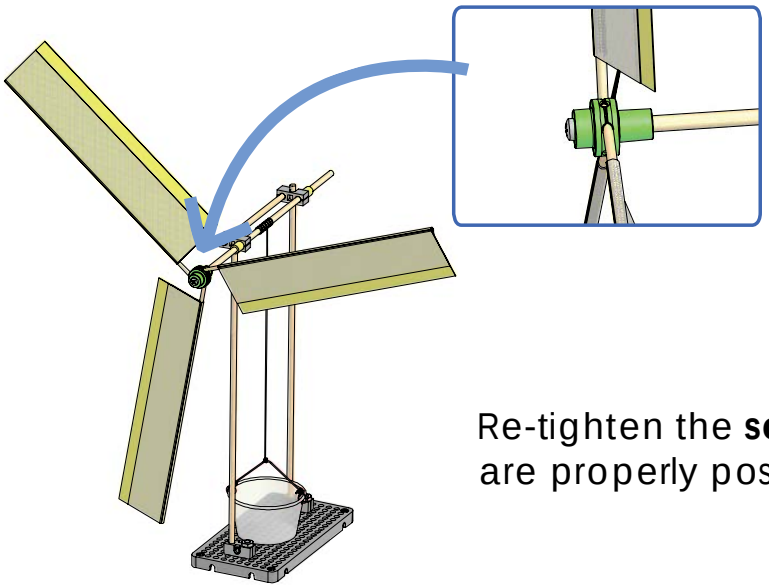
16 Attach the **blades** to the **hub** by loosening the **screw** (about a ¼ turn) to allow the **skewer** to slide in.





*How many **blades** do you want?*

*The **hub** will hold anywhere between 1 and 6 **blades**.*

Re-tighten the **screw** when **blades** are properly positioned.

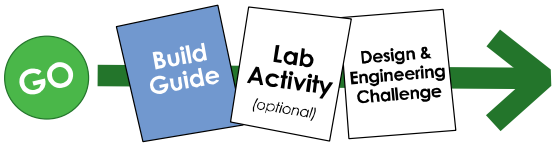
Up Next

Congratulations!

Your example Wind Lift is complete. Now it's time to learn more about your Wind Lift in the Labs.

Move on to the Energy, Blade Angle and Area Labs on the next pages.

After you've finished, download the Design & Engineering Challenge documents at **teachergeek.com/learn** and take your Wind Lift even higher.



Wind Lift Energy Lab

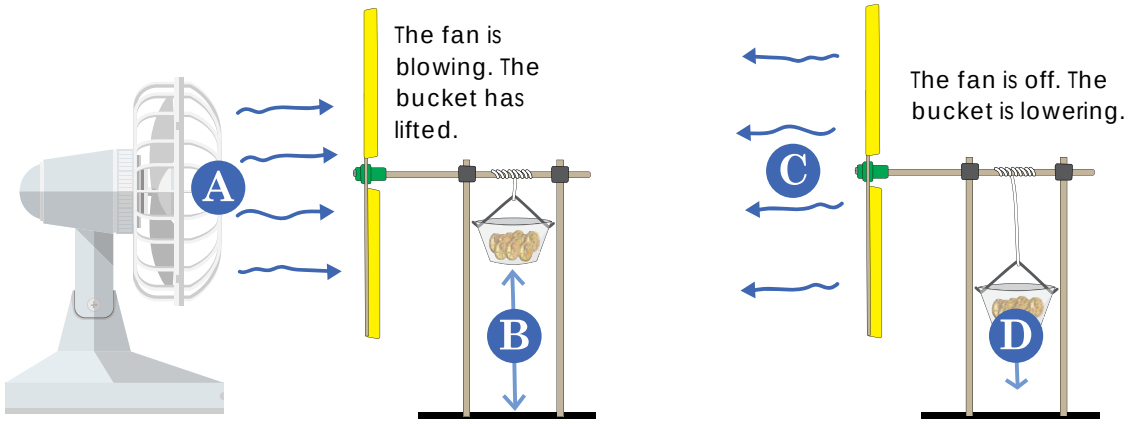
Name(s): _____

Make sure you have built a TeacherGeek Wind Lift, before starting this lab.

Energy is the ability to do work

Potential energy is stored energy. It is as the result of its position.

Kinetic Energy is the energy of motion. If an object is moving, it has kinetic energy.



Write the letters to match the type of energy shown above. Use letters only once.

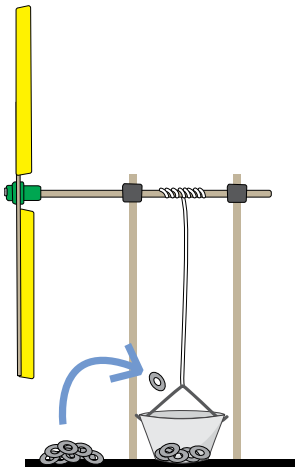
1. ____ shows potential energy turning into kinetic energy

2. ____ shows potential energy as a result of height

3. ____ shows kinetic energy that came from electricity

4. ____ shows the kinetic energy of blowing air; from the potential energy of the bucket

5. Put something heavy in the bucket. Wind up the bucket by hand (without the fan) and let it drop. Notice how fast blades spin and how much air is pushed. Now put something light in the bucket. Wind it up and let the bucket drop. What's different? Figure it out. Explain it to your teacher using these, and other words:



☐ Potential Energy ☐ Kinetic Energy ☐ More Energy ☐ Less Energy

Teacher Signature _____

Wind Lift Blade Angle Lab

Name(s): _____

Make sure you have built a TeacherGeek Wind Lift, before starting this lab.

1. Hypothesis: How do you think changing the angle of the Wind Lift Blades will affect the number of pennies it can lift?

_____

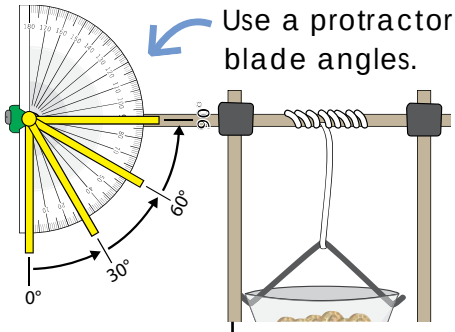
_____

_____

Many wind turbines change the angle of their blades to adjust to wind conditions.

Test your Hypothesis

Test how many pennies your wind turbine can pick up, at different blade angles.



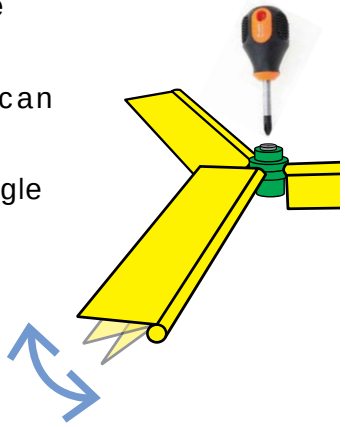
Use a protractor to set blade angles.

Change the Blade Angle

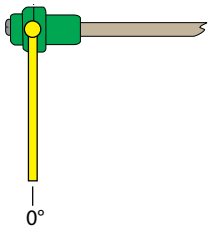
A. Loosen the hub screw a little bit; so the blades can turn, but do not fall out.

B. Change the blade angle using a protractor.

C. Tighten the screw up again.



0° Blade Angle



2. What happens when the blade is at 0°?

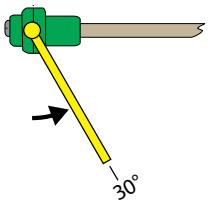
_____

_____

_____

_____

30° Blade Angle



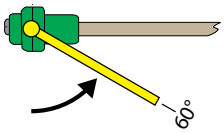
3. How many pennies can it lift at 30°?

_____

4. How long does it take to lift the bucket?

_____

60° Blade Angle



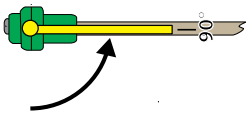
5. How many pennies can it lift at 60°?

_____

6. How long does it take to lift the bucket?

_____

90° Blade Angle



7. What happens when the blade is at 90°?

_____

_____

_____

_____

Wind Lift Blade Angle Lab

TeacherGeek

8. Was your hypothesis correct? Please explain why, or why not (don't just write "yes" or "no").

_____

_____

_____

9. The wind turbine shown on the right was damaged from high winds. What did you learn from your blade angle tests that could have helped this wind turbine? What would you have it do in high winds to protect the blades?

_____

_____

_____

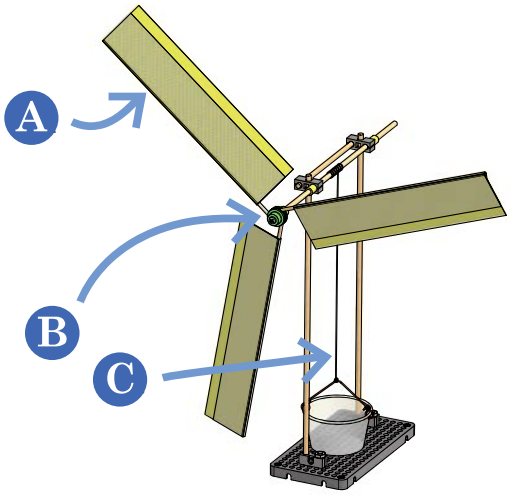
_____

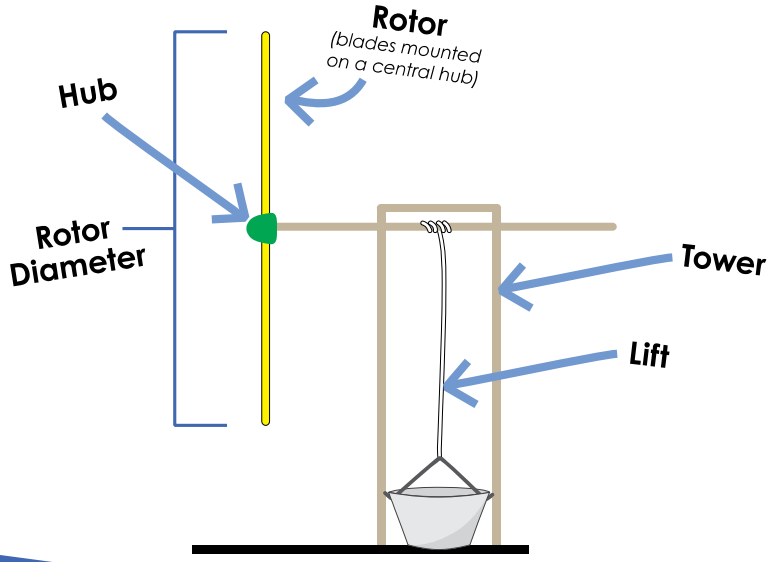
10. Write the names of the components shown below. Note: Blade is not an answer.

A _____

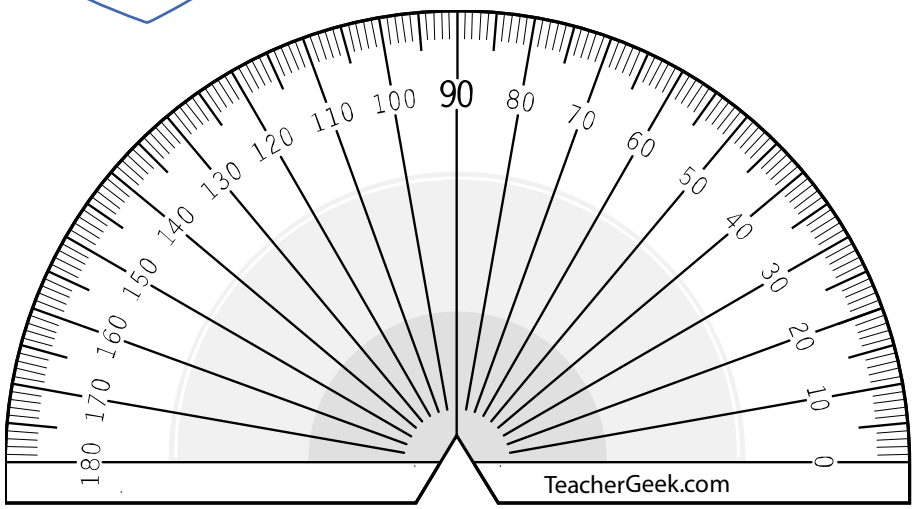
B _____

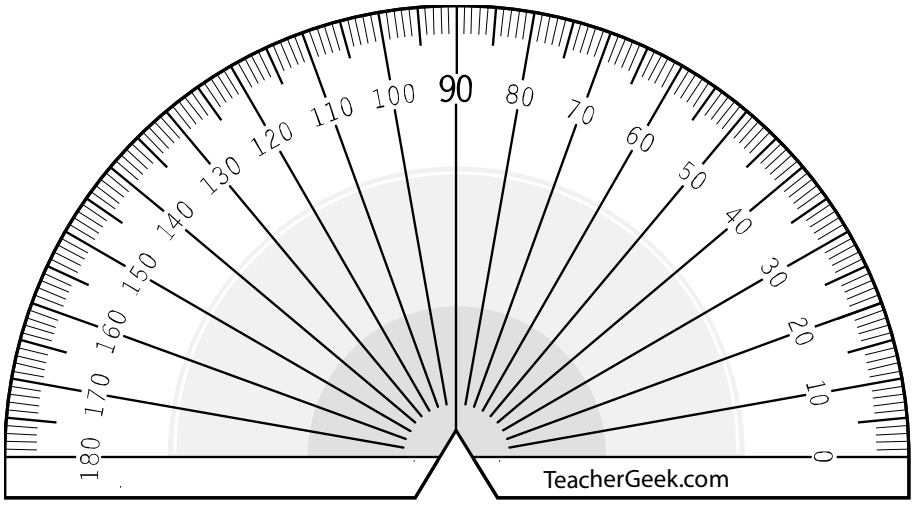
C _____

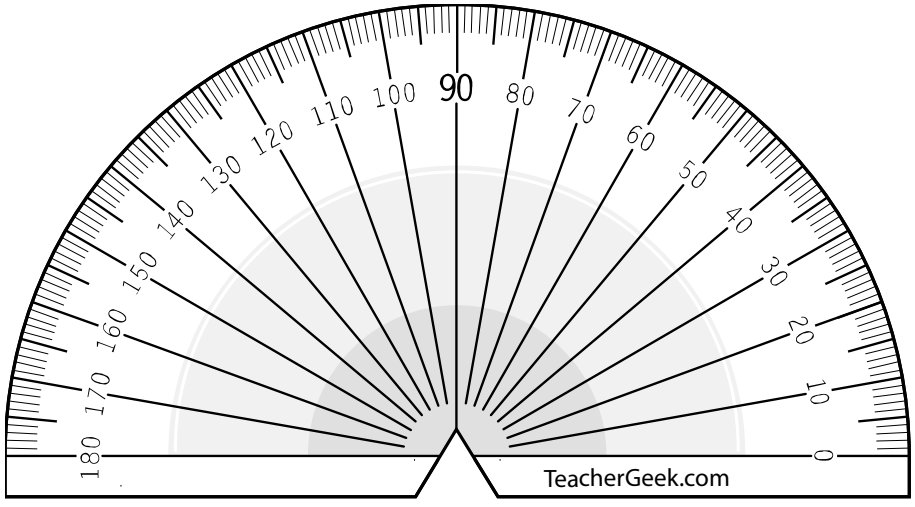




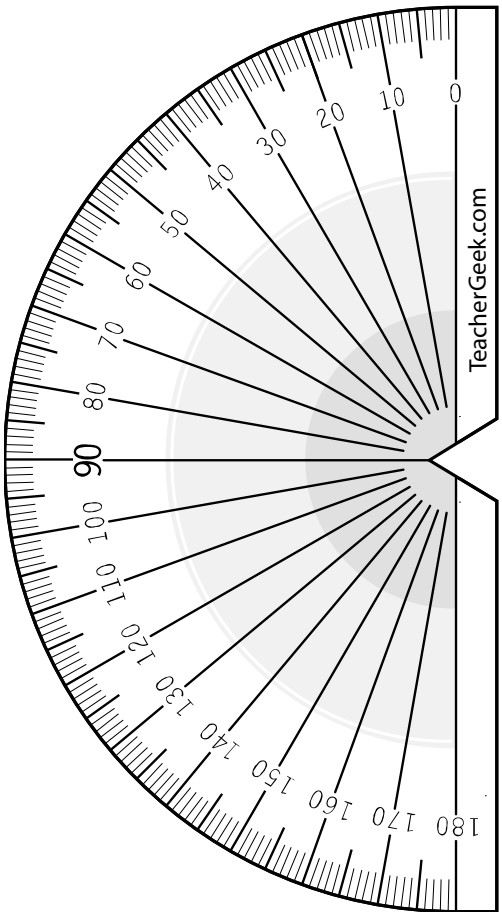
Wind Lift Blade Angle Lab







These protractors will work well for the Wind Lift Angle Lab. Print them on heavy paper and cut them out. The notch allows them to position centrally on the blade shaft.



Wind Lift Blade Area Lab

Name(s):

_____

Make sure you have built a TeacherGeek Wind Lift, before starting this lab.

1. Hypothesis: How do you think the Wind Lift blade area affects the number of pennies that can be lifted?

_____

_____

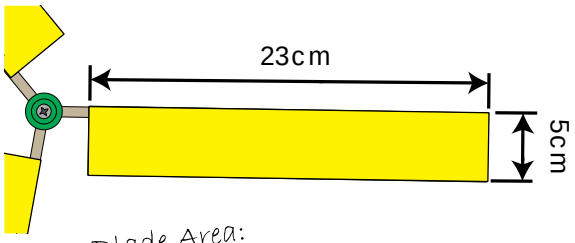
_____

_____

Some wind turbines/wind mills have blades with a lot of area. Other wind turbines have blades with very little area.

Get Ready

Make sure that your blades are 23cm x 5cm. If they are not, cut new blades and tape them on. They should be like this.



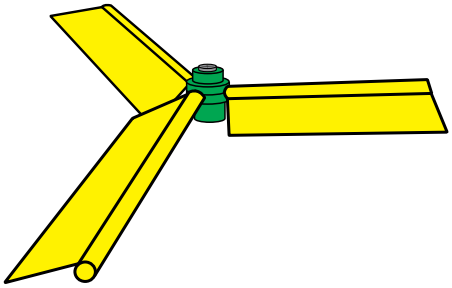
Blade Area:

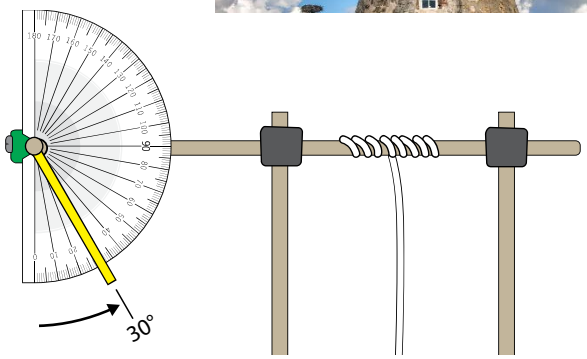
$23 \times 5 = 115cm^2$

$115cm^2 \times 3 = 345\ cm^2$

Blade Area x # of blades = total area

Set the angle of your blades to approximately 30°.



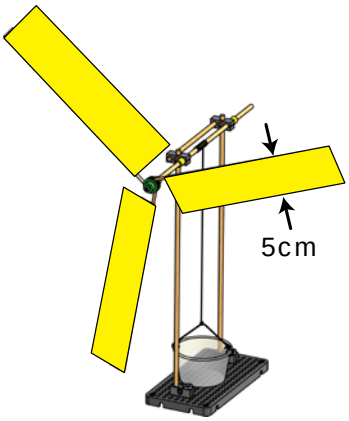


Change the blade angle by: A. Loosening the hub screw a little bit; so the blades can turn, but do not fall out. B. Changing the blade angle using a protractor. C. Tightening the screw up again.

Wind Lift Blade Area Lab

Test your Hypothesis: How does blade area affects the number of pennies that can be lifted?

Use your 5cm wide blades.



2. What is the combined area of all of the blades?

_____

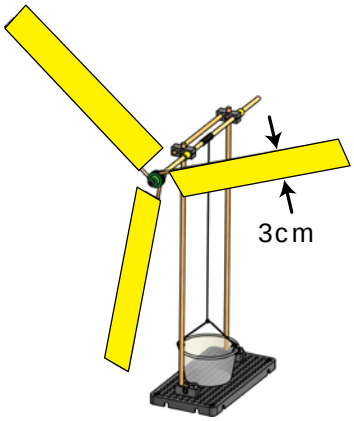
3. What is the maximum number of pennies that can be lifted?

_____

4. How long does it take to lift the bucket?

_____ seconds

Cut your blades to 3cm wide.



5. What is the combined area of all of the blades?

_____

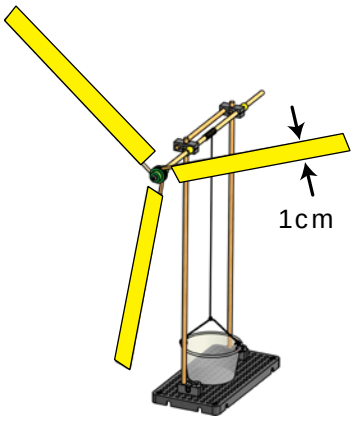
6. What is the maximum number of pennies that can be lifted?

_____

7. How long does it take to lift the bucket?

_____ seconds

Cut your blades to 1 cm wide.



8. What is the combined area of all of the blades?

_____

9. What is the maximum number of pennies that can be lifted?

_____

10. How long does it take to lift the bucket?

_____ seconds

11. Was your hypothesis correct? Please explain why, or why not (don't just write "yes" or "no").

_____

_____

_____

_____