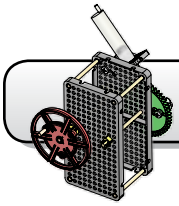
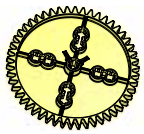
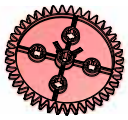
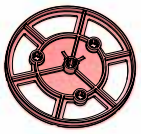
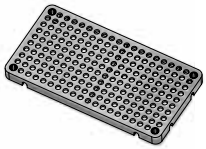
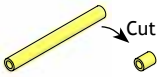
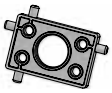


Wind Pump Construction

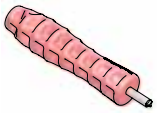
What Will You Need?

The following components can be found in your kit, and are needed to build one wind pump:

 50 Tooth Gear* Quantity: 1	 40 Tooth Gear* Quantity: 1	 20 Tooth Gear* Quantity: 1	 10 Tooth Gear* Quantity: 1	 Wheel Hub Quantity: 2	 300mm (~12in) Dowels Quantity: 10
 Hole Plate Quantity: 2	 Stop Clip Quantity: 6	 100mm (3in) Slide Stop Cut into 6mm (1/4in) from Longer Lengths Quantity: 1	 10cc Cylinder Quantity: 1	 Vinyl Tubing 1500mm (5ft)	 10cc Cylinder Clip Quantity: 1
 10cc Cylinder Mount Quantity: 1	 Fender Washer, #10 Quantity: 4	 Locking Nut, #10 Quantity: 1	 Nut, #10 (Non-locking) Quantity: 10	1in Machine Screw, #10 Quantity: 15	2in Machine Screw, #10 Quantity: 2
 Perpendicular Blocks Quantity: 14	 T-Connector Quantity: 1	 Check Valve Quantity: 2	The following materials are needed (not in the kit):  Tape  Blade Material; poster board, cardboard, plastic, wood, etc.		

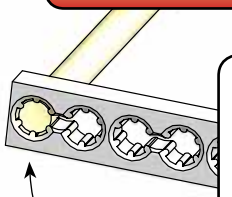
*Gear & Pulley Colors will vary.

The following tools will be needed:

 Cutters	 Reamer	 Screwdriver	 Pliers

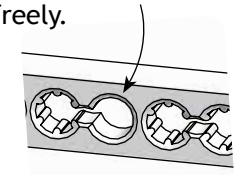
How The System Works

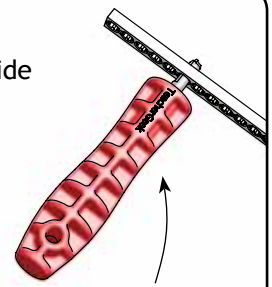
Holes & Reaming



Components come with holes that dowels press securely into.

Reaming holes to allow dowels to rotate and slide freely.

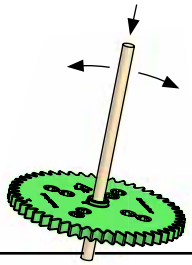


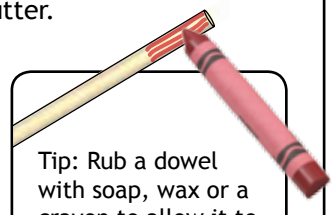


Turn a reamer back and forth through a hole.

Push, Wiggle, Tap

Push dowels into holes by:
1. Wiggling and pressing with your hands
2. Tapping dowels with a hammer or the side of your cutter.





Tip: Rub a dowel with soap, wax or a crayon to allow it to slide easier into and out of holes.

Dowels

Dowels vary in diameter. Some may be too large or small to use.

The ends of dowels may taper and need to be cut off to fit tightly into holes.

Cutting

Dowels and Connector Strips can be cut with a multi-cutter (best method), saw, side cutters or pruning shears. Wear safety glasses when cutting.

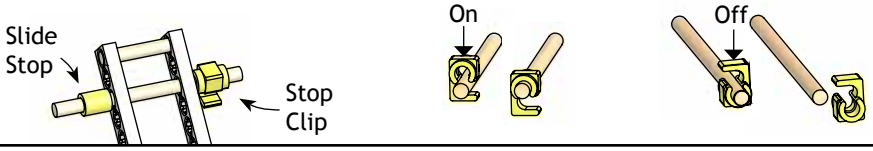
Multi-Cutters

WARNING!!!

Most holes should not be reamed. Do not ream holes which dowels should stay pressed into.

Slide Stop and Stop Clips

Use slide stop or stop clips to keep dowels from sliding in reamed holes. Slide stop sections must be cut from a longer length before use.

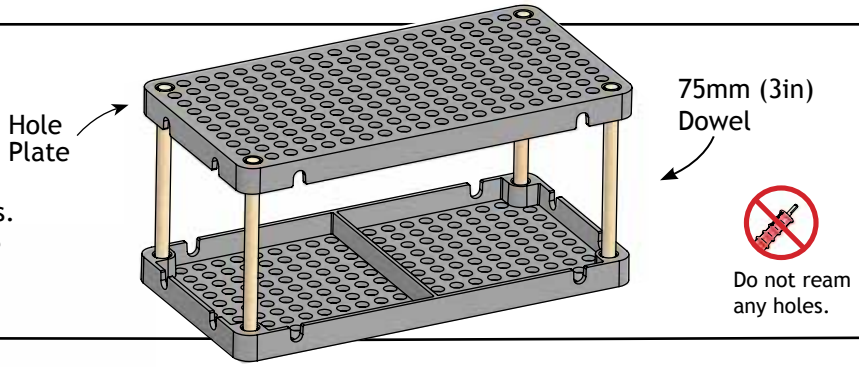


Start Building

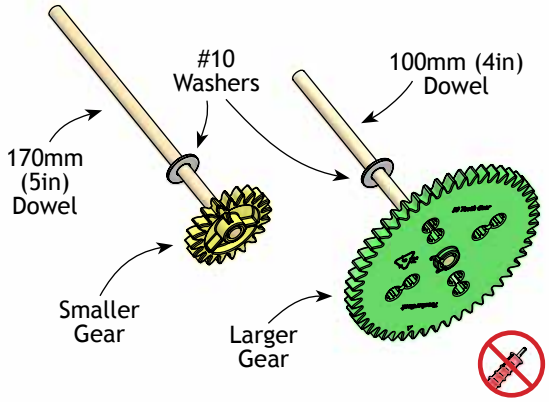
Step 1

Cut and press four 75mm (3in) dowels between hole plates.

Push dowels into holes by:
1. Wiggling and pressing with your hands.
2. Tapping dowels with a hammer or the side of your cutter.



Step 2

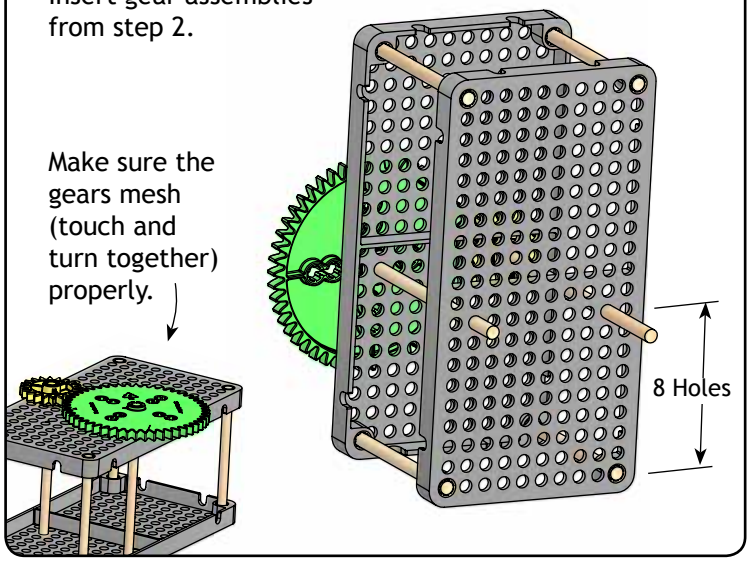


Choose the gear combination you wish to start with (you have 4 gears to choose from). Place them on the indicated dowel lengths with washers.

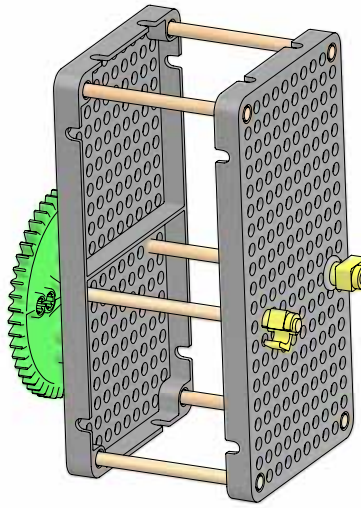
Step 3

Insert gear assemblies from step 2.

Make sure the gears mesh (touch and turn together) properly.



Step 4



Use stop clips or slide stop to keep the dowels (axles) from step 3 from sliding out of the frame.

The dowels should be able to slide back and forth 1.5mm (1/16in) when the stop clips are on.

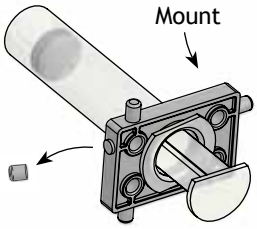
Step 5

Cut the end of the cylinder plunger as shown.

Step 6

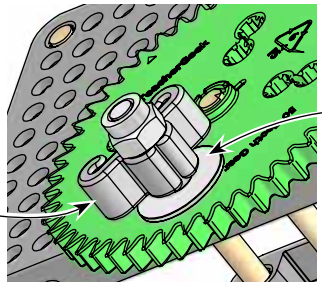
A. Snap the mount onto the cylinder.

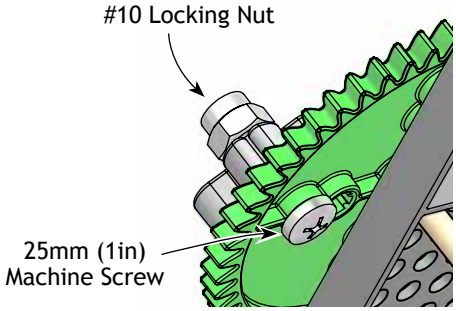
B. Cut the pin off the mount as shown.



Step 7

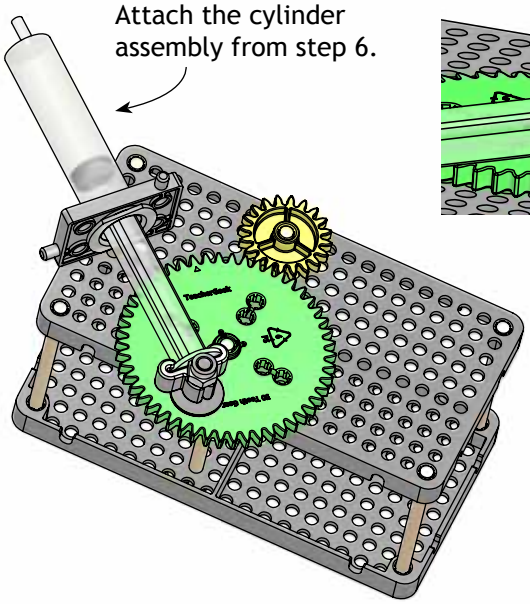
Attach the cylinder clip to the large gear. Keep the locking nut slightly loose so the cylinder clip can rotate.

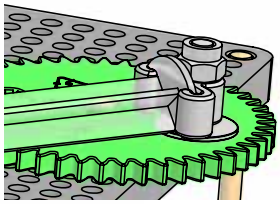




Step 8

Attach the cylinder assembly from step 6.





The cut side of the plunger should face the gear.

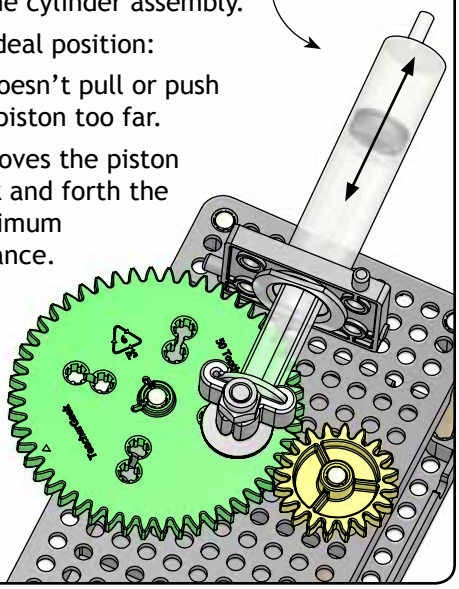
Step 9

Experiment with the positioning of the cylinder assembly.

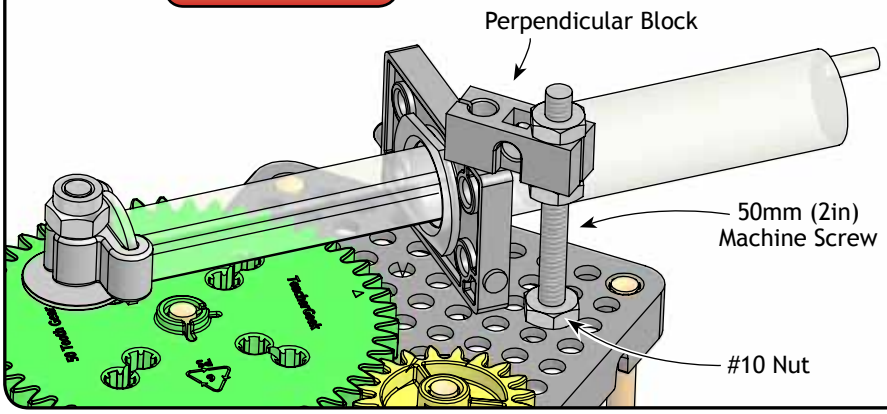
An ideal position:

A. Doesn't pull or push the piston too far.

B. Moves the piston back and forth the maximum distance.



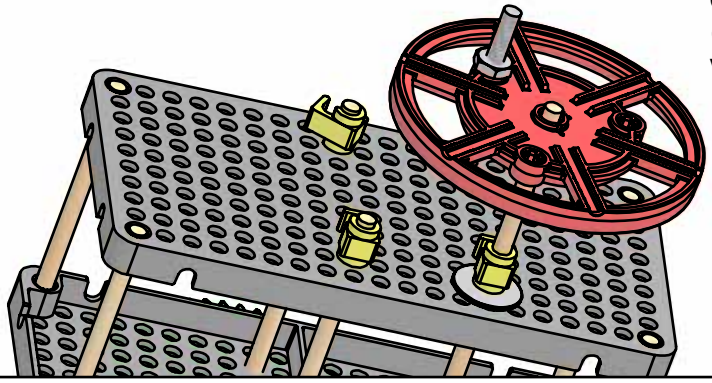
Step 10



Secure the cylinder assembly to the frame using a perpendicular block, machine screw and nuts. Tighten the nuts so the perpendicular block is fixed (can not move), but the cylinder mount can rotate.

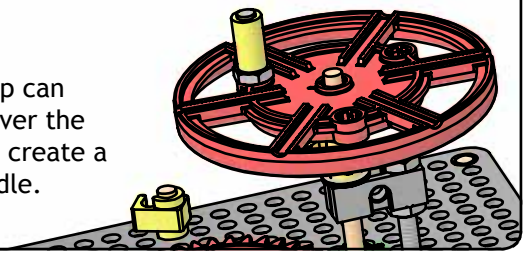
Step 11

Create a crank to test your pump. The crank can be left on (making it a hand powered pump), or converted later into a hub to hold blades (for a wind pump).



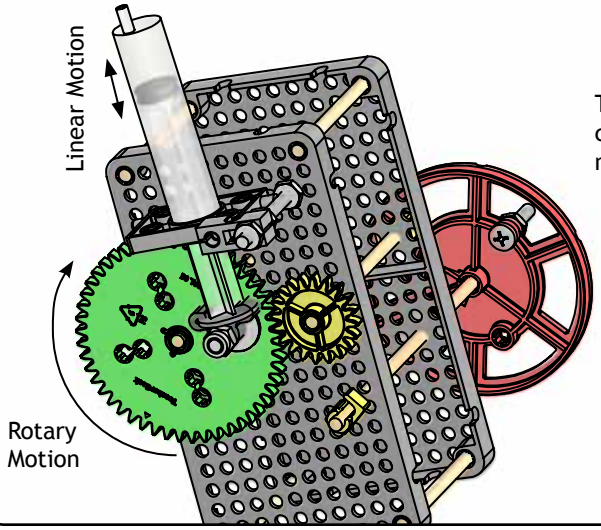
Create the crank from a 25mm (1in) machine screw, nut and wheel-hub.

Slide stop can be slid over the screw to create a soft handle.



Nice Cam

A cam turns rotary motion (turning hub and gears) into a linear motion (reciprocating piston).

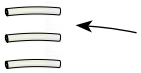


The cam shaft in an internal combustion engine turns linear movement into rotary.

Locomotive wheels are linked using cam shafts.

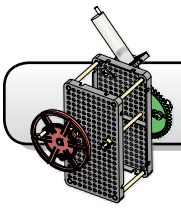
Step 12

Cut the following sections of tubing:



Three 50mm (2in) tubing sections

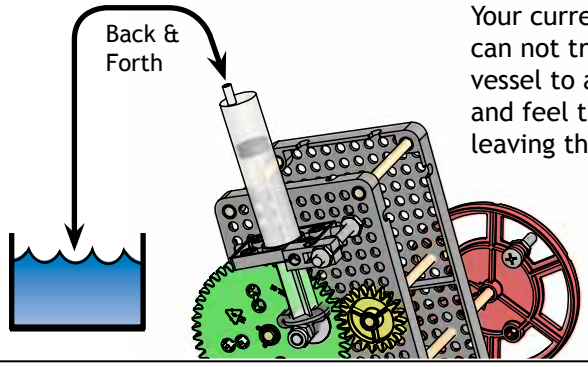
Two 600mm (2ft) tubing sections



Wind Pump Construction

From this point forward you will have to engineer many critical mechanisms for your pump.

Push, Pull

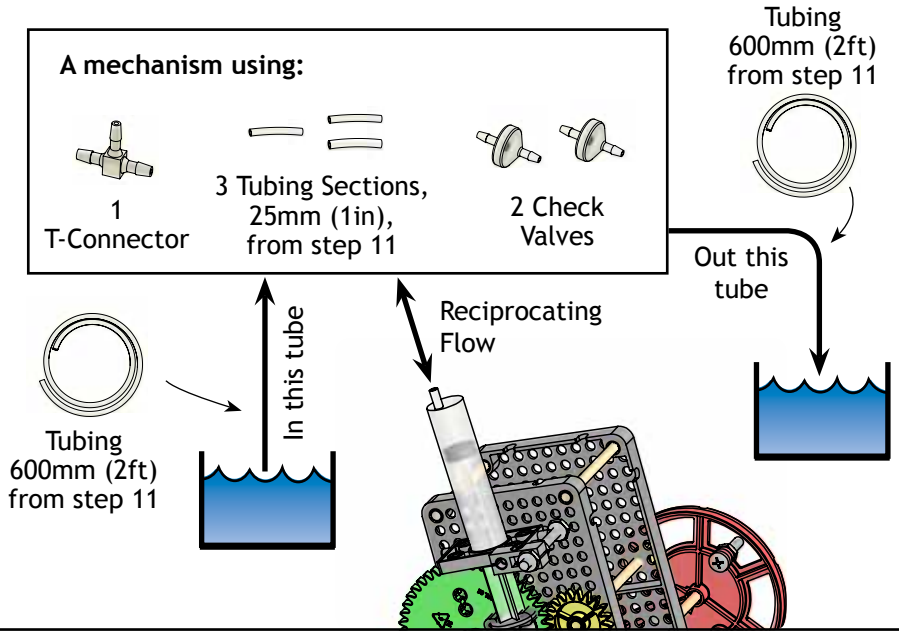


Your current pump configuration can not transport fluid from one vessel to another. Turn the crank and feel the air entering and leaving the cylinder.

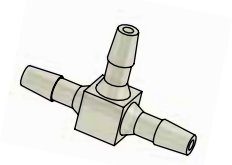
Step 13

Create a mechanism to transform the reciprocating fluid flow from the cylinder into a single direction flow (in one tube, out the other). Air or water can be used as the fluid.

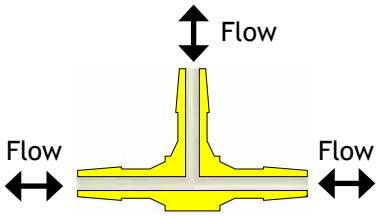
Use only the tubing cut in step 11, two check valves and one T-connector.



T-Connectors

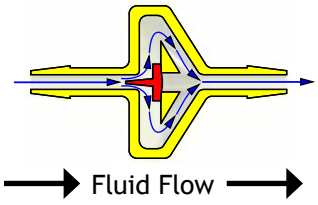


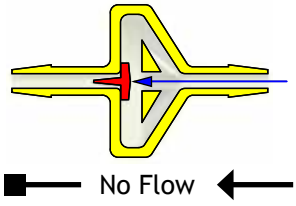
T-connectors allow fluid to flow between three ports (openings).



Check Valves

A check valve permits fluid flow in only one direction





Resources

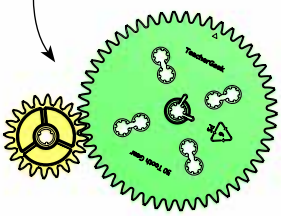
The following documents are available at TeacherGeek.com to help you with this activity:

- Fluid Power Lab
- Gears and Pulley Guide
- Mechanical Advantage Guide

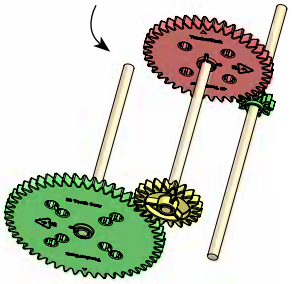
*Answer key available, password protected with code on wind pump bag label

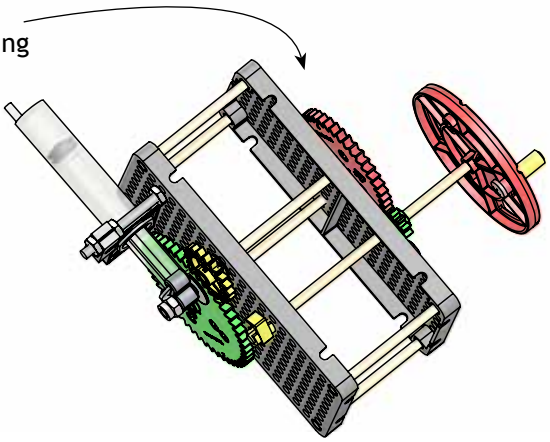
Step 14

Your pump currently uses two gears to create mechanical advantage.



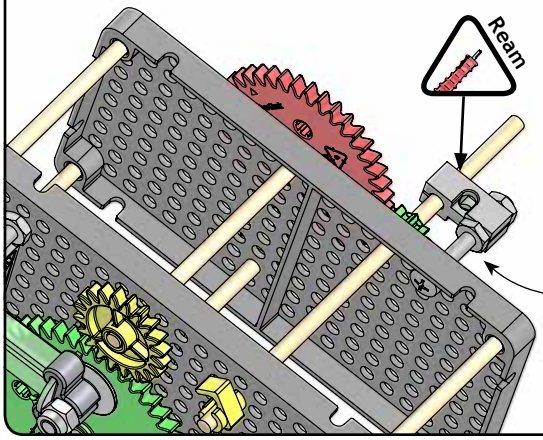
You may want to increase the mechanical advantage by adding additional gearing.





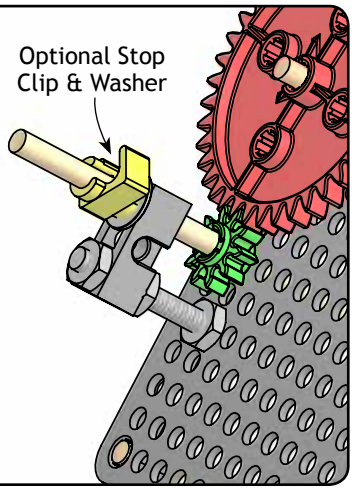
Downloadable TeacherGeek documents may help you create gear mechanisms and caclulate mechanical advantage.

Step 15



The drive shaft support can be created using a perpendicular block, nuts and a 50mm (2in) machine screw.

50mm (2in) machine screw and #10 Nuts

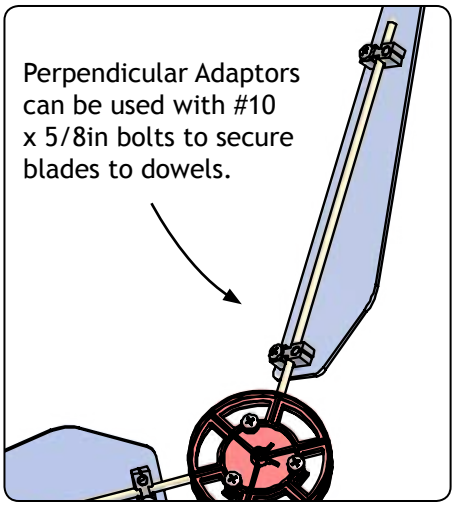


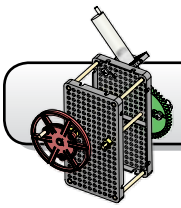
Turn It Into a Wind Pump (if you choose)

Step 16

Find your Blades: Materials for blades are not included in the kit. You are encouraged to reuse/recycle available materials.

Perpendicular Adaptors can be used with #10 x 5/8in bolts to secure blades to dowels.

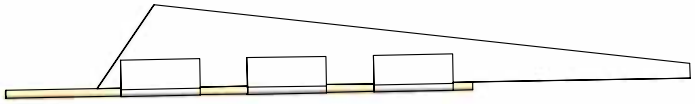




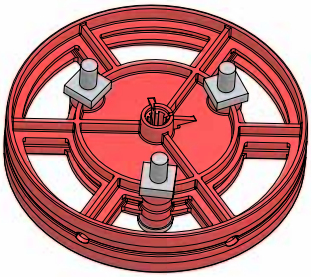
Wind Pump Construction

Step 18

Make your Blades: Create your blades and attach them to the supplied dowels.

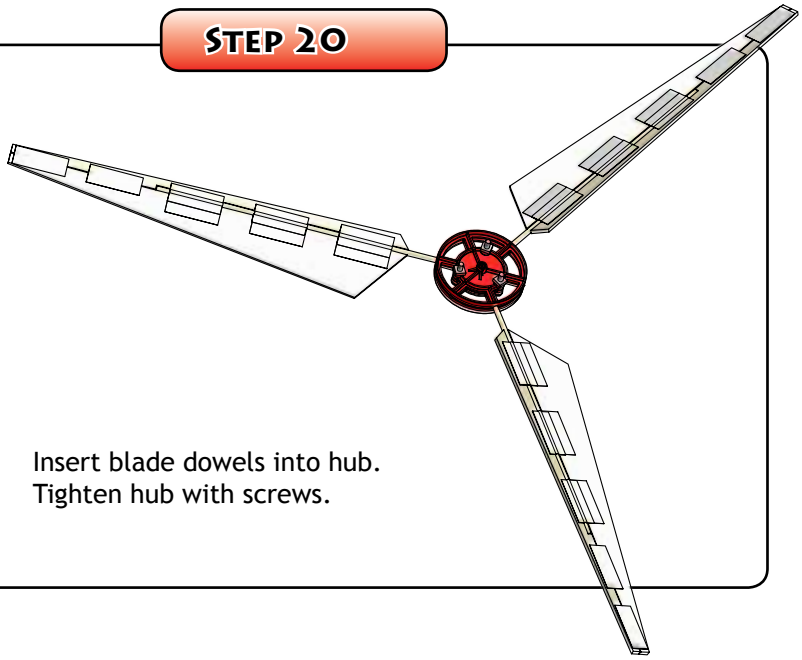


Step 19



Disassemble the crank created in step 10.
Loosely attach two wheel hubs, as shown, using #10 x 1 inch machine screws and nuts.

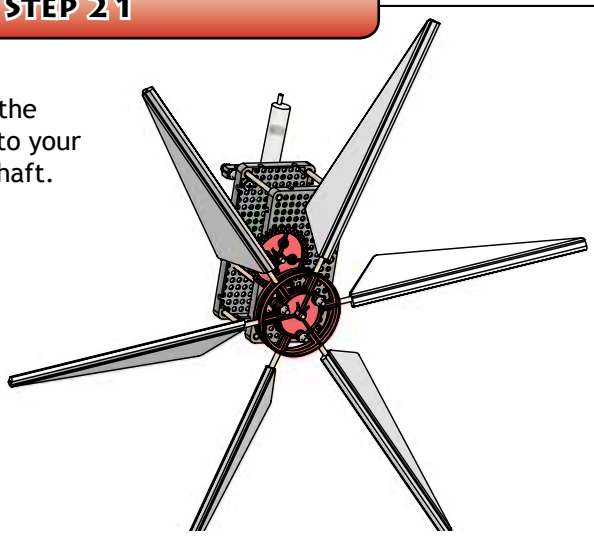
Step 20

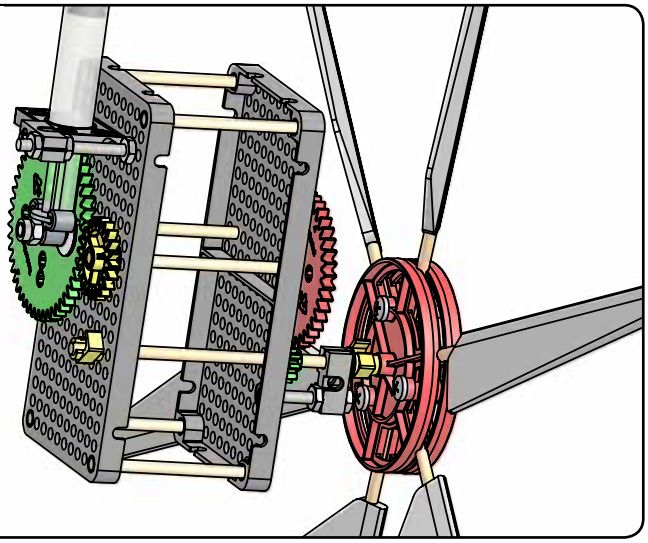


Insert blade dowels into hub.
Tighten hub with screws.

Step 21

Attach the blades to your pump shaft.





Continue to improve and evolve your wind pump.

Use the TeacherGeek Wind Stand or build your own.