

Lesson 4: Student Activity 2:

Food Chain Game with Toxins

Play the game as in Lesson 2 but this time the 1/3 of the markers of a different colour (or with the distinct marking) represent plankton containing persistent toxins. **Students should not be told this until both rounds of the game have been completed.**

At the end of the resident killer whale round, record the number of each surviving organism and the amount of food energy each surviving organism has. Ask the surviving organisms how many pieces of their food had the distinct marking without telling them what it means. The final column of the results table will be filled in at the end of the game.

Organism	Number Surviving	Amount of food energy	Total number of marked food pieces	Survived (S), Died (D) or reproduction and immune system problems (RI)
Resident killer whale	1			
Salmon		Salmon #1 Salmon #2 Etc.		
Herring		Herring #1 Herring #2 Herring #3 Herring #4 Etc.		

Repeat the game for the transient killer whale food chain. Collect the data as for the resident killer whales.

Organism	Number Surviving	Amount of food energy	Total number of marked food pieces	Survived (S), Died (D) or reproduction and immune system problems (RI)
Transient killer whale	1			
Seals		Seal #1 Etc.		
Salmon		Salmon #1 Salmon #2 Etc.		
Herring		Herring #1 Herring #2 Herring #3 Etc.		

Now tell the students that the markings meant that the food had a persistent toxin. Remember that persistent toxins build up in the food chain because they do not break down.

Use the table below to determine how many of each organism died because of the persistent toxin, how many survived and how many survived but will have reproduction and immune system problems.

Organism	Number of toxic plankton markers	What this means
Herring	<input type="radio"/> Less than 3	<input type="radio"/> Survives
	<input type="radio"/> 3 to 4	<input type="radio"/> Survives but will have reproduction & immune system problems
	<input type="radio"/> More than 4	<input type="radio"/> Dies
Salmon	<input type="radio"/> Less than 4	<input type="radio"/> Survives
	<input type="radio"/> 4 to 6	<input type="radio"/> Survives but will have reproduction & immune system problems
	<input type="radio"/> More than 6	<input type="radio"/> Dies
Seals or resident killer whales	<input type="radio"/> Less than 5	<input type="radio"/> Survives
	<input type="radio"/> 5 to 8	<input type="radio"/> Survives but will have reproduction & immune system problems
	<input type="radio"/> More than 8	<input type="radio"/> Dies
Transient killer whales	<input type="radio"/> Less than 8	<input type="radio"/> Survives
	<input type="radio"/> 8 to 12	<input type="radio"/> Survives but will have reproduction & immune system problems
	<input type="radio"/> More than 12	<input type="radio"/> Dies

Analyse the results and discuss. Possible discussion points:

- How many of the herring that survived being eaten by salmon (in both food chains) died because they accumulated too much toxin? How many of them will likely get reproduction and immune system problems.
- How many salmon that survived being eaten by resident killer whales or seals died because they accumulated too much toxin? How many of them will likely get reproduction and immune system problems.
- How many of the seals that survived being eaten by the transient killer whales died because they accumulated too much toxin?
- What will likely happen to the resident killer whale because of the toxins?
- What will likely happen to the transient killer whale because of the toxins?
- Discuss whether the game results are what you would expect in nature.

Discussion questions:

1. In nature, the amount of persistent toxins gets higher and higher as you go up the food chain. Why? **The toxins do not break down and the amount of food eaten from one food chain level to the next goes up so the amount of toxin goes up. For example, 12 herring are eaten by 4 salmon which are eaten by 1 resident killer whale.**
2. Why do transient orca have so many more toxins than resident orca? **They are higher up the food chain.**
3. How would the game need to be played differently for southern resident orca? **You would have to start with a greater percentage of markers representing plankton with toxins.**
4. Explain why the second born killer whale may have 4 or more times less toxins than the first born? **The mother has far more toxins when she has her first calf. She has all the toxins that she has built up in her lifetime – around 10 to 20 years. When the second calf is born, it only gets some of the toxins from that the mother has built up in some 2 to 5 years.**
5. Do you expect that firstborn transient calves or firstborn resident calves will have more toxins? **Firstborn transient orca will likely have more toxins since the transient killer whale mothers feed higher up the food chain than the resident killer whale mothers.**