Teacher's Resource sheet
Episode 8

Curriculum Strand - Energy & Forces
Strand Unit – Forces (pressure)

Aims and Objectives:
To explore pressure and force in the world around us, find out what the class already know, and put this to the test using experiments with eggs.

Class plan
Suggestions:

- ✓ Ask warm up questions with the class
- ✓ Watch the video
- ✓ Fill out the first two questions of the investigator's sheet (see resources below)
- ✓ Do experiments in class
- ✓ Complete the investigator's sheet

Resources contained in this print out:

- ✓ Curriculum questions explaining pressure, surface area and force
- ✓ Some warm up question suggestions
- ✓ The Science Investigators Eggs episode can be accessed here: https://scienceinvestigators.wordpress.com/about/episodes-and-resource-sheets/
- ✓ Experiments to do in class (resources and instructions are included)
- ✓ An investigator's sheet for pupils to discuss and fill out for each experiment

Curriculum Question Suggestions with answers. Explaining:
Pressure
Surface Area
Force

PRESSURE AND FORCE
What are pressure and force?

Answer:
In physics, pressure is defined as force over a given area. Given the same force, the smaller the area of contact, the more pressure is applied. So if I push a table with my hand, the pressure exerted is not as great as if I push the table with the tip of my finger.
The formula used to describe and calculate pressure is: Pressure = Force ÷ Area

SURFACE AREA
For our *eggsperiments*, the surface area of what is applying pressure to the eggs, will determine if that pressure is weak or strong. But what is surface area?
Answer:
Surface area is the total area of the surface of something. This will decide what impact the pressure can have on the egg.

FORCE AND SHAPE
Eggs are amazingly strong despite their reputation for being fragile. An egg can withstand nearly your entire strength as you try to squeeze it. Why is this?

Once again this is due to the physics of force.

Eggs are very strong because they have an arched shape. Eggs are similar in shape to a 3-dimensional arch. The force applied to one spot is distributed along the surface of the egg, so the force required to break it is greater than if the egg had flat surfaces.

Where else do we see these? What structures?

Answer: Tunnels and bridges. Arches are used when designing and building bridges to distribute the load of cars or people instead of using a flat top with vertical supports.

Warm up questions and answers (also addressed in the episode):

Question 1

When a hen sits on an egg it doesn't break but a little chick can break it open from the inside. Why is this?

Answer

A hen can sit on an egg and not break it, because the weight of the hen is evenly distributed over the egg. However the chick's beak has a sharp point and applies an uneven force directed at just one spot on the egg. So it can exert more pressure on the shell. This is what makes it possible for it to break out.

Eggs don't stand up to uneven forces, which is why they crack easily on the side of a bowl.

Question 2:

Experiment: Breaking eggs in your hand.

Can you crack an egg in one hand?

Answer

If you hold the egg vertically, with the ends in the direction of your finger tips, it will be harder and most likely impossible to crack the egg.

But if the egg is positioned horizontally in the palm of your hand, you may be able to break it!

The Science Bit:

The egg is strongest at the top and the bottom (or at the highest point of the arch, remember the bridge?). The curved form of the shell also distributes pressure evenly all over the shell rather than concentrating it at any one point. By completely surrounding the egg with your hand, the pressure you apply by squeezing is distributed evenly all over the egg. That's why the egg doesn't break when you add pressure to both ends.

However holding the egg horizontally, it can be cracked if the right amount of pressure is exerted. If you press with your finger on the sides you are applying proportionately more force to a larger surface area.

Question 3

Can you walk on eggs without breaking them?

Answer

If you stand on a single egg, the pressure will be too much for its small surface area and it will crack. However, you can walk on a carton of eggs! As long as your weight is dispersed evenly, you can walk on multiple eggs without breaking them. A few may break as your heel or toe hits one egg and focuses increased pressure on that egg.

For these experiments you'll need:

- ✓ 2 or 3 dozen eggs
- ✓ Books, lots of books, large ones are better than small paperbacks
- ✓ You can use a baking tray to balance the books on top of the eggs

Top Tip: Fresh eggs are best, older eggs break too easily.

Eggs can get messy...

- ✓ Protective clothing (art bibs work well)
- ✓ Cloth to cover the floor if you are walking on eggs or breaking eggs in your hands

To clean up:

- ✓ Kitchen towel
- ✓ Rubber gloves
- ✓ Cleaning agent

Let's get crackin'!

Experiment 1: Balancing books on eggs

What are we testing?

- ✓ How many books can you place on top of eggs before they break?
- ✓ How many eggs can stay intact as long as the pressure is spread out evenly?

Top Tip: Place a baking tray on the eggs first to balance the books and spread their weight evenly over the eggs.

Keep a record of the pupils' guess work and find out in the TV programme what our result was. The results will vary, as you will be using different sizes of books.

Experiment 2: Walking on eggs

What are we testing?

- ✓ Can you walk on eggs without breaking them?
- ✓ What happens to individual eggs if the pressure from your feet isn't evenly spread?

Top Tip: Use long egg cartons, not square trays...eggs in cartons are more even to walk on

- ✓ Place the cloth on the floor.
- ✓ Place the cartons of eggs on a line across the cloth.
- ✓ With bare feet, try to walk on the eggs without breaking them. Make sure you have classmates on either side helping you balance.
- ✓ Try putting your foot down flat each time to distribute pressure evenly.
- ✓ Do the eggs break? If some of them do, why is this? Is it because a heel or toe put more pressure on those eggs?

INVESTIGATORS SHEET

What are we going to do?

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What do you think will happen?

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What actually happened?

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Why do you think this happened?

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