

## TOXINS IN THE MARINE ENVIRONMENT

### QUESTION

How do toxins enter the marine ecosystem, what are the effects of toxic pollutants on marine life, and how do toxins become concentrated in the food web?

### UNDERLYING CONCEPT

Pollution comes from many sources, sewage outfalls and storm drain run-off are just a few. The effect of simple human actions, such as throwing motor oil down a drain, extends farther into the environment than the original action.

### SKILLS

- Calculating
- Assessing
- Analysis
- Interpretation

### OBJECTIVES

Students will be able to:

- Demonstrate the build up and concentration of toxins in an organism
- Interpret how that buildup can affect animals in an ecosystem

### TIME NEEDED

- One 55 minute class period

### MATERIALS NEEDED

- Red or brightly colored candies such as sweet tarts, etc.
- Clear plastic bags
- Score sheets (optional) students create them

### VOCABULARY

*toxin* : poisonous

*pollution* : contamination of air , soil or water by the discharge of harmful substances

*industrial wastes*: waste products produced by factories and other industries that often contain harmful chemicals

*DDT* (Dichloro Diphenyl Trichloroethane): a colorless insecticide, toxic to humans and animals when swallowed or absorbed through the skin

*bioaccumulation*: toxins building up in each organism as they eat animals in the food web who have already eaten a toxin.

### BACKGROUND INFORMATION

**Pollution** comes from many sources. It is more difficult to control when it is in water because water itself is a common solvent for many things and transfers pollutants throughout the ecosystem. Southern California has many problems with pollution in the marine environment.

There are many types of pollution, some of the worst are DDT and PCBs (polychlorinated biphenyls--used as insulation in the 1970's). **Industrial wastes** pollute wetlands, bays, estuaries, and the ocean itself.

Pollutants enter the marine ecosystem in a variety of ways. Until the 1960's some chemicals were allowed to be disposed of off-shore; we did not know then about their long-term toxic effects. Today urban street runoff, farm fields and industrial sites contribute to the **toxins** in the ocean. Some, such as mercury, which is spewed out by coal burning power plants, fall from the air.

Another important way pollutants enter the marine ecosystem is through sewage plants (outfall sites). They impact the environment through the effects at the outflow site (where the final treatment is deposited into the ocean). Soft, muddy sediments are like sponges that slowly soak up all of the chemicals and toxins. Small animals that live in the sediment pick up tiny particles of it and are then eaten by larger animals. Poisons are then spread throughout the food web. **Southern California's** Hyperian Sewage Plant is unfortunately a very good example. DDT has been found in the sludge from the Hyperian outfall site. It was thought that by depositing the sludge far out in the bay that the ocean would dilute and cleanse the outfall, but this did not happen.

Benthic (bottom dwelling) animals that live in the soft muddy sediment take the toxins and chemicals into their system, by eating the particles or through taking in the water with the dissolved contaminants. For example, on **Catalina Island** mussels have been found to contain arsenic. Small fish eat small animals and crustaceans in the sediment. Bigger fish such as the white croaker and California Halibut, eat these smaller fish as well as crustaceans who have already been contaminated. Essentially, fish that eat bottom-dwelling organisms become contaminated over time, as do the bigger fish who eat those fish.

Fish-eating birds and mammals also then become contaminated. Brown pelicans were nearly wiped out along the West Coast because they ate anchovies and other fish contaminated by **DDT** that flowed into waters off **Palos Verdes** from a pesticide plant. Scientist say that the DDT that destroyed the egg shells of the bald eagles and led to their extinction on Catalina Island, is related to the DDT in the **San Pedro Channel**. Years later after DDT had been outlawed, bald eagles were reintroduced to **Catalina Island** but once again they began to die out. It was discovered that the eagles were eating the seagulls' chicks and eggs who eat the fish which have levels of DDT in them. So although DDT was no longer being put into the San Pedro channel it was still present in the food causing the new group of eagles to have problems in hatching their young.

Dolphins in the San Pedro Channel have higher levels of toxins in them than dolphins found elsewhere. In general dolphins and seals off of Los Angeles County remain highly contaminated. They may grow tumors or lose their ability to fight off disease.

DDT (and other toxins that bioaccumulate) never leaves the system of an organism. Every time an animal is eaten by another animal the DDT or other toxin goes into the new animal and becomes even more concentrated, because the bigger the animal, the more contaminated food they will eat. It is important to note that people are not immune to this problem. People can get very sick from eating tainted fish or shellfish. These toxins can cause cancer or birth defects.

**ACTIVITY:*****DDT GAME******"INTO:"***

1. What are ways that poisons could get into the ocean and wetlands? (*storm drain run off/urban streets, farm lands, industry , air pollution, sewage plants*)
2. How do the poisons get into an animal? (*gets into the food that it eats; direct instruction about sediments under the water absorbing chemicals*)
3. Who can tell me how the food web works? (*brief review; be sure predator/prey is understood*)
4. Do you think that the poisons stay in the body of the animal or do you think that they leave? (*stay there*)
5. What do you think happens to the poisons when the small animal is eaten by a bigger animal? (*they go into that animal too*)

*Let's play a game to see how this works:*

**Before You Start**

- Divide students into predator and prey groups.
- For example: In a group of 35 students have at least 5 levels within the food web.
- Example:
  - 12 zooplankton/crustaceans/ clams/worms, etc
  - 9 small fish
  - 7 medium/large fish
  - 5 birds (sea gulls)
  - 2 bald eagles

**Explain:**

- Animals can only "eat" the level below them. Students wear crepe paper ties---colored according to predator/prey level.
- Be very clear who can "eat" whom.

**To Play:**

Students wear a color tie according to their animal group and play a simple walking tag game. Everyone starts off with 2 candies each in their bags. Teacher explains that this is a "safe" amount of DDT or toxins in the animal's system.

- 1) Assign (or let students choose) their "roles" and wear the appropriate name tag name tag sheet included).
- 2) The lowest level: plankton, tiny shrimp, crustaceans, etc. have 2 candies in their bags and these students are the "prey". The next higher up predator group (example, "small fish") are "its predators". (*NOTE trying not to use the word "taggers"*). Playing walking tag game, predators must capture the crepe tie of the prey below their "trophic" level. When they "get" someone the predator "consumes" the prey's candies by adding those candies to the predator's bag. The prey then moves out of the group and sits down.
- 3) Tagging continues until all the prey is caught.
- 4) When the game is over the eagles have all of the candies.

*Option:*

*Everyone except the sea gulls and eagles begin playing. Then the seagulls and eagles enter game as group gets smaller. (The game will take less than 5 minutes to play. Therefore, it can be played more than once.)*

**Discussion:**

- Students discuss who has the most candies/DDT. Is it too much to live, or to have healthy baby eagles?
- What happens if there are no longer any healthy baby eagles being born? (*the eagle population will die out*)
- How did the animal get so much DDT? (*by eating the other animals*)
- Teacher explains the situation on Catalina Island.

Note to teachers: This is where background information should be presented.

**"Beyond":**

Students brainstorm ways to keep the toxins out of the system. (*laws, better testing procedures*)

Is there a way to help the eagles? (*maybe monitoring and studying them, testing the sea gulls*)

<p>(LOWEST) <b>LEVEL-1:</b></p> <p><b>ZOOPLANKTON</b></p> <p>PREY for: small fish and medium fish</p> <p>PREDATOR to no one</p>	<p>(LOWEST) <b>LEVEL-1:</b></p> <p><b>CRUSTACEAN</b></p> <p>PREY for: small fish and medium fish</p> <p>PREDATOR to no one</p>
<p>(LOWEST) <b>LEVEL-1:</b></p> <p><b>CLAMS</b></p> <p>PREY for: small fish and medium fish</p> <p>PREDATOR to no one</p>	<p>(LOWEST) <b>LEVEL-1:</b></p> <p><b>WORMS</b></p> <p>PREY for: small fish and medium fish</p> <p>PREDATOR to no one</p>
<p><b>LEVEL-2:</b></p> <p><b>SMALL FISH</b></p> <p>PREY for: medium and large fish</p> <p>PREDATOR to: zooplankton, crustaceans, clams, worms</p>	<p><b>LEVEL-3:</b></p> <p><b>MEDIUM AND LARGE FISH</b></p> <p>PREY for: sea gulls</p> <p>PREDATOR to: small fish</p>
<p><b>LEVEL-4</b></p> <p><b>SEA GULLS</b></p> <p>PREY for: eagles</p> <p>PREDATOR to: medium and large fish</p>	<p><b>LEVEL-5:</b></p> <p><b>EAGLES</b></p> <p>PREY for: no one</p> <p>PREDATOR to: sea gulls</p>