Lesson 3: Food chains and biomass pyramids; understanding chemical pollution

Introduction:
These lesson tools can be adapted to your own style of teaching. They are designed to be flexible, allowing a teaching mix of demonstration, discussion and experiments, so all students can understand the theory in the context of bathing water pollution; something relevant for beachgoers of all ages.

Curriculum links:

Curriculum link:	Students should understand:	Students should be able to:
B1.5.1c	• Pyramids of biomass	• Construct and interpret pyramids of biomass • Describe how energy and mass is transferred along a food chain.
B3 4.1b	• Waste may pollute water with sewage, fertilisers or toxic chemicals. • Waste may pollute land with toxic chemicals such as pesticides and herbicides, which may be washed from the land into the waterways	• Describe the uses of DichloroDiphenylTrichloroethane (DDT) and why it was banned

Part 1: introducing microplastics
Microbeads are tiny pieces of plastic (less than 5mm diameter) which come from a range of sources:

- microbeads used in some cosmetics and detergents (e.g. some facial scrubs as an exfoliant or spot cleanser)
- Photo-degraded plastic (e.g. degradable packaging, carrier bags etc- see lesson tool 1)
- Nurdles (pre-production plastic pellets used in manufacturing packaging and plastic products. This is often the most economical way of shipping plastic supplies to end-use manufacturers around the globe.)

Resources:
Sample of cleansers & cosmetics- some containing microbeads, others not.

Suggested activity:
Hand round the samples to groups of students. Can they work out which contain microbeads and which don't? What are the clues?

Discussion:
What happens to the microbeads when we've finished with the product?

- Foul water (from sink drain) is treated at treatment works (see lesson tool 2), but microbeads are too small to be caught by the filters and pass through, ending up in our rivers and sea.

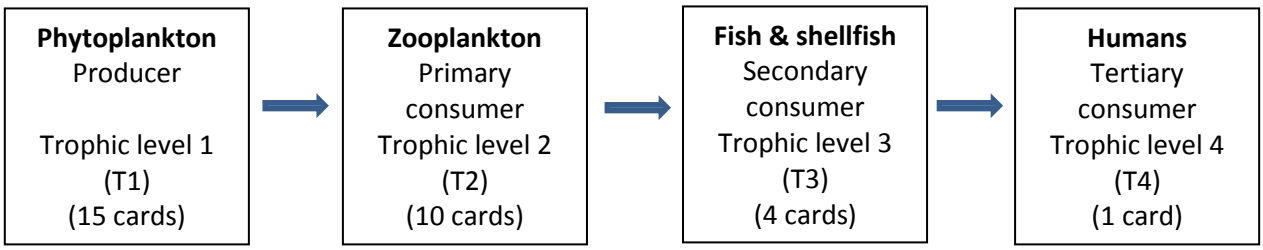
Part 2: introducing foodchains
Food chains describe the energy flow between different trophic levels in an ecosystem: more simply- they describe the hierarchy of animals and plants as food in an ecosystem.

Resources:

- Food chain cards x 30 (for larger classes, copy more single-sided phytoplankton cards)

Suggested activity

Hand out the cards randomly so each student has a role, and task them with grouping themselves with like cardholders. Discuss the role of each group within the food chain, and have students rearrange themselves so the energy flow through the trophic levels is correct:



Link to part 1:

What happens when microplastics are introduced into the system?

Suggested activity:

Phytoplankton and zooplankton: some cards are double sided with plastics represented on the reverse. These students should turn their cards over now.

What happens to the next trophic level up?

- Zooplankton can eat microplastics instead of their normal phytoplankton diet. Microplastics can't be digested so accumulate in the zooplankton gut.
- When zooplankton are eaten by fish/shellfish these plastics are eaten along with them- the zooplankton are digested but the microplastics remain- Biomagnification.

Discussion:

Plastics are a visible way of thinking about bioaccumulation- we can see the effect under a microscope or even just by dissecting a badly affected fish. What about other polluting chemicals?

- DDT (DichloroDifluoroTrichloroethane)- very effective insecticide chemical used throughout most of 20th century but found to bioaccumulate with devastating effects. First banned for use in agriculture in USA in 1972, and 1984 in the UK. Still permitted for use in preventing malaria under specific, controlled circumstances in Africa and other countries.
- Mercury- pollution from mining operations, coal extraction and natural sources such as volcanoes often contains methyl mercury. This accumulates in exactly the same way as the microplastics demonstrated above, and continues to accumulate in humans. Those fish at the top of the marine foodchain are more affected than those underneath (partly because they're at the top of the pyramid, partly because they're often long-lived species): e.g. shark meat is particularly high in mercury.

Additional resources:

- Beat the Microbead app (Plastic Soup Foundation): scan product barcodes to find out if it contains microbeads
- Good fish guide app (Marine Conservation Society): Indicates the sustainability level (including sustainability of fishing methods and biomagnification of heavy metals such as mercury) in different species of fish, categorising them into 'eat', 'think' or 'avoid'. (Seafood Watch app by Monterey Bay Aquarium, California is similar)