Try This

ICE - WATER - STEAM

Boil water in a cup made of ice

Using a microwave oven, water can be made to boil in a cup made of ice and all 3 states of water can be seen at once.

You will need

- A large mug or plastic tub, preferably with straight sides
- A small plastic tub such as a small yoghurt pot
- A few coins
- Sticky tape
- Access to a freezer and a microwave oven

Ask permission of the owner of the freezer and microwave before you start.

What you do

Nearly fill the large mug with water and float the small pot in it, weighing it down so that it just floats in the water. You want the small tub to be in the centre of the mug, not at the side (see Diagram 1). Sticky tape can help with this. Place the mug into the freezer until completely frozen (at least overnight).

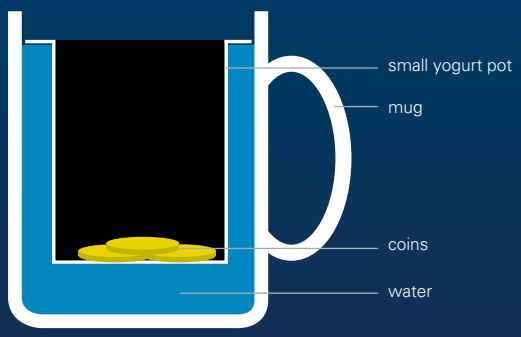

Diagram 1: Making an ice cup

Remove the coins and take the ice cup out of the mug. You may need to leave the mug out of the freezer for a few minutes to allow you to get the ice out of it. You can re-freeze the ice cup at this point until you are ready to use it.

Fill the yoghurt pot in the centre with water and place it into a microwave. Microwave for about 30 seconds until the water boils. You have water in all three states at once – ice, water and steam.

Why does it work?

A water molecule has a slight charge on it as the hydrogen atoms are slightly positive and the oxygen slightly negative. It shape is shown in Diagram 2.

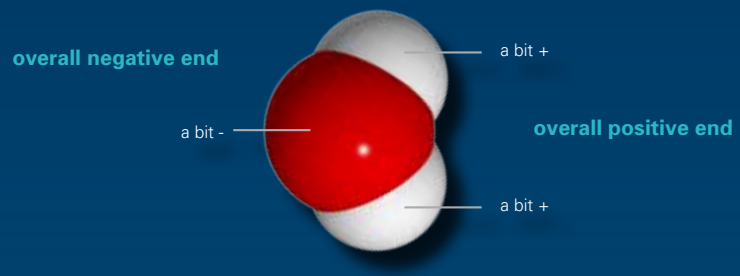

Diagram 2: The charge distribution on a water molecule

A microwave oven heats using microwave radiation which, like all other electromagnetic radiation, has an electric field which is constantly reversing its direction. In water, the molecules try to line up with the electric field but, as it keeps changing direction, so do they and they end up rotating. They have gained energy and eventually the water will boil.

In ice, the molecules are held in a lattice structure and are not free to rotate. So ice cannot absorb the energy of the microwaves and does not heat up as quickly as water.

There are some other factors to bear in mind: the ice and the water do not start at the same temperature; heat will be conducted by the water into the ice surrounding it; and the heat in a microwave oven is not evenly distributed – there are 'hot spots'.

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