

What happens to plastic when you throw it away?



Age 11-14



60 minutes

Curriculum links

- Investigate what happens to plastics when disposed
- Describe and understand alternatives to plastics
- Working scientifically to compare plastics to alternatives, through degradation tests

Resources



Slideshow 3:

What happens to plastic when you throw it away?



Activity Overview 3a:

Design a biodegrade test



Student Sheet 3a:

How long will it take to degrade?

Student Sheet 3b:

Biodegradable plastic bags academic paper

Student Sheet 3c:

Design a biodegrade test

Student Sheet 3d:

Dr Imogen Napper's study



External Link:

Inspiring Stories: Imogen Napper

Extension or home learning

Complete the home learning exercise on Student Sheet 3d: Dr Imogen Napper's study.

Lesson overview

In this chemistry Key Stage 3 (KS3) lesson, students investigate rates of decay. The lesson is focused on students designing their own investigation. Included are teacher resources allowing students to test how a conventional plastic bag decays compared to a compostable bag (using a potato as a substitute), in different conditions.

Lesson steps

1. How many questions can you think of? (5 mins)

Students are shown a picture of a plastic bag in the ocean. They must try and generate as many of their own questions about this image as they can.

2. Where does it go? (5 mins)

Students learn the possible journey plastic can take using a flow diagram.

3. Sources of plastic pollution (5 mins)

Students are introduced to sources of plastic pollution using an infographic. Students are challenged to redraw the image from memory.

4. Timeline (10 mins)

Students order objects in order of the length of time it takes them to decay.

5. What are the alternatives? Academic paper (10 mins)

Students analyse an academic paper to find alternatives to oil-based plastic.

6. Biodegrade test (20 mins)

Students investigate what factors increase decay.

7. Unintended consequences? (5 mins)

Students evaluate the alternatives to plastics and balance the advantages with disadvantages.

Learning outcomes

- Recognise that most plastic ends up in either landfill or the sea

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- Order materials based on the time they take to degrade

- Describe alternatives to using plastics

- Create an investigation on how to increase the speed of decay

- Describe alternatives to using plastics

TEACHER GUIDANCE 3 (page 1 of 4)

WHAT HAPPENS TO PLASTIC WHEN YOU THROW IT AWAY?

Step Guidance

Resources

1
5
mins



Step 1 invites students to generate their own line of enquiry about plastic in the ocean.

- On slide 2, students are shown a picture of a plastic bag in the ocean. As a settler activity they write as many questions as they can think of into their book.
- Coordinate the sharing of students' questions.
- At this point you will notice some common themes and can inform students about the lesson journey and which questions we will seek to answer in more detail during the lesson.
- Follow on by sharing the learning outcomes, linking these to the questions previously raised.

Slideshow 3:
Slides 1-3

2
5
mins



Most students will have recently drunk from a plastic bottle. Step 2 informs students about the end life of this everyday commodity.

- Show the diagram on slide 4 detailing where manufactured plastics go.
- Students may need you to remind them what kilotonne (kt) is. Break down the word kilo meaning thousand and tonne being a unit of measurement. A common misconception is scales of magnitude. You can make this data more relatable by letting them know that a small car weighs approximately 1 tonne.
- You may want to ask students "what does this diagram tell us?" and "Are you surprised? How do you feel about this information?"

Slideshow 3:
Slide 4

3
5
mins



Students have an appreciation for where most plastics end up. In this step, students identify what are the main sources of this plastic waste through the 'flash diagram activity'.

- Print off a copy of slide 5. Remember not to show this slide on the board as this will reveal the 'sources of waste diagram' that students need to draw in this 'flash diagram' activity.
- The 'flash diagram activity' is where students work in groups to reconstruct a picture from memory.
- Put the students into groups and give each group a few blank sheets of A4 paper.
- Explain the activity to students. As a group, students will be re-drawing a diagram on their sheet of paper. All the students in a group will get to see the diagram, but there are some catches.
 1. Only one group member is allowed to see the diagram at a time.
 2. Students cannot write or draw anything while they look at the diagram.

Slideshow 3:
Slide 5

Print:
Slide 5

TEACHER GUIDANCE 3 (page 2 of 4)

WHAT HAPPENS TO PLASTIC WHEN YOU THROW IT AWAY?

Step Guidance

Resources

3. Each group member is only allowed to see the diagram for a short period of time, and this time will get shorter after each viewing.



Station yourself so that class cannot see the diagram, but there is room behind you where students can stand and “view” the diagram.

4

10
mins



Having looked at where plastics go, students now consider how long they persist there through predicting how long it takes different objects to degrade.

- Either hand out Student Sheet 3a or advise students to draw timeline in their books.
- Students must predict how long we estimate different materials take to degrade.
- After most students have committed their answers, reveal the answers and ask students to correct their timeline using a different coloured pen.



Note that these values given are estimates. As many of these materials are relatively new, it is impossible to know accurately how long they will take to degrade, given different conditions.

Slideshow 3:

Slides 6-7

Student Sheet 3a:

How long will it take to degrade?

5

10
mins



Students now recognise how plastics enter the wider environment and the time taken for different materials to degrade. Now students explore alternative materials to synthetic plastics.

- Using slide 8, pose the question “Plastic persists in the environment. If we want products that degrade quicker, what material would you use?” If this does not elicit a desirable response, ask students “What sorts of things, that you can find at home, degrade quickly?” Students ought to recognise that perishable foods degrade quickly.
- Next, direct students to find out what scientists are doing by completing Student Sheet 3b, supported by slide 9.
- Review Student Sheet 3b comprehension questions using slide 10.
- Many students will have misconceptions about the differences in how plastics and bioplastics degrade. Address this common misconception on slide 11.

Slideshow 3:

Slides 8-11

Activity Overview 3a:

Degradation test

Student Sheet 3b:

Biodegradable plastic bags
academic paper

TEACHER GUIDANCE 3 (page 3 of 4)

WHAT HAPPENS TO PLASTIC WHEN YOU THROW IT AWAY?

Step Guidance

Resources



Go further by making it physical. Hand post-it notes to students. Challenge them to tear them into the smallest pieces possible. Explain that this is what happens to plastic. The post-it has not changed chemically - it has just become smaller. In contrast, natural polymers – such as starch - can be biodegraded by living decomposers, such as fungi and bacteria, which chemically change them into a new substance with different properties.

6
20
mins



Students recognise that there are alternatives. Step 6 introduces students to Dr Imogen Napper and her work on investigating how fast materials degrade. Students will then replicate this research themselves.

- Using slides 12 and 13, introduce Dr Imogen Napper by asking a student to read her comments.
- Hand out Student Sheet 3c.
- Explain that students will have to compare how plastic and a potato (proxy for bioplastic) decompose in different conditions.
- Slide 14 has a graphic which explains factors affecting rate of decomposition. Depending on the class, you may want to talk through this in detail, or just direct them to the graphic to help them with their investigation.
- Students will need to leave their samples for a week or more to see substantial results. Once they have prepared their samples get students to return to their seats and ask them to predict what might degrade most. The plastic or the potato?
- Get students to vote with a 'hands-up': "which materials, plastic or bioplastic, is better for the environment? Hand up for plastic...Hands up for bioplastic?"



This video is hosted on YouTube and you may need to unblock this service, liaising with your IT department.

The link for the video is:
Inspiring Stories: Imogen Napper
<https://youtu.be/8D0nBs9TiyI>

Slideshow 3:
Slides 12-14

Student Sheet 3c:
Design a biodegrade test

Video:
Inspiring stories: Imogen Napper

TEACHER GUIDANCE 3 (page 4 of 4)

WHAT HAPPENS TO PLASTIC WHEN YOU THROW IT AWAY?

Step Guidance

Resources

7
5
mins



Students should conclude that bioplastics are the better alternative. However, step 7 challenges students to consider unintended consequences of using the technology.

- Direct students to the opinion on slide 15. It reads: “Bioplastics need lots of starch from plants. This takes up way too much land, which may result in forests being cleared for farming. It is also unethical because many people go without food.”
- Ask students whether they agree or disagree with this opinion. The teacher can then chair a small debate on students’ opinions.
- A useful debate model is ABC (Agree, build, challenge), where students must respond with either: “I Agree” “I want to build on that” or “I want to challenge that”



The statement on slide 15 is deliberately provocative. A switch to bioplastics does not necessarily mean deforestation and famine, but the increased use of any natural resource will place pressure on habitats and supply chains.

Slideshow 3:
Slide 15

+
20
mins



Complete the homework sheet on Dr Imogen Napper’s study

Student Sheet 3d:
Dr Imogen Napper’s study