

## Understandings:

### 1. State that autotrophs convert CO<sub>2</sub> into other carbon compounds.

- As we have stated before, autotrophs have the ability to convert CO<sub>2</sub> into other carbon compounds. As a result, this reduces the concentration of carbon in the air. It is currently around 0.039% CO<sub>2</sub> in the air, or 390 micromoles of CO<sub>2</sub> /mole.

### 2. State that in aquatic habitats, CO<sub>2</sub> is dissolved in the water.

- CO<sub>2</sub> in water can either exist as bubbles or it can combine with H<sub>2</sub>O to form H<sub>2</sub>CO<sub>3</sub>/carbonic acid. This can then dissociate into H<sup>+</sup> and HCO<sub>3</sub><sup>-</sup> and hence make the water more acidic. Luckily, autotrophs can absorb both CO<sub>2</sub> and H<sub>2</sub>CO<sub>3</sub> to make other carbon compounds (and therefore reduce the acidity).

### 3. Explain how CO<sub>2</sub> gets diffused into autotrophs.

- Since plants use CO<sub>2</sub> for other carbon compounds, they have a low concentration of CO<sub>2</sub> inside their leaves so the surroundings will diffuse into the plant.

Aquatic plants are usually permeable in all areas, while terrestrial plants are permeable in the stomata.

### 4. State that CO<sub>2</sub> is a by-product of respiration of all organisms.

- Yes, it is the product of aerobic respiration. Anaerobic respiration also produces some CO<sub>2</sub> but not much at all.

### 5. Explain the process of methanogenesis.

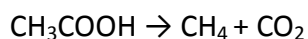
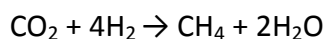
- Methanogenesis is literally the "creation of methane". So, how is it produced? We know that CO<sub>2</sub> is mainly produced in aerobic respiration. Conversely, methane is mainly produced in anaerobic respiration.

Three anaerobic prokaryotes make this possible.

1. The first bacteria convert the organic matter into a mix of organic acids, alcohol, hydrogen and CO<sub>2</sub>.

2. The second bacteria use the organic acids and alcohol to make acetate and further hydrogen and CO<sub>2</sub>.

3. Then archaeans use those acetate, hydrogen and CO<sub>2</sub> to make methane.



Where can we find these magical creatures? Well first of all, it must be an anaerobic environment. And where are those? Obviously, somewhere with not much oxygen! So it can be in mud, swamps, in other animals' guts, landfill sites (organic matter has been buried).

**6. Explain the aftermath of the methane.**

- The methane will stay in the atmosphere for around 12 years. However, it will react with single oxygen atoms and hydroxyl radicals (neutral OH) to form  $H_2O$  and  $CO_2$ .

**7. Explain what peat is and how peat is formed.**

- Peat is essentially the left-overs that decomposers could not decompose. Usually in soils, the decomposers digest the dead leaves and insects etc. However, when water cannot drain the water and provide fresh oxygen, aerobic respiration is limited.

This leads to higher acidity and inhibition of decomposers that can break down the detritus (dead material). So this compressed dark acidic material is peat.

**8. Explain what fossilized organic matter is.**

- We know that animals and plants can be fossilized. Even organic matters can! We know that organic matter can be partially decomposed, and hence form peat.

Coal is formed when peat is buried in the ground and compressed for a very long time and in high temperature.

Oil and natural gas is formed in very similar ways in coal. The only significant difference is location. Coal is formed on land while oil and natural gas are formed under seas and lakes. The peat is also compressed and heated, but also liquid carbon compounds react. That product is crude oil and natural gas.

**9. State that  $CO_2$  is also produced through combustion of biomass and fossilized organic matter.**

- Combustion can both occur naturally and intentionally. However, the difference is that naturally occurring wildfires have communities that are well adapted and therefore regenerate fast.

Coal, oil and natural gas may all be burned as fuel. This releases carbon stored inside and hence release  $CO_2$  and  $H_2O$ .

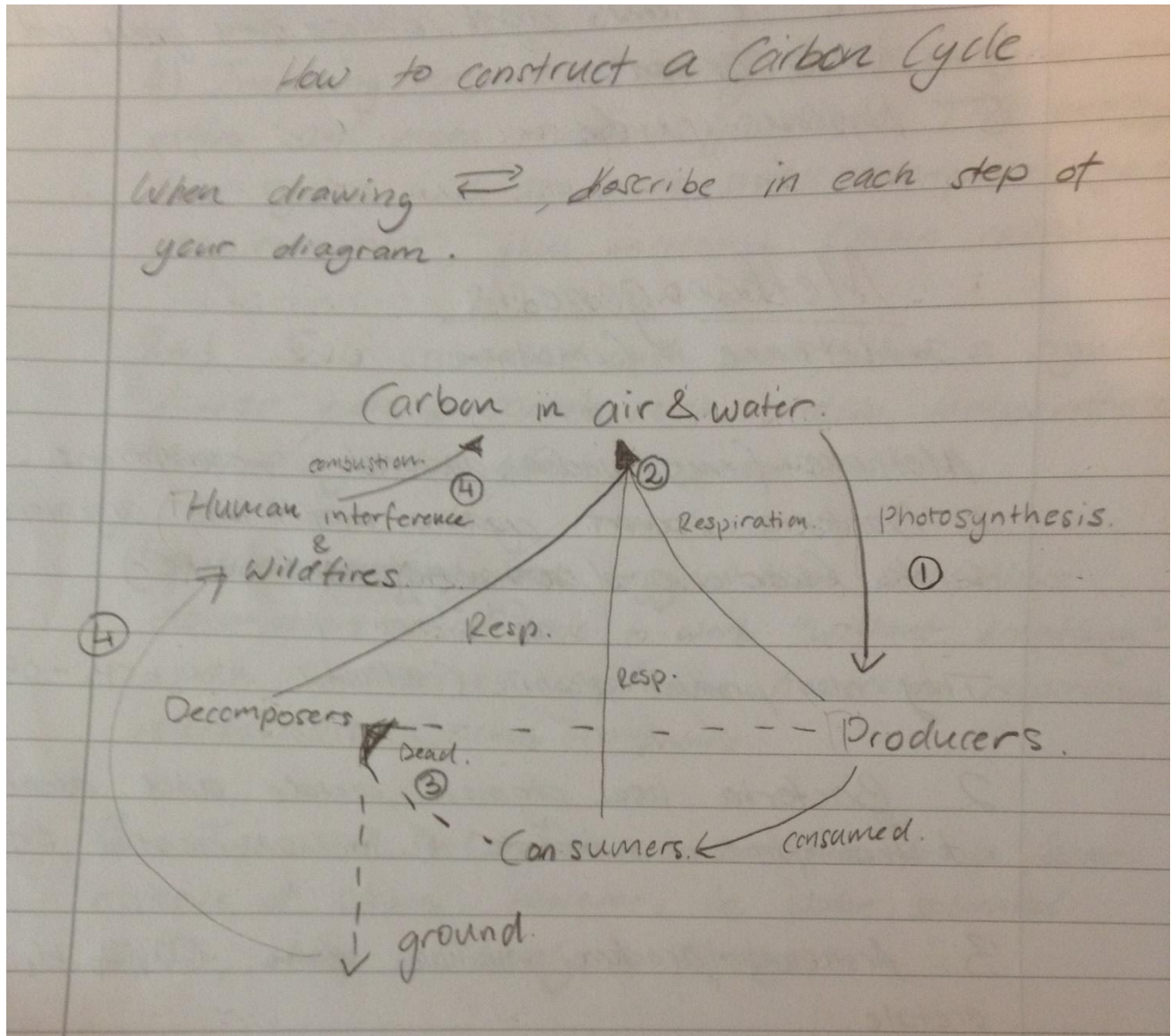
**10. State that some carbon gets stored in form of limestone.**

- There are some animals with hard material, such as snails (molluscs) and hard corals. These hard materials are made of calcium carbonate ( $CaCO_3$ ). When these die in acidic water, the calcium carbonate dissolves. However, in alkali water, the calcium carbonate remains and this forms limestone rock.

## Applications and skills:

### 1. Be able to draw a carbon cycle.

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Always start with "Carbon in air & water" because it is easiest to start with.

### 2. Estimate carbon fluxes with help of carbon cycle.

- Yeah. Good luck to you.

### 3. Analyse data from atmosphere monitoring.

- Yes.