

GROWTH, ENVIRONMENTAL & CLIMATOLOGY

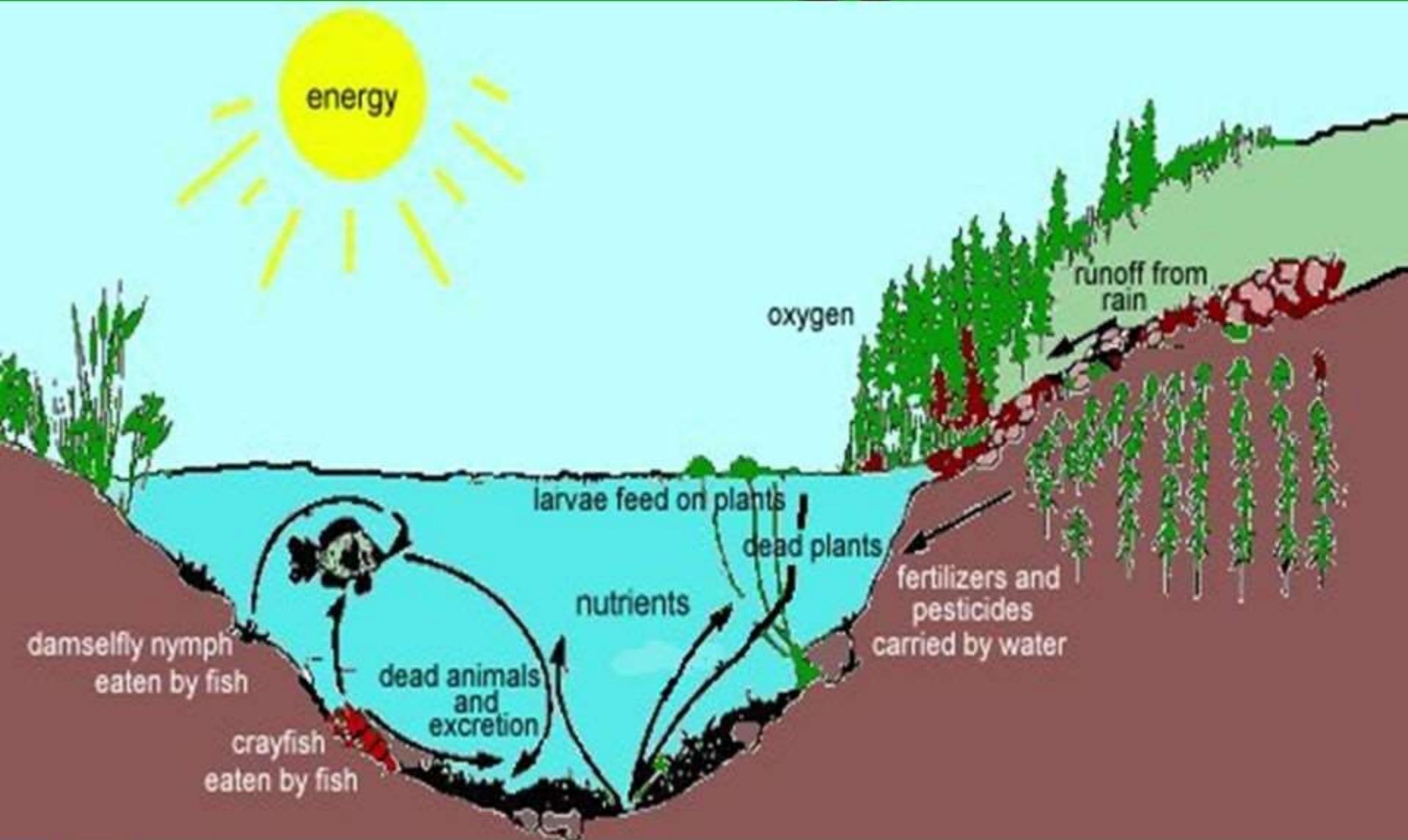
Animal ecology- It has been defined as the branch of biology that deals with the relations of living organisms to their surrounding environment, habits & their way of living. It is related with human society in respect of economy & the particulars production

- Herbivores animals are domesticated for their by-products & aptness to training & management to uplift the agricultural status for their economy & living standards (riding, transport, draught, meat, milk, wool, skin etc.)

Growth- It may be defined as the progressive ↑ in the size or weight of an animal over time. The growth of the animal tissue defined as

- a) Nervous tissue
- b) bone
- c) Muscle
- d) fat

Ecology



- Growth is characterized by an ↑ in the size of individual cells & so tissue
- The no. of cells ↑^{es} or added by the process of the cell division or differentiation process
- Differentiation may be involved in the recruitment of adipocytes in later stage of growth like muscle, bone & adipose tissue

Growth curves- It can be produced by plotting weight against age is sigmoid or 'S' shaped

- The general shape of the growth curve is produced by the interaction of two opposing forces
 - growth accelerating force (summation of cell multiplication) &
 - growth retarding force

Measure & measurement of growth- The measure of growth is ↑ in live weight but in addition to height & length it will be more informative of the particular animal growth status

- 1) growth rate may be expressed as absolute gain in weight per unit time & expressed as

$$w_2 - w_1 / t_2 - t_1$$

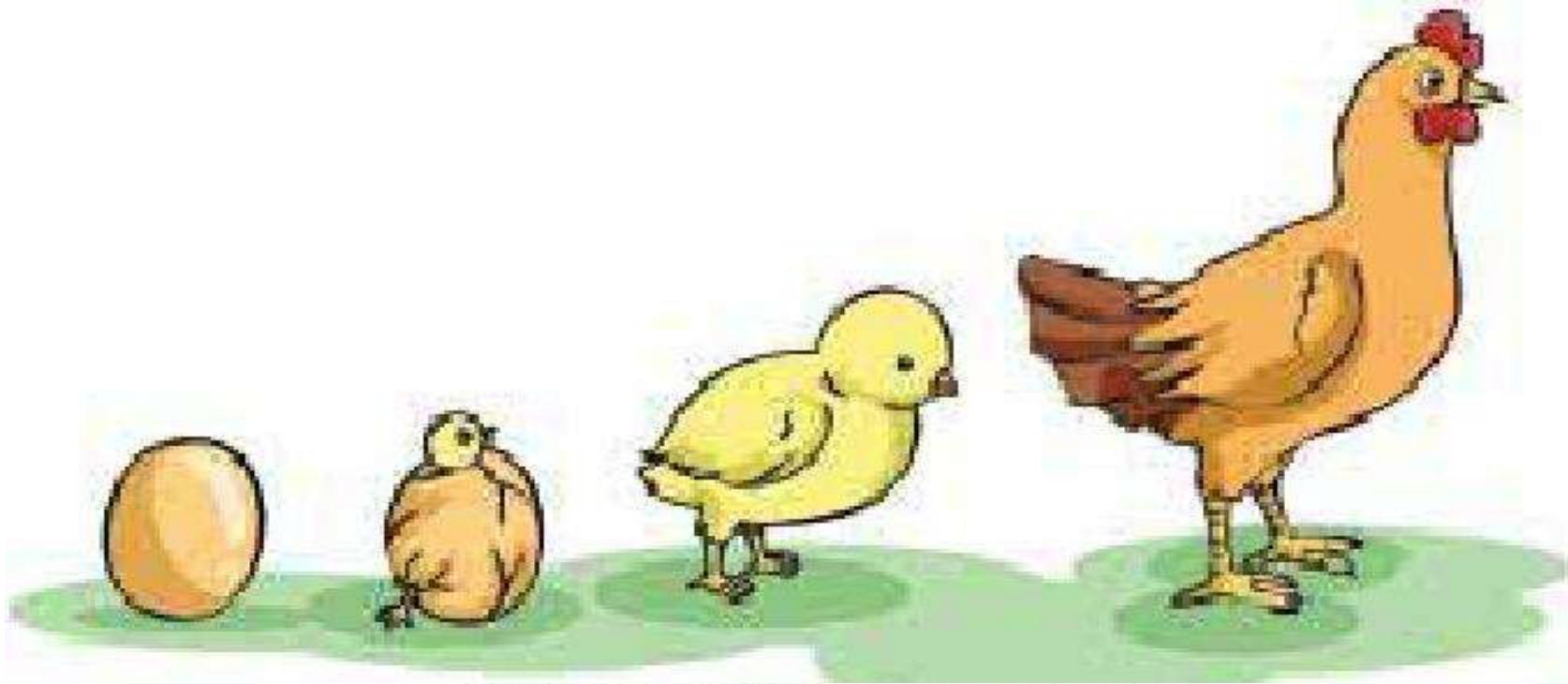
where, w_1 & w_2 are initial & final body wt.

t_1 & t_2 are initial & final body wt.

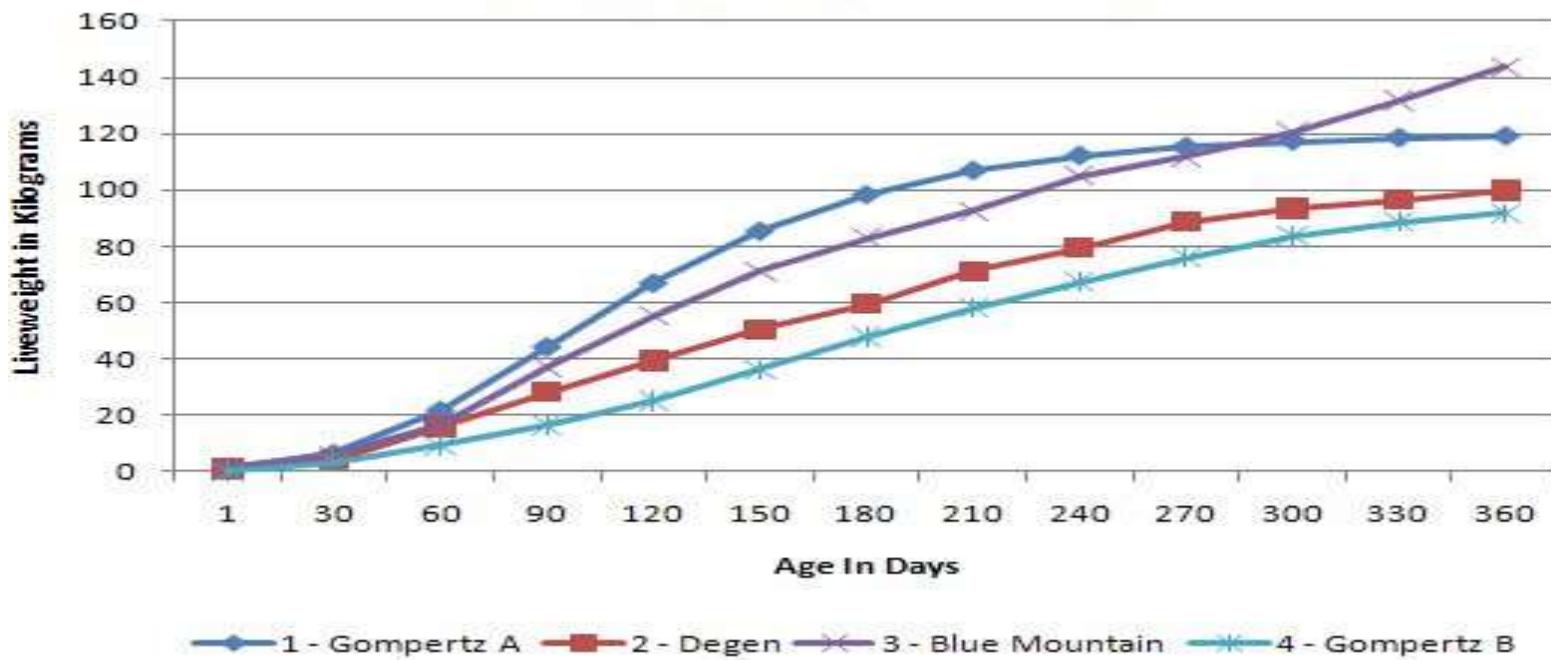
- 2) An another method to express growth rate is by means of the relative growth rate i.e.

$$w_2 - w_1 / w_1$$

Now, the days measurement of body growth in animals are very easy & up to the mark about the features involving growth likewise; MRI (magnetic resonance imaging, urea dilution measurement of body composition, x-ray, computerised tomography (CT) etc.



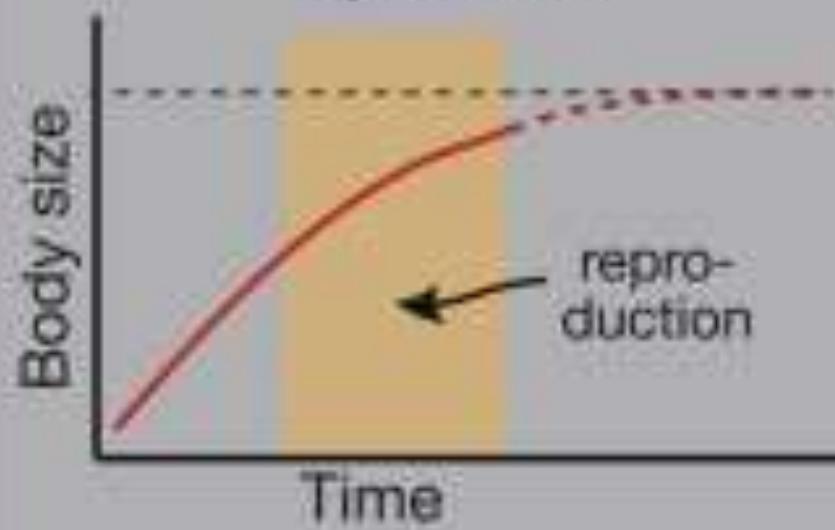
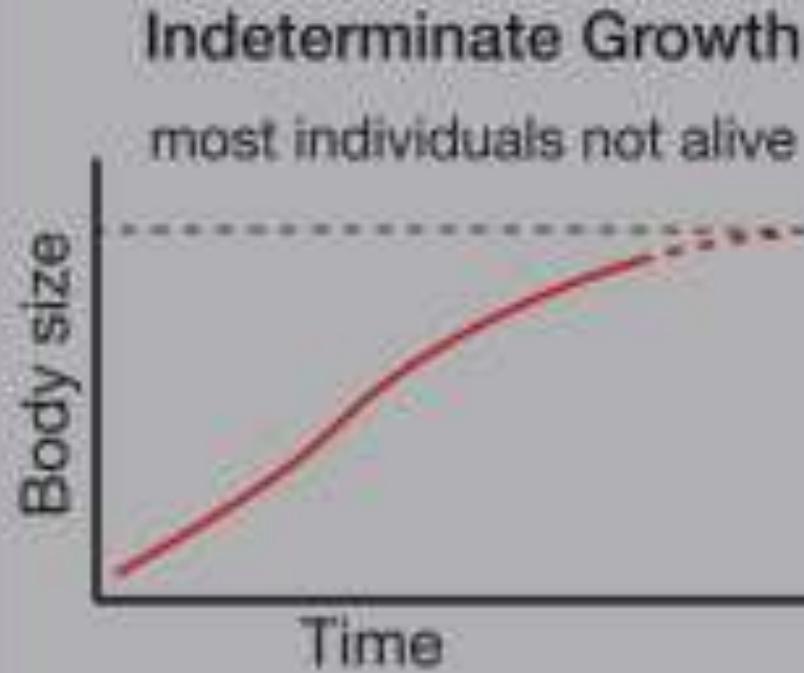
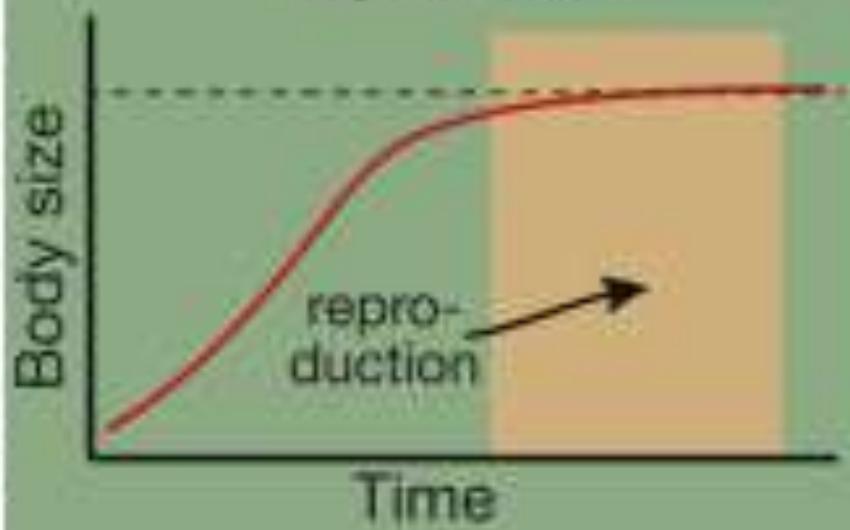
COMPARATIVE GROWTH CURVES



Survival-based



Reproductive value-based



Growth consists of two stages-

- 1) Embryonic stage (pre-natal growth)-** It consists of two stages, which is semi-independent
 - **Stage of embryo-** Generally in this stage developing embryo needs the sufficient & suitable space in the uterus & sufficient nutrition for ultimate development to come into fetal stage
 - **Stage of fetus-** Fetus get placenta for nourishment. Prior to develop, the liver & circulatory system generates them & also the key organs like brain, limb, bones, digestive tract, lungs & etc.
- 2) Adult stage (post-natal growth)-** It consists generally of 4 phases
 - ❖ **Pre-pubertal phase-** It comprises of pre weaned when a new born is dependent on the dam for nutritional aspect. On going post weaning period the animal collect the nutrition & food material from their environment for growing. Nutritional resources change the animal's growth rate unexceptionally

- ❖ **Pubertal phase-** It comprises the dormant gonads to function in full from as it get activate through hypothalamus & pituitary. Animal behavior also takes a great change during this stage or phase
- ❖ **Reproductive phase-** Females get repeated reproductive cycle tends to an annual or seasonal rhythm depending upon the species, so as follows after successful mating; pregnancy, gestation, parturition & lactation. These all stages signify the prompt growth & body development & are about to reflection of accelerating force
- ❖ **Senescence & Death-** Senescence is a gradual encroachment of retarding force. Any factor which accelerates metabolic rate, ↑^{es} such as muscular work, overfeeding, overactive nervous & endocrine systems and environmental temperature

Death also may be possible due to a genetically preset program

Factors effecting live weight growth-

- **Nutrition-** The effect of plane of nutrition on live weight growth is important because of its relationship to the economics of meat & milk production. Plane of nutrition directly affect the rate of turnover & the efficiency of conversion of food into meat & milk. The best way to feed the domestic economic animals are high plane during calf-hood followed by moderate plane
- **Sex-** The effect of sex on live weight growth consists of 2 reasons:
 - Direct effect on growth resulting presume from genetic differences between male & female
 - Indirect effect of sex due to the influence of sex hormones
- **Hormones-**
 - Estrogen inhibits growth of the long bones
 - Hypothyroidism associate with low metabolic rate, reduced feed intake, low blood sugar & liver glycogen & low nitrogen retention > Body weight

- Hypo-function of Ant. pituitary results in dwarfism & hyper-function results in gigantism or acromegaly
- **Vitamins-** Vit. B₁₂ concern with hemopoisis & also with the metabolism of proteins. Vitamins act as co-enzyme in different enzyme system in the animal body
- **Antibiotics-** It helps in ↑ animal live weight growth rate by oral administration being checked unwanted growth of microflora in GI tract tends to positive growth response eg: Aureomycin, streptomycin, bacitracin
- **Genetic factor-** By selection of genetically crossed superior germ plasm as desirable traits for fast growth rate, food conversion efficiency & desirable carcass quality would be of great economical up-liftment
- **Immunological factor-** IgM, IgG, IgA & IgE are the immunoglobulins which present retardation of growth due to diseases or infections

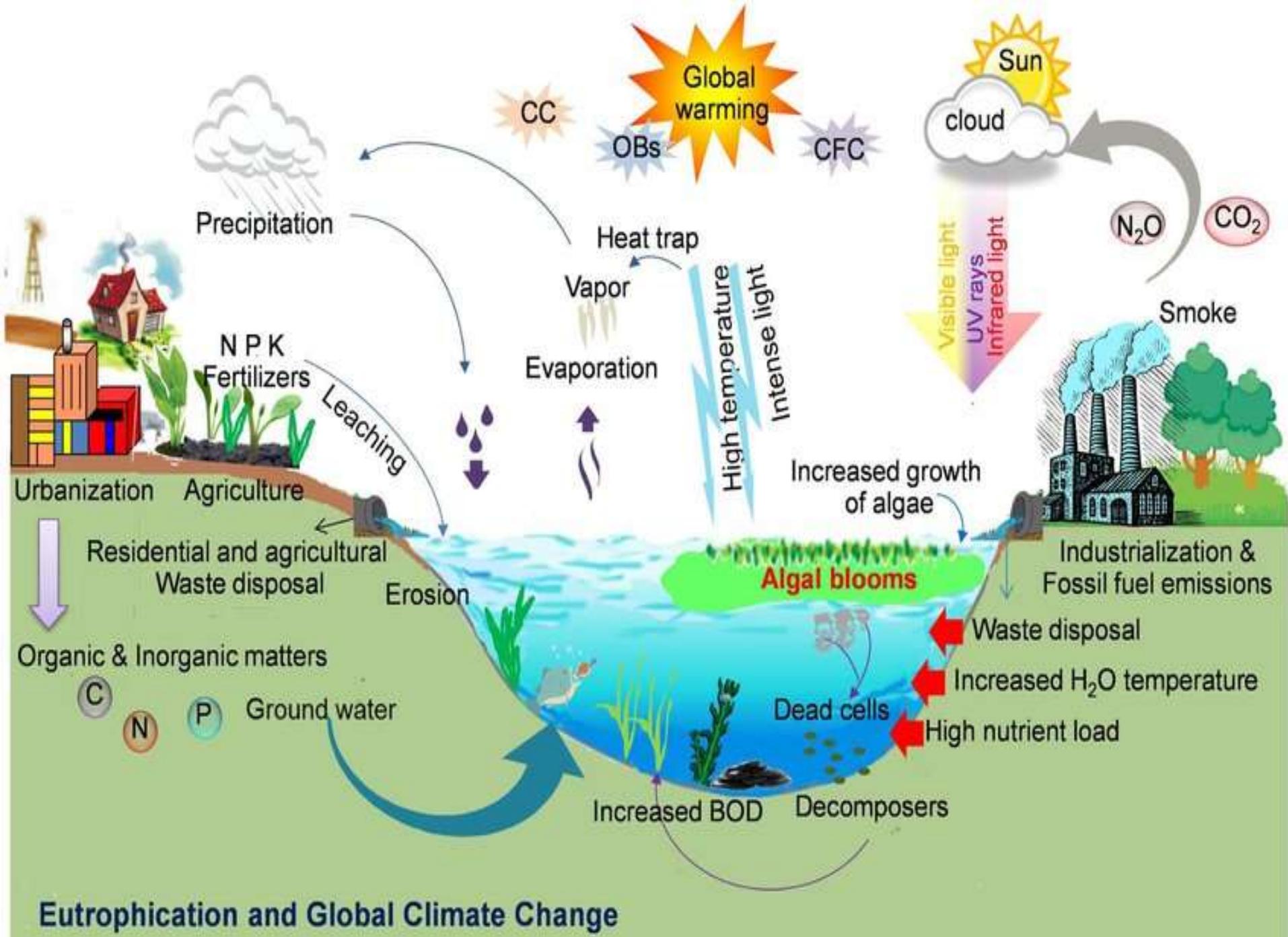
Physical reactions to environmental changes-

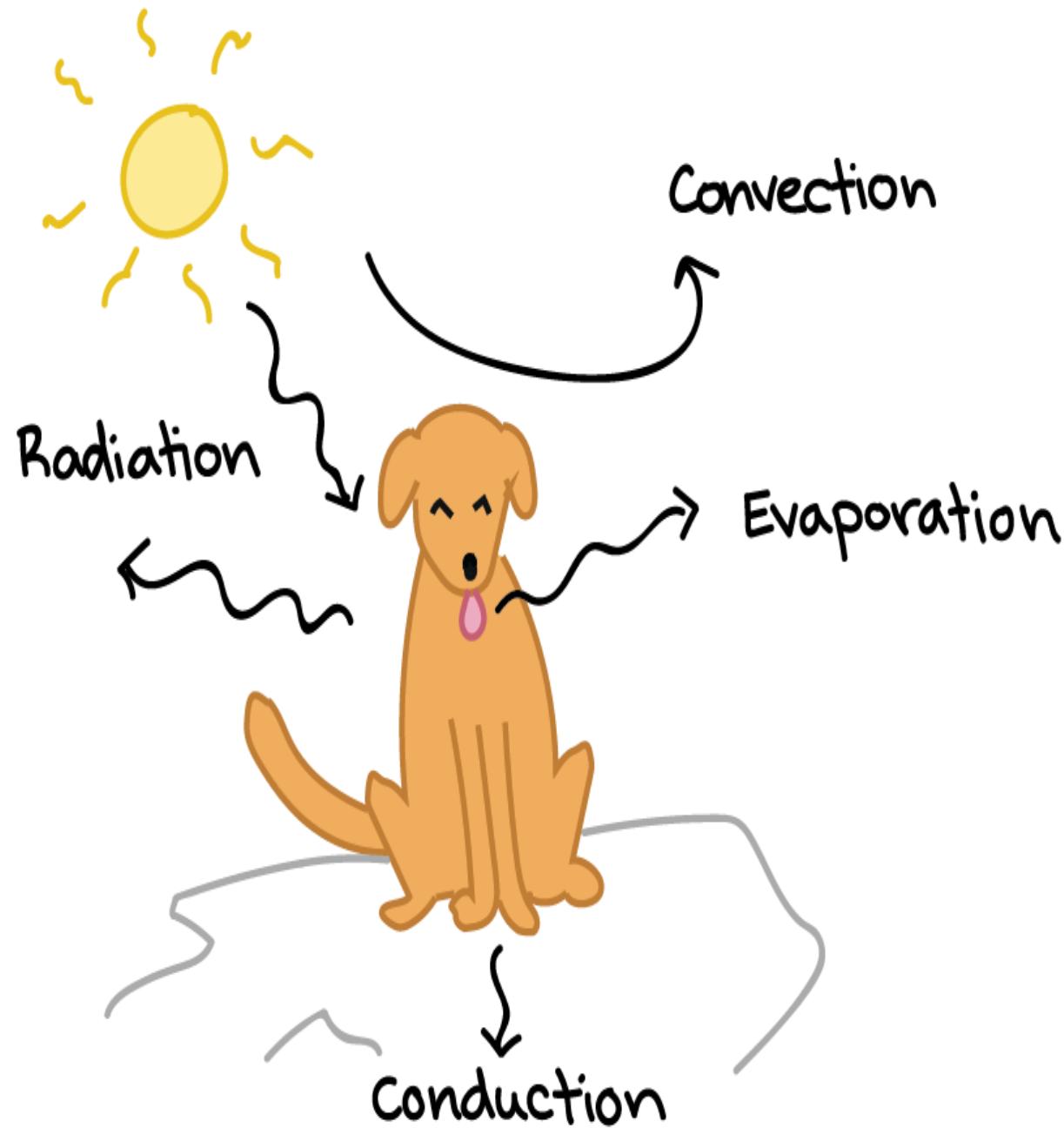
- The heat content of an animal is determined by the heat produced during metabolism & the thermal flux between the animal and their surroundings
- The animal loses heat from the body has a negative value whereas the animal conserve heat or radiation from the surrounding/environment has a positive value

Conduction- The amount of heat transfer between an object & substances when it comes in contact with each other. It results from the direct transfer of kinetic energy of the motion form molecule to molecule with the net flow of energy being from the warmer to cooler region

Convection- It is the mass transfer of heat due to mass movement of a gas or liquid. This transfer generally done between solid & liquid/fluid. Eg:- Animal tissue to its blood/water or lungs tissue to CO_2/O_2

Radiation- The heat transfer through electromagnetic radiation /rays without direct contact between objects. Sun ray to black glass





Evaporation- To change the liquid state into gas of the same temperature; being energy fluid has its own latent heat of vaporization. Animals dissipate heat by allowing water to be evaporated from body surfaces

Physiology of Behavior- All animals exhibit some behavioral characteristics but few of them were distinguish for the easy handling & production like milk, meat, wool, draught etc for the reason they were domesticated

Classification of Animal Behavior:

- **Feeding behavior-** The farm animals tend to feed early morning or late afternoon but carnivores wild animal tend to hunt in the night (darkness). Feeding behavior also varying to the smell/taste of the food. The lateral & medial hypothalamic centers are the appetite & satiety centre.
- **Thermoregulatory behavior-** These are controlled under hypothalamic centre & other parts of the brain, during cold animals consume heat by minimizing conduction, convection & evaporation. They accelerate metabolic activity to generate heat. In hot, animals seek under shelter/shadow, reduce feed intake & metabolic activity.

- **Communicating behavior-** Animal use to communicate generally by means of olfaction, visual, auditory & pheromones
- **Sexual behavior-** Female when comes in heat hormonal changes takes place & shows peculiar symptoms of heat like micturition, mucus discharge, swollen vulva, allow male to mount etc.

These are influenced by sensory or motor capacities, pheromones in male, & sexual stimuli like hormonal change

- **Maternal behavior-** After parturition, it utmost develops to Dam's. Licking of placental fluid to new born & also helps in defecate & urination of young one. Dam protects their new born fetus from strangers. A recognizable pheromone produce by means of which young one's recognize her mother from the herd
- **Agonistic behavior-** It is commonly associated with threat, attack, defense, fear. These are under the control of hypothalamus & amygdala
- **Eliminating behavior-** It is concerned with urination & elimination of feces usually all animals when defecate or urinate the tail is extended away & back is arched

Climatology- It is the branch of science which deals with the study of climatic conditions viz; temperature regulation, wind velocity, atmospheric pressure, solar radiation, rainfall humidity etc

Factors affecting climate & their importance:

- **Environmental temperature& atmospheric pressure –**
- It tends a great variation amongst different animals in respect of internal & external appearance, food habits & behavioral & adaptive aspects
- It also affects the reproduction, lactation, BMR & normal physiology of animals
- Nevertheless, animals have different body shape & size according to their surrounding
- In cold temperate, warm blooded animals have ↑^{ed} or large body size with less body surface towards the high temperature or tropics, while short extremities & compact body size in cold climates
- Well furnished fur/wool & thick skin persists in cold climate animals

- Hot climate animals tends to voluntary anorexia for ↓^{ing} metabolic activities
- Hot climate animals pursue heat loss by the way of evaporation & sweating to maintain homeotherm in extend hot

Wind velocity, humidity & rainfall-

- ❖ These are direct related to the temperature altitude & latitude
- ❖ The tropical areas, high environmental temperature is balanced by corresponding heavy rainfall except in deserts due to lack of humidity or moisture percentage due to the geographical status of that area
- ❖ In different climatic condition different types of animal use to live perspect of their need

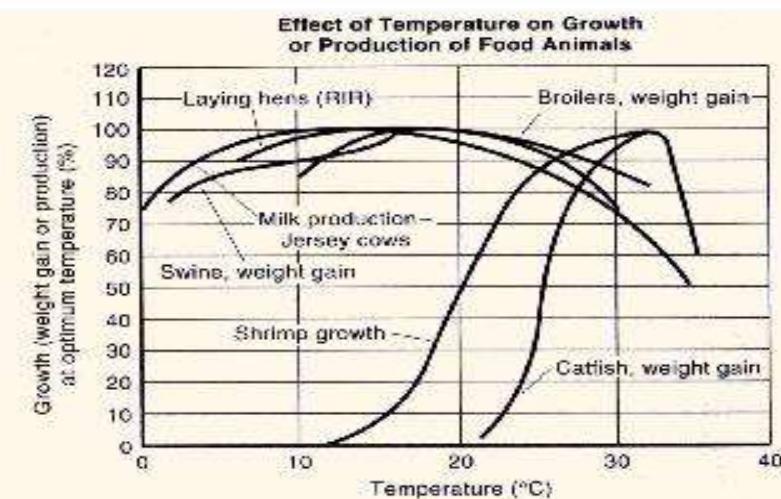
- ❖ These animals modify or adapted their body confirmation, adaptive factors & behavioral habits to their surroundings so that they can justify their needs in relation to their climatic condition
- ❖ In tropics, animal feel cold by evaporation & sweating
- ❖ On ↑^{ed} humidity, animals tend to sweat & pant to maintain homeotherm
- ❖ On going rainfall, the water accumulated at the base & is of fullfilness to the thirst & to prevent itself from the heat

Reaction of animals to temperature & fever:

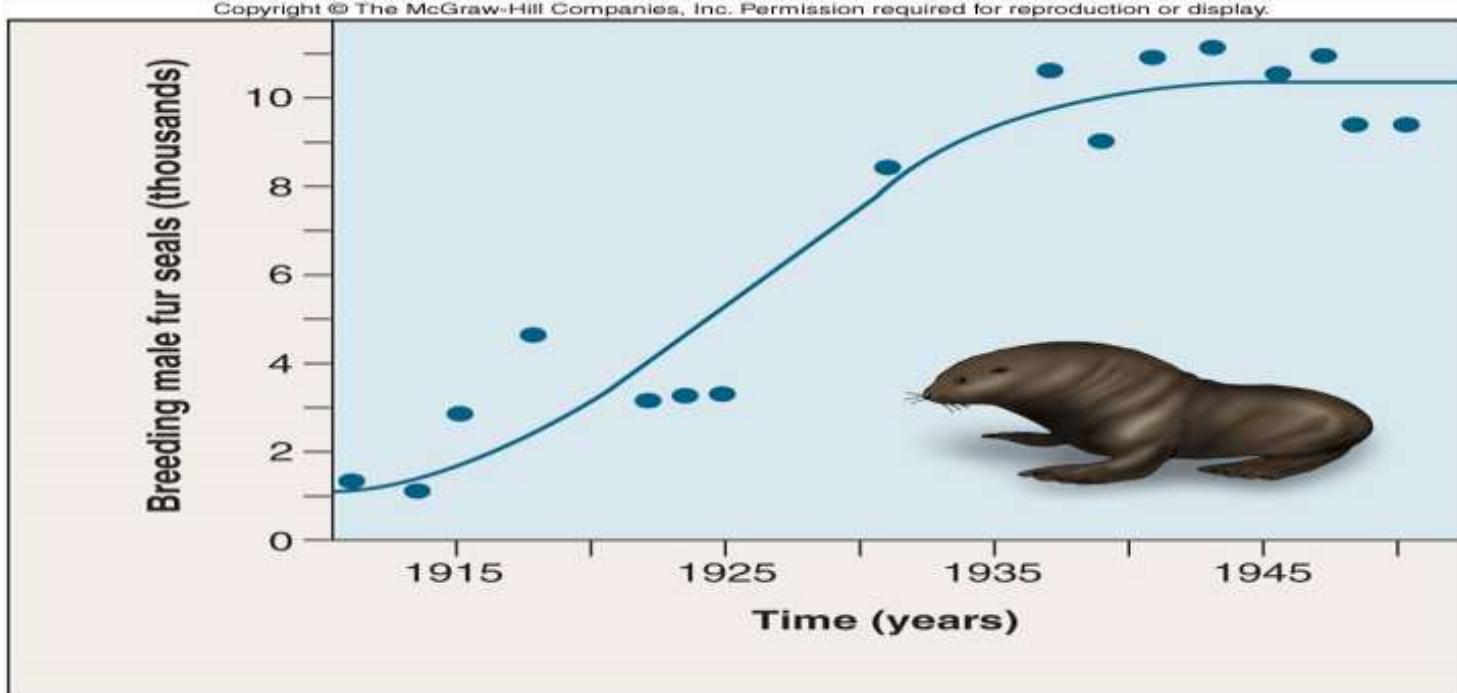
Temperature-

- It stands a lot for the animal regarding their habitats, food, reproduction, appearance & their activities
- Animals maintain homeotherm by different physical changes

Temperature and Growth of Food Animals



What is the optimum Temperature for Hens, catfish, shrimp?



- It mainly depends upon the amount of heat produced and heat exchange i.e. heat gained minus heat lost
- Surface area, shelter & ability of heat conductance are the factors for heat transfer where surface area if ↑^{es}, the animal may dissipate heat more
- Shelter provides the heat transfer depending upon directly comes in contact to the ambient temperature
- The size of skin & fur allows to maintain conductance through their body surfaces
- The fur/feather also holds the air which has low thermal conductivity & maintain homeotherm
- The animals also regulate the exchange of heat to their environment by following mechanisms:-
 - **Behavioral control-** The animals adjust their posture controlling the surface area to maintain homeotherm. In hot humid or semi arid areas they use to live under burrow or seeks in the root of thorny plants or bushes

- **Automatic control-** Flow of blood towards the periphery & skin influences the temperature gradient & heat flux from the body surfaces. Sweating & salivation also accommodate during panting causes evaporation as cooling & soothing effect
- **Adaptive control-** It includes sub-dermal fatty layer insulation probably for controlled heat loss through evaporation or sweating. In cold climate, birds have large & broad wings to maintain homeotherm

Rules followed in climatology-

Bergmann's rule- He states that warm blooded animal/species in the colder climates tend to be larger in size than those of comparable warmer regions.

Cold climate animals have a large body with relatively smaller surface area while in hot humid areas a small body with relatively larger surface area to dissipate heat.

Allen's rule- There was a general tendency for the enlargement of the peripheral parts under high temperature zone.

Increased periphery α temperature

Wilson's rule- In cold countries animal tended towards the fleecy coat whereas in warm regions hair was more strongly developed & wool almost totally absent

Wool1/ α temperature
while hair α temperature

Gloger's rule- Animals inhabiting warm region show greater melanin pigmentation than the same species in cooler or drier regions. In arid desert region the skin is characterized by yellow or reddish brown phaeomelanin pigmentation due to anticipated or protection from ultraviolet rays

Fever- It is a condition when hypothalamic regulatory center becomes sensitive to certain chemicals collectively termed pyrogens may be of internal (body's tissue or cell originated from bacteria) or from other external source (infection from microorganisms)

- It is related to positive heat balance in regard to ambient
- A rise in body temperature may induce the metabolism but in respect to ↑ in body temperature the rate of metabolic activity ↑^{es} faster & disturb the whole system
- In certain fever, blood becomes concentrated & leads to insufficient elimination of heat through body surfaces

Central control of heat regulation-

- Cerebral cortex & lower in the medulla & spinal cord have integrated action on the thermoregulation and homeotherm center's of the animal body
- There are two centers in the hypothalamus associated with overheating and overcooling having certain sensitive cells which act on change in blood temperature

- So, the efferent nerves of hypothalamic center cells identify by sensation & send the message to act their target cells to maintain heat or cold
- If the sensitive cells situated at hypothalamus receive cold/heat they allow to make change in physical reaction so that the body can maintain homeotherm by the help of (conduction, convection or evaporation)

Temperature regulation in birds:-

Endothermic control-

- **Nervous control of body temperature**- The center for heat regulation is situated in the mid brain which is sensitive to change in blood temperature. On initiating polypnoea evaporative cooling also \uparrow^{es}
- **Insulation-**
- ❖ **Sub-cutaneous fat**- Fat is present mainly in the abdomen & therefore it plays a little part in temperature regulation except- penguins, goose & domestic duck

❖ **Feathers-** The down feathers are designed to hold minimum volume of air. The feathers can interlock themselves to attain the temperature they live/survive. Different types of feather used the birds for different climatic condition as we use the cloth

The preen gland secreted oil to prevent wetting of feather from water. The flight feathers are flat & windproof for performing during flight

❖ **Metabolism related to climate & body size-** The cold region birds attain a higher basal metabolism. Birds of cooler region have larger intestines to that of hotter region. Also the body size is larger than that of hot climate birds

❖ **Cardiovascular reactions-** Birds have no sweat gland, but they can dissipate their heat through lungs & feathers much better than the tissue. If they open the interlocking of the feathers they can much better dissipate the heat & by evaporation through the lungs. Heart rate also \uparrow^{es} in cold with \uparrow^{ed} metabolism to maintain homeotherm

Exothermic control-

- **Posture & activity-** Birds use to be in flock in cold climate to maintain homeotherm & less their body surface area minimum to the air, the head, neck & feathers lie down to attain minimum surface area. In hot climates, birds drink more water. Splash water to their feathers & body to become cold
- **Migration-** Birds can tolerate minimum to starvation and they can fly from unsuitable to favorable environment in search of food & spring climatic condition. Non-fly birds use to live in their nests or shelter.

