



## TOOLS NEEDED

Cutter: Dowels and Connector Strips can be cut with a multi-cutter (best method), saw, side cutters, or pruning shears.



Cutter



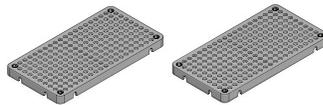
Reamer (best) or 15/64 (6mm) Drill Bit



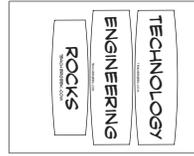
Small Hammer (optional)

Safety Glasses

## PARTS NEEDED



2 Hole Plates



1 Sign Card



5 Dowels



4 Perpendicular Blocks



1 Connector Strip



1 Rubber Band



1 Slide Stop Section



4 Stop Clips

The gears and pulleys in your pack will be a different size and color combination than shown in this guide.



1 Small and 1 Large Pulley

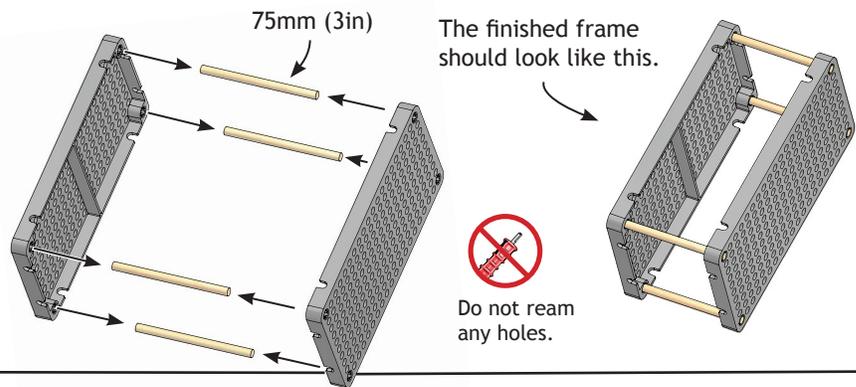


1 Small and 1 Large Gear

## STEP 1

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

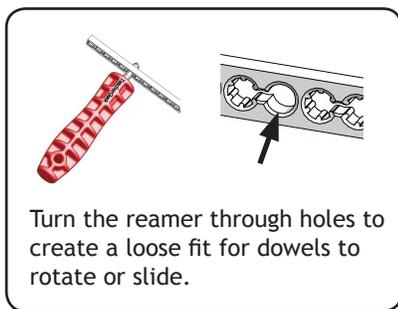
Push dowels into holes by:  
1. Wiggling and pressing with your hands  
2. Tapping dowels with a hammer or the side of your cutter.



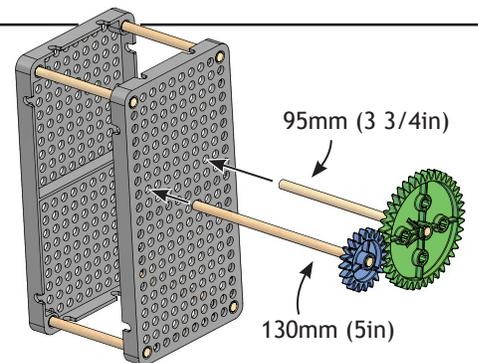
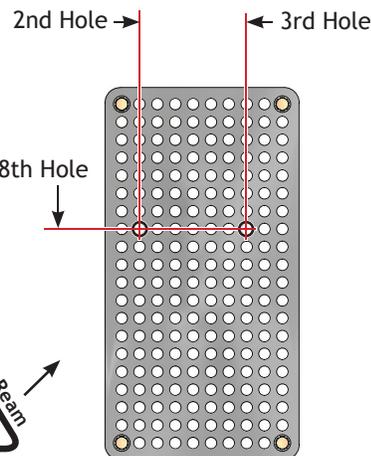
The finished frame should look like this.

Do not ream any holes.

## STEP 2



Turn the reamer through holes to create a loose fit for dowels to rotate or slide.

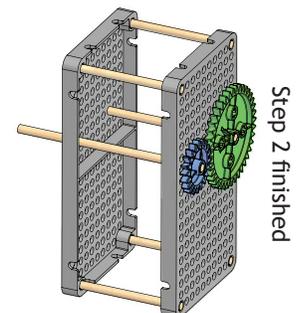


Do not ream the holes in gears.

A. Ream the holes marked with a ⊕. Both hole plates must be reamed.



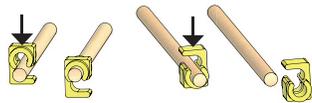
B. Cut a 95mm (3 3/4in) dowel. Slide the larger gear onto the end of it.  
C. Cut a 130mm (4 3/4in) dowel. Slide the smaller gear onto the end of it.  
D. Place the dowel & gear assemblies into the reamed holes.



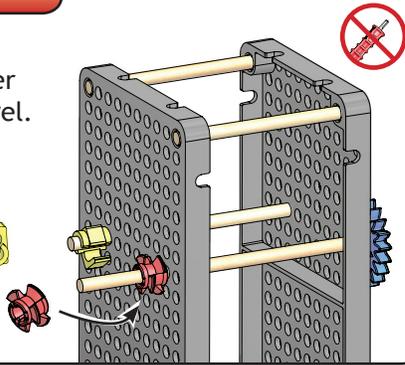
Step 2 finished

## STEP 3

Place a stop clip on the shorter dowel and smaller pulley on the longer dowel.



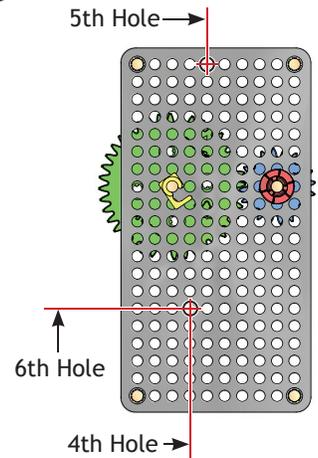
Stop Clips can be snapped on and off dowels.



## STEP 4

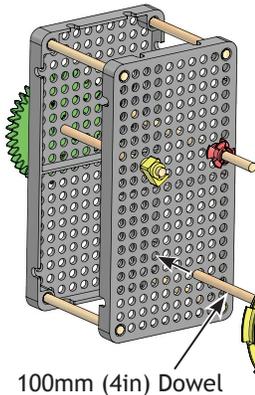


Ream the holes marked with a ⊕ through both hole plates.



## STEP 5

- A. Cut a 100mm (4in) Dowel. Slide the larger pulley onto the end of it.
- B. Place the dowel & pulley assembly into the reamed holes as shown.

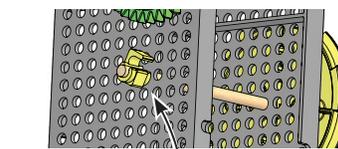


100mm (4in) Dowel

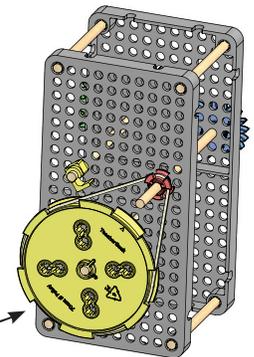


Do not ream.

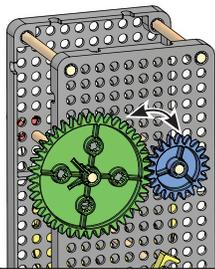
## STEP 6



- A. Place a stop clip on the end of the larger pulley dowel.
- B. Place a belt (rubber band) around the pulleys.



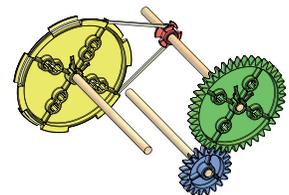
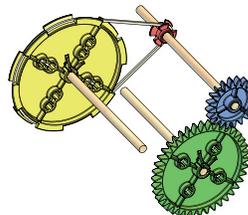
## EXPERIMENT



This is a great time to experiment with your gear transmission. Try switching gears to see how it changes your mechanical advantage.

Visit the TeacherGeek 'documents' section to find more information on transmissions and mechanical advantage.

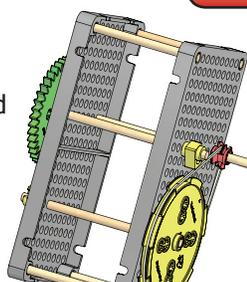
This is how your transmissions is currently configured. It is ideal for a flag waver.



This configuration allows you to develop the greatest mechanical advantage.

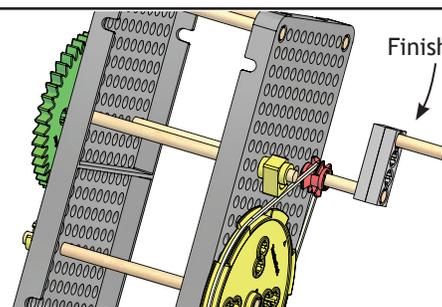
## STEP 7

Create the crank with connector strip sections and a dowel.



Connector Strips with 4 holes (30mm)

30mm (1 3/16in) Dowel

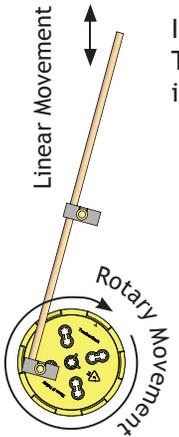


Finished Crank



Do not ream the holes in connector strips.

## CAMS



It is now time to add two cams to your mechanism. They will turn rotary motion (turning the crank) into a linear motion (back and forth).



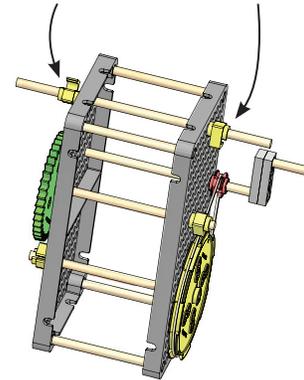
The cam shaft in an internal combustion engine turns linear movement into rotary.



Locomotive wheels are linked using cam shafts.

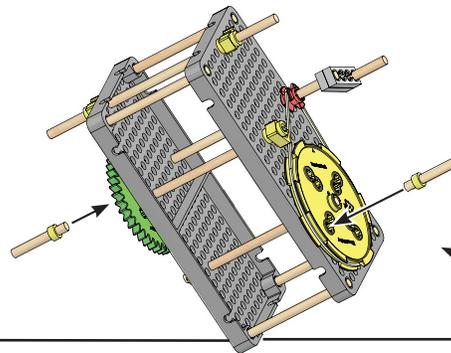
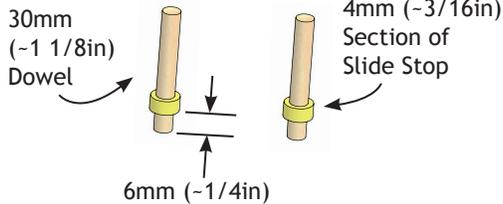
## STEP 8

Cut a 150mm (~6in) dowel and insert into the holes reamed from step 4. Secure it with stop clips



## STEP 9

Cut two 30mm (~1 1/8in) dowels and two 4mm (~3/16in) sections of slide stop.

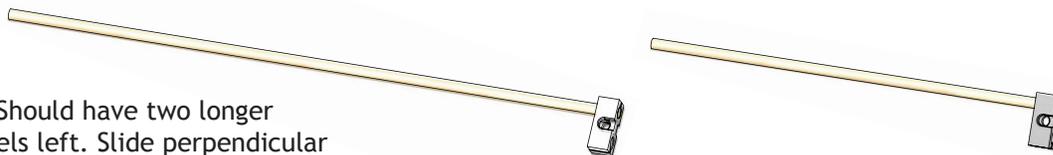


Assemble them as shown. Insert one into an outer pulley hole. Insert the other into an outer gear hole.

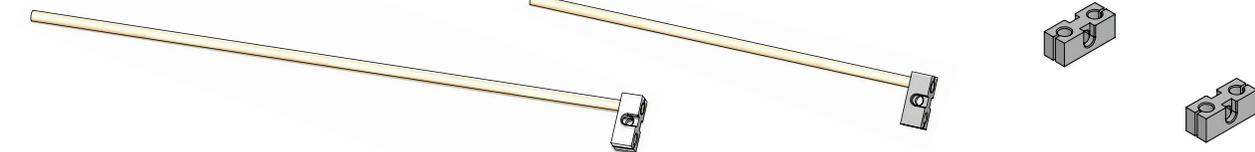


## STEP 10

You should have two longer dowels left. Slide perpendicular blocks onto the ends of them.



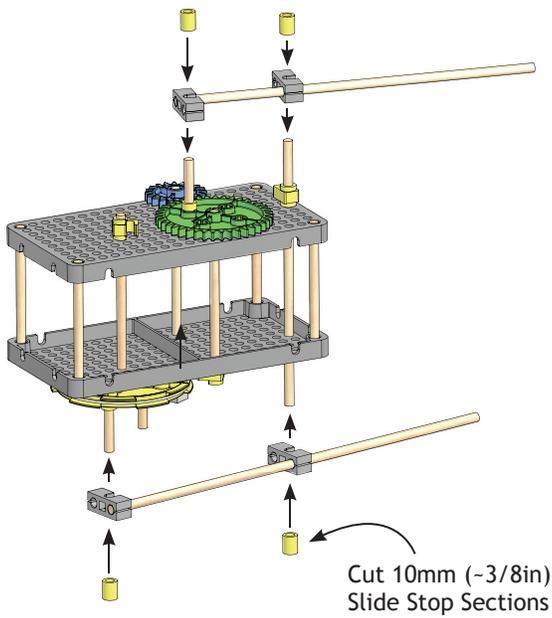
## STEP 11



Ream all the holes in the perpendicular adaptors other than the ones the dowels are inserted into. Ream all the holes in two other perpendicular adaptors.

## STEP 12

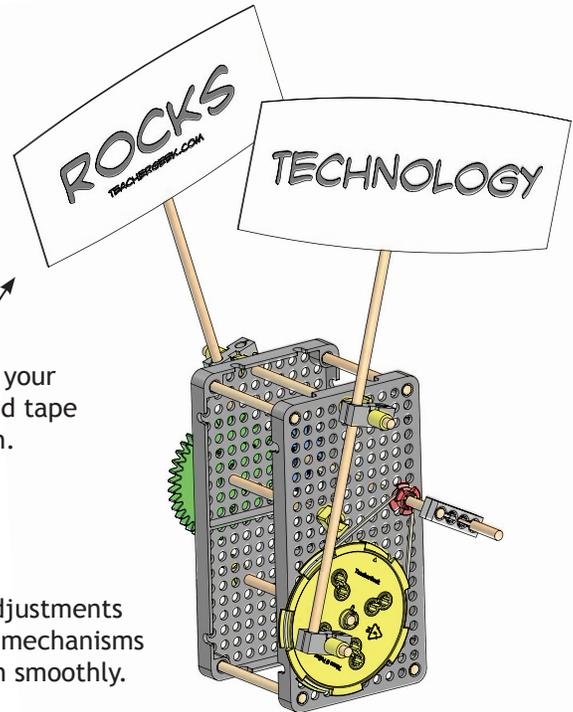
Assemble the cam linkage as shown.



## STEP 13

Cut out your signs and tape them on.

Make adjustments so your mechanisms function smoothly.



**YOU'RE DONE! KEEP EXPERIMENTING.  
MAKE IT DIFFERENT, BETTER, YOUR DESIGN!**