

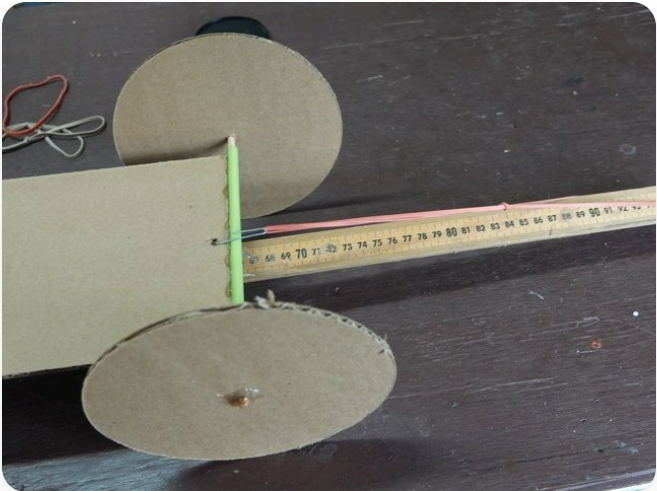
EQUIPMENT BUILD PLAN

SIMPLE MACHINES

Cardboard Rubber Band Car

A simple car with a cardboard body, cardboard wheels and skewer axles turning inside straw bearings. It runs two ways: launched like a slingshot, or driven by a rubber band wound around the rear axle. Changing the wheel size turns it into a hands-on lesson in the wheel and axle.

Written from Bruce's original workshop handout. Bruce's final review of this plan is in progress.



DIFFICULTY	BUILD TIME
Beginner	1 hour
COST	SAFETY
About \$3-5	Everyday care
GOOD FOR	
Families, Teachers, Makers	

What it shows

A shipping box, a few straws and a rubber band become a car that can roll more than 20 feet, and with giant wheels, more than 100.

Key ideas: wheel and axle, mechanical advantage, elastic potential energy, friction and traction

Safety (Everyday care). A circle cutter has a sharp blade: a grown-up should cut the wheels. Hot glue can burn, so a grown-up should help with gluing. Don't aim a stretched rubber band at anyone.

CONSTRUCTION

Build it

Materials

- ☐ **Corrugated cardboard** · 1 large box
For the body and four wheels
- ☐ **Wooden dowels or bamboo skewers** · 2
Axles
- ☐ **Plastic drinking straws** · 2
Wide enough for the axles to turn freely
- ☐ **Thin wood strips or old wooden rulers** · 2
Stiffen the frame
- ☐ **Paper clip** · 1
Rubber band anchor
- ☐ **Rubber bands** · 3 or more
- ☐ **Hot glue sticks** · Several

Tools

Circle cutter (or scissors and a compass)

Hot glue gun

Scissors

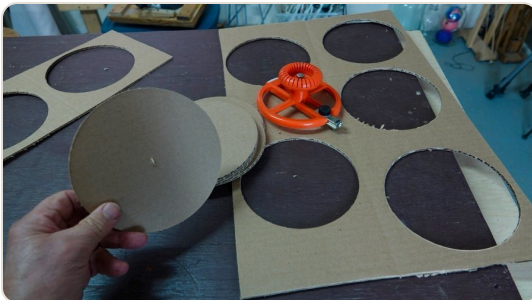
Small saw or strong clippers to cut the dowels

Ruler and marker

1

Cut the wheels

Cut four cardboard circles with a circle cutter. Don't try to cut through in one pass: score about halfway through first, then cut through on the second pass. It is easier to hold the cutter still and turn the cardboard.



2

Gather axles and straws

Dowels or bamboo skewers make good axles and plastic straws make the bearings. Both are inexpensive at a discount store.



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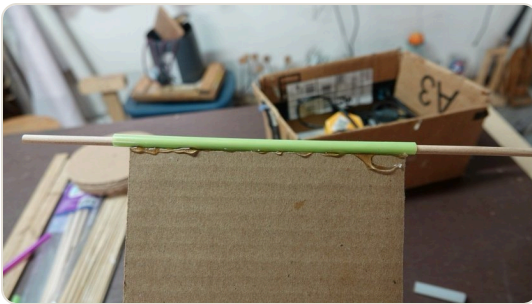
Cut the body

Cut a cardboard base 5 in by 13 in.

4

Glue on the straw bearings

Run a bead of hot glue along one short edge of the base, let it cool slightly so it won't melt the straw, and press a straw into it. Repeat at the other end.



5

Notch for axle drive

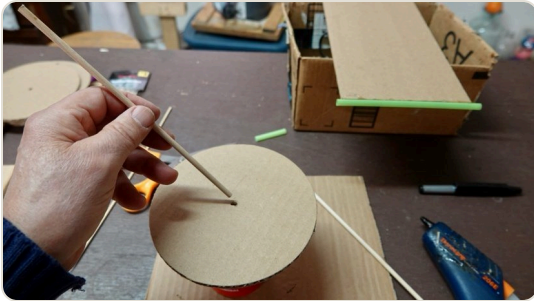
If you want to drive the car by winding a rubber band on the rear axle, cut a notch out of the base at the rear so the band can reach the middle of the axle.



6

Mount the first wheels

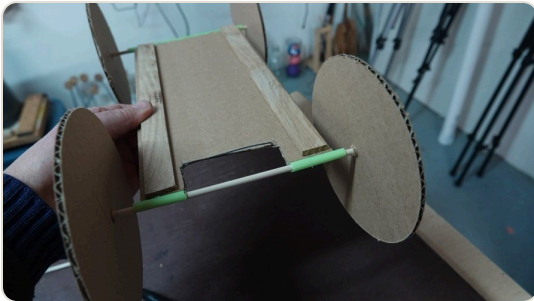
Cut the axles to length. Push each axle through the center of a wheel and hot glue it, then add extra glue around the joint and let it cool.



7

Add the second wheels

Slide each axle through its straw and glue the second wheel on the other end. Check that the wheels are straight and turn freely.



8

Stiffen the frame

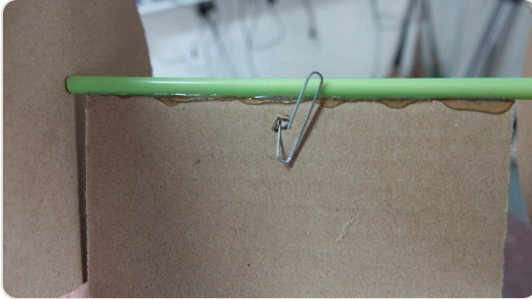
Hot glue two wood strips or old rulers along the base so the cardboard doesn't bend when the rubber band pulls on it.



9

Add the anchor

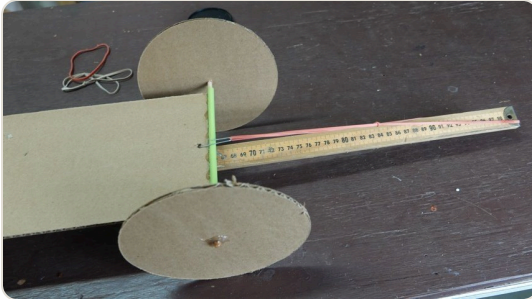
Poke a hole through the cardboard and push one end of a paper clip through it. The rubber band hooks onto this.



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Power option 1: slingshot

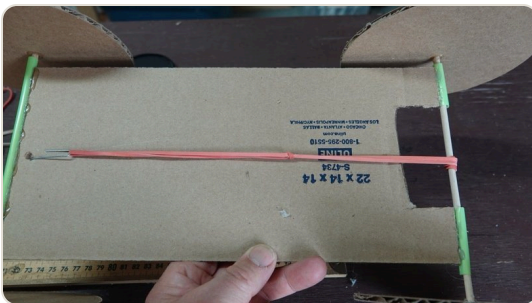
Hook a rubber band to the anchor, stretch it forward around a fixed post or a friend's fingers, pull the car back and let go. Bruce's car traveled about 24 ft this way.



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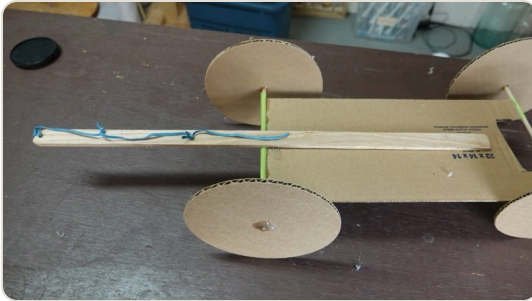
Power option 2: axle drive

Hook the band to the anchor, stretch it back to the rear axle and wind it around the axle by turning the wheels backward. Set the car down and release.



Stretch it farther

Glue an extension stick to the front of the car so the band can be stretched a longer distance. You can also cut the rubber band into a single long strip.



THE PHYSICS

How it works

Stretching or winding the rubber band stores elastic potential energy. As the band relaxes it either pulls the car forward directly (slingshot) or turns the rear axle, which turns the wheels (axle drive).

With axle drive, the car is a wheel and axle. The band pulls on the small axle, and the wheel turns that into motion at the much larger rim. A big wheel gives a smaller push on the floor but covers more distance with every turn of the axle.

If the wheels are too small, the push at the rim is large and the wheels spin and lose traction, wasting energy. Larger wheels turn more slowly, grip better and carry the car farther. Bruce's students have built wheels as large as 2 ft across that went over 100 ft on three small rubber bands.

GO FURTHER

Variations

- Giant wheels: wheels up to 2 ft across for long-distance runs.

Using it

- Compare the two power methods: which goes farther and why?
- Build sets of wheels in several sizes and measure the distance traveled with the same rubber band.
- Watch for wheel spin at the start with small wheels, and discuss traction.
- Use it as a three-rubber-band design challenge: farthest distance wins.
- Measure how far the band is stretched and graph distance traveled against stretch.

- Long stretch: an extension arm at the front and a single cut strip of rubber band for a longer pull.
- The same chassis can be fitted with other power sources, such as a balloon.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

Wheels wobble.

TRY THIS

The axle is not centered or not square to the wheel. Re-glue it, checking from two directions before the glue sets.

IF THIS HAPPENS

Straws melted.

TRY THIS

Let the hot glue cool for a few seconds before pressing the straw into it.

IF THIS HAPPENS

Wheels spin but the car barely moves.

TRY THIS

Use larger wheels, or add a strip of rubber band around each rear wheel for grip.

IF THIS HAPPENS

The body bends.

TRY THIS

Add the wood strips, or use a double layer of cardboard.