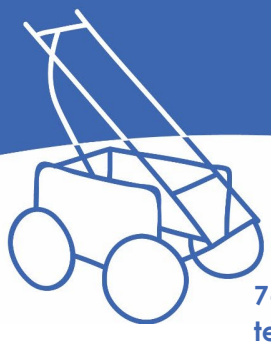
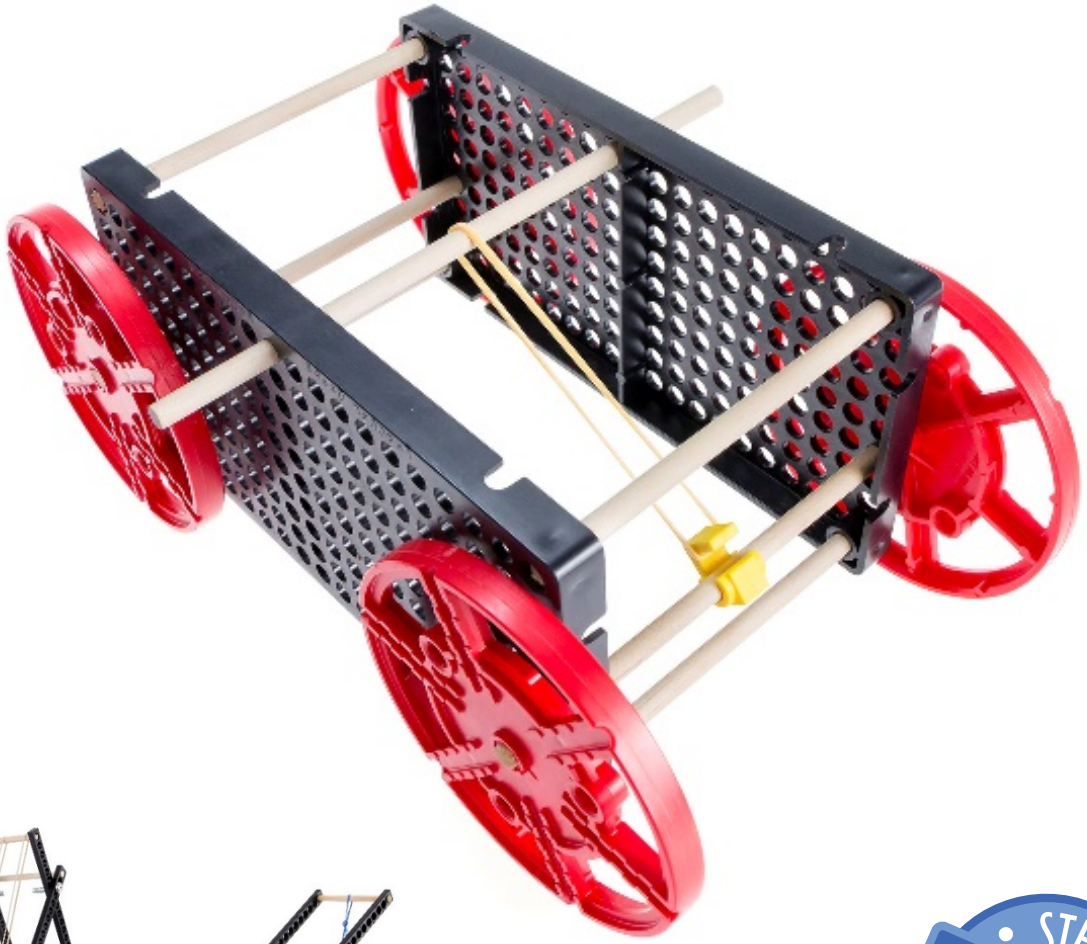


Advanced Rubber Band Racer Basic Build Guide

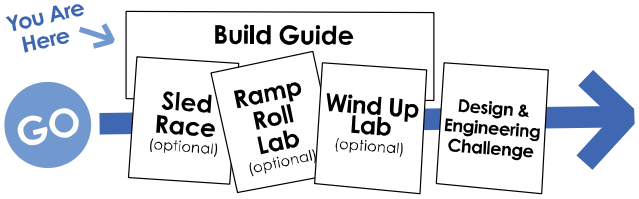
Grades
2-6

7-12+ version available at
teachergeek.com/rubberband



Start by building the example racer, then turn into your own unique design.

STEM TRUE STEAM



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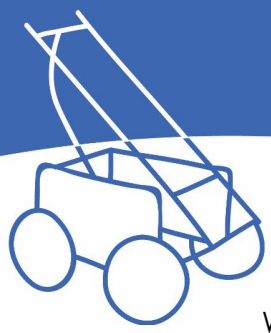
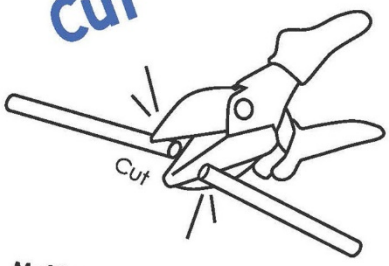


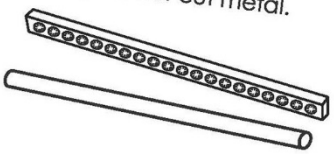
Advanced Rubber Band Racer Basic Build Guide

What do you need to know, to build your racer?

Cut



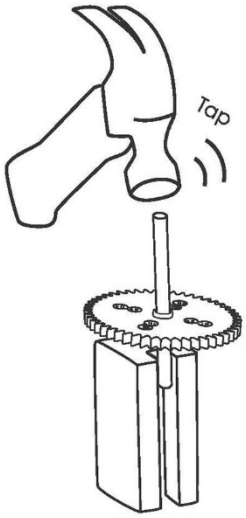
Multi-Cutters cut wood & plastic (like **dowels** and **connector strips**). They do not cut metal.



Push, Wiggle,

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

Tap



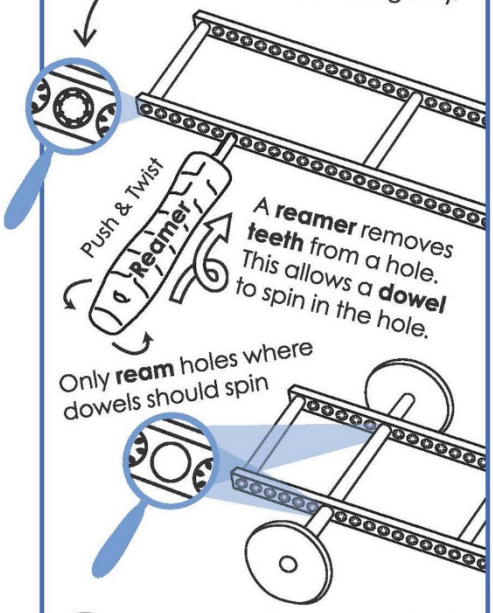
Use a **hammer** and **slider block** to tap **dowels** farther through holes.

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).



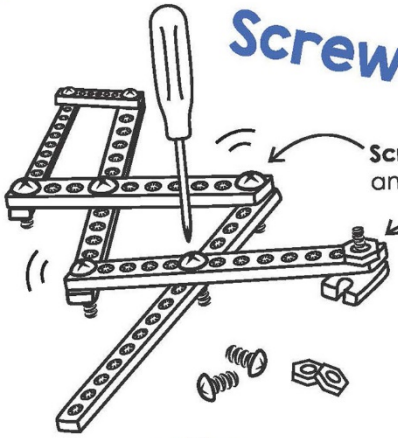
A **reamer** removes **teeth** from a hole. This allows a **dowel** to spin in the hole.

Only **ream** holes where dowels should spin

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

Screws & Nuts

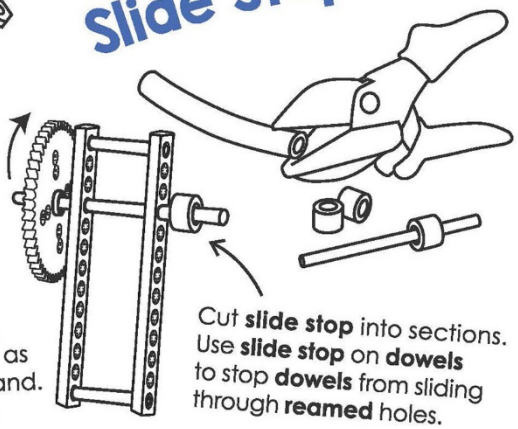
Do not **ream** holes you will put **screws** into.



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

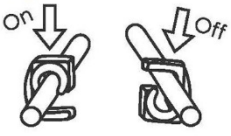
Screws (with a nut) can connect parts, and keep them from rotating.

Slide Stop

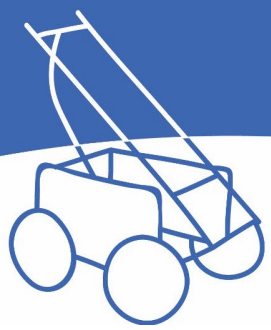


Cut **slide stop** into sections. Use **slide stop** on **dowels** to stop **dowels** from sliding through **reamed** holes.

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.

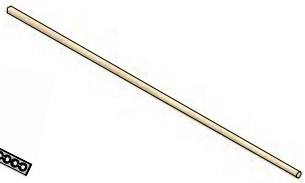


Advanced Rubber Band Racer Basic Build Guide

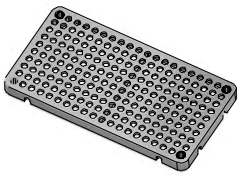
TeacherGeek Supplies

Gather components to build the example racer, and then turn it into your own amazing design.

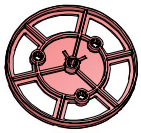
6 - Connector Strips



8 - Dowels
300mm (12")



2 - Hole Plates

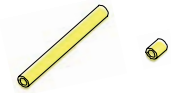


4 - Wheels

2 - Stretch Tires

4 - Screws
#10 1"

4 - Nuts
#10



1 - Slide Stop
100mm (3")

1 - Stop Clip

10 - Rubber Bands

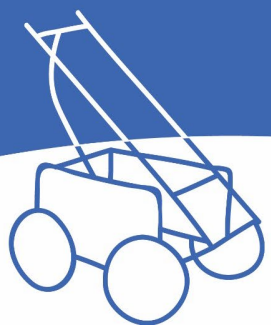
TeacherGeek Tools

This isn't a kit. You're going to really build (cut, ream, screw) your Racer. Here are tools you'll need to get started.

They can be shared by up to 4 groups at a time.

- **TeacherGeek Reamer**
- **TeacherGeek Multi-Cutter**
- **Tapping Block** -Optional
- **Small Hammer**
- **Pliers** -Optional
- **Philips Screwdriver**

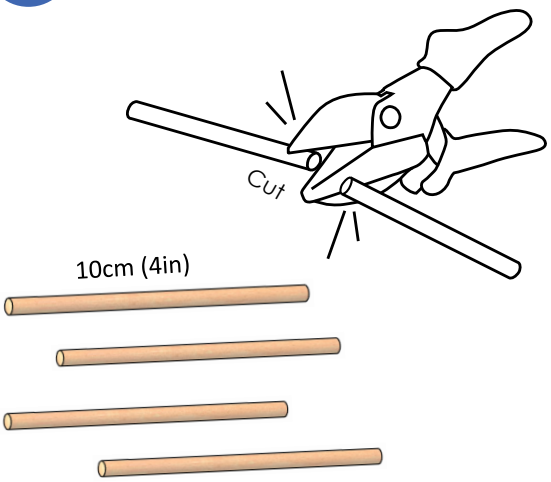
Tip: Save all your materials (even what you cut off). Keep them in a bag. They can be used later.



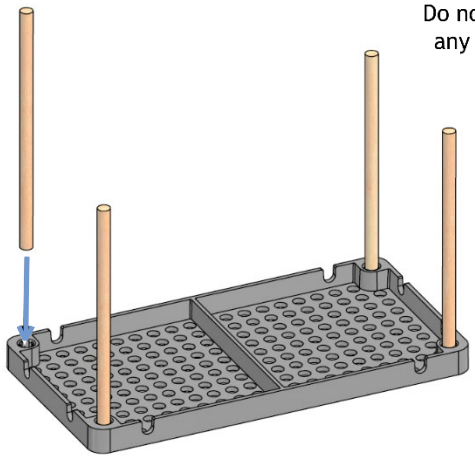
Advanced Rubber Band Racer Basic Build Guide

Frame Build

1 **Cut** four **10cm** (4") **dowels**.

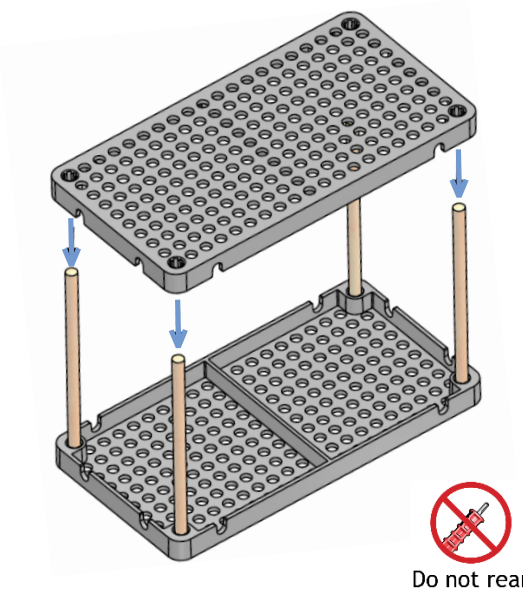


2 Tap or push **dowels** into an upside-down **hole plate**.



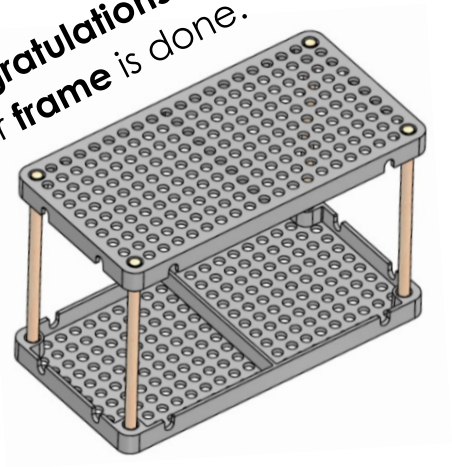
Do not ream any holes.

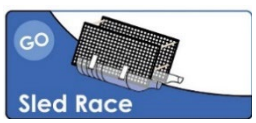
3 Tap or push a **hole plate** on top of the **dowels**.



Do not ream any holes.

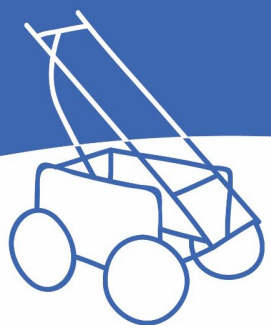
Congratulations! Your **frame** is done.





If you are going to do the optional Sled Race, it's now time.

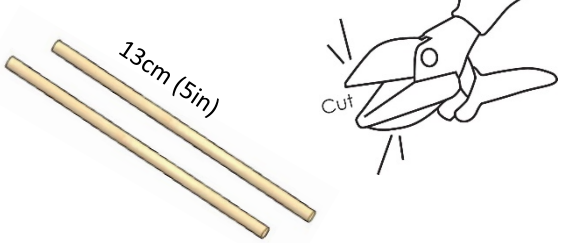
Documents at ***teachergeek.com/rubberband***



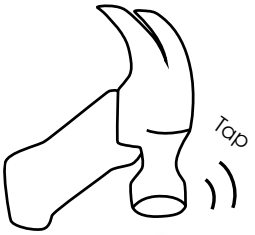
Advanced Rubber Band Racer Basic Build Guide

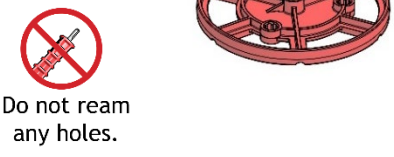
Wheels On

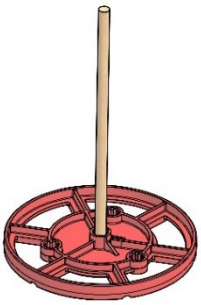
4 **Cut** two 13cm (5.1") **dowels**. These will become **axles** for the **wheels**.



5 Push or tap the two **axles** into **wheels**.

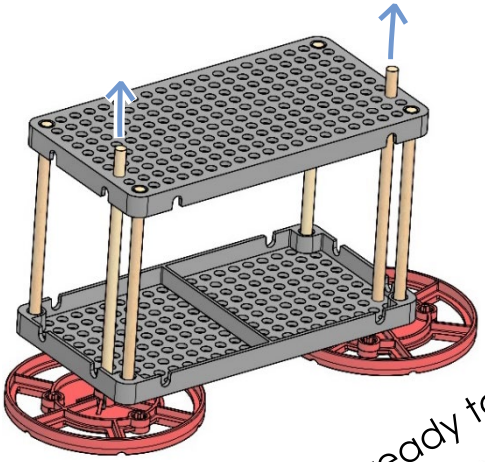




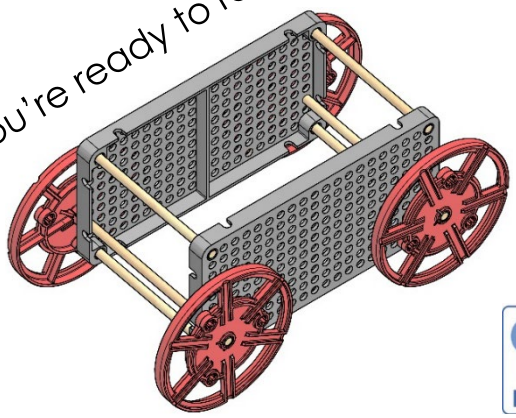


Do not ream any holes.

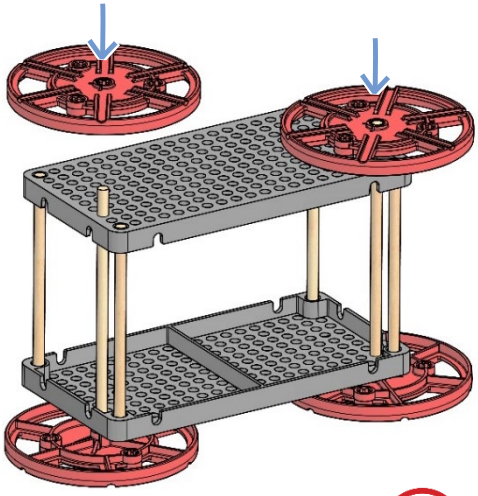
6 Place the **axles** through the **frame**, three holes up from the bottom.



You're ready to roll!



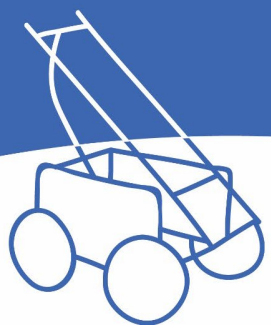
7 Push or tap two **wheels** onto the other side of the **axles**.



Do not ream any holes.

If you are going to do the optional Ramp Roll Lab, it's now time.

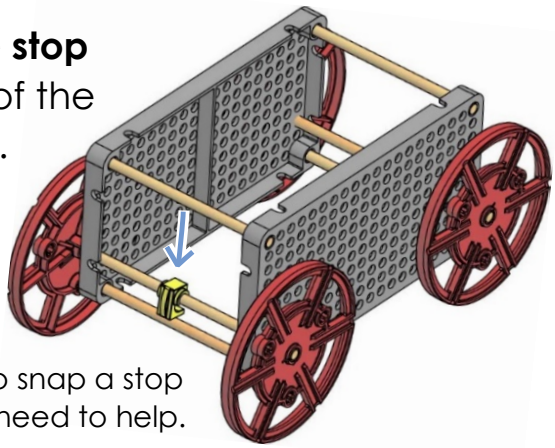
*Documents at **teachergeek.com/rubberband***



Advanced Rubber Band Racer Basic Build Guide

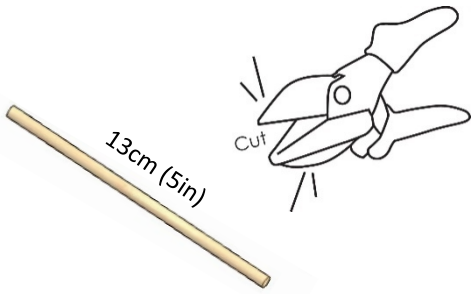
Wind-Up

8 **Snap** on the **stop clip** to one of the wheel **axles**.

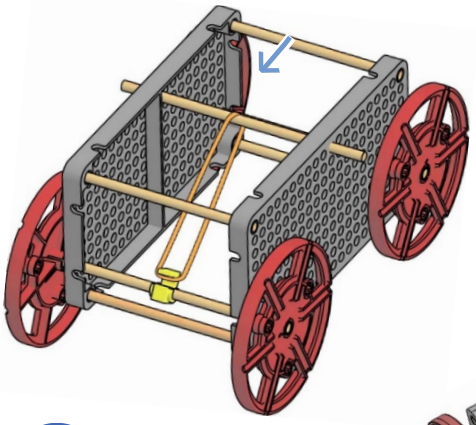


It takes a lot of force to snap a stop clip on. An adult may need to help.

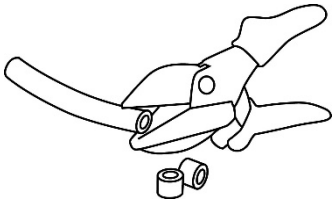
9 **Cut** one 13cm (5.1") **dowel**.

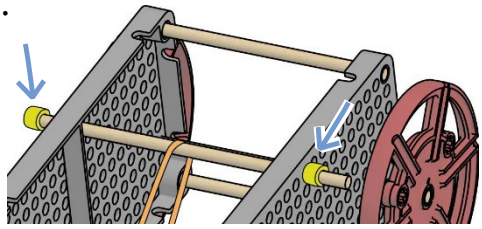


10 Place the 13cm **dowel** through the **frame**, with a **rubber band**, as shown.



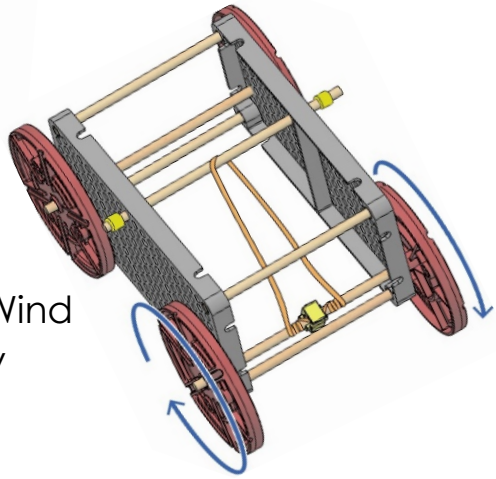
11 **Cut** two 1cm sections of **slide stop**. Use them to keep this **dowel** from falling out.



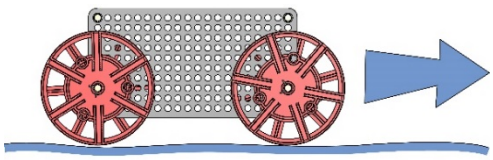


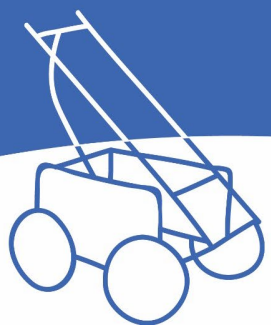
12

Hook the **rubber band** around the **stop clip**. Wind up the **rubber band** by turning the **wheels**.



Set it down and let it go. **Play** and **experiment** with it.



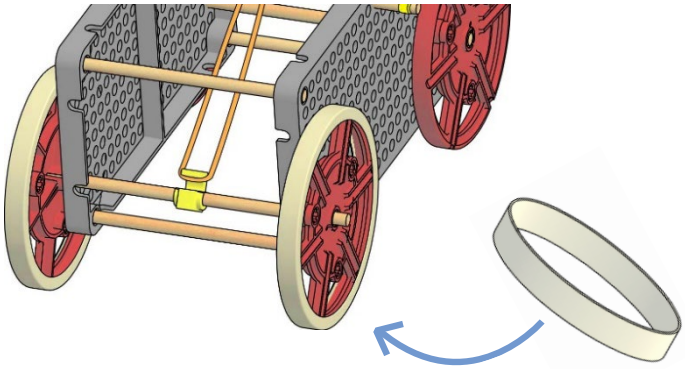


Advanced Rubber Band Racer Basic Build Guide

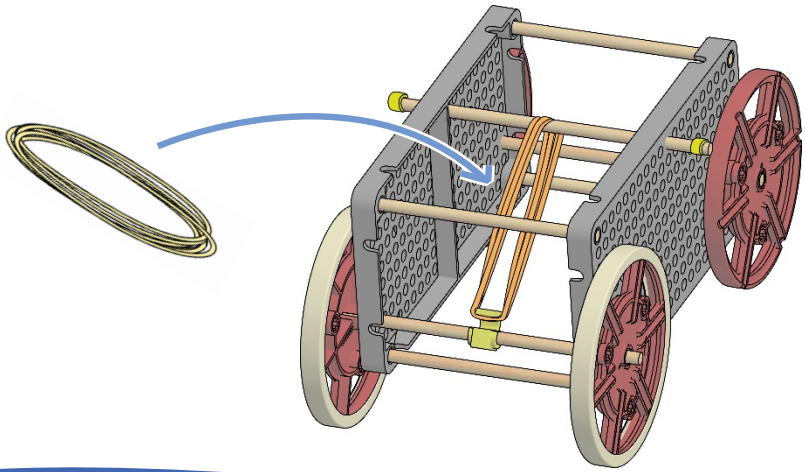
Traction

Are your **wheels spinning**? Maybe you need to give them more **traction**.

13 Place **stretch tires** on the rear **wheels**, if you have not already.

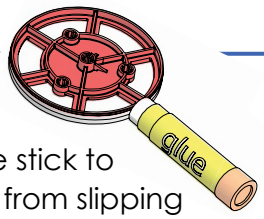


14 Try adding more **rubber bands** to your racer. What happens? Do the rubber bands **release** their **energy** too fast? Can you redesign your racer so rubber bands release energy slower?



Traction is the **friction** between the **wheels** and the **ground**. It allows the vehicle to move forwards. Increase the traction (friction) between your wheels and the ground by adding tires.

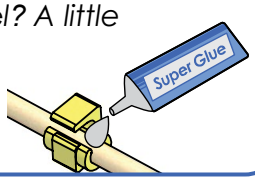
Tips



Use a glue stick to keep tires from slipping off the wheels.

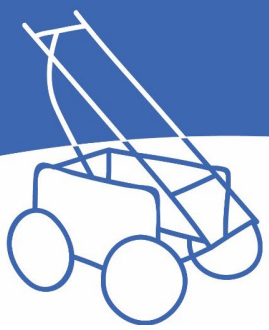
1. Coat the wheel with glue.
2. Wait a few minutes for the glue to partially dry.
3. Then put the stretch tire on.

Is your stop clip spinning on the dowel? *A little glue will fix it.*



Congratulations!

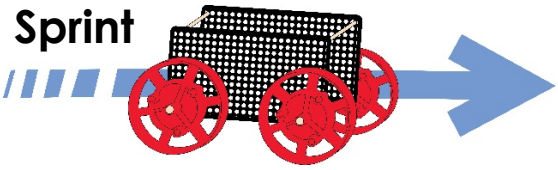
Your example racer is done. Now turn it into your **own design**.



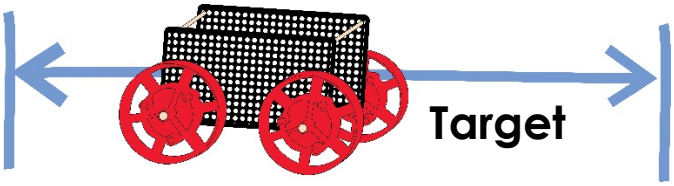
Advanced Rubber Band Racer Basic Build Guide

Engineering Challenges

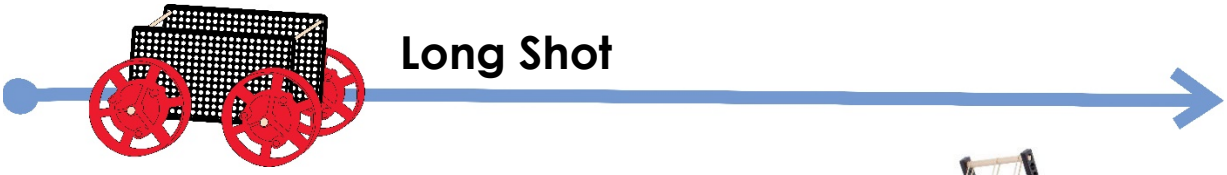
Make your racer go farther, faster, or stop on a target.
The step-by-step instructions end here, but you're just getting started.
It's time to redesign your racer for these engineering challenges.



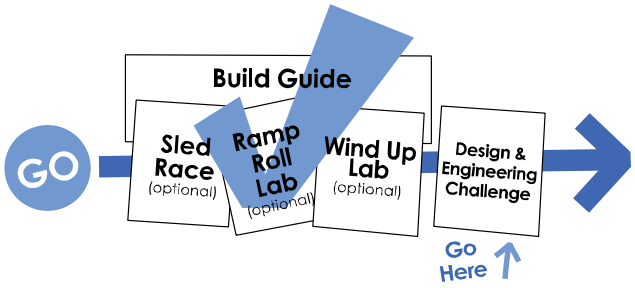
Redesign your racer to break a speed record or win a race.



Redesign your racer to stop on a target.

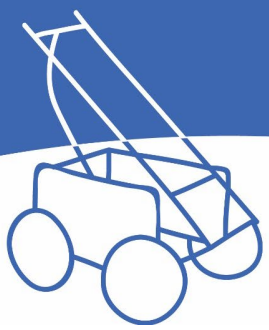


Redesign your racer to go really far.



Download the Engineering Challenge documents at ***teachergeek.com/rubberband***

The next pages will give you tips to help you redesign your racer.

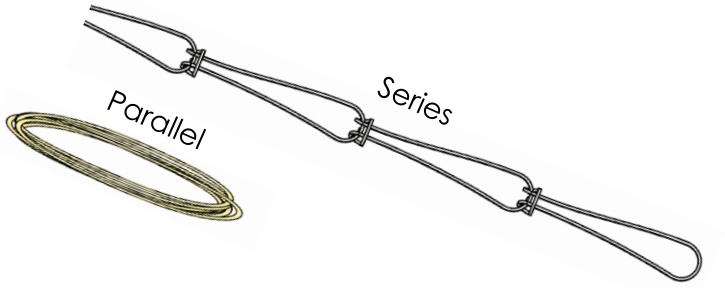


Ideas

How does your racer turn **potential** (stored) **energy** from the rubber bands into **kinetic** (moving) **energy**? Create a mechanism to release the energy over more **rotations** (turns) of the wheels. Adjust it for the different challenges.

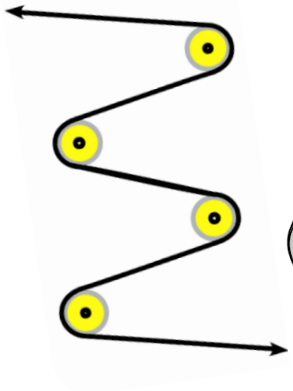
Parallel or Series

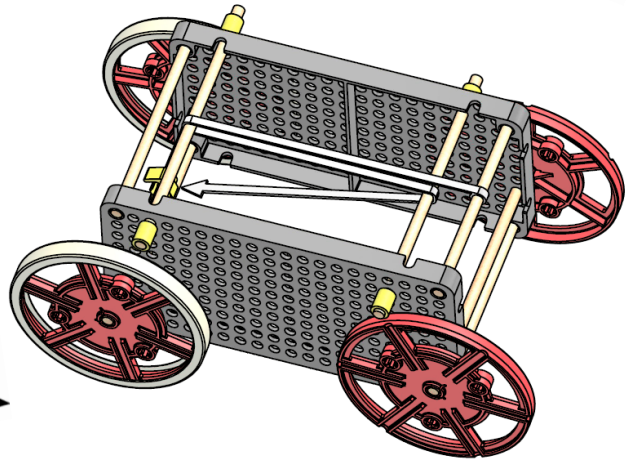
Rubber bands can be connected in **series** (forming a thin, long band) or in **parallel** (forming a short, thick band).



Use Pulleys

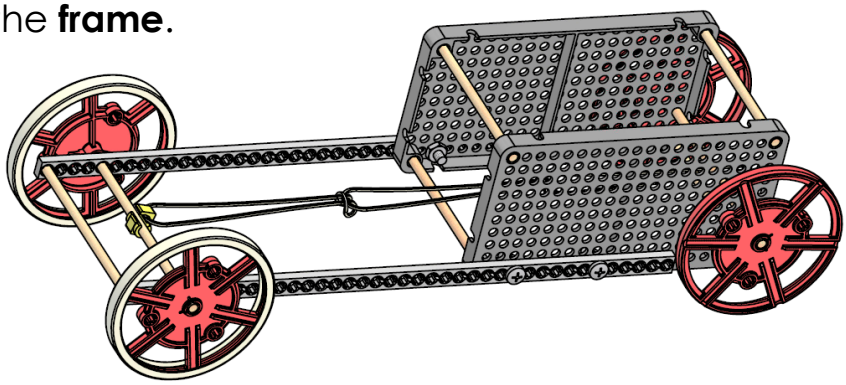
Pulleys can be used to change the direction of a rubber band or string. Dowels, that can spin, can be used as pulleys.

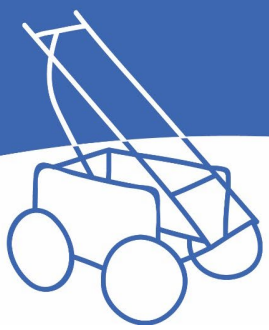




Change the Frame

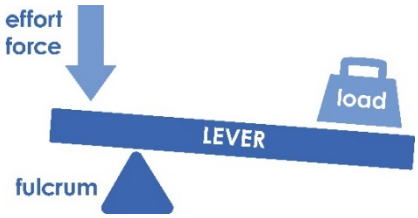
Use more parts to change the **frame**.

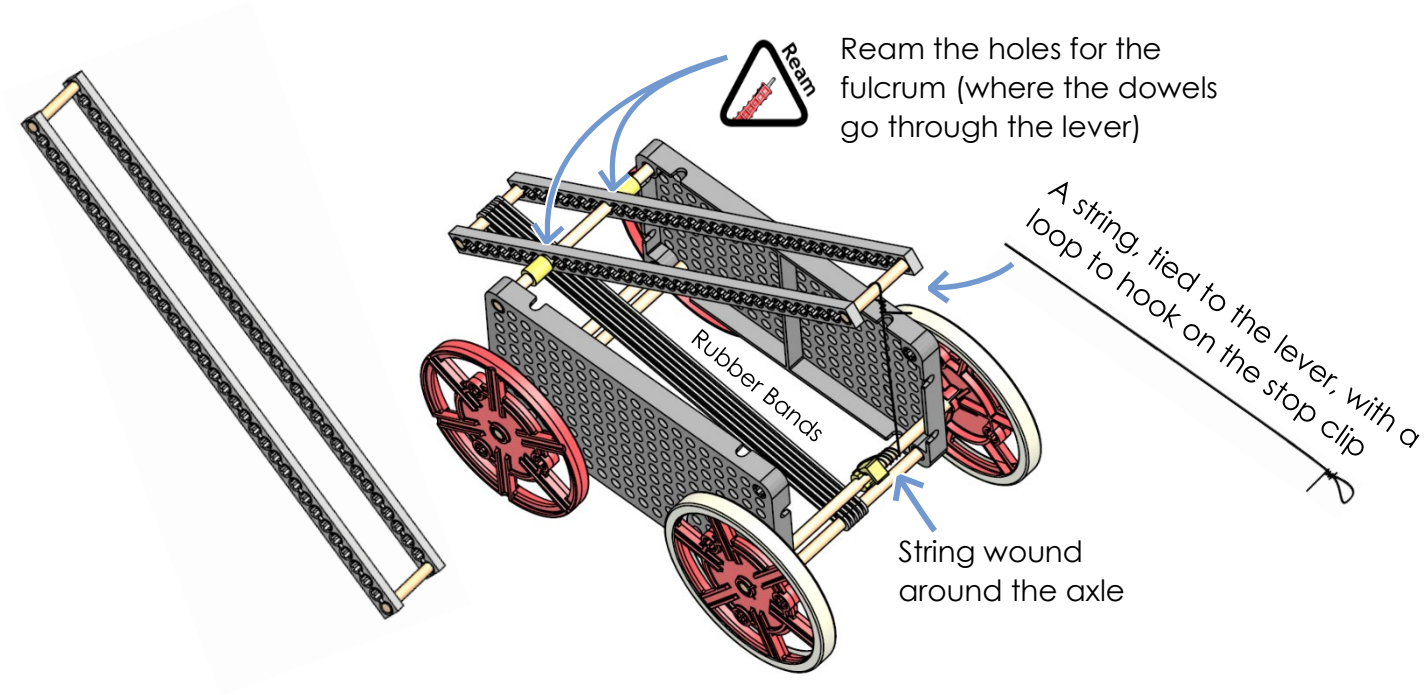




Add a Lever

A **lever** can create a **mechanical advantage** (trading force for distance). Use it to trade force from rubber bands for more wheel **revolutions** (distance).

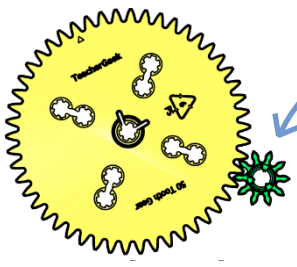




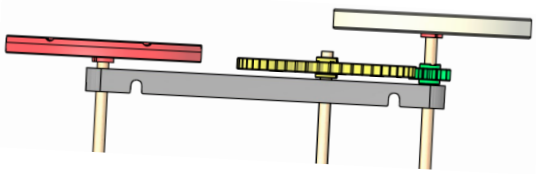
How does it work? The rubber bands pull the **lever arm**. The lever arm pulls the **string**. The string unwinds from the axle and **turns** the **wheels**.

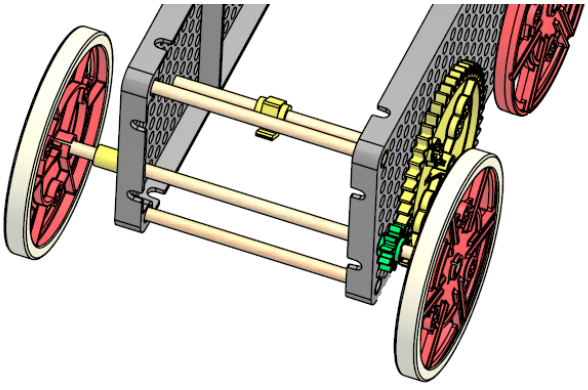
Try Gears

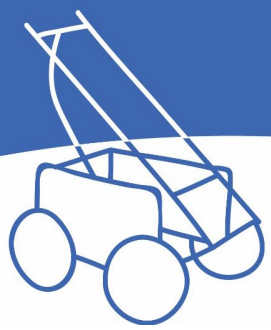
Gears can be used to create a **mechanical advantage** (like a lever).



This gear turns five times for every time the large gear turns once.





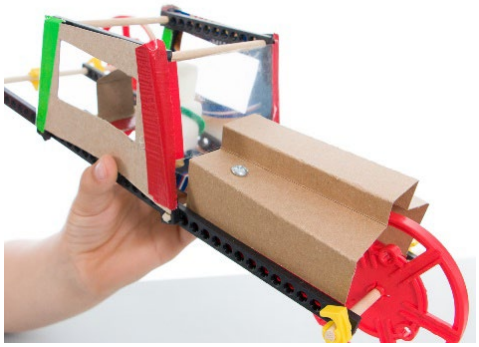


Advanced Rubber Band Racer Basic Build Guide

More Materials

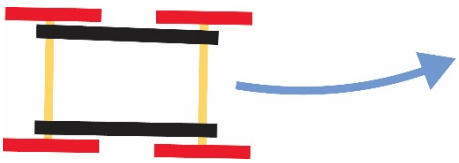
To turn your racer into your **own design**, you are going to need more materials. *Try using…*

- Extra **TeacherGeek parts**
- **Recycled materials** (food packaging, containers, bottles, cardboard, etc.)

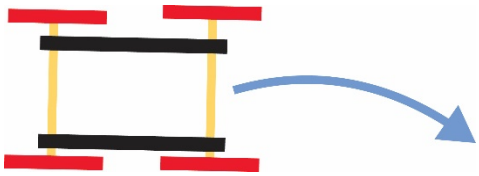


Trouble Shooting

What often makes a racer turn?

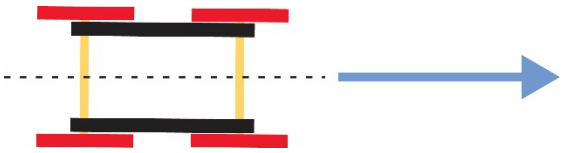


The frame is not straight or square

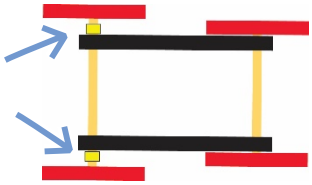


The axles are loose, or not symmetrical with the frame

How can you make your racer go straight?



The frame and axles are symmetrical



Slide stop can be placed on the axles to help "steer" the racer. It can keep the axles symmetrical with the racer frame, or offset (making the racer turn, or correct for a turning problem)