LESSON 5

Plastics and bioaccumulation

Age 11-14

60 minutes

Curriculum links

- Investigate how pollutants, accumulate in organisms, through the food chain
- Evaluate the impact of microplastics on bioaccumulation

Resources

Slideshow 5: Plastics and bioaccumulation

Mark Scheme 5a: Plastics and bioaccumulation assessment

Student Sheet 5a: Plastics and bioaccumulation assessment

Extension or home learning

Find out about at least 5 other harmful chemicals found in plastics. Provide the name of the chemical, how it is produced, and potential harm it can cause.

Lesson overview

In this biology Key Stage 3 (KS3) lesson, students will learn about plastics and bioaccumulation. This lesson is focused on how chemical pollutants cause harm to marine organisms. Included are teacher resources to model bioaccumulation and an orca case study.

Lesson steps	Learning outcomes
1. How do our surroundings affect us? (10 mins) Students are shown two images and predict how the environment can change the health of a person. Students are then introduced to the lesson and learning outcomes.	• State that pollutants can enter an organism's body from the environment
2. How does this affect the ecosystem as a whole? (10 mins) Students create their own food chain and food web using Artic animals.	• Describe how energy and pollutants are passed through a food chain / web
3. Modelling bioaccumulation (15 mins) Students use marbles or counters to model the bioaccumulation of pollutants.	• Describe how energy and pollutants are passed through a food chain / web
4. Plastics bioaccumulation assessment (20 mins) Students complete a case study on PCBs in orcas.	• Evaluate whether plastics contribute to bioaccumulation • Analyse data to identify trends
5. Review (5 mins) Students discuss how the image can be an analogy for the lesson.	

TEACHER GUIDANCE 5 (page 1 of 4)
PLASTICS AND BIOACCUMULATION

Step	Guidance	Resources
1 10 mins	Students are introduced to the topic of bioaccumulation by first considering how the environment impacts the individual. Students will relate both prior learning and their vicarious experiences. · When students enter the classroom direct them to slide 1 as a settler activity. Students write the answers into their class book. · Once most students have settled and responded to the task open a discussion. Students share their ideas with the whole class. · Using slide 2, explain how chemicals from the environment can pass into people. · Using slides 3 to 4, introduce today's lesson title and learning outcomes. · Using slide 5, students are introduced to some of the pollutants that can be found in the ocean. Pollutants which come from plastics are highlighted (appear bold on the board). · Using slide 6, ask the class: "What harm do these plastic related chemicals cause in the ocean?" · Students ought to recognise the impact on the health of marine life.	**Slideshow 5:** Slides 1-6
2 10 mins	Students now understand that the chemical pollutants in the oceans can cause harm to individual marine organisms. For the next step students must think how organisms are connected. · Directing students to slide 7, explain that pollutants in the water can accumulate in marine organisms. · Using slide 8, students follow the instructions on the board. · Ask students to draw a food chain and food web using arrows. · For younger students it may be important to model this on the board. · Remind students to use arrows to show the direction of how energy is passed. · If students finish ahead of time, ask them to respond to the extension, 'why might food webs be more useful than food chains?' · Once most students have completed, conduct a mini plenary. · Invite a student up to draw their food chain or web on the board and ask other students in the class to provide feedback. · Reveal possible answers on slide 9-10 to ensure all students see correct way to display the diagrams.	**Slideshow 5:** Slides 7-10

Step	Guidance	Resources
	If you want to make the learning more physical, you can put students in groups with some string, scissors, and post-it notes. Give them 3 minutes to make a food chain using the examples on the board. Stop to review each group's work. This may also involve reviewing attitude towards learning as well as learning, through a question like 'what went well, and what did we find challenging?'. Then give students a further 3 minutes to create a food web.	
3 10 mins	The teacher invites students to now link organism's absorption of chemicals from the environment with predator-prey relationships. · Using slide 11, invite seven students to the front of the class. · Give the seven students roles. One will be an orca, two seals, and four artic cod. · Give each a cup. · Tell the rest of the class, sat in their seats, that they will be copepods (small marine invertebrates). · Showing slide 12, pass a marble or counter to each copepod. Explain that this is a chemical pollutant they have ingested into their bodies from the environment. · Showing slide 13, send artic cod to eat the copepods. They must decant the marbles / counters into their cups. · Showing slide 14, send the seals to eat the artic cod. They must decant the artic cods' marbles / counters into their cup. · Showing slide 15, send the orcas to eat the seals. They must decant the seals' marbles / counters into their cup. · Stop the activity and begin to ask students to describe what has happened. Students should be able to explain that the chemical has passed up the food chain. · Using slide 16, introduce students to the idea of bioaccumulation. This word may need breaking down (bio = living; accumulating = gather / build). · Using slide 17, the teacher shows an infographic on biomagnification. Explain that the concentration of chemicals in organisms increase up the food chain. The food chain is shown here as a pyramid of biomass.	**Slideshow 5:** Slide 11-17

Step	Guidance	Resources
	Biomagnification is a conceptually difficult topic. Only do this with able students and if you have the time to address any misconceptions. Biomagnification relies on students understanding the pyramid of biomass. As you go up the food chain, or pyramid, the biomass decreases. Yet, the number of pollutant molecules remains the same. This means that organisms higher up the food chain have a higher concentration of pollutants. This can also be framed as, for the same mass of living matter (flesh), there are more pollutant molecules. To make the concept visual you can tell students you are going to cut 1g of blubber from an orca. Then, you will collect 1g of Plankton. Explain that the orca's flesh will have more molecules per gram than the plankton.	
4 20 mins	In step 4, students consider the real-world impact of bioaccumulation by looking at a case study. · Using slide 18, introduce students to Polychlorinated Biphenyls (PCBs). · Hand out Student Sheet 5a. · Hand out graph paper. · Using slide 19, direct students to complete the case study. · Allow students time to complete task independently, circulating for support. · Before students attempt to draw their graph, stop students and regain their attention. Model how to draw the graph. Inform students that one data set is continuous (numerical) and the other distinct (categories). Therefore, a bar chart is needed. Continue to model by showing them how to draw and label the axes. · Once students are complete, use the Mark Scheme 5a to review the answers.	**Slideshow 5:** Slide 18-19 **Student Sheet 5a:** Orca and dolphin case study **Mark Scheme 5a:** Orca and dolphin case study **Graph Paper**

Step	Guidance	Resources
	PCBs are a group of synthetic (man-made) organic chemicals consisting of carbon, hydrogen and chlorine atoms. PCBs were used in plasticizers in paints, plastics and rubber products. They were banned in the in 1979 in the USA and 1981 in the UK. However, they are called Persistent Organic Pollutants (POPs), because they do not degrade easily. This means they keep their structure and damaging chemical properties. As a result, today they can still be found in living marine organisms. In animal tests, they have been found to: · Increase risk of certain cancers. · Cause problems with reproduction. · Decrease immune response. Many exam style questions ask students to remove an anomaly from a table with 3 sample values. However, as scientists we know that three repeats are too few to discern which values are anomalous. It may be worth discussing with your class the importance taking as many repeats as possible.	
5 5 mins	In step 6, students reflect on the lesson. Students are shown an image of a whale made of plastic and asked to explain how the image could be an analogy for the topic. If timing allows go further by asking students to create their own analogy of bioaccumulation.	**Slideshow 5:** Slide 20
+ 20 mins	This lesson students have learnt about some of the harmful chemicals associated with plastics. However, there are many. Task students with finding out about at least 5 other harmful chemicals found in plastics. They must provide: • The name of the chemical. • How it is produced. • Potential harm it can cause.	**Subject Update:** How to: improve students online research skills