ECOLOGY

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ECOLOGY

- 1859 – **Isodore Geoffroy St Hilaire** coined the term "**Ethology**" 'the study of relationship of an organism with the family and the society as a whole and in the community'

- 1868 – **H Reiter** first coined and used the term '**oikologie (ecology)**'

Two Greek words

- ✓ Okios – 'home' 'habituation' or 'a place to live in'
- ✓ Logos – 'study' or 'discourse'
- ✓ Ecology - Study of organism at home

- 1869 – **Ernst Haeckel** coined the term '**ecology**' (okios –house; logus –study of)

- 1894 – **St George Jackson Mivart** coined the term 'Hexicology'

DEFINITION

- 1869 - According to "**Ernst Haeckel**" Ecology is "the science treating the reciprocal relationship of the organism and the external world".
- 1905 - **Johannes Eugenius Bülow Warming** Ecology as "the study of organisms in relation to environment".
- 1936 – **Taylor** Ecology is 'the science of the relations of all organisms in relation to their entire environment'.
- 1961 – **Kendeigh** Ecology is 'the study of animals and plants in their relations to each other and to their environment'.
- 1969 – **Odum** Ecology is defined as 'the study of the inter-relationship between organisms and their environment'.
- **Ecology:** branch of science that deals with interaction between living organisms with each other and their surroundings
- In modern days, Ecology is described in the name of '**Environmental Biology**'.

SUB-DIVISIONS OF ECOLOGY

- 1902 – **Kirchner and Schroter** ecology into two main sub divisions – **Autecology** and **synecology**

- **Autecology**: The study of individual organisms or individual species in relation to environment. Life history, behavior, population dynamics etc. EX. Fish culture, Apiculture, Sericulture etc.

- **Synecology**: the study of group of organisms, which are associated together as a unit, in relation to their environment. Community and Ecosystem. Ex pond ecosystem etc.

BRANCHES OF ECOLOGY

- **Animal ecology** – study of animals in relation to their environment
- **Plant ecology** - study of plants in relation to their environment
- **Habitat ecology** - study of habitat
- **Marine ecology** - study of marine habitat
- **Freshwater ecology** - study of Freshwater habitat
- **Terrestrial ecology** - study of terrestrial habitat
- **Population ecology – (autecology)** study of population
- **Community ecology – (synecology)** study of community
- **Behavioural ecology** – study of ecology and evolutionary basis of animal behavior
- **Chemical ecology** – deals with the ecological role biological chemicals in wide range of areas including defense against predators, attraction of mates etc.
- **Eco-physiology** – study of relationship between single type of organism and the factor of its environment
- **Ecotoxicology** – deals with the ecological role of toxic chemicals (eg pollutants)
- **Evolutionary ecology or ecoevoltuion** – evolutionary changes in the context of population and communities in which the organism exist
- **Molecular ecology** – to address ecological questions at the molecular level e.g DNA or alloenzymes
- **Landscape ecology** – study of interaction between discrete elements of a landscape
- **Applied ecology** - study of application of ecological concepts to human welfare
- **Palaeo-ecology**- study of marine habitat
- **Space ecology** – neighboring planets
- **Radiation ecology** - study of effects radiation and radioactive substances and their application
- **Human ecology** – study concerned with man and the environment.
- **Ecological economics**
- **Industrial ecology**
- **Information ecology**

SCOPE OF ECOLOGY

- Maintenance of natural resources
- Control of pollution
- To discover new sources of food
- Human welfare
- Measure the rate of evolution
- To store rare genetic materials

ENVIRONMENTAL STUDIES

- The study of basic components of our surroundings and their interactions is called **environmental studies**
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- The environmental studies includes the following aspects
- The components of the environment
- The interaction and the interdependence of the various components of the environment
- The ecosystem
- Biogeochemical cycles
- Natural hazards like earthquake, cyclones, floods, landslides etc
- Man made hazards e.g. Industries, atom bombs etc
- Pollution etc.

Universe

Galxaies

Solar system

Earth

Biosphere

Biomes

Ecosystems

Communities

Population

Organisms

Systems

Organs

Tissues

Cells

Protoplasm

Molecules

Atom

COMPONENTS OF THE ENVIRONMENT

- Environment means surroundings
- The various components present around a man is called environmental factors
- The environmental factors may be non-living (abiotic; eg soil, air water) or living (biotic; eg plants and animals)
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- **The environment is made up of four parts**
- Atmosphere - Air
- Hydrosphere - Water
- Lithosphere - Land
- Biosphere - Living organism
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ATMOSPHERE

- An **atmosphere** (New Latin *atmosphaera*, created in the 17th century from Greek [*atmos*] "vapor" and [*sphaira*] "sphere") is a layer of gases surrounding a planet
- It is present around the earth
- It consists of gases and some solid and liquid particles suspended in it.
- Gases: Nitrogen, oxygen, carbondioxide, ammonia etc. of these 78% nitrogen, 21% oxygen other gases are found in tracer amounts
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- The atmosphere is divide into the following five layers on the basis of vertical distribution of temperature:
- **Trophosphere**
- **Stratosphere**
- **Mesosphere**
- **Thermosphere**
- **Exosphere**

TROPHOSPHERE:

- Lowest layer of the atmosphere
- Temperature decreases with increasing altitudes
- Clouds are formed and carried in this layer
- Extends to 6-8 Km in poles and to about 17 km in equator
- Contains 90% of air of the atmosphere
- Seasonal variation are common

STRATOSPHERE

- Layer of atmosphere above the trophosphere
- Temperature increases with increasing altitudes
- Extends to a height of 50km
- Air is much thinner
- Long-distance aircrafts fly in the lower part of the stratosphere
- The top of this layer contains OZONE

- **Ozone layer**
- Ozone molecules are concentrated in the stratosphere, hence this layer is called as ozone layer
- It screens of UV light of the sun and protects the earth
- Often called as Ozone umbrella
- Choloro-fluro-carbons are reported to damage the ozone layer
- Skin cancer will be the result of ozone deletion

MESOSPHERE, THERMOSPHERE & EXOSPHERE

- **Mesosphere**
- Mesosphere lies above 50km to 100km
- Characterized by decreased temperature
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- **Thermosphere**
- Lies beyond the mesosphere
- Temperature rises sharply attaining 1000° C
- It extends to height of 400km
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- **Exosphere**
- It lies above thermosphere beyong 400km
- The increase in temperature ceases at this layer
- The density of the atmosphere is very low here
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HYDROSPHERE

- Layer of water on the surface of the earth is called hydrosphere
- Three fourth of the earth surface is covered by water
- It includes all liquid and frozen surface waters, ground waters held in rock and soil and atmospheric water vapour
- It is estimated that the world has 1, 46,000 cubic kilometer of water
- It includes oceans, sea, ponds lakes, rivers, dams etc.
- All these waters are constant circulation through hydrologic cycle

- **Oceans and sea – 97%**
- **Polar ice caps and glaciers – 2%**
- **Freshwater bodies, ground water – 1%**
- **and atmospheric vapour**

LITHOSPHERE

- The solid component of the earth is called lithosphere
- The lithosphere is made up of three layers
- An outer crust (outer most solid zone, its thickness, varies from 12 to 60km)
- Middle mantle (it is in molten state, thickness is estimated to be 2900km)
- Inner core (It is in solid or molten state, 2500km in thickness and composed of nickel and iron)
- Lithosphere is compared with hen's egg
- Shell represents crust
- Egg white represents mantle
- Yolk is compared to the core
- The lithosphere is made up of rocks and soils
- The rock is formed of minerals

BIOSPHERE

- Sphere of life
- Consists of plants and animals (also called as ecosphere)
- Biosphere is found in lithosphere, hydrosphere and atmosphere
- The total mass of biosphere is 5×10^{12}
- Consists of organisms, population community and ecosystem

WATER

- Medium is the material which immediately surrounds the organism
- The organism lives inside the medium
- Medium is an abiotic factor

Medium is divided into two types

- Water
- Air

SYNOPSIS

1. Structure of water
2. Forms of water
3. Sources of water
4. Types of water
5. Properties of water
6. Hydrologic cycle
7. Classification of animals on the basis of water requirement
8. Adaptation in animals based on water problems

1. **Structure of water**

Simple inorganic compound formed by the combinations of hydrogen and oxygen

$2H_2O + O_2 \quad 2H_2O$

2. Forms of water

Liquid

Solid (Below 0° C – Ice)

Vapour (Gaseous state, temperature increases – vapour, moisture,

- Two forms invisible (humidity) visible (Cloud)

3. Sources of water

Precipitation (rainfall)

Ground water

Springs

Sea

Ponds

Lakes

Rivers

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TYPES OF WATER

- **Based on the salts present in the water, the water is classified into**

1. **Hard water:** Contains soluble chlorides, sulphates and bicarbonates of Ca and Mg ions

Permanent hardness : caused by the presence of chlorides or sulphates of Ca and Mg ions

Temporary hardness : Can be converted into soft water on boiling, calcium bicarbonates, magnesium bicarbonates

2. **Soft water :** produces foams with soap. The salts like Ca and Mg ions are absent

PROPERTIES OF WATER

- **Solvency:** Water is the only solvent which dissolves maximum number of organic and inorganic substances – **Universal solvent** - This property makes water highly polluted
- **Specific heat:** The total number of calories necessary to raise 1 gram (ml) of water to 1°C. The specific heat of water is 1.0. This is very high when compared to other liquids.
- **Latent heat:** The quantity of heat required to change a substance from solid to liquid state or from the liquid state to gaseous state.
- **Thermal conductivity:** Among liquids, water has the highest thermal conductivity. Thermal conductivity of water is 0.0125.
- **Viscosity:** Viscosity is a property arising from friction between neighboring particles in a fluid that are moving at different velocities.
- **Surface tension:** The surface tension of water is high. This helps certain insects to walk and run on the surface of water
- **Buoyancy:** The buoyancy of an object is equal to the weight of the water it displaces

PROPERTIES OF WATER CONTD…

- **Density:** The density of water is directly proportional to the concentration of dissolved salts and inversely proportional to temperature

- **Salinity:** **Salinity** is the saltiness or dissolved salt content of a body of water. **Stenohaline** describes an organism, usually fish, that cannot tolerate a wide fluctuation in the salinity of water. Stenohaline is derived from the words: "*steno*" meaning narrow, and "*haline*" meaning salt.
- Many fresh water fish, such as goldfish (*Carassius auratus*), tend to be stenohaline and die in environments of high salinity such as the ocean. Many marine fish, such as haddock, are also stenohaline and die in water with lower salinity.
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- Alternatively, fish living in coastal estuaries and tide pools are often euryhaline (tolerant to changes in salinity) as are many species which have life cyclerequiring tolerance to both fresh water and seawater environments such as salmon and herring.

- **Pressure:** Pressure is the weight of the water column above an organism plus the weight of the atmosphere

- **Transparency**: Transparency is the property of water by which it allows light to pass through so that objects in the depth can be seen. In freshwater, the transparency is decreased by suspended materials like clay, slit, water-plants, planktonic blooms etc. These objects cause turbidity.

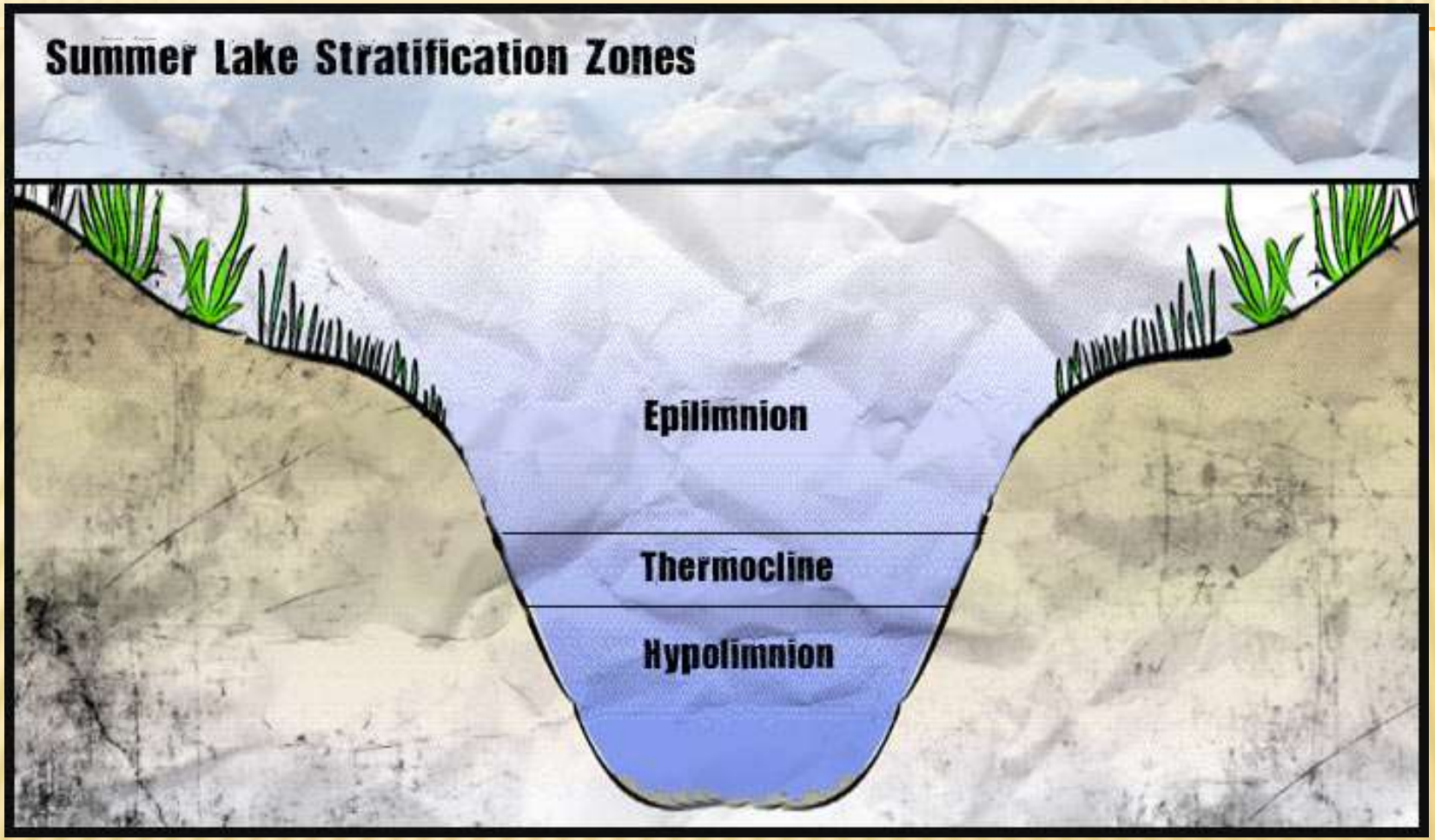
PROPERTIES OF WATER CONTD…

- **Hydrogen ion concentration (pH)**: The negative logarithm of hydrogen ion (H^+) concentration in water is called pH. It depends on the amount of two components present in water. They are hydrogen ion (H^+) and hydroxyl ion (OH^-).
- **Equal amount of** (H^+) and (OH^-) it is neutral with a pH value of 7.0
- **More amount of** (H^+) it is acidic with a pH value of pH less than 7.0
- **More amount of** (OH^+) it is alkaline with a pH value of pH more than 7.0

- **Temperature:** Temperature variation is much lesser in watr than in terrestrial habitat. The changes occur very slowly. In fresh water habitats such as lakes and ponds there is a gradual decrease in temperature from the surface to the bottom. Different layers of water with different temperatures is called **thermal stratification**
- In summer, three distinct layer
- An upper layer **epilimnion:** it is the warmth layer. Temperature fluctuates with the atmospheric temperature.

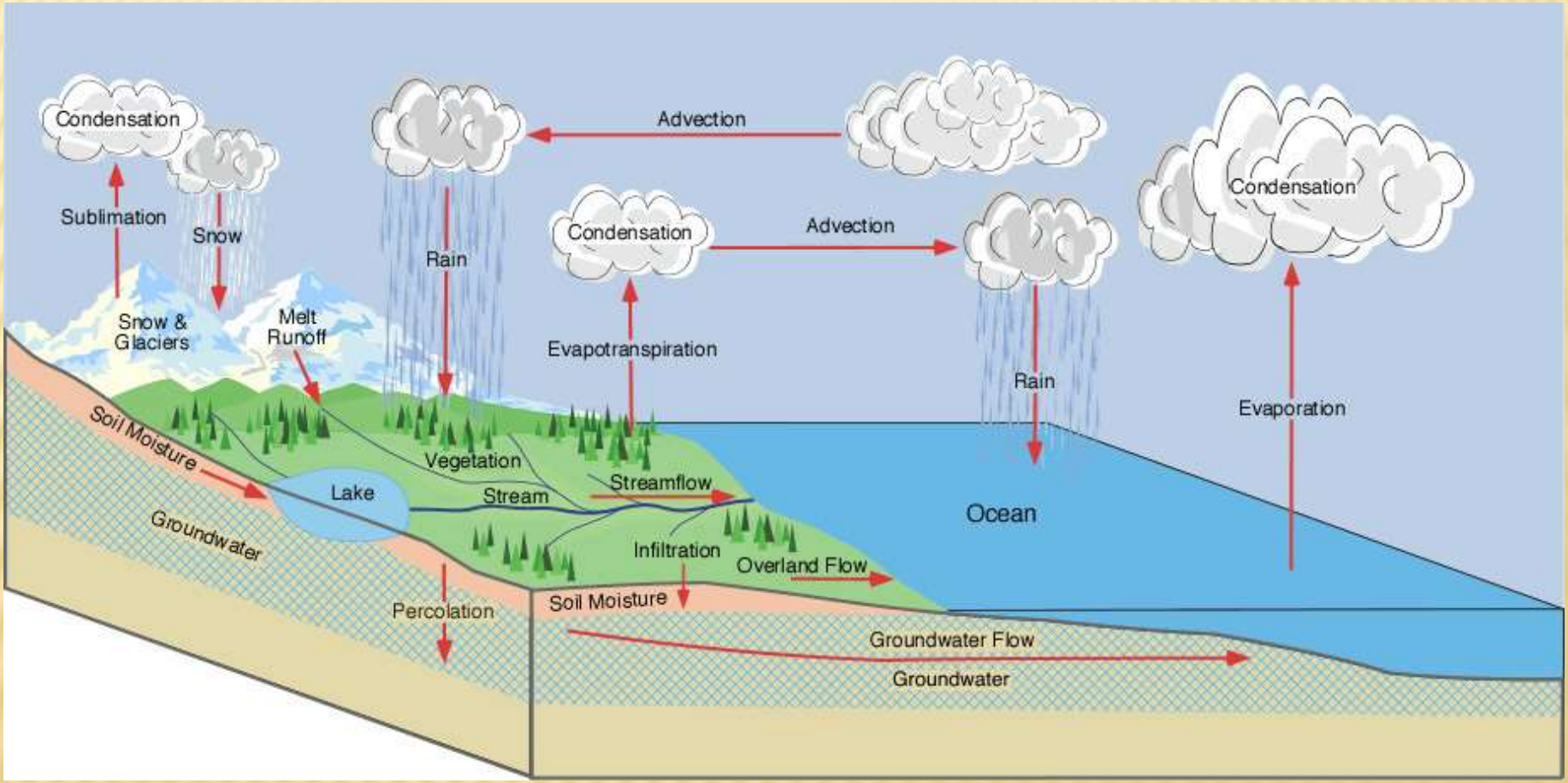
- A middle layer **metalimnion** or thermocline: Temperature is in-between upper and lower layer. Gradual decrease from top to bottom. It is also called transition zone

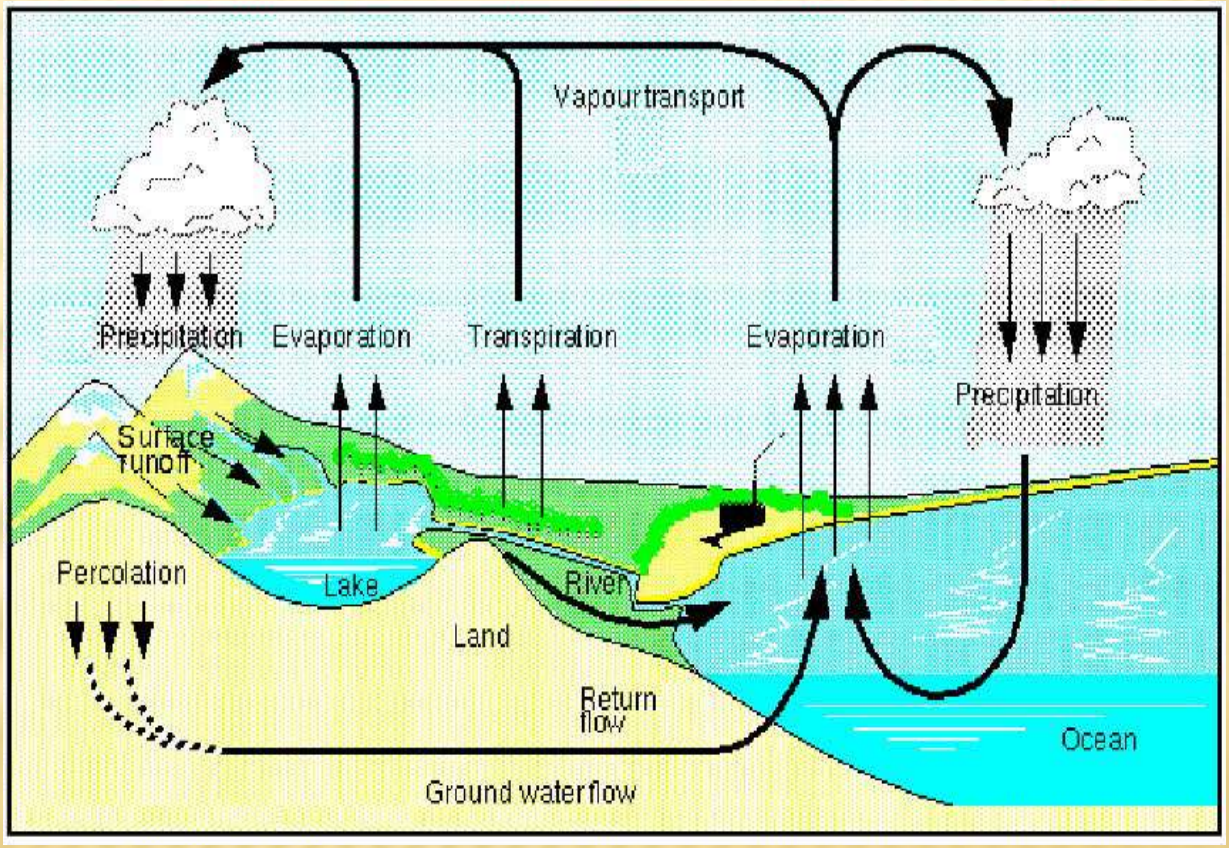
- A bottom layer **hypolimnio**n: at this level the water is cool. It is the stagnant water or standing water column.



http://www.untamedscience.com/biology/biomes/lakes-ponds-biome/

HYDOLOGICAL CYCLE




Vapour transport
Precipitation
Evaporation
Transpiration
Evaporation
Precipitation
Surface runoff
Percolation
Lake
River
Land
Return flow
Ocean
Ground water flow

CLASSIFICATION OF ANIMALS ON THE BASIS OF WATER REQUIREMENT

- Depending on the requirement of water, ecologically animals are classified into the following groups

1. **Hydrocoles** – Require large amount of water eg fishes
2. **Xerocoles** - Survive long time without water eg desert animals
3. **Mesocoles** - Require moderate amount of water eg amphibians

ADAPTATION IN ANIMALS BASED ON WATER PROBLEMS

- Aquatic animals

Fresh water

- **Osmoregulation –** hyper tonic body fluid, hypotonic fresh water **endosmosis**
- Stenohaline and eury haline
- Glomerular kidney with chloride cells in gills (fishes)
- Green glands with chloride cells in gills (crustaceans)
- Contractile vacuoles (amoeba)
- **Ammonotelism :** excrete ammonia (which can easily dissolve in water) eg fishes, amphibians etc
- **Accessory respiration:** Having accessory respiratory organs
- **Arborescent organ (eg.** Ophiocephalus – fish)
- **Air chamber (** g Saccobranchus - fish**)**
- **Lung fishes** (eg. Protopterus - fish)
- **Labyrinthine organ** (e.g Anabas – fish)
- **Aestivation :** Summer sleep(eg. Protopterus - fish)
- **Encystment :** producing heat resistance cyst (eg. Amoeba, euglena), gemmules (eg Sponges)
- **Sedentary mode of life :** Attached life style (eg Vorticella)
- **Organs for attachment:** specialized organs for attachment eg suckers, hooks, tentacles etc
- **Streamlined body**
- **Flattened body**
- **Positive thigmotaxis:** inherent property to keep close with the substratum
- **Positive rheotaxis :** inherent ability to move upstream

Seawater

- Osmoregulation

Sea water hypertonic, body fluid hypotonic exosmosis

Chloride secretary cells (eg gills of marine fishes)

Salt gland near eyes (eg turtle)

- Steamline body
- Gills
- Bioluminescence

- Estuary
- Osmoregulation – animals are euryhaline tolerate wide range of salinity

Green gland, salt gland, chloride cells

- Burrowing mode of life
- Parental care (carrying egg in mouth by fishes)
- Mode of feeding : most of the animals are detritius feeder

TERRESTRIAL HABITATS

- Impervious skin
- Nocturnal habits
- Burrowing habits
- Aestivation
- Epiphragm : land snail Ariophanta – shell mouth with a membrane called epiphragm
- Cocoon
- Excretion – uric acids
- Migration
- Water from food (seeds blood etc)
- Metabolic water
- Hygroscopic skin eg spiny lizard Moloch horridus, absorbs water from moisture
- Intestinal storage - eg lizard uromastix stores water in the intestine
- Water cells – Eg Camel rumen and reticulum of stomach
- Absence of sweat glands

AMPHIBIOUS LIFE

- Respiration, skin, gills and lungs
- Migration
- Aestivation
- Hibernation – winter sleep
- Desiccation – eg shell