Timed essay: How nitrogen-containing substances are made available and used by organisms.

Friday 27th April 2018

PLAN:

~~ATP~~ ~~= acids~~ N. cycle - ammonification (dead orgs.) extracellular digestion. saprobionts. $\rightarrow NH_4^+$ in soil.

~~Nitrogenation~~ Nitrification : $\rightarrow NO_2 \rightarrow NO_3$ nitrosomas / bacters.

Nitrogen fixation: lightning, legumes

a. acids - proteins ← Nitrogen

DNA / RNA bases - DNA

↳ ~~proteins~~.

Uses: a. acids → growth

The nitrogen cycle allows the recycling of nitrogen-rich compounds so that they can continue to be used by other organisms as, otherwise, the supply of nitrogen-containing substances would run out. ~~Saprobionts~~ Saprobionts in the soil break down nitrogen-containing compounds from the waste material and dead remains of organisms in order to release NH_4^+ ions into the soil.* saprobiotic organisms do this by releasing enzymes to hydrolyse the dead or waste material extracellularly. The ammonium ions can then be converted to nitrite ions by nitrosomas in a process called nitrification, and these NO_2^- ions can be further converted to NO_3^- ions by nitrification again, by nitrobacters. The conversion of NH_4^+ ions to NO_3^- ions is essential in order for plants to be able to take up nitrogen in ~~ionic~~ mineral ion form by active transport in the root hair cells of their roots. This is because NO_3^- ions are soluble. Plants use nitrate ions to manufacture amino acids, which are assembled into proteins. Proteins are essential in all plants for growth and also specific proteins such as enzymes are needed to catalyse many metabolic reactions. ~~such as ph~~ For example, the enzymes ATP synthase and ATP hydrolase are ~~both~~ required in active transport to release energy (hydrolase) and then to recombine ADP and Pi (synthase). Without nitrogen-containing NO_3^- ions, these enzymes could not be made and so energy could not continue to be released.

*This process is called ammonification.

Another way that nitrogen-containing substances are made available to plants is in nitrogen fixation, which is the conversion of atmospheric N_2 gas to ~~NH~~ NO_3^- ions. Specific bacteria known as nitrogen fixing bacteria are found associated with the root nodules of leguminous plants, and they can carry out nitrogen fixation for the plant. Nitrogen fixing bacteria have a symbiotic relationship with the root nodules as they obtain carbohydrates from the plant and the plant obtains nitrate ions from the bacteria. In this way, legumes are more efficiently adapted to surviving in areas where the concentration of NO_3^- ions in soil is low as they do not have to rely on getting their required nitrogen from ions in the soil alone. An example of a leguminous plant is clover, which thrives in soils that other grasses may not. This is because it does not have to compete for the limited ~~supply of NO_3^-~~ available availability of NO_3^- ions in the soil as it can obtain NO_3^- ions from nitrogen fixation, and therefore it can ~~grow~~ produce amino acids and therefore proteins more

Then secondary consumers can do this in the same way by ingesting the primary consumers.

than other plants can, so it can grow taller and is more likely to survive for longer.

* The peptide bonds in

Primary consumers obtain the nitrogen-containing substances they need from by ingesting producers and digesting the proteins.* Polypeptide chains are hydrolysed by protease enzymes in the stomach and small intestine of humans. Exopeptidases act on the ends of polypeptides, whilst endopeptidases hydrolyse peptides bonds in the middle of the protein, forming smaller polypeptides. Finally, membrane-bound dipeptidases hydrolyse dipeptides into individual amino acids, which are ~~are~~ then absorbed into the blood by cotransport. In this way, the nitrogen-containing amino acids can circulate in the blood and be transported to tissues that require them in order to ~~build up~~ form proteins by condensation reactions. A

Another use of nitrogen-containing compounds is DNA as the nucleotide bases that are incorporated into DNA nucleotides contain nitrogen. DNA replication is semi-conservative and it involves the breaking of hydrogen bonds between the 2 complementary strands of DNA by DNA helicase, followed by the addition of free complementary nucleotide bases in the nucleus to each template strand by DNA polymerase. In this way, ~~an~~ exact copies of DNA are made so that the cell can divide, either to form two identical daughter cells by mitosis ~~or~~ for ~~cell~~ tissue growth and repair or to form 4 unique daughter cells by meiosis. In the case of meiosis, the genetic information, in the form of sequences of nitrogen-containing nucleotide bases, is passed on to the next generation when ~~the~~ two gametes from meiosis in two organisms of the opposite sex fuse during fertilisation. The phosphodiester backbone of DNA ensures that the nitrogen-containing bases are protected so that genetic information can be passed on without being altered or damaged.

Amino acids, containing nitrogen, are also important for the synthesis of carrier proteins and channel proteins for transport across cell membranes. These proteins must have a specific ~~co~~ binding site, complementary to a specific molecule or ion for ~~a~~ facilitated diffusion. The specificity of a protein molecule's binding site arises from the ~~p~~ formation of ionic and hydrogen bonds between N-H / H ~~one~~ groups of amino acids at particular places along the protein chain. Nitrogen is important here to allow the formation of hydrogen bonds between the $N^{\delta-}$ and the $H^{\delta+}$ of another amino acid.

	Topic	G	AO1	AO2	AO3.
'Available'	Nitrification		✓		
	N-Fixation		✓		
	Ingestion/digestion		✓		
	uptake		✓		
Uses	Proteins			✓	
	DNA			✓	
	Transport			✓	
	Enzymes			✓	

Detailed and full of correctly applied scientific phrases.

22/25 Well done!

$\boxed{\text{AO3}}$ "beyond spec" possibility: link of Nitrite in drinking water to O_2 carrying capacity of Hb (called methaemoglobinaemia, or blue-baby syndrome) and stomach cancer. See JS text book!