Chocolate melting

Specific heat capacity, energy

You will need
Milk chocolate buttons

What to do
- Place a piece of chocolate on your tongue and HOLD it in your mouth while it melts.
- DO NOT CHEW.
- Rub your tongue across the melting chocolate.

What happens?
You should notice that your tongue and your mouth feel cool.

How it works
Chocolate has a melting point close to 36 ^{o}C.
It changes from a solid to a liquid very quickly.
36 ^{o}C is lower than your body temperature so chocolate melts in your mouth
The melting chocolate is using heat from your mouth to melt, so your mouth feels cooler.

What next?
See if you get the same effect with other types of chocolate.

Safety notes
This activity should be carried out in hygienic conditions (and preferably not a science lab). Cover samples with clingfilm if they are prepared in advance.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Dancing Couscous

Electrostatics

You will need

- Plastic plate
- Couscous
- Cling film
- A piece of silk or similar material

What to do

- Put a thin layer of couscous onto the plate.
- Stretch cling film across the top of the plate.
- Rub the bottom of the plate with the material.

What happens?

The couscous begins to jump up to the cling film and then falls back to the plate.

How it works

When you rub the plate it becomes charged by friction and a potential difference is set up between the cling film and the plate.

The couscous is attracted to the cling film. When it touches the cling film, charge is exchanged and the couscous then falls back to the plate.

What next?

Look at experiments on electrostatic cereal and eggs.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Coupled Apple Pendulums

Simple harmonic motion, energy

You will need
- 2 apples
- String
- Two retort stands

What to do
- Attach the string between the retort stands.
- Attach two lengths of string to the apples.
- Suspend the apple pendulums from the string support, making sure that they have the same length of string.
- Set one apple pendulum swinging.

What happens?
- The swinging pendulum will gradually lose amplitude and come to a stop.
- As this happens the other pendulum will start swinging reaching its maximum amplitude as the first pendulum comes to a stop.
- The pendulums will continue to oscillate in this fashion

How it works

Energy is exchanged between the two pendulums through the non-rigid string coupling.

What next?

The weight of an average size apple is 1 newton.
Remembering the story of the apple falling on Newton's head, it is nice to use an apple for any pendulum experiment.

Safety notes
Beware of apples falling on your head.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Cola Float

Density

You will need

Large bucket / bowl of water
Two cans of the same brand of soft drink: one normal and one diet
Other brands of soft drink

What to do

- Put the unopened cans into the water

What happens?

The cans will float at different levels in the water.

How it works

The sugar in the can makes the non-diet drink more dense than the diet drink. The diet drink will float slightly higher in the water.

Safety notes

Mop up any spills

Comparison of amount of sweetener and sugar in soft drinks

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Breaking Biscuits

Properties of materials

You will need
Cracker type of biscuit (e.g. water biscuit or nice biscuit)
Biscuit with currants
Magnifying glass

What to do

- Break the biscuits in half.
- Compare how they break (their failure mode)
- Look at the broken edges with a magnifying glass

What happens?
The cracker should break into many small pieces which could be fitted together again.

How it works
The cracker breaks easily with no deformation just like a brittle material. The other biscuit is a composite material and the currants deform plastically.

What next?
Consider why the manufacturers use a cardboard box for crackers but a less rigid packaging for the currant filled biscuit.

Safety notes
Tidy up the crumbs.
Do not eat the biscuits after the experiment

With thanks to Ruth Wiltsher and Alison Alexander, IOP

How quickly does the foam on a glass of beer decay?

Exponential decay

You will need
measuring cylinder (or beer glass for authenticity)
Can of beer
Ruler
Stop watch
Graph paper

What to do

- Draw a table with columns for *time* and *length of the foam*.
- Fix a ruler alongside the glass.
- Pour in the beer until the foam reaches the top of the glass.
- Take measurements of the length of the foam at fixed time intervals.
- Draw a graph of *time* on the *x* axis against *length of the foam* on the *y* axis.

What next?
Test your results to see if the decay is exponential.

Safety notes
Dispose of the beer sensibly (do not drink).

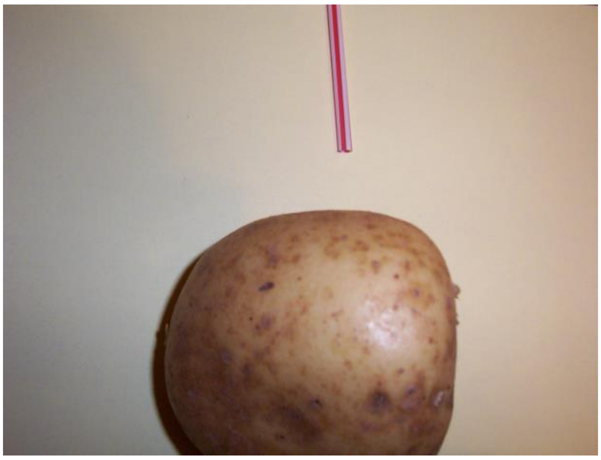
With thanks to Ruth Wiltsher and Alison Alexander, IOP

Spearing a potato

Forces and momentum

You will need

Potato
Drinking straws



What to do

- Hold the potato in one hand and a straw above the potato in the other hand.
- Slowly push the straw against the potato.
- Try again but this time move the straw downwards as fast as you can.

What happens?

The first time the straw probably crumpled.
The second time the straw should have speared the potato.

How it works

When the straw is moved quickly there is a large force because there is a large change of momentum in a short time so there is no plastic deformation and the straw does not bend.

What next?

See if you can get the straw right through the potato.
Does this work with other vegetables or fruits?
Does the size of straw make a difference?

Safety notes

Make sure no pieces of potato are left lying around.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Stretching Strawberry laces

Properties of materials, forces

You will need
Strawberry laces
10g masses and holder
Bulldog clip, small pieces of card
Clamp stand, bosshead and clamp
ruler

Image Credit:Liz Swinbank

What to do

- Hang a strawberry lace from the clamp stand.
- Measure the length of the lace
- Carefully add 10g masses to the lace
- Measure the extension of the lace
- Plot a force-extension graph

What next?
Measure the breaking stress of the lace

Safety notes
The strawberry laces should not be eaten.
Protect toes from falling masses

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Flexible Eggs

air pressure

You will need

- One hard-boiled egg
- Hyacinth vase or conical flask

What to do

- Put about 1 cm of hot water into the hyacinth vase.
- Wait a minute to allow the air in the vase to become warm.
- Place a hard-boiled egg (without the shell) on the neck of the flask.

What happens?

As the flask cools the egg is gradually squeezed into the flask, stretching as it goes through the neck.

How it works

The hot water heats up the air in the vase.
The hot air will expand and some will be expelled from the vase before the egg is put in place.
As the air cools it contracts leaving a partial vacuum in the vase.
The egg is sucked in.

What next?

Getting the egg out!

First empty out the water and run the flask under cold water to cool it down.
Then hold flask upside down so that the egg sits in the neck of the flask.
Run hot water over the flask to make the air inside expand and push the egg out.

Note

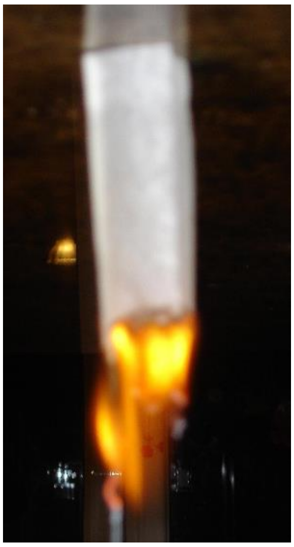
The same effect can be achieved using a lighted splint dropped into the flask. However, that then brings in ideas of chemical reactions etc which can obscure the point of the demo.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

The Floating Teabag

convection

You will need



A one cup teabag – the ones with a string that you can drape over your cup
Matches or a lighter

What to do

- Remove the staple and empty the tea out of the teabag.
- Make the bag into a tube and stand it upright on the table.
- Light the top of the bag.
- Watch**.**

What happens?
When the bag has burnt almost to the table it floats up to the ceiling.

How it works
The burning teabag heats the air inside it. This warm, less dense air is pushed upwards on a convection current taking the remains of the teabag with it.

Safety notes
Beware of the naked flame. Avoid draughts.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Marshmallow expansion

Air pressure

You will need
vacuum saver tub
Marshmallows

What to do

- Put the marshmallows into the tub
- Use the pump supplied with the tub to remove as much as possible. Watch what happens to the marshmallows.
- Let the air back into the tub.

How it works
Marshmallows are full of bubbles of air. Removing the air from the jar reduces the pressure. The bubbles in the marshmallows expand, causing the mallow to expand.

What next?
Try shaving cream for a similar effect.

This can be done using a wine bottle and a vacuvin.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Density Cocktails

You will need
Small cup or glass
Ice
Soft drinks with different sugar content

What to do

- Pour in a small amount of the drink with the highest sugar content.
- Add ice cubes to the glass
- Slowly pour in the soft drink with the next highest sugar content. Use the ice to try to prevent them mixing.
- Repeat with the soft drink with the lowest sugar content.

How it works
The density of the drinks increases as their sugar content increases. The least dense drink will float on top of the others without mixing.

What next?
How many layers can you achieve? Have a look at Steve Spangler's 9 layer density tower.
You could try floating cream on coffee (or hot chocolate)

Safety notes
Clear up spilt liquids.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Pick and Mix

properties of materials

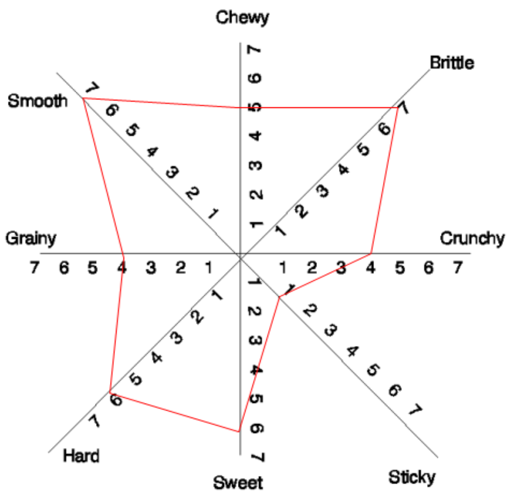
You will need

A selection of sweets which should have a variety of mechanical properties and textures (eg toffee, boiled sweets, fudge, chocolate, pastilles, Mars bars, Snickers, Kit-Kat, wafers, crackers). Broken into bitesize pieces

Paper plates
Copies of blank 'star diagrams' (several per student)

What to do

- Eat the samples (one at a time!)
- Complete a 'star diagram' for each one to record the assessment of its various properties.
- Plot points on the axes (eg a score of 7 for hardness means 'very hard') and join them to make a star.



What happens?
Different sweets produce a different shaped star chart.
Can you use the charts to identify a sweet?

What next?
Carry out the same investigation using biscuits or vegetables. You may need to change the labels on the star chart.

Safety notes
This activity must be carried out in hygienic non-laboratory conditions.
Cover the plates of samples with clingfilm if they are prepared in advance.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Dancing raisins

Density and nucleation sites

You will need

Fizzy water
Glass
Raisins

What to do

- Fill the glass with fizzy water.
- Drop in a few raisins

What happens?

The raisins float to the surface and than fall down again.

How it works

The nuts and raisins act as ‘nucleation’ sites for bubble formation. The gas bubbles are less dense than the water and so float to the surface, where they burst.

What next?

Does this work with salted and unsalted peanuts?
Look at where bubbles form when water boils in a pan or beaker.
Read up about nucleation sites.

Safety notes

If using peanuts, check for peanut allergies.

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Balancing cans

Forces, moments, centre of gravity

You will need
A soft drink can with a small amount of water
A full soft drink can

What to do
- Try to balance each can at an angle.

What happens?
The can with a small amount of water will balance. The full can will not balance.

How it works
The centre of gravity of the full is in the middle of the can. This makes it impossible to balance because the centre of Gravity is always outside the base of the balancing can.

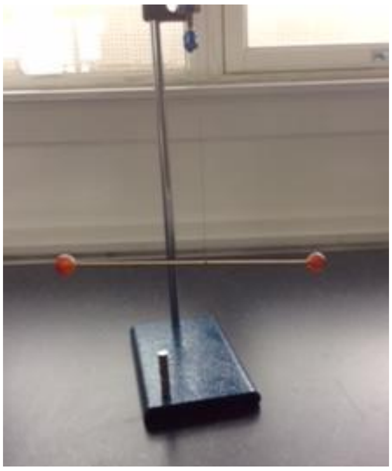
The centre of gravity of the other can is lower, so it can balance.

Safety notes
Mop up any spills

With thanks to Ruth Wiltsher and Alison Alexander, IOP

Magnetic Grapes

You will need
Two large grapes
String (about 50cm)
Clamp stand and clamp
Skewer (or straw)



What to do
- Tie the string in the middle of the skewer and attach the other end of the string to the clamp.
- Push a grape onto each end of the skewer. The skewer needs to be balanced so you may need to move the grapes and string slightly
- Bring one pole of the magnet close to (but not touching) the grape. Observe what happens.
- Repeat using the other pole of the magnet.

How it works.
Grapes are an example of a diamagnetic material. Diamagnetic materials create an induce magnetic field in a direction opposite to an externally applied magnetic field (like Lenz's law) and are repelled by the applied magnetic field.

What next?
Can you find examples of materials that are attracted by an external magnetic field (paramagnetic)?

Safety notes
Neodymium magnets can pinch skin
Neodymium magnets are brittle and can shatter if they 'click together' too hard.

With thanks to Ruth Wiltsher and Alison Alexander, IOP