

**ACTIVITY DESCRIPTION:**

This activity shows the students a working model of a steam-powered engine. This activity encourages the students to learn more about how the state of water changes when heat is added.

MATERIALS

Model of a steam-powered engine
2 attachments
Steam tractor
Picture of a piston head
Gloves
Water pitcher
Distilled water
Fuel
Thermometer

Make sure you have all items before the students arrive!

BEGIN THE ACTIVITY

EVERYONE DO NOT TOUCH ANYTHING ON THE TABLE. IT IS HOT AND DANGEROUS.

Who can tell me the three forms of water? **Wait for answers.**

That's right *SOLID, LIQUID and GAS.*

Who can give me some samples of each one?

Solid = ice,

Liquid = water

Gas = steam and water vapor, like clouds.

How does water change from a liquid to gas or to a solid? **Wait for answers.**

Water changes **states**, the way it looks and how it behaves when heat is added, like warming it up, or when heat is taken away, like putting something outside in the winter or in the freezer.

How many people have seen the ice melt? (Melting icicles or ice cubes in a drink).

Once ice has melted what do we get? *Liquid or water.*

Can liquid water be turned into ice again? *Yes.*

Here is a trick question, after it has been heated to boiling, can water be turned to ice? *Yes, but it must be cooled down and have the heat taken away first.*

This is a model engine that will make these tools work. But it doesn't run on gas like a car and we don't plug it into the wall or wind it up, how do you think it runs? *It runs on steam power.*

Can anybody tell me anything else that runs on steam power? *Old-fashioned trains used to run on steam power, that's why they were called steam engines.*

In order to have steam, do we heat or cool water? *We are going to heat the water right now. In order to create heat so we can heat the water for this machine, we need to burn a fuel - in this case a gas mixture. Other engines run on liquid or solid fuel, it's like burning wood or coal, which is what they used to burn for steam engines on trains. Coal is only used for large power plants now.*



What about burning wood? We burn it in barbecues, fireplaces or when having a camp fire. Once we burn the wood, can we use it again? No, once the wood has been burnt, it's gone and we're left with only ashes.

What is the temperature of the water we are going to add to the machine?

*Now we are pouring water in this machine to heat the water to boiling point. While we are waiting, does anybody know what the temperature for the **boiling point** of water is? It's 100 degrees Celsius.*

How do we know when water is boiling? Any time that water boils, there is steam and water vapor.

Although steam is invisible, we will know the water is boiling if the machine attachments work because it needs steam (which comes from boiling water) to work.

*How can a machine work on steam? When water is heated it expands, or takes up more space. If it is inside a closed container, like this machine, then it will push against the walls. Here is a picture of a piston head and how it moves when pushed. The same thing is happening inside the engine, which moves the lever that makes the tool work. We can say that the steam is **exerting force**, or making something move. That is how this machine is steam-powered; the steam makes the parts move.*

What makes the steam? Heated water.

Can ice cubes become steam? Yes, once heated.

Can steam become ice cubes? Yes!

*How? Steam cools and becomes water vapor (the mist coming from the machine). It keeps on cooling to become liquid water eventually, forming into droplets just like on the mirror in your bathroom after someone's had a shower. That's called **condensation**.*



If we collect the droplets, we have liquid water which can then be cooled enough to become a solid known as what? Ice.

At what temperature does liquid water become ice? Zero degrees Celsius. Water expands when it freezes just like when it's heated. That's why cans of pop in the freezer will burst.

If water is solid at zero degrees Celsius and vapor at 100 degrees Celsius, at what temperature is it liquid? Water remains in liquid state between zero degrees Celsius and 100 degrees Celsius.

No let's see the tractor move around the table under its own power.

WHAT HAVE WE LEARNED?

Each of the states of water has purposes! Water is very important.

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