Trails and Trials of Marine Toxins

Background

Food Chains /Food Webs

Food chains are relatively simple and may include no more than two or three links. Interlocking food chains form food webs. Food webs are formed because few animals rely on a single type of food. The bottom of the food chain is dominated by large numbers of small organisms like plankton. As the chain grows in length, the size of the animals at each level increases. Each successive level tends to be dominated by larger organisms preying on animals smaller than themselves.

Marine Pollution

Increasing quantities of industrial waste, agricultural chemicals, untreated sewage, radioactive discharges, oil, plastics, and a huge variety of other pollutants are dumped directly in the sea – or slowly make their way there via rivers, run off and atmospheric deposition. Once released into the environment recovering them is very difficult and they could continue to cause harm for years or even decades. The effect of these pollutants on marine organisms is difficult to measure. In large quantities they may cause immediate death. However in most cases they are believed to weaken the animals, gradually causing hormonal imbalances, a lowering of disease resistance, brain damage and various neurological disorders, cancer, liver troubles, lowering or a total loss of fertility, thickening of shells, and many other abnormalities and chronic health problems.

Biomagnification

Minute quantities of toxins in the sea are picked up by marine plankton, which are then eaten by fish and squid and these in turn are eaten by top predators, such as whales, dolphins and sharks. In this way, high concentrations of toxins build up in the body of animals at the top of the food chain. This build-up increases with age and may be passed on from one generation to another. For example, a lactating female whale may deliver high concentrations of toxins to her calf through her milk.

Objectives

To explain the feeding relationships of marine animals and plants and to investigate the results of human intervention on these relationships.

Curriculum Links

Science/Living World – level 4.4, 5.4, 7.4,

Biology – level 7.3, 8.3

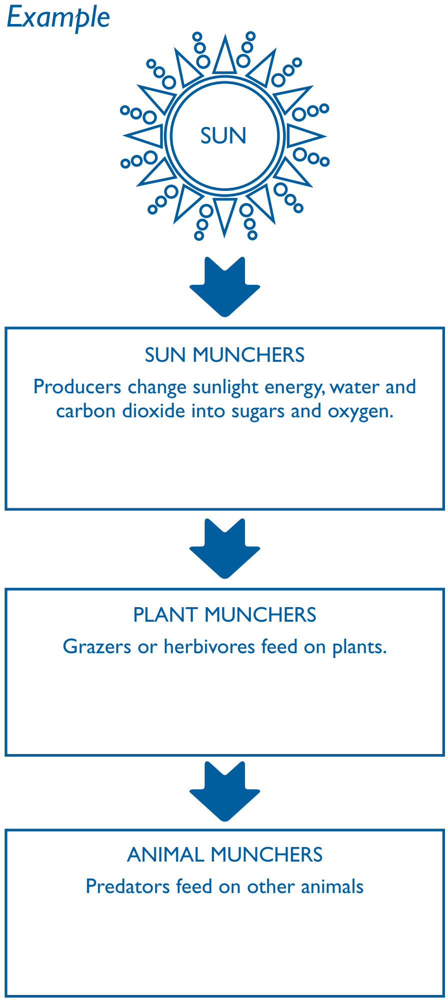
What You Need

A label for each student in the class (these can be made by the students), About 20 rocks (3 to 5 cm in diameter), open space. The activity works best with 12 or more students.

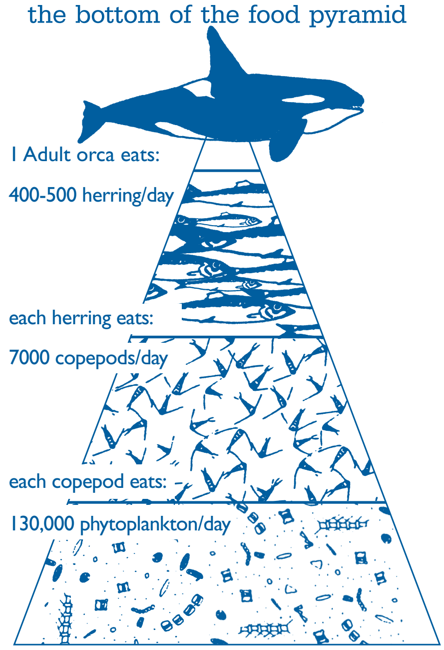
Method

1. Review concepts of food chains, food webs and feeding strategies with students.
2. As a class or in small groups compile a list of organisms that fit in each trophic level – then create food chains and food webs

Example



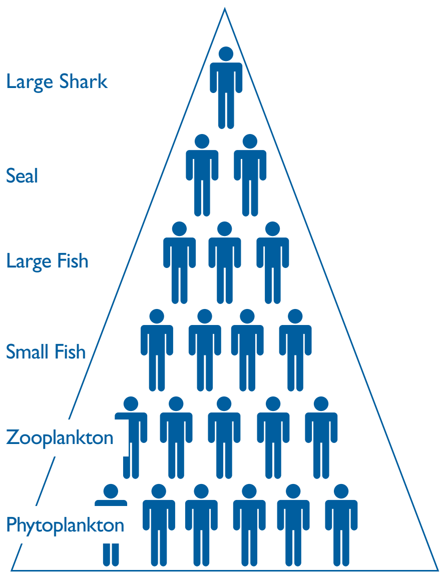
3. Choose one food chain and create a food chain pyramid. Because all animals depend on plants directly or indirectly for food, they are at the bottom of the food pyramid



Human made chemicals like PCB's, DDT and dioxins affect reproduction in marine mammals, sometimes causing sterility. These have been found in the tissues of NZ's threatened Hector's Dolphin.

The harmful effects of pollution can be subtler than death or infertility. When sticklebacks (a freshwater fish) were feed PCB-contaminated crustaceans, they took 35% more time rolling the food around in their mouth. This may result in the fish having less time to mate or evade predators as a result of their altered dining habits.

4. Have the students choose a role and make themselves a label or costume. Ask the sun munchers to line up side by side, the plant munchers to line up behind and so on – so that you create a pyramid formation. Remember that you will need more students to be sun munchers than animal munchers otherwise you won't have a stable pyramid. Your pyramid may have less levels than the example given.



5. Now introduce a toxin into the water (rocks) – think about what that toxin may be and how it might have got into the sea.
6. Pass on the toxin (1 or 2 rocks per person) to the bottom of the food chain – the sun munchers. They in turn are eaten by the plant munchers – who are eaten by the animal munchers and the toxin continues to be passed up the pyramid.

Results

1. What happens to the top predator? How many rocks do they have? Can they hold on to them? Can they move normally with them?

Discussion

Have the students brainstorm answers for the questions as a class or in small groups, then have them do some research to confirm their predictions.

1. What effect you think toxins might have on marine species? Do some research to follow up your ideas.
2. What are the potential sources of marine toxins in your local area? Do some research to find out which ones are likely sources.
3. Should we be concerned about pollution sources in other parts of NZ or the world? Investigate the migration of local seabirds, marine mammals, sharks and fish.
4. Why are top predators typically more vulnerable to toxins than species lower on the food chain? Find out what toxin levels have been measured in marine mammals or sharks in NZ and other parts of the world.
5. Are all toxins in the marine environment a result of human activity? Investigate toxic algal blooms.
6. How do marine toxins affect us? What safeguards are in place to ensure that humans aren't affected?
7. How do marine toxins and other pollutants affect biodiversity? Why is biodiversity in the marine environment so important?

NZ's first outbreak of shellfish poisoning from a harmful algal bloom occurred in 1992. Some species of phyoplankton produce a natural toxin that can find their way through the food chain from fish to shellfish to humans causing gastrointestinal and neurological illness in humans. Algal blooms are a natural occurrence but are increasingly the result of elevated nutrient loads caused by human activities (eg. effluent disposal and fertilising arable land).

Tri-butyl tin, found in antifouling paints used on the bottom of boats, causes gender bending in snails. Microalgae absorb it, it is then passed on to the grazing snails that eat the algae and on to the predatory snails that eat the grazing snails. High levels of tri-butyl tin cause male snails to develop female sex organs, making them incapable of breeding as a male or a female.

Extension Activities

1. Think about what YOU could do to increase awareness about the number of toxins entering the local marine environment.
2. Design a plan to carry out one of the actions suggested above.

   Identify the skills you will need to carry out your plan. Find out who makes the decisions about the place and the activity. Explore what other people think about the issue. Discuss how you will increase other people's awareness of the issue.

Large levels of mercury were released to the environment during the industrial revolution. Although strict regulations are now in place, mercury does not degrade once it is in an ecosystem. In Victoria, Australia, the shark fishery has a minimum size to protect the fishery but also a maximum size to protect human health. The older, larger specimens have often built up high levels of mercury in their tissues. As there is no way organisms can process and excrete the mercury, it would quickly build up to life threatening levels in people who ate a lot of fish and chips!

"Seaweek – See Life"
Seaweek 2001
March 9 - 18

www.environment.org.nz/seaweek

For more information about pollution and the marine environment check out these web sites:

NZ Ministry for the Environment – *www.mfe.govt.nz*

Environment Canada – *www.ns.ec.gc.ca/pollution/water.html*

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