SNC1D
CHAPTER 1: NUTRIENT CYCLES & ENERGY FLOW

1.2: THE BIOSPHERE & ENERGY

What is the SOURCE of energy, that is the fuel, for each of the following:

- A campfire _____
- A car _____
- Migrating birds _____

When you eat, you are putting energy, or calories, into your body.

What is the original source of that energy? _____

Photosynthesis and the Sun's Energy (See Textbook Pages 21 to 24)

Energy enters most ecosystems in the form of _____.

Organisms, called _____, convert this energy into **chemical energy** using a process called _____. All organisms who cannot make their own energy are called _____and they are directly or indirectly dependent on the output of producers.

Photosynthesis is a relatively complicated process that takes place inside of small disc-like **chloroplasts** found in plant cells. Chloroplasts contains **chlorophyll –** a light-trapping molecule that gives leaves their green colour.

See Figures 1.12 and 1.13 on page 22.

Write the **word equation** that summarizes the photosynthesis reaction:

_____

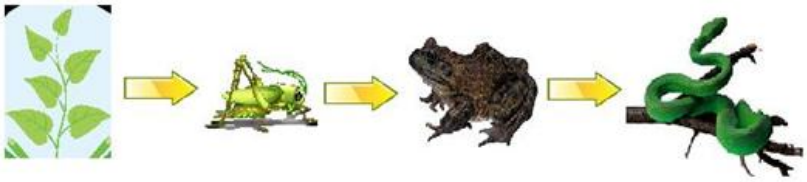
Write the **chemical equation** that summarizes the photosynthesis reaction:

_____

Trophic Levels (See Textbook pages 24 and 25)

A _____ is the pathway along which food is transferred from one organism to another. Organisms are divided into _____to help us determine where they fit into an ecosystem.

- **Producers** will always be positioned in the **first trophic level**.
- **Primary consumers**, those that consume only producers, are at the **second trophic level**.
- **Secondary consumers** are at the **third trophic level**, and so on.

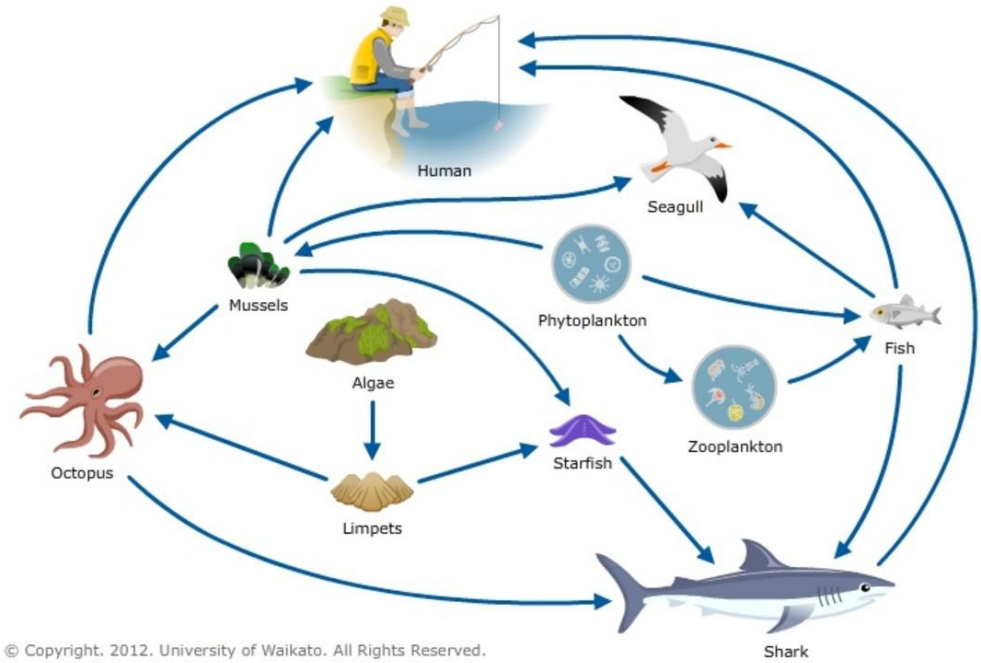


FOOD CHAIN... Note that the arrows are in the direction in which the food is going.

_____(e.g., worms, maggots, bacteria) are a special type of consumer that break down organic wastes and the remains of dead organisms at all of the trophic levels.

See Figure 1.15 on page 24

In most cases a consumer such as a snake will eat several other animals and therefore may fit into a variety of different food chains. If the food chains are woven together they form a _____.



FOOD WEB

Trophic Efficiency (See page 25 of your textbook)

The amount of energy that is transferred along a food chain decreases considerably from trophic level to trophic level. Only about **10 %** of the energy available at each trophic level is converted to new biomass at the next trophic level. The other 90% of available energy is used as energy for **respiration** and **body functions**, or it is **lost as waste**.

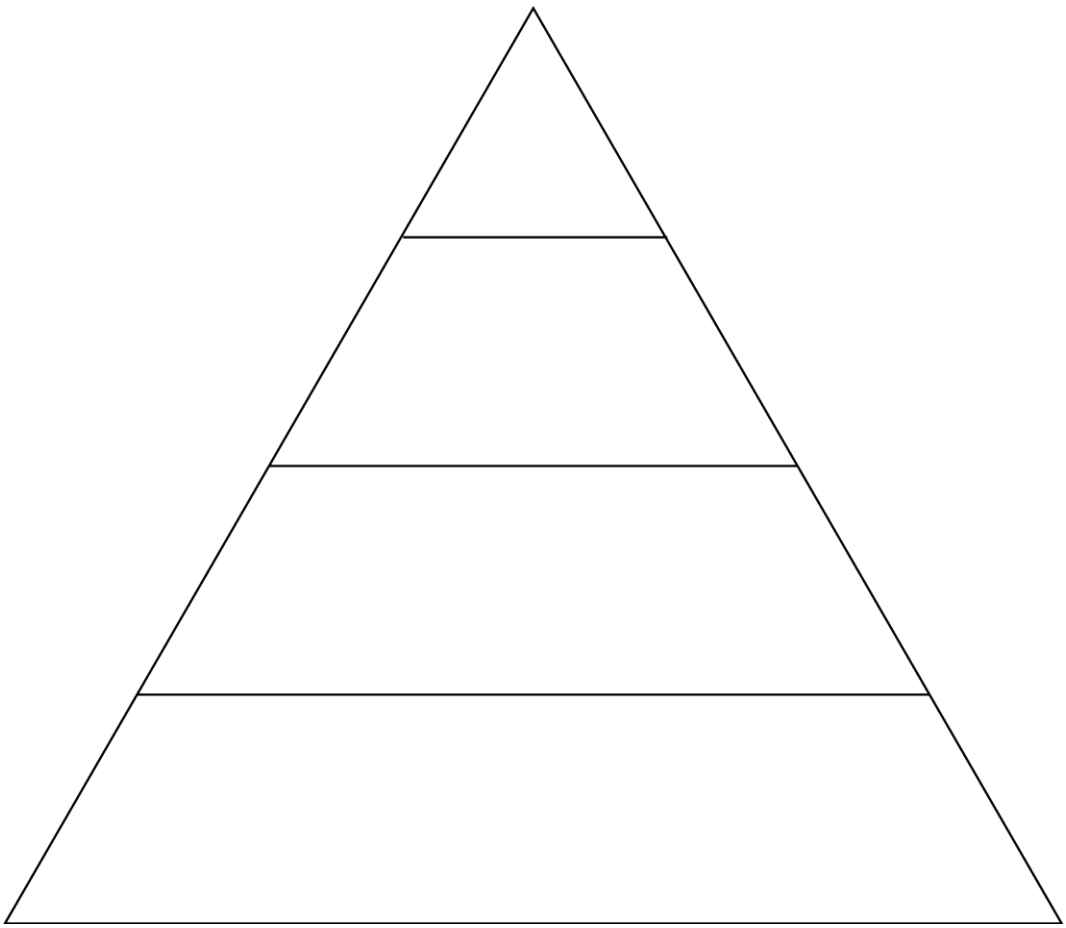
A Food Pyramid

BLM 1-14

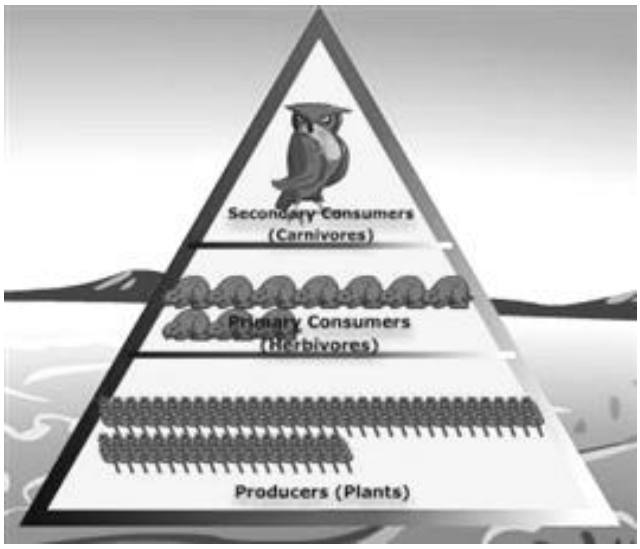
Use the information below to create a food (or energy) pyramid. Label your pyramid and describe each level. Be sure to include the number of energy units stored at each level.

See **Figure 1.16 on page 25** for an example.

Algae is eaten by Arctic cod who are then eaten by ringed seal. Seals are then hunted by polar bears and consumed.



Another type of pyramid is one that is based on **POPULATION.** The decrease in available energy for new biomass limits the **number** of organisms at higher trophic levels resulting in fewer individuals of a species as you move along.



A **population pyramid**.

Consumers and Producers

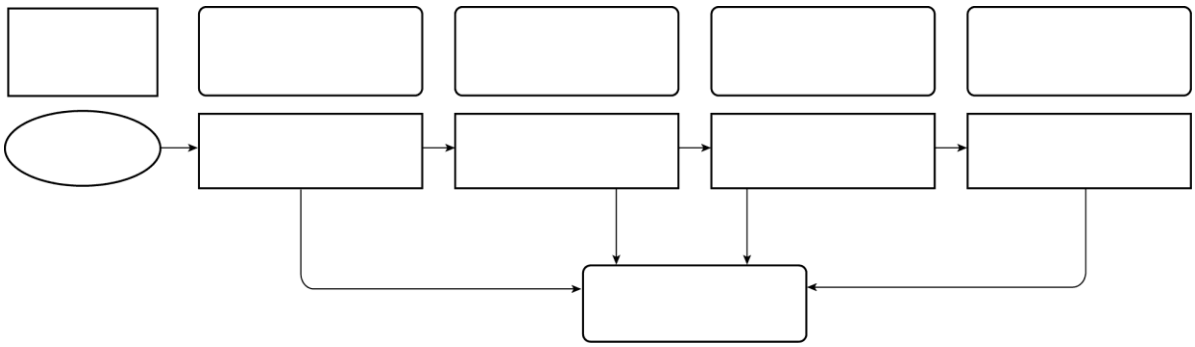
BLM 1-15

Draw and label a food chain to illustrate the following information.

Algae is eaten by Australian black fish who are then eaten by trout. The trout are caught by fishermen and consumed.

Use the following labels to help you.

- first trophic level
- second trophic level
- third trophic level
- fourth trophic level
- primary producers (plants)
- primary consumers (herbivores)
- secondary consumers (carnivores)
- tertiary consumers (top carnivores)
- decomposers
- Sun energy



Bioaccumulation **(See Textbook Page 26)**

Another factor that will affect the populations of species particularly at higher trophic levels is the accumulation of_____.
Poisons can be passed along a food chain. The concentration of toxins, especially those that are fat soluble, increase in higher order carnivores in a process called **bioaccumulation**. Top carnivores (e.g., ospreys, falcons) at the ends of longer food chains suffered declines in population size in the 1970's due to the accumulation of a fat soluble pesticide called DDT. DDT has since been banned here in Canada.

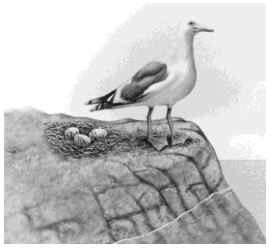
How toxins can accumulate:

1. A marsh is first sprayed with a pesticide to control mosquitoes.
2. Trace amounts of the pesticide accumulate in the aquatic microorganisms.
3. Insect larvae that feed on the microorganisms eat a large quantity and the toxins accumulate.
4. This process of accumulation continues through small fish, larger fish, and then to top carnivores such as hawks, gulls, and falcons. **See figure 1.17 on page 26**

Understanding the Mathematics of Biomagnification

BLM 1-17

Calculate the concentration of PCBs that biomagnify in the tissues of herring gulls by tracing how the concentration increases throughout the herring gull's food web. For example, to determine the concentration of PCBs in phytoplankton, "magnify" or multiply the concentration of PCBs in water (0.000 002 ppm) by 1250.



Water	Phytoplankton	Zooplankton	Rainbow Smelt	Lake Trout	Herring Gull & its eggs
0.000 002 ppm	x 1250	x 49.2	x 8.46	x 4.64	x 25.67
PCB concentration					

Questions:

1. How many times (by what factor) has the concentration of PCBs increased from the water to the herring gull?

2. Think of the food web that you are part of. Do you think biomagnification is affecting your health? Explain.

Section 1.2 Review

1. Select the correct description of photosynthesis.

___ Carbon and oxygen from carbon dioxide gas is combined with hydrogen from water.
___ Light energy works on chlorophyll in green plants to produce a glucose. A by-product is oxygen.
___ Glucose from foods and oxygen combine to produce carbon dioxide gas, water, and energy.

2. Circle the building blocks of carbohydrates.

oxygen phosphorous hydrogen nitrogen carbon

3. The table outlines the process of photosynthesis. Circle the statements in the table that indicate why photosynthesis could be the most important process on Earth.

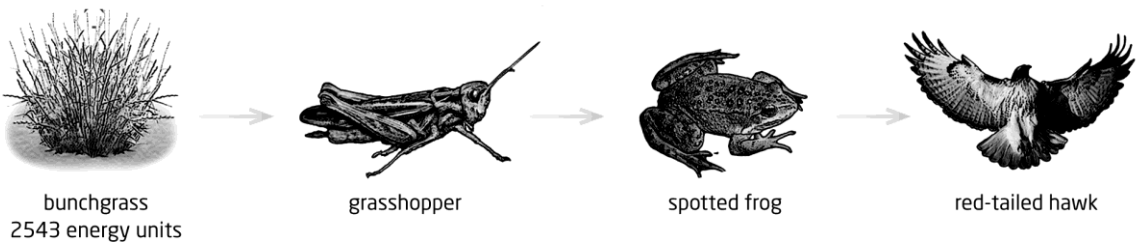
	Photosynthesis
1. What is it?	A series of chemical changes in which green plants capture and convert Sun light energy to energy-rich food like sugar.
2. Which living things use it?	Only green plants and certain single-celled organisms.
3. How is energy changed?	Light energy is changed to chemical energy.
4. What substances does it use?	carbon dioxide and water
5. What substances does it produce?	glucose and oxygen
6. How can it be represented?	light energy + carbon dioxide + water → glucose + oxygen
7. Why is it important?	**1.** It transforms light energy into a form that living things can use to survive. **2.** It produces oxygen that most living things needs to survive.

4. Complete the statement about producers and consumers by circling the correct words.

A producer such as a plant / movie financier / breeder is an organism that can make enemies / nutrients / wastes for itself and others.

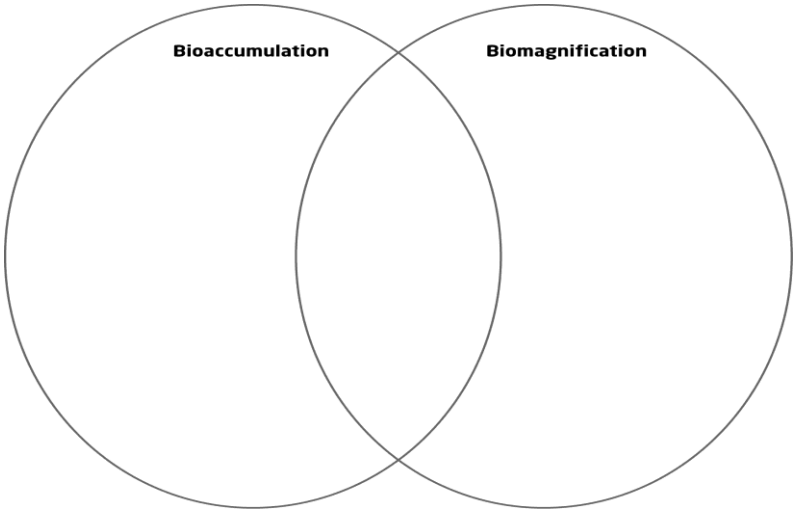
A consumer is an organism that feeds on / is relied on / cooperates with other organisms.

5. Complete the diagram of the energy exchange at each trophic level in the food chain. The trophic efficiency at each level is 10 percent.



6. What happens to the energy that does not move up to the next trophic level?

7. Complete the Venn diagram contrasting bioaccumulation and biomagnification.



8. Complete the statement. [See Figure 1.17 on Page 26]

A lake is located beside an abandoned manufacturing factory. The factory is leaking chemicals into the lake. The chemicals are absorbed by the phytoplankton, which are consumed by zooplankton. Small fish eat zooplankton and larger fish eat smaller fish. I expect the small / large fish to have higher levels of chemicals because _____

_____