

## Enriched Living World Worksheet

1. How does the Phosphorus cycle start?  
 A) It begins with the formation of rocks and phosphorus.  
B) It begins when phosphates move from plants to animals.  
C) It begins by decomposing through bacteria and fungi.  
D) It begins when leaching occurs.
2. The company "Cleanall" conducts tests in their laboratory to determine the toxicity threshold of their cleaning products. Every 10 minutes, a technician adds a drop of a detergent to an aquarium containing a population of Daphnia (small crustaceans). She must determine the toxicity threshold of the detergent.

*harm* →

Which of the following statements indicates that the toxicity threshold for the detergent has been reached?

- A) The Daphnia are behaving normally, 10 minutes after the detergent has been added *x*
  - B) The mobility of a few of the Daphnia is reduced, 20 minutes after the detergent has been added *✓*
  - C) Half of the Daphnia are dead, 30 minutes after the detergent has been added *x*
  - D) All of the Daphnia are dead, 40 minutes after the detergent has been added *x*
3. A toxicologist must assess the danger related to the human consumption of some rice which may be contaminated with arsenic.  
Listed below are 4 possible factors which may affect the toxicity of this rice to humans.  
1- Frequency of consumption *✓*                      3- Concentration of arsenic in rice *✓*  
2- Volume of container *x*                              4- Mass of consumer *✓*  
Which factors listed above should be assessed?  
A) 1 and 2              B) 1, 2 and 3               C) 1, 3 and 4              D) 2, 3 and 4
  4. As long as the Earth's resources are able to sustain the Ecological Footprint of its human population, the Earth will be able to continue to provide for all of our needs. What step can be taken by different nations to contribute towards making Earth a sustainable planet?  
A) Create more mineral resources.  
B) Increase the Ecological Footprint.  
C) Plan cities with single family housing units.  
 D) Provide subsidies (cash bonuses) for the purchase of electric vehicles.
  5. Where would the lowest concentration of DDT (contaminant) be found? *→ producer*  
A) Predatory birds              B) Fish              C) Plankton               D) Phytoplankton
  6. Eutrophication \_\_\_\_\_.  
A) Is caused by the runoff of nitrogen and phosphorus. C) Results in massive fish kills.  
B) Causes algae to proliferate                       D) All of the above.

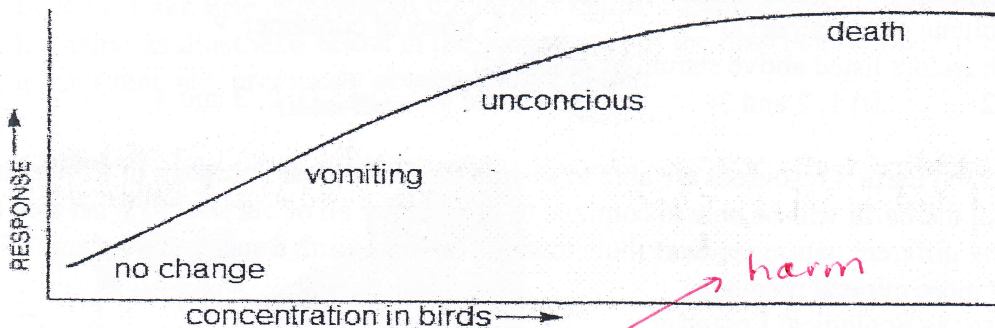
7. Bioconcentration refers to the process :
- A) where living organisms retain certain substances.
  - B) where the concentrations of toxic substances increases as we move up the food chain.
  - C) where the concentrations of toxic substances decreases as we move up the food chain.
  - D) of accumulating important nutrients during the life of an organism.
8. In Canada, microplastics have been added to a variety of personal care products such as shampoos and toothpaste, to enhance the product's scrubbing effect. The microplastics are not removed by waste water treatments and end up in freshwater systems. Microplastics can be ingested by aquatic organisms such as Atlantic mudsnails.



*→ makes its way to ocean*  
*harm*

Which of the following statements refers to the toxicity threshold for microplastics ingested by the mudsnails?

- A) Microplastics, at a certain concentration, cause Atlantic mudsnails to die.
  - B) Microplastics can be transferred to higher trophic levels in higher concentrations.
  - C) Microplastics cause significant harmful effects once a certain concentration is reached.
  - D) Microplastics cause a stress on digestion such as physical blockage and more energy expenditure.
9. In response to the use of a new pesticide an increase was seen in the death of herbivorous birds. Medical tests were performed on the birds to detect how they respond to increasing concentrations of the pesticide. The graph below shows the birds' response as the concentration of the pesticide increases.



At which point in the graph has the toxicity threshold been reached?

- A) When there is no change
- B) When vomiting begins
- C) When the bird is unconscious
- D) When the bird dies.

10. An industry that employs 1 000 workers is looking to reduce its ecological footprint. Here are some proposed measures.

- 1. Salary bonuses for all employees that carpool on a regular basis. ✓
- 2. Changing the cafeteria menu to include international foods. ✗
- 3. Installing air conditioning in all offices. ✗
- 4. Hiring an outside company to do all the necessary printing. ✗

Which of the above measures would reduce the industry's ecological footprint.

- A) 1
- B) 2
- C) 3
- D) 4



11. Phosphorus cycles through the planet naturally occur. During this cycle, phosphorus can promote the process of eutrophication of a natural body of water. Which of the following has the lowest impact on eutrophication?
- A) Phosphorus dissolved in the hydrosphere
  - B) Phosphorus present in the atmosphere**
  - C) Phosphorus stored in sediment
  - D) Phosphorus in dead organisms
12. In April 1986, the nuclear power plant in Chernobyl experienced a catastrophic nuclear accident that led to large quantities of radioactive particles being released into the environment. After the accident sunflowers were planted around Chernobyl in order to clean up the environment.



- a- What is the process of using sunflowers to clean up the environment around Chernobyl called? **phytoremediation**
- b- Explain a consequence of using this process and identify it as advantageous or disadvantageous. **↓ radiation soil/air**

13. Eutrophication is a widespread environmental problem. Most scientists agree that eutrophication is caused by increasing inputs of phosphorus and nitrogen, which are abundant in human sewage, in the excrement of the livestock and in fertilizers applied to agricultural land. How do increases in nitrogen and or phosphorus lead to eutrophication in Quebec lakes? Give 4 statements.

- 1- Phosphates, Nitrates runoff into lakes/rivers
- 2- Plants flourish
- 3- Proliferation of algae
- 4- ↑ decomposition (↓ O<sub>2</sub>)
- 5- fish die (lack of O<sub>2</sub>)
- 6- sediments fill lake.

14. The accelerated eutrophication of lakes is a concern in several regions of Québec. One town in Québec passed by-laws requiring lakefront property owners to:

- a) Plant more shrubs and trees along the shoreline. **→ act as a filter so less nitrates/phosphates enter lake**
- b) Stop using chemical fertilizers on their lawns and gardens.

Explain how the requirements of the by-law listed above could help prevent accelerated eutrophication.

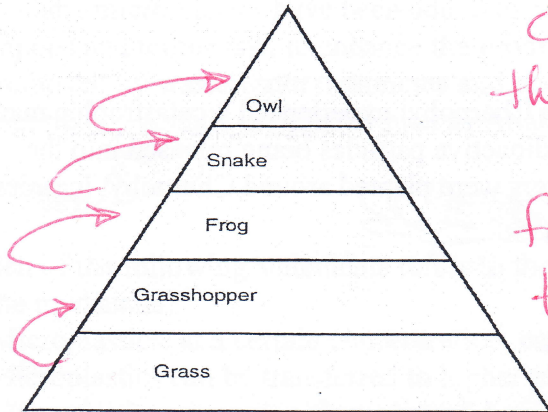
**less phosphates/nitrates end up in the water = ↓ eutrophication**

15. Many countries have such a high ecological footprint that they are taking up the space of more than one planet. Yet, we only have one planet. Explain how this can occur.

**balances each other out** { some countries with high ecological footprints  
" " " low " "  
average = 1 planet!

16. Herbicides are chemicals used to control unwanted plants. Commercial herbicides can have a negative impact on wildlife and are considered contaminants. A herbicide is sprayed on the grass in a park to control unwanted plants. The frog population in the area is affected because a chemical in the herbicide makes the male frogs unable to reproduce.

Trophic Relationship



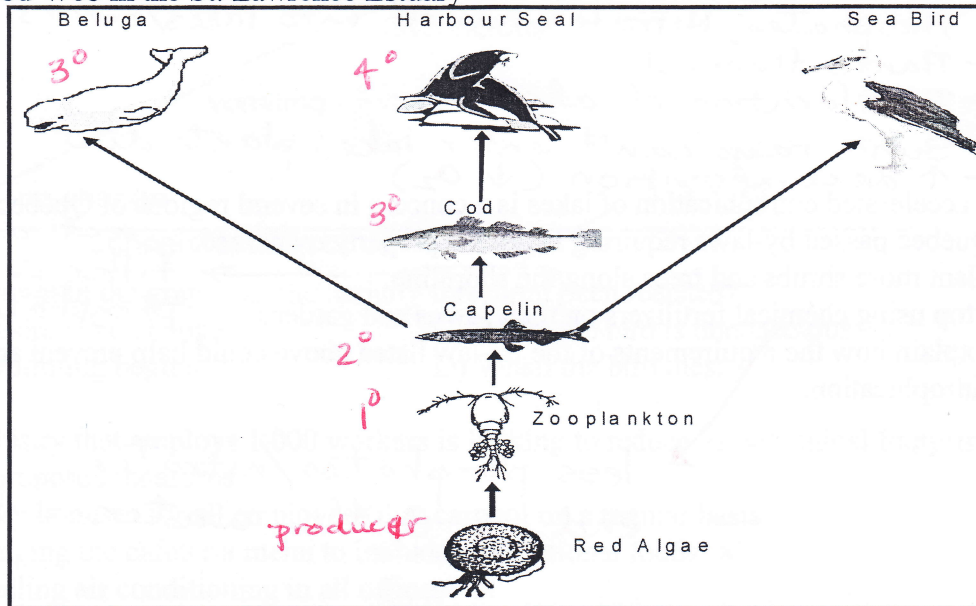
Contaminant moves up the food chain.  
 → the contaminated frogs are eaten by the snakes, the snakes are eaten by the owls  
 ∴ contaminant ends up in owl too.

Explain how the accumulation of the herbicide in the tissues on the frogs would lead to the herbicide having a negative effect on the owl population.

this is bioconcentration

17. In the summer of 2008, a toxic red algae bloom which lasted between 2 to 3 weeks caused the death of 10 belugas, 100 seals and over 1 000 birds and fish in the St. Lawrence Estuary. The red algae contain toxins that are harmful to the organisms in the estuary.

Food Web in the St. Lawrence Estuary



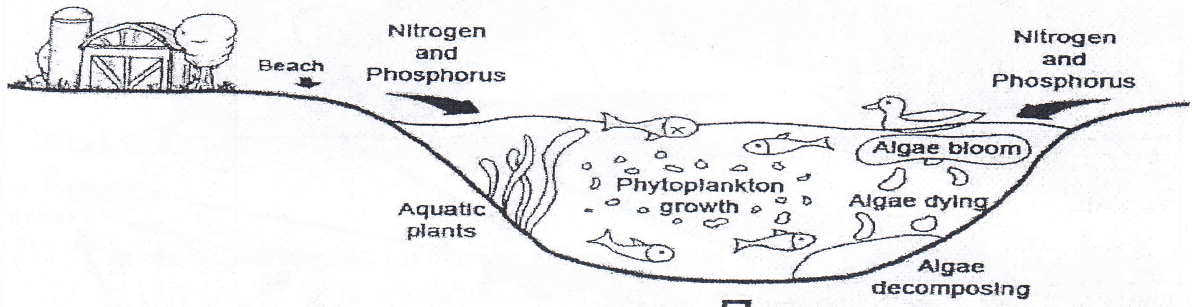
Why did more harbour seals than belugas die as a result of the red tide? Justify your answer.

4<sup>th</sup> order consumer → because of the phenomenon called bioconcentration the seals have ingested more toxins (higher trophic level) than the belugas.



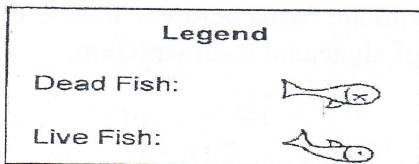
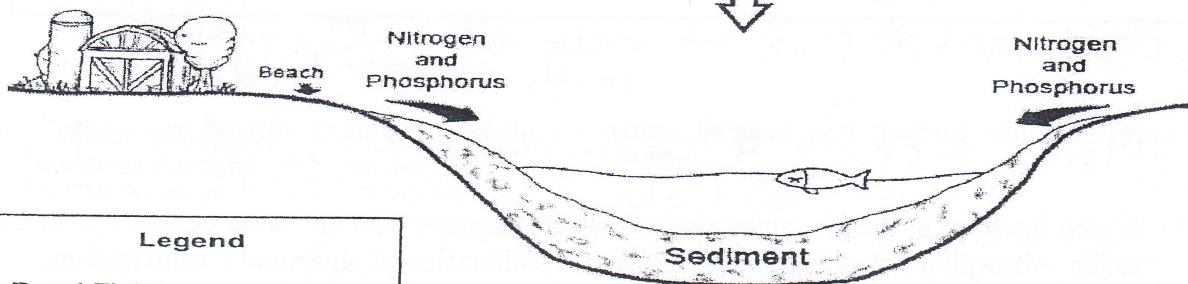
18. Jennifer visits her grandparents who operate a small farm by a lake. Her grandparents had cleared a path to the lake to have access to a small beach. In doing so, many trees and shrubs were removed. Recently, her grandparents noticed an increase in algae bloom in the lake and a decrease in the quantity of fish. Jennifer explains to her grandparents the causes and effects of this ecological phenomenon by referring to the diagram below. Diagram 1 refers to the current state of the lake and Diagram 2 refers to the future state of the lake.

Diagram 1: Current state of lake



The same lake later in time

Diagram 2: Future state of lake



- a) What is the name of the ecological phenomenon Jennifer is referring to? *eutrophication*

- b) What are the causes of this phenomenon?

*↓ trees + shrubs = ↓ filtering of fertilizers from farm  
 ↑ amount of fertilizers in lake  
 leads to algal bloom (proliferation of algae)*

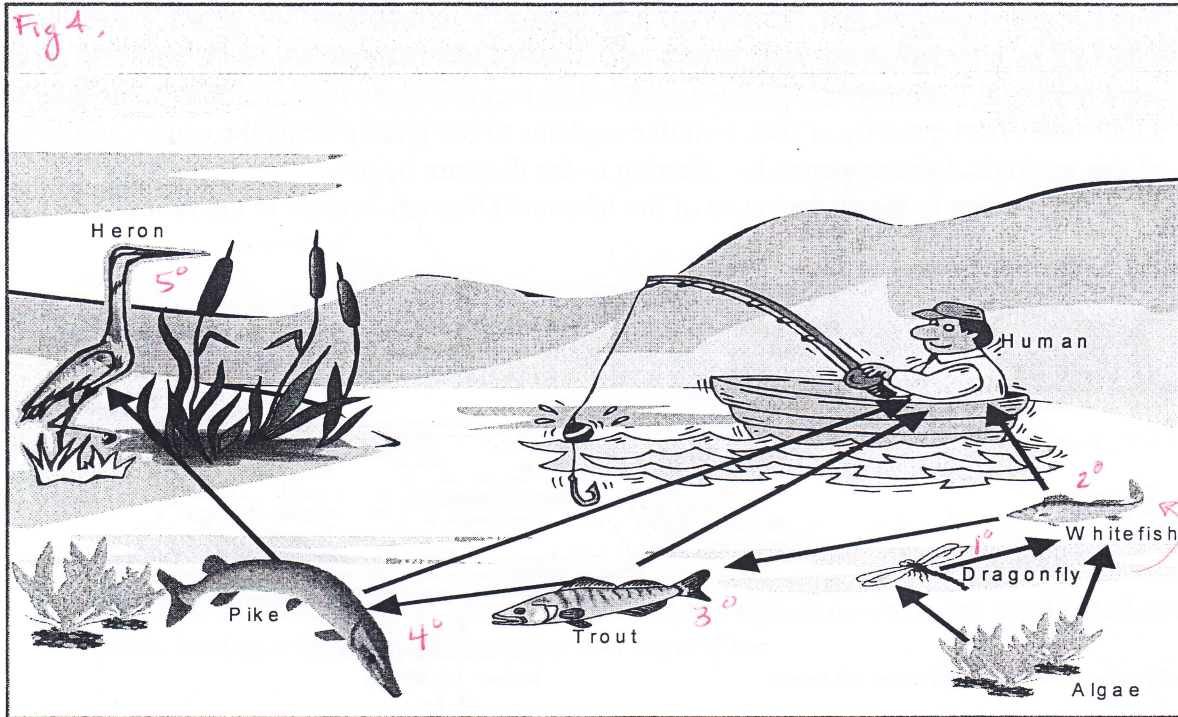
19. Using the steps below, give the correct order of the phosphorus cycle.

- |   |  |
|---|--|
| <del>1</del> - Decomposition of waste and dead organic matter | <del>5</del> - Proliferation of algae      |
| <del>2</del> - Uplifting of rock (new rock formed)            | <del>6</del> - Consumers eat the producers |
| <del>3</del> - Plants absorb phosphates                       | <del>7</del> - Leaching occurs             |
| <del>4</del> - Erosion of rocks                               | <del>8</del> - Sediment is formed          |

*4 → 3 → 6 → 1 → 7 → 5 → 8 → 2*



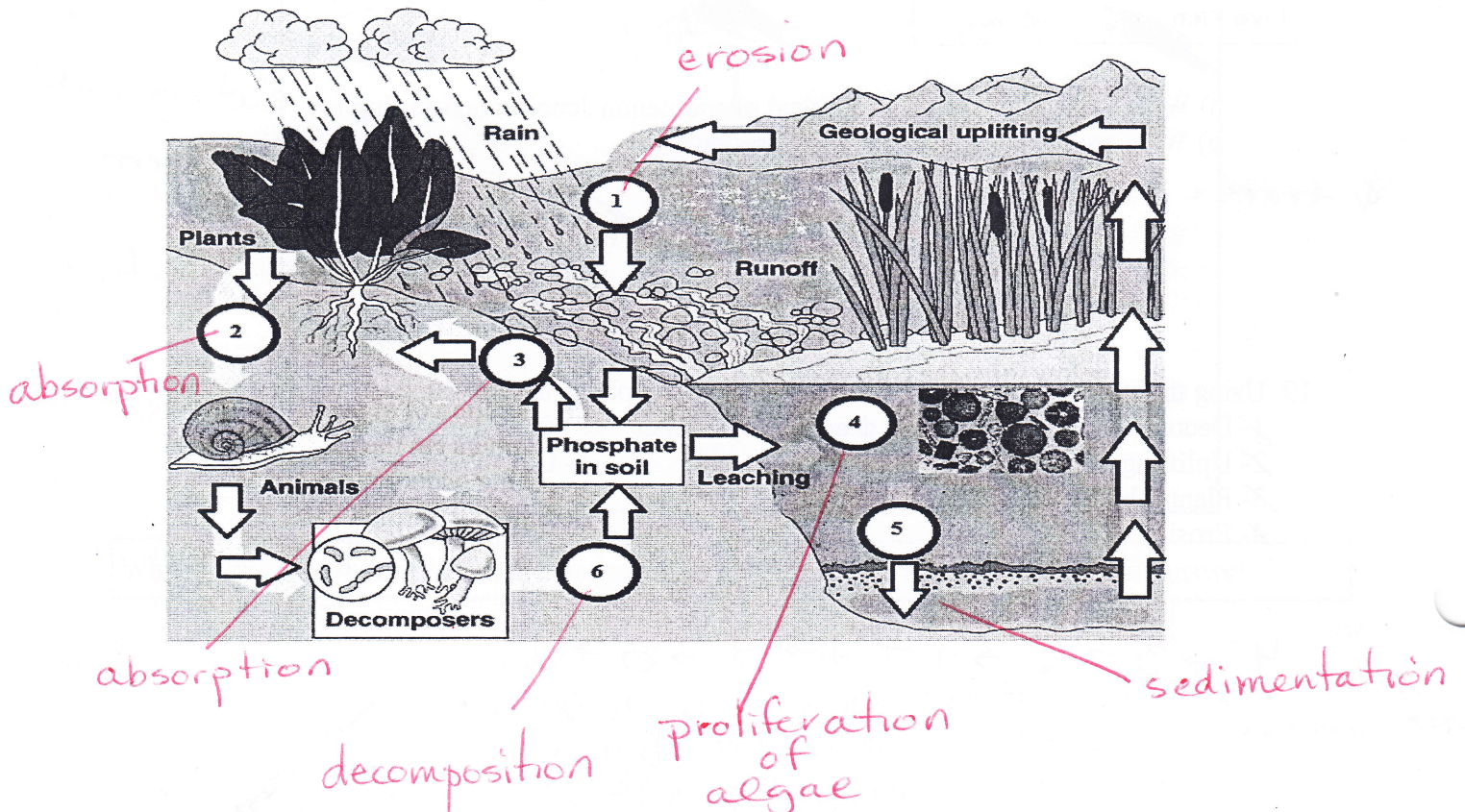
20. Use the food web in Figure 4 to explain which species of fish can be eaten more often and which can be eaten less often than the others.



most often = white fish → only a 1<sup>o</sup> or 2<sup>o</sup> consumer lower in the food chain

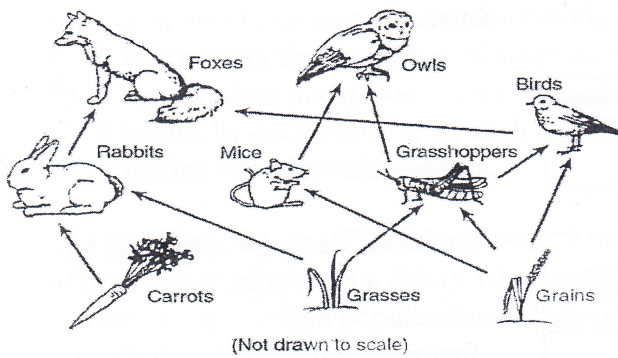
least often = pike → 4<sup>th</sup> order consumer; higher up food chain ∴ more contaminated.

21. Match the steps of the phosphorous cycle in the diagram with the terms below. 1 term is used twice. Absorption, Decomposition, Erosion, Proliferation of algae and sedimentation.





23. Use the picture below to answer questions a-c.







- a- Which biotic organisms will show the least ~~bioaccumulation~~ <sup>\* bioconcentration</sup>?  
*carrots, grasses, grains*
- b- Looking at the picture, the fox can be either a second or third order consumer. Explain if it will be exposed to more contaminants as the second order consumer or the third order consumer.  
*3° ⇒ has ingested more toxins  
higher trophic level = more toxins accumulated*
- c- If pesticides have been spread over the producers. Explain why the bird will have more bioconcentration than the grasshopper even if they both eat grains.  
*bird: higher up food chain  
grain → grasshopper (1°) → bird (2°) \* → has ingested all the toxins that are in the grasshoppers*

24. More than half of humanity now lives in cities. This is projected to rise to about 70% by 2050. According to the United Nations, managing urban areas has become one of the most important challenges of the 21<sup>st</sup> century. The environmental consequences of traditional urban development need to be addressed. As such, the United Nations Development Program suggests that a new ecological footprint should be a goal of sustainable development. Make four recommendations to potential city planners that would have a positive impact on decreasing the ecological footprint of our cities.

- 1- local markets (shop in town)
- 2- reduce waste (composting, recycling)
- 3- availability of public transport
- 4- build apartments, condos (smaller homes)
- 5- community gardens
- 6- activities available \* make people stay in their town ⇒ less travelling

25. Methyl mercury,  $\text{CH}_3\text{Hg}$ , ingested through fish consumption can cause health problems in humans such as reduced coordination and night blindness.  $\text{CH}_3\text{Hg}$  is found in fish that live in the lakes and reservoirs of hydroelectric dam regions. The consumption recommendations based on the length and species of fish are shown below.

**Fish Consumption Recommendations**

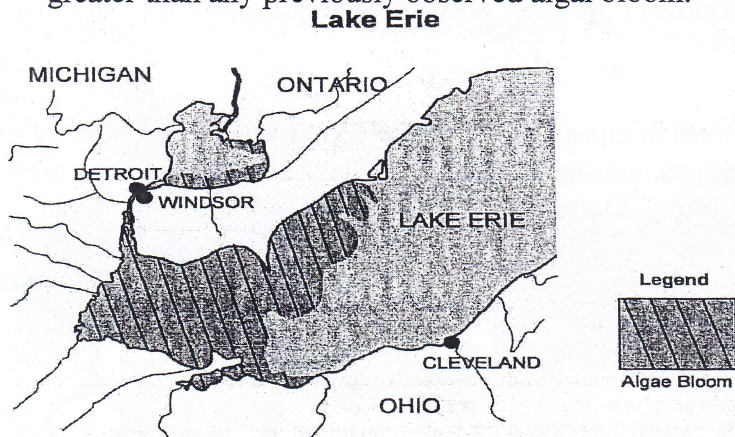
Fish Species	Length	Recommended Serving
Lake Whitefish 	500 mm	No restrictions
Walleye 	500 mm	Two meals per month
Pike 	800 mm	Two meals per month
Lake Trout 	600 mm	Two meals per month

- a) What biological process explains the presence of methyl mercury in fish tissue?  
 b) Why do a Lake Whitefish and a Walleye of the same size and age have a different number of meal recommendations per month?

*bioconcentration  
bioaccumulation*

*whitefish → no restrictions ∴ less contaminated  
→ must have a lower trophic level*

26. In 2011, Lake Erie experienced the largest harmful algal bloom in recorded history. The peak intensity, as illustrated below in the striped area of the map below, was over three times greater than any previously observed algal bloom.



- a) Give an example of human activity that promotes algal growth.  
 b) How does an increase in algal growth affect the oxygen level and ecosystem in Lake Erie?

*use of fertilizers  
sewage.*

*proliferation of algae  
→ blocks sun from entering lake  
→ plants die (leads to ↓  $\text{O}_2$  concentration)  
→ ↑ decomposition (leads to ↓  $\text{O}_2$  conc.)*