Tracing toxins in the Antarctic food web activity

Harmful algal blooms (HABs) can negatively impact organisms in a variety of ways that can range from cell and tissue damage to organism death. Some HABs are not toxic; in other words, they are caused by algae that do not produce a toxin that directly kills organisms, but they are *harmful* in that they create unhealthy conditions in the environment (e.g., too little oxygen, decreased sunlight). In contrast, *toxic* blooms are caused by algae that produce potent toxins that can cause massive fish kills, marine mammal deaths, and human illness.

There are several types of toxins produced by these harmful algae. Commonly, the toxins affect the functioning of nerve and muscle cells. Other toxins affect proteins or act like amino acids. Toxic blooms have been responsible for causing respiratory irritation and distress, diarrhea, vomiting, numbness, dizziness, paralysis, and even death.

An important component involved in our scenario above is bioaccumulation. Bioaccumulation is the process by which compounds accumulate or build up in an organism at a rate faster than they can be broken down. Several organisms, including copepods, krill, mussels, anchovies, and mackerel, have been found to retain toxins from phytoplankton in their bodies. These organisms are often not affected by the toxins, but act as vectors and transport the toxins up the food web. There have been several cases of whale and sea lion illness and death attributed to this process.

In many cases the toxins can be transported through the food web to humans, often through contaminated shellfish. The toxins can impact humans in different ways leading to mild symptoms or even death. The toxins cause many illnesses, including Ciguatera Fish Poisoning, Diarrhetic Shellfish Poisoning, Neurotoxic Shellfish Poisoning, Paralytic Shellfish Poisoning, and Amnesic Shellfish Poisoning.

http://dnr.wi.gov/lakes/bluegreenalgae/

Procedure:

1. Divide the class into trophic groups. If you have 28 students, assign roles as follows: 1 killer whale, 3 seals, 9 fish, 15 krill. Have each student write his/her role on his/her name tag.

2. Without the students watching, randomly distribute the M&M's in a grassy area. Boundaries of the area should be made clear with the use of rope or something similar.

3. Have the students gather around the grassy area. Distribute a food bag to each of the students. Explain to them that there has been an "M&M" algal bloom in the area. The organisms that are able to eat the M&M algae are the krill. Remind the students of the food web involving algae, krill, fish, seals, and whales. Distribute the appropriate "Life Card" to each student and explain that each "animal" is being given specific directions as to how they should respond to this bloom.

4. Step 1 – The Krill: Tell the "krill" that they will have 30-60 seconds (depending on the number of students involved and the size of the area) to "graze." They should move around the area feeding on the algae (collecting M&M's and placing them in their food bags). Remind the students to refrain from truly eating their food, since they will need to assess their feeding success at the end of the game. At the end of the timed period, the "krill" should remain where they are in the area, but stop collecting M&M's.

5. Step 2 – The Fish: Tell the fish to enter the feeding area and do what is indicated on their "Life Card." Explain to the class that in this simulation, predators "eat" their prey by tagging their prey's elbow. Once an organism is "eaten," it relinquishes its food bag to its predator and sits down in the feeding area. During this time, the living krill can continue to graze on the algae.

6. Step 3 – The Seals: Once the fish accomplish what they were guided to do by their "Life Cards," tell the seals to enter the feeding area and do the same.

7. Step 4 – The Killer Whale: Once the seals complete their tasks, allow the killer whale to enter the feeding area and accomplish what is indicated on the killer whale "Life Card."

8. Once the killer whale has eaten, review what occurred by having the students share what was written on their “Life Card” starting with the krill and ending with the killer whale.
9. At this time, inform the students that some of the algae that they ate were toxic! If the krill consumed red or orange M&M’s, they consumed toxic algae!
10. Have the students go through their food bags and sort their food. Have them cou number of M&M’s they collected and the number of red and orange M&M’s they coll them calculate the amount of toxic algae they consumed as a percent of their total consumption.
100 x [# red + # orange]/[total #]
11. If there are any krill still alive that “ate” ANY red or orange M&M algae, they are now dead.
12. If there are any fish still alive that “consumed” 20% or more red and orange M&M algae, they are now dead.
13. If there are any seals still alive that “consumed” between 20%-30% red and orange M&M algae, they are now sick. If there are any seals still alive that “ate” over 30% red and orange M&M algae, they are now dead.
14. If the killer whale “ate” between 20%-30% red and orange M&M algae, it is now sick. If the killer whale “ate” over 30% red and orange M&M algae, it is now dead.
15. Discuss the conclusions that can be made from this activity with your group. Draw a pyramid of the Antarctic food chain with numbers living at each level.
16. Your individual assignment: Investigate a current event with algal blooms (hopefully in Wisconsin). See instructor for parts of current events to include.

Life cards

Activity