

# BREAKING IT DOWN

with Dr. Michelle Dickinson



## SCIENCE OF PLASTICS

### Welcome to Breaking It Down with Dr Michelle Dickinson.

This worksheet is to help you to support your teaching after your students have watched the 'plastics' episode. It contains a summary of the science knowledge, experiment instructions, topics for further inquiry, and links to the NZ curriculum at levels 3-4.

Use this sheet alongside the video for the Plastics episode of "Breaking It Down with Dr Michelle Dickinson" to help with your teaching around the science of plastics, materials and sustainability. During the episode, Dr Michelle Dickinson will cover the physical and chemical science of plastics, talk to polymer chemist Dr Florian Graichen from Scion and conduct an experiment which students can follow along with.

### For this session, your students will each need:

- **Samples of plastic from recycle bin**
- **Fruit (banana preferred)**
- **Nut (peeled and sliced - coconut works if there are allergies)**
- **Matches or lighter (adult supervision needed)**
- **Notebook to draw in and write down their observations**

### Achievement Aims

#### NZ Curriculum Strand:

#### Properties and changes of matter

Group materials in different ways, based on the observations and measurements of the characteristic chemical and physical properties of a range of different materials.

Compare chemical and physical changes.

#### NZ Curriculum Strand: Chemistry and Society

Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes.

### Learning Outcomes

- Understand how plastics are called polymers and made up of different 'mer' groups
- Understand that polymers are made by the polymerisation of monomers.
- Understand that the recycle number on a plastic item indicates the type of plastic it is made from and that it is a thermoplastic meaning it will soften when heated.
- Understand that thermoset polymers don't soften when heated which is desirable for electronics.
- Carry out a simple experiment showing how plastic items can be substituted for more sustainable ones.

### BREAKING IT DOWN:

#### Science of Plastics

The scientific name for the group of materials which are normally called plastics are polymers. 'Poly' means many and 'mer' means group.

Traditionally, plastics are made from crude oil, which is a non-renewable material. Crude oil is extracted from underground heated to separate out different hydrocarbon chains. In the case of polyethylene, the monomer we need is ethylene. Through a reaction called polymerisation which uses a catalyst, the double bond in the ethylene group breaks and the monomer groups bond together to form polyethylene.

Depending on how dense the polymer is it can be described as low-density (LDPE) used to make single-use bags or high-density (HDPE) polyethylene

to make milk bottles. In polymers that can be recycled this information can be found in the number inside a triangle on the item. HDPE is a number 2 and LDPE a number 4.

An important property of polymers is their behaviour at high temperatures. 'Thermoplastics' become moldable and can be reformed at high temperatures - these can be recyclable. 'Thermoset' plastics keep their shapes at high temperatures, meaning that they usually cannot be recycled however they are used for electronics like plugs and circuits where they may be exposed to high heat.

Single-use plastic, which is especially common for packaging things are designed to be thrown away after using. As plastics can last hundreds of years, they may sit in a landfill or make their way to natural habitats like the ocean where they can cause problems for animals.

When plastic waste breaks down it can form microplastics which can trap a lot of chemicals due to their high surface area to volume ratio.

New ways of making plastics from non-crude oil sources are being developed to help them to become more sustainable in their manufacture.

Some plastics can be used inside the body - these need to be biocompatible and include plastics like contact lenses, hip replacement linings and heart stents.

## EXPERIMENT INSTRUCTIONS

### Experiment 1: Recycle Number

- Find items from around the house made from plastic.
- Look for the recycle triangle number and find out which plastic the object is made from
- See if you can determine a polymer's properties from its composition.

### Experiment 2: Sustainable Candle

- Cut your fruit so it can stand up like a candle
- Push a slice of nut into the top surface. This will act as your 'wick.'
- Safely light the nut as you would a candle, demonstrating that the natural oils inside nuts are a source of energy.
- Discuss natural, sustainable sources of oil.

## EXPLORE FURTHER

(Use these prompts to start a discussion or further inquiry on the topic of plastics)

- Why do we make things from plastic instead of other materials
- What are microplastics and where do they come from?
- What other materials can we make plastics from that aren't crude oil?
- What sort of plastic is in my clothes?
- How many types of recyclable plastics are there?
- What is the difference between compostable and biodegradable for plastics?



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