Name: _____

Date: _____

Class: _____

IB ESS

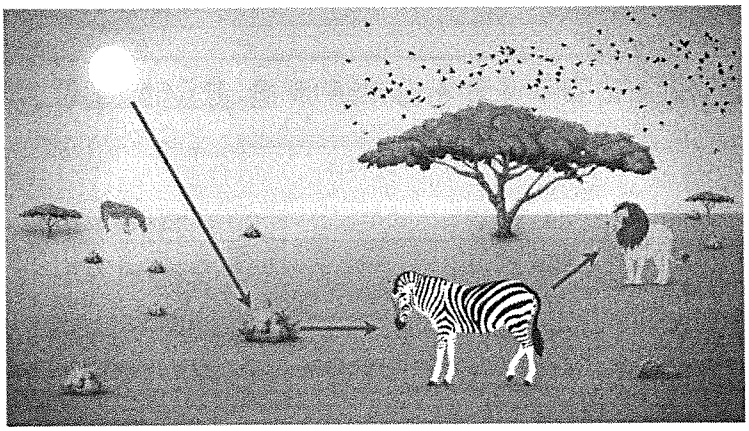
2.2 Communities and Ecosystems

Significant Ideas:

The interactions of species with their environment results in energy and nutrients flow.

Photosynthesis and respiration play a significant role in the flow of energy in communities.

The feeding relationships in a system can be modeled using food chains, food webs and ecological pyramids.



Photosynthesis and Respiration

1. Define respiration.

Respiration is the conversion of organic matter into carbon dioxide and water in all living organisms releasing energy. Can be aerobic (using oxygen) or anaerobic

2. Respiration releases energy. State the form of energy that this will eventually become.

Heat energy dissipated into the environment

3. State three energy conversions that occur in ecosystems ending in the energy form stated above.

stored energy → kinetic energy (movement) → heat

4. Write the word equation AND chemical equation for <u>respiration</u>.

glucose + oxygen → carbon dioxide + water

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

5. Define photosynthesis.

Photosynthesis is the process by which green plants convert light energy into useable chemical energy stored in organic matter

6. Write the word equation AND chemical equation for <u>photosynthesis</u>.

carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

7. State a type of organism that can occupy the first trophic level of a food chain but not perform photosynthesis.

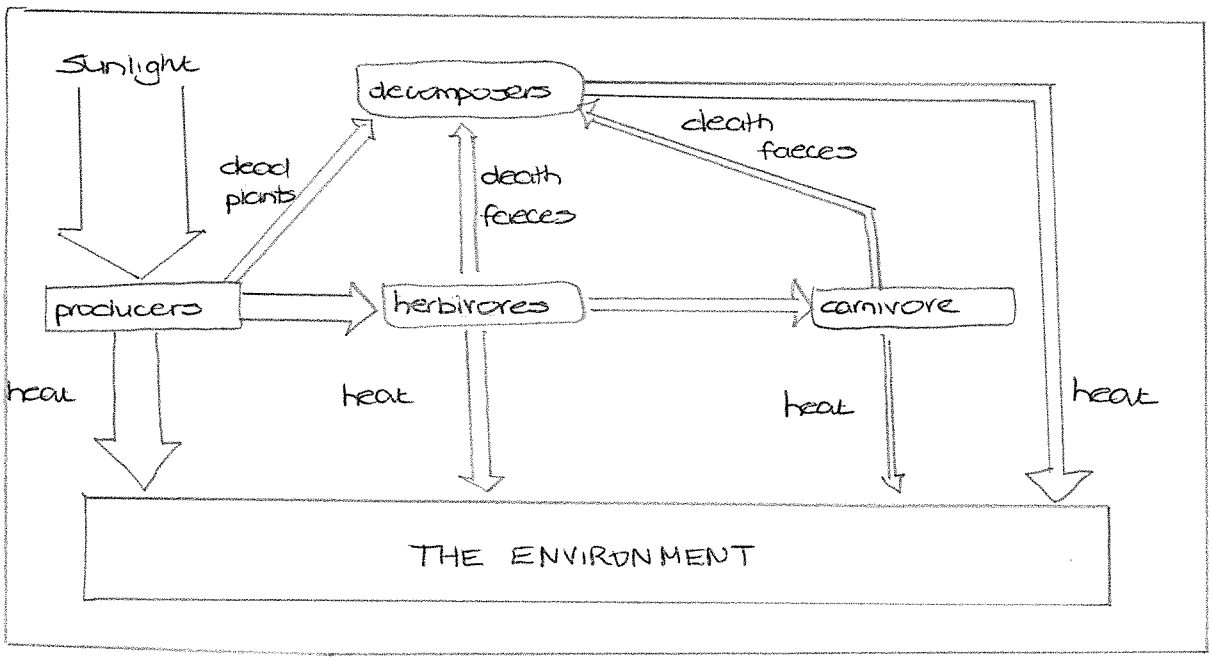
Chemosynthetic bacteria

8. Explain how the transfers of energy and matter through photosynthesis support the first and second laws of thermodynamics. Booklet 1.3

First law: Energy can neither be created nor destroyed: it can only change form.
Solar energy enters an ecosystem as light energy. Photosynthesis converts light energy to stored chemical energy.

second law: Energy goes from a concentrated form into a dispersed form. The availability of energy to do work therefore decreases and the system becomes increasingly disordered.
The solar energy that falls on plant is dispersed in that;
- some is reflected or passes through the leaf
- some is lost through respiration (heat)
- some is stored as biomass

9. Construct a systems diagram showing the transfers of energy and matter through an ecosystem with four trophic levels. (Don't forget to draw a boundary). Peterson p 52



Ecological Pyramids

1. Compare and contrast pyramids of biomass and pyramids of productivity.

Pyramids of biomass represent the biological mass of the standing stock at each trophic level at a particular point in time

Pyramids of productivity show the flow of energy through each trophic level over a period of time

2. State the units used for storages of biomass as represented in pyramids of biomass.

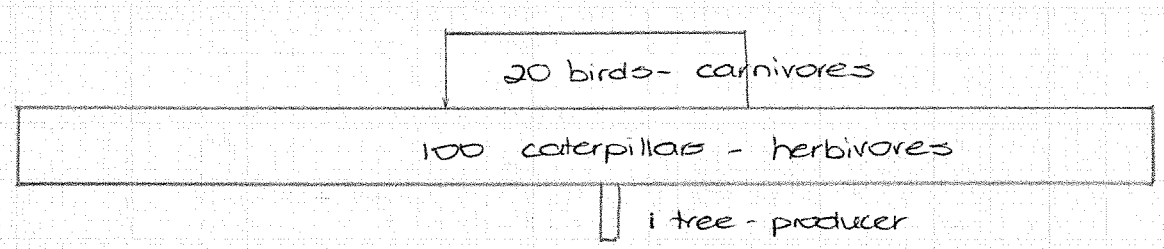
Grams of biomass per square metre ($g.m^{-2}$) or $J.m^{-2}$

3. State the units used for energy flow as represented in pyramids of productivity.

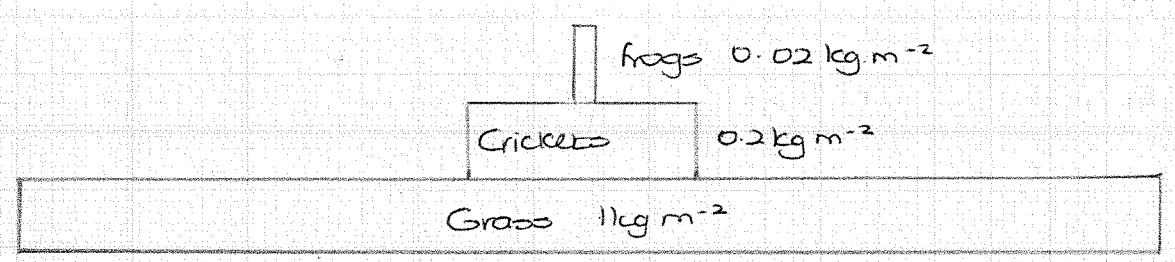
$gm^{-2}yr^{-1}$ or $Jm^{-2}yr^{-1}$

4. Draw ecological pyramids to represent the following data:

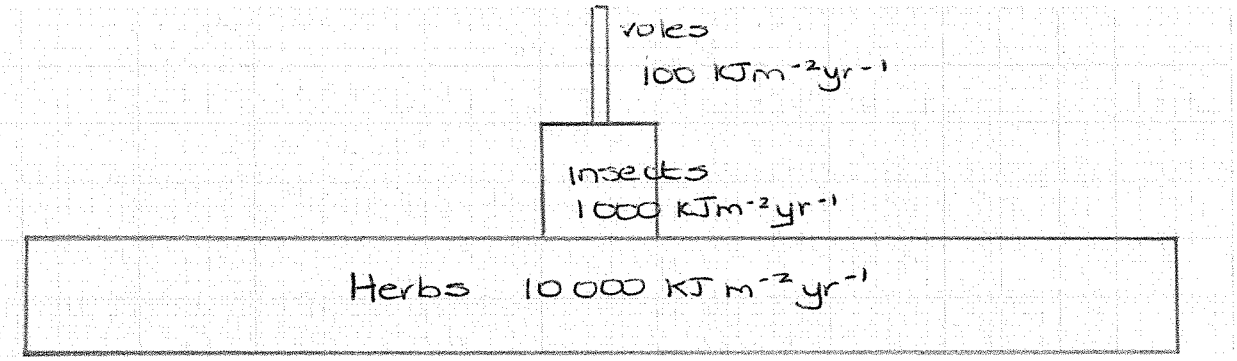
a) A pyramid of **numbers**: one tree is consumed by 100 caterpillars, which are eaten by 20 birds.



b) A pyramid of **biomass** for an ecosystem which contains 1kg m^{-2} of grass. Crickets eat the grass and frogs eat the crickets. 20% of the energy is transferred to the second trophic level, and 10% is transferred to the third level.



c) A pyramid of **productivity** for a food chain involving herbs, insects and voles. Assume an efficiency of transfer of 10% between all trophic levels, and an NPP value of 10,000 KJ m^{-2} yr^{-1}



Biomagnification and Bioaccumulation

1. Define "bioaccumulation".

Bioaccumulation is the build up of persistent / non-biodegradable pollutants within an organism or trophic level because they cannot be broken down.

2. Define "biomagnification".

Biomagnification is the increase in concentration of persistent / non-biodegradable pollutants along a food chain. This makes the pollutant more toxic to higher trophic levels.

3. Explain how the emission of elemental and methyl mercury into Minamata bay resulted in local people suffering from Mercury poisoning.

Waste water containing mercury and methylmercury were released into Minamata Bay (some bacteria can convert mercury to methylmercury). Methylmercury is easily absorbed into the bodies of small organisms such as shrimp.

When the shrimp are eaten by the fish the methylmercury enters the fish. As the fish eat more and more shrimp the amount of methylmercury increases. The same thing happened to the humans that were eating the shrimp and fish from the bay.

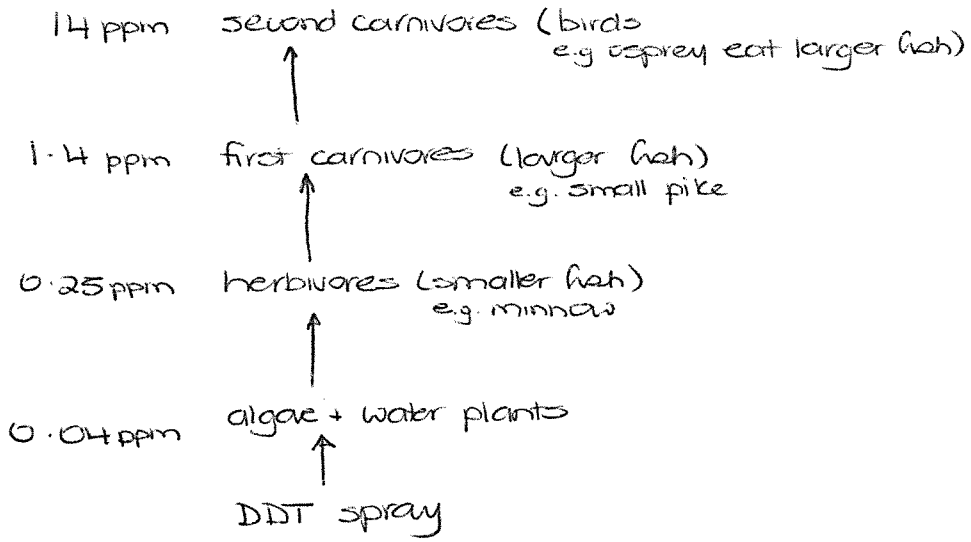
4. DDT is used as a pesticide. The material is persistant: explain what this means.

DDT cannot be broken down naturally; they will remain in the environment until they are physically removed by clean up.

5. According to a study in Long Island Estuary, concentrations of less than 0.1ppm of DDT in plankton led to concentrations of up to 25 ppm in sea birds (Ehrlich *et al.* 1998). Explain why the concentration is notably higher in seabirds.

Bioaccumulation - the concentration of the DDT builds up over time within each organisms trophic level.
Biomagnification - the concentration of a chemical substance increases at each trophic level which results in the top predator potentially having an accumulation as stated above.

6. In sufficient amounts, DDT effects the hardness of bird shells (which often results in the shell breaking and the offspring dying before hatching at an appropriate time). Draw a diagram to show how DDT run-off from farmland can result in egg-thinning in seagulls.



References

Ehrlich, P. R., Dobkin, D. S. and Wheye, D. (1998) *DDT and Birds* [online] Available: https://web.stanford.edu/group/stanfordbirds/text/essays/DDT_and_Birds.html