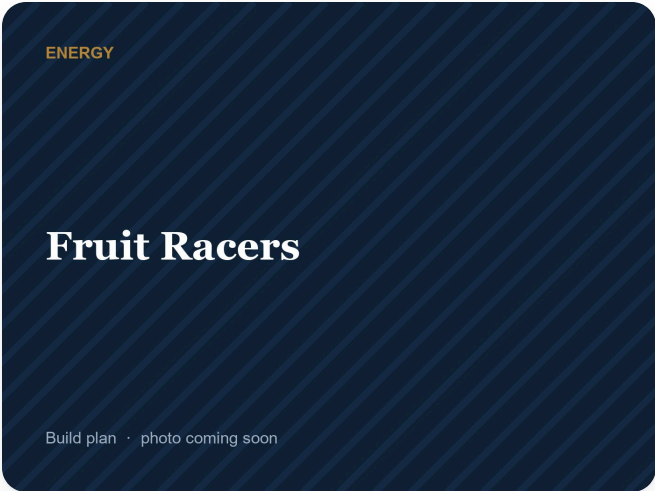


EQUIPMENT BUILD PLAN ENERGY

Fruit Racers

Students build gravity-powered racers using a piece of fruit as the body, then race them down an inclined table. Bruce ran it as a Night of Science event for all ages: builders get basic materials, bring their own fruit and decorations, and have one to two hours to build and test before the race-off.

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



<div>DIFFICULTY</div> <div>Beginner</div>	<div>BUILD TIME</div> <div>1-2 hours (the challenge itself)</div>
<div>COST</div> <div>About \$1-2 per racer</div>	<div>SAFETY</div> <div>Everyday care</div>
<div>GOOD FOR</div> <div>Teachers, Families</div>	

What it shows

Pick a fruit, add wheels, and race it down a tilted table in a family-night challenge built on potential energy.

Key ideas: potential and kinetic energy, friction, mass, engineering design

Safety (Everyday care). Wooden skewers have sharp points; trim or cover them once the axles are in. An adult should handle any knife used on the fruit. Ask about food allergies before the event.

CONSTRUCTION

Build it

Materials

- ☐ **Fruit for the body** · 1 per racer
Builders bring their own: apples, pears, cucumbers, bananas, lemons...
- ☐ **Wooden skewers or dowels for axles** · 2-3 per racer
- ☐ **Wheels** · at least 3 per racer
For example plastic bottle caps, cardboard disks, wooden craft wheels or thick round candies
- ☐ **Drinking straws** · 2-3 per racer
Axle bearings
- ☐ **Tape and rubber bands** · as needed
- ☐ **Decorations** · optional
Builders may add their own
- ☐ **Long table and blocks or books** · 1
The race track

Tools

Scissors

Small hand drill or nail (for poking axle holes in wheels)

Ruler

Stopwatch

1

Set up the track

Use a long table as the track. Raise one end by placing blocks under two legs, and decorate the table like a racetrack with lanes and a finish line.

2

Prepare the kits

Set out basic construction materials for each team. Builders bring their own fruit and any extra decorations.

3

Explain the rules

Each racer must have at least three wheels and the fruit must be the body. Racers start from rest at the top of the track with no pushing.

4

Build the axles

Push straws through the fruit or tape them underneath as bearings, then slide skewers through the straws as axles.

5

Add the wheels

Fasten wheels to the ends of each axle so they turn freely and run straight. Trim sharp skewer ends.

6

Test and improve

Give teams one to two hours to build and run test races. Encourage them to change one thing at a time and see what helps.

7

Race-off

Release racers two at a time from the top of the track and time them or judge the finish. Run heats until a champion emerges.

THE PHYSICS**How it works**

Raising one end of the table gives each racer gravitational potential energy at the top. As it rolls down, that energy turns into kinetic energy of motion.

Some energy is lost to friction at the axles, rubbing between wheels and body, and air resistance, and some goes into spinning the wheels. The fastest racers waste the least.

In an ideal frictionless world all racers would reach the bottom at the same speed regardless of mass. In real racers, a heavier fruit helps overcome the fixed losses from friction, which is why mass often helps, as long as the wheels and axles stay free and straight.

Using it

- Ask builders before the race: Will a heavy fruit or a light fruit win? Then compare results.
- Measure the track length and race time to calculate each racer's average speed.
- Have teams list every change they made and whether it helped, as an engineering design log.
- Award prizes for more than speed: best design, best decoration, straightest run.

- Try three-wheel and four-wheel versions and discuss stability versus friction.

GO FURTHER

Variations

- Use vegetables instead of fruit.
- Measure how far racers roll across the floor after leaving the table, rather than timing them.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

The racer veers off the track.

TRY THIS

Check that the axles are parallel and the wheels are square to them.

IF THIS HAPPENS

The wheels do not turn.

TRY THIS

Either fix the wheels to the axle and let the axle spin inside a straw bearing, or fix the axle and let the wheels spin on it. Check that nothing rubs against the fruit.

IF THIS HAPPENS

The fruit splits around the axle.

TRY THIS

Tape the straws under the fruit instead of pushing them through it.