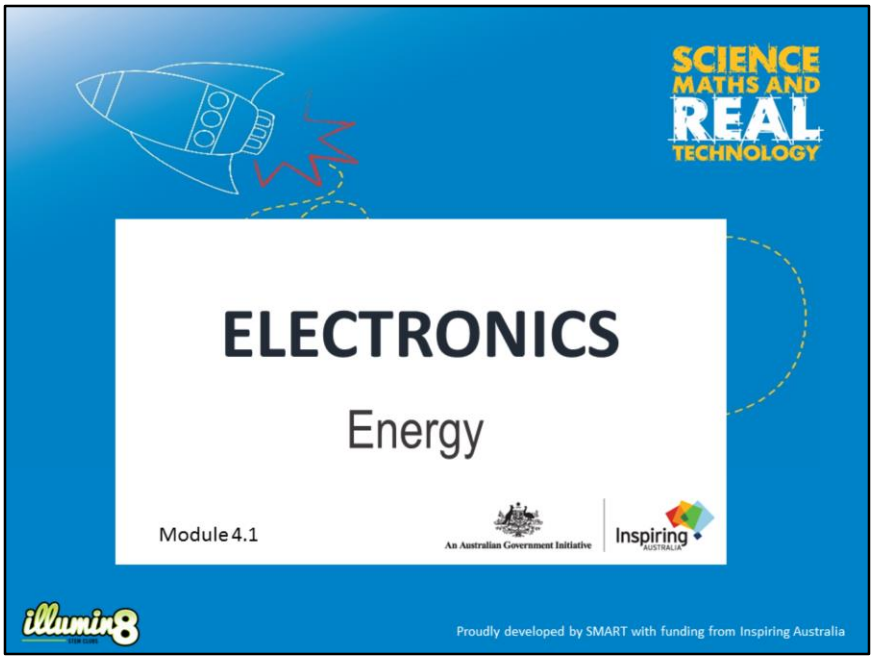
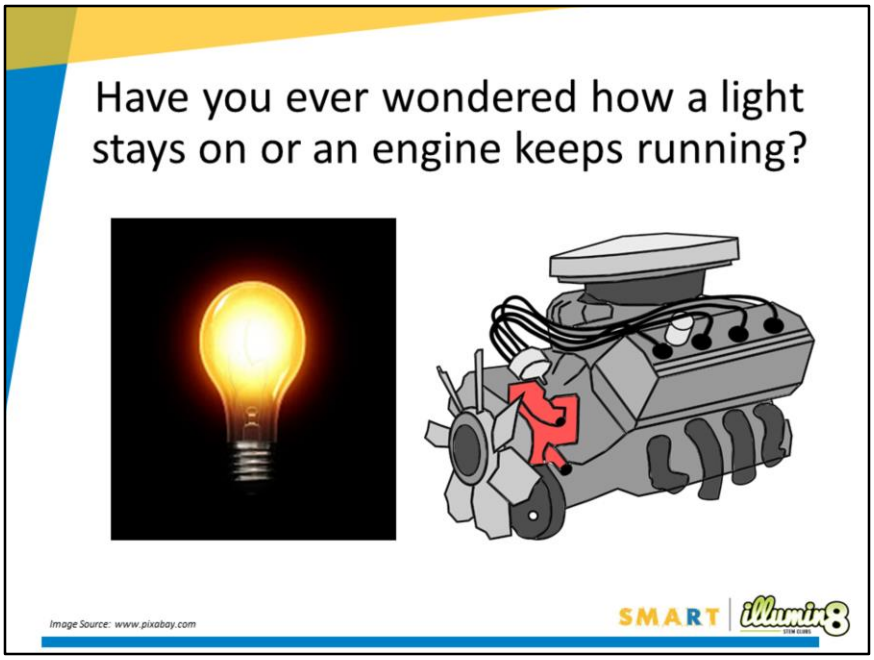
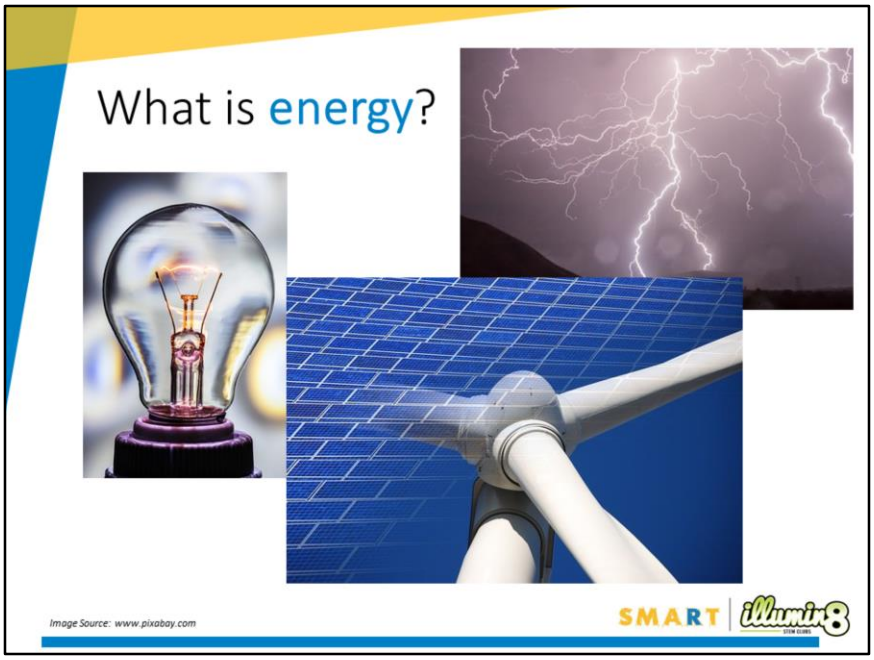


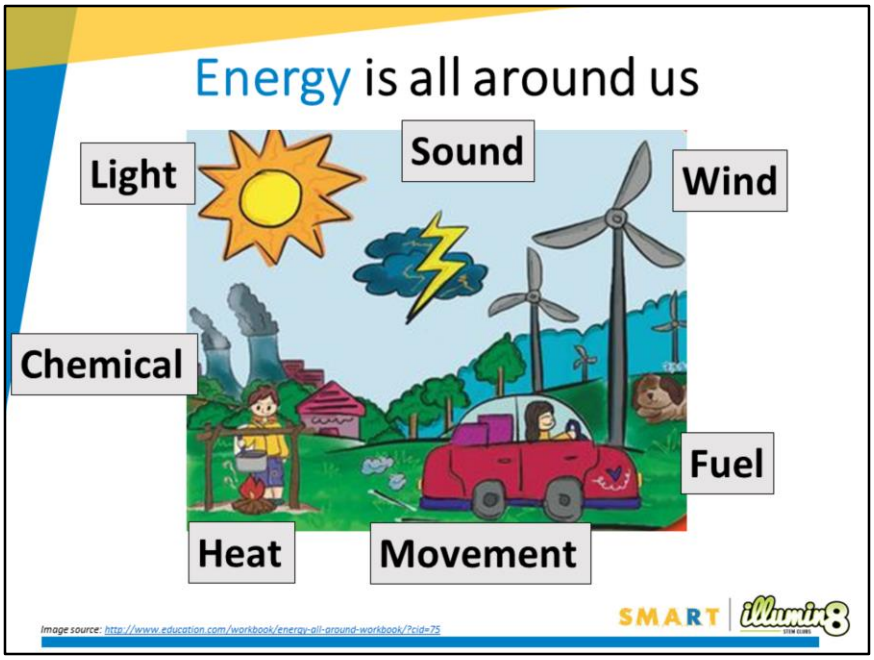
Welcome! This week we're going to explore a powerful topic… energy!



Ask students for ideas and suggestions:
How do lights stay on? (in our houses, schools, cars, street lights?)
How do engines run? (in cars, trains, machines?)
Answer: Energy! But what is energy?



Students may know how some forms of energy are generated (cars, lights): power stations, fuel, wind, nuclear, solar etc.
But what exactly is energy?
Energy is what makes things happen. It is everywhere and in everything, giving objects the ability to move or glow with heat. We rely on energy to make our world function.
Energy is quite simply: the ability to do **"work"!**
Energy can be put to **"work"**. It warms our bodies and homes, it bakes cakes and keeps milk cold. It runs our TV's and cars. Energy can help us grow, move and think.
What else do we need energy for?
…….
Extension:
For physicists, the word **"work"** means the amount of energy involved in moving an object. Work can be measured as the amount of force exerted on an object, multiplied by the distance the object is moved.
This is sometimes measured in a unit called a "joule" (J). One joule is roughly equal to the amount of energy we'd transfer to an apple, if we held it in our hand, and lifted it up through a distance of 1 metre.



There are many different types of energy! Energy is all around us, and inside our bodies! Energy can be see working in many ways, from the energy released by an exploding star, to the energy in a bouncing ball, all types of energy are closely related, and each one **can change into other types**.

For example, heat energy from the sun, can be transformed using solar panels into electrical energy to power our homes. Electrical energy can be turned into sound, heat and light energy.

Fun fact: The amount of energy in the world never changes, it stays exactly the same – energy can't be lost! It just turns into another form.

Ask students what other types of energy they can they think of? What can they use those energy types for?

……..

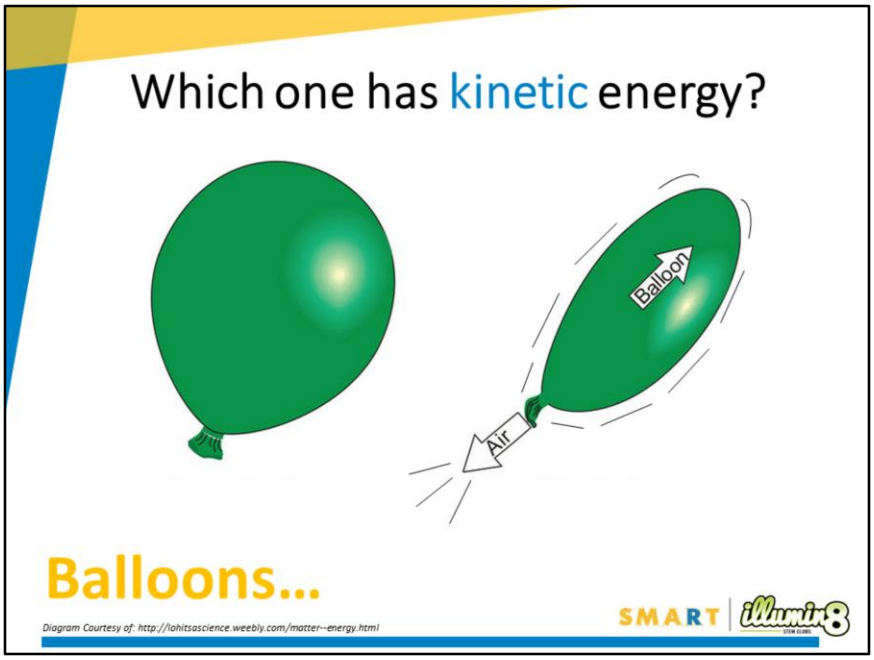
Types of energy:

Electrical – this type of energy is carried by an electric current that supplies all kinds of appliances.

Kinetic – this is the energy of motion. As an object speeds up, it contains more kinetic, or movement energy.

Potential – a diver standing on the edge of a pool diving board has potential energy, due to their height above the water, this changes to kinetic energy as the diver jumps and falls into the pool.

Chemical –the form of energy released when chemical reactions take place, such as burning fuel.
Thermal – (heat) the air blowing out from a hairdryer is hot because electrical energy is converted into thermal (heat) energy.
Radiant – the form of energy carried by light and other types of electromagnetic radiation.
Sound –a type of energy that objects produce when they vibrate in a medium, such as air.
Nuclear – this form of energy is released when atoms split apart (fission) or join together (fusion)



Remember, energy can be transferred from one type to another.
Potential energy is often turned into **kinetic** energy.
In this image, which balloon has potential energy? Which balloon has potential energy?

Potential energy:

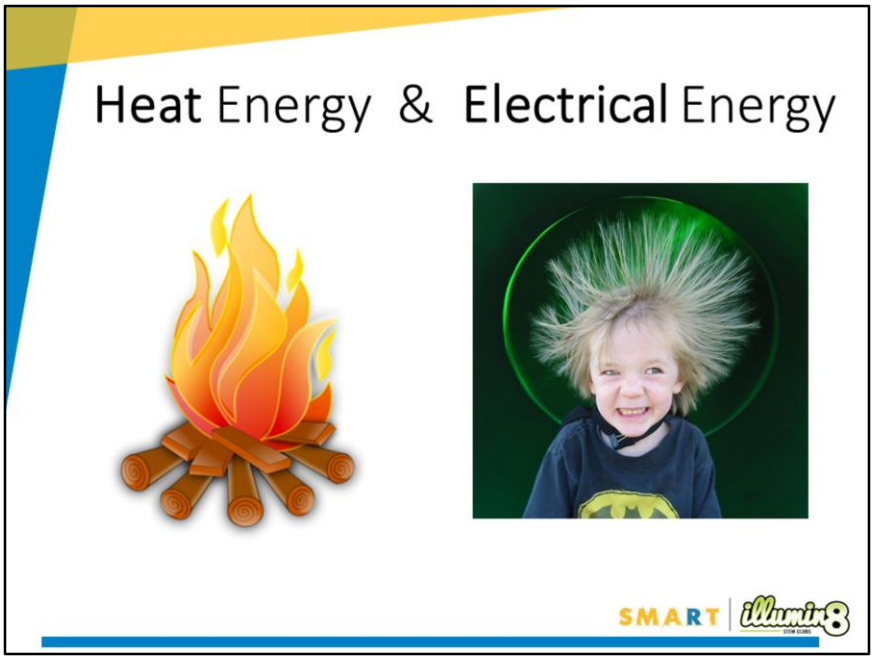
- Energy that is stored within an object at rest.
- The energy of a stationary object.

Kinetic energy:

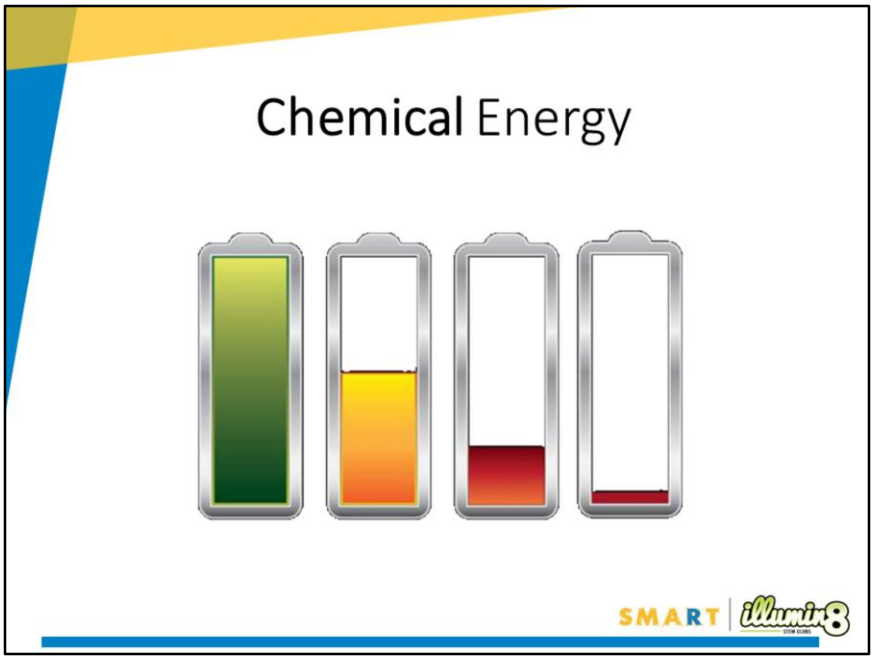
- Energy responsible for motion.
- If an object is moving, it has kinetic energy.

All moving things have kinetic energy. It is energy possessed by an object due to its motion or movement. Potential energy is energy that is stored within an object. E.g. A rock sitting at the edge of a cliff has potential energy. If the rock falls, the potential energy will be converted to kinetic energy.
Ask students to suggest other examples of the conversion of potential to kinetic energy. Can they think of any examples of kinetic energy turning into potential energy?
Undertake activity 4.1.1. Refer to coordinator notes and risk assessment.
Discuss how the blown up balloon has **potential energy**, as it is storing the air for

future use.
The deflating balloon has **kinetic energy** as the air that was stored inside the balloon is moving out of the opening causing the balloon to be propelled (moved) in the opposite direction.
Do students think a balloon that is not blown up, also has potential energy? Why? Why not?
Ask how does this relate to a battery? Answer: A battery has potential energy (energy stored inside it).



Both heat and electrical energy can be transformed into light energy.
Heat energy is a measure of the vibration of molecules. All materials are made up of molecules which vibrate constantly. But when we heat up a material, its molecules vibrate faster. The faster the vibrations, the higher the heat energy.
We call heat energy "thermal" energy. We can get heat energy from the sun, and also from heat sources under the earth (heat from the earth is called "**geothermal** energy").
Consider a large swimming pool with water at a temperature of 40°C, and a small cup of tea with tea at a temperature of 90°C. The swimming pool contains a lot more water. Therefore, the pool actually has more thermal energy than the cup of tea, even though the tea is hotter than the water in the pool.
Electrical energy is created by the movement of an electrically charged particle. We call electrical energy "**electricity**". This can be seen when rubbing a balloon on hair. Electrons (charged particles) jump from your hair to the balloon (creating static electricity). Test it out with your balloon!
Batteries can be used to store electrical energy.
For further information:
https://www.originenergy.com.au/blog/about-energy/what-is-electricity.html and
http://www.eschooltoday.com/energy/kinds-of-energy/what-is-electrical-energy.html



Chemical energy is stored in the atoms of substances, and is released during a chemical reaction.

Chemical reactions occur inside our bodies when we eat food! Our digestive system transforms a food's chemical energy into energy our body can use.

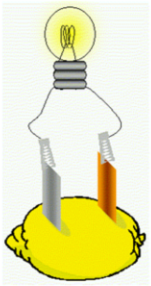
Chemical energy can also be stored in **batteries,** and then transferred into **electrical energy** (electricity) to power lights and other devices.

Can a LEMON power a light?

Aim: To harness the power stored in a lemon

Materials:

- 2 - 4 lemons (or potatoes)
- 1 LED Light (3mm – 5mm)
- Alligator clips and insulated electrical wire
- 4 pieces of copper wire (4 cm long each)
- 4 galvanised nails (4cm long each)



Procedure:

1. Roll and squeeze 2 of the lemons by hand, making them juicy inside (don't cut them open, keep the juice in!)
2. Into each rolled lemon, insert 1 nail, and a 4 cm piece of copper wire. Leaving a small section of each sticking out.
3. Using electrical wire and the alligator clips, connect the nail in the first lemon to the copper wire in the second.
4. Connect the copper wire sticking out of the first lemon to the longer leg of the LED light (using the electrical wire and the alligator clips).
5. Connect the nail sticking out of the second lemon to the shorter leg of the LED light (using the electrical wire and the alligator clips).
6. Observe!

Is there a difference if you change how far the nail and copper wire are pushed in?
Is there a difference if you add more lemons to the system?

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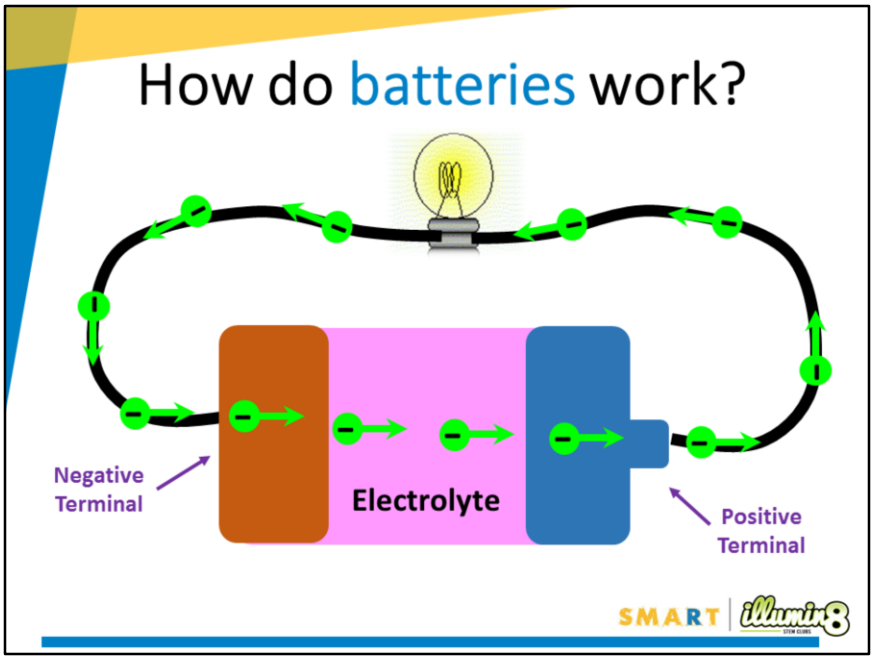
Let's see if we can use the chemical energy in a lemon (or a potato) to power up a small light.
We'll use an LED light – which is a type of light that doesn't need a lot of power to glow.
LED is short for "**L**ight **E**mitting **D**iode". It is an electronic device which lights up when electricity passes through it. So if the LED glows…. we will have successfully transferred stored chemical energy from food into electrical energy!
Refer to coordinator notes for activity 4.1.2 and risk assessment for Module 4 before proceeding.



Energy allows us to see in the dark and fuel our bodies, cars and technologies. We need ways to collect, store and transfer energy. Batteries are one way in which we can easily store and transfer energy!

Batteries are sometimes called **cells.** Batteries can be made up of one cell, or many cells, depending on how much energy, or power, they need to store. The power of a battery is measured in a unit called VOLTS (V).

When an electric charge flows through an object, it is called a **current.** Electrical wires are very good at carrying electrical currents between power sources and objects that need power, such as light globes.

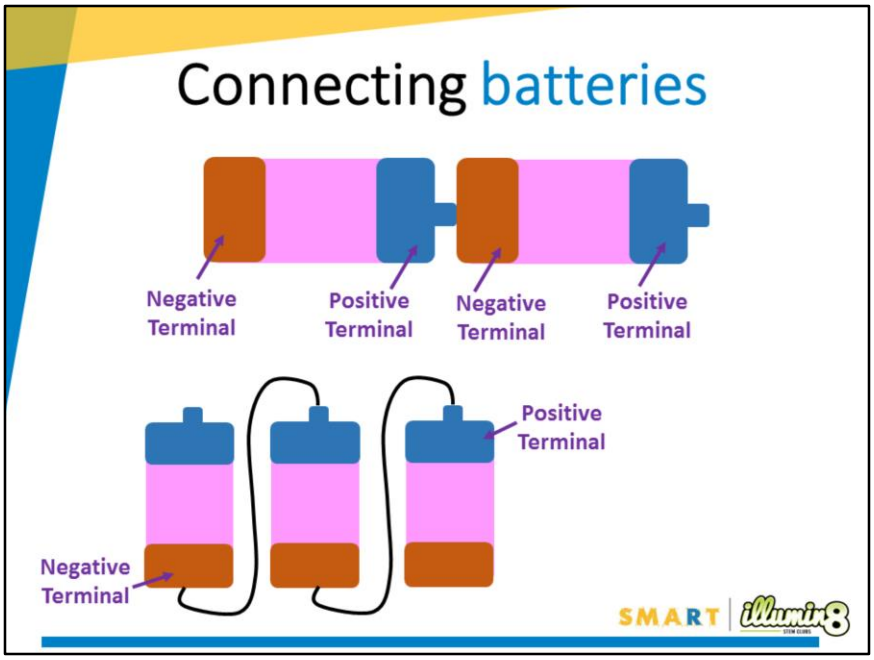
A battery cell is made up of two terminals with something between them. The button at one end of a battery is called the **positive terminal**, and the base at the other end is called the **negative terminal.** When a battery supplies energy, the electrical current flows through the battery from the negative side to the positive side.

We call the terminals 'electrodes' and the thing that is between them the 'electrolyte'.

The image shows the general structure of a battery with one cell.

The electrodes are always made of two different metals, just like in our lemon battery experiment, where we had a copper wire and a galvanised iron nail. In our lemon experiment, the lemon juice was the electrolyte.

…….
Extensions:
Positive electrodes are also called Cathodes and negative electrodes called Anodes.



Batteries can be connected together, to provide the amount of power needed for a device, or a light. In our lemon experiment, we added extra lemons to provide more power.

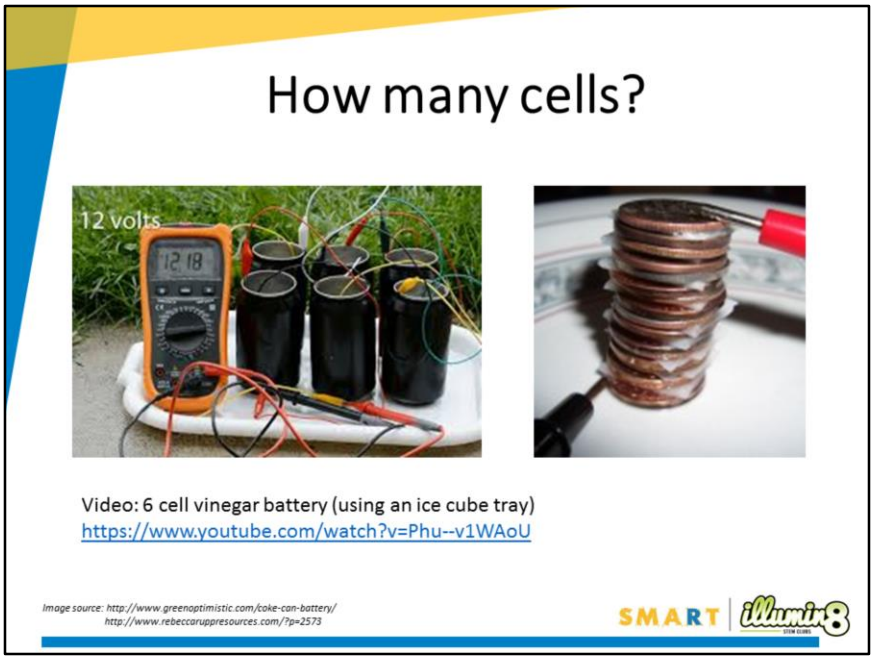
Can you think of any battery powered devices you have at home?

How many batteries do they take to work?

If batteries are to be connected, they must be placed with a positive terminal next to a negative terminal, to allow electrical current to flow. If two batteries are connected with both positive terminals together or both negatives together, no electricity will flow.

A multimeter is an instrument designed to measure electric current and voltage.

A battery cell has 2 electrodes with an electrolyte in between.
Remember to use different materials for your positive and negative electrodes.
Take some time to test out and decide which electrolyte and which electrode materials you'll choose for your battery!



You can make your battery stronger by having lots of 'cells' linked up together.
If you link up cells, don't forget to only link positive electrodes to negative electrodes, or current will not flow through your cells.
The image that looks like a coin tower above is a basic version of a special kind of battery cell called a **"Voltaic Pile".**
It also has electrodes and electrolytes, with many cells linked together. The one pictured uses coins and paper towel soaked in lemon juice.
Video: 6 cell vinegar battery, using an ice cube tray
https://www.youtube.com/watch?v=Phu--v1WAoU

Rules

- The team who can light up the most LED's OR give the highest reading on the multimeter wins.
- You can use any of the supplied materials to construct your battery.
- Do not drink the coke, vinegar or lemon juice, especially if it has had coins and nails in it!
- All materials must be returned.
- You can pre-test your design using only one LED to ensure, that current is being produced.

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