THE EGG BOX

7 Eggsperiments for Hardboiled Investigators

(Because eggs aren't just for eating…)

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EGGS-TRAORDINARILY STRONG

Eggs are designed to provide a safe growing chamber for a developing bird and are very strong, considering their light weight. Their shape allows any pressure put on one area of the egg to be spread out over the whole egg, reducing the chance of them cracking.

Here's a demonstration that shows just how strong they are.

YOU WILL NEED:

- 5 raw eggs (or hard-boiled eggs)
- a large egg carton
- a strong board
- lots of heavy books

READY, EGGY, GO…

(NB This might get messy, so do this investigation over a sink. They're strong these eggs, but not unbreakable!)

1. Take an egg and squeeze it tightly in your hand – you'll be amazed at how much pressure it can take. Does the way you hold the egg affect how hard you can squeeze it?

   Now see how much weight you can support on *four* eggs…

2. Pop an egg in each corner of a large egg carton then place a strong board on top of it. You will need to have similar sized eggs so that the board is held evenly.

3. Pile books on top of the board until the eggs break.

4. Using boiled eggs instead of fresh ones reduces some of the mess when they eventually crack, but it isn't quite as much fun!

Try weighing your books after the eggs have broken… You'll be surprised how much weight they can support.

EGG-STRORDINARILY STRONG: THE INSIDE STORY

Eggs have what engineers call an 'arch structure' at each end.
This is an excellent design for supporting weight, which is why it's the main type of structure used in many bridges. When a bridge with a single arch supports a weight, the force is transferred down each side of the arch into the ground. An egg, with its two arches, transfers any force placed on it through to the entire shell. This makes it very hard to break an egg by squeezing it 'longways'. However, once the first crack develops, the protective structure is destroyed and any further force will crush the egg.

HOT WATER BOTTLE EGG

Here's a spectacular way to get an egg to go inside a bottle.

(This experiment uses boiling water, so be careful and make sure kids have adult supervision. And it's probably best to do this experiment in the sink just in case!)

YOU WILL NEED

- One small, **shelled**, hard-boiled egg
- A glass bottle with a neck that's almost, but not quite, the same diameter as the egg (milk bottles may work but some drinks bottles e.g. Oasis have even wider necks)
- Boiling water

READY, EGGY, GO…

1. Boil a kettle and pour the hot water into the bottle, filling it up. Leave for a couple of minutes.

2. The bottle will be hot! Carefully pour the water out of the bottle, and then immediately put the egg in the bottleneck. Make sure it is a snug fit and that there are no gaps.

3. Wait a few minutes…. The egg will start to be sucked into the bottle. Finally it should go all the way in, making a fantastic noise as it does so!

(If the egg's too big for the bottle, then it will break in half instead.)

HOT WATER BOTTLE EGG: THE INSIDE STORY

To be truly accurate, the egg isn't "sucked" into the bottle at all – it's pushed. The reason is all down to air pressure. Before you start the experiment, the air pressure is the same inside the bottle and outside it.

However, you heat up the bottle with the boiling water and when you pour the water out, warm air fills the empty bottle. As warm air has more energy than cold air, less of it is needed to provide the same pressure. So although the pressure is the same, there's less air in the warm bottle than in the cold bottle. As the bottle cools, so the air inside cools. The cold air now in the bottle cannot provide the same pressure, but no new air can enter the bottle because the egg is in the way.

The air pressure outside the bottle is now greater than the air pressure inside it. The air above pushes down on the bottle and is stronger than the air inside. The egg – as it's in the way – gets pushed down too causing it to drop in. Once the egg is through the neck, air rushes into the bottle to equalise the pressure.

ROTTING EGGS AND ROTTING TEETH

Everyone says that fizzy drinks are bad for our teeth, but how can we test the effects of cola on teeth without actually damaging any in the process?

You can do this experiment with real teeth if anyone you know has a milk tooth that's falling out and is willing to give up the tooth fairy visit for the sake of science. However, eggshells react in a similar way to the acid in drinks and so make a good substitute.

YOU WILL NEED

- 4 pieces of eggshell
- 4 plastic cups
- thread
- straws (optional)
- drinks: cola, squash drink, fresh orange juice, water
- sticky tape

READY, EGGY, GO…

1. Hang a bit of eggshell in a plastic cup by tying a piece of thread through a hole in the shell and attaching it to the cup with sticky tape (or hang it from a piece of straw). Fill the cup with cola.

2. Do the same in three other plastic cups but fill them with the squash drink, the orange juice and the water.

3. Leave the cups for a week and then remove the eggshell fragments for comparison.

4. Examine the shells. Are some softer to the touch than others? Can you scrape away some of the surface with your fingernail?

ROTTING EGGS AND ROTTING TEETH: THE INSIDE STORY

Cola is very definitely acidic as it contains phosphoric acid, carbonic acid and citric acid. Over time, the calcium carbonate in the eggshells reacts with these acids and is slowly dissolved into the drink, softening the shells.

Fresh orange juice also contains acids, particularly citric acid, and can be just as acidic as colas. Squash drinks contain acids such as citric, tartaric and malic acid and the level of acidity can vary from brand to brand. Still water is far less acidic than fruit juice so the eggshell remains unaffected.

Our teeth are made out of calcium phosphate which also reacts with these acids, and so drinking too many acidy drinks *will* slowly dissolve your teeth…

THE NAKED EGG

What's round and wears a shellsuit?

An EGG of course!

This activity will let you see what happens when you dissolve its shellsuit off it by chemical means…

YOU WILL NEED

- 1 small jar or glass
- 1 raw egg
- vinegar

READY, EGGY, GO…

1. Gently place the egg in the bottom of the jar or glass – don't crack it! Pour enough vinegar over the egg to cover it completely. Leave the egg to sit overnight.

2. The next day, remove the egg from the jar or glass and gently rinse it under a trickle of water in the sink while gently rubbing the shell with your fingers. You'll feel the shell schmushing under your fingers… If the shell does not come off completely, return the egg to the jar or glass, making sure the vinegar still covers the entire egg.

3. Try rinsing the egg again the next day and continue soaking overnight and rinsing until all the shell has gone. You may need to replace the vinegar with a fresh batch.

Eventually, you'll be left with one naked egg – eeeeurgh. Hold it up to the light. Bet you never thought you'd be able to see inside an egg, did you?!

(PS You can use your naked egg for the 'Incredible Shrinking Egg' experiment also in this Egg Box. All you need to do is take the egg out carefully and put it in a plastic bag in the refrigerator ready for action next time you need some egg-citement!)

NAKED EGGS: THE INSIDE STORY

The bubbles that form on the surface of the egg are carbon dioxide gas, which are caused by a reaction between the vinegar (acetic acid) and the shell (calcium carbonate). After a day or so the reaction will have dissolved the shell, leaving the membrane of the egg.

Chalk is also made up of calcium carbonate, and if you drop chalk in vinegar you'll see the same carbon dioxide bubbles forming … as before, the chalk will slowly disappear.

ABRACADABRA EGGS

This is a demonstration for an to perform in front of kids, and it's not for the faint-hearted. Flippin' impressive though!

YOU WILL NEED

- a box of eggs
- 3 wine glasses – all the same size and weight (or 3 mugs)
- 3 empty Smarties tubes
- a jug of water
- a small wooden (or other hard flat substance) board – flat and about the size of a paperback book
- nerves of steel

READY, EGGY, GO…

1. Eat the Smarties. Tricky, but maybe your friends will help.

2. Pour water into the wine glasses (or mugs) so that they are about half full. Mugs are useful if your board is quite big as they provide a stronger, heavier base. Then rest the wooden board on top of the wine glasses, making sure it is flat, smooth and is touching the rims of all the glasses.

3. Take the lid off the empty Smarties tubes and stand them upright on the board so that they are directly over each glass.

4. Take three eggs and carefully balance each one on top of the Smarties tubes. You might want to practice this first using tomatoes as a good approximation. Check from each side that the tubes and eggs are over each glass.

5. Hit the edge of the board firmly with the heel of your hand so that it flies away (be careful where you do this, obviously). Make sure your hand stops as it hits the board, do NOT follow though. Watch what happens to the board, tubes and eggs.

6. If all goes to plan the eggs should drop down straight into the glasses while the board and tubes fly off into the distance. Stand back, and modestly accept the applause and cheers from your audience….

ABRACADABRA EGGS: THE INSIDE STORY

Nobody knows whether Isaac Newton ever performed this stunt – he wasn't known for his lighthearted nature, so it's hard to imagine. And he'd have had to improvise on the Smartie tubes in any case… However, we believe that had he witnessed this activity, he would have been very impressed at the nifty way it demonstrates his First Law of Motion, which concerns "inertia".

This law of physics states that objects only change the direction and speed at which they're moving when a push or a pull is applied to them. If an object is *stationary*, it will therefore remain stationary unless pushed or pulled.

In this experiment, no force is applied to the eggs – just to the board which is whacked out from under them, so they do not fly off with the board. They stay where they were (above the glasses) until gravity (another force) pulls them down into their respective glasses.

THE INCREDIBLE SHRINKING EGG

If you thought doing the Naked Egg experiment was a load of fun, just try this. It's not appetizing (rather yuk-tastic actually) but it does show how eggs can change size, depending on where you put them…

YOU WILL NEED

- 1 small jar or glass
- 1 raw egg without a shell (see Rubber Egg experiment)
- Some golden syrup (or a really, really sweet mixture of sugar dissolved in water)

READY, EGGY, GO…

1. Gently place the shell-less egg in the jar. Fill the jar about half-full with golden syrup or sugar solution.

2. Look at the size of the egg and then leave it alone for two hours.

3. Come back and see what's happening.

4. Then leave the egg in the jar for three days. You may want to change the syrup or sugar solution after a day for a fresh batch. After three days, remove the egg and gently rinse it off in fresh water.

5. Check out what's happened… Weird huh?

6. Put your egg in a glass of fresh water and let it sit overnight. Check out the egg again…bet you didn't know eggs could do that!

INCREDIBLE SHINKING EGGS: THE INSIDE STORY

The membrane that surrounds the egg is "semi-permeable". This means that some substances, such as water molecules, can pass into and out of the egg while other substances, like the proteins in the egg white, cannot. Once the shell is removed water easily moves into or out of the egg through the membrane.

The concentration of water molecules in the sugar solution is less than inside the egg. When you put the egg into the sugar solution, the water molecules move from inside the egg into the sugar solution to try and make the concentrations of water on each side the same. This movement of water makes the egg shrink. If you place the shrunken egg in pure water then some water molecules will move back into the egg and make it swell up again.

TELLTALE EGGS

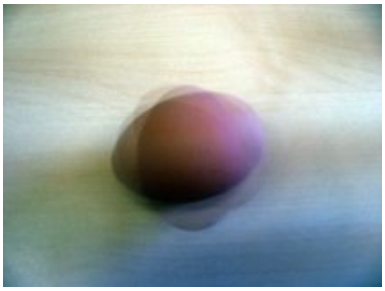
Another activity which can be used to impress and amaze your friends and family with just a little bit of showmanship!

It uses the fantastic new science of spinning to let you see right into two identical looking eggs…

YOU WILL NEED

- 1 raw egg
- 1 hard-boiled egg
- a flat surface

READY, EGGY, GO…



1. Show your audience the two eggs (one hard-boiled, one raw). Tell them you've got your lunch mixed up and you need to work out which is which.

2. Spin the hard-boiled egg. It will spin like a top and if you try to stop it using light finger pressure and then let go, it will have stopped dead.

3. Spin the raw egg. It will have a very unsteady spin and if you try to stop it with your finger and then let go, it will start spinning again.

If you want to get a bit messier, pierce a hole in each end of a raw egg and blow the contents out. Try spinning it and see what happens!

TELLTALE EGGS: THE INSIDE STORY

The two eggs behave differently simply because their insides are different. A hard-boiled egg is solid all the way through and so spins as a solid. All of it stops at the same time when you put your finger on it. Liquids, however, are a whole different kettle of fish (or saucepan of eggs?) and the liquid centre of a raw egg carries on moving even after the solid shell has been stopped, which is why the uncooked egg continues to wobble around…