# Power! From the Past to Future – Workshop Outline READY TO USE

## WELCOME

Meeting Room

Usual health and safety briefing

## STARTER – 2 MINUTES

**Quick Quiz - What sorts of energy can you think of?**  
  
*Objects/Clues on table to examine (objects from the museum)*

Heat  
Light  
Sounds  
Movement/Kinetic  
Electrical

With Upper KS2 could expand to include;  
Magnetic  
Gravitational  
Chemical

**What is energy?**

Energy is strength and power. All work requires energy. Everything we do uses energy - even sleeping!

Energy isn’t only found in food or in fuel, such as petrol, but comes in many forms. Heat, light, sound, movement, electric - these are all different kinds of energy. Energy cannot be created, lost or destroyed - but it can be changed from one form into another.

Today we are going to be investigating energy and why it is so important to the objects we have on display here at the Industrial Museum.

## THE BIG PICTURE – 8 MINUTES

## *Power point - Show picture of metal sheep at Dean Clough mill and Piece Hall sheep?*

Ask pupils if they have seen the sheep? What is the link to Halifax?

Halifax (and Yorkshire) in particular thrived on making textiles like clothes, uniforms and even carpets.

*Show wool samples and textiles samples.*

Ask pupils what these products are made from. Explain that wool is the raw material (ensure the pupils understand that fleece is sheared from sheep).

Making textiles from wool by hand took lots of work. The wool needed to be washed, carded, spun into long threads called yarn and then woven on looms before being beaten, rinsed, stretched and dried. Then it was finished and dyed using natural dyes from plants and even beetles! (Reference to the Fleece to Piece gallery here).

### *Could show drop spindle or similar object to demonstrate hand production*

Over time technology improved and new spinning wheels and looms were developed. Eventually the process became mechanised. Ask pupils what this means and elicit answers. Using machines was much more efficient and meant that products could be mass-produced and sold cheaper.

The ‘Industrial Revolution’ describes the transition from a society based on hand manufacturing and human or animal power, to a society based on machinery. This happened in the early 1800s. This museum looks after many machines which were very important to the textile mills in Halifax during the Industrial Revolution.

One of the most important inventions of the Industrial Revolution was the steam engine. It was so important because it meant the energy from fossil fuels could be used to provide power.

*Show coal, ‘oil’ and ‘gas’ samples*

Has anyone heard of fossil fuels before? Coal, oil and natural gas are fossil fuels, they have formed over millions of years from the remains of dead animals and plants which become buried.

The pressure and heat of being buried changed the fossils into coal, oil and gas. We call these energy sources non-renewable. That’s because they would take so long (millions and millions of years) to renew - so when humans have used them up they will gone.

### *Show solar panel, windmill*

Scientists and Engineers have been investigating other sources of energy which are renewable – this means we have a supply which nature ‘renews’. The sun, wind, waves, water and heat from underground are all examples of renewable energy.

Today, we are going to find out about and investigate **non-renewable energy and renewable energy**.

Give instructions on the activities;

One group will explore the museum and discover how the machines we have here at the museum were powered. The second group is going to take part in a scientific investigation.

Then the groups will swap over after 50 minutes.

Ask lead teacher to split class into two groups with teachers/adult helpers in both groups.

Group 1 – dress as Victorians

Group 2 – lab coats

You may need to give time for the teacher to take photographs.

## ACTIVITIES – 100 minutes

Throughout the activities the key message is that before the industrial revolution machines were powered by renewable energy. The impact of steam was huge on factories but it needed to use non-renewable fossil fuels which have contributed to global warming. Now industries are looking to using more renewable energy sources again to power electrical machines.

Split class into two groups for 50-minute sessions, then swap

Group 1: Non-Renewable Energy tour and gallery activities

Group 2: Renewable Energy Investigation

### Group 1: Non-Renewable Energy tour and gallery activities

(5 minutes for moving around the museum)  
  
MINE DISPLAYS – 15 minutes

### *Show coal fossil*

### Ask pupils what it is and what it is used for – may have to elicit the answer.

Coal is found under the ground, in coal beds. It is a sedimentary rock.

### *Show how coal is made diagram*

Coal is a non-renewable energy source – this means the Earth will eventually run out of it. It took millions of years for the coal we use today to form. Coal contains energy thanks to the dead plants which it formed from.

### *Turn the over the coal to show the fossil.*

Ask pupils where plants gain energy from? Plants collect energy from the sun so that they can make their food from water and carbon dioxide.

These plants were on the Earth even before the dinosaurs – and they were enormous! ***Use a toy dinosaur here to illustrate time*** When the plants, like the fern you can see in this coal fossil, died they were buried in the swamps which covered the Earth. Over time more soil and water covered them, building up in layers. Over time the heat and pressure of all these layers pushed out the oxygen from the plant remains and gradually turned them to coal.

## *What is coal used for?*

Coal can be burned for energy or heat. Today about two-thirds of the coal mined is used in power stations to make electricity.

One really important thing to remember is that energy doesn’t disappear and it can’t be made! But it can be released or transferred by changing it from one form to another. Burning coal causes a chemical reaction with oxygen which releases heat energy. The reaction also produces water and a gas called carbon dioxide.

## *How do we get coal ready to be used?*

To get coal out from under the ground it needs to be mined. Today huge machines are used to extract the coal but at the start of the industrial revolution mining was dependent on people, even children.

## Activity – Investigating how coal was mined

In pairs, ask the pupils to explore the gallery and look carefully at the displays. Can they work out how coal was mined?

After a few minutes give out the laminated cards and ask pupils to put these into the correct order and discuss what they think is happening in each of the pictures.

Ask for volunteers to give their answers.

Discuss what is happening in the displays which show how coal is mined - using the picture cards to show the correct order;

1. Hewer were the oldest and strongest members of the family, almost always grown men or strong youths. Their job was to work at the coal face cutting the coal from the seam with a pickaxe. They had a safety lamp, as they needed the light to see the coal face.
2. Getters were also strong, as they had to gather up the cut coal and put it into wooden sleds.
3. Hurriers had a really tough job as they had to pull the wooden sleds full of coal to the surface – maybe as far as a mile in a passage like the one we have in the museum – show pupils the crawl through.

There were other jobs for kids too;  
Trappers kept the airflow going which stopped the build-up of dangerous gases. Drawers dragged truckloads of coal to the surface. Older children operated the mine shaft pulleys

Children could spend up to twelve hours underground, six days a week. In winter sometimes they would not see daylight from one day to the next. With only one day off a week on Sunday, they had little time to rest or play and could not go to school.

In 1842, a law was passed that stopped women and children under ten years from working underground in mines in Britain. Before this law was passed, it was common for whole families to work together underground to earn enough money for the family to live on. The Victorians saw child labour as a normal part of working life. Huge amounts of coal were needed and children as young as five worked at jobs that were dangerous and exhausting. They would work the same hours as adults, sometimes longer, at jobs that paid far less.

## Discuss with the group how it felt to be working in the darkness and small spaces – would they like to do that job for 12 hours a day instead of school?

## POWER GALLERY – 15 minutes

## Horizontal Steam Engine

Many mills and factories had steam engines to drive their machinery. Smoking chimneys dominated the skyline of many industrial towns in England. The first steam engine was invented by James Watt for a cotton mill in 1789. You may have been on a train/locomotive pulled by a steam engine? But we are talking about stationary steam engines which were fixed in position and were used for driving mill machines.

### *Steam Engine demo if available*

This engine was made after the industrial revolution in 1926 – it was one of the last steam engines made in Yorkshire. It is called a Horizontal engine because the cylinder is horizontal – other engines could have vertical cylinders or inclined (angled) cylinders.

Coal is burned in a fire releasing heat energy. The heat energy is used in a boiler to heat water. The steam is piped into a cylinder. The steam builds up in pressure which is what causes the pistons inside the cylinder to move backwards and forwards. The piston is attached to this big flywheel which turns and transfers the energy to the mill machine.

‘Horsepower’ is the term we use to describe the amount of power an engine can produce. It does what it sounds like – compares the amount of power to how much power horses can produce!

Steam was a reliable source of power and it was able to power very large machines. Factories needed to have their own steam engine to power their machines. This was until the widespread use of electricity as a power source.

### Activity – Investigating how electricity works

Ask if anyone knows what electricity is? Demo static electricity with a balloon (rub it on a pupils/volunteers hair - making a volunteers hair stand up).

Explain that this is called static electricity. It happens because of tiny particles called electrons. Electrons are inside atoms and they have a negative charge. Sometimes objects can steal electrons from other objects – like the balloon which steals electrons from your hair. When it does this the balloon has extra negative charges and your hair is positively charged because its lost its electrons! Have you heard the phrase opposites attract? Your positively charged hair is attracted to the negatively charged balloon so it stands up!

Electricity is a flow of these electrons along a circuit – show a completed circuit. In this circuit the battery is supplied the source of stored electricity.

Materials which allow electricity to flow through them are called conductors. Materials which don’t allow electricity to flow through are called insulators.

**Pupils work in small groups add wires to connect circuits to light a lamp – see Andy for circuit kits mounted on wooden boards**.

Discuss why the lamp won’t light if the circuit is incomplete. You could talk about switches here – they open or close a circuit.

Discuss safety when using electricity;

* Don’t ever put fingers or objects into an electrical socket
* Don’t touch switches with wet hands
* Don’t use electrical appliances near water

Pupils can use an ammeter to record the current. Introduce the unit of amps. Link to the ammeters on display and discuss why they should a reading of 0 (no current).

### Douglas Generator

The use of electrical generators to power machines had a big impact on industry. Generators were much smaller and cheaper to run than the large steam engines. Which meant that factories could be smaller. Electrical generators produce electrical energy. To do this they chance mechanical energy into electrical energy. A coil of wire is spun in a magnetic field and this creates an electric current.

Mechanical energy is energy an object has because of motion and its position. We all use mechanical energy every day to do work – for example opening a door uses mechanical energy.

For some generators the mechanical energy can be provided by human power – turning a hand crank. Sometimes generators are linked to turbines or wheels which provide the mechanical power.

## Coal is a very dirty fuel. When it is burnt it produces big clouds of grey/black smoke. *Show images of Halifax – chimneys/pollution*

Burning coal (and the other fossil fuels) releases a gas called carbon dioxide into the atmosphere. Carbon Dioxide is greenhouse gas – this means more carbon dioxide in the atmosphere is contributing to global warming (the Earth becoming warmer). Today we still burn fossil fuels in power stations to produce steam to make electricity for our houses by powering large electrical generators, but the pollution problems and the impact on climate change mean that using renewable fuels in the future will be much better for the environment. In your next activity (or for the second group refer back to the waterwheel investigation) you will find out more about renewable energy sources.

## Water wheel

Water power is a renewable fuel but it was first used by mills hundreds of year ago! Before steam power was used factories relied on water and wind power to drive their machines. This meant that factories needed to be close to fast flowing rivers. This water wheel is over 200 years old!

## Industry Partner video on gallery screen if available – wind farms?

Show pupils the short film about renewable energy used in industry today – Yorkshire Water wind farms, with link to the wind power of mills in the past.

Today we still use waterwheels and windmills to provide the mechanical energy for electrical generators.

Leave costumes in reception area for the next group. Because water and wind are resources which don’t run out – we call them renewable.

Plenary – Quick Q&A to test understanding of what is non-renewable fuel and what are renewable energy sources.

### Group 2: Renewable Energy Investigation

Can you remember what type of energy water power is? *Renewable*.

### *Demo of other renewable energy examples*

Use torch on a solar energy kit  
Windmill/LED

***Use Power point slides 6,7,8***

## Investigation of Water Power

In the museum on display is a water wheel which is 200 years old. It was used to power the machines in a mill.

Water was a very important source of power before the industrial revolution before steam power. Hydropower is used today to generate electricity, using water turbines. Water turbines are turned by the movement of water. The turbine powers an electric generator, which produces electricity carried in power cables for us to use.

In 1759 an engineer called John Smeaton was the first person to analyse the performance of water wheels. He measured the effect of water velocity (for example how fast the water falls for an overshot wheel) and the speed of the wheel. One of the big improvements Smeaton made was to use cast-iron wheels instead of using wood.

In groups of five you are going to investigate water wheels and power.

Discuss the ***AIM*** of the investigation – what are we trying to find out? The aim of the experiment is to work out which arrangement of the waterwheel best transfers the energy of the falling water into the energy of the turning wheel called rotational energy.  To work this out we are going to test which angle of falling water will lift the load the highest.

#### Demo of the equipment

We are going to investigate what happens when we change **the angle of the bottle**.  We are going to choose the same botte position for each test and change the angle of the bottle.

## *Ask pupils to record the aim on their investigation sheets.*

Each person in your group will have an allocated job;

Test Engineer – decide on the angle to place the bottle  
Test Engineer 2 – ensure all the other variables are kept the same  
Measurement Technician – measure the height the load reaches  
Experiment Technician 1 – place the bottle and start the experiment

Experiment Technician 2 – rewind the pulley to reset the load

Discuss with the pupils and ensure understanding of the possible **variables** and how we will ensure it is a **fair test**.

What will we **change**? The angle of the bottle

What will we keep the **same**? The position of the bottle. The amount of water in the bottle.

What will we **measure**? The height the load is lifted to

Give out pupil investigation sheets and give pupils 2 minutes to decide upon their ***HYPOTHESIS***in the form of;

*“The best position for the bottle is \_\_\_\_\_\_\_\_ because I think that \_\_\_\_\_\_\_\_\_\_\_\_”*

## Investigation

Allow groups opportunity to carry out their investigations independently, with an adult helper assigned to each group.

Repeat the test for each angle setting three times.

Remind pupils at intervals to record their results on the investigation sheet.

Calculate the average height lift of the load for each angle position and **record the results**.

## Results

Discuss the results with the group. Did they all get the same results?

Why do they think they got those results?

Ask pupils to complete the **Conclusion** section of their investigation sheet.

Tidy up – ask pupils to leave their tables and equipment as they found it. Leave lab coats by each station.

Follow up at school – the equipment diagram and results presented as graphs could be completed back at school.

## Extension – if enough time or you have a high ability group you could also investigate the position of the bottle, keeping the angle the same.

## Groups Change Over – 5 minutes

Groups swap over and change costume/lab coats.

## PLENARY – 5 minutes

Renew or No? Quiz

Pupils each have a 2-sided card to hold up to show their answer – Renew! For renewable and No! for Non-Renewable energy.

Use powerpoint slides 9 – 18

Pupils hold their card up to show which type of energy the image is linked to.

* Solar Power – Renewable
* Oil – Non-renewable
* Global Warming – Non-renewable
* Train representing Industrial Revolution – Non-renewable
* Wind Power – Renewable
* Pollution – Non-renewable
* Water Power – Renewable
* Coal – Non-renewable
* Electricity – trick question! Both.