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UIET

UTKAL INSTITUTE OF ENGG & TECHNOLOGY

LECTURER NOTES

ON

(TH.5)

ENVIRONMENTAL STUDIES

Diploma in ETC Engineering.

(3rdSemester)

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Designation:LECTURER IN ETC ENGG

CONTENTS

UNIT - II

ENVIRONMENTALPOLLUTION

UNIT - III
NATURALRESOURCES

SYLLABUS

GE6351 ENVIRONMENTALSCIENCEANDENGINEERING LTPC
3 003

OBJECTIVES:

Tothestudyofnatureandthefactsaboutenvironment.

- Tofindingandimplementingscientific,technological,economicandpolitical solutions to environmental problems.
- Tostudytheinterrelationshipbetweenlivingorganismandenvironment.
- Toappreciatetheimportanceof environmentby assessingits impacton thehuman world; envision the surrounding environment, its functions and its value.
- Tostudythedynamicprocessesandunderstandthefeaturesoftheearth‟sinteriorand surface.
- To study the integrated themes and biodiversity,natural resources, pollution control and waste management.

UNITI ENVIRONMENT,ECOSYSTEMSANDBIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction,types,characteristicfeatures,structureandfunctionof the(a)forestecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values– Biodiversity at global, national and local levels– India as a mega-diversity nation– hot-spotsofbiodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNITII ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NOX, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNITIII NATURALRESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects onforests andtribalpeople– Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused byagriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems,water logging, salinity, case studies – Energy resources: Growing energy needs, renewable andnonrenewableenergysources,useofalternateenergysources.EnergyConversion

processes– Biogas– productionand uses, anaerobicdigestion;casestudies– Land resources: Land as a resource, land degradation, man induced landslides, soilerosionand desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNITIVSOCIALISSUESANDTHEENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNITVHUMANPOPULATIONANDTHEENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme– environment and humanhealth– humanrights–valueeducation– HIV/AIDS – womenand child welfare–Environmentalimpact analysis (EIA)- -GIS-remotesensing-role of information technology in environment and human health – Case studies.

TOTAL:45PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Publicawarenessofenvironmentalisatinfant stage.
- Ignoranceandincompleteknowledgehasleadtomisconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. GilbertM.Masters,"IntroductiontoEnvironmentalEngineeringandScience",2nd edition, Pearson Education, 2004.
2. Benny Joseph,"Environmental ScienceandEngineering",TataMcGraw-Hill,New Delhi, 2006.

REFERENCES:

1. Trivedi.R.K.,"HandbookofEnvironmentalLaws,Rules,Guidelines,Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham,W.P.Cooper,T.H.Gorhani,"EnvironmentalEncyclopedia",JaicoPubl., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan,R,"EnvironmentalStudies-FromCrisistoCure",OxfordUniversity Press, 2005.

UNIT-I
ENVIRONMENT,ECOSYSTEMAND BIODIVERSITY

ENVIRONMENT

Environmental science is the study of nature and the facts about environment. Environment can be defined as "allthe social, economical, physical and chemical factorsthat surrounds man" or "all abiotic and biotic components around man-all living and non living things surrounds man".

PREREQUISITEDISCUSSIONS

The word environment is derived from the French word 'environ' which means to 'encircle or surround'.

Objective of this course is to develop concern for our own environment which will lead us to act at our own level to protect the environment we all live in.

Ever since people first recognized that their health and well-being were related to the quality of their environment, they have applied thoughtful principles to attempt to improvethe quality of their environment.

Therearethreereasonsforstudyingthestateoftheenvironment.

The first isthe need for informationthat clarifies modernenvironmentalconcepts like equitable use of natural resources, more sustainable life styles etc.

Second, thereis aneedtochangetheway inwhich weview our own environment, using practical approach based on observation and self learning.

Third,thereisaneedtocreateaconcernforourenvironmentthatwill triggerpro-environmentalaction; including simple activities we can do in our daily life to protect it.

CONCEPTS

According to ancient man the environment was the Panchaboodhas (i.e.) air, water, land, sky and energy.

The human were disciples of nature. They were able to protect themselves from harmful one and protect the others. But according to modern manthe environment is onlyair land and water.

Exploitation of various earth resources to satisfy the increasing needs of human population hasresulted in 1) depletionofvariousresourcesofearth2) pollution. Principlesof environmental education:

- Examinethemajorenvironmentalissues
- Discovertherootcause
- Developproblemsolvingskills
- Promoteco-operationinsolvingproblems
- Emphasisactiveparticipationinpreventionandsolutionto problems

SCOPEOFENVIRONMENTALSCIENCE

- Studyingtheinterrelationshipbetweenthecomponentsofenvironment.
- CarryingoutimpactanalysisandEnvironmentalAudit
- Preventingpollutionfromexistingandnewindustries
- Stoppingtheuseofbiologicalandnuclearweapons
- Managingunpredictabledisastersetc.

PUBLICAWARENESS

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.

- Publicawarenessofenvironmentalissueisatinfantstage
- 30-40%ofpublicofdevelopingcountryareawareofenvironmental. Problems but they do not bother about it.
- Ignoranceandincompleteknowledgehasleadtomisconceptions.
- Development and improvement in std. of living has lead to serious environmental disasters.
- DebatesonenvironmentalIssuesaretreatedasanti-developmental.

APPLICATION

- Environmental science is essentially the application of scientific methods and principles to the study of environmental issues, so it has probably been around in some forms as long as science itself.
- Environmental science is often confused with other fields of related interest, especially ecology, environmental studies, environmental education and environmental engineering.
- Environmental science is not constrained with any one discipline and it is a comprehensive field.

RISKANDHAZARDSINTHEENVIRONMENT

Environmental risk due to various environmental hazards is an important topic for environmental engineers to recognise and understand in order to protect human society and ecosystems from harms or damages at local, regional or global scales. For example, to deal with contaminated soil and ground water at a brown field, risk and exposure assessment help engineers choose an optimal solution to either treat the hazard (e.g., to remove the contaminants fromthe soil and water) or reduce the exposure (e.g., to cover up the land witha barrier).

A hazard is a threat to life, health, property, or ecosystems, i.e., it involves something that couldpotentiallybe harmful. Therefore, whenadormant hazardcomes to fruition, it will cause physical damage or destruction, loss of life, or drastic change to the environment, and result in an incident, accident, emergency event, or disaster. Hazards may be classified into:

- Chemical hazards – Combustionof Fossil fuels, industrial effluence, pesticides heavy metals.
- Physicalhazards–RadioactiveandUVradiations,Globalwarming,Chlorofluro carbons, Noise etc.
- Biologicalhazards–Bacteria,Viruses,Parasites.

ECOSYSTEM

Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the farmer.

An ecosystem is therefore defined as a natural functional ecological unit comprisingof living organisms and their non-living environment that interact to form a stable self supporting system.

PREREQUISITEDISCUSSIONS

EO Wilson is an entomologist who envisioned that biological diversity was a key to human survivalonEarth. He wrote 'Diversityoflife' in 1993, whichwasawarded a prize for the best book published on environmental issues.

He emphasised the risks to mankind due to manmade disturbances in natural ecosystems that are leading to the rapid extinction of species at the global level.

An Indian ornithologist and naturalist, Salim Ali known as the "birdman of India", was among the first Indians to conduct systematic bird surveys across India.

He was instrumental in creating the Bharatpur bird sanctuary (Keoladeo National Park) and prevented the destruction of what is now the Silent Valley National Park. He was awarded India's second highest civilian honour, the Padma Vibhushan in 1976.

His autobiography, **Fall of a sparrow**, should be read by every nature enthusiast. He wasour country's leadingconservationscientist and influenced environmentalpolicies inour country for over 50 years.

CONCEPTS

Ecology is the study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

StructureofEcosystem

1. Abioticornon-livingcomponentsorphysicalcomponents
2. BioticorLivingcomponents
3. Energycomponents

Functionoforganismsinanecosystem

- Producer(autotrophy):makefood;plants,algae
- Consumer(heterotrophy):eatotherorganisms
- Decomposer:eatdeadorganicmatter;bacteriaandfungi

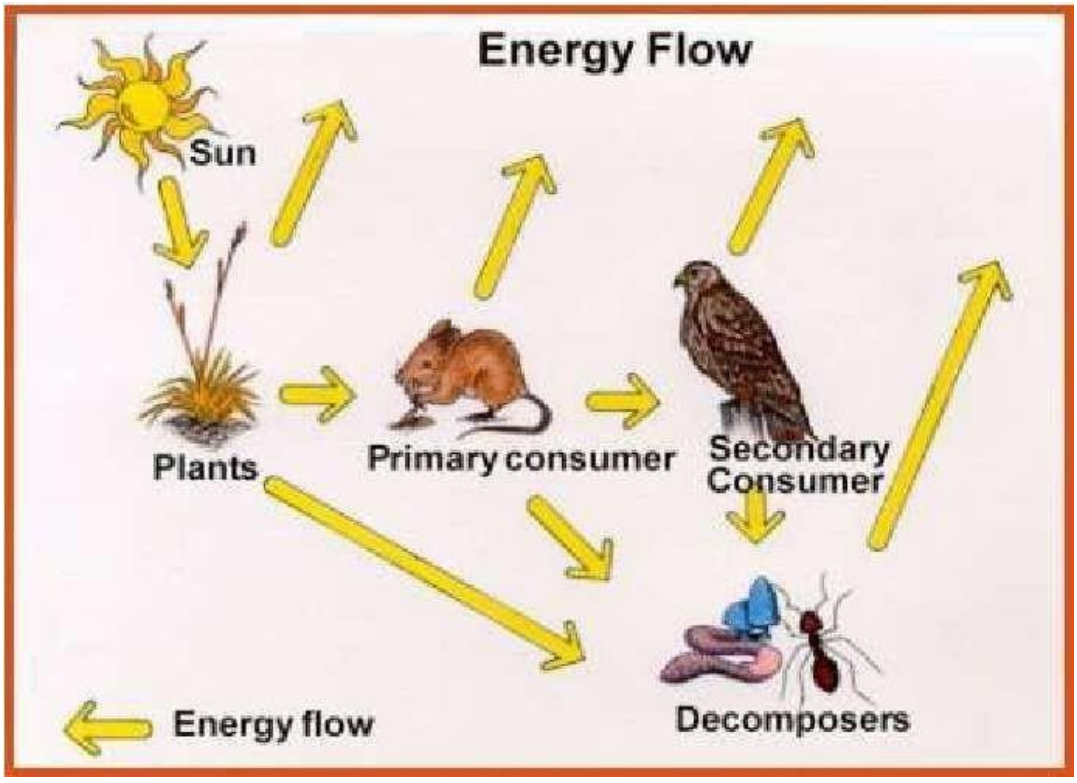
ClassesofConsumers

- Herbivore–primaryconsumer–eatsplants
- Carnivores–secondary–meateaters;eatherbivores
- Tertiary–feedoncarnivores
- Omnivores–eatplants/animals

ENERGYFLOWINECOSYSTEM

- Allorganismsmustobtainasupplyofenergyandnutrientsfromtheirenvironment in order to survive.
- The transformationsofenergyin an ecosystembegin first withthe input ofenergy from the sun.
- Because, it isthe first stepinthe productionofenergyfor livingthings, it iscalled "Primary production".
- Photosynthesis--Chemicalreactionwheregreenplantsusewater&carbondioxide to store the sun's energy in glucose.
- ENERGYisstoredinglucose.
- Glucoseisstoredasstarchinplants
- The majorityof autotrophs are photoautotrophs that harness the energy of the sun and pass some of this energy onto consumers through feeding pathways.
- The energy contained within producers and consumers is ultimately passed to the decomposers that are responsible for the constant recycling of nutrients.

- Thus, there is a one-way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem
- Energyflowcannotoccurinreversedirection.



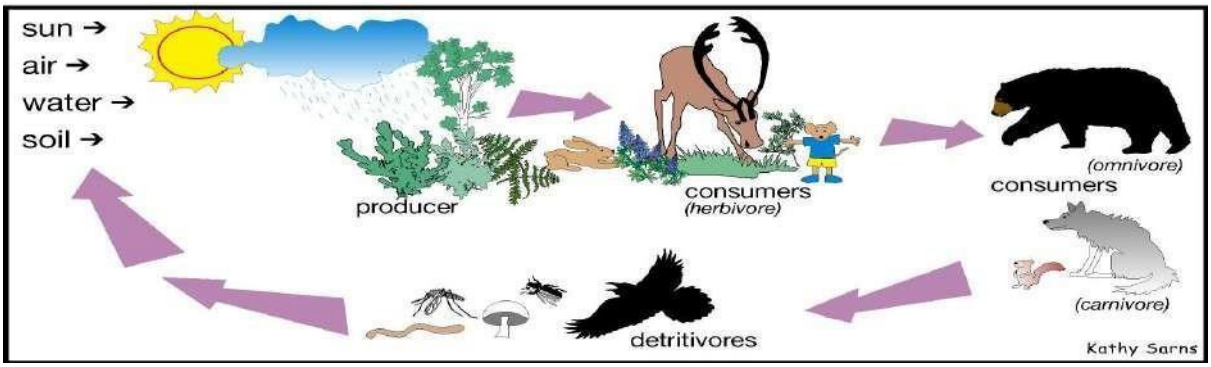
EnergyFlow

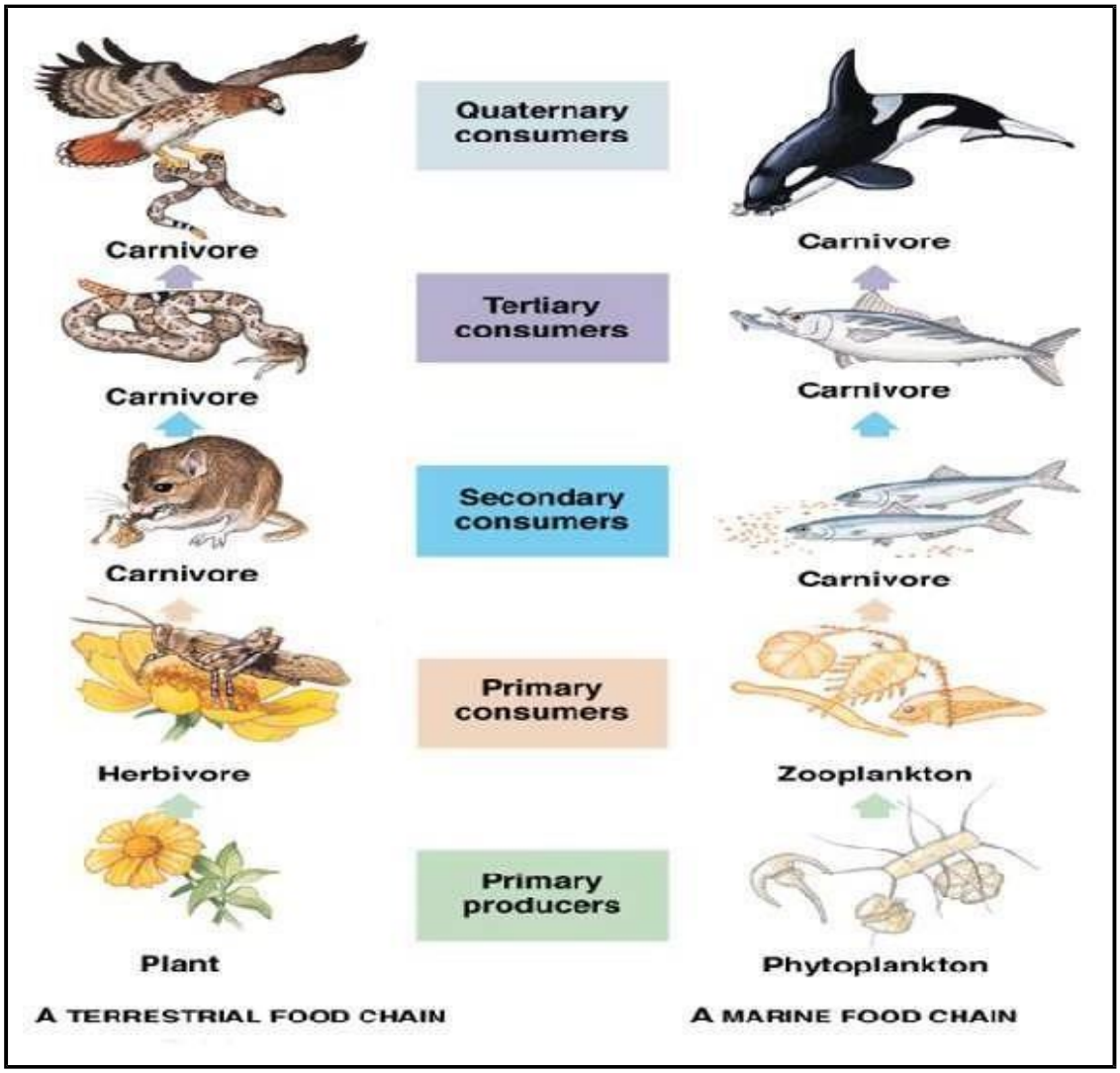
- Starts fromautotrophs (the producer level, i.e., first trophic level) to Heterotrophs including plant eaters or Herbivores (second trophic level) and so on.
- Theamountofenergydecreaseswithsuccessivetrophic levels.
- Only About 1% of energy from the sun is used by green plants & rest remains unutilized.
- Similarly,thereislossofenergyineachtrophic level.
- Thetransfer offood energybetweentheorganisms inanecosystemcan betracked by constructing food chains, food webs, pyramids of numbers, biomass andenergy and energy flow diagrams.

FOODCHAIN

Plants by photosynthesis convert solar energy into protoplasm. Small herbivores consume the vegetable matter and convert into animal matter which in turn eaten by large carnivores.

- A food chainmay be definedas,"thetransfer of energy andnutrients through a series of organisms with repeated process of eating and being eaten".
- In an ecosystem, all the organisms are linked together with one anotherby foodrelationship.
- Eachorganismlivingordeadispotentialfoodforsomeotherorganism.

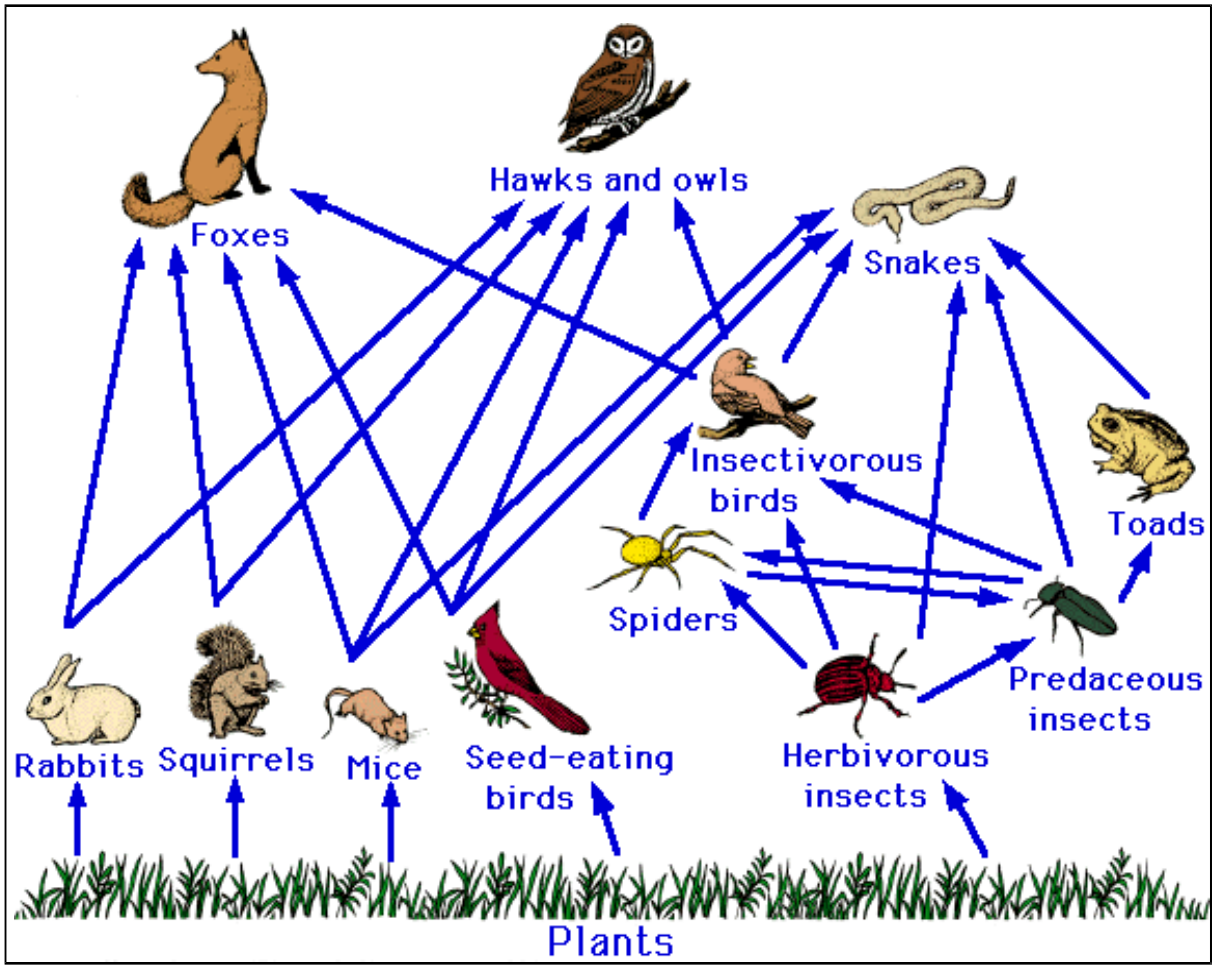




FoodChain

FOODWEB

The food relationship between various organisms is being depicted by linking all the possible prey and predators of different food level. In an ecosystem linking of feeding habit relations will provide a food web or Interlocking patternof several interlinked food chains is termed as FOOD WEB.

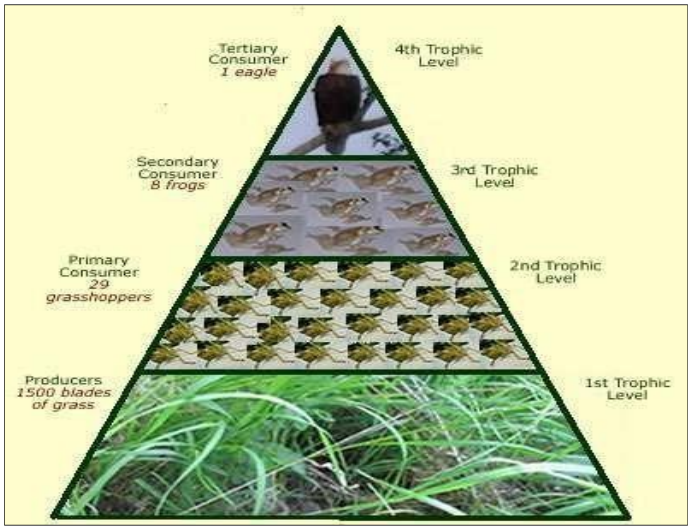


Foodwebingrasslandecosystem

ECOLOGICALPYRAMIDS

An"Ecological pyramid" is a graphical representation that showsthe relative amounts of energy or matter contained within each tropic level in a food chain or food web.

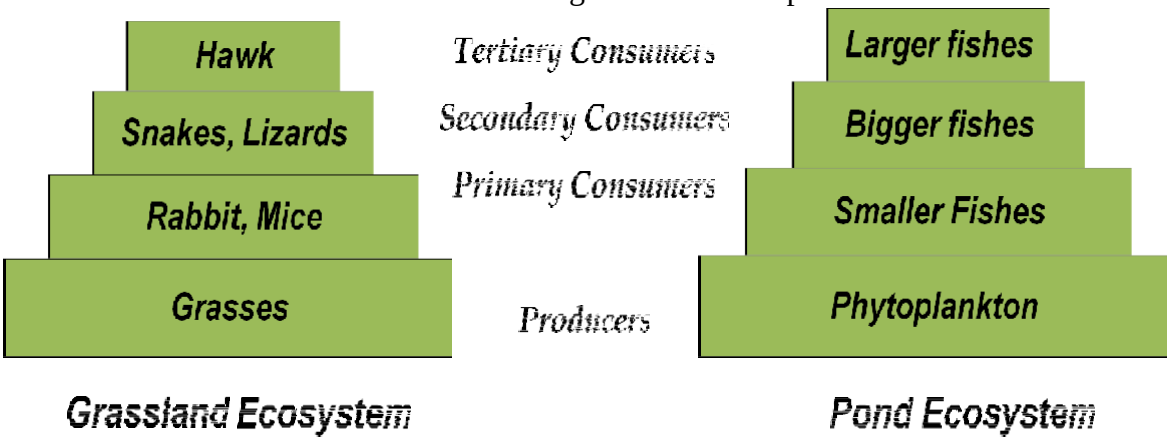
An ecological pyramid shows the relationshipbetween consumers and producers atdifferent tropic levels in an ecosystem.



EcologicalPyramid

TypesofEcologicalPyramids Pyramid of Numbers

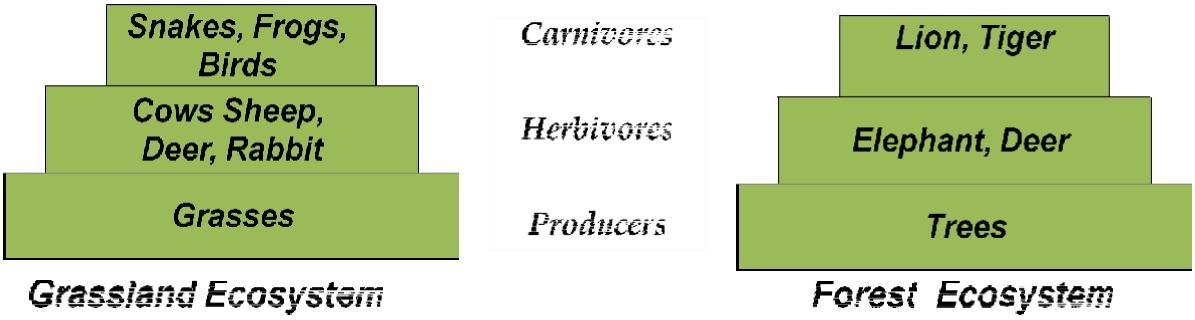
Showstherelativenumberofindividualorganismsateachtropiclevel.

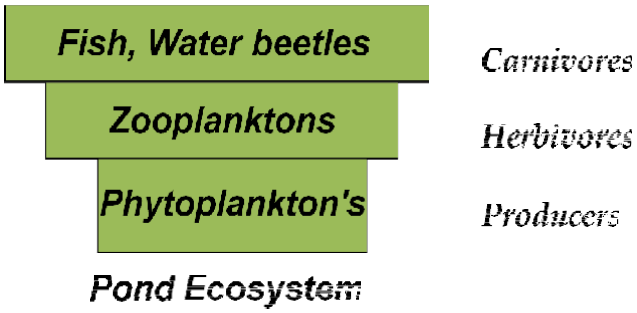


PyramidofNumbers

PyramidofBiomass

Apyramidofbiomassrepresentsthetotaldrymass(ingramspersquaremeterof area) of all the organisms in each tropic level at a particular time.

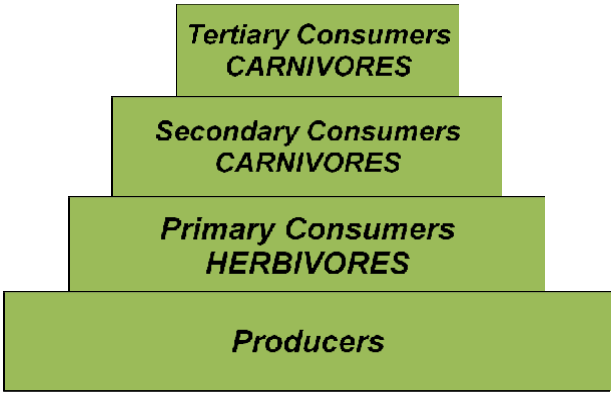




PyramidofBiomass

PyramidofEnergy

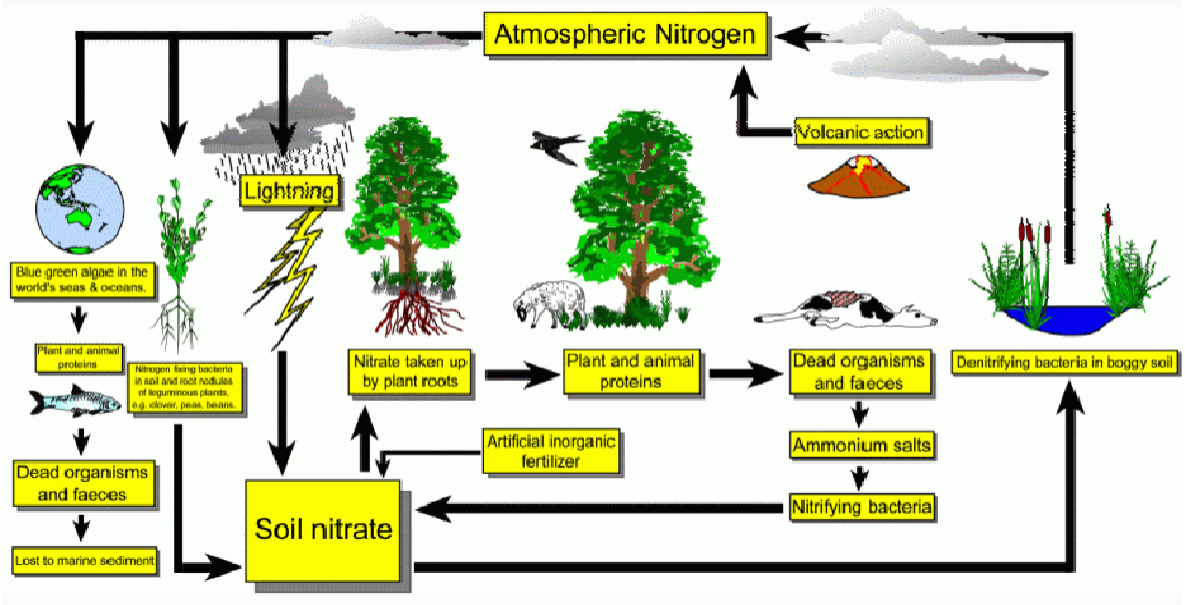
Apyramidofbiomassrepresentstherateofenergyflowand/orproductivityatsuccessive tropic levels. The pyramids of energy are always upright.



PyramidofEnergy

NITROGEN CYCLE

- Nitrogeniscrucialforallorganisms
  - Nucleic acids
  - Proteins
  - Chlorophyll
- Nitrogen-78%inAtmosphere
- N2isverystableand must bebrokenapart byorganisms, combinedwithother atoms into a usable form.



NitrogenCycle

Nitogencyclecompletesin5steps:

1) NitrogenFixation

Conversionof$N_2 \rightarrow NH_3$

Combustion,volcanicaction,Lightning,Industrialprocesses(makingfertilizer). Bacteria (Azotobactor, Clostridium, Nostoc etc.)

2) Nitrification

ConversionofNH3→NO3

Soilbacteriaconvertinatwostepprocess.

3) Assimilation

RootsabsorbNH3,NH4,orNO3andincorporatethemintonucleicacidsandprotein.

4) Ammonification

AminoacidsandnucleotidesarebrokendownintowasteproductsNH_3or NH_4

5) Denitrification

ThereductionofNO_3toN_2.Denitrifying bacteriareturnsomeofthenitrogentothe atmosphere

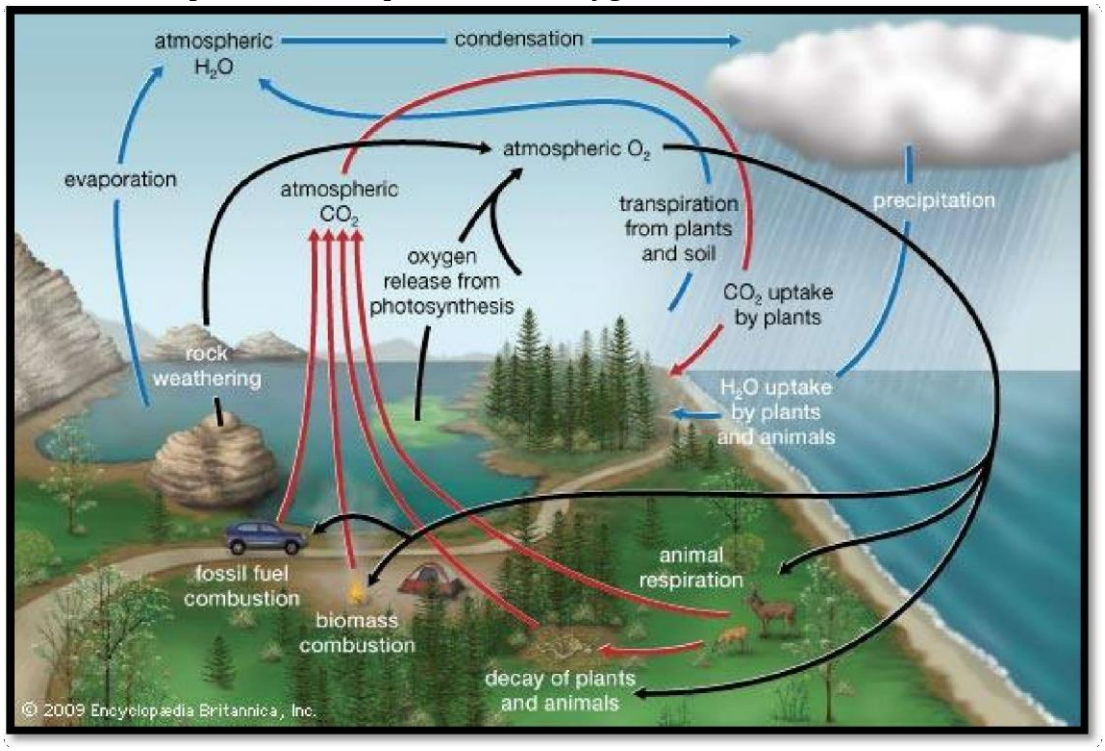
OXYGENCYCLE

oxygen cycle is the circulation of oxygen in various forms through nature free in the air and dissolved in water.

Oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere.

Plants and animals use oxygen to respire and return it to the air and water as carbon dioxide (CO_2). CO_2 is then taken up by algae and terrestrial green plants and converted into carbohydrates during the process of photosynthesis, oxygen being a by-product.

The waters of the world are the main oxygen generators of the biosphere; their algae are estimated to replace about 90 percent of all oxygen used.



Thegeneralizedoxygencycle

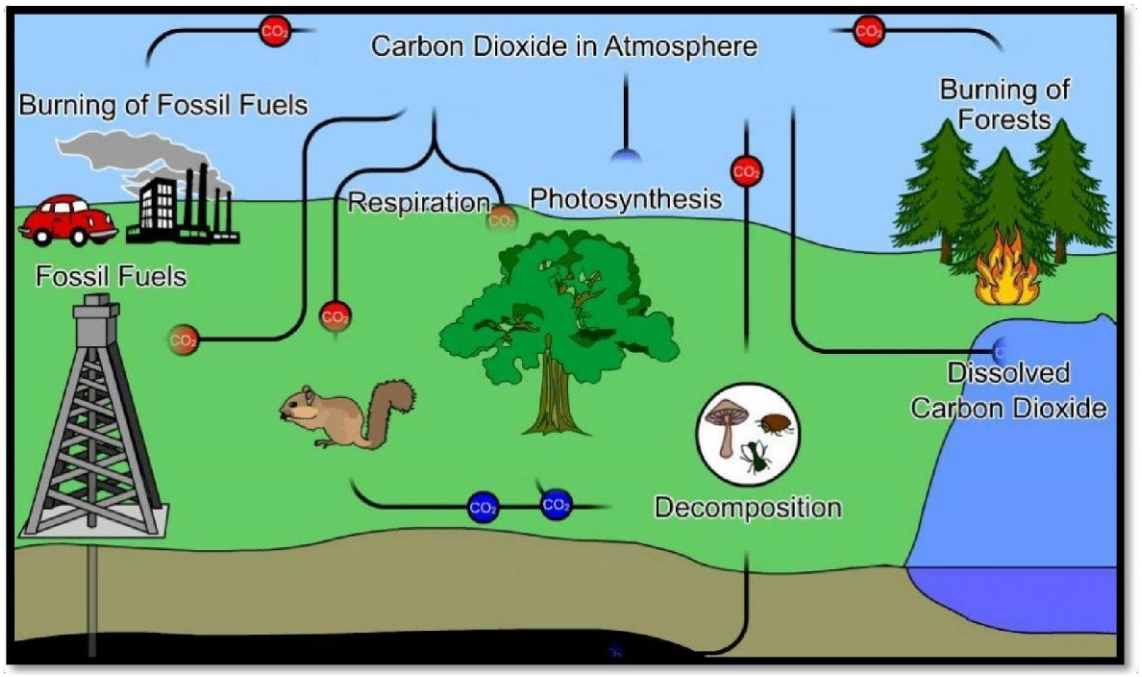
Oxygen is involved to some degree in all the other biogeochemical cycles. For example, over time, detritus from living organisms transfers oxygen-containing compounds such as calcium carbonates into the lithosphere.

Despite the burning of fossil fuel and the reduction of natural vegetation (on land and in the sea), the level of atmospheric oxygen appears to be relatively stable because of the increase in plant productivity resulting from agricultural advances worldwide.

CARBONCYCLE

- Carbonentersplants,etc.,asCO2
  - Bacteriaprocesscarboninafashionthatallowsittoberecycled.
  - Obtainenergyfromthe molecules,andconvert carbohydratestocarbon dioxide as a result of respiration.
- Photosynthesisremovescarbonfromtheabioticenvironment (fixescarboninto organic molecules)
- Carbonmovesthroughfoodchainthroughconsumptionofoneorganismsbyanother

- Cellular respiration, combustion, anderosionoflimestonereturncarbontothe atmosphere, water and abiotic environment.

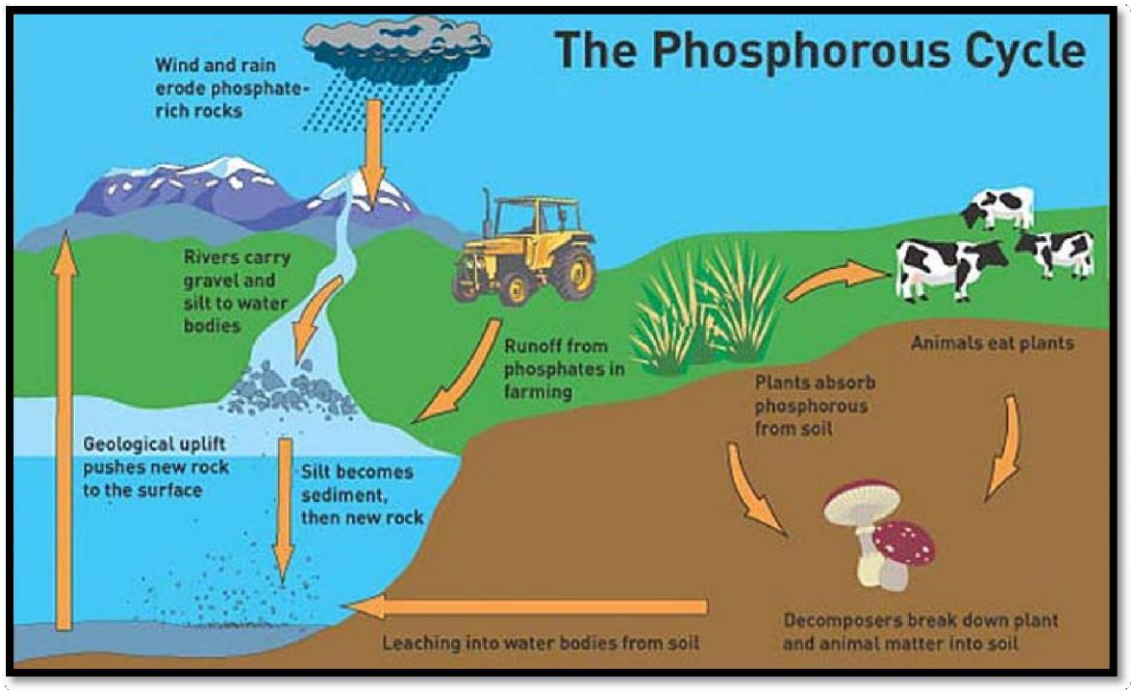


CarbonCycle

Thesourceofatmosphericcarbondioxide is variable but onlyplantscanutilizeatmospheric carbon directly.

PHOSPHOROUS CYCLE

- Theonlycyclethatdoesnothaveagaseousstate.
- InorganicphosphatePO$^{3-}_4$ isreleasedfromrocksandsedimentsthroughtheactionof erosion.



PhosphorousCycle