**ACTIVITY: Drama in the microworld**

**Activity idea**

In this activity, students use drama to model science ideas about atoms and molecules, transferring heat and the process of combustion.

By the end of this activity, students should be able to:

* appreciate that everything is made up of very small particles
* understand why scientists use models to explain ideas
* understand differences in structure of a gas, liquid and solid in terms of particles
* understand how particles respond to heat
* understand how heat transfer occurs
* understand that, in a chemical reaction, a rearrangement of particles occurs
* develop an understanding about a combustion reaction, specifically in the combustion of methane gas.

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**Introduction/background**

In this activity, students are taken from their macroworld and are led (through their imagination) to the world of tiny particles (atoms, molecules and ions).

Using drama as a medium, the students understand that atoms are the building blocks of matter.

The students are able to explore, through drama, concepts of:

* the particle model for solids, liquids and gases
* the transfer of heat
* chemical change
* the combustion process.

**What you need**

* 3D models or drawings of molecules
* Coloured cards or headbands
* Bands (or strips of material
* Playdough, plasticine or blocks
* Jubes or jellybeans and toothpicks

**What to do**

1. Pick up an article (for example, a pen or a book) and ask the students to imagine that you divide it in half. Then they imagine you halve it again… and again… and again, many, many times, in fact, until you no longer can see it. Then you keep dividing until you can’t possibly divide any longer – you get to the smallest possible particle that can exist (there is no need to explain smaller particles within the atom at this stage).
2. Ask students what the name of that particle might be. Someone will probably tell you it’s an atom. Tell the students that atoms are extremely small. For example, look at a full stop. If the smallest atom (hydrogen) was placed side by side across the diameter of the dot it would take 10 million of them! Atoms can be grouped together in a variety of ways. One way is to form molecules. For example, the water molecule has one oxygen atom bonded to two hydrogen atoms (H2O).

***Becoming a model***

1. Explain to the students the idea of scientists needing models to show things because we can’t actually ‘see’ them. You might have some 3D models or drawings of molecules to show them.
2. Explain that the students are going to be the models of the atoms and molecules. All students are individual atoms. They can be bonded in pairs or groups to become different molecules. Explain that the bonds are very strong, but for the models’ sake, they will use bands (or strips of material) to tie their wrists together.

***Solids, liquids and gases***

1. Discuss differences of movement of molecules in each of the states of matter. Students then mime molecules in a solid (packed together in an array, vibrating), liquid (moving in between and over each other) and a gas (moving freely). This could be done by arranging the students in groups in marked out (confined) spaces for the solid and liquid. They stand in array, tightly packed as the solid, but vibrating. Within the same space, they move around each other (out of array) as the liquid. As the gas, they would move out of their space and go all over the room.

To use the water molecule analogy, the molecules in ice are fixed in position. The molecules in water slip and slide over one another but are still confined because they have the same volume. The molecules in water vapour (gas) move about freely with spaces between them. For example, 1ml of ice will become 1ml of water, which becomes 1350ml of steam if the temperature is 25°C.

The students could dramatise the particle model for water molecules in its three states (solid, liquid and gas). They will need to be ‘bonded’ in threes (two hydrogen and one oxygen atom). If that is too awkward, each person could imagine they are a complete water molecule already. Their head could be the oxygen atom, their arms are bonds and their fists could be the hydrogen atoms.

***Heating***

1. Students (now molecules) imagine the teacher is heating up the ice, then the water and then the gas. Students mime movement of the molecules – vibrating faster and expanding out a little as molecules in a solid, sliding and slipping more quickly, expanding a little more as molecules in a liquid and moving much faster as the gas molecules, spreading out all over the room.

***The transfer of heat***

1. To show the transfer of heat, the ice model could come into contact with the water model. The water molecules (having more heat energy or movement of molecules) collide into the ice, increasing the molecules’ movement until the molecules in the ice have the same movement as the water – slipping and sliding over each other (demonstrating melting and thermal equilibrium). Emphasise a slowing down of movement of the water molecules and an increase of movement from the ice molecules (as they warm up).

***A general idea of chemical reaction***

1. Generate a discussion with students as to what they think might happen to the molecules in things (fuel) when it begins to burn. Develop the idea of molecules breaking up then reforming to make new molecules. Students could mime this by breaking (untying) some of the bonds (bands) and joining with other molecule fragments or atoms. Explain this is what happens in chemical reactions (molecules breaking and rejoining to form new molecules).

***Combustion***

1. To develop the idea further, the students could become specific molecules to show a combustion reaction. You could give them coloured cards or headbands to represent the different atoms, for example, red for oxygen, black for carbon and white for hydrogen.

You will need a group of 9 students (three groups in a class of 27). Some of the students in the group join together to be a methane gas molecule (methane gas is the gas that many of the students would use for cooking and heating in their homes) – 1 student becomes a carbon (C) atom, and 4 are hydrogen (H) atoms. They bond together to form CH4 – a methane gas molecule. They might like to label themselves.

4 other students become oxygen atoms, attaching themselves in pairs to form 2 oxygen (O2) molecules.

Mime igniting the gas. As the gas is heated, the CH4 molecule breaks apart and reforms with 2 of the O2 molecules to form 2 H2O (water) molecules and 1 CO2 (carbon dioxide) molecule. All the atoms are used – there are none left over.

The chemical equation for this is: CH4 + 2O2 + heat  CO2 + 2H2O + heat.

Use this model to discuss how the final products (water and carbon dioxide) are completely different to the original product (methane gas). This is chemical change.

Other ways to model the chemical reaction:

* Playdough, plasticine or blocks could also be used for modelling combustion. Different colours represent different atoms. Students could make model atoms and join them together to make molecules. They could use the methane gas molecule to show burning by breaking their molecules apart and rejoining them as water and carbon dioxide molecules.
* Another alternative is to use jubes or jellybeans and put them together with toothpicks to make the molecules.

***Why use the methane gas molecule as a model?***

Methane gas is clean burning in a plentiful supply of air (complete combustion) and produces just water and carbon dioxide. Other fuel items (such as wood) also produce water and carbon dioxide but they produce a number of other things as well (for wood, this might include other gases, organic compounds, carbon and minerals), which would be difficult to show and may be confusing for the students.