

# Why are plastics useful?



Age 11-14



60 minutes

## Curriculum links

- Investigate properties of materials
- Develop investigation skills including use of independent, dependent and control variables

## Resources



### Slideshow 2:

Why are plastics useful?



### Activity Overview 2a:

Plastics independent investigations



### Student Sheet 2a:

Plastics independent investigations

## Extension or home learning

“On a hot day, would you rather drink from a cold single-use plastic bottle or a warm metal reusable bottle?” Write 200 words explaining the advantages and disadvantages. Give a conclusion.

## Lesson overview

In this chemistry Key Stage 3 (KS3) lesson, students investigate the different properties of plastics. In groups students design an investigation testing either thermal insulation or tensile strength. Included are teacher resources with an investigation template.

## Lesson steps

## Learning outcomes

### 1. I couldn't disagree more because...(5 mins)

Students use media-based knowledge on plastics to describe how they can be both harmful and useful. These ideas are put on the board. Students work in pairs to play 'I couldn't disagree more because'.

- Describe how plastics can be both harmful and useful

### 2. Variables (5 mins)

Teacher explains what independent, dependent, and control variables are. The teacher shows two examples of investigations into plastics with the variables identified.

- Identify independent, dependent, and control variables

### 3. Designing a practical (35 mins)

Students design and carry out their own investigation using Student Sheet 2a: Plastics independent investigations.

- Develop investigation skills including control variables and repeats

### 4. Analyse Data (10 mins)

Students must graph their data using the design your test worksheet.

- Evaluate results in a graph

### 5. Reflection: love, recycle, bin (5 mins)

Students reflect on the lesson. They state one thing they loved, one thing they would bin (had rather not done) and one thing learned that they would like to recycle (needed for the next lesson).

## TEACHER GUIDANCE 2 (page 1 of 3)

### WHY ARE PLASTICS USEFUL?

#### Step Guidance

#### Resources

1  
5  
mins



Introduce the topic of plastics by discussing its advantages and disadvantages as a material.

- Introduce the lesson and the learning outcomes using slides 1-2.
- Using slide 3 as a prompt the teacher initiates a discussion on “Why are plastics harmful?” and “Why are plastics useful?”
- Students discuss why plastics can be harmful and useful.
- Collect ideas onto the board for reference
- **Using slide 4 - 7, introduce some of the ways in which plastic impacts on the climate crisis and marine eco-systems. Add these to the idea list.**
- Using slide 6, students work in pairs to play ‘I couldn’t disagree more because’. one argues for and one against the use of plastic. Students must start every sentence with “I couldn’t disagree more because...”



“I couldn’t disagree more because...” is designed to increase oracy in the classroom. First of all a statement is given. For example, “Cheese is the best food.” Students work in pairs, each taking opposing sides to an argument. Person A supporting the statement and person B opposing. Person A could start by saying, “Cheese is fantastic because it makes everything taste great.” To which person B responds, “I couldn’t disagree more because most cheese smells like feet.” Person A must then respond to person B’s last comment, and the pair continue, always starting their sentence with “I couldn’t disagree more because...” The person who argues the longest is the winner.



If you have not taught a marine or plastics focused lesson to your class before this lesson, consider using some of the activities and lessons from Oceans for beginners 11-14 to provide a broader context. This mini-unit can be accessed at [http s://encounteredu.com/teachers/units/oceans-for-beginners-11-14](http://s://encounteredu.com/teachers/units/oceans-for-beginners-11-14).

**Slideshow 2:**  
Slides 1-7

## TEACHER GUIDANCE 2 (page 2 of 3)

### WHY ARE PLASTICS USEFUL?

#### Step Guidance

#### Resources

2  
5  
mins



Step 2 involves students considering what makes a scientific investigation. They will be introduced to variables, which they will apply to their own investigation relating to plastics.

- Explain to students that they will be learning what makes a good scientific investigation.
- List the three types of variable: the independent (what we change); the dependent (what we measure); and the control (what we keep the same).
- Give context by posing a question, such as “How would I investigate if blue cars are faster than red cars?” Then either apply the variables to the question in your explanation or encourage a student to do so.
- Move to slide 6, allow students to work in pairs to read the scenario and identify the independent, dependent and control variables. Review these on slide 7.
- Move to slide 8, again allow students to work in pairs to read the scenario and identify the independent, dependent and control variables. Review these on slide 9.

**Slideshow 2:**  
Slides 5-9

3  
35  
mins



Students have the opportunity to work in small groups and create their own independent investigation, while applying knowledge from the lesson.

- Put students in small working groups.
- Hand out Student Sheet 2a.
- Direct students to Slide 10 to understand the sequence of activities.
- It would benefit students if they received their trays with equipment during planning, so that they design their investigation appropriately. Move to slide 8, again allow students to work in pairs to read the scenario and identify the independent, dependent and control variables. Review these on slide 9.
- If a significant number of students are struggling to draw a table, stop the group work and model how to do this on a white board for the whole class.
- After a set time period, invite groups to share their plan to model to other students what they will be doing during the practical.
- During step 4 students will work in small groups to carry out the investigation.
- Circulate the class coaching students through questioning such as, “Why are you keeping this the same?”, or “How are you making your investigation repeatable?”

**Slideshow 2:**  
Slide 10

**Student Sheet 2a:**  
Plastic independent investigation



Allow 15 minutes for designing the activity and 20 minutes for carrying it out

## TEACHER GUIDANCE 2 (page 3 of 3)

### WHY ARE PLASTICS USEFUL?

#### Step Guidance

#### Resources



Remind students by demonstrating how to conduct the investigations safely. For those conducting the insulation investigation, do not give students water hotter than 43 degrees Celsius. This can be achieved by boiling water in advance and allowing it to cool to the appropriate temperature, or by asking technicians to bring the correct temperature water to the class when needed.

4  
10  
mins



Once students have collected their data, they must present their findings in a graph.

- Direct students to return equipment and return to a seated position to allow them to concentrate on producing their graph.
- Continue to model how to draw a graph by demonstrating how to plot a single point from the two axes.
- Draw axis labels and remind students that these are essential for another person who was not part of the experiment, to understand the findings



Note that students often struggle plotting the axes on graphs correctly. Remind students that each square has a value. They must go up in equal amounts (e.g. increasing by a value of 10 for every 10 squares means each square has the value of 1).

**Slideshow 2:**  
Slide 10

**Student Sheet 2a:**  
Plastic independent investigation

5  
5  
mins



Students reflect on the lesson to practise metacognition.

- Students should state one thing that they liked; one thing they would bin (rather not have done); and one thing they will need to recycle (remember for next lesson).

**Slideshow 2:**  
Slide 11

+  
20  
mins



Challenge students to respond to the following statement "On a hot day, would you rather drink from a cold single-use plastic bottle or a warm metal reusable bottle?" Ask students to write 200 words explaining the advantages and disadvantages. Remind them to give a conclusion. This evaluation challenge is brilliant for promoting structured answers to exam-style questions. Furthermore, it allows students to think critically about their attitude to sustainable issues. You can model this in class by taking a few opinions from students in class and constructing it into a comparative sentence. You can support students further by giving them appropriate connective words which they must include, such as "whereas", "however", "inversely" or "alternately".

# Plastics independent investigations



Age 11+  
(adult supervision)



planning  
15 minutes  
investigation  
20 minutes

## Details

### What you need per group For insulation test:

- 3 beakers (250ml)
- 2 or more different materials (paper and plastic)
- Scissors
- Sticky tape
- Thermometer
- Kettle
- Timer
- Student Sheet 2a: Plastic independent investigation

### For strength test:

- Two different materials
- Sticky tape
- Scissors
- Scales / balance
- 10g weights

## Overview

In this activity students will discover how to design and carry out their own investigation into the properties of plastics. Specifically, they will investigate the insulation properties and strength of plastic.

## Running the Activity

- Ask technicians to set up individual trays with equipment.
- Giving students the trays whilst they are planning their investigation ensures that they only plan a practical with the equipment available.
- For a class of 30 you may have ten groups. Therefore, request five trays with the insulation test and five trays with strength test.

## Expected results

Students will recognise that plastic is both a good insulator of heat and a strong material.

## Safety and Guidance



### Precautions

Remind students by demonstrating how to conduct the investigations safely. For those conducting the insulation investigation, do not give students water hotter than 43 degrees Celsius. This can be achieved by boiling water in advance and allowing it to cool to the appropriate temperature, or by asking technicians to bring the correct temperature water to the class when needed.

# Plastics independent investigations



Choose one of the following models for your investigation

- A) Which material is the best insulator?
- B) Which material is the strongest?

## Method A

1. Collect 3 250ml beakers
2. Wrap one in plastic, one in paper, and leave one uncovered
3. Add 100ml of hot water to each beaker
4. Measure the starting temperature
5. Measure the temperature every 2 minutes for 10 minutes
6. Calculate the change in temperature between the first and last reading

## Method B

1. Collect paper and plastic materials
2. Weigh the materials so you have the same mass of both (in grams)
3. Build two identical bridges between two tables
4. Fix the hook of the weight to the bridge
5. Add 10g at a time until the bridge collapses
6. Record the weight which causes the bridge to collapse

## Summary Questions

1. What is the **independent variable** (the thing that you are changing)?

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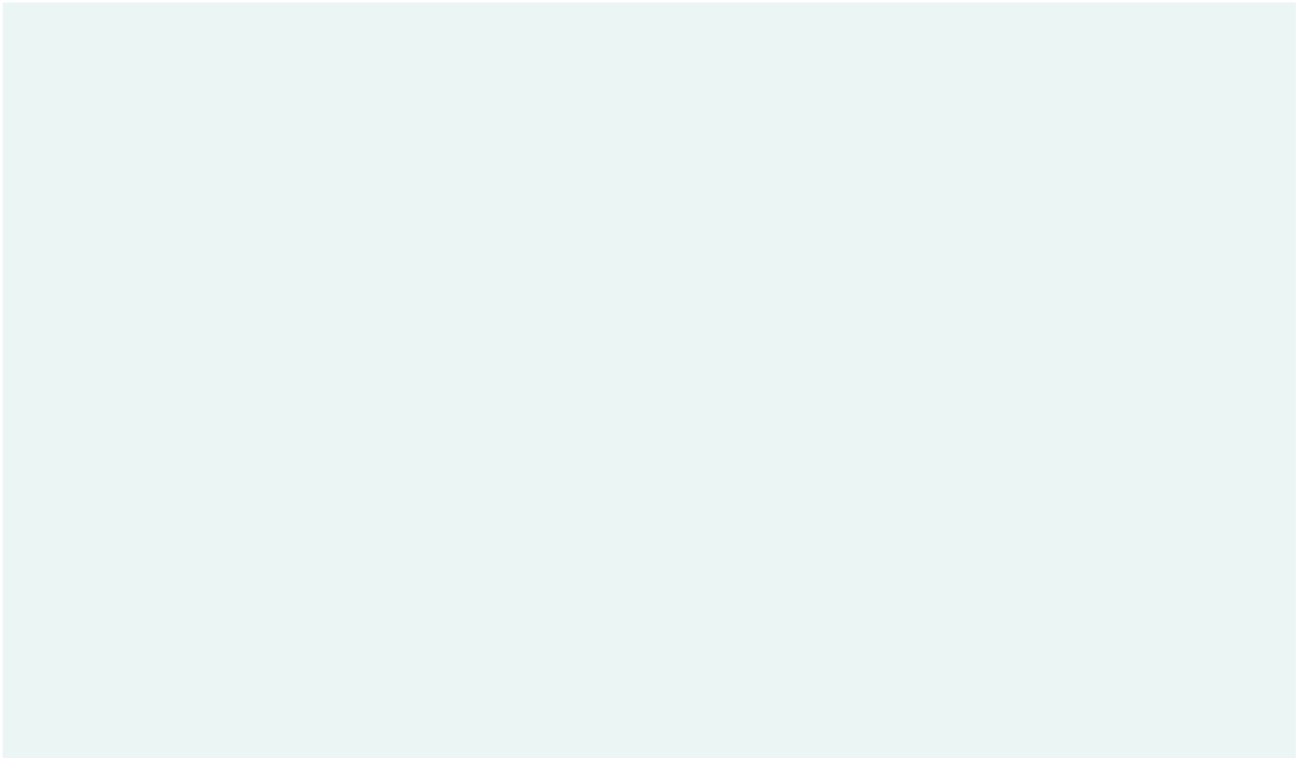
2. What is the **dependent variable** (the thing that you are measuring)?

.....

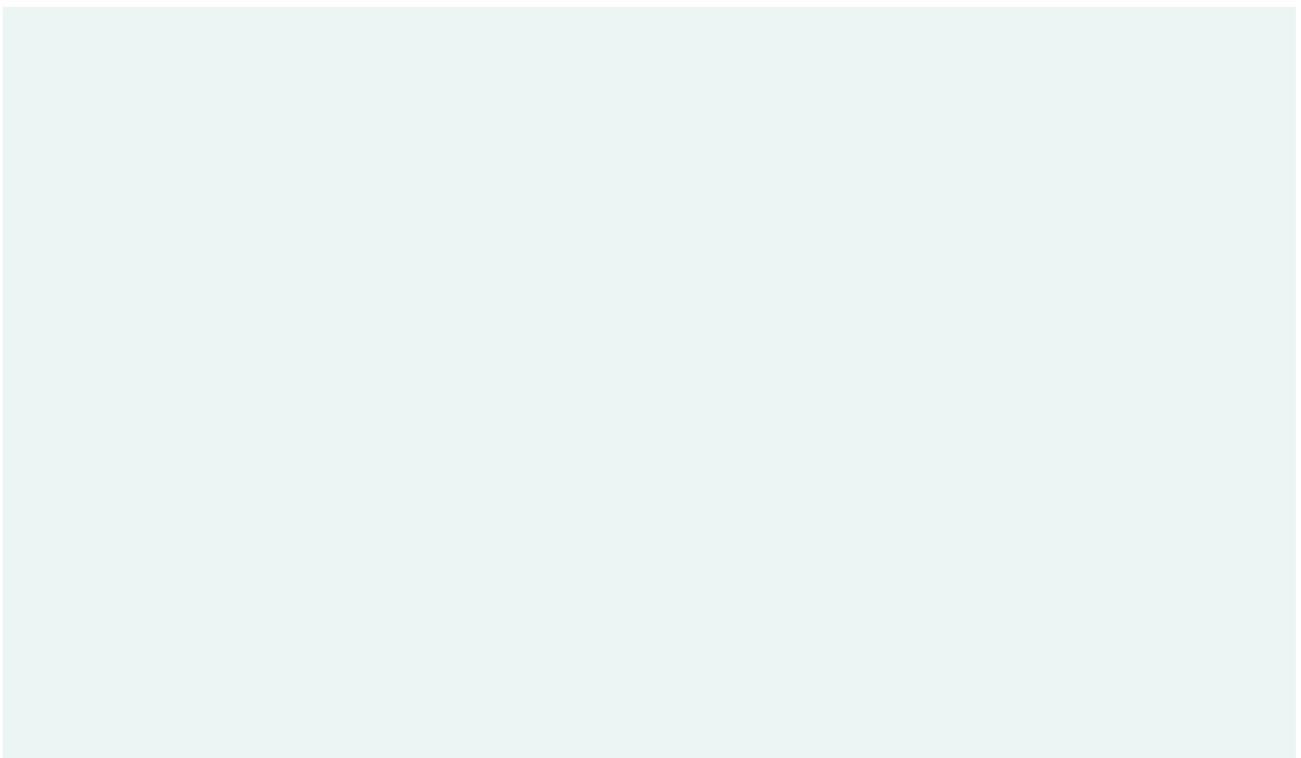
3. What is the **control variable** (the thing that you are keeping the same)?

.....

4. Draw and label a diagram of your practical in the box below.



5. Draw a table of your results.  
The dependent variable goes in the far-left column



STUDENT SHEET 2a

- 6. Draw a bar chart of your results.  
Remember the independent variable goes on the horizontal axis and the dependent variable on the vertical axis.



- 7. What do your results tell you?

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- 8. Do you think your results are accurate? Explain why.

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- 9. How could you make your investigation more fair?  
(Identify more control variables.)

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