

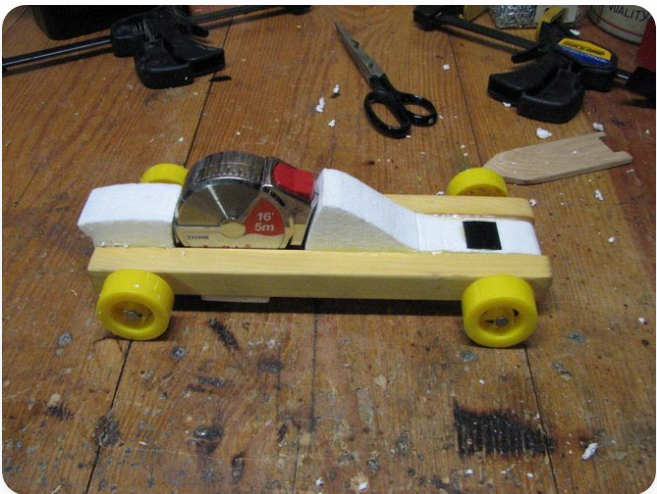
EQUIPMENT BUILD PLAN

MOTION & FORCES

Tape Measure Racer

A small car built around an ordinary 12 ft retractable tape measure. The tape's hook catches on a block taped to the floor; as the spring rewinds the tape, it pulls the car forward, then the hook slips free and the car coasts. It is a hands-on way to explore force, mass and acceleration, like a mousetrap car with a cheaper motor.

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



DIFFICULTY	BUILD TIME
Intermediate	2-3 hours
COST	SAFETY
About \$10-15	Adult build / supervision
GOOD FOR	
Teachers, Families, Makers	

What it shows

Pull a tape measure out 12 feet, let go, and the spring that rewinds the tape launches your car another 25 feet past the start.

Key ideas: Newton's second law, force, mass and acceleration, elastic potential energy, friction

Safety (Adult build / supervision). An adult should handle the drilling and any saw work. The edges of a tape measure blade are sharp, and a released tape whips back fast: keep fingers and faces clear of the tape, hold the car (not the tape) while pulling it out, and wear eye

protection when testing. Hot glue can burn; a grown-up should supervise.

CONSTRUCTION

Build it

Materials

- ☐ **Retractable tape measure, 12 ft** · 1
Belt clip removed
- ☐ **Pine strips** · 2, about the length of the car
The side rails of the chassis
- ☐ **Rigid foam (Styrofoam) block** · 1
Fills the body and holds the tape measure
- ☐ **Wheels** · 4
Plastic wheels like those from a pinewood car kit
- ☐ **Nails** · 4
Axles; long enough to pass through a wheel into the rail
- ☐ **Thin plywood** · Small piece
Base plate under the tape measure
- ☐ **Thin piece of hardwood** · About 5 in long
The launch catch
- ☐ **Wood glue or hot glue sticks** · As needed
- ☐ **Masking tape** · 1 roll
To fix the launch catch to the floor

Tools

Screwdriver

Drill with a bit sized for the nail axles

Hot glue gun

Hobby knife or foam cutter

Clamps

Marker

Small saw for the launch block

1

Gather the parts

You need a tape measure, two pine strips, a foam block, four wheels, four nails and scraps of thin wood.



2

Remove the belt clip

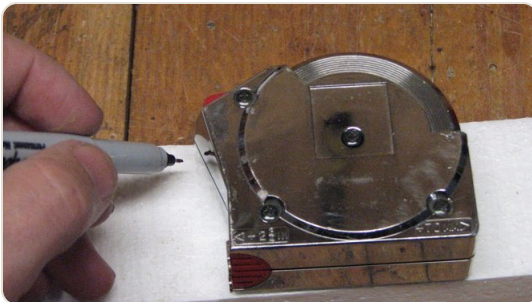
Unscrew the belt clip from the back of the tape measure so it sits flat in the car.



3

Mark the tape's pocket

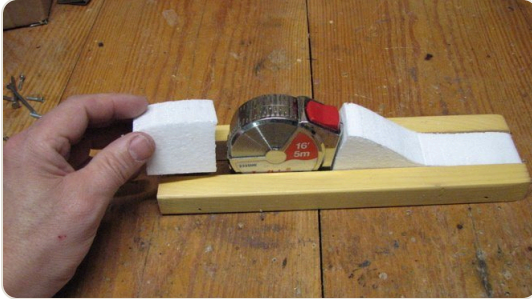
Set the tape measure on the foam block and trace around it. Cut out the pocket so the tape measure sits low in the body.



4

Lay out the car

Arrange the foam body pieces and the tape measure between the two pine rails. The tape should face the back of the car, where it will feed out.



5

Drill the axle holes

Drill holes near each end of both rails for the nail axles. Line the holes up carefully so the car will roll straight.



6

Mount the wheels

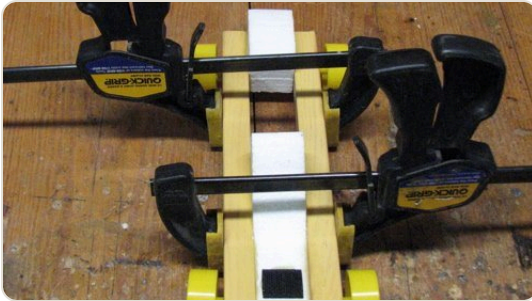
Push a nail through each wheel and into its hole. Leave a little play so the wheels spin freely.



7

Glue up the body

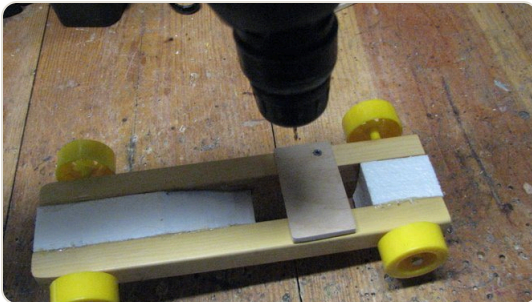
Glue the foam pieces and the rails together and clamp them. Bruce's students started with wood glue and switched to hot glue because it was faster.



8

Add the base plate

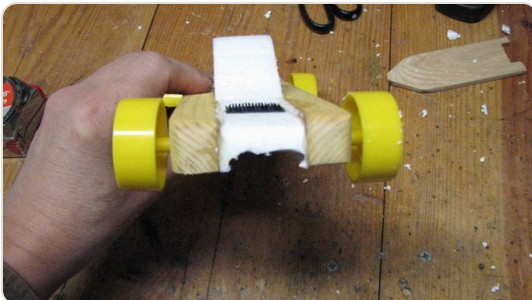
Glue a thin plywood plate across the rails as a seat for the tape measure.



9

Taper the foam

Shape the foam behind the tape measure into a ramp so the tape feeds out and back without catching.



10

Make the launch catch

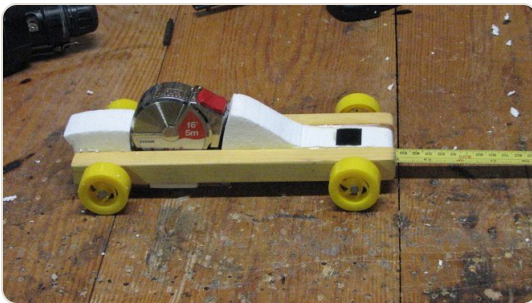
Cut a thin, flat piece of wood with a notch in one end and a pointed nose on the other. Tape it to the floor: the tape slides into the notch and its hook catches on the end.



11

Launch

Hook the tape on the catch, hold the car and walk it back until the tape is fully out, then let go. The tape rewinds, pulling the car toward the catch; the car passes over it, the hook slips off, and the car coasts.



THE PHYSICS

How it works

Pulling out the tape winds the coiled steel spring inside the case, storing elastic potential energy. When you let go, the spring pulls the tape back in. Because the tape's end is hooked to the floor, the spring pulls the whole car toward the hook instead.

The pull of the spring is the unbalanced force that accelerates the car. Newton's second law says the acceleration equals that force divided by the mass, so a lighter car speeds up faster with the same tape measure.

When the tape is fully rewound, the hook unhooks as the car rolls over the catch. With

Using it

- Distance challenge: who can build the car that coasts farthest past the catch?
- Race challenge: clip the end of the tape to the edge of a table, pull the cars back, and release them side by side.
- Add measured masses to the same car and time the run. Graph acceleration against mass.

no more push, the car coasts until friction in the axles and the rolling wheels brings it to a stop. Bruce's sample car coasted a good 25 ft past the catch.

- Compare tape measures of different lengths or widths: which provides more force?
- Discuss where the energy goes: spring, motion, sound and heat from friction.

GO FURTHER

Variations

- Coasting car: built to travel as far as possible after the hook releases.
- Drag racer: the tape is clipped to a table edge and pulls the car the whole way, for head-to-head races.
- Try different wheel sizes and axle materials to cut friction.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

The car veers to one side.

TRY THIS

The axle holes are not lined up. Re-drill one side, or check that a wheel isn't rubbing the body.

IF THIS HAPPENS

The hook doesn't release.

TRY THIS

Make the catch thinner and taper its nose so the car rides over it and the hook slides off.

IF THIS HAPPENS

The tape jams as it rewinds.

TRY THIS

Taper the foam more behind the tape measure so the blade has a clear path.

IF THIS HAPPENS

The car stops quickly after release.

TRY THIS

Reduce axle friction: wheels should spin freely on the nails without wobbling.

and supervise children.