# Overview

This Item looks at explaining states of matter and changes of state using the particle model. It then investigates chemical reactions in terms of the particle model. Finally, the item introduces the idea of the conservation of mass and reversible reactions. These are further investigated in topic *ELC7 Let’s get together* and *ELC10 Are you overreacting*.

# Activity ELC1a-c *States of matter*

**Requirements** *(for the teacher):*

* Three identical 500 cm3 glass jars with lids filled with 19mm polystyrene spheres:
* Jar 1 – 10 spheres
* Jar 2 – one-third full of spheres
* Jar 3 – full to the top
* Ice
* Measuring scales

**Requirements** *(per student):*

* Activity sheet ELC1a-c

**Teaching notes:** Use to jars of spheres to demonstrate the different states of matter.

Jar 1 – simulates a gas and should be shaken vigorously to show that the particles in a gas are further apart and freer to move.

Jar 2 – simulates a liquid and should be swirled around to show that the level stays the same and that the spheres are less free to move than in Jar 1. They stay in contact with each other.

Jar 3 – simulates a solid and should be shaken gently to show that the particles are not free to move and can only vibrate.

After this demonstration you could move on to talk about the different energies of the particles and how the particles change from one state to another if they are heated (have energy added). You could demonstrate this by looking at what happens to ice as you heat it and explaining that the particles gain more energy so the bonds between the particle break and so the state changes. You could then demonstrate that as ice melts in a glass of water or another drink there is no change in mass. This will show that mass is not lost when a substance changes state.

To sum this up and to introduce students to the names of the different processes, you could show this YouTube video:

<https://www.youtube.com/watch?v=xYU7RSoOZ0U>

information about the particle models and states of matter can be found on BBC Bitesize weblink;

<https://www.bbc.co.uk/bitesize/guides/z3gxdxs/revision/1>

# Activity ELC1d-g *Physical change*

**Requirements** *(for each group):*

* Activity sheet ELC1d-g each
* Ice in a beaker on a tripod and gaze
* Clap stand
* Thermometer
* Stirrer
* Bunsen burner
* Helium filled balloon with H2O written on the balloons

**Requirements** (for the teacher):

* As per <https://amrita.olabs.edu.in/?sub=73&brch=2&sim=29&cnt=2> Determining the boiling point of water

**Teaching notes:** You could introduce this Activity by showing the students the clip from the RSC 2013 Christmas Lecture: <https://edu.rsc.org/resources/ri-christmas-lectures-2012-chemical-change/1118.article>

You could then have the students re-enacting the illustration from the clip using helium filled balloons.

In this way, you can show that it is the bonds between the water molecules that break not the bonds between the hydrogen and oxygen within the molecules.

Now demonstrate how to work out the boiling point of water. See weblink: <https://amrita.olabs.edu.in/?sub=73&brch=2&sim=29&cnt=2>

Show the students the YouTube video or demonstrate how to work out the melting point of water. See weblink: <https://www.youtube.com/watch?v=38QZEsB2xJM&feature=emb_rel_end>

While the students are watching ask them to take notes of the steps in the procedure. After the video/demonstration discuss with the class a plan to work out the melting point of water. Write out the joint plan on the board pointing out any hazards. Ask the students to follow the plan using the apparatus provided and work out the melting point of water. Discuss with the class the temperatures that water is solid, liquid and gas.

# Activity ELC1f,i-j *Chemical change*

**Requirements** *(for the teacher):*

* eye protection
* conical flask (100 cm3)
* small paper or plastic cup
* cotton wool
* measuring cylinder (100 cm3)
* marble chips (see Technical notes)
* balance with tare facility
* access to dilute hydrochloric acid (about   
  2 mol/dm3) (irritant)

*(per student):*

* Activity sheet ELC1f,i

**Technical notes:** The marble chips should be washed beforehand in dilute hydrochloric acid and then in water to remove surface powder. They should be allowed to dry in air.

**Procedure:** Start off by measuring the acid (50 cm3) into the flask. Put a loose plug of cotton wool in the neck of the flask. Measure out marble chips (5.0 g) into the paper cup. Place both the chips in the cup and the flask on the scales. Reset the scales to zero.

Tip the chips into the acid. Remember to put the empty cup back on the scales. Read out the reading of the scales every minute until the reaction has finished. It takes about ten minutes.

**Teaching notes:** You may be able to involve some students in the demonstration. One student, for example, can take the readings as another student indicates the time to do so.

Discuss with the students what is happening to the reading on the scales. It appears that mass is being lost, explain that this is an open system. Show the students the equation for the reaction on their activity sheet. Ask them to identify the states of each reactant and product. Discuss why mass reading on the scales has reduced.

Discuss with the students what is happening to the particles in the mixture, that the acid particles are colliding with marble chips with enough energy to react with the calcium carbonate in the marble chips.

Discuss what makes a successful collision.

You could them move on to discuss that the reaction between hydrochloric acid and marble chips stops when all the acid has reacted.

Then introduce the concept that some chemical reactions are reversible. You could demonstrate the reversible reaction of anhydrous copper (II) sulfate as suggested by BBC Bitesize at weblink:

<https://www.bbc.co.uk/bitesize/guides/z88739q/revision/1>

# Meanings of words

A glossary of words about the particle model can be found at:

[**https://www.bbc.co.uk/bitesize/guides/z96qv9q/revision/1**](https://www.bbc.co.uk/bitesize/guides/z96qv9q/revision/1)

[](https://www.surveymonkey.co.uk/r/ZL5Z53B)

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