KEMPTON STEAM MUSEUM

# Clean Water for Life
# Learning Resources

## Under Pressure: Steam Powered
Educator's Notes

KS2

### Keywords

Force, pressure, industrial history, steam, condensation

### Topic Overview

This topic provides an introduction to the concept of a triple-expansion steam engine based on simplified themes connected to the two impressive examples housed at Kempton Steam Museum. The engines are very similar in design and size to the RMS Titanic's engines.

This topic links to energy efficiency and sustainability because the steam is used 3 times, as opposed to being used once in single cylinder engines.

### Key Stage Two Curriculum Links

#### Science

- **States of matter** e.g. Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter. Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled.
- Forces e.g. Pupils should explore the effects of levers, pulleys and simple machines on movement.
- Properties and changes of materials e.g. They should explore reversible changes, including evaporating, filtering, sieving, melting and dissolving, recognising that melting and dissolving are different processes.

#### Maths

- **Geometry – properties of shapes** e.g. illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius.
- **Measurement** e.g. Convert between different units of measure [for example, kilometre to metre; hour to minute].
- **Number** e.g. perform mental calculations, including with mixed operations and large numbers.

#### Geography

- **Human and physical geography** e.g. human geography, including: types of settlement and land use, economic activity including trade links and the distribution of natural resources including energy, food, minerals and water.

#### History

- **A study of an aspect or theme in British history that extends pupils' chronological knowledge beyond 1066** e.g. a significant turning point in British history, for example, the first railways or the Battle of Britain.

### Prior Learning

- Pupils will benefit from being familiar with different types of fuels and being aware of fossil fuels and renewable energy.
- Pupils should understand what a cylinder is and what is looks like in 2D and 3D form.

# Under Pressure: Steam Powered
## Educator's Notes – Continued

- Pupils should understand the basic principles of evaporation (water changing to a gas) and condensation (a gas changing to a liquid).
- For an introduction to steam engines please see our KS1 resource 'Puff, push power' resources.

### Presentation slides

Look out for the speech symbol throughout the presentation — it marks moments for discussion, questions and shared ideas.

1. **Title slide:** Under Pressure: Steam Powered
2. **What is steam?** Remind children that water boils at 100°C.
3. **What is steam pressure?** Discuss the idea of trapping steam in a container, consider discussing a bottle of fizzy drink. When it's sealed and pressurised the bottle is firm.
4. **The superpower of steam:** Ensure children understand the term **expansion**. 'Think of your tummy when you've eaten a really big dinner and your belt or waistband is really tight'.
5. **The Sir William Prescott Engine** The 'Sir William Prescott' and 'Lady Bessie Prescott' engines are inverted marine-type triple-expansion engines. They stand opposite each other in the Kempton Steam Museum. The engines were installed to each pump up to 19 million gallons of clean, drinking water per day to reservoirs in North London for the supply of fresh water to The City, Central, East and West London.
6. **Just like us, engines need chemical energy to do work:** Chemical energy is a type of potential energy that's stored in the bonds between atoms and molecules. Think of chemical energy as energy waiting to be used. Your body breaks down food molecules to get energy for moving and growing. It's stored in things like wood, coal and even batteries.
7. **Coal** At Kempton, coal fired boilers originally produced the steam. Steam is now generated by a small gas-fired boiler. We can control gas easier and we only run the engine on steaming weekends or special events to save fuel and energy. The benefits of natural gas over coal are lower carbon dioxide emissions, reduced air pollutants (fewer sulphur, nitrogen and particulate emissions) and higher thermal efficiency. Coal is a fossil fuel - These natural resources formed from the remains of plants and animals that died millions of years ago. Oil and gas are also fossil fuels.
8. **Making steam on a big scale!** You could liken the steam engine boiler to a domestic boiler the children might have at home. Ask if they have to run the tap for a little while before the water gets warm. At Kempton Steam museum it takes us 3 days to start the engine; we have to turn the boiler on, check the pressure systems, check oil and lubrication etc. Remind children that a valve is like a door opening and closing, to stop steam, or to let steam out.
9. **Inside an engine** Help children to identify the main engine parts; the cylinder, valve and piston. Remind pupils what a cylinder is. You could liken the piston inside the cylinder to a medicine syringe or a push-pop style lolly. You may like to focus in on the word 'exhaust' and ask: "How do you feel when you are exhausted? The steam has done a lot of work!", "What noise do you make?".

| Feature | Force | Pressure |
|---|---|---|
| **Definition** | A push or a pull | Force spread over an area |
| **Unit** | Newtons (N) | Pascals (Pa) or PSI (pounds per square inch) |
| **What it does** | It changes how things move or behave. | Tells us how "sharp" a force is |
| **Formula** | Force = Pressure x Area | Pressure = Force ÷ Area |

# Under Pressure: Steam Powered
## Educator's Notes – Continued

10. **Triple-expansion steam engine:** You could link the system to sustainability or recycling – "It's a bit like using a yoghurt pot three times before you recycle it. Once for the yoghurt, then for paint pot, then for starting a seed and finally put in the recycling."
11. **Energy efficiency** Explain to pupils that energy efficiency is getting more useful work from the same energy. Discuss why it is important to use energy wisely.
12. **Different pressure: Same force:** Discuss the difference between pressure and force – Force is how strong the overall push is. Pressure is the effect of a force acting over a specific area. Children may be able to relate this to the pressure of car tyres.
13. **Imagine you are making a new engine to pump water:** Use this as an opportunity to talk about electricity and fuel. Batteries store energy. There is chemical energy inside coal and petrol but it needs to be burnt. Batteries are used to store electrical energy. We can make electrical energy in lots of different ways, but it is generally considered a cleaner source of energy.

    Depending on ability and/or time you may be able to discuss clean energy or renewable energy.

    Clean energy is energy that comes from sources that do not pollute the environment. It helps to reduce the harmful effects on our planet and is better for our health. Some examples of clean energy sources are wind power, solar power, hydropower.

    Renewable energy is energy that comes from sources that can be replenished naturally and are not depleted when used. This means that, unlike fossil fuels such as coal, oil, and natural gas, which can run out, renewable energy sources are always being produced. Here are some renewable energy sources: wind energy, solar energy, biomass (organic waste materials), tidal energy.
14. **The triple-expansion steam system:** – Work together as a class to complete the missing words. This activity is also available as a printable activity. Answers: Heated – boiler – pistons – valve – exhaust – condensed – low – intermediate – high

### Extension ideas

Demonstrate the difference between force and pressure. You could use a piece of dough to press different objects into it and examine the indentation. A force is a single push or pull, while pressure is how much that force is spread out over an area.

You might like to show your pupils a piece of coal. This could be used to discuss the topic of fossil fuels and renewable energy.

Take a closer look at the cylinders and discuss the concept of radius and diameter. The size of the cylinders is given below; show what this looks like with a tape measure or ruler. Pupils could also practice rounding numbers.

| High pressure cylinder diameter | Intermediate Pressure cylinder diameter | Low pressure cylinder diameter |
|---|---|---|
| 73.66 cm | 137.16 cm | 218.44 cm |

Make connections with the Titanic ship. The Titanic was constructed between 1909 and 1912 and sank on April 15, 1912. The Sir William Prescott engine was built in 1928. The engines at Kempton feature in many films and documentaries about the ill-fated ship.