IB Biology: Ecology Review (4.1-4.4) **NAME:** Mr. Cedarbaum

1. What is missing from an **ecosystem** if I just list all the *organisms* found there?

The abiotic (non-living) surroundings

2. What are all the organism populations in an ecosystem called, together?

A community

3. Describe the purpose of quadrat sampling and how it is done:

- A way to estimate the size of a (non-motile) population by random sampling.
- Quadrats (square frames) are randomly placed throughout a habitat and organisms are counted within each frame.
- Quadrat count is scaled up, proportional to habitat size.

4. Based on species frequency data, below, use a chi-squared test to determine if there is a significant association between these two species:

Species	Frequency
Cattails only	6
Seaweed only	8
Both species	11
Neither species	5

Table 3-1 Critical Values of the χ^2 Distribution

					P	
df	0.995	0.975	0.9	0.5	0.1	0.05
1	.000	.000	0.016	0.455	2.706	3.841
2	0.010	0.051	0.211	1.386	4.605	5.991
3	0.072	0.216	0.584	2.366	6.251	7.815
4	0.207	0.484	1.064	3.357	7.779	9.488
5	0.412	0.831	1.610	4.351	9.236	11.070

a. Draw a contingency table of observed values:

	Cattail	NO Cattail	
Seaweed	1: 11	2: 8	19
NO Seaweed	3: 6	4: 5	11
	17	13	30 — grand total

b. Calculate degrees of freedom: 1

~~c.~~

d. Determine the critical value: 3.841

e. Calculate the chi-squared value:

$X^2 = 0.032$

Expected Values:

$F_{E1} = \frac{19 \times 17}{30} = 10.77$

$F_{E2} = \frac{19 \times 13}{30} = 8.23$

$F_{E3} = \frac{11 \times 17}{30} = 6.23$

$F_{E4} = \frac{11 \times 13}{30} = 4.77$

f. Explain whether there is a significant association:

No significant association exists since the X^2 value is less than the critical value (3.841).

5. Where does energy come from on the earth? What happens to it as it gets passed through the food web?

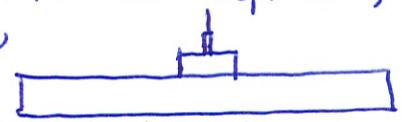
Sunlight is the initial energy source for most ecosystems. Energy flows through food chains by consumption, but is also lost along the way (see #6).

6. What are nutrients? What happens to them as they get passed through the food web?

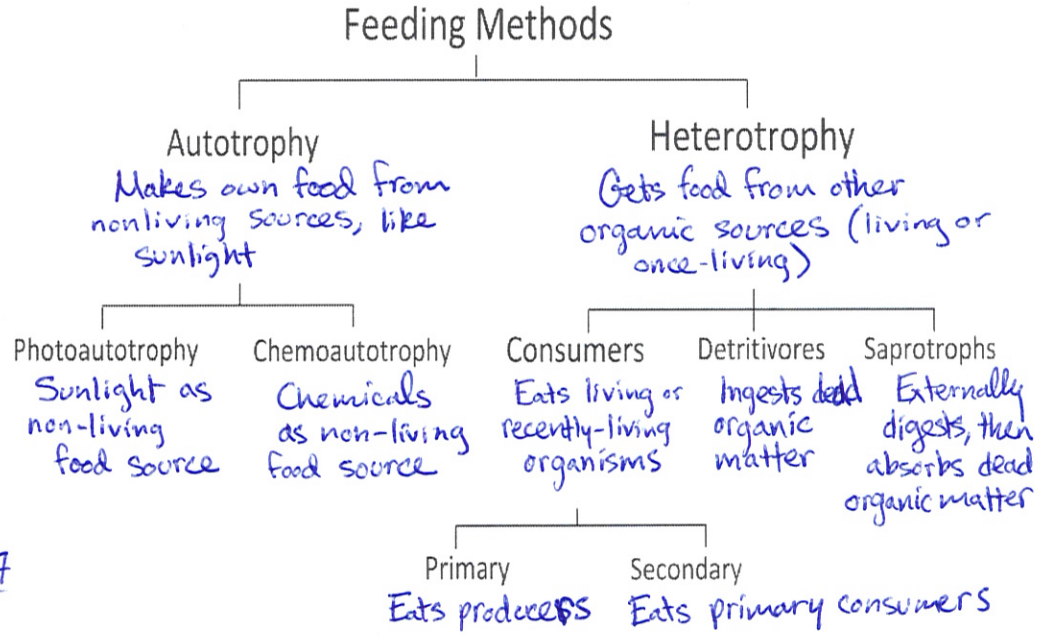
Nutrients are molecules organisms need to live and grow. Nutrients move through food chains by consumption and are recycled back into the soil for producers, by decomposers, once organisms die.

7. Why is there a limit to the number of trophic levels an ecosystem can support? Draw an accurately-sized trophic pyramid with four tiers to support your answer:

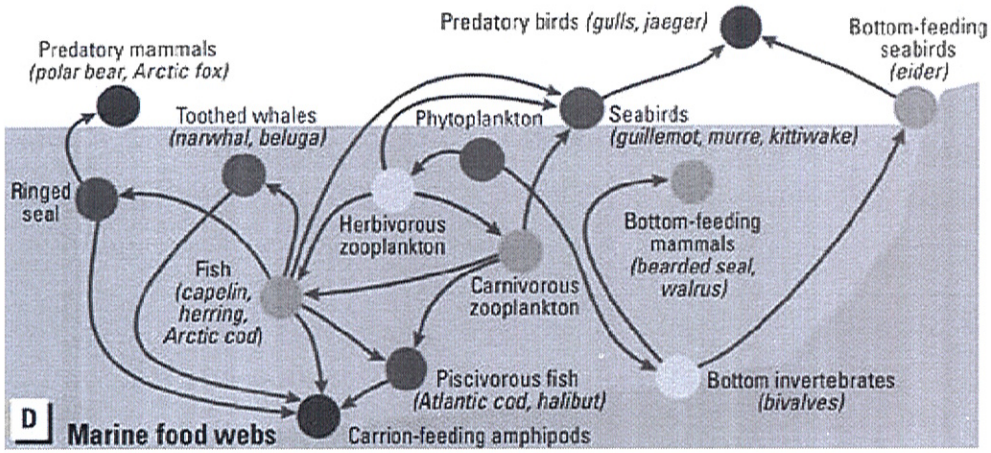
Since ~90% of energy is lost in transition between each trophic level due to (1) heat loss from respiration, (2) material not consumed, digested, or assimilated, (3) excretion



8. Complete the tree below with definitions and examples of each type of feeding strategy:



9. Use the food web below to answer the following question:



a. Identify one example of each of the following trophic levels: (answers may vary)

- Producer: Phytoplankton
- Primary consumer: Herbivorous Zooplankton
- Secondary consumer: Fish
- Tertiary consumer: Toothed whales
- Decomposer: Carrion-feeding amphipods

b. Using an example from the diagram above explain how organisms can be at multiple trophic levels:

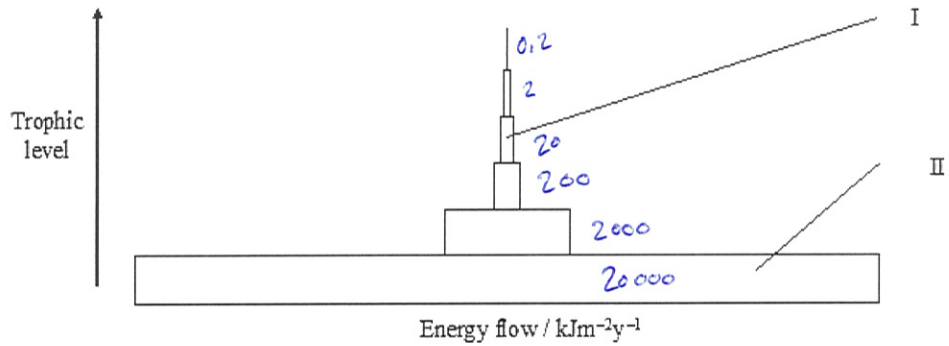
The fish can be a primary of a secondary consumer depending on the food chain followed from phytoplankton

c. Write two food chains, below, from the food web above:

Phytoplankton → Herb. Zooplankton → Seabirds → Predatory birds

Phytoplankton → Bottom Invertebrates → Bottom-feeding sea birds → Predatory birds

10. Use the diagram below to answer the following questions:



a) State the trophic levels of organisms I and II:

I: tertiary consumer

II: producer

b) Describe what happens to the roughly 90% of energy not passed to the next level of the trophic pyramid. Include two examples of how energy is lost:

1) Lost as heat produced in cell respiration
2) Material not consumed (eaten), digested, or assimilated
3) Material excreted (feces)

c) If organism II originally contained 20,000 Calories of energy. How much energy would be obtained by organism I?

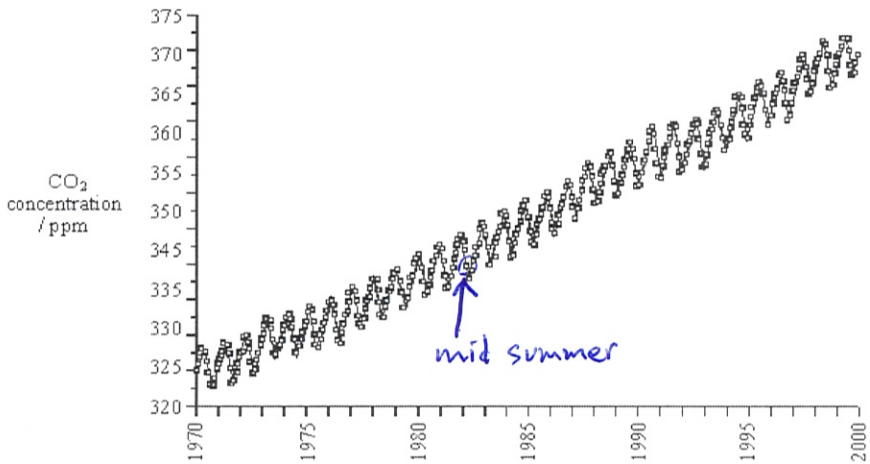
20 kJ $m^{-2}yr^{-1}$

d) Which organism (I or II) would there be a greater **biomass** (amount) of in this ecosystem and why?

Organism II since it is the energetic base upon which the entire foodchain is based.

11. The topic of increasing carbon dioxide levels in the atmosphere has been the source of intense debate with regard to climate change in recent years.

The graph below shows the variation in the concentration of atmospheric carbon dioxide since 1970.



[Source: C D Keeling and T P Whorf, *Atmospheric CO_2 concentrations (ppm) derived from in situ air samples* collected at Mauna Loa Observatory, Hawaii]

The annual fluctuation is mainly the result of changes in the levels of photosynthesis associated with the seasons in Northern Hemisphere forests.

a. Describe the overall trend shown in the graph:

Over the past 30 years, CO_2 concentration in the atmosphere has been increasing

b. Suggest one anthropogenic (human) impact and one natural cause that could have led to the overall trend shown in the graph:

Human: combustion of fossil fuels

Natural: forest/prairie fires, decreases in photosynthesis

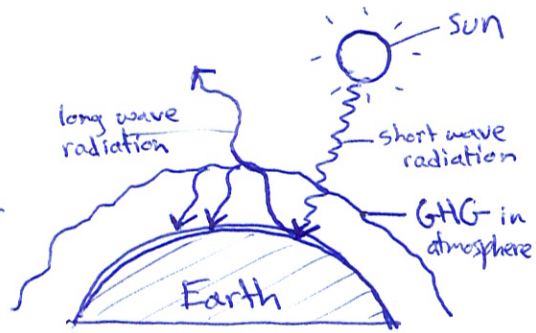
c. Identify with an arrow any one point where the graph is in **mid-summer**.

d. Explain the seasonal fluctuations in CO_2 levels:

CO_2 increases in the fall/winter when many terrestrial producers in the northern hemisphere are less active, then decreases when they regrow and increase rates of photosynthesis in the spring/summer.

12. Explain, with the aid of a labeled diagram, the **greenhouse effect**.

- short wave radiation from sun passes through Earth's atmosphere.
- Some is absorbed by surface as heat, the rest is reflected as long-wave radiation
- Some of this radiation is trapped by GHGs in lower atmosphere, the rest is reflected back into space



13. Identify three greenhouse gases *other than* **carbon dioxide**.

Methane, Water vapor, Nitrous Oxide, CFCs

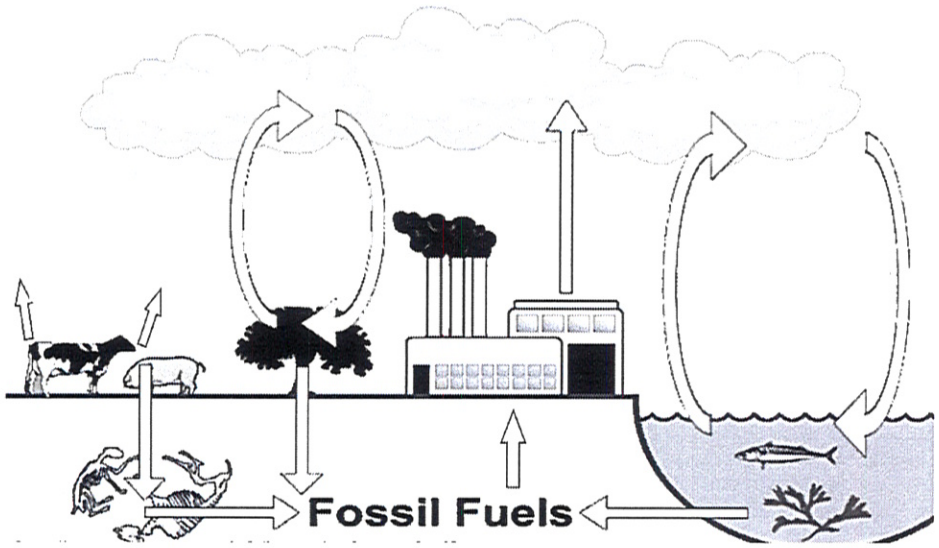
14. Explain how **increased** atmospheric levels of greenhouse gases lead to an **enhanced** greenhouse effect.

More greenhouse gases in atmosphere cause more long-wave radiation to be trapped, raising global temperatures

15. Outline at least 4 possible consequences of a global temperature rise due to climate change:

- Melting sea ice/ice caps + rising sea levels
- Extinction of various species
- Migration of temperature-sensitive species, causing ripple effects through food webs
- Flooding of coastal habitats
- More frequent fires and droughts and stronger storms.

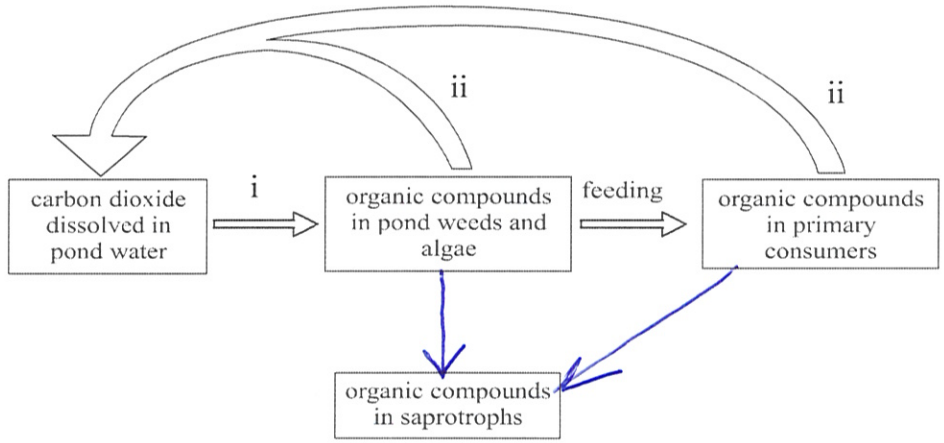
16. Annotate the diagram of the carbon cycle, below, to indicate the ways in which carbon-based matter flows between the Earth and the atmosphere:



17. Describe the role played by each of the following in the carbon cycle:

- Peat formation
  A carbon sink of partially-decayed organic matter but also a major producer of methane.
- Limestone formation
  Stores dead matter of shelled sea creatures in rock form in oceans.
- Combustion
  Reacts carbon matter / fossil fuels with heat and oxygen to release energy — CO_2 is a major waste product.
- Methanogenesis
  Archaea produce and release methane as part of their metabolism.
- Carbon fixation / photosynthesis
  CO_2 is removed from air and fixed as organic molecules (i.e. glucose) in producers
- Fossilization of organic matter
  Dead organic matter is buried beneath layers of Earth — pressure and heat over millions of years turn it into oil, gas, or coal.

18. The diagram below is part of a carbon cycle diagram for a pond ecosystem:



(a) State the names of the processes (or *fluxes*) that:

(i) convert carbon dioxide into organic compounds in pond weeds and algae (producers):

Photosynthesis

(ii) convert organic compounds in pond weeds, algae and primary consumers into carbon dioxide:

Respiration

(b) Draw arrows on the diagram above to show how the saprotrophs obtain carbon.