

**1. Biodiversity p 303**

a- **Definition:** Biodiversity describes the variety of species living in a community.

What is a species?

Two things have to be considered when measuring biodiversity:

- (1) Species richness ( how many species live in a community)
- (2) The relative abundance of each species (how many there are of each compared to the total.

For biodiversity to be high we need a high number 1 and similar ratios for number 2.

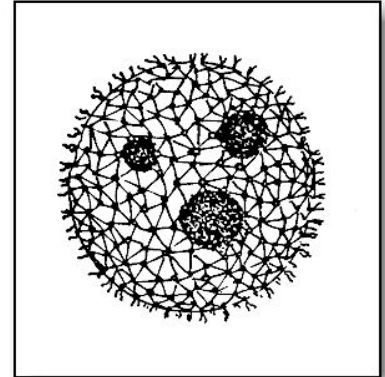
**Example:** Determine which community has a higher biodiversity.

Community	Species	Number of species	Total number	Relative abundance
Section of Parc National de la Yamaska	Spiders	210*	8000*	
	Maple, balsam fir, hemlock, birch	40*	100 000	
	mammals	35*	2000	
	birds	230*	?	
20 Square km in Montreal	Homo sapiens	1	18000	
	Maple trees	1	1000	
	spiders	12	9000	
	linden	1	800	
	Sewer rats	1	18000	
	birds	5	?	

- \*= estimates by biologists; no \* = my guess

## 2. Trophic Relationships

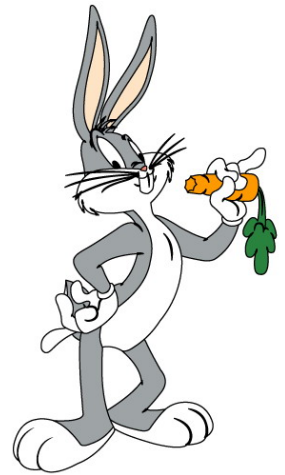
- Describes the trophic levels (producers, consumers, decomposers)
- Explains the relationships between the trophic levels of a food web



1. a) What is a **producer**? Give examples.

b) Why is a producer said to convert inorganic matter into organic matter? Give examples.

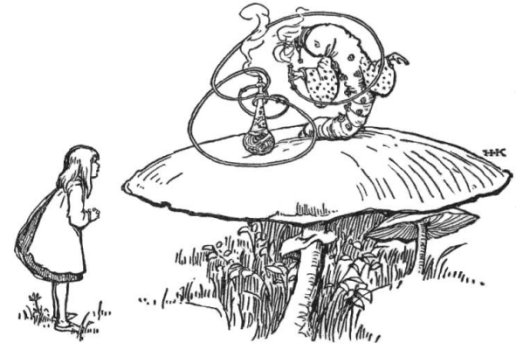
2. a) What is a **consumer** in an ecological context?



b) What is the difference between a first order, second order consumer and an omnivore?



3. What is a **decomposer**? Give examples.



4. **Trophic relationships** are the feeding connections among the living organisms in an ecosystem.

*What is an ecosystem? It's a community of living organisms (plants, animals and microbes) including the nonliving parts of their environment (air, water and minerals). They all interact as a system.*

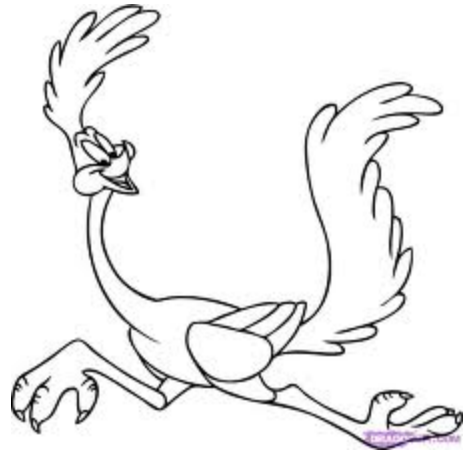
Example Draw a food web for the following:

Hare, fox, snake, fungi, bacteria, grasshopper, termite, autotrophs (photosynthesizers), shrew, woodpecker, field mouse,

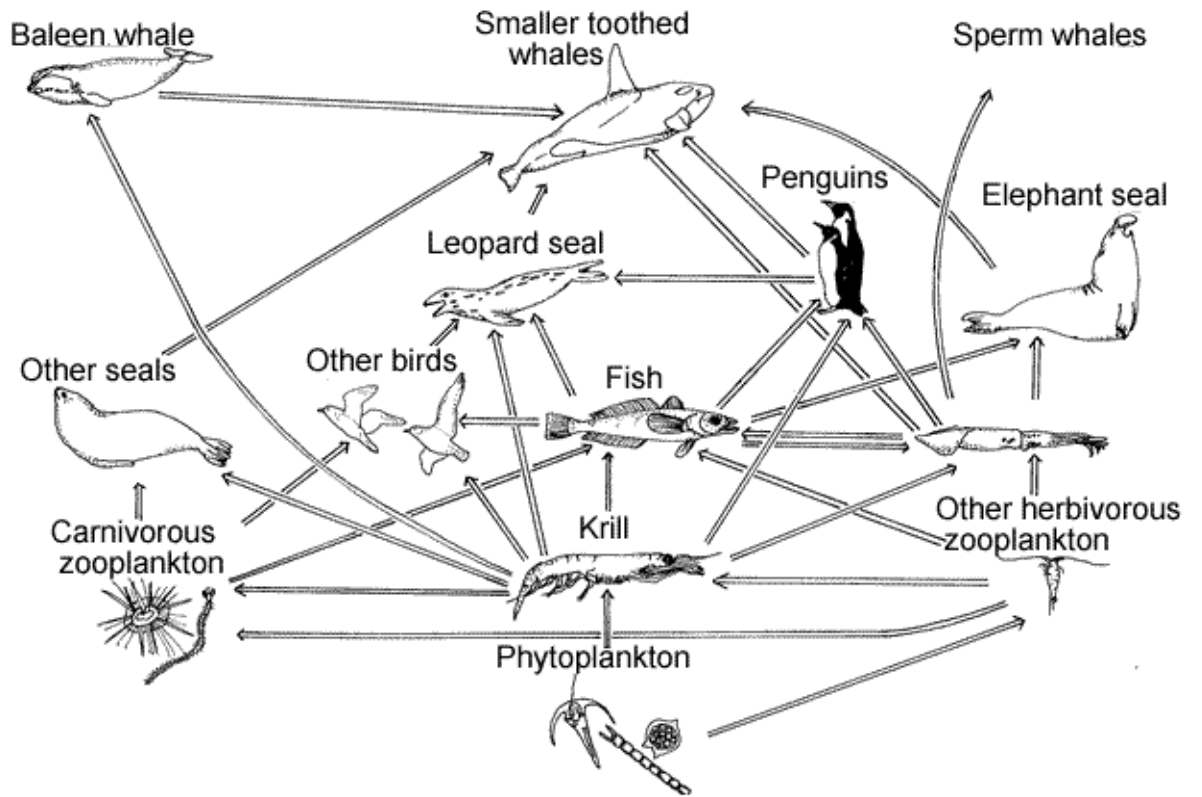
## Exercises

1. Why do all humans belong to the same species? List evidence.
2. What is biodiversity?
3. How is biodiversity measured?
4. a) Give examples of the different species of plants found in a lawn that has not been treated with weed killer.  
b) Do the same for a lawn that has been treated.  
c) Which has the greater biodiversity?
5. What is the energy source of producers?
6. What carbon-containing inorganic gas is needed by most producers?
7. What nitrogen containing ion is also needed by producers?
8. What organic material is the primary product of producers?
9. Give an example of the primary producer found in deserts.
10. What first order consumers are found in temperate forests?
11. A road runner`s consists of 90% of animal matter (insects, scorpions, lizards, snakes, rodents and other small birds) and the remainder is fruit and seeds.

Why isn't the roadrunner a second order consumer?



12. a) Aside from fungi, what other decomposers exist in nature?  
b) In what cycles do decomposers play a role in? Give examples.
13. Use the food web to identify two mammals that are secondary consumers.



14. Which animal wastes the most energy if you consider all the trophic level exchanges needed to feed it?

15. What factors can affect primary productivity in the sea?

### 3. Disturbances

**A-Definition:** a disturbance is an event that damages an ecosystem, possibly killing organisms or change the availability of food and water.

**Example** Think of disturbances that can occur ...

- a) In a Quebec winter
- b) In the spring in Quebec
- c) In the spring in Texas
- d) In the fall in Florida and elsewhere on the North Atlantic coast.

#### **B- Types of Disturbances**

##### **1. Natural Disasters**

**Examples:**

##### **2. Human Disturbances**

**Examples:**

#### **C- Ecological succession**

**Definition:**a series of changes in an ecosystem that occur following a disturbance

## Exercises

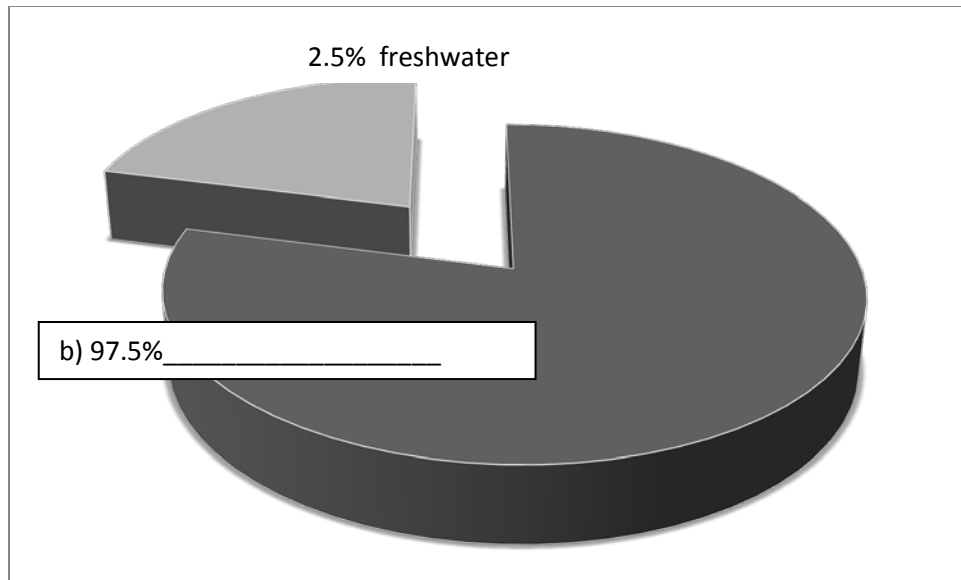
1. Using the internet find an example of a recent natural disaster.
2. Using the internet find an example of a recent human disturbance.
3. Describe the impact of a volcanic eruption on ecosystems. See <http://volcano.oregonstate.edu/how-do-volcanoes-affect-plants-and-animals>
4. Describe the impact of strip mining on a mountain top. What do you think will happen when sediment from the mountains ends up in valley streams? What will happen to biodiversity if large parts of forests are cut?
5. Find an example of ecological succession associated with
  - a) a natural disaster such as a fire. See [http://en.wikipedia.org/wiki/File:Secondary\\_Succession.png](http://en.wikipedia.org/wiki/File:Secondary_Succession.png)  
(if the above does not work see big picture in the Wikipedia article on ecological succession)
  - b) The cutting down of part of a forest to make a shopping mall.

The Hydrosphere

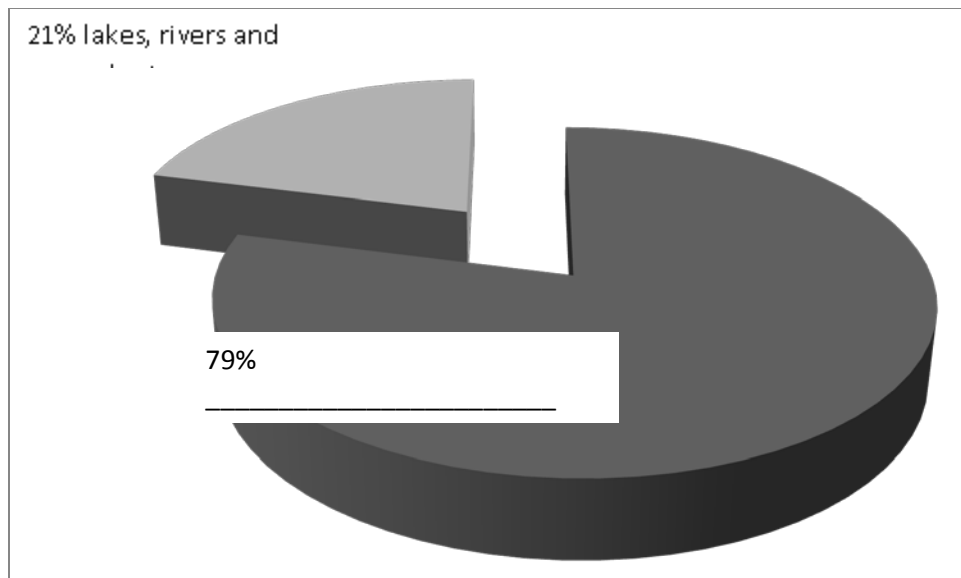
1. Basic Facts

Fill in the blanks:

- a) The hydrosphere is the Earth's outer layer of \_\_\_\_\_, including its three states \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.



- c) Where is the freshwater (drinkable) found?





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**Example 1** The concentration of dissolved salts in freshwater is less than 500 ppm. Show that the equivalent of 500 ppm in m/V % is 0.05% salt.

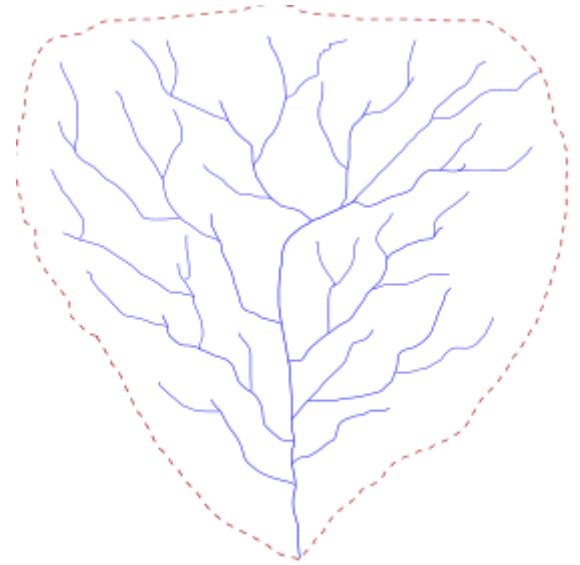
**Example 2** Convert 1% m/V salt to ppm.

2. **Inland Waters:**

a) **Definition:** What do they include? All bodies of freshwater found on land. They include \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.

b) **Watersheds** = catchment areas = drainage basins

- A catchment area or drainage basin or watershed is an area of land where all inland waters from rain and melted snow drain into the same lake, river or sea.



**Example 1:** Explain how the following factors can affect how water flows within a watershed:

a) **Topography:**

b) **Geology:**

c) **Climate:**

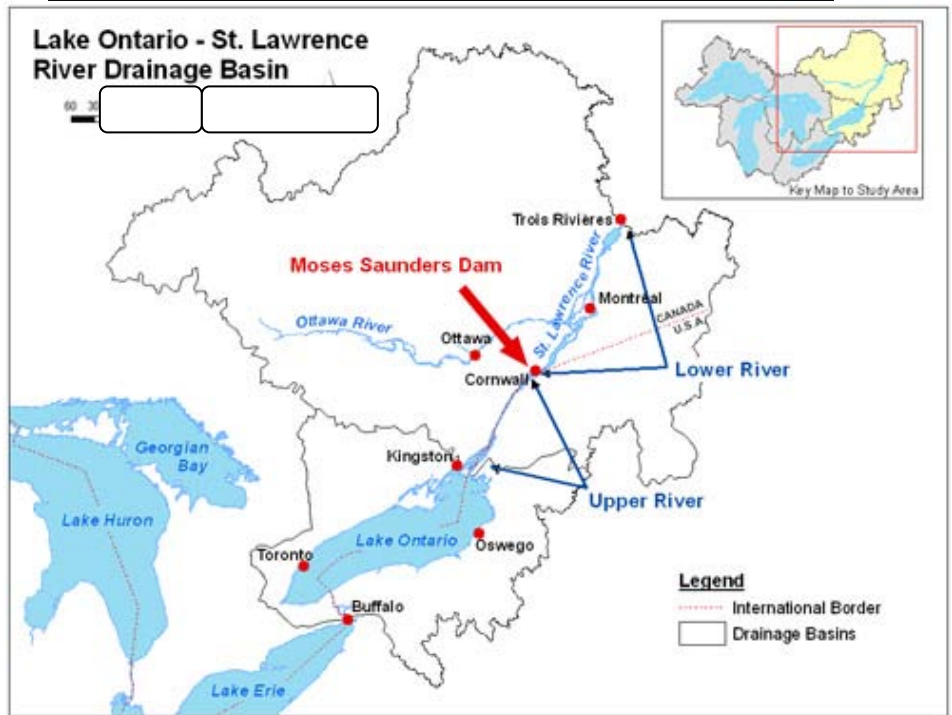
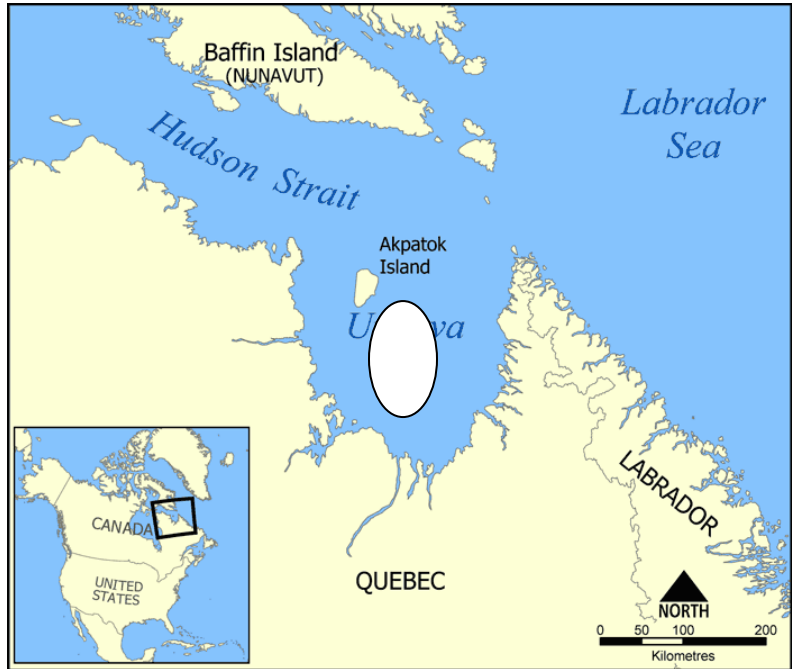
d) **Vegetation:**

e) **Development:**

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**Example 2** How does catchment (the amount of water actually absorbed by land) affect towns, cities and the economy?

**Example 3** Name each of the 3 following watersheds, all of which are at least partly in Quebec



3. Oceans

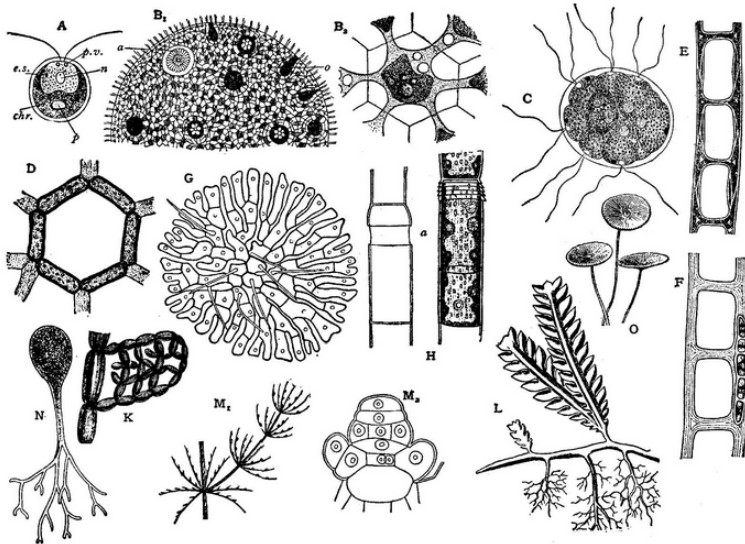
- a) **Basic facts:** There are five oceans on earth, making up about 72% of the planet's surface and holding 97% of the hydrosphere. Oceans supply the planet with most of its oxygen, play a vital role in the carbon cycle, weather and climate. Deep oceans are largely unexplored.

**Example 1** Identify the 5 oceans.



**Example 2**

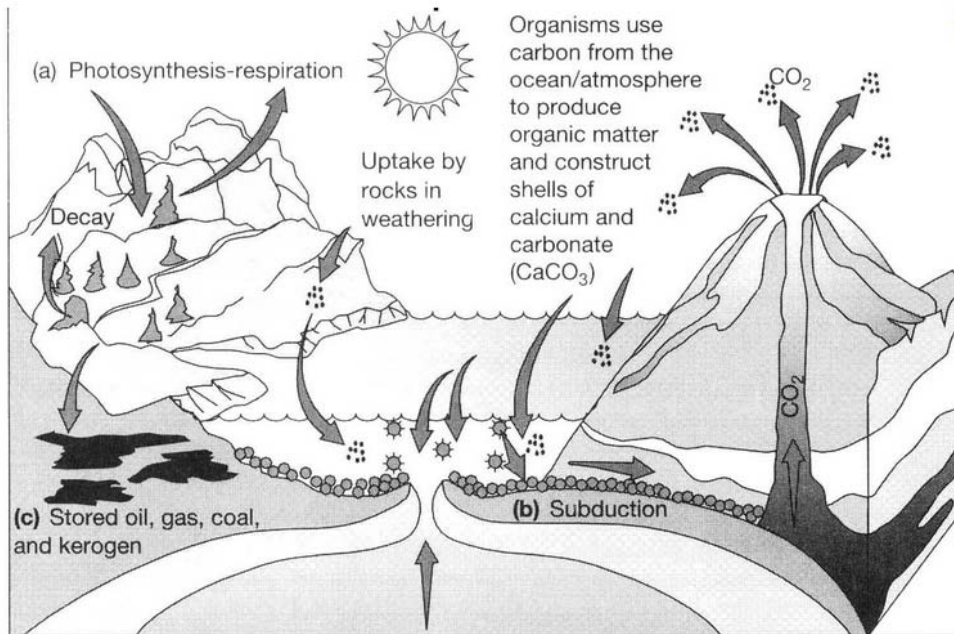
What organisms in the ocean supply the Earth with oxygen and how?



**Example 3**

How do oceans play a role in the carbon cycle?

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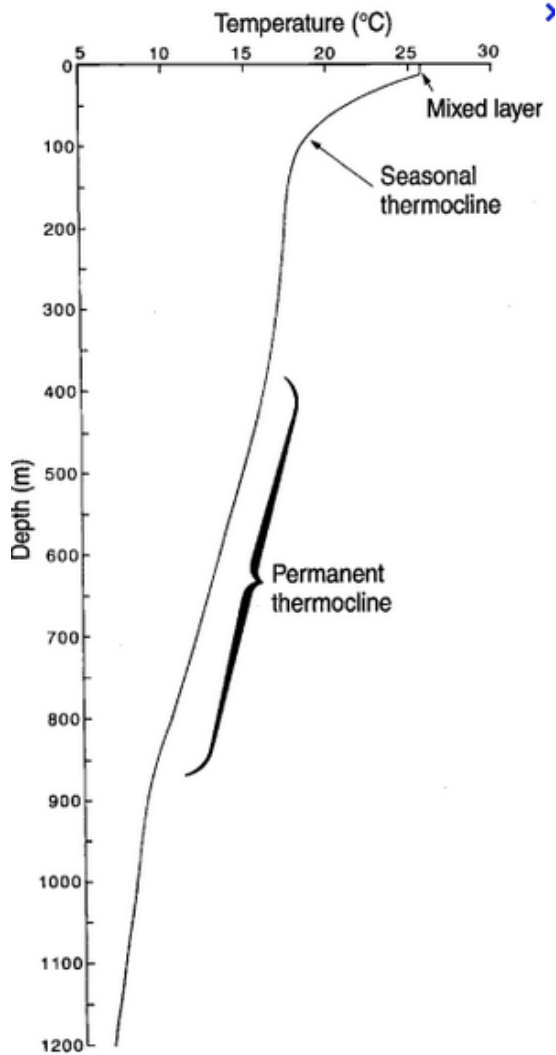
**Example 4** How do oceans affect weather and climate?

**b) Ocean Temperature**

Three factors affect ocean temperatures:

- (1) Depth
- (2) Season
- (3) Latitude

**Example 1** The following data was collected in 1983 at 33°N and 43°W. Which ocean was it taken from and during what season?



**Example 2** What do you notice about the mixing layer's temperature? Why is this so?

**Example 3** Why is the temperature so low at a depth of 1100 m?

**Example 4** How will seasons affect the curve in the previous example?

**Example 5** How do seasonal ocean temperature changes compare to those from the continent?

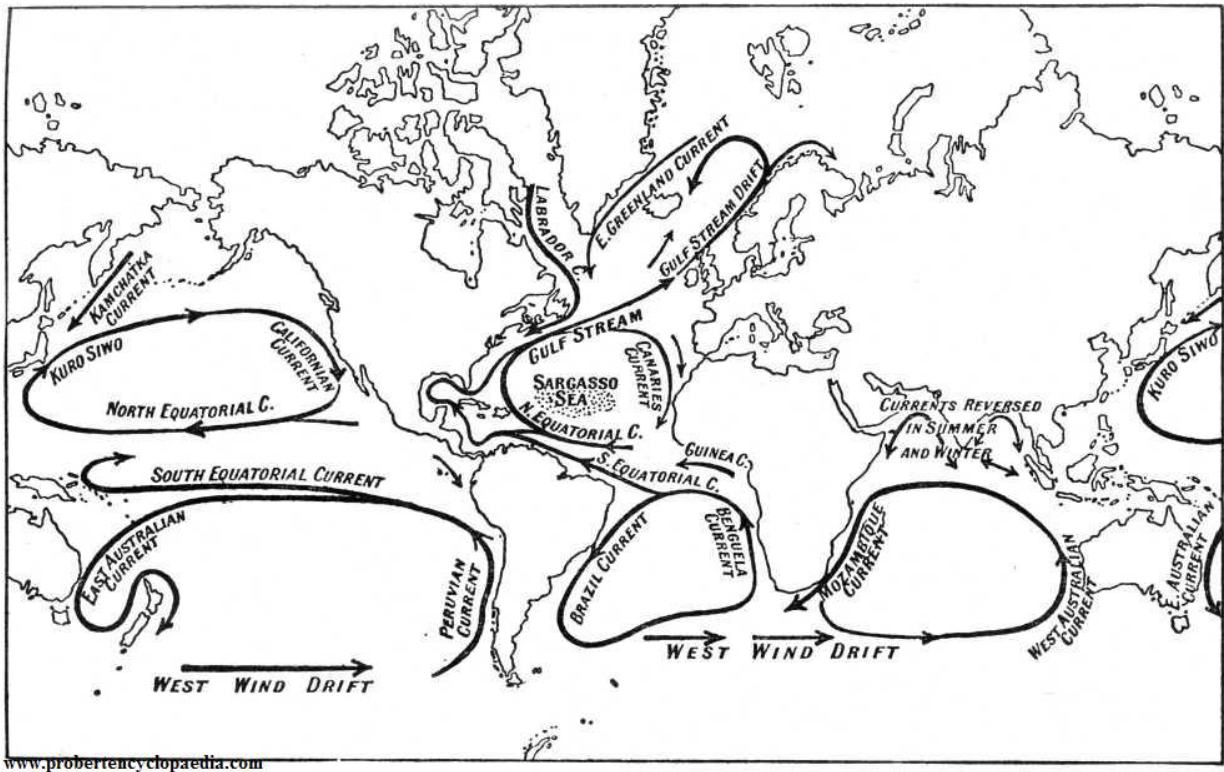
**Example 6** Which latitudes will have the warmest ocean temperatures?

c) **Ocean Currents**

1. **Definitions:**

## IMPORTANT TOPICS NOT included IN YELLOW BOOK

- An ocean current is the movement of the seawater in a certain direction and over a large distance .
- Ocean circulation refers to the combined movement of several ocean currents.



**Example 1** Which current bring cold waters to Quebec and Maritime beaches?

**Example 2** What will be warmer in the winter: eastern or western Florida waters? Why?

## 2. Factors Affecting Currents

## IMPORTANT TOPICS NOT included IN YELLOW BOOK

Oceanic currents are driven by several factors.

- One is the rise and fall of the tides, which is driven by the gravitational attraction of the sun and moon on Earth's oceans. Tides create a current in the oceans, near the shore, and in bays and estuaries along the coast. These are called "tidal currents." Tidal currents are the only type of currents that change in a very regular pattern and can be predicted for future dates.
- A second factor that drives ocean currents is wind. Winds drive currents that are at or near the ocean's surface. These currents are generally measured in meters per second or in knots (1 knot = 1.15 miles per hour or 1.85 kilometers per hour). Winds drive currents near coastal areas on a localized scale, and in the open ocean on a global scale.
- A third factor that drives currents is thermohaline circulation - a process driven by density differences in water due to temperature (thermo) and salinity (haline) in different parts of the ocean. Currents driven by thermohaline circulation occur at both deep and shallow ocean levels and move much slower than tidal or surface currents.

Example 1      What kind of tide would result in a tidal current away from the land?

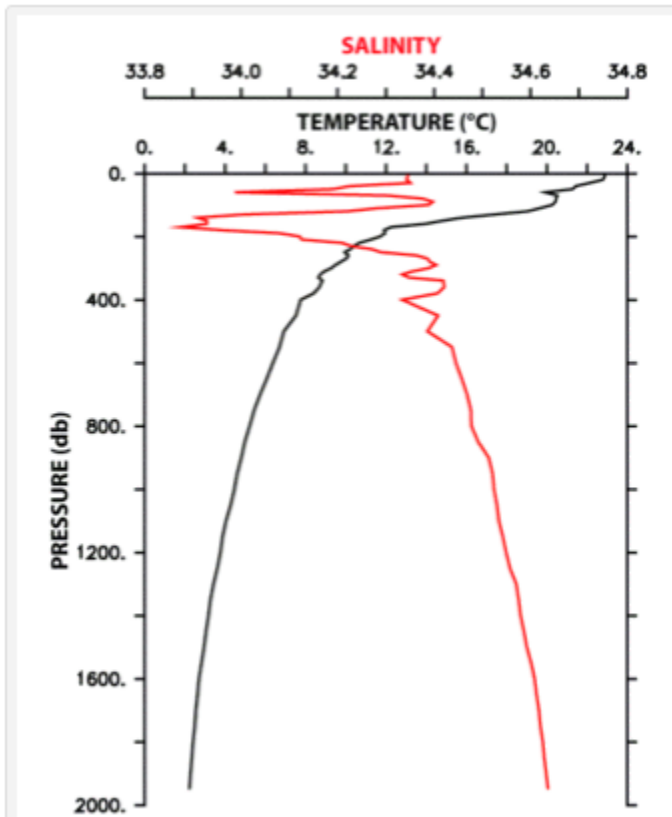
Example 2      What is about the earth that combines with wind to create the curved effect of ocean currents?

Example 3      Will warm water near the equator sink or will it remain above colder water to the north? What effect does this have on the water in Northern latitudes?

### Exercises

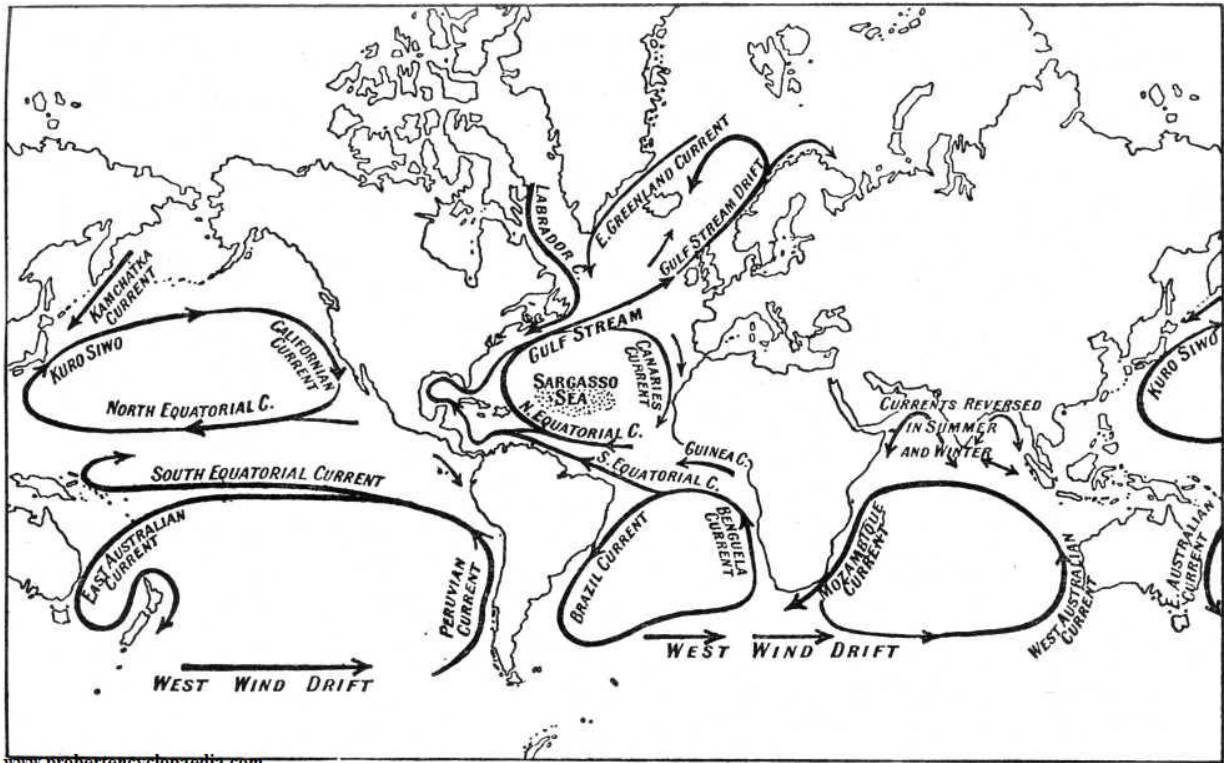
IMPORTANT TOPICS NOT included IN YELLOW BOOK

1. Classify as freshwater or sea water
  - a) Water with 700 ppm of salt.
  - b) Water with a m/V concentration of 0.03%. Convert to ppm first.
  - c) The water in Lake Superior
  - d) The St-Lawrence River between Quebec city and Montreal
  - e) The St-Lawrence River near Gaspé
  - f) The Southern Ocean
2. What three types of freshwater do inland bodies include?
3. Where is most our freshwater tied up?
4. How do topography and geology each affect the way water flows within a watershed?
5. Which watershed extends from northern Quebec to the northeast into Ontario and Manitoba?
6. What part of the hydrosphere supplies the Earth with most of its oxygen?
7. Give two reasons why Boston is generally warmer than nearby Worcester, especially in late fall and winter.



8. The data shown was collected at 20N, 121 W, between Asia and N America.
  - a) Which ocean was measured?
  - b) Which season was the water's temperature recorded in?
  - c) Why is so cold past a couple of hundred meters in depth?
  - d) Are deeper waters saltier?
  - e) Why?
9.
  - a) Which are the two coldest oceans?
  - b) Which is the warmest of the 5 oceans?

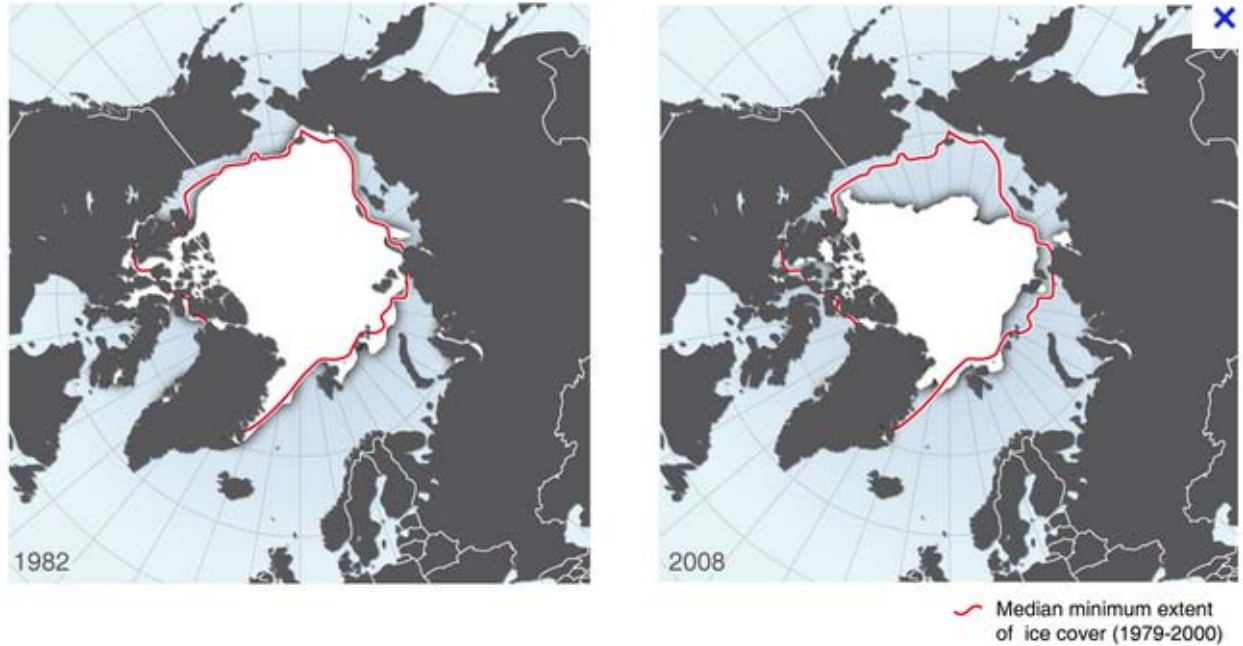




10. a) Examine the above map and figure out why California waters are cold in the winter.  
b) In which ocean does the Labrador current originate?
11. What three factors affect ocean currents?
12. Why is Arctic water less salty than the Indian Ocean?

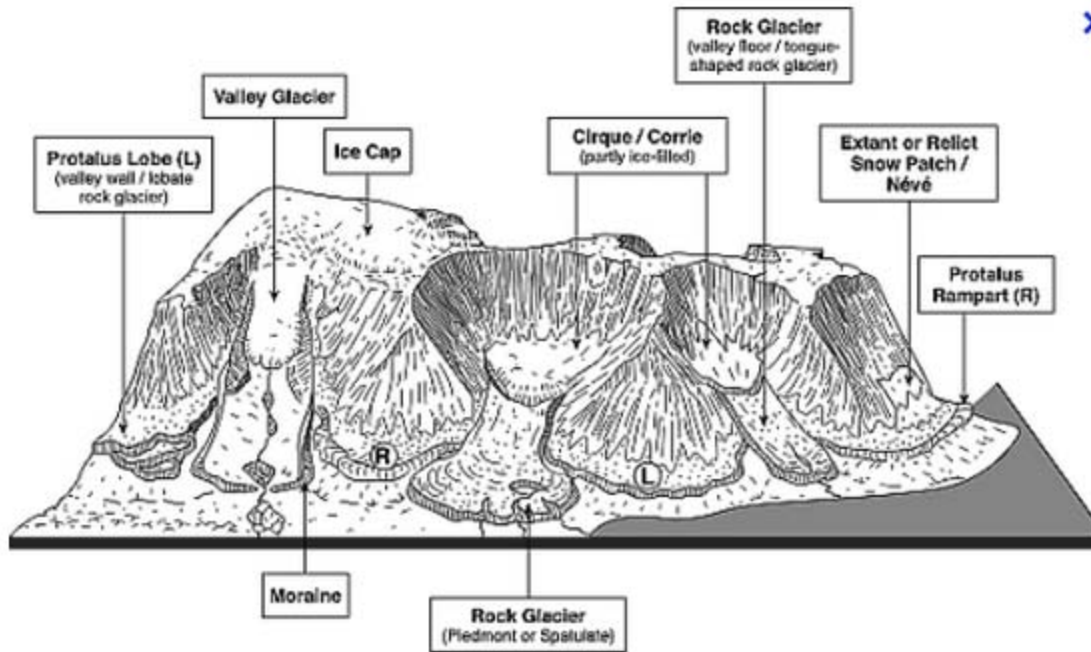
4. The Hydrosphere's Cryosphere:

**A-Pack Ice:** (Sea Ice) They are large sheets of ice found in the oceans around Antarctica and in the Arctic Ocean. Smaller ones are called *ice floes*.



Example 1: What are the consequences of melting pack ice?

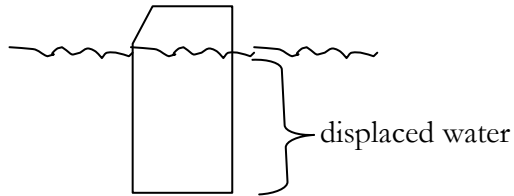
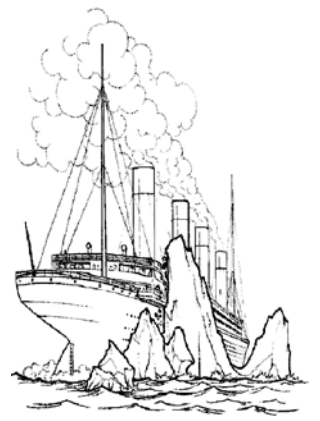
**B-Glaciers:** These persistent sheets of ice at least 50 m thick are found on land, on mountaintops at mid or high latitudes and elsewhere on continents. Large glaciers are known as ice sheets or ice caps.



**Example 1** How do glaciers form?

**Example 2** a) How are glaciers related to icebergs?

b) **STE only** Prove that over 90% of an iceberg is submerged. The density of ice is  $0.917 \text{ g/cm}^3$ . Use the idea that the buoyant force is the product of  $g$  and the **mass of water displaced** by a floating object. The buoyant force balances the weight of the floating object. Assume  $1.00 \text{ g/cm}^3$  for water's density. (STE diversion)



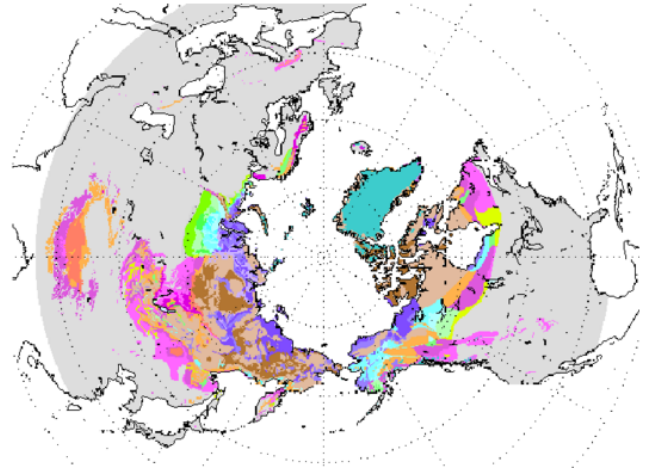
**Example 3** When does sea level rise?



### C-Permafrost

1. What is permafrost?
2. Large parts of northeastern Russia and almost 50% of Canada's land can be frozen up to a depth of 0.5 km.

Where else is this permafrost found?



3. What can happen to the top part (active layer) of permafrost during summer?
4. a) How could climate change lead to large amounts of methane being produced?  
b) What's wrong with releasing methane into the atmosphere?

**EXERCISES**

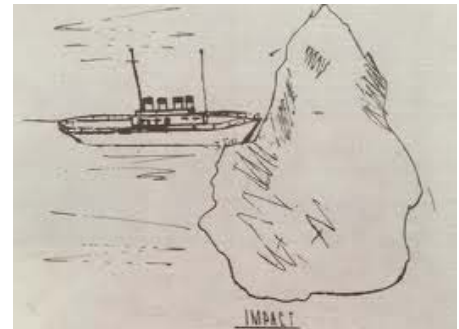
1. Why do parts of British Columbia have permafrost even though its northern boundaries are south of the Arctic Circle?
2. a) How is methane released from permafrost?  
b) What actually produces it?  
c) What do the microorganisms act as?



3. a) What is the active layer of permafrost?  
b) Is it possible for the active layer not to exist in certain areas?
4. Is a sandy area less likely to be flooded? Why or why not?
5. a) How do storm drains help during heavy rainfall?  
b) What can act as a natural storm drain?  
c) How does deforestation affect the amount of water that ends up in a river?

6. What is the difference between a glacier and an iceberg?

7. If sea water has a density of  $1.027 \text{ g/cm}^3$ , what percentage of an iceberg will be submerged if ice's density =  $0.917 \text{ g/cm}^3$ .



8. What can cause ice sheets(glaciers) to leave land? What will subsequently happen to sea level?

9. a) What happens to the volume of water if an already submerged ice cube melts?  
b) In what way does this not contradict the answer from 9(a)?

10. What is the difference between pack ice and a glacier?

34. **The Hydrosphere: Sources of Energy**

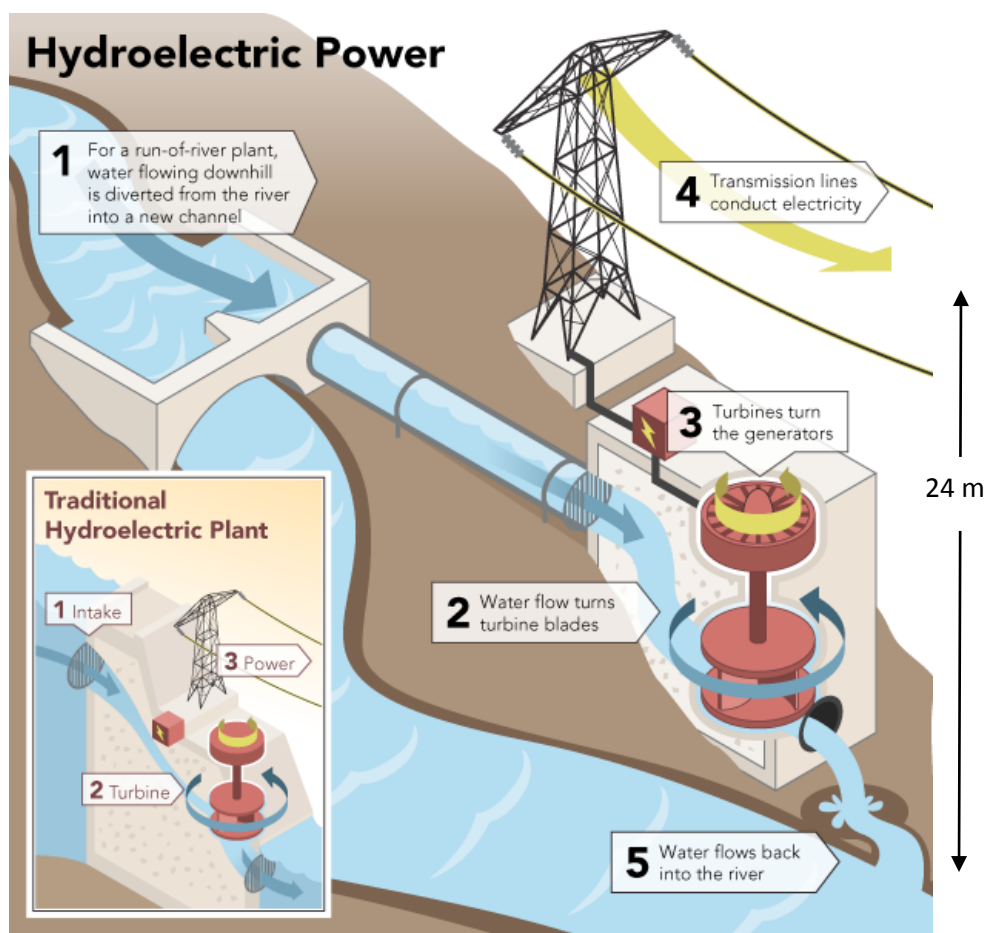
There are two major sources of energy from the hydrosphere, both of which are renewable.

- (1) Tide or ocean current powered turbines.
- (2) Hydroelectricity powered by dammed rivers.

DE BEAUHARNOIS  
ACTIVITY (STE only)

1. a) Calculate the energy of the water rotating the turbines **every second**, using the following figures:

- The height difference between the entrance and exit for the water going through the turbines is 24 m.
- Three Olympic sized pools of water pass through the Beauharnois turbines every second.
- $2.9 \times 10^6 \text{ L}$  = volume of one Olympic sized pool; density of water = 1.0 kg/L
- $g = 9.8 \text{ m/s}^2 = 9.8 \text{ J}/(\text{kg}\cdot\text{m})$



b) The total power generated by the 38 units of the Beauharnois plant is  $1911 \times 10^6 \text{ W}$  (1911 MW). Using the answer in (a), calculate the efficiency of the conversion from water's potential energy into electrical energy.

- c) Where does the wasted energy go?  
 There are two processes that convert it to heat.

Fill in the blanks:

- (1) Copper loss:

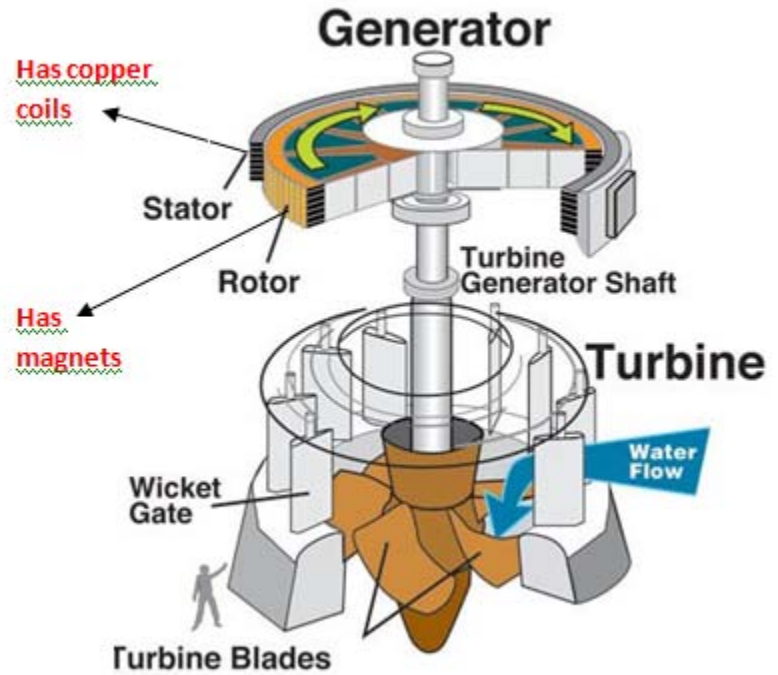
The moving magnets in the rotor cause the magnetic field to change. This forces the \_\_\_\_\_ in the surrounding copper coils to flow. But as the amount of charge per second or \_\_\_\_\_ increases, heat loss also increases.

- (2) Magnetic loss:

The continuous movement of the magnetic particles in the rotor's magnets, as they try to align themselves with the magnetic field, produces molecular friction. This, in turn, produces \_\_\_\_\_.

- (3) Mechanical friction:

Moving parts, through friction, can generate heat. This can be minimized through \_\_\_\_\_.



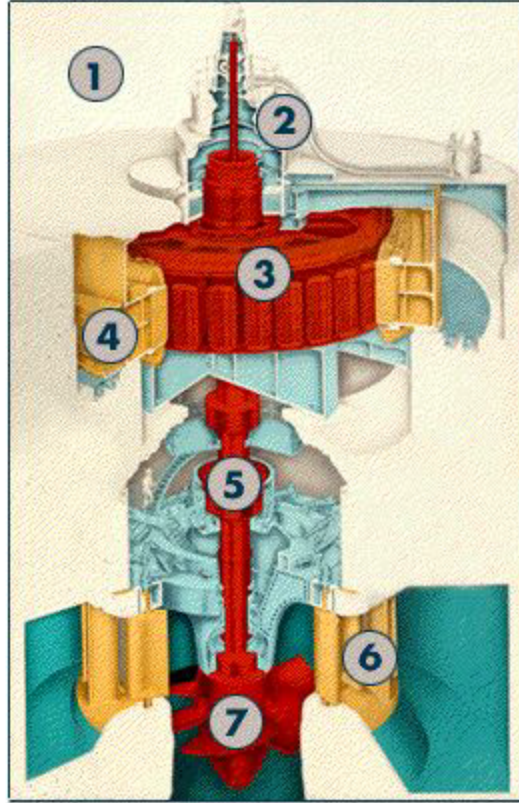
- d) Use the values in (c) to estimate the temperature *increase* that could potentially result after the generators work for 1 hour. Assume that in that time period, only 30% of the heat stays in the building. The building's dimensions are 1000m by 100 m by 60 m. The specific heat of air is 1,0 J/g°C, and its density is about 1.0 g/L. There are 1000 L in 1 m<sup>3</sup>.



2. Read the following and answer the questions that follow.

## Inside a Hydropower Generator

1. Water flows through the dam and turns a large wheel called a turbine. The turbine turns a shaft which rotates a series of magnets past copper coils and a generator to produce electricity. The process produces clean renewable energy.
2. The Kaplan Head is the hydraulic associated with adjustable blades on the turbine. Adjustable blades operate efficiently despite variations in water flow and energy demands.
3. The rotor is a series of magnets. It's the rotating portion of the generator where the magnetic field is created.
4. The stator is the stationary part of the generator made of coils of copper wire. Electricity is produced as the rotors spin past the stationary wiring.
5. The shaft connects the turbine to the rotor section of the generator. All three elements, the turbine, shaft, and rotor turn at the same speed of 90 revolutions per minute.
6. The wicket gates are a series of 20 adjustable vanes, resembling vertical blinds. They control the volume of water flowing through the turbine.
7. The 172 ton hydraulic turbine resembles a large water wheel. The turbine converts the energy of falling water into mechanical energy to drive the generator.



- a) In the components of part 3, what metallic elements are most likely to be found?
- b) What causes the magnetic field of the rotor to change, which in turn forces electrons to flow out of the copper coils?
- c) In what numbered part are the copper coils found? \_\_\_\_\_
- d) Why is copper chosen as the material in the stator? \_\_\_\_\_
- e) How many direct links are there between components 3, 5 and 7. \_\_\_\_\_
- f) How does the speed of the shaft compare to that of the turbines and rotor? \_\_\_\_\_

IMPORTANT TOPICS NOT included IN YELLOW BOOK