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**Knowledge Rich Curriculum Plan**

Biology 3.5 Energy Transfers in and between organisms

Year 13



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| **Lesson/Learning Sequence** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this, students need to already know that…* | **Tiered Vocabulary and Reading Activity** |
| **Lesson 1:**  **B7 Key content review** | Students will know that in any ecosystem (all the organisms living in a particular area), plants synthesise (make) organic compounds (chemicals that contain Carbon - Hydrogen bonds) from atmospheric, or aquatic, carbon dioxide.  Students will learn that most of the sugars synthesised by plants are used by the plant as respiratory substrates (any organic molecule broken down to release energy for the synthesis of ATP). The rest are used to make other groups of biological molecules. These biological molecules form the biomass (dry mass) of the plants. | Students need to already know that producers are organisms that make their own food (plants and algae through photosynthesis. Students will know the equation for photosynthesis. Students need to already know how plants use the glucose made in photosynthesis | Biodiversity  Community  Species  Competition  Ecosystem  Habitat  Biotic Factors  Abiotic Factors  Interdependence  Predator  Prey  Pathogen |
| **Lesson 2 Biomass** | Students will know that biomass can be measured in terms of mass of carbon or dry mass of tissue per given area per given time. Students will know how to carry use calorimetry to estimate the chemical energy store in dry biomass. Students will learn how to carry out a practical investigating the energetics of stick insects | Students need to already know that biomass is the dry mass of an organism (mass with water removed) and what pyramids of biomass look like. Students need to already know the method for calorimetry and how to calculate energy transferred from GCSE | Reading comprehension booklet  Biomass  Calorimetry |
| **Lesson 3 GPP and NPP** | Students will know that Gross Primary Production (GPP) is the chemical energy store in plant biomass in a given volume or area in a given time. Net Primary Production is the chemical energy store in **plant biomass** after respiratory losses to the environment have been taken into account. Students will use the equation NPP=GPP-R to calculate net productivity and energy transfers within ecosystems. Net production of consumers is calculated using N=I-(F+R). N is number of animals, I is chemical energy in ingested food, F is chemical energy lost in faeces and urine, R is respiratory losses. | Students will already know that not all energy is passed on in a food chain, some is lost at each trophic level in various ways (eg Respiration, egestion, excretion) | Reading comprehension booklet  Gross Primary Production (GPP)  Net Primary Production (NPP) |
| **Farming Practices and Productivity** | Students will know that farming practices aim to increase the amount of energy that is available for human consumption. This increases the NPP for plants and NP for livestock (animals raised in a agricultural setting) Students will know 2 ways of doing this; simplifying food webs to reduce energy losses to non human food chains or reducing respiratory losses within the human food chain. Students will know that simplifying food webs involves using chemicals. Insecticides will kill insects, herbicides will kill weeds and biological agents kill parasites or pathogenic bacteria and viruses) Students will know that respiratory losses are reduced by controlling the conditions the animals live in so more of their energy is used for growth and less through respiration (eg pens, cages, indoor and warm | Students need to already know that food chains and webs show how energy is transferred through an ecosystem. Each of the stages is called a trophic level. Food webs show how lots of food chains and how they overlap. Students need to already know that decomposers breakdown dead or undigested material allowing nutrients to be recycled. Students will already know that energy from respiration is used for growth, movement, building larger molecules from smaller ones (proteinsynthesis) | Reading comprehension booklet  Livestock  Insecticides  Herbicides  Biological agents |
| **Nitrogen Cycle** | Students will know that microorganisms are important in food chains and webs. Many are saprobionts ( organisms that digest their food externally and then absorb the products.) They do 2 things 1) Feed on remains of dead plants and animals and on their waste products breaking them down. This makes saprobionts a type of decomposer and allows certain elements to be recycled. 2) They secrete enzymes and digest their food externally then absorb the nutrients they need (extracellular digestion) Organic molecules are broken down into inorganic ions. This is known as saprobiotic nutrition. Students will learn that some fungi (Mycorrhizae) form symbiotic relationships (both species benefit) with root of plants. Fungi are made of long thin strands called hyphae which connect to plant roots. The hyphae increase the surface area of the roots helping them absorb more ions from the soil (N, P, K, Mg). They also increase water uptake of water by the plant. The fungi benefit as they also obtain organic compounds such as glucose from the plant. Students will learn that plants and animals need nitrogen to build proteins from nucleic acids (DNA & RNA) Students will learn about each of the main steps in the cycle. NITROGEN FIXATION- Nitrogen gas in the atmosphere is turned into nitrogen containing compounds. Involves a bacteria called (*rhizobium*) which turns nitrogen into ammonia which can then dissolve to for ions in solution to be absorbed by plants. rhizobium is found in the roots of legumes (beans, peas, clover) and form a mutualistic relationship with the plants. AMMONIFICATION- nitrogen compounds from dead organisms are turned into ammonia by saprobionts which then form ammonium ions. This happens mainly to animal waste. NITRIFICATION- ammonium ions in the soil are changed into nitrites. Nitrifying bacteria) Nitrosomonas) then (Nitrobacter) change nitrites into nitrates.DENITRIFICATION- nitrates in the soil are converted to nitrogen gas by denitrifying bacteria which is then released back into the atmosphere. Lightening also fixes nitrogen to nitrogen oxides. | Students will already know that microorganisms include bacteria and fungi. Students will already know that N, P, K, Mg are ions obtained by active transport from the soil. Students will already know that 78% of the air is made of nitrogen gas but plants and animals cannot use it in this form, it must be converted to nitrates. Students will already know that ammonia contains nitrogen and the formula is NH3. | Reading comprehension booklet  Saprobionts  Extracellular digestion  Saprobiotic nutrition  Symbiotic Relationship  Mycorrhizae  NITROGEN FIXATION  AMMONIFICATION  NITRIFICATION  DENITRIFICATION |
| **Phosphorus Cycle** | Students will know that plants and animals need phosphorus to make biologcal molecules such as phospholipids, DNA and ATP. P is found in rocks and dissolved in oceans as phosphate ions (PO43-) . When dissolved in water, they can assimilate ( be absorbed and then be used to make more complex molecules) by plants and other producers. Students will learn that the phosphorus cycle works as follows: Weathering releases phosphate ions into the soil. These ions are then taken in by plant roots. (Mycorrhizae involved to increase the rate) Animals then eat the plants and the ions are transferred the them. Some phosphate ions are lost in the waste. When plants and animals die, saprobionts breakdown the organic compounds releasing phosphate ions into the soil for plants to assimilate. These microorganisms also release phoshate ions in waste. Weathering rocks releases phosphates into the sea, lakes and rivers which can be taken up by aquatic producers (algae) and passes along the food chain to birds. The waste from birds (guano) contains high levels of phosphate ions. A significant amount is returned to the soil. (natural fertilizer) | Students will already know that rocks contain minerals and that weathering erodes rocks. Students will already know that mycorrhizae is a fungi that increases the SA for absorption. Students will know that waste refers to urine and faeces. Students will know that saprobiotic feeding involves extracellular digestion. | Reading comprehension booklet  Assimilate  Weathering  Aquatic producers  Guano |
| **Fertilizers and Eutrophication** | Students will know that Crops take mineral ions from the soil as they grow. Crop harvesting removes the plants from the soil rather than letting them die and decompose naturally. Removing animals and taking them to be slaughtered also interferes with the nitrogen and phosphorus cycle. Fertilizers can be added to replace lost mineral ions and can be natural (manure) or artificial (ammonium nitrate). Students will know that using fertilizers can have negative impacts on the environment. Affects the balance of nutrients and some plants die due to having too much of a particular nutrient. Leaching- Excess fertilizers seeps into waterways Eutrophication- Mineral ions seep into waterways, algae bloom blocking sunlight, plants die due to lack of sunlight for photosynthesis, bacteria feed on dead plants and use oxygen for aerobic respiration, fish and other aquatic animals die due to lack of oxygen. | Students will already know that fertilizers can get into rivers and this leads to eutrophication (GCSE) | Reading comprehension booklet |