Using the text: Allott, Andrew, and David Mindorff. *IB biology*. Oxford: Oxford U Press, 2014. Print.

1. Read/ Study Chapter 4 Ecology pages 201-240.
2. Preparation Work
    a. All problem data questions and end of the chapter problem set.
    b. Practice with PIB Questions (attached).
3. Be prepared to review and answer questions during first class meeting on August 17, 2017.
4. Test covering this topic area will take place August 21, 2017.
5. Although I will be traveling at different times, you may contact me at my school email address if you have questions.

Topic Sheet Past IB Questions

PIB Questions:

1.
   (a) Describe a method for measuring the size of a population of plants using quadrats. [4]
   (b) Outline, using three named examples, how different plants can be used to provide fuel, clothing and building materials. [5]
   (c) Discuss how C3, C4 and CAM plants are adapted to hot and dry habitats. [9]

2. Explain the factors that cause a population to follow the sigmoid (S-shaped) growth curve. [8]

3. Discuss the relationship between the different nitrogenous waste products and the habitats of birds and amphibians. [5]

4. Explain how energy and nutrients enter, move through, and exit a food chain in an ecosystem. [8]

5. Outline ways in which leaves take part in the carbon cycle in ecosystems, apart from photosynthesis. [4]

6. Describe the flow of energy in an ecosystem. [5]

[5]

7. Draw a food web containing at least eight specifically named organisms properly linked to indicate the energy flow. [4]

8. List four adaptations of xerophytic plants. **[4]**

9. (a) The carbon cycle involves both the production and the fixation of carbon dioxide. Draw a labelled diagram to show the processes involved in the carbon cycle. [5]
(b) Outline the consequences of rising carbon dioxide concentrations in the Earth's atmosphere. [5]

10. Outline the potential harmful effects of increased carbon dioxide concentration on the ecosystem and state one measure that could be taken to reduce the amount of carbon dioxide in the atmosphere. **[6]**

11. Describe a pyramid of energy and the reasons for its shape. **[4]**

12. Outline the effects of factors that increase or decrease the size of a population. [4]

13. Explain the energy flow in a food chain as exemplified by a pyramid of energy. [8]

14. (a) Describe the relationship between the rise in the concentration of atmospheric carbon dioxide and the enhanced greenhouse effect. [5]
   (b) Outline the precautionary principle. [5]

15. All organisms in an ecosystem are involved in the carbon cycle. Outline the roles of living organisms in the carbon cycle. [8]

16. Outline how the energy flow through food chains limits their length. [8]

17. Describe how energy flows through and is used by organisms in ecosystems. [4]

PIB Answers:

1. (a) Describe a method for measuring the size of a population of plants using quadrats. [4
   - random positions for the quadrats;
   - use of random numbers for co-ordinates / other randomisation procedure;
   - many repeats / quadrats;
   - size of quadrat depends on size / density of plants;
   - count number of plants in each quadrat;
   - find mean number of plants per quadrat;
   - multiply number per unit area by total area to obtain total population;

   (b) Outline, using three named examples, how different plants can be used to provide fuel, clothing and
   - building materials. [5]
   - burn wood / vegetable oil / straw / alcohol from sugar / other fuel from plants;
   - named example (e.g. oil from oil seed rape);
   - spin / weave cloth using plant fibres;
   - cotton fruits (bolls) / linen from flax / other plant textile / fibre source;
   - construct buildings / bridges / roofs / doors / windows using timber;
   - named tree species providing timber for construction;

   (c) Discuss how C_3, C_4 and CAM plants are adapted to hot and dry habitats. [9]
   - C_3 plants are less / not well adapted;
   - because they transpire rapidly in hot dry conditions;because they fix carbon dioxide inefficiently above 30°C;
   - C_4 plants are quite well adapted / intermediate; they can open their stomata less wide and so transpire less;
   - because they can fix carbon dioxide at low concentrations;
   - they can fix carbon dioxide above 30°C;
   - CAM plants are well / best adapted;
   - because they open their stomata at night;
   - cooler at night so less transpiration;

2. Explain the factors that cause a population to follow the sigmoid (S-shaped) growth curve. [8]
   - during exponential growth the population grows at an increasing rate;
   - all / most / many offspring survive / birth rate higher than death rate;
   - all / most / many offspring reproduce;
   - each generation produces more offspring than the last;
   - plateau reached eventually / population levels off / birth rate equals death rate;
   - when carrying capacity of environment is reached;
   - e.g. when no more food / nutrients / resources available*;
   - e.g. when no more space for nesting / space for another purpose is available*;
   - e.g. when numbers of predators have increased*;
   - e.g. when levels of parasites / diseases have become very high*;
   - transitional phase when limits to growth are starting to act;
     (* for exponential growth phase, accept converse examples) [8 max]

3. Discuss the relationship between the different nitrogenous waste products and the habitats of birds and amphibians. [5]
   - ammonia is very soluble in water / ammonia is very toxic;
   - ammonia is used by amphibian larvae / aquatic amphibia as their toxic waste;
   - excretion of the ammonia is easy for an aquatic animal as it dissolves in the surrounding water;
   - urea is quite soluble in water / it is not as toxic as ammonia;
   - adult amphibians use urea as their nitrogenous waste;
   - necessary water can be consumed in humid habitats to flush the urea from the amphibians body;
   - uric acid is insoluble so birds do not need to fly with / carry so much water to excrete it;

- uric acid is insoluble so no water is needed to excrete it / it is non-toxic so it can be stored in the body;
- uric acid is used by birds;
- habitat of birds is terrestrial and may be dry requiring maximum water conservation;
- insoluble waste product essential during development inside egg; [5]

4. Explain how energy and nutrients enter, move through, and exit a food chain in an ecosystem. [8]
- energy enters from (sun)light;
- chloroplasts / plants / producers / autotrophs capture (sun)light;
- energy flows through the trophic levels / stages in food chain;
- energy transfer is (approximately) 10 % from one level to the next;
- heat energy is lost through (cell) respiration;
- energy loss due to material not consumed / assimilated / egested / excreted;
- labelled diagram of energy pyramid;
- energy passes to decomposers / detritivores / saprotrophs in dead organic matter;
- nutrient cycles within ecosystem / nutrients are recycled;
- example of nutrient cycle with three or more links;
- nutrients absorbed by producers / plants / roots;
- nutrients move through (food chain) by digestion of other organisms;
- nutrients recycled from decomposition of dead organisms;
- nutrients from weathering of rocks enter ecosystem;
- nutrients lost by leaching / sedimentation (e.g. shells sinking to sea bed); **[8 max]**

5. Outline ways in which leaves take part in the carbon cycle in ecosystems, apart from photosynthesis. [4]
- leaves release carbon dioxide when they respire;
- when they are burned/combustion;
- C passed to decomposers when they die;
- C passed to detritus feeders from leaf litter;
- C passed to consumers/herbivores in the food chain;
- carbon removed from the carbon cycle when leaves are fossilized / turn to peat/coal; **[4 max]**

6. Describe the flow of energy in an ecosystem. [5]
- sun is source of energy for most ecosystems;
- energy is fixed by producers / photosynthesis brings energy into the food chain;
- energy passed through the food chain;
- from producer to consumer;
- energy transfer to next trophic level is only about 10 % efficient;
- because of losses due to cellular respiration/heat/metabolic activity/undigested material;
- losses limit the length of the food chain;
- energy in detritus utilized by saprotrophs; [5 max]

7. Draw a food web containing at least eight specifically named organisms properly linked to indicate the energy flow. [4]

Award [1] for every two linkages correctly shown.
Award [3 max] if fewer than eight organisms are correctly named.
Deduct [1 max] for arrows in the wrong direction.
Reject responses that state plant, grass, bird, insect or other broad groups of organisms.

Acceptable examples maple, egret, trout, marine iguana, Biston betularia.
Deduct [1 max] if organisms are unlikely to encounter one another in their habitat.
Deduct [1 max] if any chain does not have a producer/ source of organic material. [4 max]

8. List four adaptations of xerophytic plants. **[4]**
- CAM/C4 physiology;
- reduced leaves;
- rolled leaves;

- sunken stomata;
- thick cuticle;
- hairs;
- water storage tissue;
- wide-spreading network of shallow roots;
- vertical stems to avoid mid-day sun; **[4 max]**

9. (a) The carbon cycle involves both the production and the fixation of carbon dioxide. Draw a labelled diagram to show the processes involved in the carbon cycle. [5]

- carbon dioxide to plants/producers by photosynthesis;
- carbon dioxide released by respiration in plants/producers;
- plants/producers to animals/consumers by feeding / heterotrophic nutrition;
- carbon dioxide released by respiration in animals/consumers;
- carbon dioxide released by respiration in fungi/bacteria/saprotrophs/decomposers;
- formation of fossil fuels and release of carbon dioxide from them by combustion; **[5 max]**
- Award **[2 max]** if no diagram is provided but above relationships given.

(b) Outline the consequences of rising carbon dioxide concentrations in the Earth's atmosphere. [5]

- increased rates of photosynthesis in plants;
- increased greenhouse effect /global warming / temperature of Earth rises;
- rise in sea levels and flooding;
- melting of glaciers / ice caps;
- more extreme weather patterns / hurricanes / droughts / changing climate patterns;
- loss of habitat for polar bears / other example of effect on living organism;
- displacement of ecosystems;
- (mass) extinction of species;
- changes in ocean currents; **[5]**

10. Outline the potential harmful effects of increased carbon dioxide concentration on the ecosystem and state one measure that could be taken to reduce the amount of carbon dioxide in the atmosphere. **[6]**

effects: **[5 max]**

- global warming/causing the earth to be warmer;
- leads to range/altitude shifts of species;
- increased competition;
- rising of sea levels affects coastal ecosystems;
- melting ice caps leads to changes in salinity/upwelling/currents;
- increased frequency of coral bleaching;
- changes in weather patterns / climate could affect biome distribution in long-run;
- increased microbe activity in permafrost;
- rapid ecological change favours emergent pathogens/pest species;

measure: **[1]**

- carbon dioxide absorption by photosynthesis must be encouraged / avoid deforestation /
- induce reforestation / nutrients in oceans to induce growth of algae / burning of fossils
- fuels must be reduced / use of solar energy / insulating homes / any other suitable
- measure; **[6 max]**

11. Describe a pyramid of energy and the reasons for its shape. **[4]**

- (a pyramid of energy is) a diagram to show decreasing amounts of energy in successive trophic levels;
- producers at the base and secondary/tertiary consumers at the top;
- if diagram is drawn it must be labelled and show relative sizes. 10-20 % passed / on 80-90 % less in each successive level;
- energy is used (by organisms) / lost at each trophic level;
- energy is released in all respiration/lost as heat;
- not all tissues are eaten i.e. bones/hair/cellulose / some tissues are
- egested/undigested / some organisms die before being eaten; [4 max]

[3 max] marks if no reasons given.

12. Outline the effects of factors that increase or decrease the size of a population. [4]
- natality/immigration causes increased population size;
- mortality/emigration causes decreased population size;
- predation / disease / any other limiting factor decreases population size;
- population change **=**(natality **+** immigration) **−**(mortality **+** emigration);
- natural disasters / density independent factors; **[4 max]**

13. Explain the energy flow in a food chain as exemplified by a pyramid of energy. [8]
- a food chain includes a producer and consumers;
- represents the direction of energy flow;
- energy loss occurs between trophic levels;
- due to material not consumed/assimilated;
- and from heat loss due to cell respiration;
- energy passed on from one level to next is 10−20%;
- which limits length of food chain;
- photosynthesis / producers convert solar energy to chemical energy (in organic
- molecules);
- consumers obtain necessary energy from eating organisms of previous trophic level;
- an energy pyramid shows the flow of energy from one tropic level to the next
- (in a community);
- units are energy per unit area per unit time / $Jm^{-2}\ yr^{-1}$;
- Pyramid of energy – properly drawn, each level no more than one fifth the width of
- the level below it, with three correctly labelled trophic levels
- e.g. producer, primary consumer; **[8 max]**

14. (a) Describe the relationship between the rise in the concentration of atmospheric carbon dioxide and the enhanced greenhouse effect. [5]
- CO_2 is a greenhouse gas;
- increases in CO_2 increase/enhance the greenhouse effect;
- greenhouse effect is a natural phenomenon but not its increase;
- Earth receives short wave radiation from the sun;
- reradiated from Earth as longer wave radiation/infra red/heat;
- CO_2 /greenhouse gases trap/absorb longer wave radiation/infra red/heat;
- global warming happened during same time/period as CO_2 rise;
- CO_2 concentration correlated (positively) with global temperature / global temperature increases as CO_2 concentration increases;
- (causal) link accepted by most scientists;
- no proof that man-made increases in CO_2 have caused global warming; ***[5 max]***

(b) Outline the precautionary principle. [5]
- those proposing something must prove that it causes no harm;
- before they start to do it;
- objectors do not have to prove that there will be harm;
- activities that risk/threaten/may cause harm are banned;
- trials/tests must be done first;
- precautionary principle is applied when possible consequences are severe;
- precautionary principle should be used in the case of global warming;
- action should be taken to reduce CO_2 emissions before proved it is the cause;
- another example of implementation of the precautionary principle; ***[5 max]***

15. All organisms in an ecosystem are involved in the carbon cycle. Outline the roles of living organisms in the carbon cycle. [8]
- plants/producers fix carbon (dioxide)/use carbon (dioxide) in photosynthesis;
- sugars/carbon compounds (produced) in plants/producers from photosynthesis;
- (carbon compounds in) plants/producers eaten by animals/primary

- consumers/herbivores;
- (carbon compounds in) primary consumers eaten by secondary consumers/ passed
- along food chain;
- carbon compounds/sugars/organic molecules digested and absorbed by
- consumers;
- carbon dioxide released by cell respiration (in plants/animals/consumers);
- plants/animals die and are decomposed by (saprotrophic) bacteria/fungi;
- carbon dioxide released by cell respiration in bacteria/fungi/decomposers;
- enzymes released to digest/hydrolyse carbon compounds in organic matter;
- forest fires/combustion releases carbon dioxide;
- humans burn fossil fuels adding carbon dioxide to the atmosphere; **[8 max]**

  Award any of the above points if clearly drawn in an annotated diagram.

16. Outline how the energy flow through food chains limits their length. [8]
    - only a small proportion/20 %/10 % **«**of energy**»** can pass from one trophic level to the next

    OR

    large proportion/80 %/90 % lost between one trophic level and the next such as a pyramid of energy.

    - energy released by respiration AND lost as heat ü Not just respiration or heat. **3 max**
    - energy losses due to uneaten parts/undigested parts/feces/egestion

    - not enough energy for 4th/5th/later stages of a food chain

    OR

    more energy available if feeding at an earlier stage in a food chain

    Accept named trophic levels or named stages in a food chain in place of “trophic levels”.

    Accept if clearly shown in a diagram

17. Describe how energy flows through and is used by organisms in ecosystems. [4]
    - producers/plants/autotrophs obtain energy from light/sun/inorganic sources
    - food contains energy / energy passed in the form of food/carbon compounds (along food chains/between trophic levels)
    - consumers obtain energy from other organisms/from previous trophic level
    - energy released (in organisms) by (cell) respiration ATP produced
    - energy/ATP used for biosynthesis/movement/active transport/other valid use of ATP
    - less energy available / energy lost at each trophic level

      Reject energy used in respiration.