# EndoTherm™

## ECO-SCHOOLS LESSON GUIDE

**EndoTherm is an award winning energy saving additive that works in any wet heating system from residential houses (radiator systems) to large high-rise offices and even farms and other agricultural sites.**

This lesson plan is designed to give an introduction into these heating systems, why we use water in them, and how EndoTherm improves the efficiency. The key to it all is surface tension, which EndoTherm reduces by 60%. This surface tension reduction allows water to touch a larger surface area inside the radiator meaning heat can get into the room quicker.

## PART 1 - Why do we use water in a heating system?

**Discussion:** Why are the majority of UK heating systems 'wet' and use water to distribute heat?

| | | |
|---|---|---|
| Good heat transfer properties | WATER | Slightly corrosive but managable |
| Safe, non-toxic | | Inexpensive |
| Flows well | | Readily available |

Water has many benefits however listed above are the main ones. This is why 90% of homes in the UK use water to distribute heat throughout the heating system.

## PART 2 - Explaining water surface tension

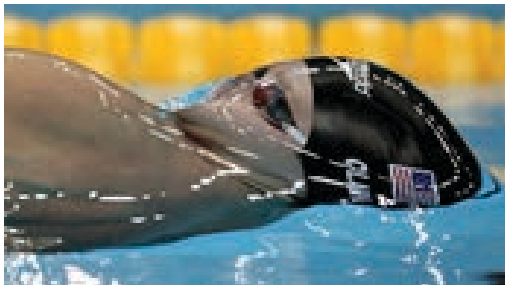
**How can we improve the performance of water to transfer heat?**

**EndoTherm works by changing the surface tension of water.**

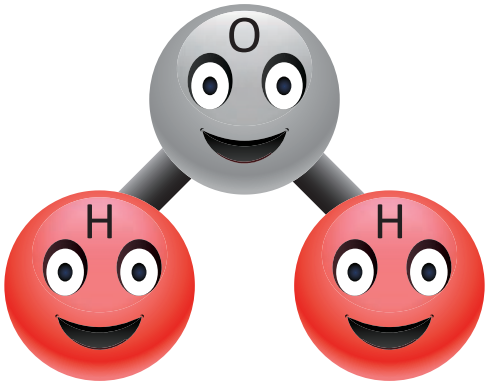
## PART 2 - Explaining water surface tension continued

**Question:** What is surface tension? Can anyone explain what it is and give examples?

**Answer:** Surface tension is a force on the surface of a liquid like water which binds water together and allows liquid to resist external forces. Examples. Spiders or Insects that walk on the surface of the water or paperclips that float on the surface use surface tension.

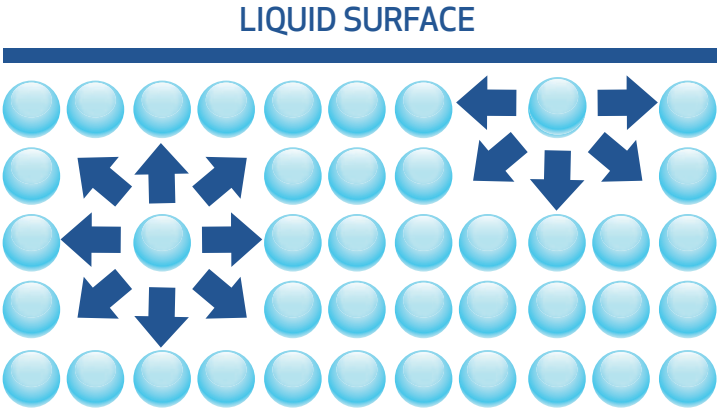


**This is what a water molecule looks like:**

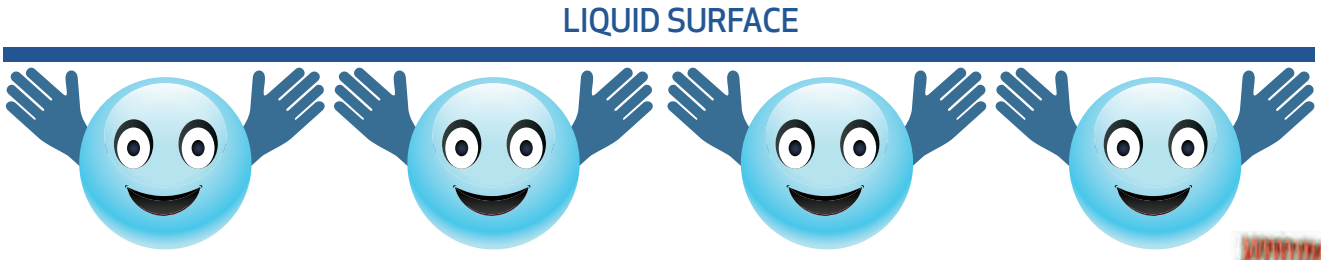



**2 Hydrogen Atoms. 1 Oxygen Atom = H20**

**Water molecules join together in many directions. This is called Hydrogen bonding:**




However, the hydrogen bonding at the surface is different. It has left over energy resulting in closer bonds with neighbouring molecules (water does not attract to the air).




The surface of the water consists of clingy molecules. This layer is called the water's **surface tension.**

## PART 3 - Practical experiments

We have identified a number of practical experiments to show the high surface tension of water and how the addition of EndoTherm can change the qualities of water.

Step one will show EndoTherm reducing the surface tension of water. Step two will show the changes/benefits of a wetter liquid.

**WARNING**

Washing up liquid can be used as an alternative to mimic the EndoTherm effect in the practical experiments in the classroom. Washing up liquid is not a substitute for EndoTherm and should NOT be dosed into a heating system under any circumstances.

**Step 1 - Does water have a high or low surface tension? / How does EndoTherm change this?**

**Practical Experiment 1 - The Penny Test (difficulty low)**
**Practical Experiment 2 - The Paperclip Test (difficulty low)**

**Step 2 - What does a lower surface tension mean?**

**Practical Experiment 3 - The Soaking Test**
**Practical Experiment 4 - The Soap Boat**

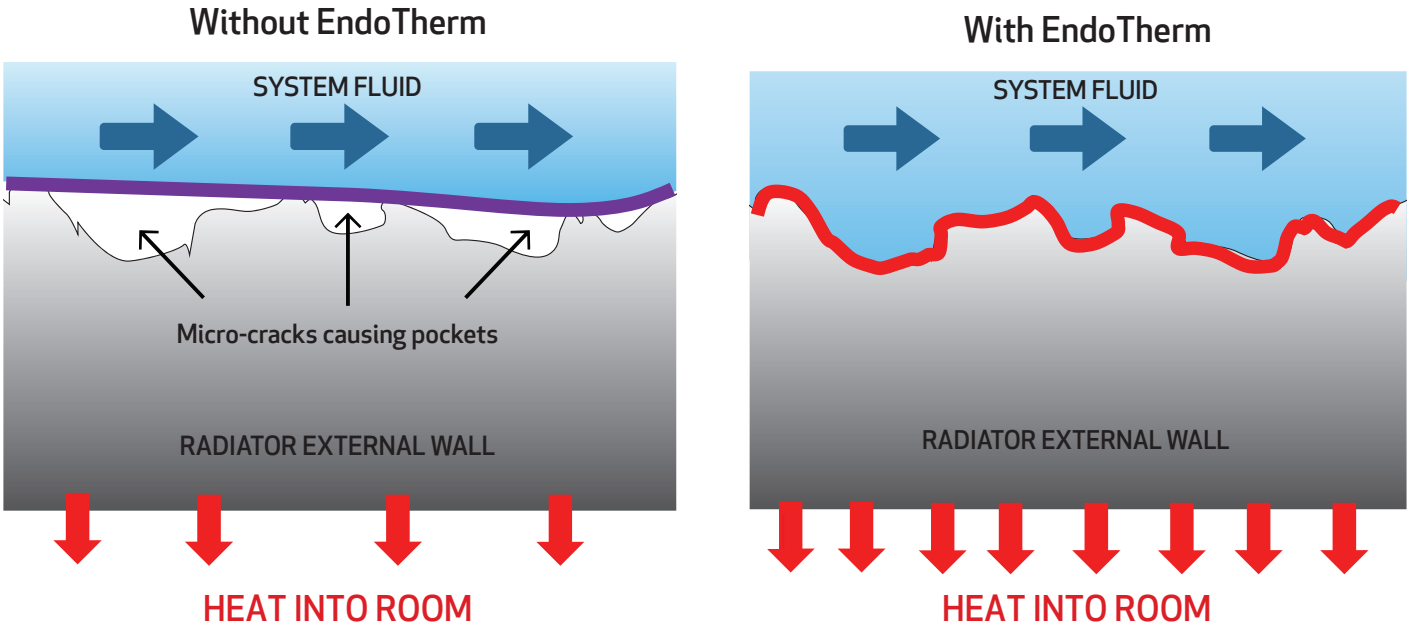
Surface tension is a force on the surface of a liquid like water which binds water together and allows liquid to resist external forces. Examples. Spiders or Insects that walk on the surface of the water or paperclips that float on the surface use surface tension.

## PART 4 - How can we use water surface tension to save energy?

Consider the inside of a wall hung radiator, it is full of water. It works by the transfer of heat from the hot water through the metal radiator wall.

**Little known fact:** Under a microscope smooth surfaces are not smooth! The inside of plastic/metallic surfaces are full of imperfections.

A reduction of surface tension of the water inside the radiator allows the water to touch more of the radiator. It increases the cross-sectional area of the radiator. **This makes the water/radiator more efficient!**





**Summary:** EndoTherm allows the water to touch more of the metal of a radiator so more heat can escape into the room.

This means the room reaches the temperature set quicker (and then the thermostat can tell the boiler to turn off).

This process continues to happen even when the boiler is off and the room will remain warmer for longer. This increases the time between boiler cycles and the number of cycles over an extended period. This has been proven to show a saving of 15%.

# Curriculum information

| **Forces and Movement**<br><br>Investigate forces and movement as well as surface tension. | | |
|---|---|---|
| **Curriculum key words** | | |
| • Forces and movement<br>• Surface tension | | |
| **National Curriculum** | **Curriculum for excellence** | **Northern Ireland Curriculum** |
| Forces and their effects (KS1 SC4 2b,c). Forces can affect motion (KS3 3.1b). Explanations can be developed using scientific ideas (KS4 1.1c). | Forces on toys and other objects (SCN 1-07a). Relate forces to motion (SCN 4-07b). | Pushes can cause movement (KS2 Strand 2). Forces and Energy (KS3). Explanations can be developed using scientific ideas (KS4). |

**Energy**

**Calculation of fuel uses and costs in the domestic context**

- Comparing amounts of energy transferred
- Domestic fuel bills, fuel use and costs
- Fuels and energy resource

**Energy Changes and Transfers**

- Heating and thermal equilibrium: temperature difference between two objects leading to energy transfer from the hotter to the cooler one, through contact (conduction) or radiation; such transfers tending to reduce the temperature difference: use of insulators
- Other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels.

**Matter**

**Physical changes**

- Similarities and differences, including density differences, between solids, liquids and gases

| **Curriculum key words** | |
|---|---|