**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 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**

1. What happens to the top predator?
2. How many rocks do they have? Can they hold on to them? Can they move normally with them?
3. How many copepods do they have? Can they move normally with them?
4. How many herring do they have? Can they move normally with them?
5. How many phytoplankton do they have? Can they move normally with them?
6. How many zooplankton do they have? Can they move normally with them?

**Results**

1. What effect do 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 sealbirds, 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?

**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.

**Curriculum/contracted links**

Science/Living World – level 4.4, 5.4, 7.4

Biology – level 7.3, 8.3

www.environment.org.nz/seaweek

www.environment.org.nz/seaweek
Trails and Trials of Marine Toxins

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Example

1. SUN
   - Producers change sunlight energy water and carbon dioxide into sugars and oxygen.

2. PLANT MUNCHERS
   - Grazers or herbivores feed on plants.

3. ANIMAL MUNCHERS
   - Predators feed on other animals

4. Large Shark
   - Top predator

5. Seal
   - Large Fish
   - Small Fish
   - Zooplankton
   - Phytoplankton

6. 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.

Results

1. What happens to the top predator?
2. 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.
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Conclusion

The harmful effects of pollution can be subtler than death or infertility. When sticklebacks (a freshwater fish) were fed 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.

Appendix

1. PCB’s
   - Polychlorinated biphenyls
   - Used in electrical equipment
   - Bioaccumulative
   - Persist for 30-70 years

2. DDT
   - Dichlorodiphenyltrichloroethane
   - A pesticide
   - Bioaccumulative
   - Persist for 10-20 years

3. Dioxins
   - 2,3,7,8 Tetrachlorodibenzo-p-dioxin
   - A pesticide
   - Bioaccumulative
   - Persist for 3-4 years

4. Mercury
   - Methylmercury
   - A pollutant
   - Bioaccumulative
   - Persist for 10 years

5. Tri-butyl tin
   - Used in antifouling paints
   - Bioaccumulative
   - Persist for 1-2 years

6. Other pollutants
   - Heavy metals
   - Polycyclic aromatic hydrocarbons
   - Chlorinated hydrocarbons
   - Volatile organic compounds
   - Polybrominated diphenyl ethers

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

- Environment Canada – www.environment.org.nz/seaweek
- NEW ZEALAND MARINE STUDIES CENTRE

www.environment.org.nz/seaweek