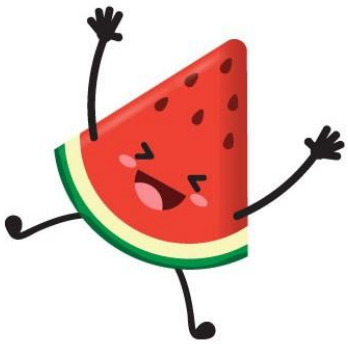
The BIG Watermelon Experiment

Physics, Forces and Flying Fruit



Setting up and doing the experiment

1. What makes this a Science Experiment?

In any science experiment, there are a few things that are fairly common.
The question that is trying to be answered.
The hypothesis: This is a thought-out prediction (or educated guess) as to the outcome of the experiment. In other words, what you think will happen.
The method: A logical and repeatable way of doing the experiment.
The results: These are the things you measure when doing the experiment.
The discussion: What do all the measurements mean? Do they help answer the question?
The conclusion: What has been found from the experiment.

The Big Watermelon Experiment has all of these things, although you won't do all of them on the day the watermelon implodes. In fact, whilst each school is conducting a mini-experiment, each melon that implodes forms one part of the Big Experiment (often known as a "trial").

For example, at the school level you are trying to answer:
How many rubber bands will implode this watermelon?

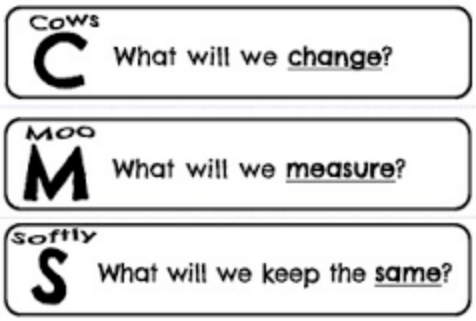
But the Big Experiment is trying to answer a slightly different question:
How many rubber bands does it take to implode a watermelon?

Q. Can the students explain the difference in the two questions above?
A. The big experiment question is really asking: If there is enough data, gathered from enough watermelons being imploded in the same manner, can we predict how many rubber bands it should take? Is there a pattern? Does it depend upon size, shape, density, rind width, or a combination?

This is why it is important that each school follow the same method when doing their experiment, so that the results can be fairly compared.

2. Variables

You may have heard or used this in relation to a science experiment: **Make it a Fair Test**, or, **Cows Moo Softly**



Every experiment has variables. Even something as simple as dissolving sugar in water has many (water volume, temperature, sugar type, crystal size, amount of stirring etc).

Q. Can students think of the variables in the melon experiment?
A. Rubber band size, placement on the melon, narrowness of band belt, quality of rubber bands (new, old, brand), freshness of watermelon, watermelon size, shape, rind width.

In an ideal science experiment, only one variable is changed (while all the others are kept the same) and one is measured.

Often these are called the dependent variable (measured) and independent variable (thing changed)

Q. Can the students identify the independent and dependent variables here? (what will change, what will they measure?)
A. The independent variable is the watermelon, the dependent variable is the number of rubber bands.

Obviously our independent variable (watermelon) is not going to be the same for every school. Watermelons vary quite a bit, but that is why we need to do so many trials (melons imploding) so that we get many examples of round, and oval melons, thick rinds and thin until we hopefully see a pattern develop.

3. Materials required

- 1 watermelon
- 500g bag size 64 rubber bands
- Measuring tape
- Scales (or weight from store receipt)
- Melon “holder” - metal dog bowl, sand bag, metal saucepan. This *cannot* be fragile!
- PPE - eye protection and clothes protection for rubber band adders
- A table or stool to sit the melon on

4. Setting up

- Location: Outside most preferably, unless you like cleaning.
- A sturdy stool/small table to sit the melon on (ideally not too low, otherwise students end up leaning over it to put rubber bands on, and that is not so safe.
- 2m exclusion zone, perhaps marked out by chalk or rope. Only band adders inside the rope.
- Viewing area for everyone else.
- Separate table outside the zone for spare coats/glasses and the next lot of rubber bands to be added

5. Conducting the experiment

Before you add any bands

- Measure and record the circumferences (waist and top to bottom)
- Measure the weight
- Note any major blotches defects
- (optional) Calculations of volume and density can now be done. See next section.
- Make predictions! It is great if everyone involved can make a prediction, these could be written up on a white board or flip book, or Excel. At the end you'll then have a "winner" too.
- Previous melon data available on the website (conducted over the years by Dr Rob) can be used to help shape predictions.

Doing the Experiment

- Best if students add bands in pairs and perhaps do a set amount each pair (eg. 10 bands)
- Keep count!
- Keep a narrow belt near the middle

After the Experiment

- Measure the rind thickness
- Clean up and eat up or compost the remains
- Rubber bands can be pulled apart, washed and used again.

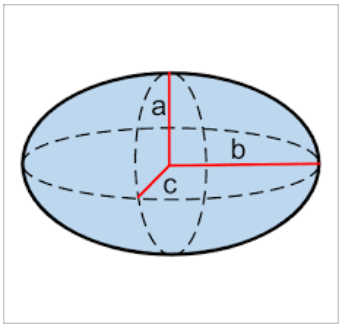
6. <u>Calculations</u>

Depending upon the level of maths the students have done, they can be asked to work out the volume and density of the melon.

Volume (sphere) = 4/3 πr^3

But given the melon might not be a sphere, you can also use:

Volume (ellipsoid) = 4/3 π abc



[So use the top to bottom circumference to calculate b,
Then the waist measurement to calculate a (and assume c is the same).]

or use this **handy shortcut**:
Volume (L) = Circumference, cm (top to bottom) x Circumference, cm (sideways) x Circumference, cm (sideways) ÷ 59,000.

Density = weight(kg)/volume(L)
(likely around 1. How does this compare to water, or other fruit?)

7. <u>Risks</u>

Whilst this experiment is essentially an implosion, as Isaac Newton liked to say, every action has an equal and opposite reaction. In other words, when all that force collapses inwards, the result is that some material flies outwards.
The major risk areas to watch out for are:

- Rubber bands breaking when being stretched (one big reason for the eye protection)
- As the implosion occurs, the resulting rubber band ball often flings out in a random direction. It can cause a solid, dull impact to anyone close (hence the exclusion zone).
- As the implosion occurs, the top section of the watermelon can be pushed upwards suddenly, up to 1 metre in the air. Ensure students avoid placing their heads or anything directly above the melon.
- It is quite hard to predict when the implosion will occur, so try and ensure students do not get complacent - treat the melon as “ready to go off” at any point.
- All that said, Dr Rob has safely done this many times, with young children (some need help with bands), older children and even adults.

8. Teacher Tips

Filming

- The implosion and lead up is spectacular to watch back.
- It makes great pictures and is even better on video. **Patience is key**.
- If you have access to a Go-Pro or similar, that should be safe to set up close to the action.
- When the implosion nears, using a high frame rate (slo-mo mode) is good if you can.
- If a camera is precious, best to avoid the 2m exclusion zone that watermelon can fly!

9. Sharing your results

Results will be submitted via an online form, details of which will come via an email soon. These results will all be added to The Big Experiment database.

Once all the results are in, Experimentary will collate them and share with participating schools, so you can compare your results to others.

You can also share your photos/videos and experiences on social media; tagging Experimentary and using the hashtags **#watermelonimplosion #bigexperiment #scienceweek**

Share/tag on:
Facebook: @experimentarydrrob
Instagram: @experimentary_