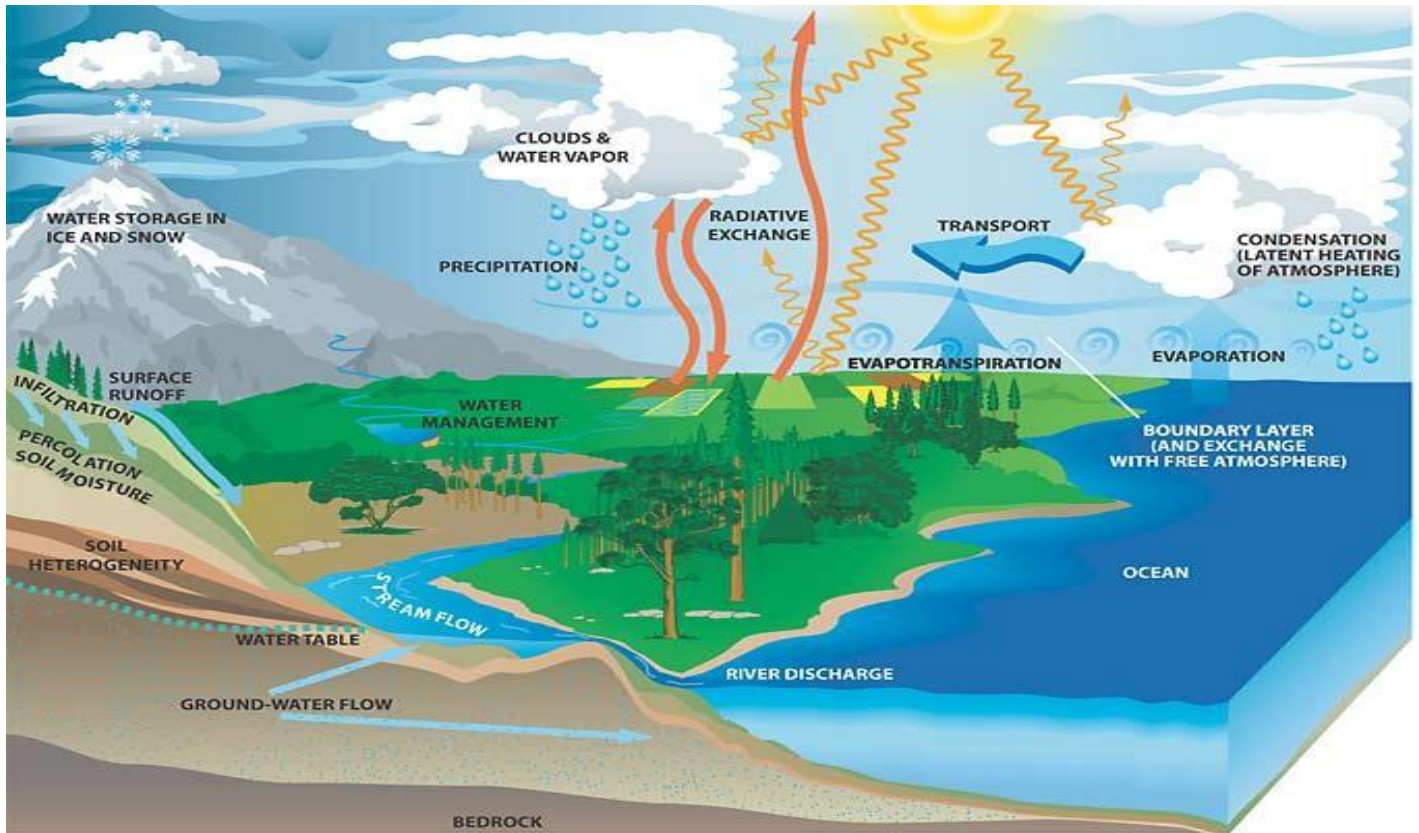


Water Quality (Freshwater) - Practice Activities – Part 1

Characteristics of Water and the Water Cycle:



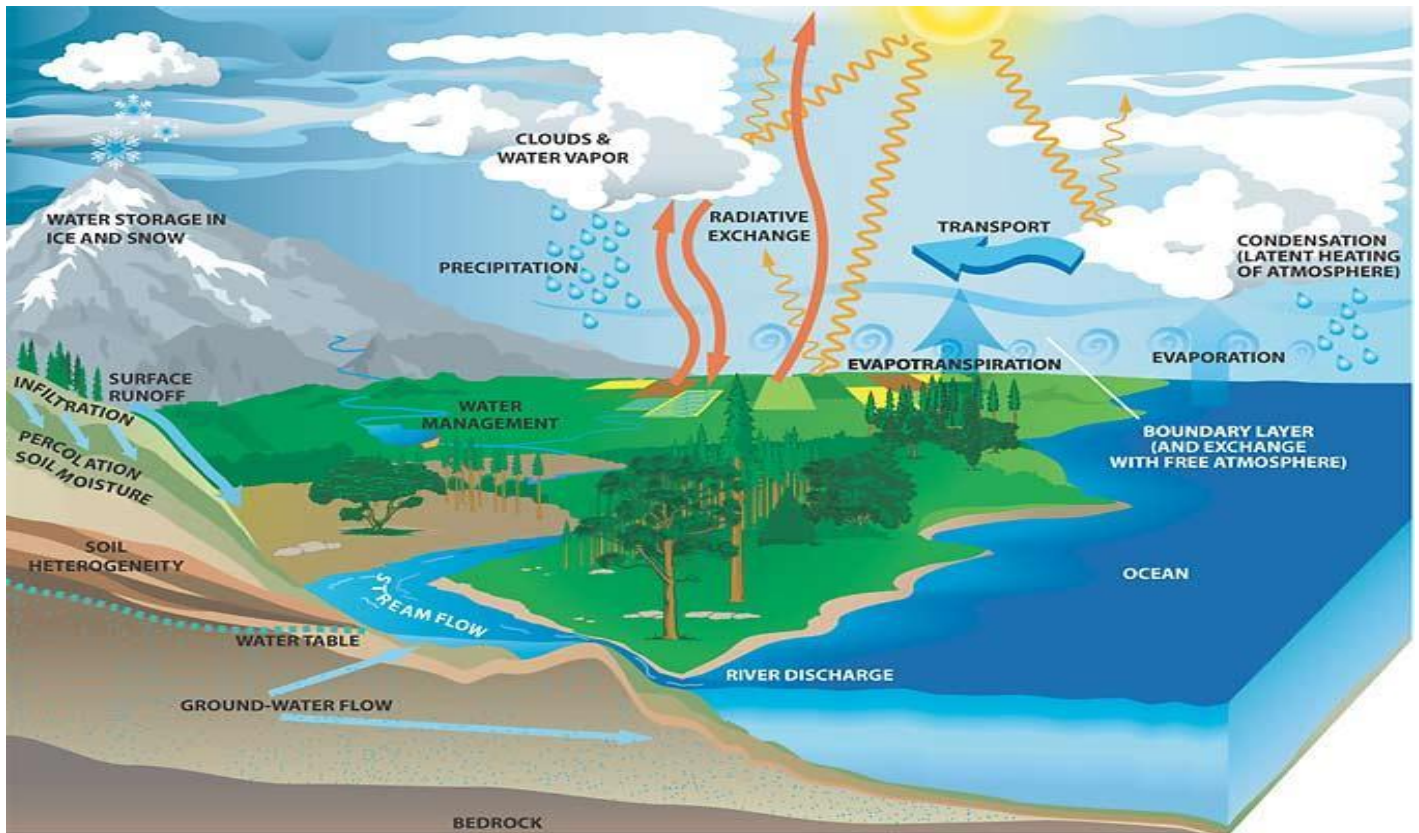
For Questions 1-5, indicate whether the statement is true or false.

- _____ 1. Water is over 1000 times more dense than air.
- _____ 2. Under normal atmospheric pressure and temperature, water exists as a liquid.
- _____ 3. Water has its greatest density at 0 degrees Celsius – its freezing point.
- _____ 4. The water molecule is polar and hydrogen bonding is present
- _____ 5. The surface tension of water is very high due to cohesion of the water molecules at the surface.

For Questions 6-10, use the water cycle

6. During the water cycle, what forms does water exist?
7. What two processes take water back into the atmosphere?
8. What two processes bring water from the atmosphere down to earth?
9. What ways can moisture get into the ocean?
10. How can the water stored as snow and ice get into the ground water flow?

Characteristics of Water and the Water Cycle:



For Questions 1-5, indicate whether the statement is true or false.

- False 1. Water is over 1000 times more dense than air. (**775 times more dense**)
- True 2. Under normal atmospheric pressure and temperature, water exists as a liquid.
- False 3. Water has its greatest density at 0 degrees Celsius – its freezing point. (**4 degrees Celsius**)
- True 4. The water molecule is polar and hydrogen bonding is present
- True 5. The surface tension of water is very high due to cohesion of the water molecules at the surface.

For Questions 6-10, use the water cycle

- 6. During the water cycle, what forms does water exist?
gas (water vapor) , liquid water, and solid (snow and ice)
- 7. What two processes take water back into the atmosphere?
Evapotranspiration (Transpiration) and Evaporation
- 8. What two processes bring water from the atmosphere down to earth?
Precipitation and Condensation (Latent Heating of the atmosphere changes water vapor to liquid)
- 9. What ways can moisture move toward the ocean?
Ice and Snow melt, Surface Runoff, Ground Water Flow, Stream Flow and River Discharge
- 10. How can the water stored as snow and ice get into the ground water flow?
Spring and summer snow melt to infiltration and percolation through the soil and rock below the Water Table

Watershed



1. What is a watershed?
2. What types of aquatic environments are shown in the above watershed diagram?
3. What type of structure houses ground water in this watershed? What process gets ground water into the system?
4. What are the areas in the watershed that could be sources of pollution?
5. What types of activities could introduce pollution into the watershed?



Watershed

1. What is a watershed?

an area of land where water from rain and melting snow or ice drains downhill into a body of water, such as a river, lake, reservoir, wetland

2. What types of aquatic environments are shown in the above watershed diagram?

tributaries (streams), lake, wetlands, river

3. What type of structure houses ground water in this watershed? What process gets ground water into the system? **an aquifer percolation**

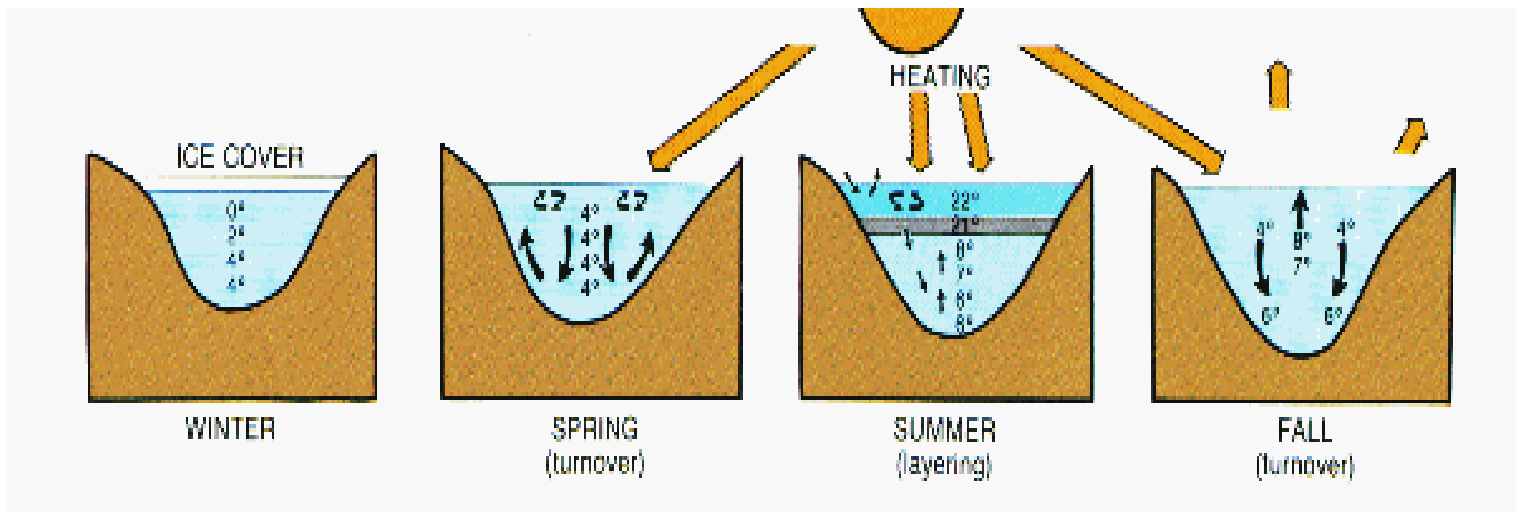
4. What are the areas in the watershed that could be sources of pollution?

Agriculture, town, factory, forestry, riparian zone

5. What types of activities could introduce pollution into the watershed?

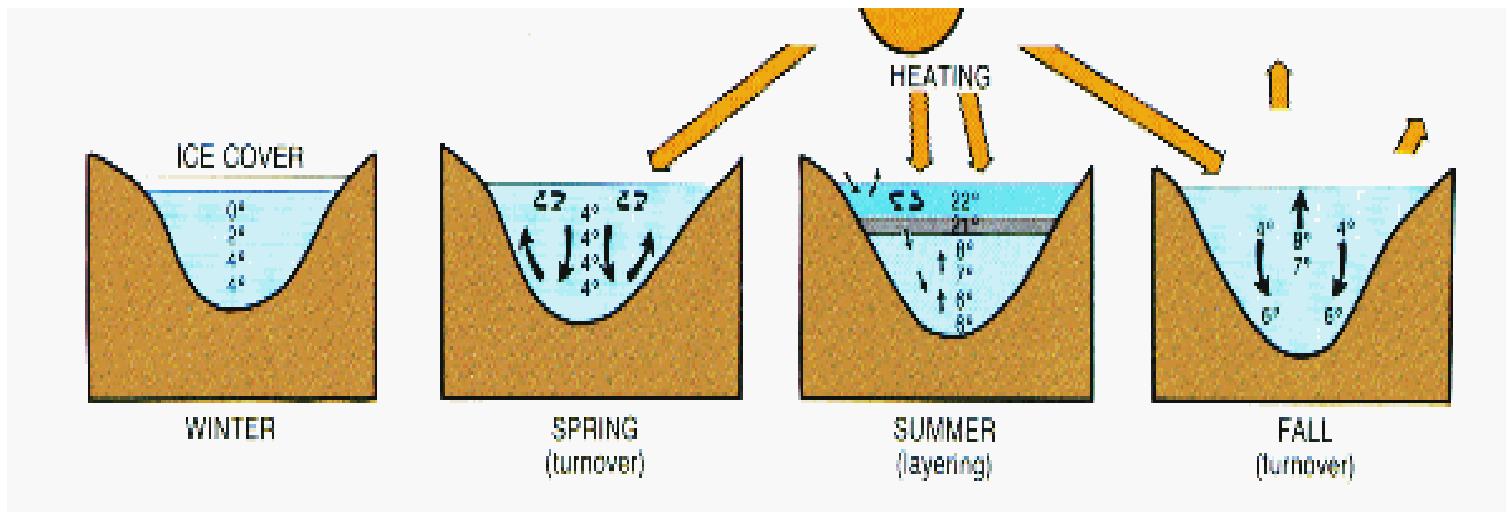
fertilizer compounds, pesticides, animal waste, industrial wastewater and waste into atmosphere, power plant cooling water, municipal waste water or septic tank seepage problems, oil or service station waste, forestry debris, erosion from deforestation development and construction waste, destruction of trees in riparian zone , organic debris as leaf and grass clippings,

Lake Turnover



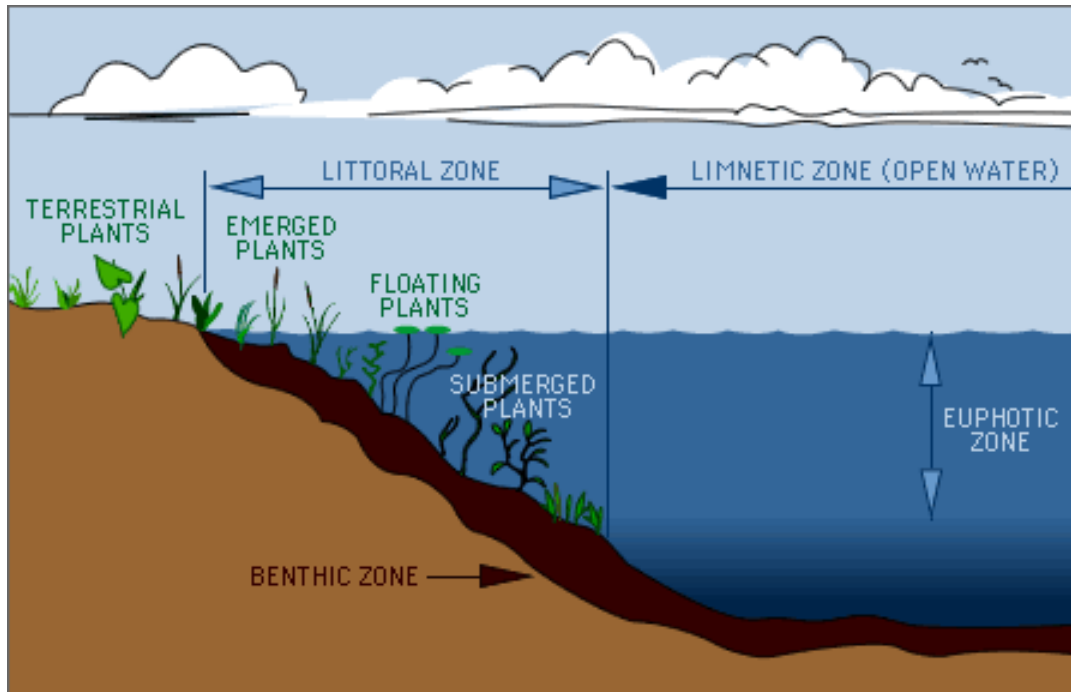
1. Why is the temperature 4 degrees Celsius at the lake bottom in winter?
2. Why is the temperature at the surface where ice forms 0 degrees Celsius?
3. What causes the surface water to warm in spring so the entire lake becomes 4 degrees Celsius?
4. What happens when the spring turnover occurs?
5. What is the layer called the **thermocline** which forms during the summer layering?
6. What determines how far down the major heating will occur during the summer layering?
7. In the fall, why does the cooler water forming at the surface drop to the bottom of the lake?

Lake Turnover



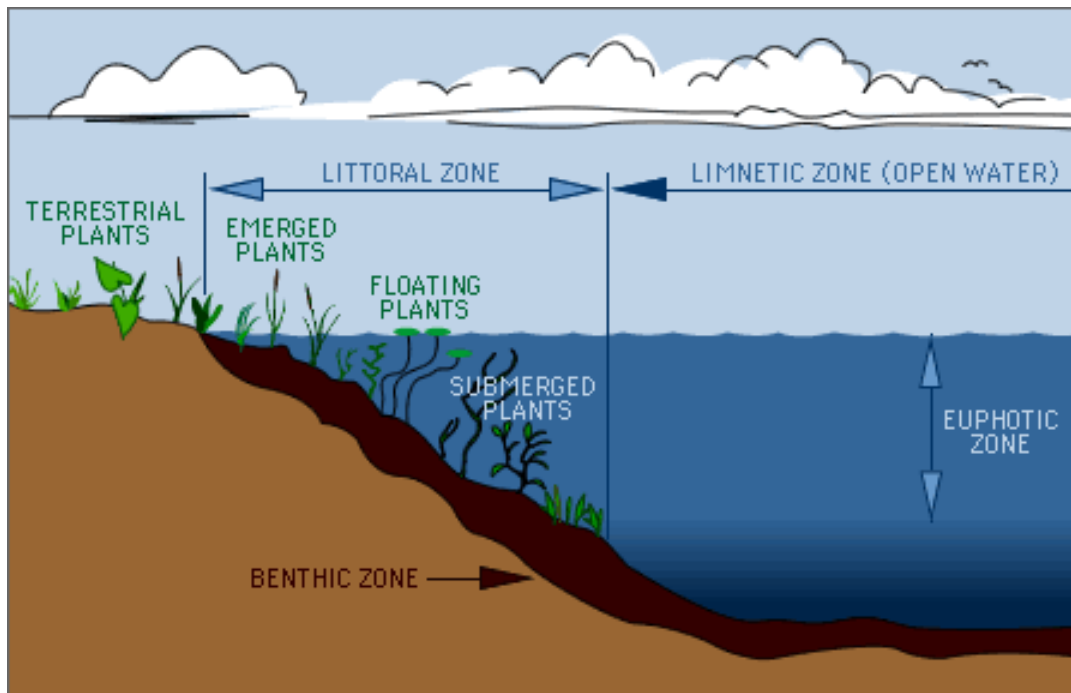
1. Why is the temperature 4 degrees Celsius at the lake bottom in winter?
Water is densest at 4 degrees Celsius – below that temperature the lighter water rises
2. Why is the temperature at the surface where ice forms 0 degrees Celsius?
The lightest water is near 0 degrees and ice forms at 0 degrees – water expands as ice forms causing the ice to float
3. What causes the surface water to warm in spring so the entire lake becomes 4 degrees Celsius?
Heating from the sun and warmer air temperature
4. What happens when the spring turnover occurs?
When the water reaches 4 degrees Celsius it drops and the water mixes with the lower water of the same temperature
5. What is the layer called the **thermocline** which forms during the summer layering?
The gray area on the diagram is the thermocline – a narrow vertical zone between the warmer and colder waters where a rapid temperature change occurs
6. What determines how far down the major heating will occur during the summer layering?
The clarity of the water and the depth that the light will penetrate down through the water
7. In the fall, why does the cooler water forming at the surface drop to the bottom of the lake?
As water cools it becomes more dense and sinks until it reaches its maximum density at 4 degrees Celsius

Lake Zones



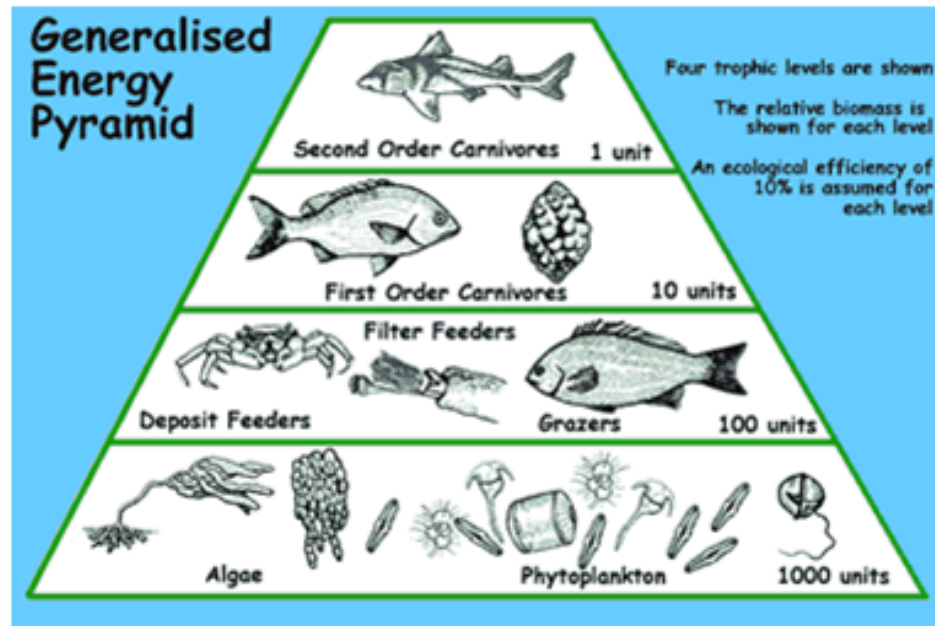
1. What is the advantage of having aquatic plants and trees along the shores of the lake?
2. Why are plants able to grow in the littoral zone of the lake?
3. What types of plants live in the littoral zone of the lake?
4. What types of animals might be found in the littoral zone of the lake?
5. What is the benthic zone of the lake and what types of organisms might live there?
6. What types of plankton might be found in the limnetic or open water zone?
7. How does the lake turnover that the lake does twice a year benefit the lake?

Lake Zones



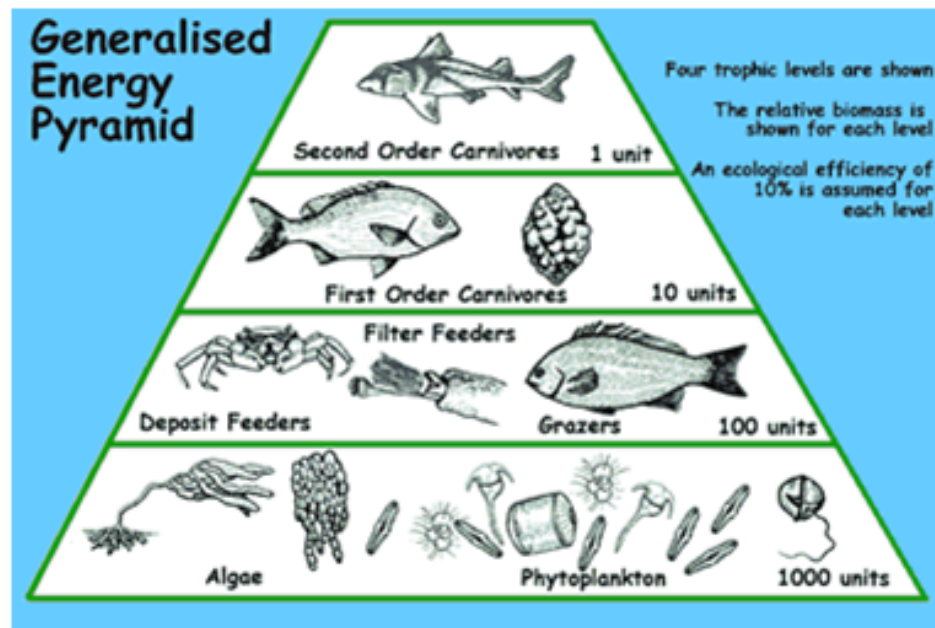
1. What is the advantage of having aquatic plants and trees along the shores of the lake?
They prevent erosion of the banks and keep the water cooler at the shore
2. Why are plants able to grow in the littoral zone of the lake?
The light is able to penetrate through this region to allow photosynthesis to occur
3. What types of plants live in the littoral zone of the lake?
emerged plants, floating plants and submerged plants and algal communities as diatoms, diatoms and green algae
4. What types of animals might be found in the littoral zone of the lake?
clams, snails, snails, herbivorous and carnivorous insects, crustaceans, amphibians, and fishes
5. What is the benthic zone of the lake and what types of organisms might live there?
the benthic zone is the bottom layer and it will contain bottom dwellers, and decomposers as bacteria who feed off of the organic matter that drops to the bottom
6. What types of plankton might be found in the limnetic or open water zone?
phytoplankton and zooplankton
7. How does the lake turnover that the lake does twice a year benefit the lake?
it allows oxygen to be mixed with the water at the bottom and nutrients to be cycled through the water

Pyramids and Trophic Levels



1. What is the difference between a numbers pyramid and a biomass pyramid?
2. What does the Energy Pyramid tell you about the different trophic levels?
3. What does the 10% rule of energy efficiency mean?
4. Who are the producers on this energy pyramid?
5. Who are the first order consumer on this pyramid?
6. What order consumer are the herbivores?
7. What order consumer are the first order carnivores?
8. Why do most food chains or pyramids have only three or four levels?

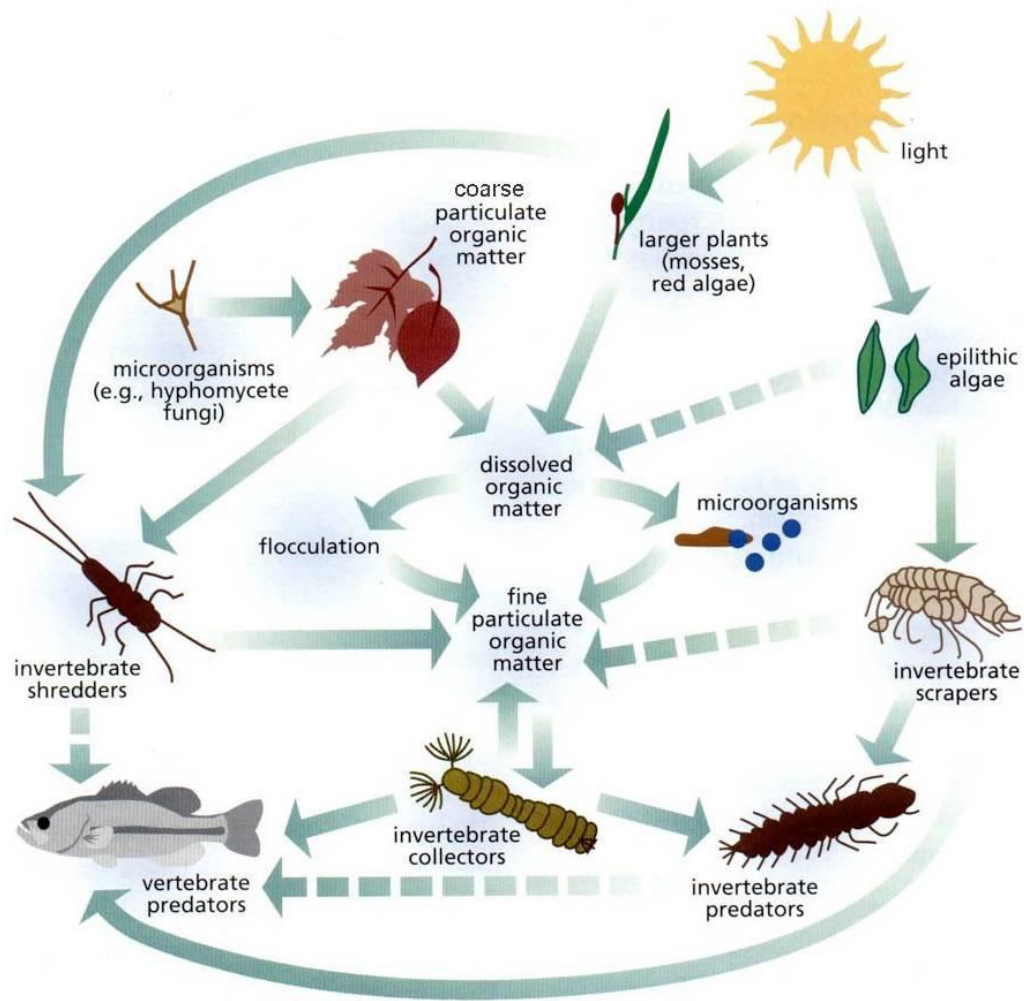
Pyramids and Trophic Levels



1. What is the difference between a numbers pyramid and a biomass pyramid?
Numbers pyramid counts the number of organisms at each trophic level while the biomass pyramid show the total mass of all of the organisms at each trophic level

As the size of organisms varies so greatly, the biomass gives a better representation
2. What does the Energy Pyramid tell you about the different trophic levels?
The amount of energy stored by the producers that is available to the organisms at that level
3. What does the 10% rule of energy efficiency mean?
Only 10% of the energy is available for the next level (of the 1000 units available for the producers, only 100 units is available for the organisms eating the producers)
4. Who are the producers on this energy pyramid?
algae and phytoplankton
5. Who are the first order consumer on this pyramid?
deposit feeders, filter feeders and grazers
6. What order consumer are the herbivores?
1st order consumers because they eat plants who are the producers
7. What order consumer are the first order carnivores?
2nd order consumers
8. Why do most food chains or pyramids have only three or four levels?
only 1% of the original energy is left by the 3rd level and only 0.1% of the original energy is left by the 4th level

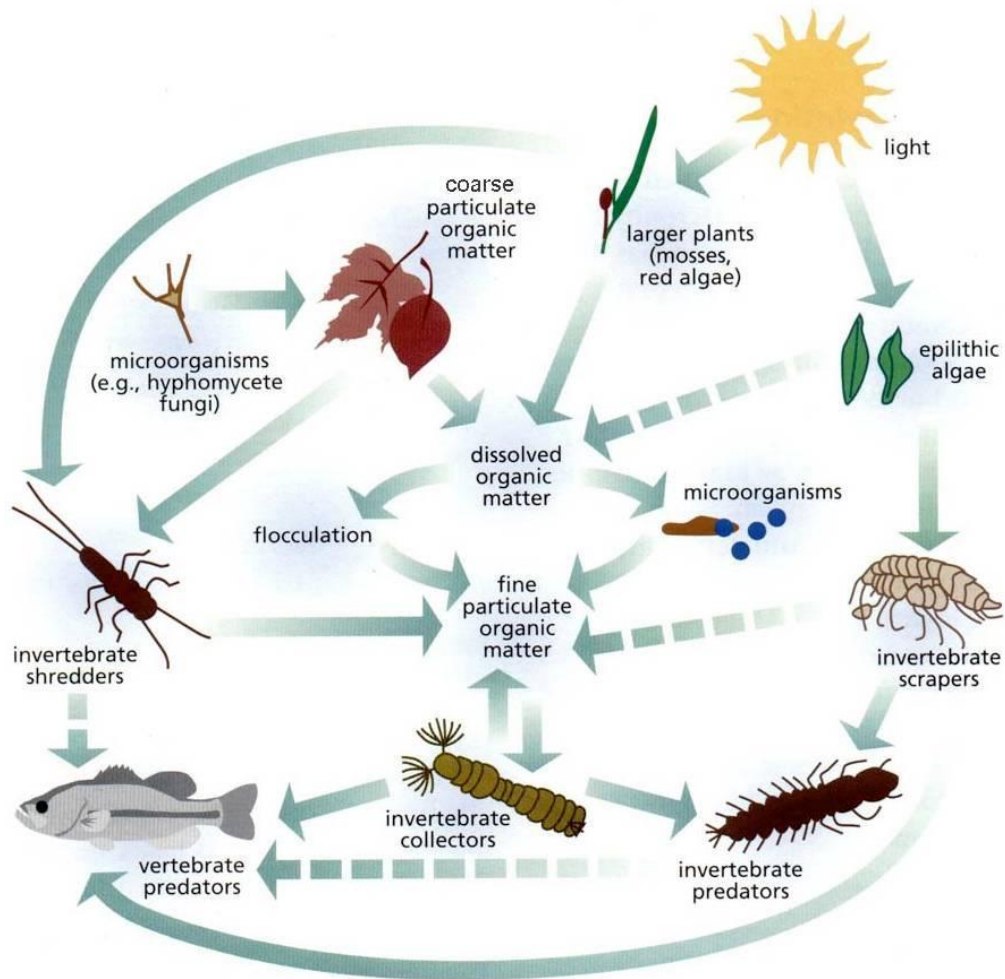
Food Web Analysis



1. Who are the producers on this food web?
2. Who breaks up the coarse particulate organic matter into fine particulate organic matter?
3. What do the invertebrate scrapers eat?
4. Who feeds on the fine particulate organic matter?
5. What do the invertebrate predators eat?
6. What is the highest order consumer on this food web?
7. Who are the decomposers?
8. Where might you find the organisms in this food web?

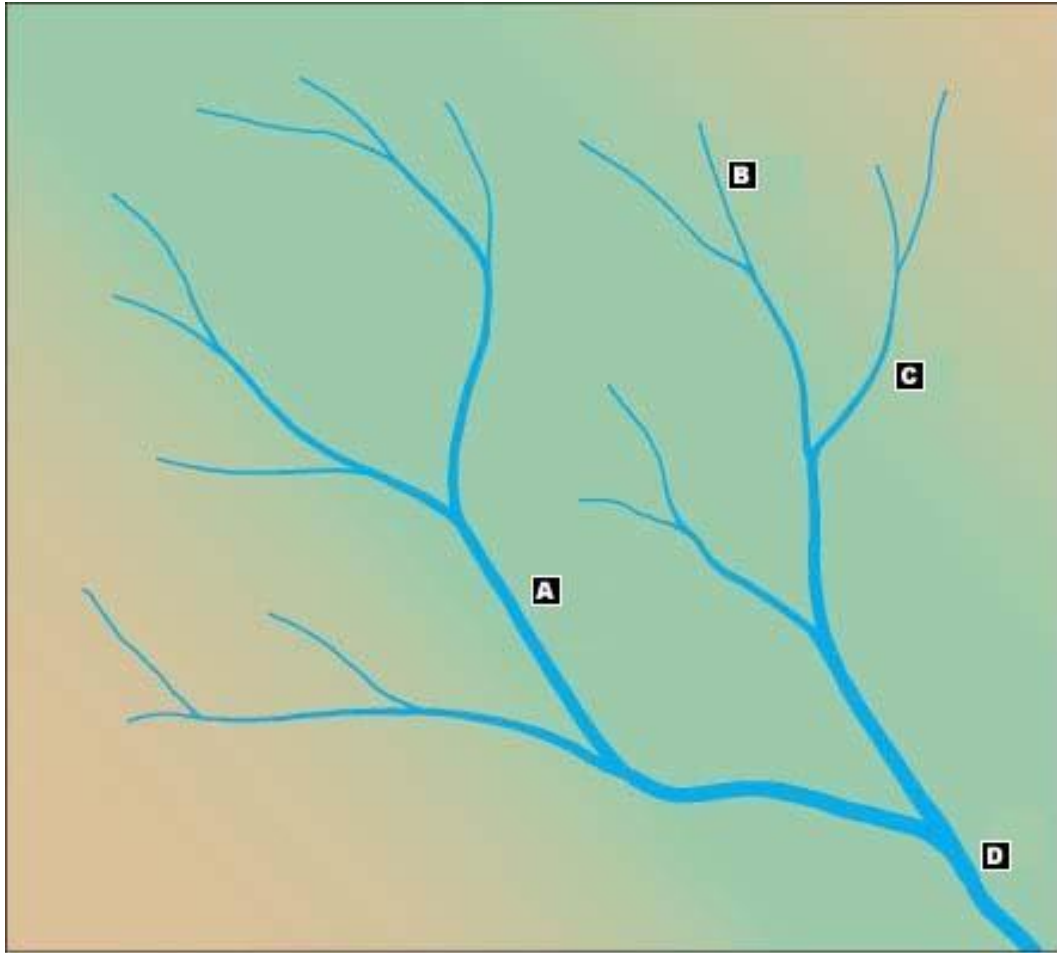
Food Web

Analysis



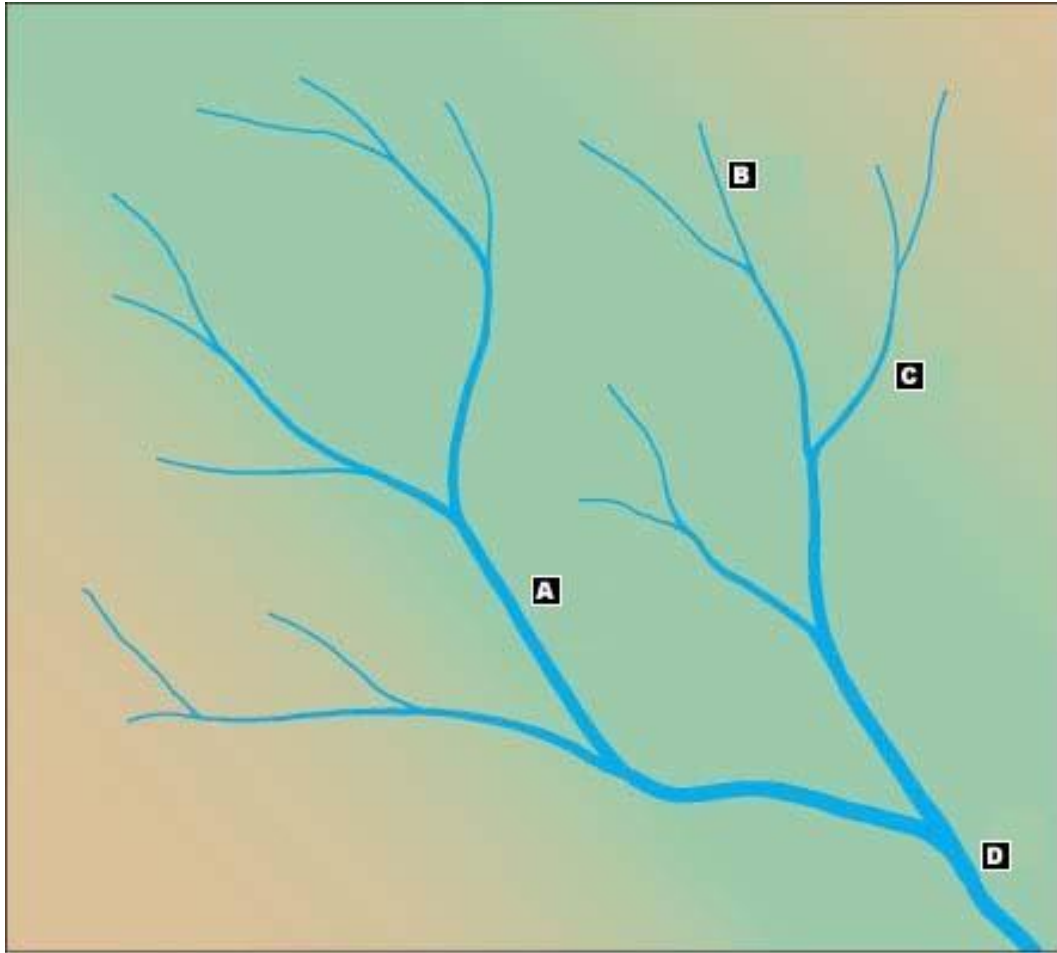
- Who are the producers on this food web?
larger plants, epilithic algae,
- Who breaks up the coarse particulate organic matter into fine particulate organic matter?
invertebrate shredders, microorganisms as fungi,
- What do the invertebrate scrapers eat?
epilithic algae
- Who feeds on the fine particulate organic matter?
invertebrate collectors
- What do the invertebrate predators eat?
invertebrate scrapers and invertebrate collectors
- What is the highest order consumer on this food web? What do they eat?
vertebrate predators – they eat invertebrate shredders, invertebrate collectors, invertebrate predators and invertebrate scrapers
- Who are the decomposers?
fungi and microorganisms
- Where might you find the organisms in this food web?
pond, stream, littoral zone of lakes

Determining Stream Order



1. In the stream ordering system, what is the number for the smallest stream or tributary and what is the number for the largest river in the world?
2. What is the stream order for A?
3. What is the stream order for B?
4. What is the stream order for C?
5. What is the stream order for D?

Determining Stream Order



1. In the stream ordering system, what is the number for the smallest stream or tributary and what is the number for the largest river in the world?

Smallest stream is 1st order and largest river is 12th order

2. What is the stream order for A?

3rd order

3. What is the stream order for B?

1st order

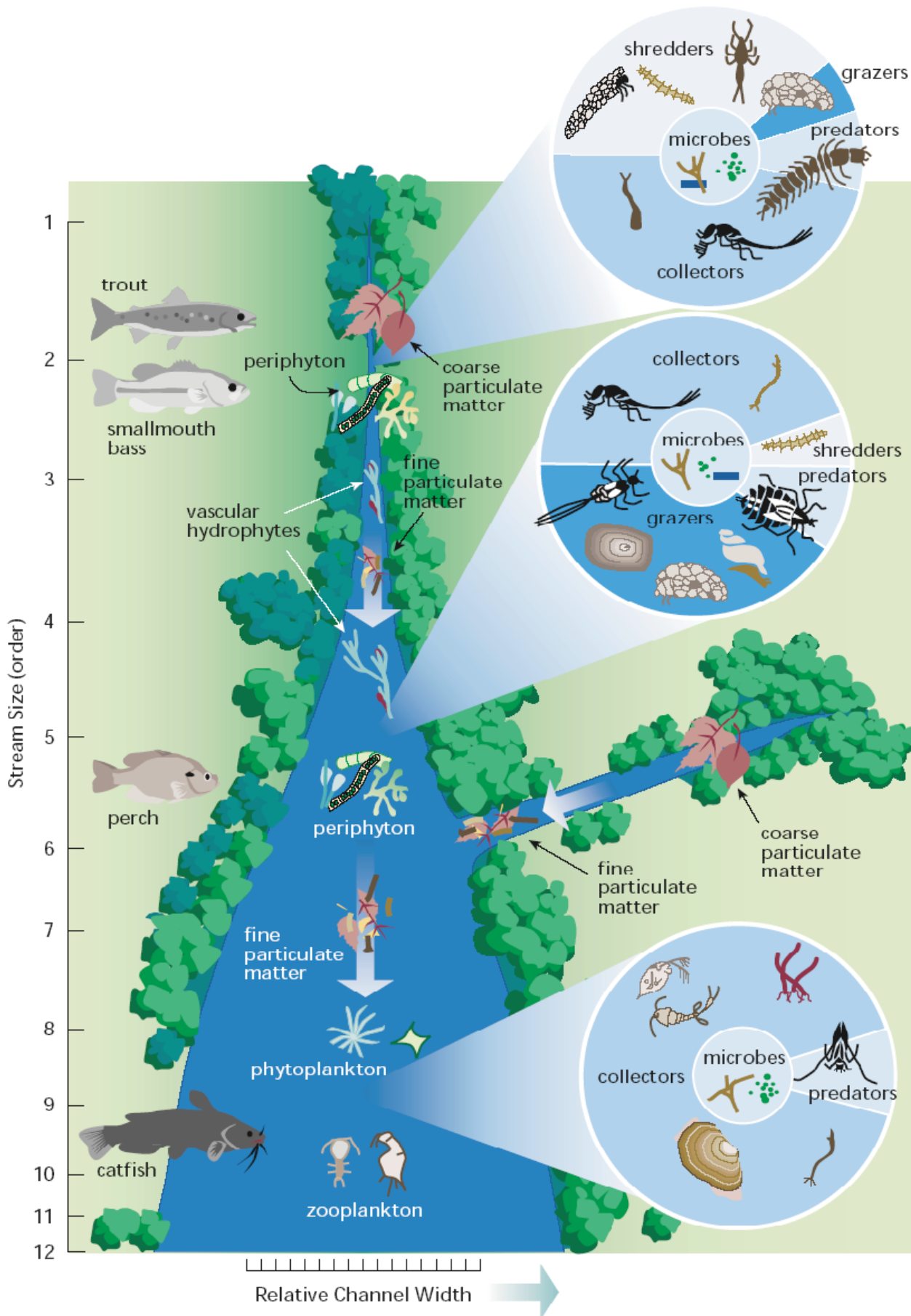
4. What is the stream order for C?

2nd order

5. What is the stream order for D?

4th order

Stream Analysis



Stream Analysis

Use the diagram of the River Continuum to answer the following questions

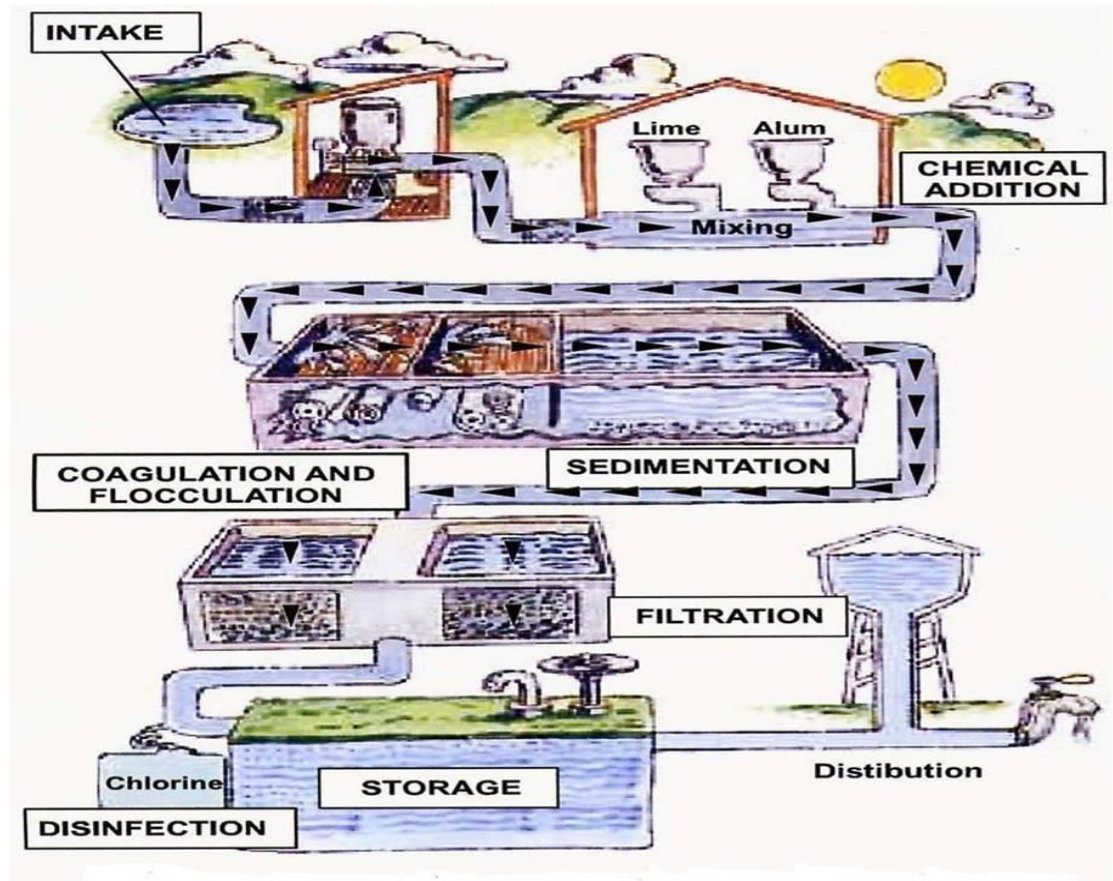
1. Stream order reflects what about the stream or river?
2. What happens to the relative channel width as the stream size order increases?
3. In what order streams would you expect to find catfish?
4. In what order streams would you expect to find trout?
5. In what order streams would you expect to find perch?
6. What happens to the water temperature and dissolved oxygen as the stream order increases?
7. In the higher order streams or large rivers, what makes up the largest feeding group of macroinvertebrates?
8. In what order streams would you expect to find the most shredders? Why?
9. What happens to the shredders as you go from a 1st order stream to a 12th order river?
- 10.. How do the relative percent of macroinvertebrate predators compare as the stream order increases? Why?

Stream Analysis

Use the diagram of the River Continuum to answer the following questions

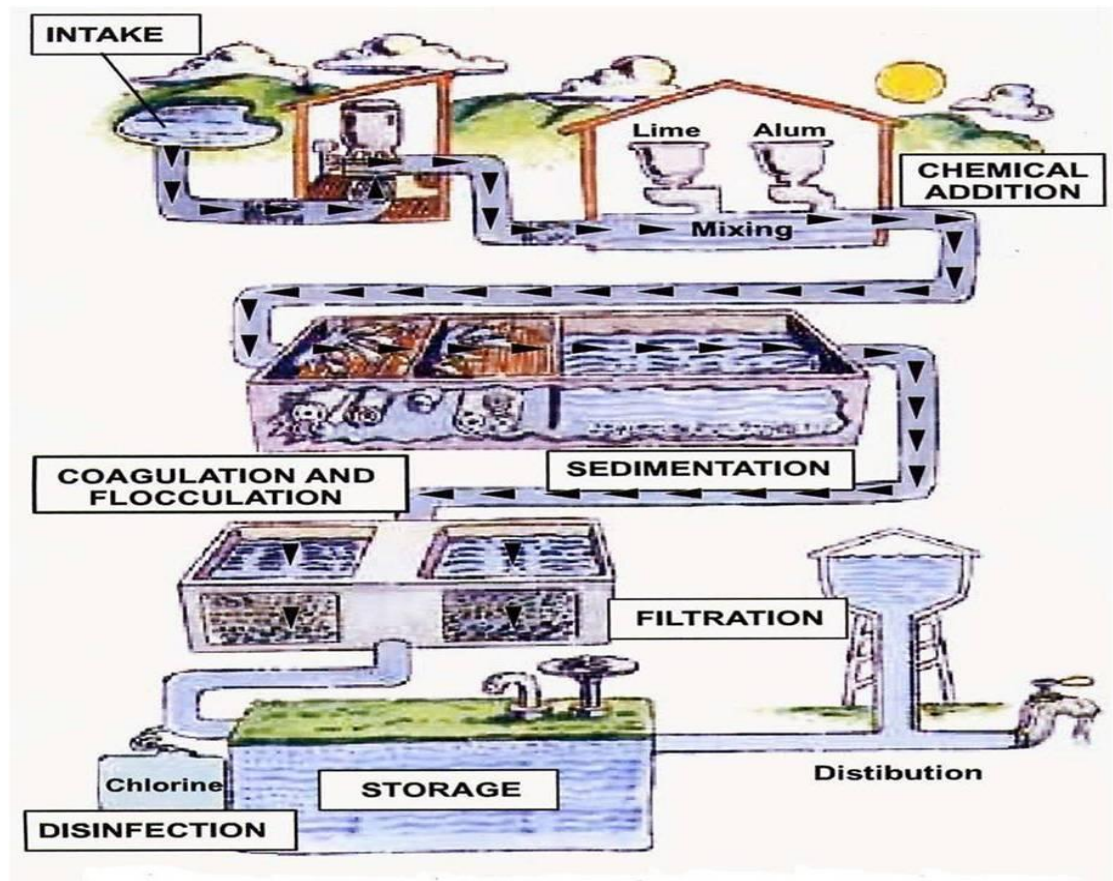
1. Stream order reflects what about the stream or river?
size of stream – as the number increase the stream size increases
2. What happens to the relative channel width as the stream size order increases?
the width increases as the size of stream and stream order increases
3. In what order streams would you expect to find catfish?
9th order stream
4. In what order streams would you expect to find trout?
1st order stream
5. In what order streams would you expect to find perch?
5th order stream
6. What happens to the water temperature and dissolved oxygen as the stream order increases?
temperature increases and dissolved oxygen decreases
7. In the higher order streams or large rivers, what makes up the largest feeding group of macroinvertebrates? why?
collectors because they feed on fine particulate matter and there is a lot more fine particulate matter and sediment in the larger order rivers
8. In what order streams would you expect to find the most shredders? Why?
1st and 2nd order streams because they break up the coarse particulate matter such as leaves that are present in smaller streams and wooded areas
9. What happens to the shredders as you go from a 1st order stream to a 12th order river?
they decrease and are missing from the highest order rivers
- 10..How do the relative percent of macroinvertebrate predators compare as the stream order increases? Why?
it remains pretty constant because there are other feeding groups to serve as their food (Notice that the types of organisms in each feeding group changes as the stream order increase and the environmental conditions change)

Potable Water Treatment



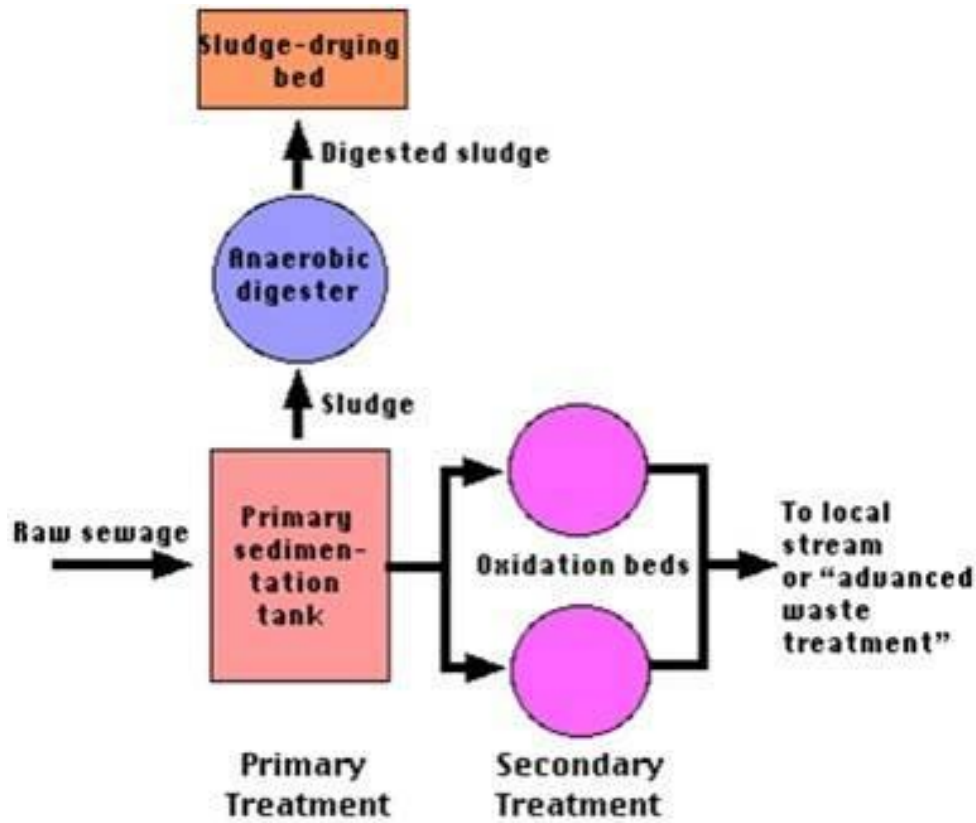
1. What is potable water?
2. What chemicals are added during the chemical addition stage?
3. What are coagulation and flocculation?
4. What types of materials can serve for the filtration process?
5. What disinfectant is added?

Potable Water Treatment

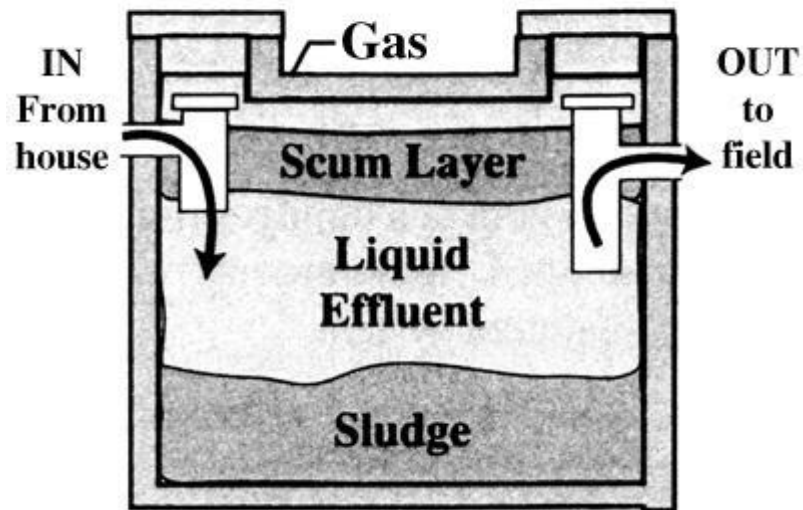


1. What is potable water?
potable water is water safe for drinking
2. What chemicals are added during the chemical addition stage?
Lime and Alum –to form sticky particles called *floc* that attract dirt particles
3. What are coagulation and flocculation?
coagulation removes dirt and other particles which stick to the flock
flocculation is the formation of floc which attract dirt
The combined weight of the dirt and floc is heavy enough to sink to the bottom and be filtered out of the water
4. What types of materials can serve for the filtration process?
layers of sand, gravel, and charcoal are used to remover smaller particles
5. What disinfectant is added? Why is the storage tank important?
chlorine is used and the storage tank allows the chlorine to kill any microbes

Sewage Treatment Plant



• *Section view of a septic tank*



Note: Home septic tanks are miniature waste treatment facilities

Sewage Treatment Plant and Septic Tank Analysis

Use the diagrams of the Sewage Treatment Plant and Septic Tank in answering the questions.

1. What is sludge?
2. What is used to digest the sludge?
3. What is liquid effluent?
4. What is used liquid effluent ?
5. How is the liquid effluent treated in a septic tank?
6. What is the role of the drain field?
7. What happens to the remaining sludge from the septic tank or sewage treatment plant?
8. What gas is commonly produced in the sludge tank that is used to fuel the treatment facility?
9. What are the potential sources for pollution from Septic Tanks or Sewage Treatment Plants?
10. What can be done to prevent the potential sources of pollution?

Sewage Treatment Plant and Septic Tank Analysis

Use the diagrams of the Sewage Treatment Plant and Septic Tank in answering the questions.

1. What is sludge?

The solids in the wastewater are called sludge. They will sink to the bottom of a septic tank or be filtered out of the raw sewage at the sewage treatment plant

2. What is used to digest the sludge?

Anaerobic microbes as bacteria, Archaea, and fungi

3. What is liquid effluent?

The liquid remaining after the solid sludge is removed or settles out of the wastewater

4. What is used liquid to digest the remaining waste present in the effluent?

Air is allowed into the effluent so aerobic microbes can consume the organic matter

5. How is the liquid effluent treated in a septic tank?

It will drain into the drain field

6. What is the role of the drain field?

Holes in the tiles of the drain field allow water with organic matter to seep into the soil where soil bacteria will complete the decomposition process

7. What happens to the remaining sludge from the septic tank or sewage treatment plant?

It is usually burned or buried in a landfill

8. What gas is commonly produced in the sludge tank that is used to fuel the treatment facility?
methane

9. What are the potential sources for pollution from Septic Tanks or Sewage Treatment Plants?
leakage of the main septic tank or incomplete treatment of the sewage at the sewage treatment plant

10. What can be done to prevent the potential sources of pollution?

proper inspection and maintenance of the septic tank and tertiary or advanced treatment at the sewage treatment plant to remove phosphates and nitrates that could cause pollution before the water is returned to the natural waterways