

Bioaccumulation & Biomagnification

Tracing the Toxins

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Unit Workshop: Life Systems: Grade 7 – Interactions Within Ecosystems

Curriculum Expectations:

- Interpret food webs that show the transfer of energy among several food chains.
- Investigate the impact of the use of technology on the environment (e.G. The use of pesticides).
- Use appropriate vocabulary to communicate ideas

Connections to later years (providing background knowledge):

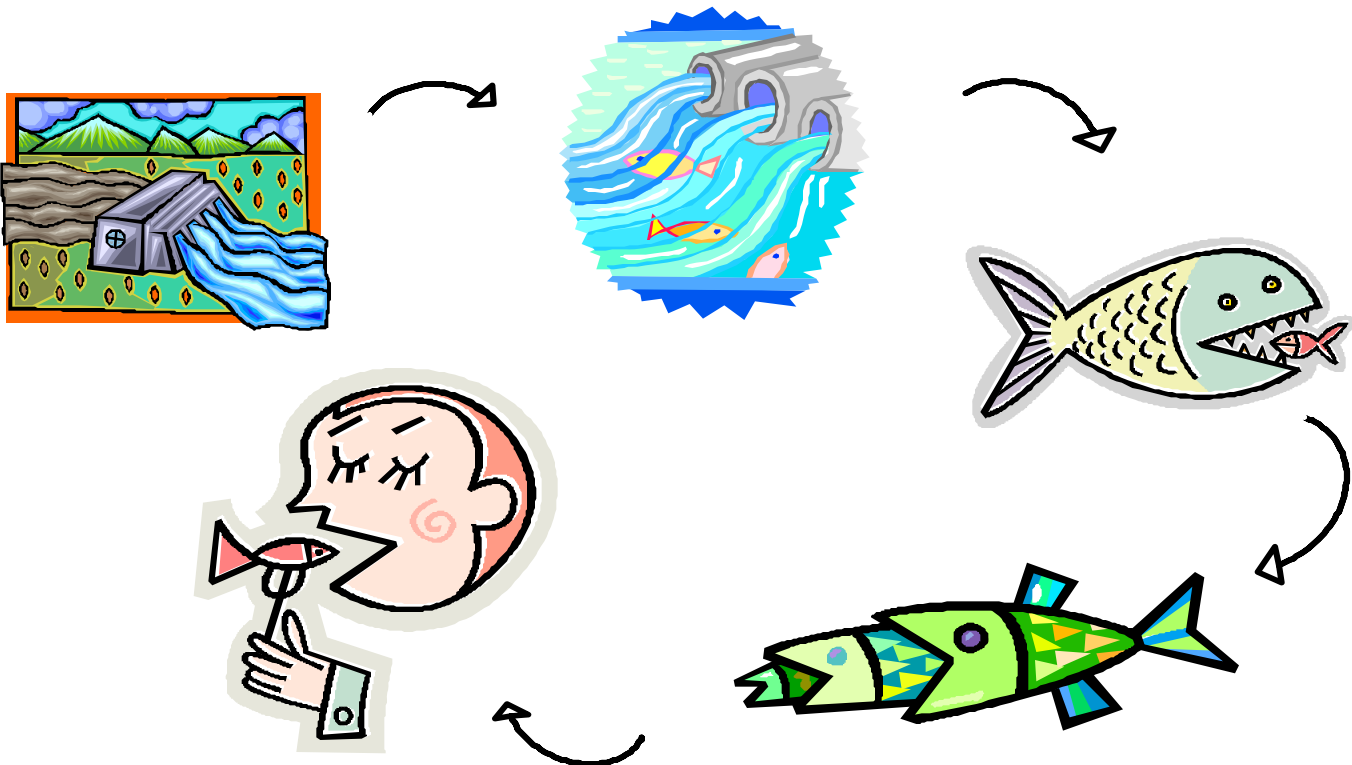
Gr. 10 Biology – Sustainability of Ecosystems

- Examine the factors (natural and external) that affect the survival and equilibrium of populations in an ecosystem (e.G. Resource limits, *bioaccumulation*).

Bioaccumulation refers to an increase in the concentration of a chemical in the tissue of an organism over time. Whereas, *biomagnification* refers to the increased concentration of a toxic chemical the higher an animal is on the food chain. Chemical toxins build up into higher concentrations as they are passed up the food chain. Toxins that commonly bioaccumulate are mercury, DDT and other pesticides, PCBs and fire retardant chemicals.

bioaccumulation & biomagnification

“Tracing the Toxins”



There are numerous activities designed to illustrate the concept of bioaccumulation/biomagnification.

- 1) Cards can be made of each animal in a food chain – with one coloured dot on the lowest level. As creatures eat their prey, the toxin dot is transferred to the predator, and will accumulate up the food chain.
- 2) Cups or buckets can be used to represent each creature in a food chain – as they eat their prey, balls or beads from each cup or bucket are dumped into the predator’s bucket, and will accumulate up the food chain.
- 3) Students can be involved in a recreation/ activity to demonstrate bioaccumulation, similar to predator/prey survival games:

“You Are What You Eat!”

Illustrating Bioaccumulation

(Source: Bigelow Laboratory for Ocean Sciences http://www.bigelow.org/edhab/tracing_toxins.html)

In this game, an Antarctic food chain is used – consisting of killer whales, seals, fish and krill. Any food chain could be used (eg. algae, insects, fish and bears).

Materials: 1 pound of M&M regular candies, sandwich bags, cut out “life cards”

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.
2. Distribute the M&M’s in a grassy area or throughout classroom. 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. 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:** The “krill” have 30-60 seconds to “graze.” They should move around the area feeding on the algae (collecting M&M’s and placing them in their food bags). 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:** The fish enter the feeding area and follow instructions from 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 their “Life Cards,” tell the seals to enter.
7. **Step 4 – The Killer Whale:** Once the seals complete their tasks, the killer whale enters.
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. Students can then sort their food and count the total number of M&M’s they collected and the number of red and orange M&M’s they collected. Have them calculate the percentage of toxic algae they consumed. $100 \times \frac{\# \text{ red} + \# \text{ orange}}{\text{total \#}}$

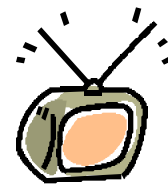
Discussion

- Discuss the conclusions that can be made from this activity. This can be accomplished through a group discussion, through individual reflective papers, or through individual journal entries.
 - What can we do to reduce use of toxins, or keep them out of the food chains?
 - How did you feel when you heard that the red and orange M&Ms were toxic?

Creature	% Toxins Consumed	Condition
KRILL	Any	Dead
FISH	More than 20%	Dead
SEAL	20-30%	Sick
	More than 30%	Dead
WHALE	20-30%	Sick
	More than 30%	Dead



Environmental Media



Curriculum Expectations:

- Use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results
- Investigate the impact of the use of technology on the environment
- Explain the long-term effects of the loss of natural habitats and the extinction of species
- Identify and explain economic, environmental and social factors that should be considered in the management and preservation of habitats

Description of the activity:

- This is a discussion-based activity that incorporates multi-media and current events into a science unit
- Students form small groups and circulate through stations, answering questions and engaging in group discussion at each station based on the media presented (pictures from magazines/newspapers, music, etc.)
- Teacher circulates and observes/partakes in discussion (facilitates)
- Follow-up discussion as a class is essential for deeper learning and closure (issues raised as a class may include main themes/ideas individual groups had or anything else you, as a teacher, want to specifically address)
- For assessment purposes students may be required to hand in a written component (ex. Personal reflection, handout/chart to fill in as they circulate through stations, etc.)

**Note

- This activity could be used either to generate interest at the beginning of a unit and as a diagnostic assessment for foundational knowledge OR at the end of the unit as a summative assessment for learning.
- This type of activity could apply to almost any unit of study depending on the nature of images and questions used.

Station Ideas

A. Positive Initiatives/Images

Sample questions:

1. Look at the images. How do they make you feel? What words and thoughts come to mind?
2. Who do you think is writing/producing these advertisements, articles, or pamphlets? What is their purpose or intent?
3. What are individuals/organizations doing to prevent long-term, negative impacts on the environment?
4. What are some things you could do as an individual, as a class, or at home to lessen our impact on the earth?

B. Negative Displays

Sample questions:

1. Look at the images. How do they make you feel? What words and thoughts come to mind?
2. How has technology influenced our interaction with and perception of nature?
3. How do companies use nature to sell products?
4. In what other ways are these technologies or products impacting our environment (i.e. something *not* shown in the picture)

C. Music

Sample questions:

1. Is it obvious that these songs have an “environmental focus” or do you have to really pay attention to the lyrics to find that out?
2. How do the songs make you feel? Does the music have a tone that is sad, happy, angry, dark etc?
3. In the song “One Sweet World”, what do you think that the following lines mean?

“If green should slip to grey

Would our hearts still bloody beat?”

4. In the song “Gone” by Jack Johnson, can you find any mentions of technology? What is he trying to say about our society and the use of technology?
5. In the song “Escarpment Blues” by Sarah Harmer, what do you think that she means by the following line?

“We’ll keep driving on the Blind Line”

D. Issue specific images (ex. food production, endangered species, consumerism, etc.)

Criteria for Effective Critical Questions/Challenges

- Does the question or task require reasoned judgment? (i.e., involve assessment among plausible options/possibilities based on criteria)
- Is the challenge likely to be perceived as meaningful by students?
- Will significant curricular understanding be uncovered as students work through the challenge?
- Is the challenge focused so as to limit the required background knowledge?

🎵 Some song suggestions for environmental themed lessons

“Don’t Drink the Water” – Dave Matthews Band

“Gone” – Jack Johnson

“Escarpment Song” – Sarah Harmer

“Animal” – Ani DiFranco

“Excuse Me Mr.” – Ben Harper

“Seek Up” – Dave Matthews Band

“One Sweet World” – Dave Matthews Band

“Big Yellow Taxi” – Counting Crow

List of image sources

- This list is essentially endless, be creative! Ours included the following:
 - *National Geographic*
 - *The Ecologist*
 - *Women’s Health*
 - *Glamour*
 - ROM’s Biodiversity Gallery pamphlets



Bald Eagle Chicks

Web of Life Activity

Curriculum Expectations

- Formulate questions about and identify the needs of various living things in an ecosystem, and explore possible answers to these questions and ways of meeting these needs
- Identify and explain the roles of producers, consumers, and decomposers in food chains and their effects on the environment
- evaluate the effects of the elimination or weakening of any part of the food web
- Use appropriate vocabulary, including correct science and technology terminology, to communicate ideas, procedures, and results
- Explain the long-term effects of the loss of natural habitats and the extinction of species

This activity is designed to help students better understand the relationship between the organisms of the earth. The Web of Life is a fun and interactive game in which the students assume the role of various organisms in nature and witness the interrelationships that exist among them.

Sources

- http://www.evcb.coe.int/compass/en/chapter_2/2_42.html
- <http://www.nps.gov/crmo/chap4d.htm>
- <http://www.littlerockzoo.com/edzoocation/weboflife.html>
- <http://www.ipm.iastate.edu/ipm/schoolipm/node/69>

Materials Required:

- 1 ball of yarn or roll of string
- Web of Life activity cards

Procedure

Part 1 – Building The Web

1. Have all students stand in a circle.
2. Distribute one activity card to each student in the class. (Note: Ensure that the “Human” and “Sun” cards are given to a student even if there are more than enough cards for the class.)
3. Explain to the class that for this activity they will represent the organism/object identified on their card. Have students read over the card and address any questions they might have.
4. Go around the circle and have each student state what was on their card and indicate whether they are a plant, animal, etc.
5. Once all students have identified themselves, ask the class to think about which card represents the origin of all energy and basic need of all life forms (the sun). Give the ball of yarn to the student holding the sun card.

6. Ask students which organisms need the sun for its energy (plants). Have all students who are representing plants put up their hand. Pick one student and have them identify the type of plant they represent and the information given on their card. While the sun holds onto one end, extend the yarn/string from the sun to this student and have them hold on to a section.
7. Determine which organisms get their energy from the plant (i.e. which animals feed on this plant, this is indicated on the cards), and extend the yarn/string to that student.
8. Continue to connect students with the yarn/string until everyone is holding a piece of the web. Questions that could be asked include: How do plants need insects? (For pollination) How do sharp-shinned hawks trees? (As places to nest) Encourage students to know what their organism requires and to speak up when the string is at a species that it needs.
9. You should create a criss-cross mesh that goes back and forth across the circle.
10. Explain to students that they have just created a web of life and point out the various connections. Help student to see that plants and animals do not exist independently of one another but are connected in a complex relationship with nature.

Part 2 – Connections In The Web

11. Demonstrate the importance of each member of an ecosystem by taking away one member of the web. Provide students with real-life situations that could affect an ecosystem.

Examples include:

- A fire or logger kills a limber tree in a forest
 - A highway is built over farmland killing large patches of grass
 - Decline of the American eagle population
 - Have students come up with other examples of what is damaging the environment and which specific organism is being affected
12. The initial organism affected by the damage to the ecosystem will pull on the threads in their hand. Organisms that feel the tug, should tug on their strings as well. Discuss the effect these situations will have on the ecosystem and identify which organisms are affected. Continue until all possible organisms are shown to be effected by the damage sustained.
 13. As the chain sustains damage, help students realize the important role each organism plays in an ecosystem.

**Note: During the activity you may want to remind students that when an organism dies, bacteria helps to decompose the organisms and the minerals released during this process are

taken up by other plants. However, this point can also be brought up during the post-activity discussion.

**Note: For a more dramatic effect, you can use scissors to cut one connecting string for each example of environmental damage. After students witness the destruction of their web of life, have them suggest ideas that could reverse the damage that was done. For each solution, tie the cut ends of string back together.

Post-Activity Discussion

Once students have returned to their seats engage the class in a discussion using the following questions as a guide:

- How did you feel when you saw the web gradually being destroyed?
- Would it be a good idea if there were a human right to the environment, like there are other human rights?
- Whose responsibility is it to protect the environment?
- After seeing what happened to our web of life, how might you change your actions in your everyday life?
- How is it possible to make decisions about how we as citizens of the earth use the earth's resources? Who should decide whether to cut down a forest so that the land can be used to grow crops?

End the activity by reading the following quote by Chief Seattle:

"This we know, the earth does not belong to [humans], [humans] belongs to the earth. This we know, all things are connected like the blood that unites one family ... [Humans] did not weave the web of life, [they are] merely a strand in it. Whatever [they do] to the web, [they do] to [themselves]."



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