

How are plastics made?



Age 11-14



60 minutes

Curriculum links

- Investigate and understand how changing a substance's structure can change its properties
- Describe how plastics are made from crude oil

Resources



Slideshow 1:
How are plastics made?



Activity Overview 1a:
How to make slime



Student Sheet 1a:
Plastic production table

Student Sheet 1b:
Plastic card sort

Student Sheet 1c:
How to make slime



Diagram:
Seven types of plastic

Extension or home learning

Students find a selection of products at home made of plastic. Photograph the symbols, printed or etched, on to the plastic. Bring an A4 sized sheet of the photographs. Add a key stating what these symbols mean. Students can be directed to an online resource as an exemplar - (<https://encounteredu.com/discover/images/seven-types-of-plastic>).

Lesson overview

In this chemistry Key Stage 3 (KS3) lesson, students will learn how monomers and polymers dictate the properties of plastics. This lesson focuses on how plastics are made. Included are teacher resources for students to make their own polymer, using PVA and borax, to observe how changing the structure of a substance changes its properties.

Lesson steps

1. What can we do with oil? (5 mins)

To recap prior knowledge, students guess what can be done with oil.

2. Plastic production carousel (15 mins)

Students are invited to discover how oil is made by moving to different stations around the room while they fill in Student Sheet 1a: Plastic production table.

3. Monomers and polymers (5 mins)

Students learn how the physical changes to the hydrocarbons happen through the process of polymerisation.

4. Thermosetting vs thermoplastics (10 mins)

Students sort plastics by their properties into two categories: thermosetting and thermoplastics.

5. Making Slime (20 mins)

Students make their own polymer using PVA and borax.

6. 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 have done), and one thing learned that they would like to recycle (needed for the next lesson).

Learning outcomes

- State that plastics are made from oil
- Describe the steps involved in making plastic
- State what a monomer and a polymer is
- Describe how changing a substance's structure can change its properties
- Describe how changing a substance's structure can change its properties

TEACHER GUIDANCE 1 (page 1 of 3)

HOW ARE PLASTICS MADE?

Step Guidance

Resources

1
5
mins



Step 1 allows the teacher to assess student's prior knowledge of the topic through a settler activity.

- On slide 2, students list things that can be done, or made, with oil into their books.
- Collect this to understand where to pitch the introduction.
- Explain, if not elicited from students, that oil can be used to make plastics.
- Using slides 3-4, introduce the lesson and learning outcomes.
- Leading the students on to the next part of the lesson ask them to predict how oil is turned into plastic. This question is displayed on slide 4.



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 <https://encounteredu.com/teachers/units/oceans-for-beginners-11-14>.

Slideshow 1:
Slides 1-4

2
15
mins



In step 2, students will begin the journey of how oil is transformed into plastic through a carousel activity.

- Print slides 16-20 and place around the classroom. You may need 2 copies depending on class size.
- Students use Student Sheet 1a and move to different stations in the room to collect information, which they write into their table.
- Inform students to return to their seats once completed.
- Once several students have returned to their seats, call all students to return to their seats and review the steps, as a class, allowing students to fill in missing sections.
- Once reviewed you have opportunity for a mini-plenary. Referring to slide 6, ask a students to identify the image which represents the first step in the process. Ask them to describe what is involved in the process. Continue to direct questions at students to check understanding. This is a valuable opportunity to identify and correct misconceptions.

Slideshow 1:
Slides 5-6

Student Sheet 1a:
Plastic production table

Print:
Slides 16-20

TEACHER GUIDANCE 1 (page 2 of 3)

HOW ARE PLASTICS MADE?

Step Guidance

Resources

3
5
mins



In step 3, students consider the change in structure that the oil has undergone to become a plastic. Students are introduced to key terms, monomer, polymer, and polymerisation.

- Using slide 7, pose a whole class question, “What have we changed to make oil become plastic?” Remember to leave at least 5 seconds think time before taking a response.
- Referring to slide 8, inform students that the process changed the structure. The crude oil is extracted and separated. A type of oil is removed. It is broken down into a monomer. With that monomer we can make extremely long chains called polymers. This process is called polymerisation.



Note that monomer is a generic name for any small molecule. Polymer is generic name for any longer molecule made of repeating units. Polymerisation is the process where these units combine. In manufacturing and biologically this is often done in the presence of a catalyst.



Go further by modelling the process. Get students to line up and either the teacher or another student moves down encouraging them to hold hands. Be respectful of social, emotional, and religious beliefs.

Slideshow 1:
Slides 7-8

4
10
mins



Students now have an appreciation of the steps involved in making plastics and key terms which describe their structure. Now students sort plastics by their properties into two categories: thermosetting plastics and thermoplastics.

- Ask students to look at the diagrams on the board. Ask a student to describe what they can see. Followed by asking another student, “What do you think the differences are between thermosetting and thermoplastics?”
- Inform students that thermosetting plastics are generally much harder and more brittle whereas thermoplastics are generally softer and more flexible. This is because of the presence of more cross links between polymer chains in the thermosetting plastics and fewer cross-links present between polymer chains in the thermoplastics.
- Hand out Student Sheet 1b.
- Using slide 10, direct students to sort out the plastics into two categories.
- Once students have placed each plastic in one of two categories, show slide 11 to share the answers.

Slideshow 1:
Slides 9-11

Student Sheet 1b:
Plastic card sort

TEACHER GUIDANCE 1 (page 3 of 3)

HOW ARE PLASTICS MADE?

Step Guidance

Resources

5
20
mins



Students work in groups to create their own slime. This demonstrates how changing the structure of a substance changes the properties.

- Inform students they will be making their own polymer using PVA and Borax.
- Hand out Student Sheet 1c.
- Demonstrate to students what they must do. This will vary depending on how you and your technician have set up the equipment.
- Remind students of safety precautions, including not to ingest the PVA-borax mixture.
- Once students have made the slime ask that they answer the summary questions.
- Review summary questions as a class.



The borax acts like a bridge connecting the individual PVA molecules. This increases the length of the molecules, changing the texture of the substance. This is like the change observed with the polymerisation of oil (a liquid) to form plastic (a solid).



Borax is toxic and should not be consumed or touched with bare hands. Ensure students do not ingest mixture and that they wash their hands if they have come into contact with borax.



Go further by explaining that slime is a non-Newtonian fluid. This means that under different conditions it can either act like a solid or a liquid. When under stress, from pulling sharply or hitting, the material becomes firm and breaks easily. When under low stress, from stirring smoothly, the material flows and can be stretched.

Slideshow 1:
Slides 12

Activity Overview 1a:
How to make slime

Student Sheet 1c:
How to make slime

6
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 1:
Slide 13

+
20
mins



Challenge students to find a various products at home made from plastic. Ask students to photograph the symbols, printed or etched, on to the plastic. Explain that these symbols represent the type of plastic the product is made from. Students should bring an A4 sized sheet of photographs or drawings with 5 or more different products they have found. Students should include a key which identifies what plastic each symbol represents.

Diagram: Seven types of plastic can be used to complete this home learning. (<https://encounteredu.com/discover/images/seven-types-of-plastic>)

Diagram:
Seven types of plastic