

EQUIPMENT BUILD PLAN

MOTION & FORCES

Impulse Blowgun and Egg-in-a-Sheet

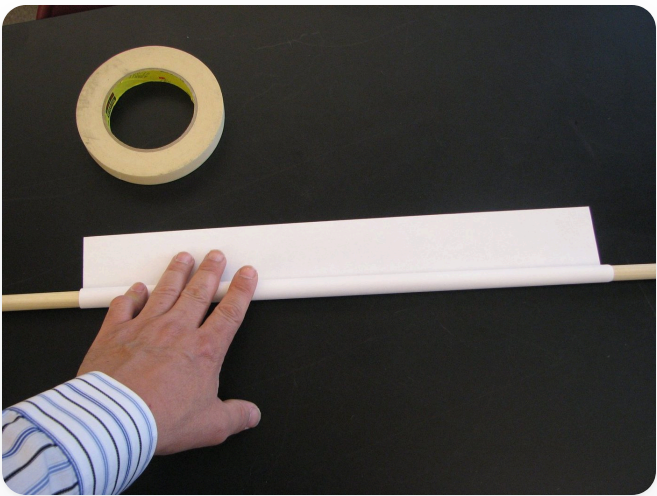
A paper tube rolled around a dowel fires mini marshmallows. Each time you trim the barrel, the push from your breath acts for less time and the dart lands closer, a clear and cheap demonstration of impulse. Pair it with the classic egg-in-a-sheet toss, where stretching out the stopping time keeps a raw egg from breaking.

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

What it shows

Cut the barrel shorter and shorter and watch the marshmallow fall shorter every time.

Key ideas: impulse, momentum, Newton's second law, force and time



DIFFICULTY	BUILD TIME
Beginner	10 minutes
COST	SAFETY
Under \$5	Everyday care
GOOD FOR	
Teachers, Families	

Safety (Everyday care). Only blow out through the blowgun; breathe in through your nose, never through the tube, so a marshmallow cannot be inhaled. One blowgun per person, thrown away after use. Never aim at people or animals. For the egg toss, work outdoors or on a covered floor, and wash hands after handling raw eggs.

Build it

Materials

- ☐ **Legal-size copy paper (8 1/2 × 14 in)** · 1 sheet per blowgun
- ☐ **Wooden dowel matching the dart's diameter** · 1
Used as a rolling form
- ☐ **Mini marshmallows or soft rubber toy darts** · 1 bag
Must be soft and all the same size
- ☐ **Raw eggs** · several
Egg-in-a-sheet demo
- ☐ **Bed sheet** · 1
Egg-in-a-sheet demo

Tools

Scissors

Masking tape

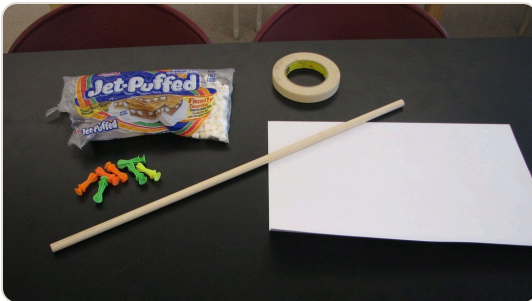
Tape measure

Video camera or phone (optional)

1

Gather the materials

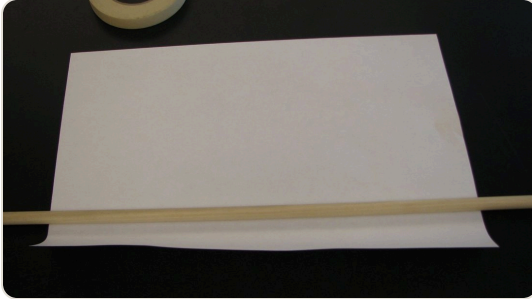
You need legal-size paper, masking tape, a wooden dowel about the same diameter as your darts, and a bag of mini marshmallows or soft toy darts.



2

Roll the barrel

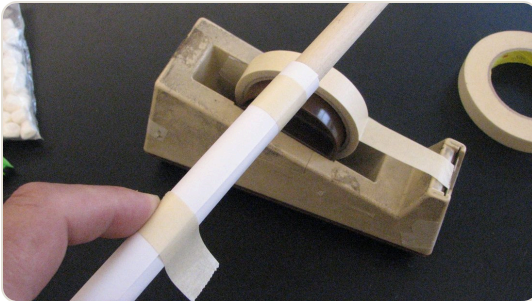
Lay the dowel along the long edge of the paper and roll the paper lengthwise around it into a long, snug tube.



3

Tape it in several places

Tape the tube at several points along its whole length. The barrel will be cut shorter during the demonstration, so every section needs its own tape.



4

Slide out the dowel and load

Remove the dowel and drop a marshmallow or dart into the mouth end of the tube.



5

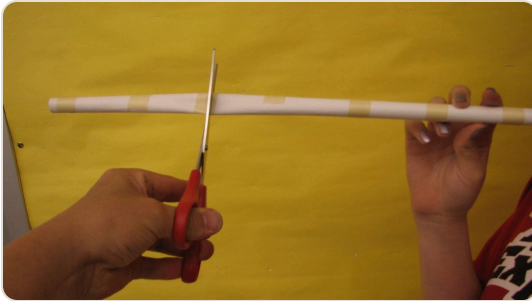
Take baseline shots

Hold the barrel level at the same height each time and blow with the same effort. After a few tries the darts should land in about the same place. Mark and measure the distance.

6

Cut the barrel shorter

Cut about 25 percent off the barrel. Ask for predictions, then shoot again with the same effort and measure.



7

Repeat

Keep trimming the barrel and shooting. Record barrel length and distance each time and graph the results.

8

Set up the egg sheet

Two people hold a bed sheet up by its top corners, with the bottom edge folded up and held to form a pocket so a caught egg rolls into the fold and stays there.

9

Throw eggs into the sheet

First show that a raw egg breaks when thrown against a hard surface outdoors. Then throw eggs into the middle of the sheet, softly at first and then harder. They do not break.

10

Measure the speed (optional)

Record the throws on video and step through frame by frame. Using the camera's frame rate and a measured distance, calculate the egg's speed and how long it takes to stop.

THE PHYSICS**How it works**

Impulse is force multiplied by the time the force acts, and it equals the change in an object's momentum. A small force for a long time can produce the same change in momentum as a large force for a short time.

In the blowgun, your breath pushes on the dart the whole time it is in the barrel. If you blow with about the same force each time, a shorter

Using it

- Ask: which shoots farther, a long blowgun or a short one? Have students predict the distance after each cut.

barrel means the push lasts a shorter time, so the dart leaves with less momentum and speed and lands closer.

Stopping an egg requires the same change in momentum whether it hits a wall or a sheet. The wall stops it in a tiny fraction of a second, which takes a very large force, and the shell breaks. The sheet gives way and stretches the stopping time out, so the force needed is much smaller and the egg survives. Car crumple zones, air bags, padding and catching a ball with 'soft hands' all work the same way.

- Ask how the barrel length changes the time part of impulse, and whether it should change the force (ideally not).
- What would happen with the same barrel length if you blew harder or softer?
- Apply the idea to rifles versus handguns, golf swing follow-through, or a long jump run-up.
- For the eggs: if you played catch with raw eggs, how would you catch them? Relate it to crumple zones and an egg-drop project.

GO FURTHER

Variations

- Bruce also made a reusable set of blowguns from PVC pipe cut to different lengths.
- Graph distance against barrel length and look for the pattern.
- Try the egg toss with a towel held tight versus held loosely.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

Distances vary a lot between shots.

TRY THIS

Keep the barrel level at the same height, use same-size darts, and practice blowing with the same effort before you start cutting.

IF THIS HAPPENS

The marshmallow sticks in the tube.

TRY THIS

Roll the paper on a slightly larger dowel, or use fresher, firmer marshmallows.

IF THIS HAPPENS

The egg breaks in the sheet.

TRY THIS

The sheet was held too tight or the egg hit the holders' hands or the edge. Hold it loosely and aim

for the center.

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