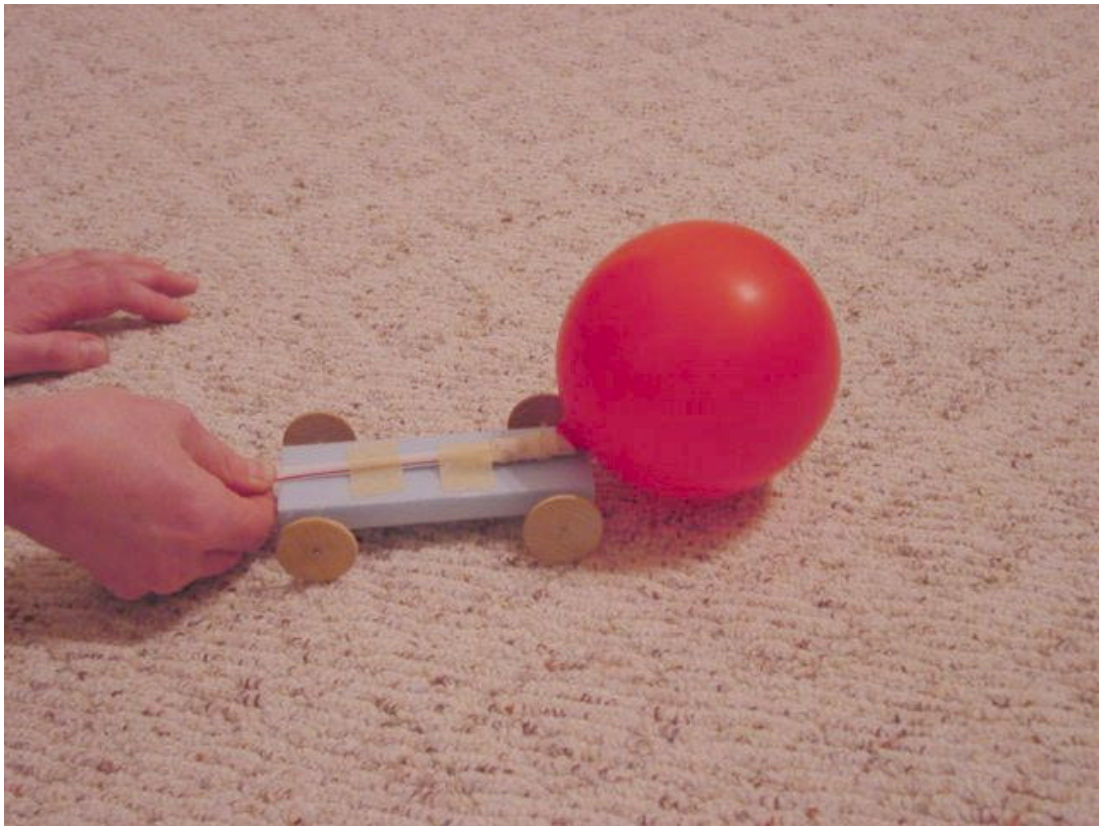
How to Build and Race a Balloon Racer!

By Michael O. Tjebben.

For “kids” ages 7 and up, as long as
they have someone to help them cut the Styrofoam.

Special thanks to John O. Tjebben for the ideas of precutting grooves and using Chupa-Chup lollipop sticks for axles, and all the work getting 27 of the parts together for the students.



Balloon Racer!

Materials

The following materials are needed:

- Four disks for wheels. The 1 – ½" diameter by 1/8" wide disks available at Michael's or A.C. Moore work well, because they are relatively light weight. However, a 0.096" hole must be drilled (with a No. 41 drill bit) in the center of each disk.
- A 6" x 2" x ½" piece of Styrofoam (DOW STYROFOAM, the extruded polystyrene insulation) that homebuilders often use and that is available at Home Depot or Lowe's works quite well for the body.
- Two "used" Chupa-Chup lollipop sticks (www.chupachups.com, the lollipop inventor) that are hollow and plastic make exceptionally good axles.
- Two 6d, 2" long bright finishing nails with the points ground or filed off for pins to hold the wheels to the axles. The 6d nails have the correct diameter for the No. 41 drill hole.
- One 9" helium-quality balloon or similar. Get a few extras, as the balloon will wear-out.
- Two 8" long x ¼" diameter straight straws or very similar. A straw with a bend may work, but the bend (and corrugated portion) may slow the airflow).
- Masking tape: 1" wide works particularly well.

Figure 1: Supplies Needed.

Crimping the Axles

Carefully use a wire cutters or garden shears to just crimp both ends of each of the two Chupa-Chup lollipop sticks about ¼" from each end as shown in Figure 2a. Do NOT cut the sticks – just apply enough pressure to crimp only. This crimping action helps to hold a nail that will be used to hold the wheel to the "lollipop axle" as explained later.

Figure 2a: Crimping the lollipop axle (Use just enough pressure to leave a mark: do NOT cut into the stick!)

Building the Axles

Wrap a few turns of the masking tape around the center of each of the two Chupa-Chup lollipop sticks as shown in Figure 2.

Figure 2b: Masking tape around the Chupa-Chup lollipop stick to help anchor it.

Adding the Wheels

First, take each of the 6d nails whose pointed ends have been filed off as shown in Figure 3, and push them through each of the four wheels (whose centers have been pre-drilled with 0.092” holes), as shown in Figure 4.

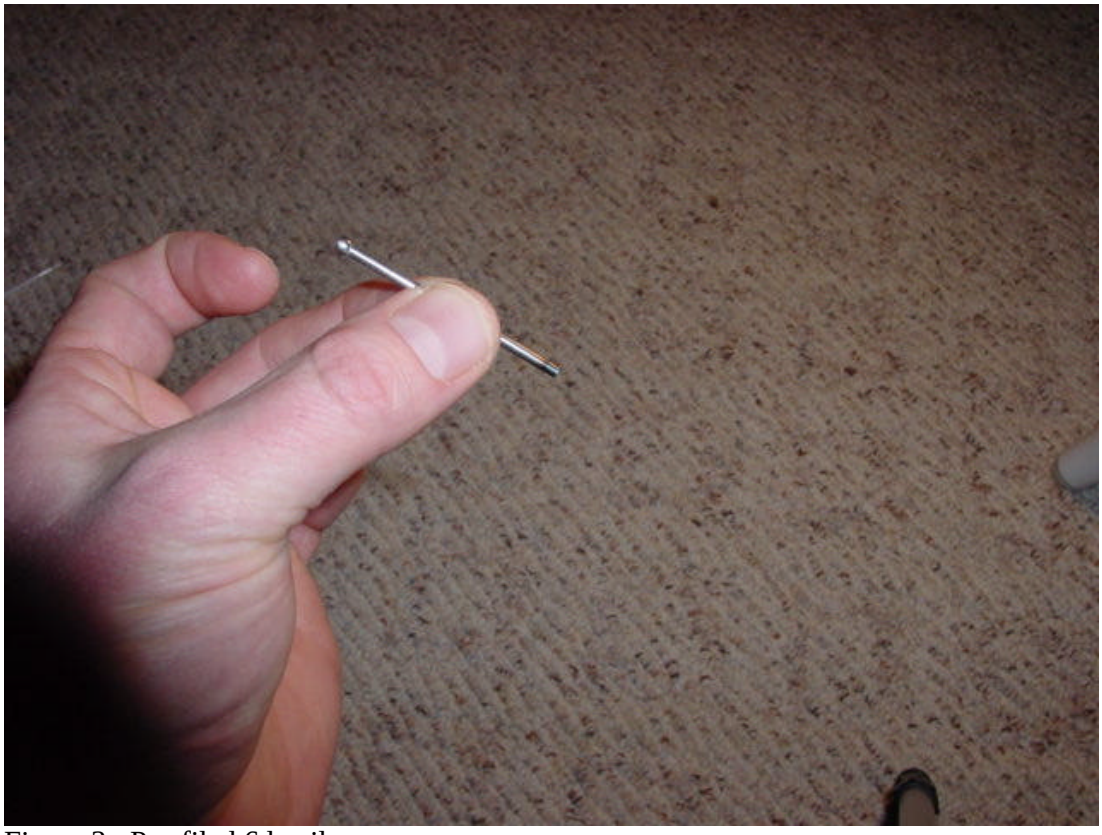


Figure 3: Pre-filed 6d nail.

Figure 4: Nail through wheel.

Then push the nails into the Chupa-Chup lollipop sticks as shown in Figures 5 and 6.

Figure 5: One wheel on the Chupa-Chup lollipop stick.

Figure 6: Both wheels on the Chupa-Chup lollipop stick.

Preparing the Car's Body

Have someone use a table saw to cut 1/8" x 1/8" grooves in the center top and bottom lengthwise of the Styrofoam and also widthwise ¾" from the front and back of the bottom *only* of the car as shown in Figure 7. You'll now have 3 slots on the bottom of the car, and only one on the top.

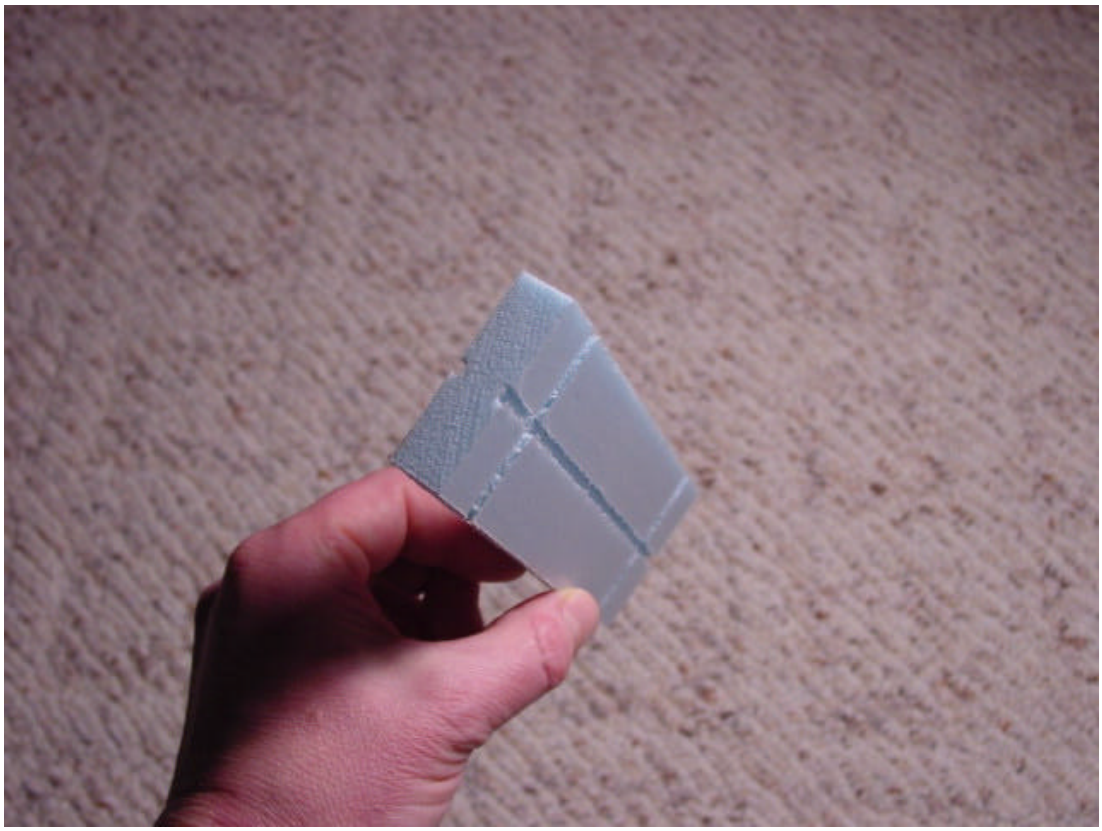


Figure 7: Slots on the Styrofoam body of the car.

Adding the Wheels to the Car

Push the Chupa-Chup axles into the widthwise slots of the bottom of the car as shown in Figures 8 and 9.

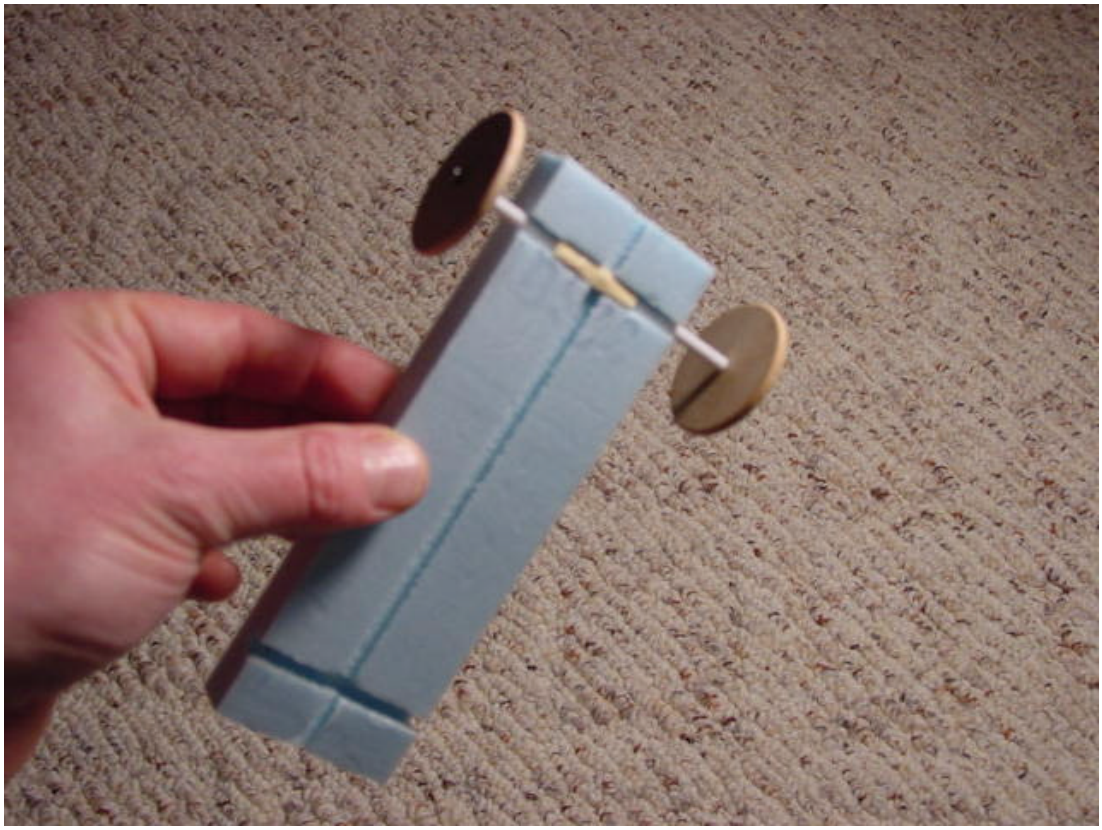


Figure 8: Adding the first set of wheels to the car.

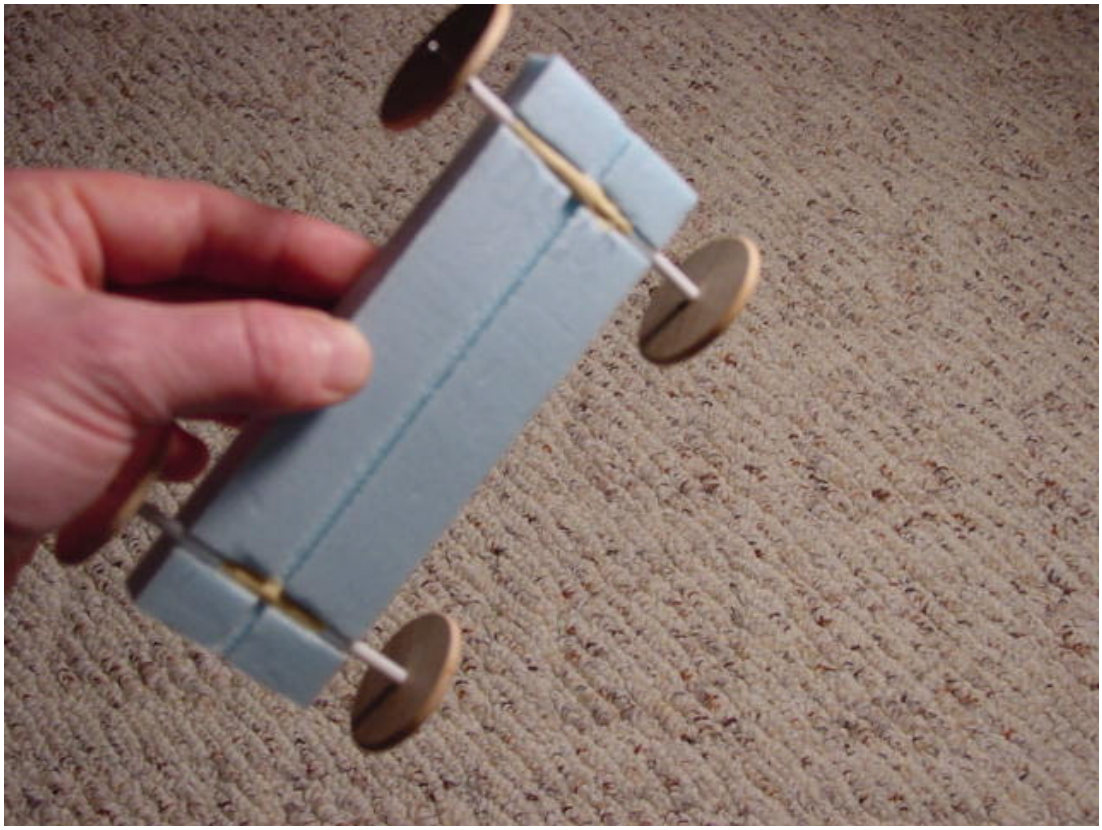


Figure 9: Both sets of wheels on the car.

Adding a Guide Tube.

To keep the car going straight during a race, a straw can be added to the bottom of the car through which a string can be threaded to guide the car during a race. Cut a straw to match the length of the car and tape it into the lengthwise slot of the bottom of the car as shown in Figure 10. If you put the tape over the straw and above the axles, it will help hold the axles in place.

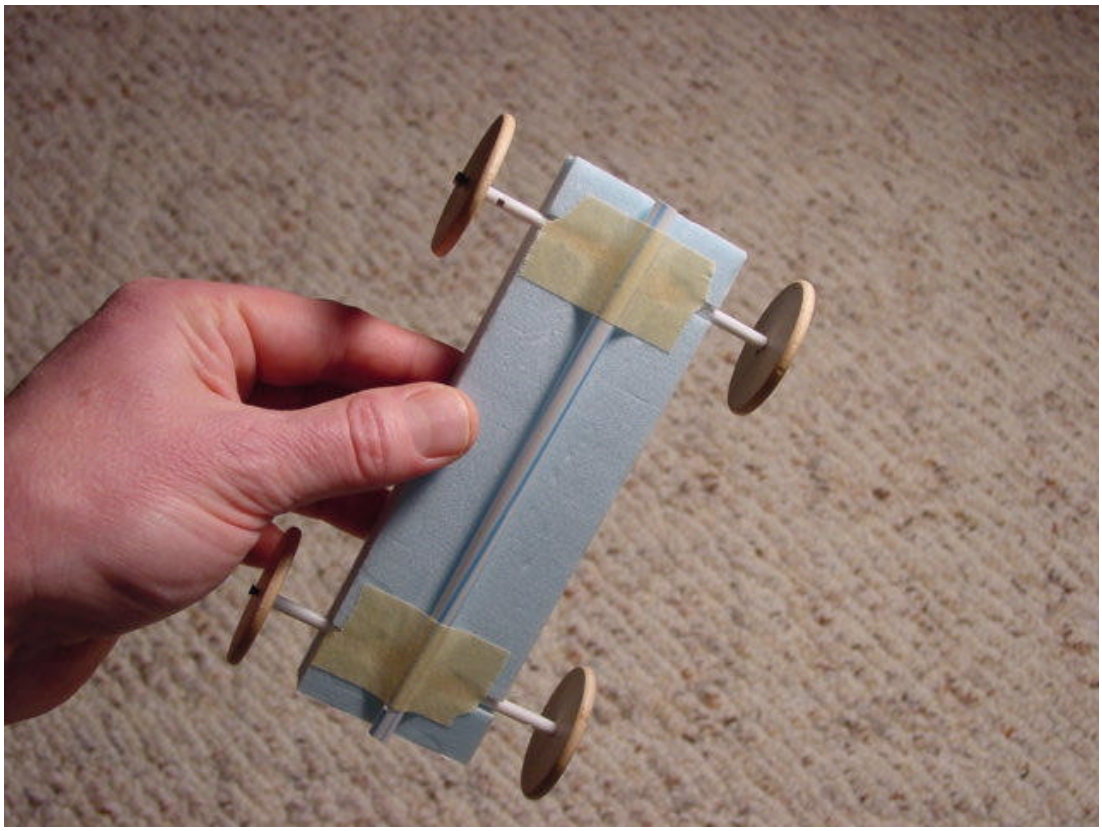


Figure 10: Adding the guide tube to the car.

Assembling the "Power Source"

Take the other straw and pull about 2" of a balloon onto it. Take a 4" or so length of 1" masking tape and first wrap a few turns about the balloon and then finish by wrapping a few turns around the straw to hold the balloon to the straw as shown in Figure 11. Your wraps should be reasonably tight to prevent air from escaping where the balloon covers the straw. However, a small quantity of air escaping is normal.

Figure 11: Preparing the balloon "power source"

Mounting the "Power Source" to the Car

Tape the straw with the balloon on it onto the slot (it won't fit *into* the slot – it just sits on top of the slot) as shown in Figures 12 and 13. Leave about 1" of straw extending out over the back of the car. It doesn't matter which end is the back of the car – until the balloon has been mounted.

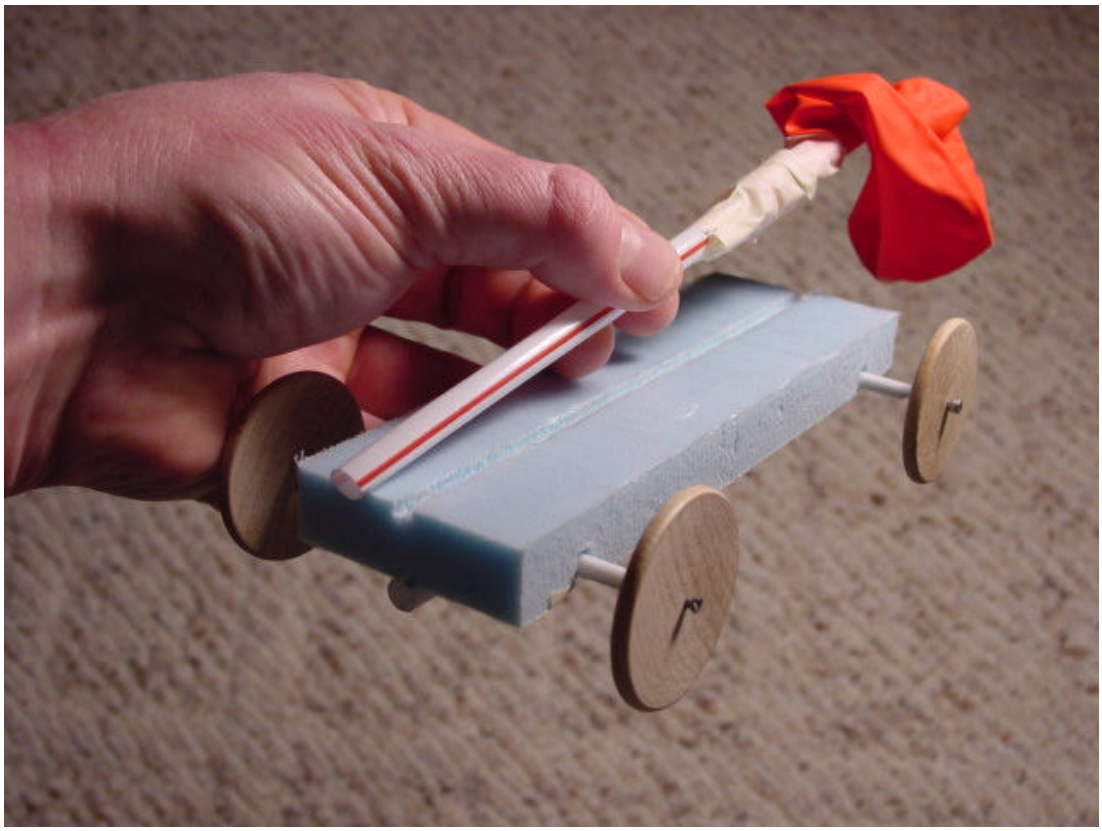


Figure 12: Aligning the straw with the lengthwise slot on the top of the car.

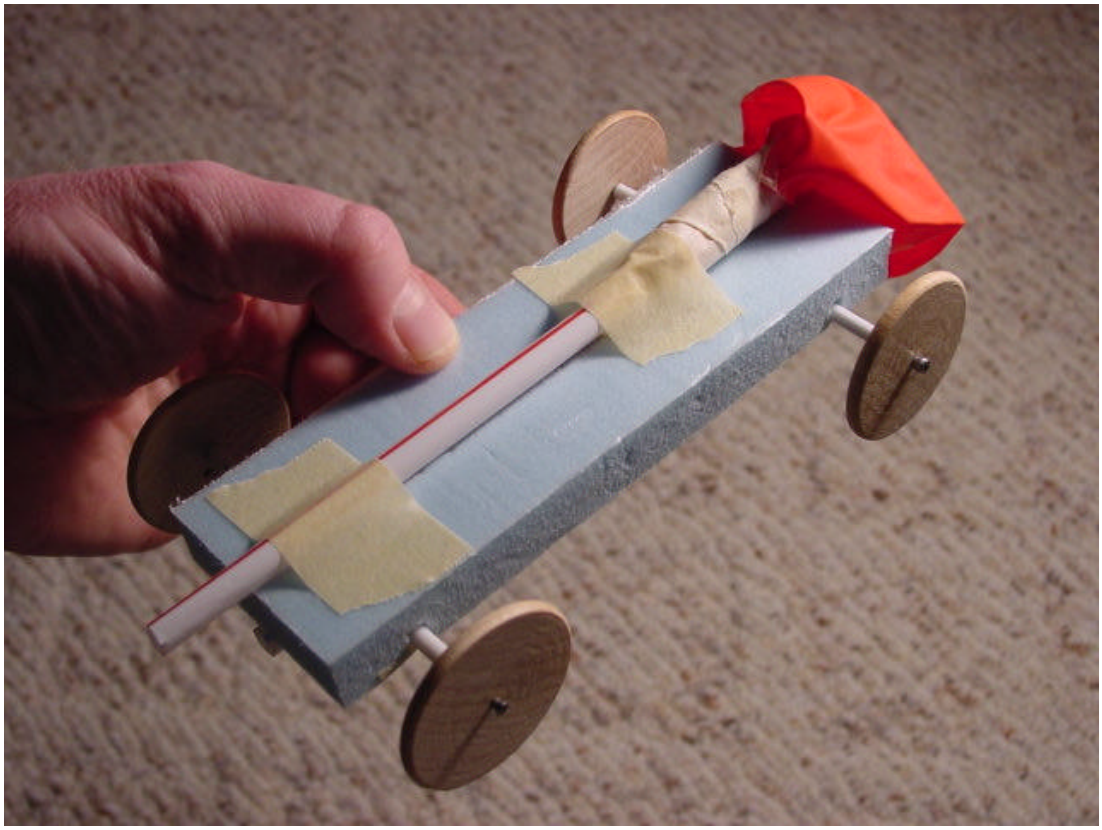


Figure 13: Taping the straw to the top of the car, leaving 1” extending at the back.

How to Fill the Balloon

Put the end of the straw that extends at the back of the car into your mouth and blow up the balloon. Be ready to quickly pinch that same end of the straw, as shown in Figure 14, so that the air will not escape until you have put the car on the ground.

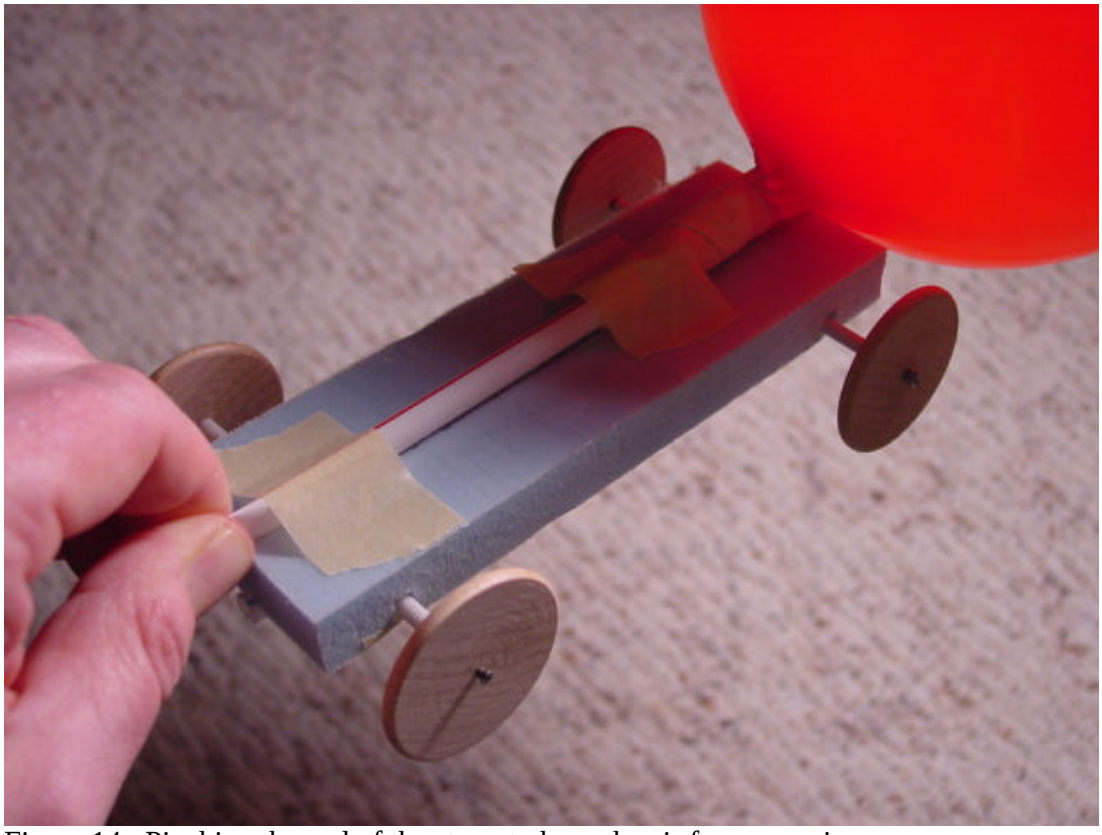


Figure 14: Pinching the end of the straw to keep the air from escaping.

Now, put the car on the ground and let go! **HAVE FUN!**

How to Race more than one Car!

If you want to race a friend, get two pieces of string that are about 15' long. The pieces must be of equal length. Thread one end of each string into the guide tubes at the bottom of each car as shown in Figures 15 and 16.

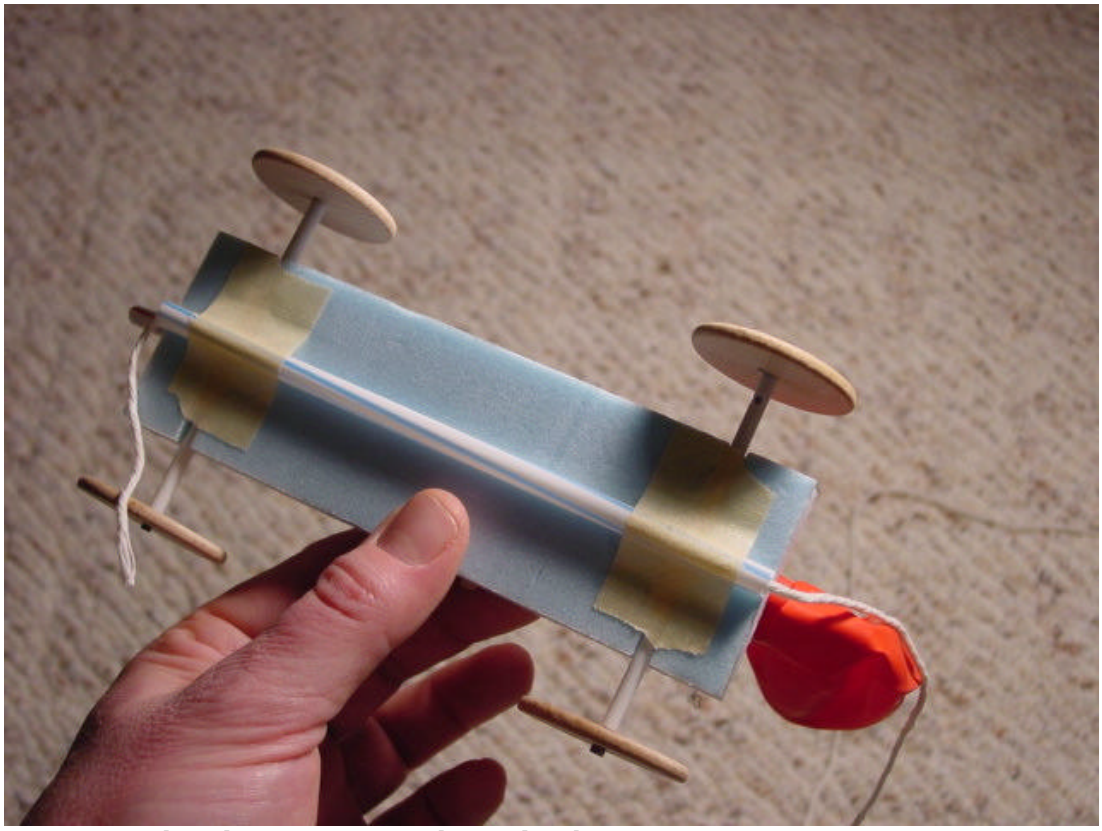


Figure 15: Threading a string into the guide tube.

Put the cars side-by-side on the ground. Have someone hold the far-ends of each string or tie them to a chair rail. Have someone hold the near ends or tie them also to a chair rail. Make sure that when the cars are on the ground side-by-side, and the strings are held or tied, that the strings are still of equal length to make the race fair.

Have the race "drivers" lie close to their cars and blow their own balloons up. They can pinch the straws closed until someone yells go, or the blowing-up of the balloons can be a part of the race.

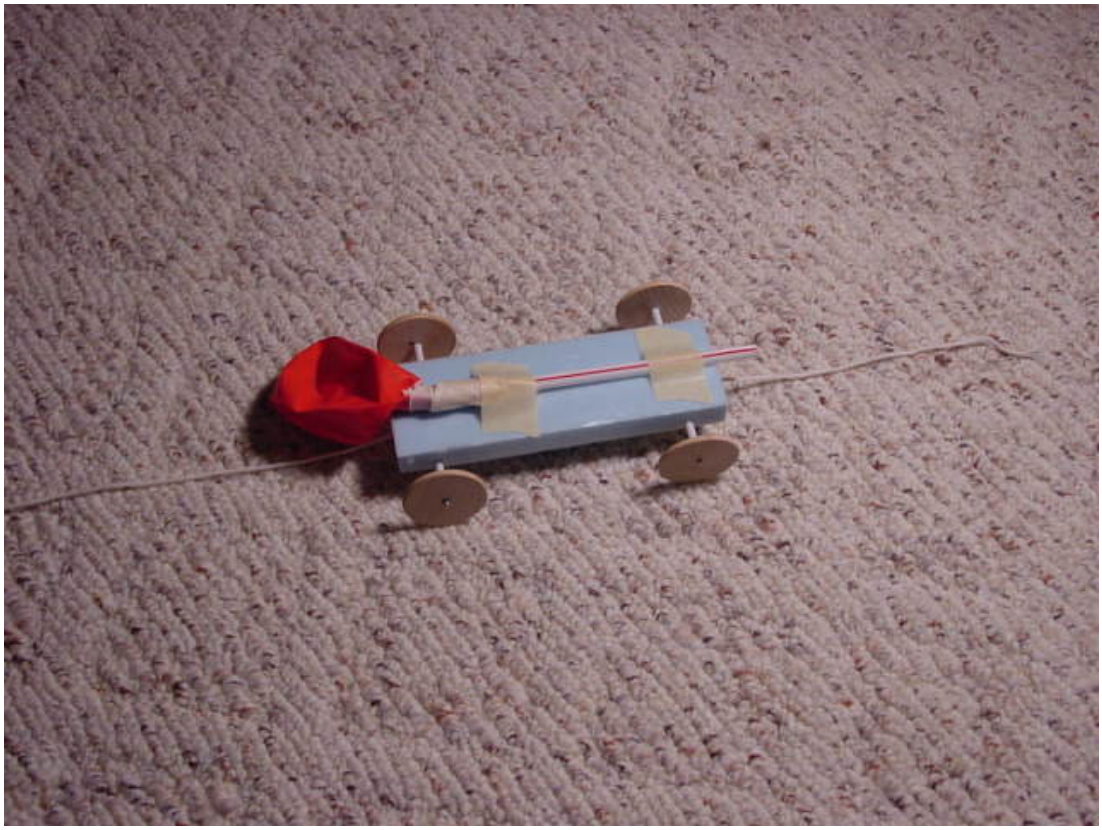


Figure 16: Car with string threaded and near-end of string ready to be held or tied to a chair rail for racing.

Conclusion

This project provides a fun demonstration of physics: the balloon air pressure and forces causing the car to move give a demonstration of Newton's Third Law, "For every action, there is an equal and opposite reaction." To generate more excitement, prizes can be offered for the car that is the fastest, the car the travels the farthest, and the car that has the best decorations. Note that if one wishes to decorate the car, it might be easier to decorate parts of the car *before* it is assembled. Also note that when one decorates a car, it adds weight to the car, slowing it down, and thereby illustrating conflicting goals of trying to win a race versus win for a showy car!