

TRENDS IN ECONOMIC ZOOLOGY

UNIT V

Chapter 13

Trends in Economic Zoology

Chapter Outline

- 13.1 Scope of Zoology
- 13.2 Vermiculture
- 13.3 Sericulture
- 13.4 Apiculture
- 13.5 Lac culture
- 13.6 Aquaponics
- 13.7 Aquaculture
- 13.8 Animal Husbandry and management



Give a man a fish and you feed him for a day;
teach a man to fish and you feed him for a lifetime.

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Charles Darwin

Without the work of this humble creature, who knows nothing of the benefits he confers upon mankind, agriculture, as we know it, would be very difficult, if not wholly impossible.

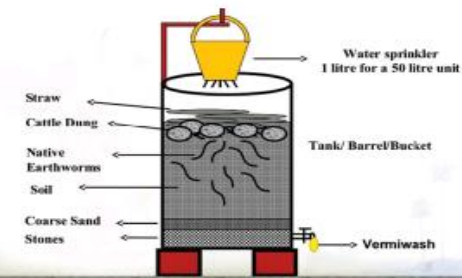


Aristotle

Worms are the intestines of the earth.



Earthworm is farmer's best friend
Earthworms are capable of moving 6 tonnes of soil up and down in a year.
This is equivalent to 100 litres of fossil fuel.



LEARNING OBJECTIVES

- **Creating awareness on self employment opportunities in various fields.**
- **Understands the economic importance of earthworm, honeybee, lac insect, silk worm, fish, cattle and birds.**
- **Knows the techniques and tools required for various culture methods.**
- **Learns to manage the culture practices.**



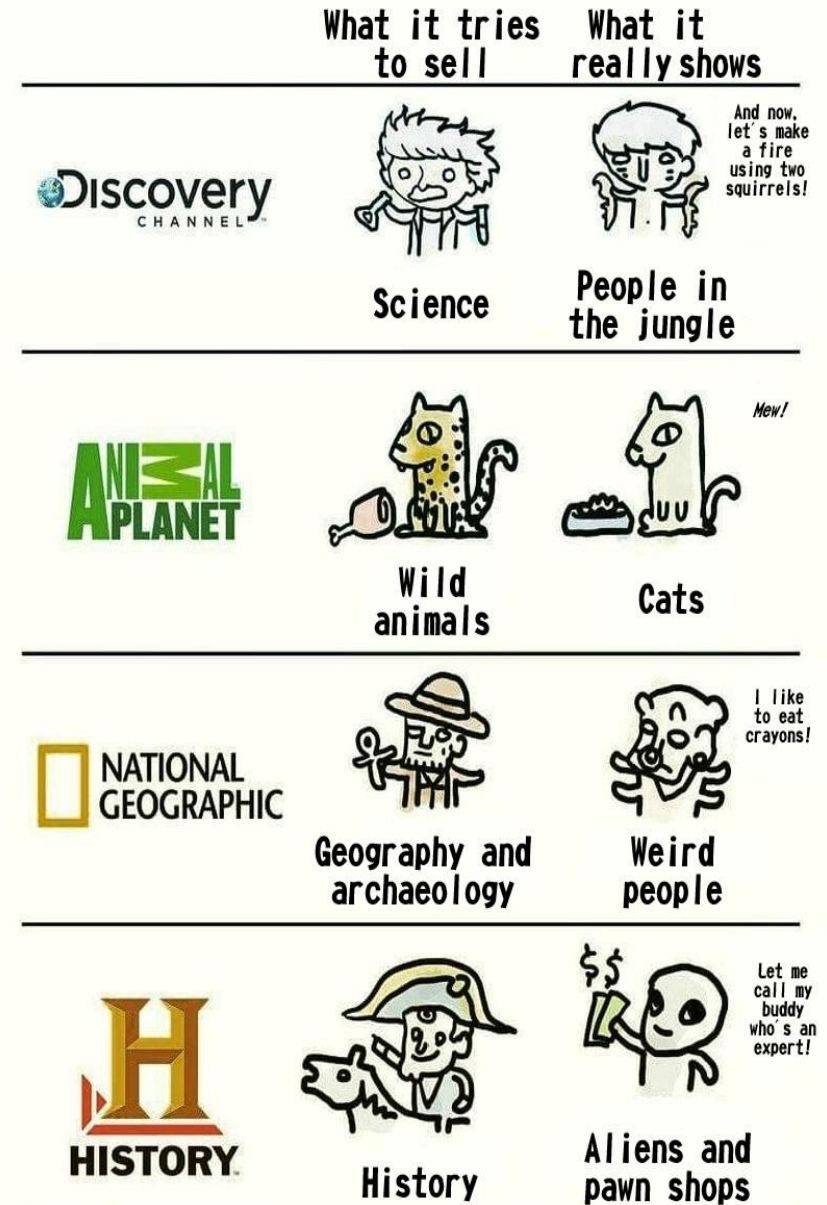
TRENDS IN ECONOMIC ZOOLOGY

- Zoology is a branch of science which deals with the **study of animals.**
- For someone who is interested in pursuing a career in Zoology, there are **several specializations** that the students can venture into.
- There are **physiologists**, who study the **metabolic processes of animals.**
- There are **taxonomists** who deal with the **naming and the classification of animal species.**
- **Embryologist** whose job is to **study and focus on the early developmental stages of animal life.**



TRENDS IN ECONOMIC ZOOLOGY

- Zoology as a career as a number of specializations and students are **presented with a plethora of career options** once they chose to be associated with this field.
- This field is concerned with the **preservation and management of animal kingdom** and a career in it would mean that you are a part of that responsibility.
- A zoologist might even get to travel because the **nature of his/her job**.
- Channels like **National Geographic, Animal Planet, and Discovery Channel** are in constant need of Zoologists for research and documentaries.



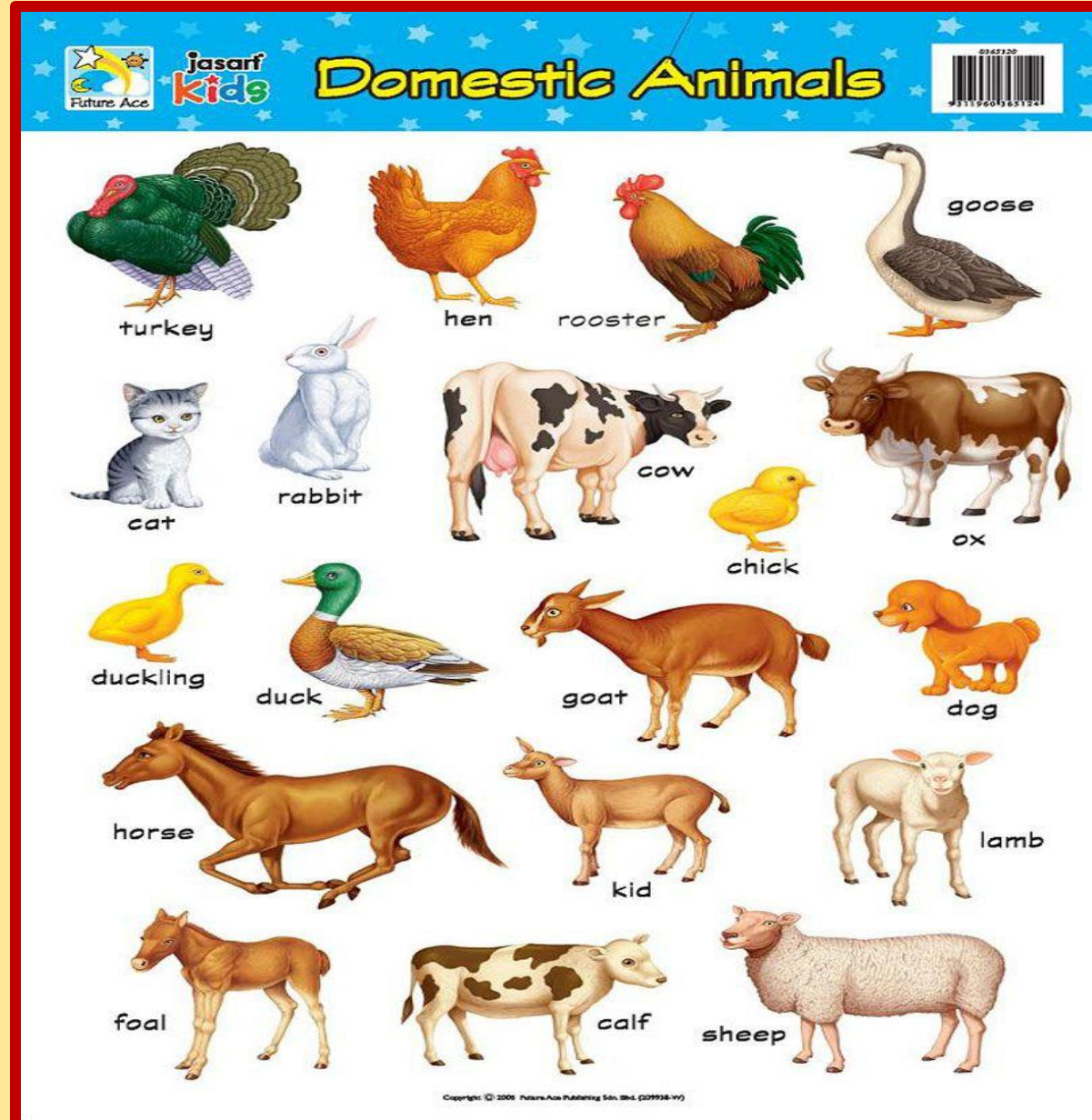
TRENDS IN ECONOMIC ZOOLOGY

- Zoologists are also hired for **zoos, wildlife services, botanical gardens, conservation organizations, national parks, nature reserves, universities, laboratories, aquariums, animal clinics, fisheries and aquaculture, museums, research, pharmaceutical companies, veterinary hospitals, etc.**
- **If you want to be an entrepreneur you have to learn the methods of culturing farm animals and their importance, since farm animals possess great economic value.**



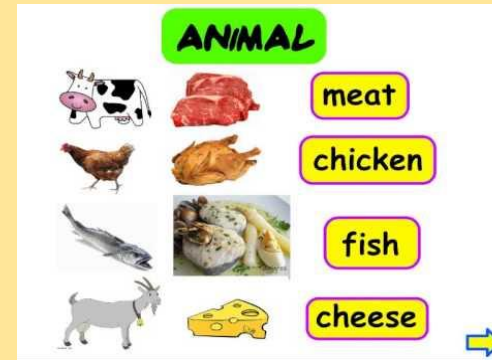
TRENDS IN ECONOMIC ZOOLOGY

- Since prehistoric time human beings taken **maximum advantage from animals by keeping them under their control through domestication.**
- The economic success of the industries, based on animals and their products, depends on the proper production, management and development of the **next generation of farm animals.**



- Studying Zoology can provide **self employment opportunities** and you can become an entrepreneur.
- Economic Zoology is a branch of science that **deals with economically useful animals**.
- It involves the study of application of **animals for human welfare**.
- The need of Zoology is not just to improve our economic condition but also to **provide food security and provide employment opportunities**.
- Based on the economic importance, animals can be categorized as:

1. Animals for food and food products
2. Economically beneficial animals
3. Animals of aesthetic importance
4. Animals for scientific research.



VERMICULTURE



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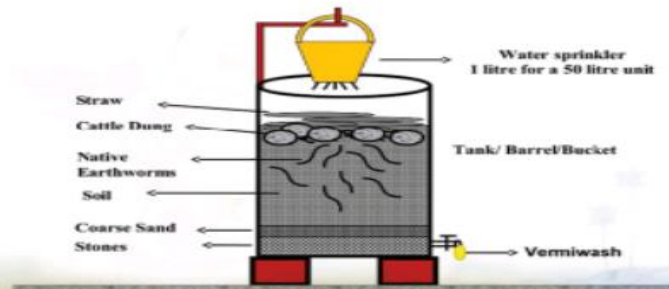


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1 litre for a 50 litre unit

Tank/ Barrel/Bucket

Labels in diagram:
Straw
Cattle Dung
Native Earthworms
Soil
Coarse Sand
Stones
Vermiwash

71DBBK

- Vermiculture is the process of **using earthworms to decompose organic food waste, into a nutrient-rich material** capable of supplying necessary nutrients which helps to sustain plant growth.
- The aim is to **continually increase the number of worms** to have a sustainable harvest.
- The excess worms can either be used to expand a **vermicomposting operation or sold to customers.**
- Vermicompost is the primary goal of **vermiculture.**

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- Technically, the worm castings are **pure worm waste and are fine and nutrient rich organic soil amendment.**
- Vermicompost on the other hand, is **comprised of the castings, bits of bedding and other organic matter.**
- Essentially, though the terms are used interchangeably, they are **both worm manure and are valuable for improving soil health.**
- Applications of earthworm in technology of composting and bioremediation of soils and other activities is called **Vermitech** (Sultan Ismail, 1992).

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- The disposal of solid wastes (biodegradable and non-biodegradable) remains **a serious challenge in most of the countries.**
- Earthworms play a vital role in **maintaining soil fertility;** hence these worms are called as **“farmer's friends”**.
- These are also called as **“biological indicators of soil fertility”**.

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- The reason is that they support bacteria, fungi, protozoans and a host of other organisms which are **essential for sustaining a healthy soil.**
- The breakdown of organic matter by the activity of the earthworms and its elimination from its body is called **vermicast.**
- It is a finely divided granular material and is noted for its porosity, aeration, drainage and moisture holding capacity and serves as **rich organic manure.**

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- Earthworms are divided into **two major groups**.
- The **first group**, the humus formers, dwell on the surface and feed on organic matter.
- They are generally **darker in colour**.
- These worms are **used for vermicomposting**.

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- The **second group**, the humus feeders, are burrowing worms that are useful in making the soil porous, and mixing and distributing humus through out the soil.
- There are different **endemic (native) species** of earthworms cultured in India for vermicomposting such as **Periyonyx excavatus, Lampito mauritii, Octochaetona serrata.**
- Some earthworm species have been introduced from other countries and called as **exotic species.**
- Eg. **Eisenia fetida, Eudrilus eugeniae.**

VERMICOMPOSTING



- Vermicompost is the compost produced by the action of earthworms in association with all other organisms in the **compost unit**.
- Vermicompost bed may be selected on upland or an elevated level as it prevents the **stagnation of water**.
- You may construct a cement pit of **3x2x1m size** (LxWxD) **over ground surface using bricks**.
- The size of pit may vary as per **availability of raw materials**.

VERMICOMPOSTING



- **Cement pot or well rings** are practically good.
- Provision should be made for **excess water to drain**.
- The **vermibed should not be exposed to direct sunlight** and hence shade may be provided.
- The first layer of vermibed contains **gravel at about 5 cm in height, followed by coarse sand to a thickness of 3.5 cm,** which will facilitate the drainage of excess water.

VERMICOMPOSTING



- **Earthworms collected from native soil** prefer a layer of local soil in their compost beds.
- If local soil earthworms are used, add a layer of native loamy soil for about 15 cm on top of the gravel sand layer and introduce earthworms into it.
- For **exotic species such as Eisenia fetida and Eudrilus eugeniae**, the layer of soil is not needed.
- The unit can now be loaded with **digested biomass or animal dung such as cow dung** that has lost its heat.

VERMICOMPOSTING



- The number of earthworms to be introduced in an unit depends on the **size of the vermibed prepared.**
- Earthworms such as **Periyonyx excavatus, Eisenia fetida or Eudrilus eugeniae** are introduced on the top.
- **Jute bags or cardboards or broad leaves** are used to cover the unit.
- As worms require **moisture, water management is most important for the survival of the earthworms.**
- **Too little or too much of water** is not good for the worms.

VERMICOMPOSTING



- Earthworms **release their castings on the surface.**
- One can start harvesting this from the surface on **noticing the castings on the surface.**
- It may take several days for the **entire biomass to be composted depending on the amount of biomass.**
- When all the compost is harvested, **earthworms can be handpicked by creating small conical heaps of harvested compost and leaving in sunlight for a few hours.**
- The earthworms then move down and **settle at the bottom of the heap as a cluster.**
- Earthworms from the lower layers of the compost can be recovered and the worms can be **transferred to new composting units.**

VERMIWASH



- **Vermiwash is a liquid collected** after the passage of water through a column of vermibed.
- It is useful as a **foliar spray to enhance plant growth and yield.**
- It is obtained from the **burrows or drilospheres** formed by earthworms.
- **Nutrients, plant growth promoter substances and some useful microorganisms are present in vermiwash.**

Earthworm Pests and Diseases



- Earthworms are subjected to attack by a **variety of pests**.
- Most outbreaks are the result of **poor bed management**.
- Earthworm enemies include **ants, springtails, centipedes, slugs, mites, certain beetle larvae, birds, rats, snakes, mice, toads, and other insects or animals** which feed on worms.



Earthworm Pests and Diseases



- The earthworm has a number of **internal parasites** including numerous protozoa, some nematodes, and the **larvae of certain flies**.
- Larger predators can be excluded from worm beds by **proper construction of the bins, and by use of screens or gratings at the bottom and top of the beds**.

Advantages of Using Vermicompost



- People are **aware about benefits of organic inputs in farming.**
- Vermicompost is **excellent organic manure for sustainable agro-practices.**
- So, **marketing vermicompost** is now a potential and flourishing industry.
- **Retail marketing of vermicompost in urban areas** is most promising.
- Vermicompost is neatly packed in designed and **printed packets for sale.**
- People of **different age groups are involved** in the production and selling of vermicompost.
- Marketing of vermicompost can provide a **supplementary income.**

Advantages of Using Vermicompost



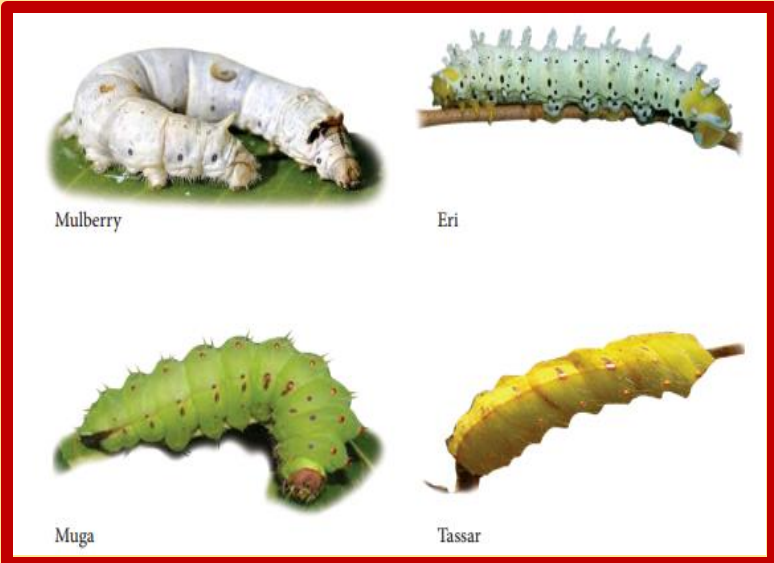
1. Vermicompost is **rich in essential plant nutrients**.
2. It improves **soil structure texture, aeration, and water holding capacity and prevents soil erosion**.
3. Vermicompost is **a rich in nutrients and an eco-friendly amendment to soil for farming and terrace gardening**.
4. It enhances **seed germination and ensures good plant growth**.

VERMICOMPOSTING



My vermicompost manufacturing unit is plagued by a number of red ants. Are there any bio-friendly measures to tackle the menace as I do not want to use any chemicals?

SERICULTURE



SERICULTURE



- Silk is **Nature's gift to mankind** and a commercial fiber of animal origin other than wool.
- Being **eco-friendly, biodegradable and self-sustaining material**; silk has assumed special relevance in present age.
- Sericulture is an **agro –based industry**, the term which denotes commercial production of silk through **silkworm rearing**.
- Historical evidence reveals that sericulture was practiced in **China long back** and they **preserved the secret for more than 3000 years** and maintained **monopoly in silk trade with the rest of the world**.

SERICULTURE



Mulberry



Eri



Muga

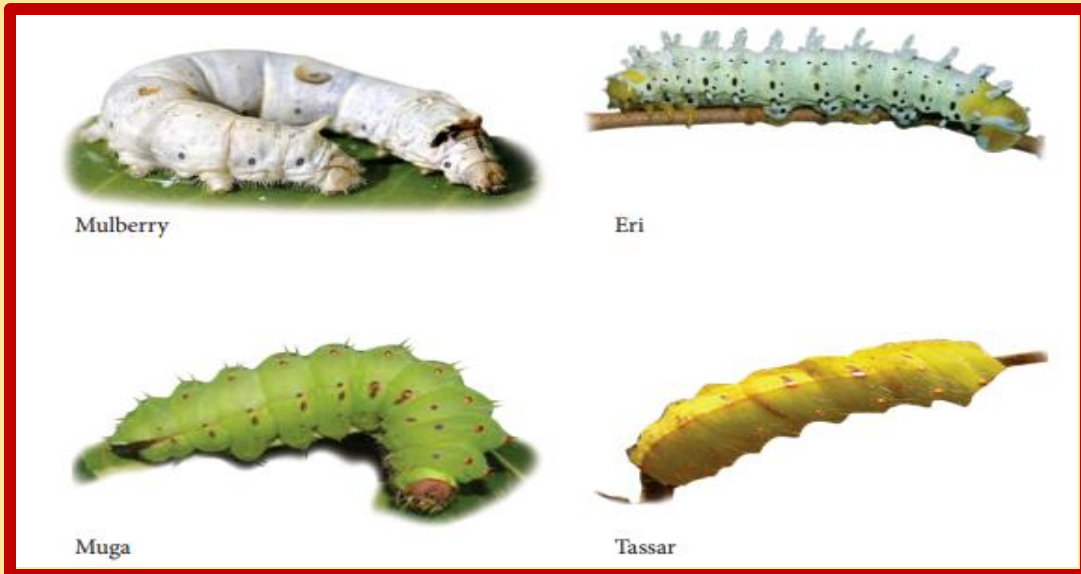


Tassar



- According to Western historians, **mulberry cultivation spread to India about 140BC from China through Tibet.**
- The fabulous silk from China and India were **carried to European countries.**
- The 7000 mile lengthy road, historically called the “**Silk road**” passing through **Baghdad, Tashkent, Damascus and Istanbul** was used for silk transport.
- Today more than **29 countries** in the world are **practicing sericulture** and producing different kinds of silk.
- India stands **second in silk production next to China.**

SERICULTURE

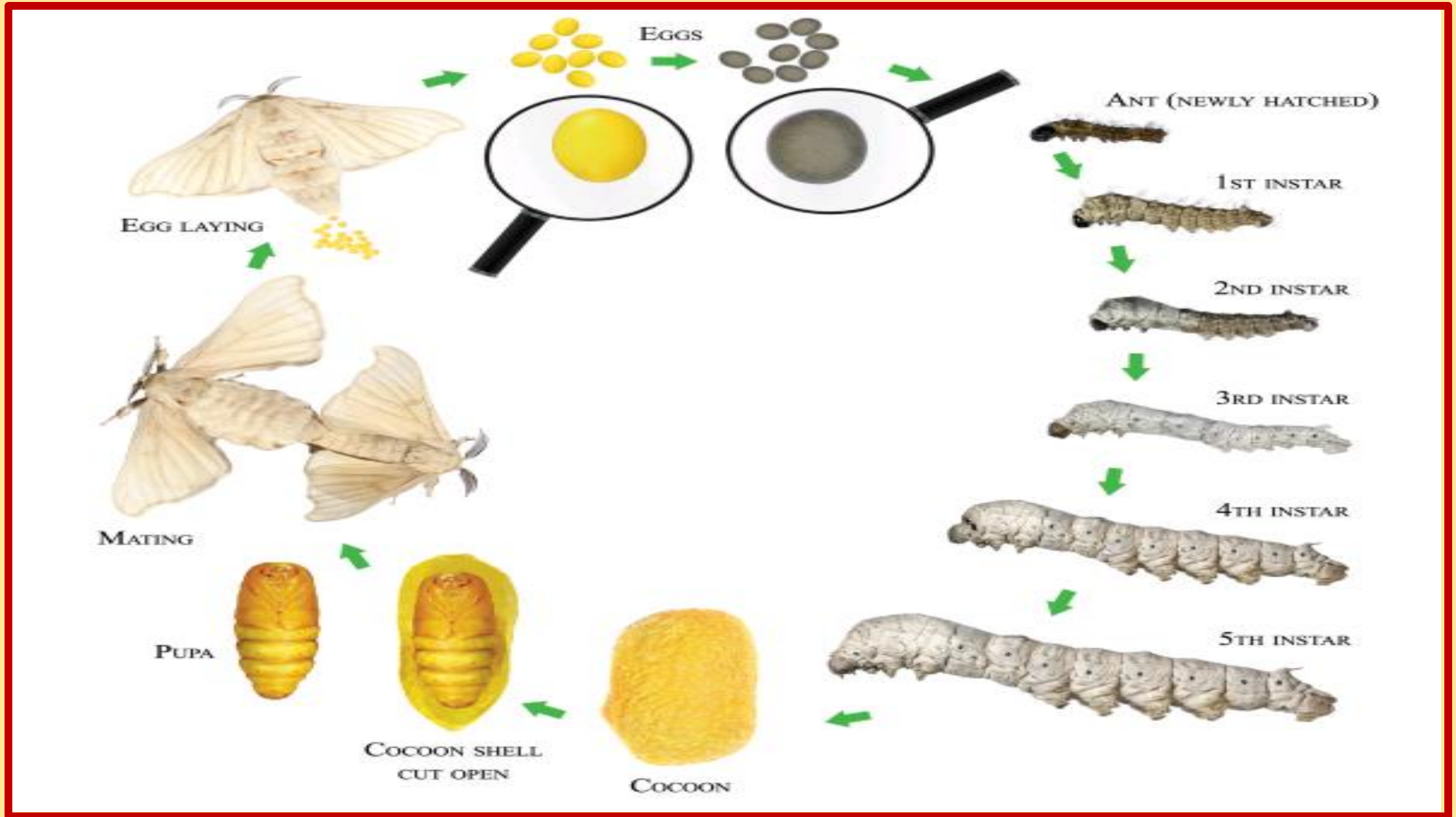


- Production of silk from the silk worm, by rearing practices on a commercial scale is called **sericulture**.
- It is an **agrobased industry** comprising three main components:
 - i) Cultivation of food plants for the silkworms.**
 - ii) Rearing of silkworms.**
 - iii) Reeling and spinning of silk.**
- The **first two are agricultural** and the **last one is an industrial component**.
- Only **few species of silkworms are used** in the sericulture industry.

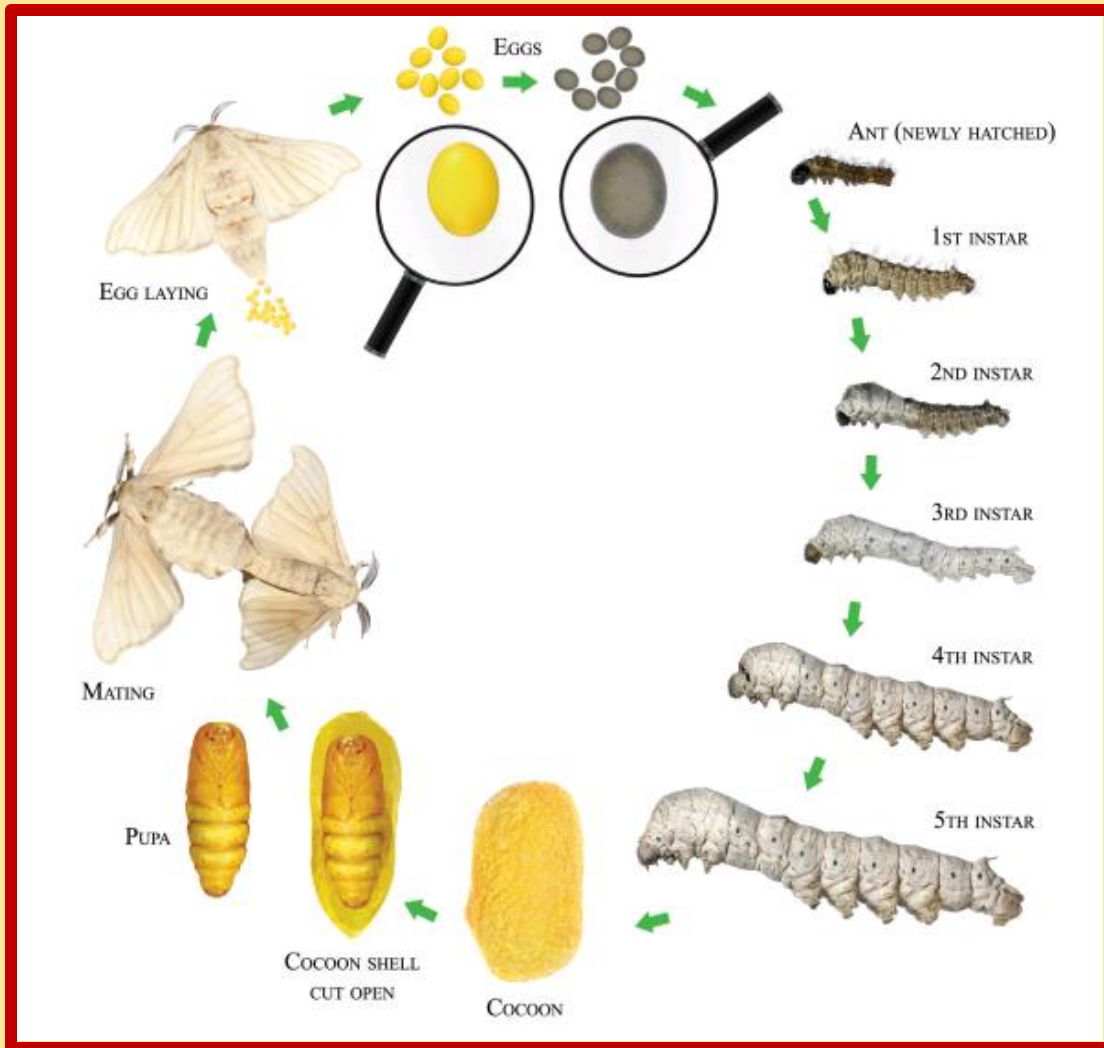
DIFFERENT TYPES OF SILKWORM

Species of silkmoth	Silk Producing States	Preferred Food (Leaves)	Type Of Silk
<i>Bombyx mori</i>	Karnataka, Andhra Pradesh and Tamil Nadu	Mulberry	Mulberry Silk
<i>Antheraea assamensis</i>	Assam, Meghalaya, Nagaland, Arunachala Pradesh and Manipur	Champa	Muga Silk
<i>Antheraea mylitta</i>	West Bengal, Bihar and Jharkand	Arjun	Tassar Silk
<i>Attacus ricini</i>	Assam, Meghalaya, Nagaland, Arunachala Pradesh and Manipur	Castor	Eri Silk

Life cycle of Bombyx mori



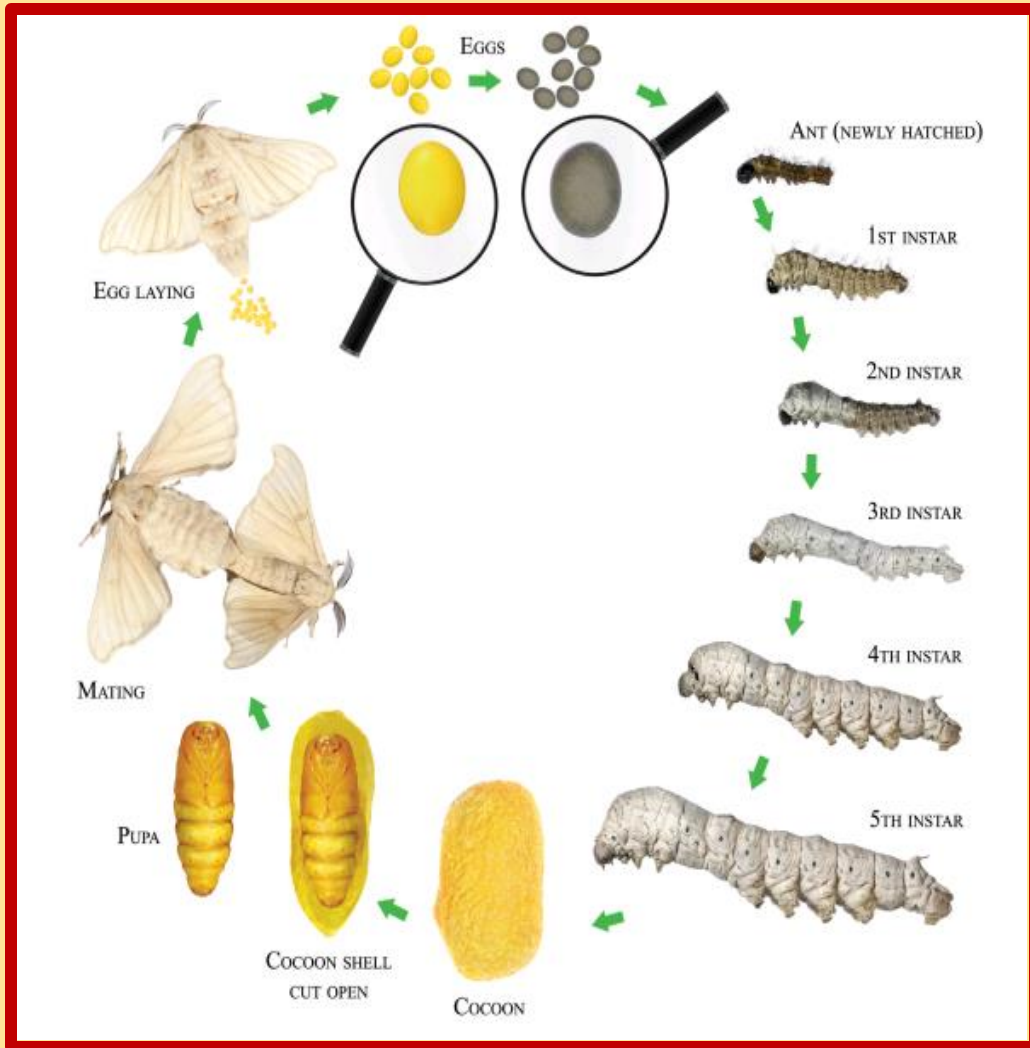
Life cycle of Bombyx mori



- The adult of **Bombyx mori** is about **2.5 cm in length** and **pale creamy white in colour**.
- Due to **heavy body and feeble wings**, flight is not possible by the female moth.
- This moth is **unisexual in nature** and **does not feed** during its very short life period of **2-3 days**.
- Just after emergence, **male moth copulates with female** for about **2-3 hours** and if not separated, they may die after few hours of copulating with female.
- Just after copulation, **female starts egg laying** which is completed in **1-24 hours**.

www.Padasalai.Net www.TrbTnpsc.com

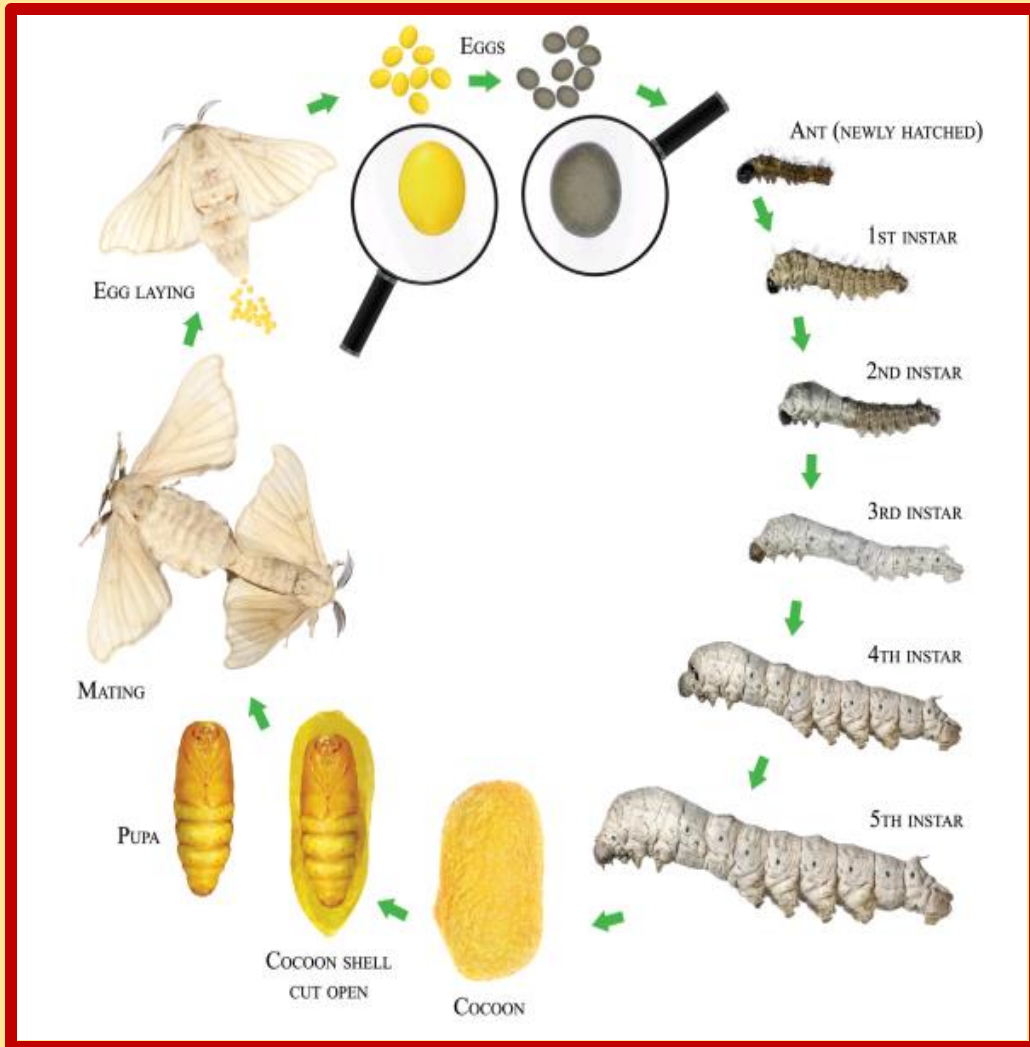
Life cycle of Bombyx mori



- A single female moth lays **400 to 500 eggs** depending upon the **climatic conditions**.
- **Two types of eggs** are generally found namely diapause type and non-diapause type.
- **The diapause type is laid by silkworms inhabiting the temperate regions, whereas silkworms belonging to subtropical regions like India lay non-diapause type of eggs.**

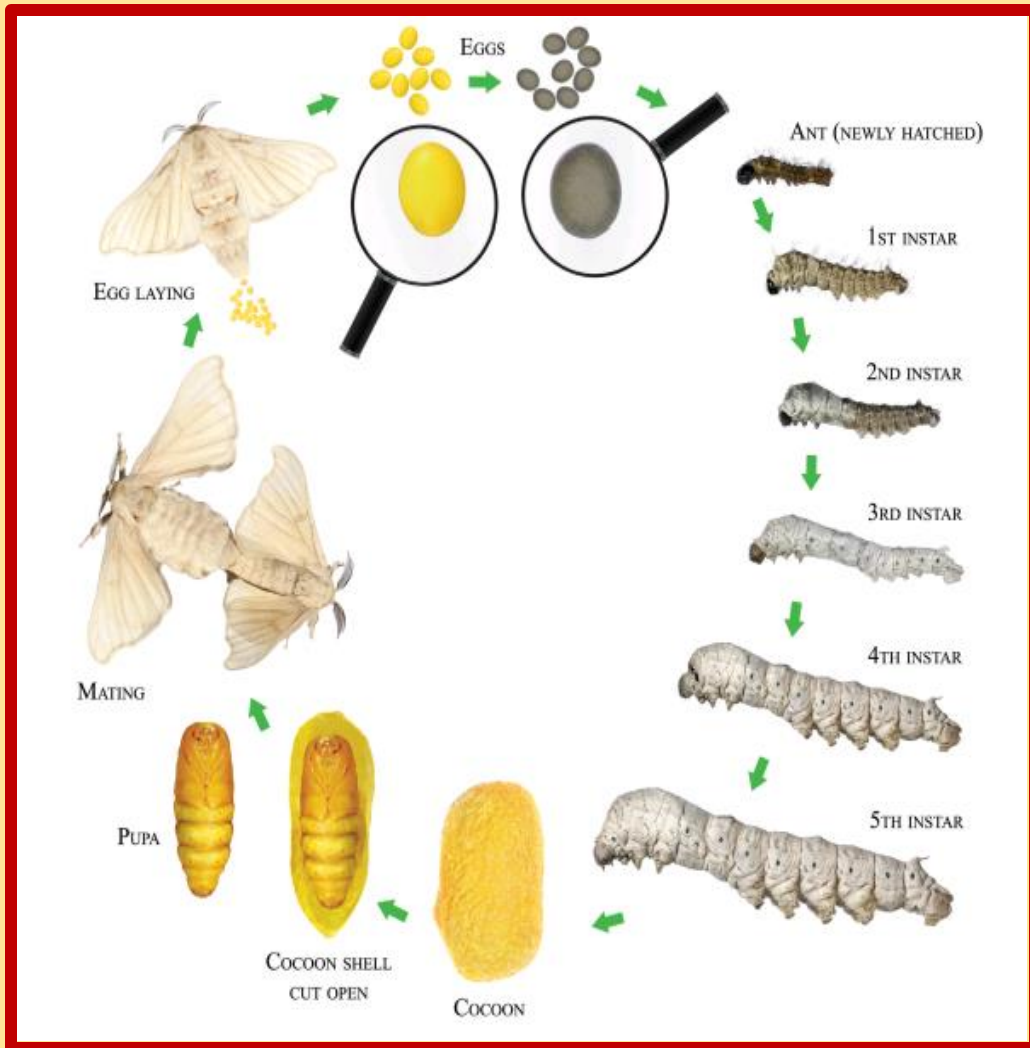
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Life cycle of Bombyx mori



- The eggs after **ten days** of incubation **hatch into larva** called as **caterpillar**.
- The newly hatched caterpillar is about **3 mm in length** and is **pale, yellowish-white in colour**.
- The caterpillars are provided with **well developed mandibulate type of mouth-parts adapted to feed easily on the mulberry leaves**.

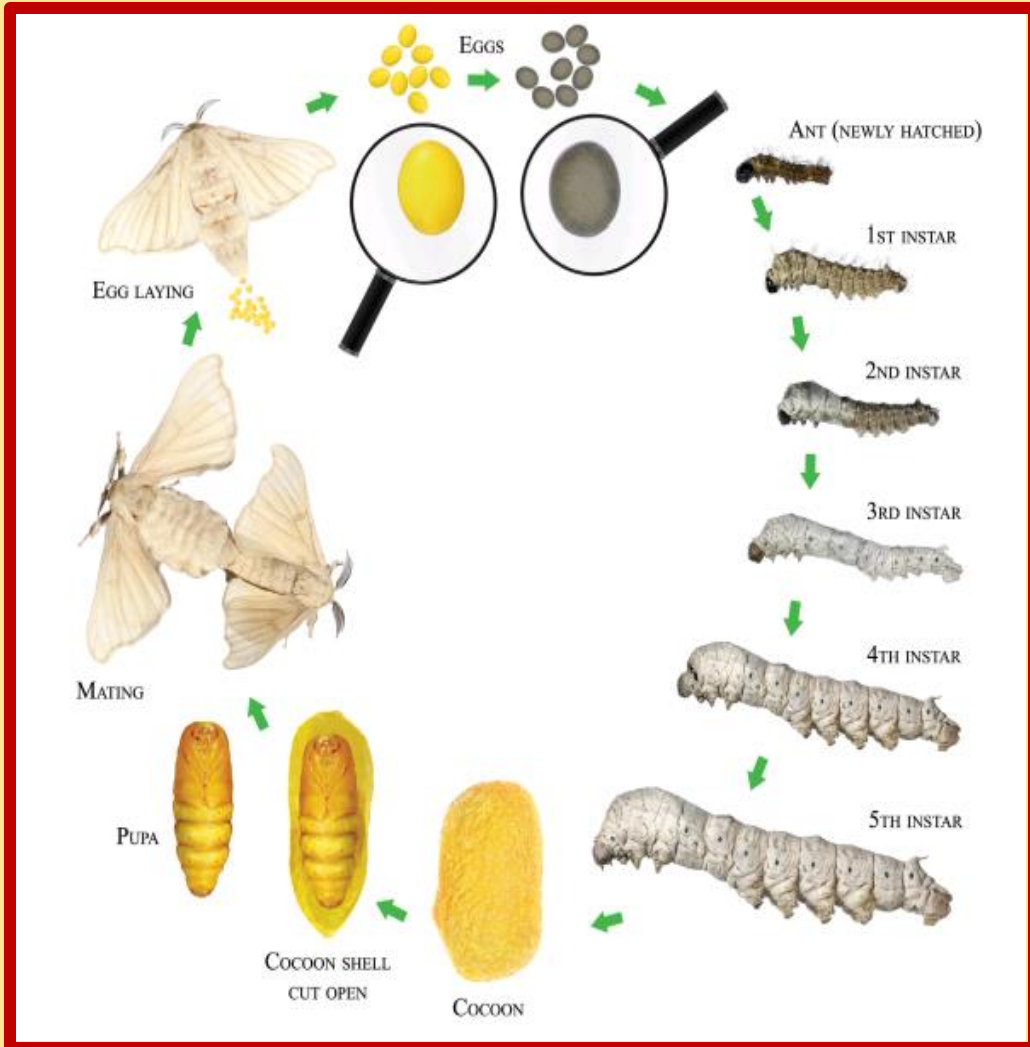
Life cycle of Bombyx mori



- After 1st, 2nd, 3rd and 4th moultings caterpillars get transformed into **2nd, 3rd, 4th and 5th instars** respectively.
- It takes about **21 to 25 days** after hatching.
- The **fully grown caterpillar is 7.5 cm** in length.
- It develops **salivary glands, stops feeding and undergoes pupation.**
- The caterpillars **stop feeding and move towards the corner among the leaves and secrete a sticky fluid through their silk gland.**

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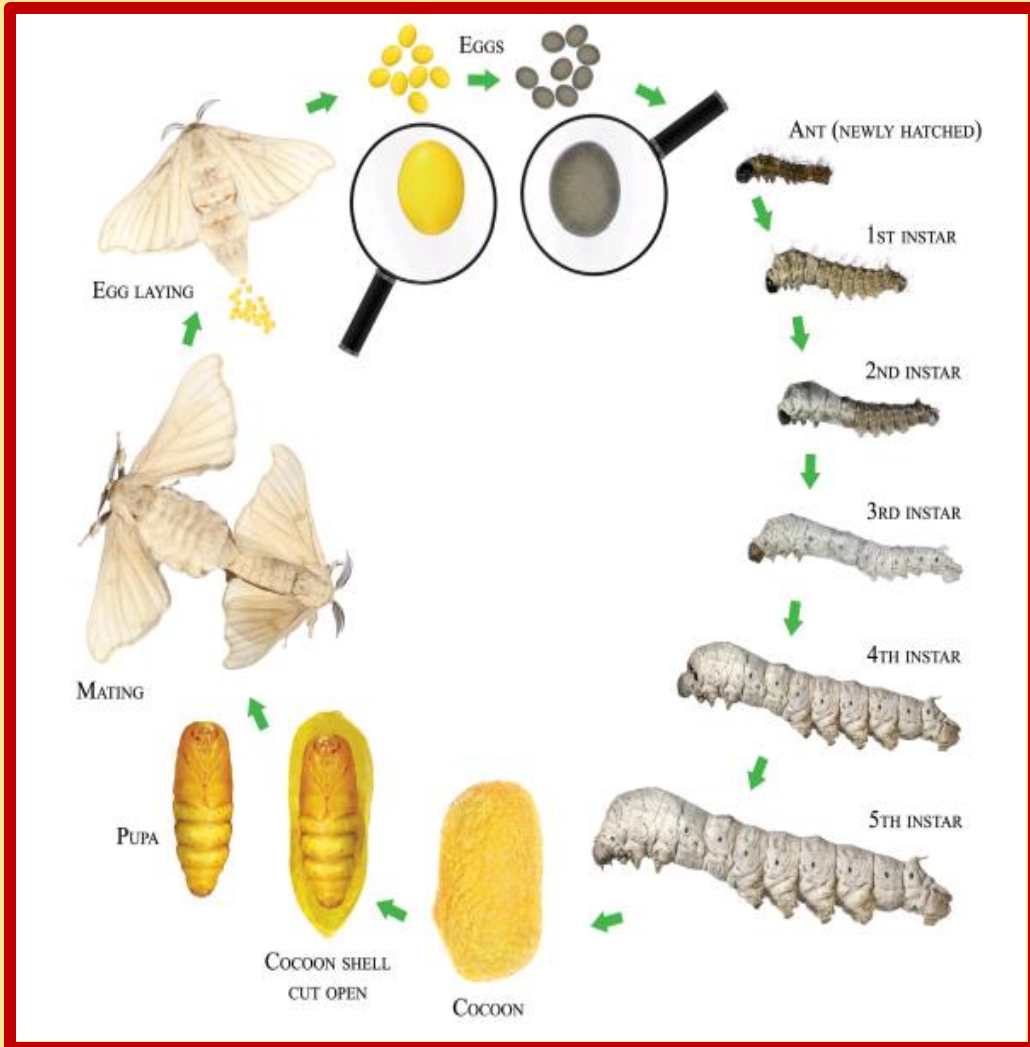
Life cycle of Bombyx mori



- The **secreted fluid comes out through spinneret** (a narrow pore situated on the hypopharynx) and takes the form of **long fine thread of silk** which hardens on exposure to air and is wrapped around the body of caterpillar in the forms of a covering called as **cocoon**.
- It is the **white coloured bed of the pupa** whose **outer threads are irregular** while the **inner threads are regular**.

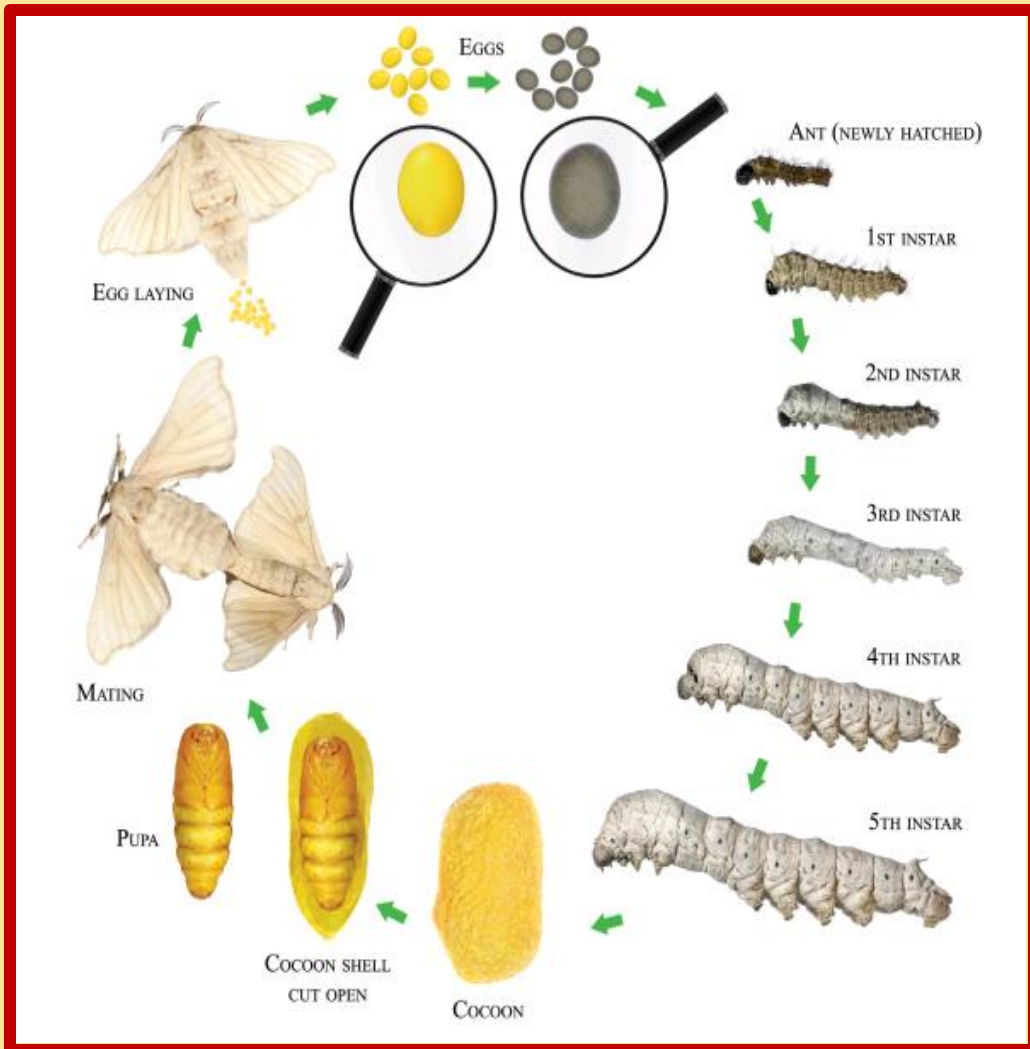
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Life cycle of Bombyx mori



- The length of continuous thread secreted by a caterpillar for the formation of cocoon is about **1000-1200 metres** which requires **3 days to complete**.
- The pupal period lasts for **10 to 12 days** and the **pupae cut through the cocoon and emerge into adult moth**.

Life cycle of *Bombyx mori*



- On the basis of the moults which they undergo during their larval life, **B. mori is divided into three races.**

1. Tri-moulters

2. Tetra-moulters

3. Penta-moulters.

- Based on **voltinism** (the number of broods raised per year), **three kinds of races are recognized** in mulberry silkworm.

1. Univoltines - one brood only.

2. Bivoltines - two broods only.

3. Multivoltines - more than two broods.

TYPES OF SILK



Mulberry



Eri



Muga



Tassar

- India has the distinction of producing all the **four types of silk** i.e.

(a) Mulberry silk (91.7%)

(b) Tassar silk (1.4%)

(c) Eri silk (6.4%)

(d) Muga silk (0.5%)

- which are produced by **different species of silkworms.**
- Name the species that produces **large amount and least amount of silk in India.**

Cultivation of food plants for the silkworms

- The first component, is to grow the **food plants for the silkworms**.
- **Mulberry leaves** are widely used as **food for silkworm Bombyx mori**.
- The **cultivation of mulberry** is called as **Moriculture**.
- Presently improved mulberry varieties like **Victory1, S36, G2 and G4** which can withstand various **agro - climatic and soil conditions** are used for planting.
- The **favourable season for cultivating** of the mulberry plants is **June, July, November and December**.

Cultivation of food plants for the silkworms

- **The mulberry crop production technology includes**
 - 1. Land preparation**
 - 2. Preparation of cutting**
 - 3. Planting techniques**
 - 4. Maintenance of mulberry nursery**
 - 5. Disease and pest management**
 - 6. Uprooting for raising new mulberry gardens**
- **Mulberry is also being grown as tree plant at an height of 123-152 cm with 20 x 20 cm or 25 x 25 cm spacing to harvest better silkworm cocoon crops.**

Rearing of silkworms

- The second component is the **rearing of silkworm**.
- A typical rearing house (6m x 4m x 3.5m) is constructed on an elevated place under shade to **accommodate 100 dfls** (disease free layings).
- Space of **1m should be provided surrounding the rearing house**.
- **Sufficient windows and ventilators** should be provided for free circulation of air inside the rearing house.
- The windows and ventilators should be covered with **nylon net to restrict the entry of uzi flies and other insects**.

Rearing of silkworms

- Apart from the specified area of the rearing house, the following appliances such as
 1. Hygrometer
 2. Power sprayers
 3. Rearing stands
 4. Foam pads
 5. Wax coated paraffin papers
 6. Nylon nets
 7. Baskets for keeping leaves
 8. Gunny bags
 9. Rotary or bamboo mountages
 10. Drier
- These appliances are needed for effective rearing of silkworms.

Rearing of silkworms

- **The steps involved in rearing process of silkworm are**
 - 1. Disinfection of rearing house**
 - 2. Incubation of eggs**
 - 3. Brushing**
 - 4. Young larval rearing**
 - 5. Late age larval rearing**
- **The selected healthy silk moths are allowed to mate for 4 hours.**
- **Female moth is then kept in a dark plastic bed, it lays about 400 eggs in 24 hours; the female is taken out, crushed and examined for any disease, only certified disease-free eggs are reared for industrial purpose.**

Rearing of silkworms

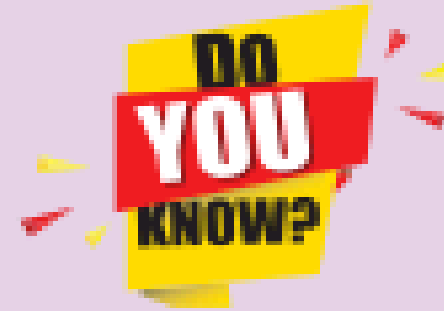
- The **eggs are incubated in an incubator.**
- The **small larvae (caterpillars) hatch between 7-10 days.**
- These larvae are **kept in trays inside a rearing house at a temperature of about 20°C - 25°C.**
- These are first fed on **chopped mulberry leaves.**
- After **4-5 days fresh leaves are provided.**
- As the larvae grow, they are transferred to **fresh leaves on clean trays, when fully grown they spin cocoons.**
- Their **maturity is achieved in about 45 days.**
- At this stage the **salivary glands (silk glands) starts secreting silk to spin cocoons.**

Post cocoon processing

- The method of obtaining silk thread from the cocoon is known as post cocoon processing.
- This includes stifling and reeling.
- The process of **killing the cocoons is called stifling**.
- The process of **removing the threads from the killed cocoon is called reeling**.
- For reeling silk the cocoons are gathered about **8 -10 days after spinning had begun**.
- The cocoons are **first treated by steam or dry heat to kill the insect inside**.
- This is necessary to **prevent the destruction of the continuous fibre by the emergence of the moth**.

- The cocoons are then soaked in **hot water (95° -97°C) for 10-15 minutes** to **soften the gum that binds the silk threads together.**
- This process is called **cooking.**
- The “cooked” cocoons are kept in hot water and the **loose ends of the thread are caught by hand.**
- Threads from several cocoons are wound together on spinning wheels (Charakhas) to form the **reels of raw silk.**
- Only about **onehalf of the silk of each cocoon is reelable**, the **remainder is used as a silk waste** and formed into spun silk.
- Raw silk thus obtained is processed through **several treatments** to bring about the **luster on the thread.**

SERICULTURE



New silkworm diet produces coloured silk. The Institute of Materials Research and Engineering (IMRE) in Singapore has developed a way to replace the traditional dyeing process necessary to make coloured silk. A simple dietary change (feeding a diet of mulberries treated with fluorescent dye) for the silkworm larva and they are able to produce silk in a variety of colors. The colour directly integrated into the

Uses of Silk

1. **Silk fibers are utilized in preparing silk clothes. Silk fibers are now combined with other natural or synthetic fibers to manufacture clothes like Teri-Silk, Cot-Silk etc. Silk is dyed and printed to prepare ornamented fabrics. They are generally made from Eri-silk or spun silk.**
2. **Silk is used in industries and for military purposes.**
3. **It is used in the manufacture of fishing fibers, parachutes, cartridge bags, insulation coils for telephone, wireless receivers, tyres of racing cars, filter fibres, in medical dressings and as suture materials.**

Diseases and Pests of Silkworm

- The profitable silk industry is threatened by various diseases caused by the **virus, fungal, bacterial and protozoan infections** but also by **insect predators, birds and other higher animals**.
- **Ants, crows, kites, rats, feed upon silk worms** thereby causing a great loss to silk industry.
- **Pebrine, is a dangerous disease to in silkworms** and the causative organism is **Nosema bombycis**, a protozoan.
- This silkworm disease is **transmitted through the egg of the mother silkworm** and also **through ingestion of contaminated food**.

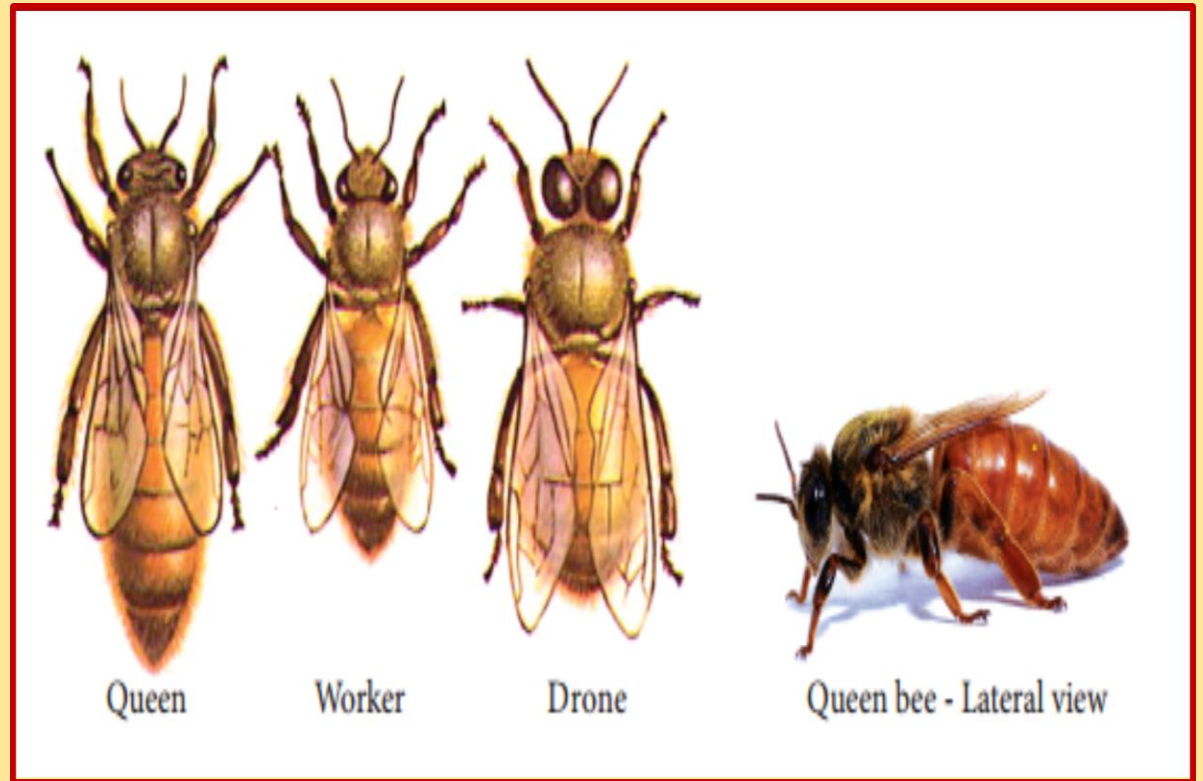
Diseases and Pests of Silkworm

- **Flacherie** generally occurs in the **mature larvae** and is **caused mainly by bacteria like Streptococcus and Staphylococcus.**
- **Grasserie** is a **most dominant and serious viral disease.**
- It is caused by **Bombyx mori nuclear polyhedrosis virus (BmNPV)** a **Baculovirus**, which belongs to sub group 'A' of the **Baculoviridae.**
- Among the fungal diseases, **white muscardine is common.**
- This disease is caused by fungus **Beauveria bassiana.**

APICULTURE



Care and management of honey bees on a commercial scale for the production of honey is called Apiculture or Bee Keeping.



APICULTURE



- Ever since the **beginning of civilization**, man has been trying to make use of organisms around him for various purposes and to rear them for increasing their number.
- One of the finest discoveries is our knowledge regarding the procurement of honey collected by **honey bees**.
- Care and management of honey bees on a commercial scale for the production of honey is called **Apiculture or Bee Keeping**.
- The word ‘apiculture’ comes from the Latin word ‘**apis**’ meaning **bee**.
- Bees are reared in apiaries that are areas where a lot of bee hives can be placed.

APICULTURE



- **There are five well recognized types of bees in the world.**

- **They are**

- 1. Apis dorsata - Rock bee**

- 2. Apis florea - Little bee**

- 3. Apis indica - Indian bee**

- 4. Apis mellifera - European bee**

- 5. Apis adamsoni - African bee**

HONEY BEE



Honey bee uses its long-tube like tongue to extract sugary liquid called nectar from the flowers. The nectar is stored in the stomach and the enzyme *invertase* transforms it into honey. This increases the storage life of honey and also contributes to its medicinal value.

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SOCIAL ORGANIZATION OF HONEY BEES



Queen



Worker

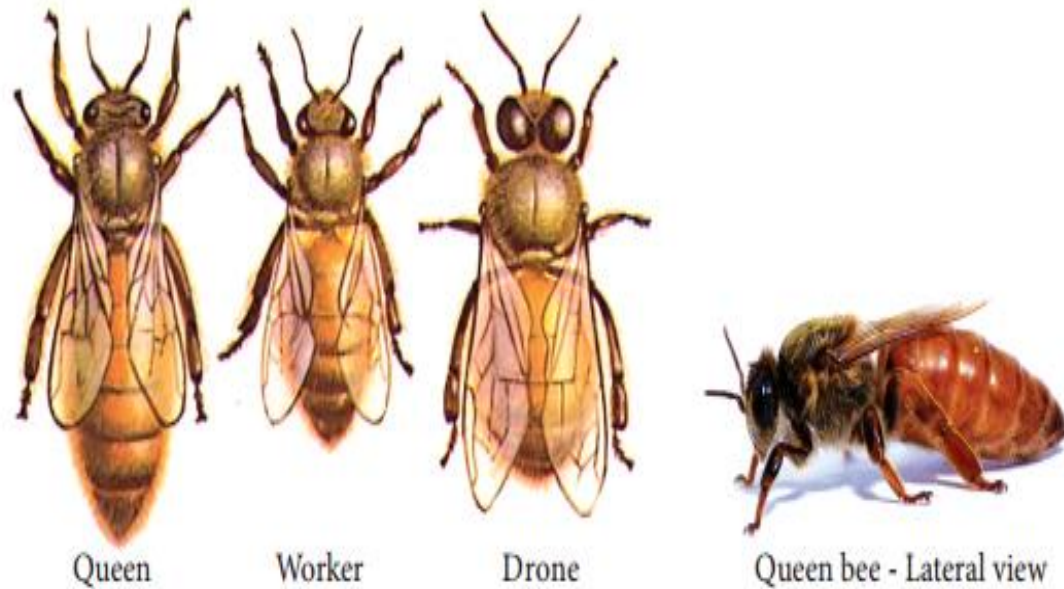


Drone



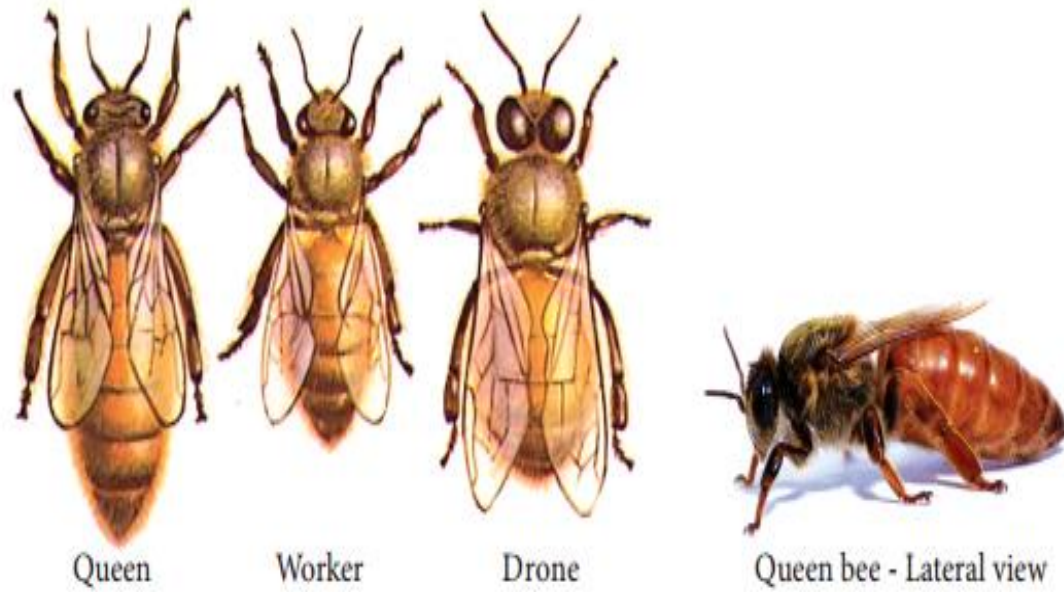
Queen bee - Lateral view

SOCIAL ORGANIZATION OF HONEY BEES



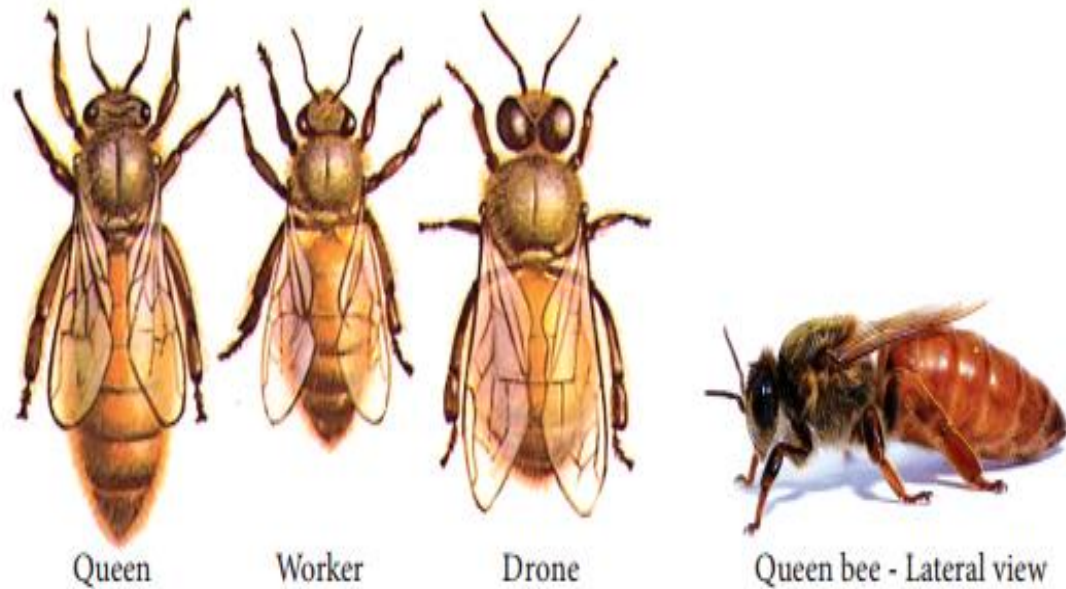
- In honey bees, a highly organized division of **labour** is found.
- A well developed honey bee colony consists of the
 1. **Queen**
 2. **Drones**
 3. **Workers**
- All the three types **depend on each other** for their existence.
- There is normally **one queen, 10,000 to 30,000 workers** and **few hundred drones** (male bees) in a colony.

SOCIAL ORGANIZATION OF HONEY BEES - QUEEN BEE



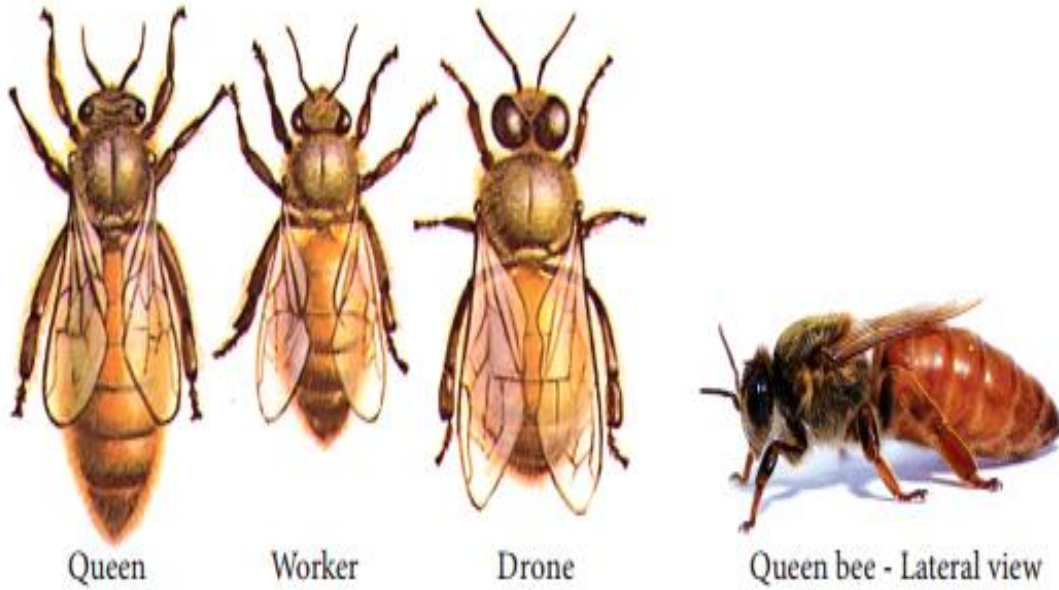
- **Queen bee is a functional female bee present in each hive and feeds on Royal Jelly.**
- **Its sole function is to lay eggs throughout its life span.**
- **The virgin queen bee mates only once in her life.**
- **During the breeding season in winter, a unique flight takes place by the queen bee followed by several drones.**
- **This flight is called “nuptial flight”.**
- **The queen bee produces a hormonal chemical substance called pheromone.**

SOCIAL ORGANIZATION OF HONEY BEES - QUEEN BEE



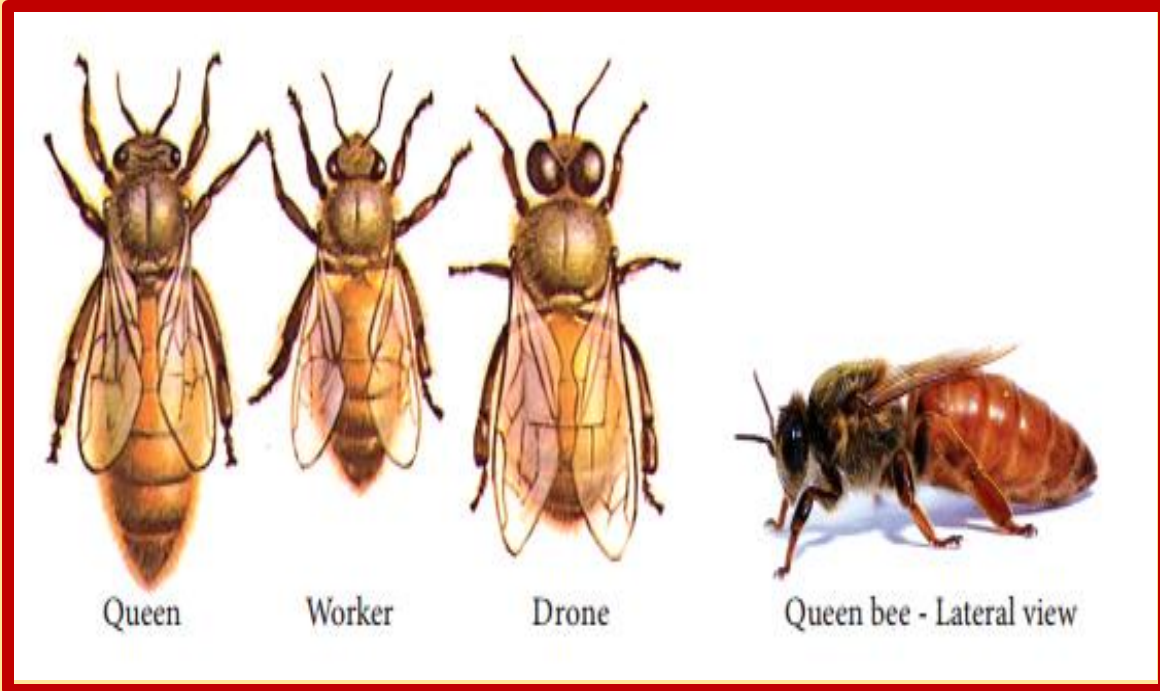
- The **drones** in the area are **attracted to the pheromone** and **mating takes place**.
- During mating, the **drone releases large number of sperms** for sufficient fertilization.
- In a life span of **two to four years**, a **queen bee lays about 15 lakh eggs**.
- When the **queen bee loses its capacity to lay eggs**, another **worker bee starts feeding on the Royal Jelly** and **develops into a new queen**.

SOCIAL ORGANIZATION OF HONEY BEES - WORKERS BEE



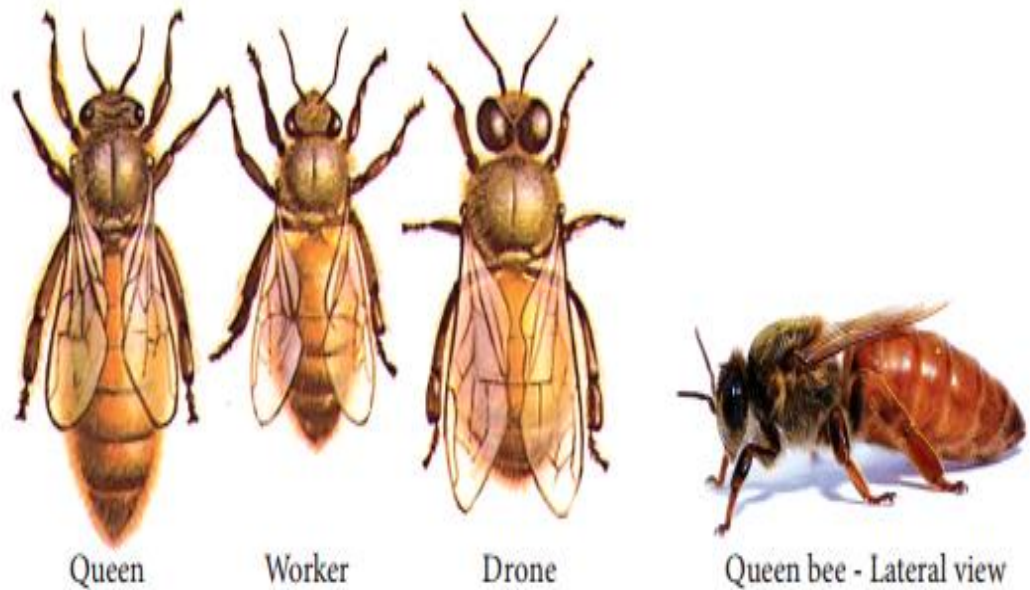
- Among the honey bees, **workers are sterile females** and smallest but yet function as the main spring of the complicated **machinery in the colony**.
- Worker bee lives in a chamber called '**Worker Cell**' and it takes about **21 days to develop from the egg to adult** and **its lifespan is about six weeks**.
- **Each worker has to perform different types of work in her life time.**

SOCIAL ORGANIZATION OF HONEY BEES - WORKERS BEE



- During the **first half of her life**, she becomes a **nurse bee** attending to **indoor duties** such as
 1. **Secretion of royal jelly**
 2. **Prepares bee-bread to feed the larvae**
 3. **Feeds the queen**
 4. **Takes care of the queen and drones**
 5. **Secretes bees wax**
 6. **Builds combs**
 7. **Cleans and fans the bee hive**
- Then she becomes a **soldier and guards** the bee hive.
- In the **second half her life** lasting for three weeks, **she** searches and gathers the **pollen, nectar, propolis and water**.

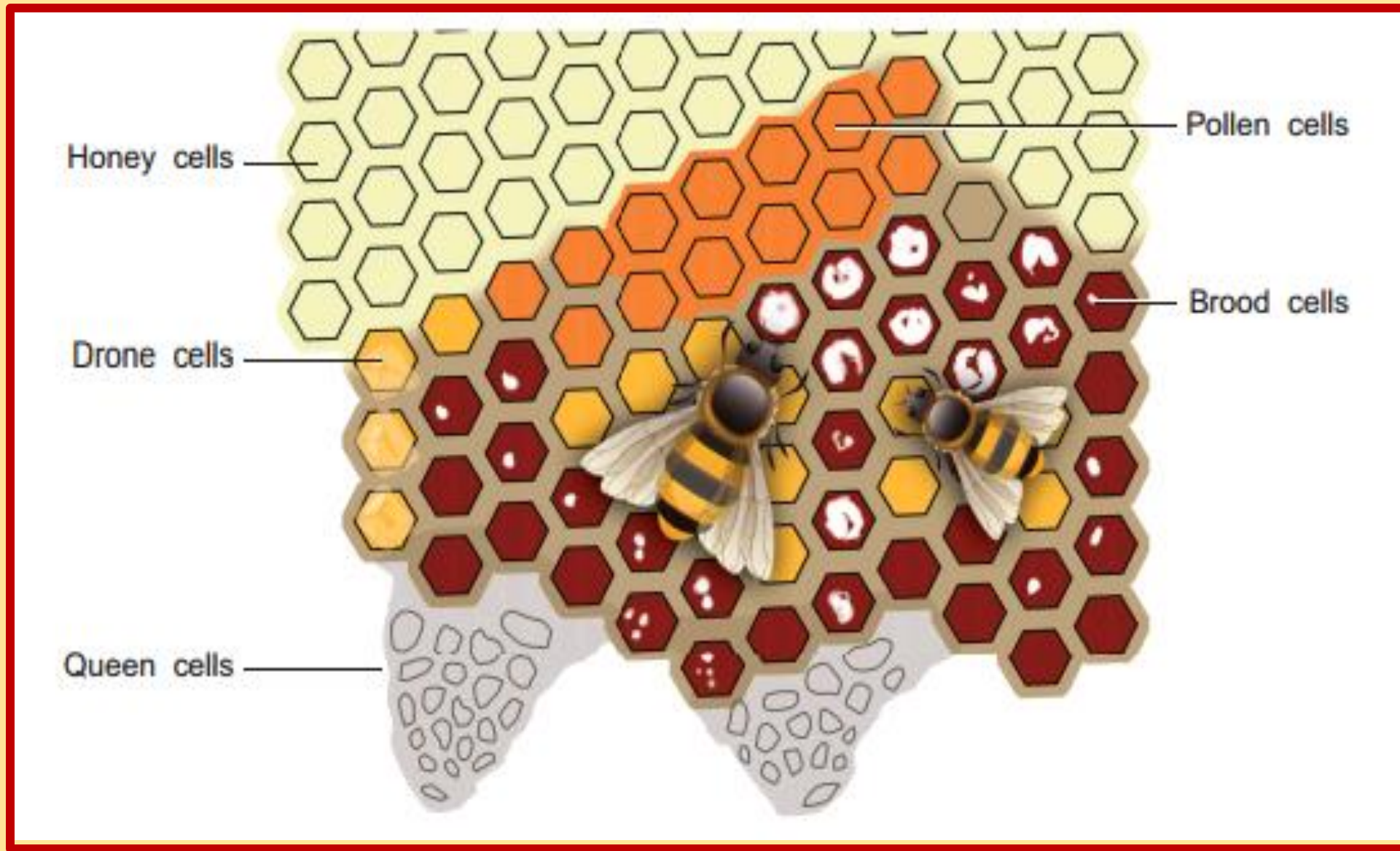
SOCIAL ORGANIZATION OF HONEY BEES – DRONE BEE



- The drone is the functional **male member of the colony** which **develops from an unfertilized egg**.
- It lives in a chamber called **drone cell**.
- Drones totally **depend on workers** for honey.
- The sole duty of the drone is to **fertilize the virgin queen** hence called **“King of the colony”**.
- During **swarming** (the process of leaving the colony by the queen with a large group of worker bees to form a new colony) **the drones follows the queen, copulates and dies after copulation**.

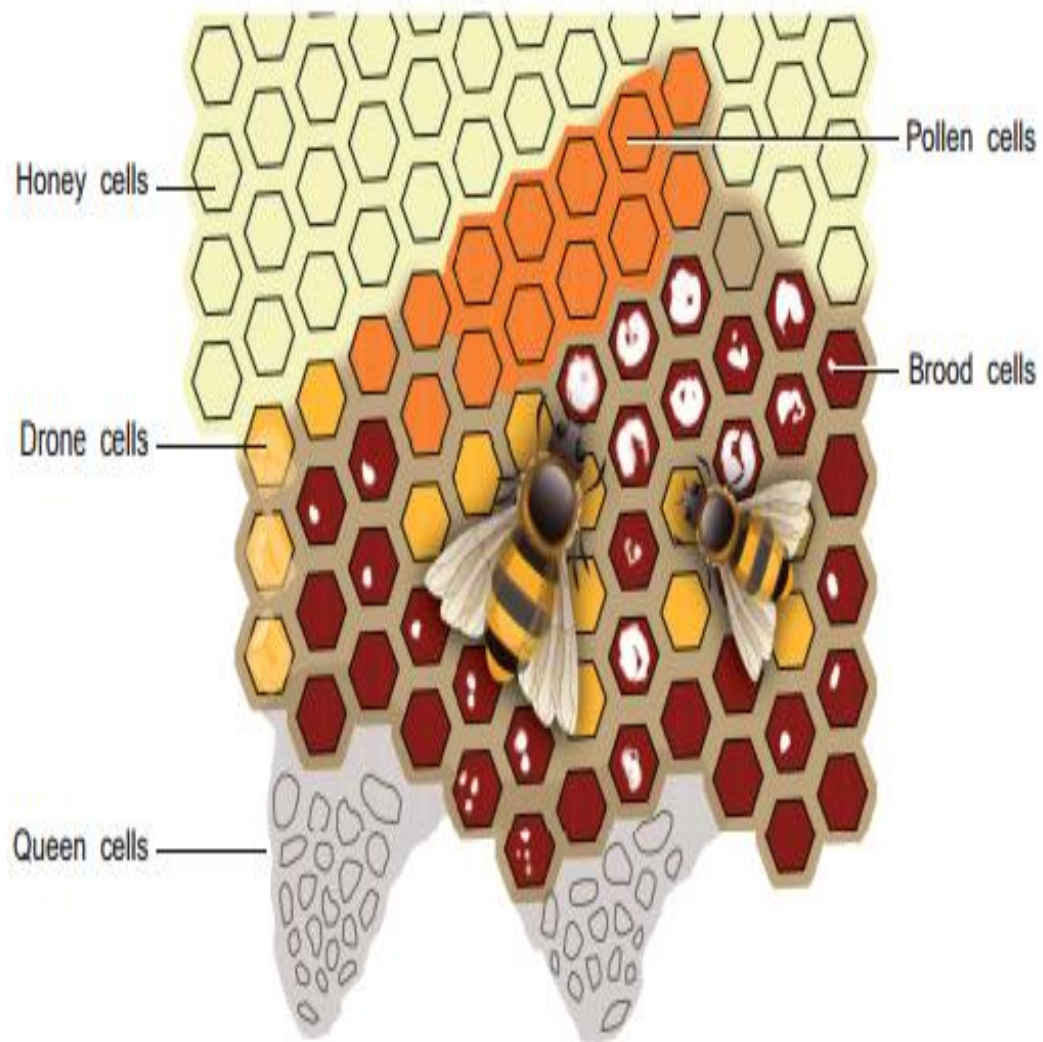
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STRUCTURE OF A BEE HIVE



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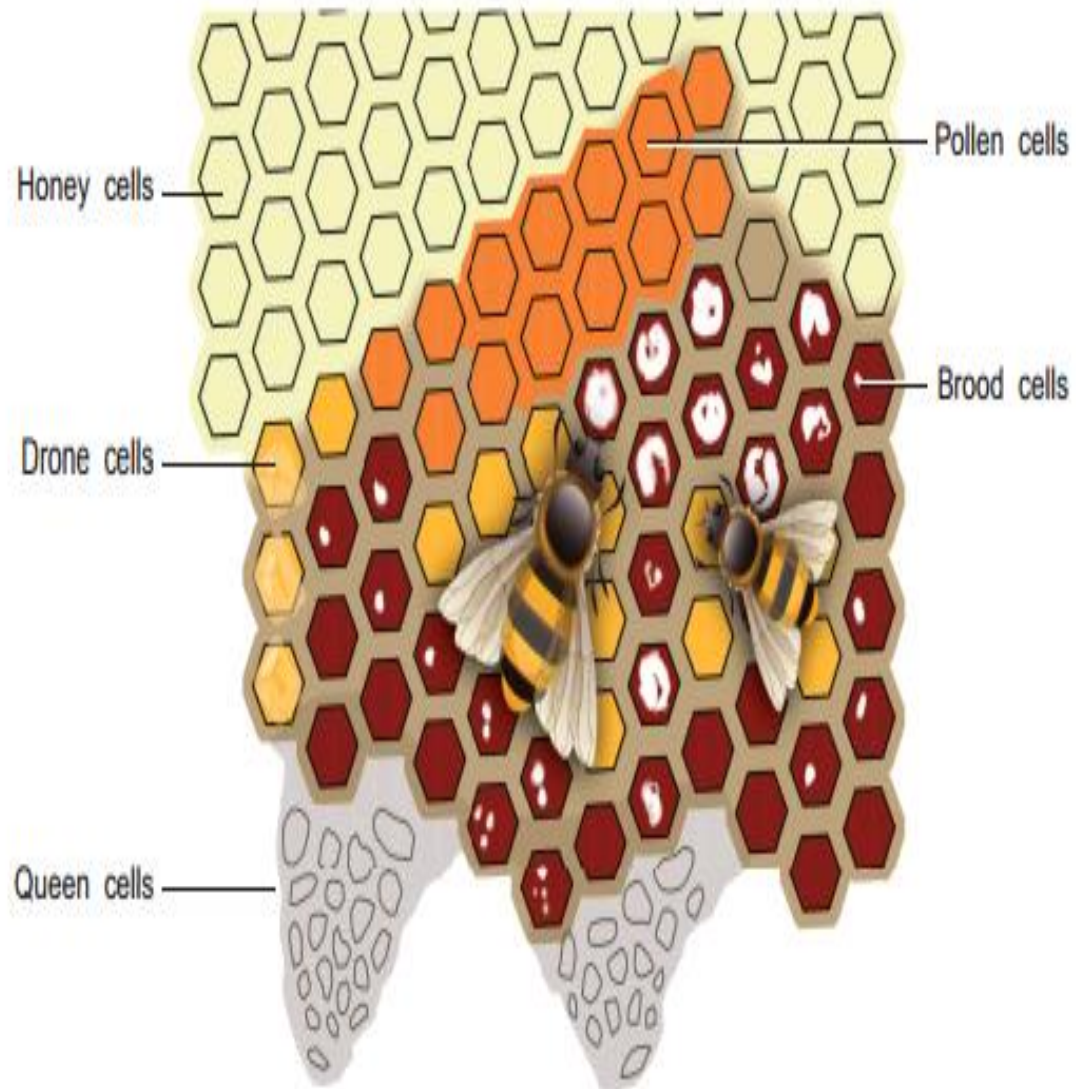
STRUCTURE OF A BEE HIVE



- The house of honey bee is termed as **bee hive or comb**.
- The hive consists of **hexagonal cells made up of wax secreted by the abdomen of worker bees** arranged in **opposite rows on a common base**.
- These hives are found hanging vertically from the **rocks, building or branches of trees**.
- The young stages of honey bees accommodate the **lower and central cells of the hive called the brood cells**.

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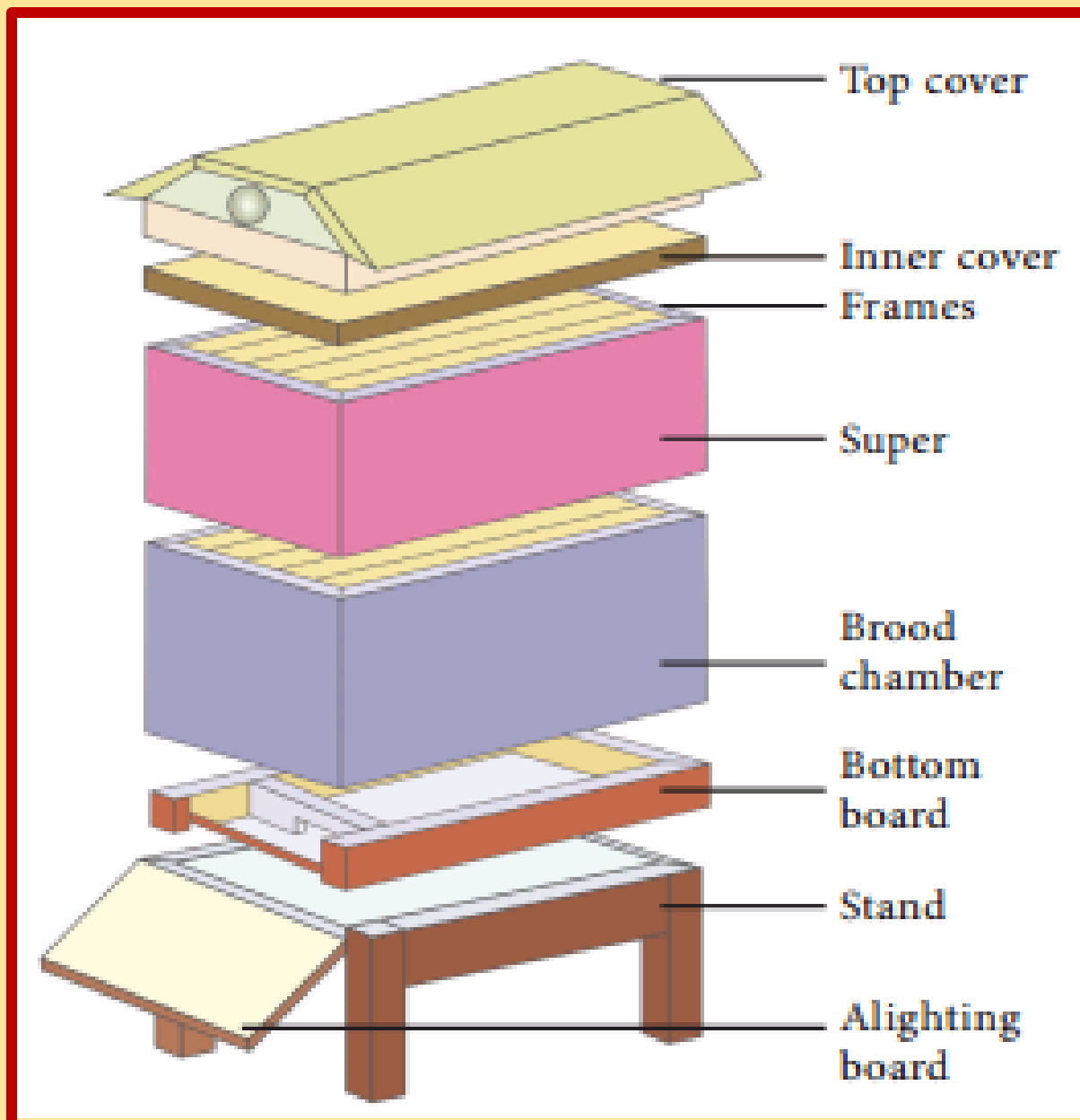
STRUCTURE OF A BEE HIVE



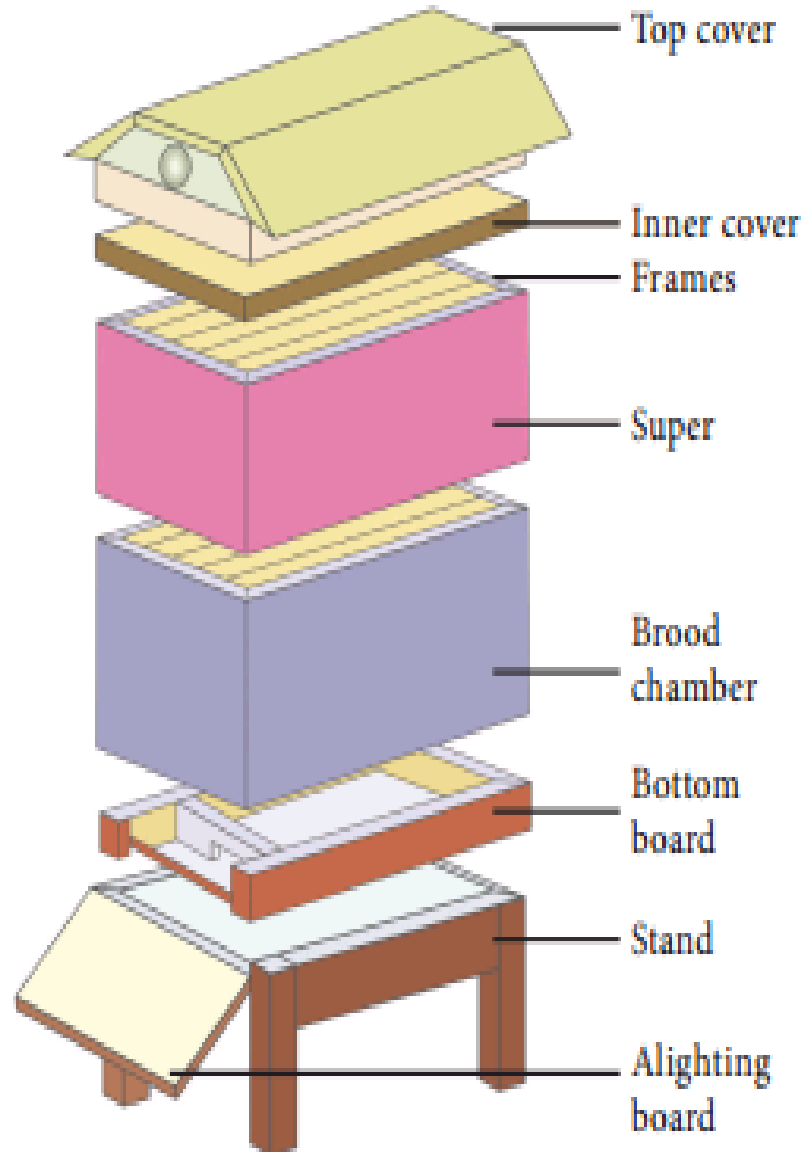
- In *Apis dorsata*, the brood cells are of similar in size and shape but in other species, brood cells are of three types viz.,
 1. Queen cell for queens
 2. Worker cell for workers
 3. Drone cells for drones
- The cells are intended for storage of honey and pollen in the upper portion of the comb whereas the lower portions are for brood rearing.

METHODS OF BEE KEEPING

Langstroth bee hive

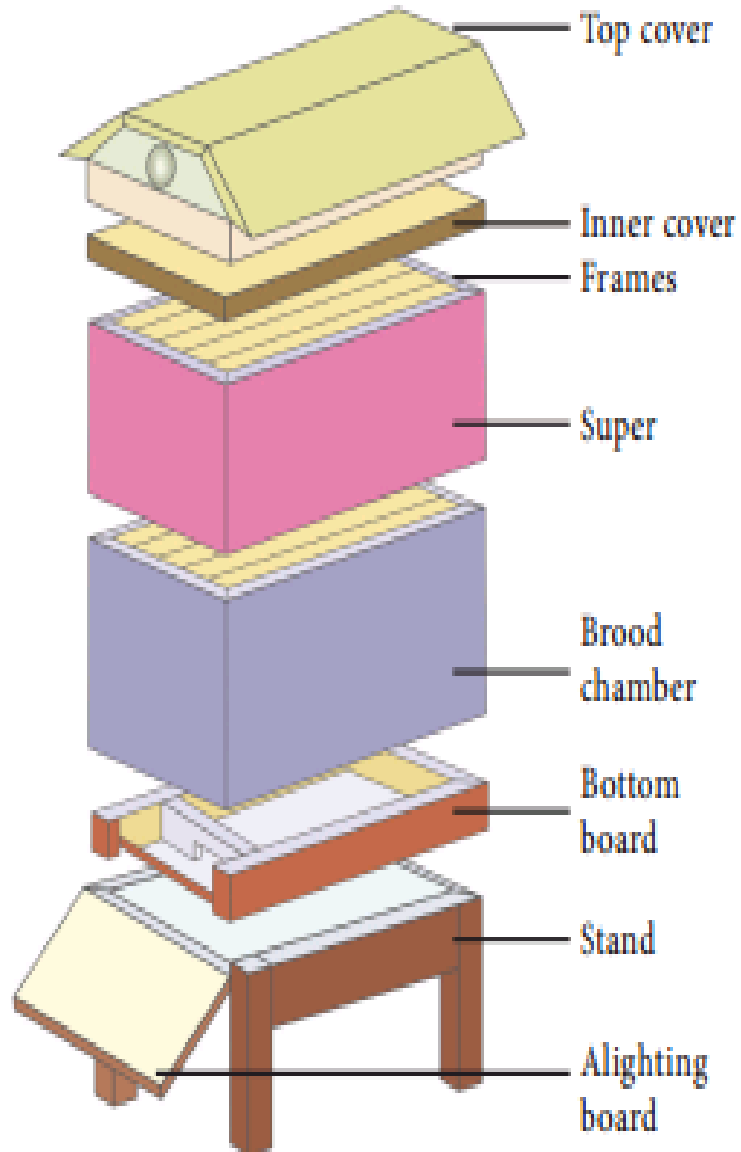


METHODS OF BEE KEEPING



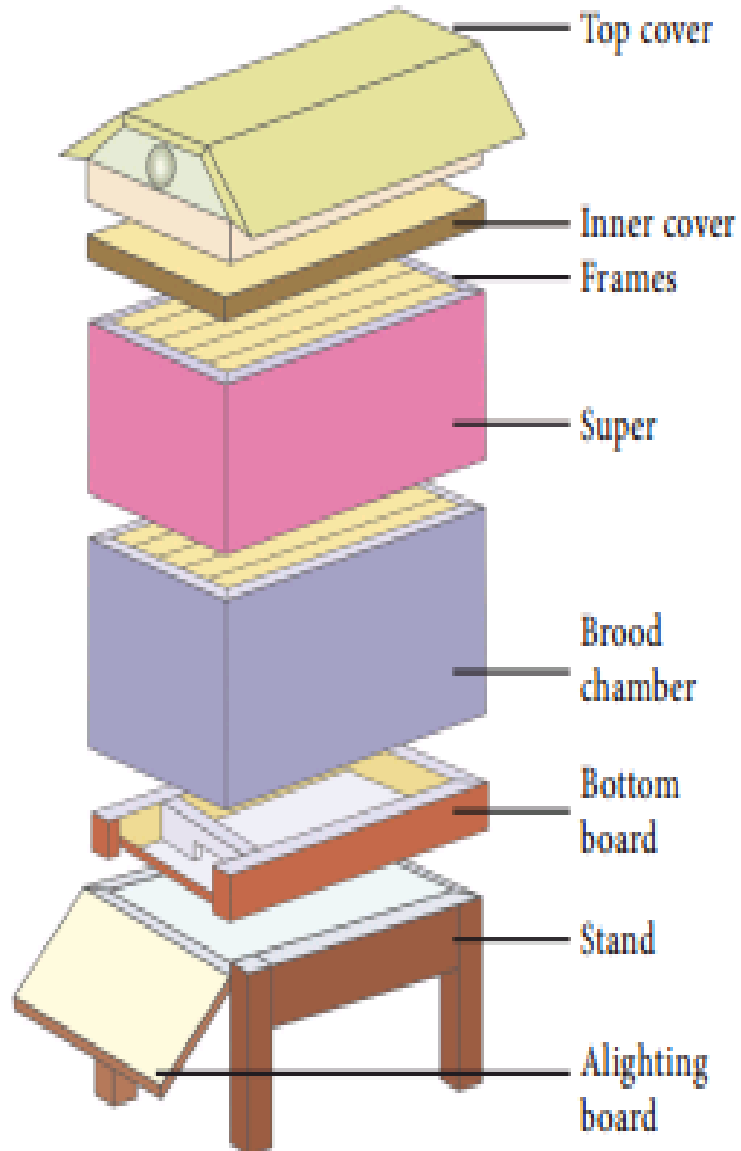
- The **main objective** is to get more and more quality honey.
- There are **two methods** used by apiculturists.
- They are **indigenous method** and the **modern method**.
- In indigenous method, the **honey extracted from the comb contains wax**.
- To overcome the **drawbacks** of the indigenous method, the **modern method** has been developed to improve the texture of hives.
- In India, there are **two types of beehives** in practice namely, **Langstroth** and **Newton**.

METHODS OF BEE KEEPING



- The Langstroth bee hive is made up of wood and consists of **six parts**
 1. **Stand** is the basal part of the hive on which the hive is constructed. The stands are adjusted to make a **slope for rain water to drain.**
 2. **Bottom board** is situated above the stand and forms the proper base for the hive. It has **two gates**, one gate functions as an **entrance** while the other acts as an **exit.**

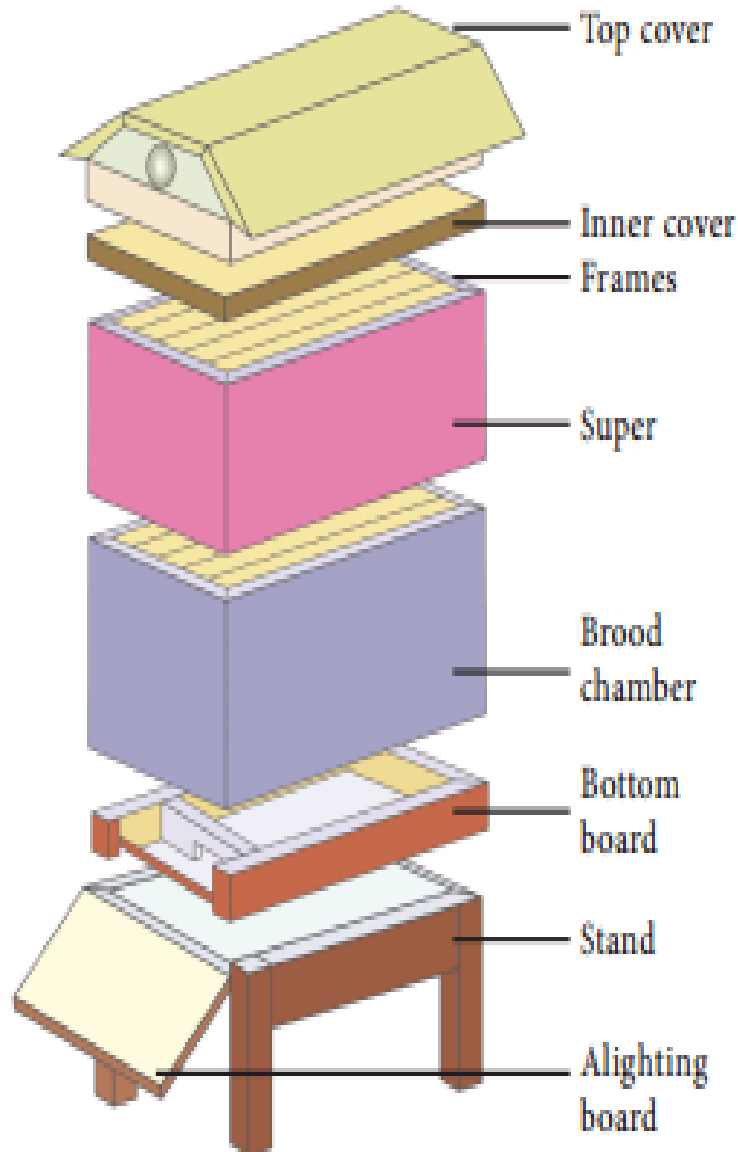
METHODS OF BEE KEEPING



3. Brood chamber

- **Brood chamber is the most important part of the hive.**
- **It is provided with 5 to 10 frames arranged one above the other through which the workers can easily pass.**
- **The frame is composed of wax sheet which is held in vertical position up by a couple of wires.**
- **Every sheet of wax is known as Comb Foundation.**
- **The comb foundation helps in obtaining a regular strong worker brood cell comb which can be used repeatedly.**

METHODS OF BEE KEEPING



4. Super is also a chamber **without cover and base**.

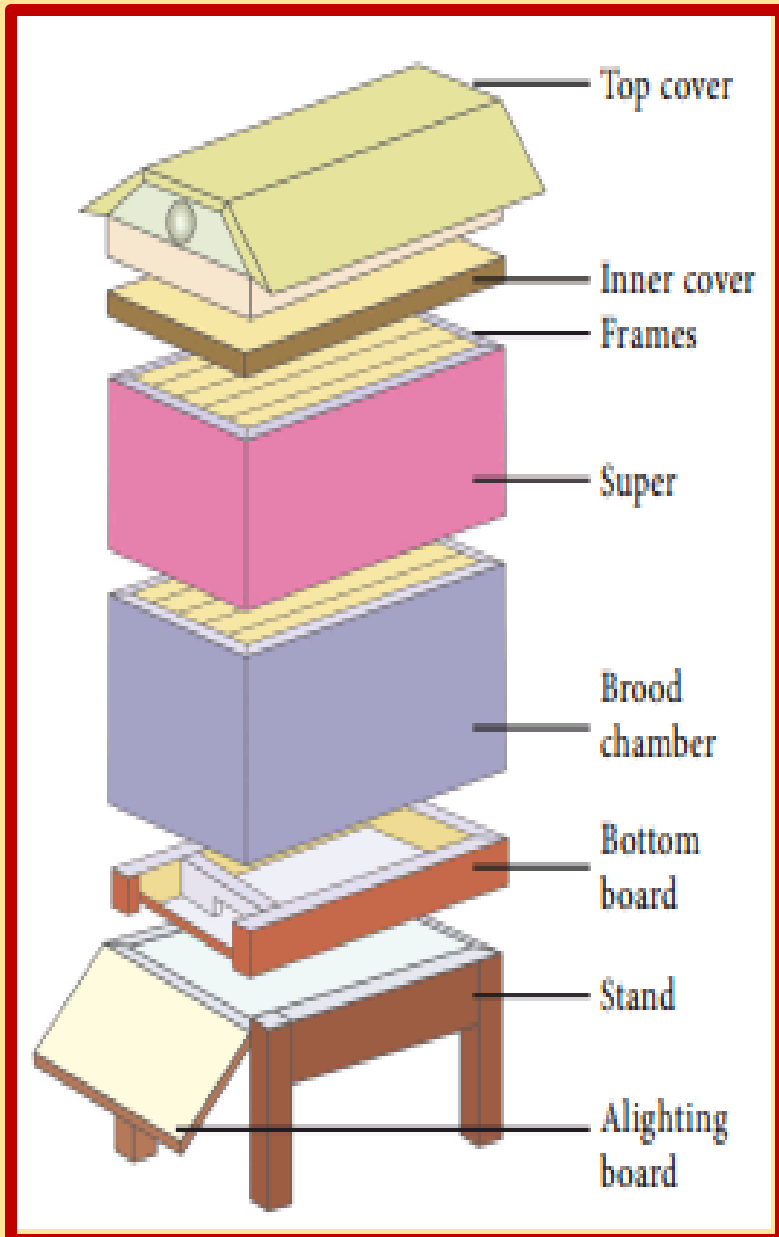
It is provided with **many frames containing comb foundation** to provide **additional space for expansion of the hive**.

5. Inner cover is a wooden piece used for **covering the super** with **many holes for proper ventilation**.

6. Top cover is meant for **protecting the colonies from rains**.

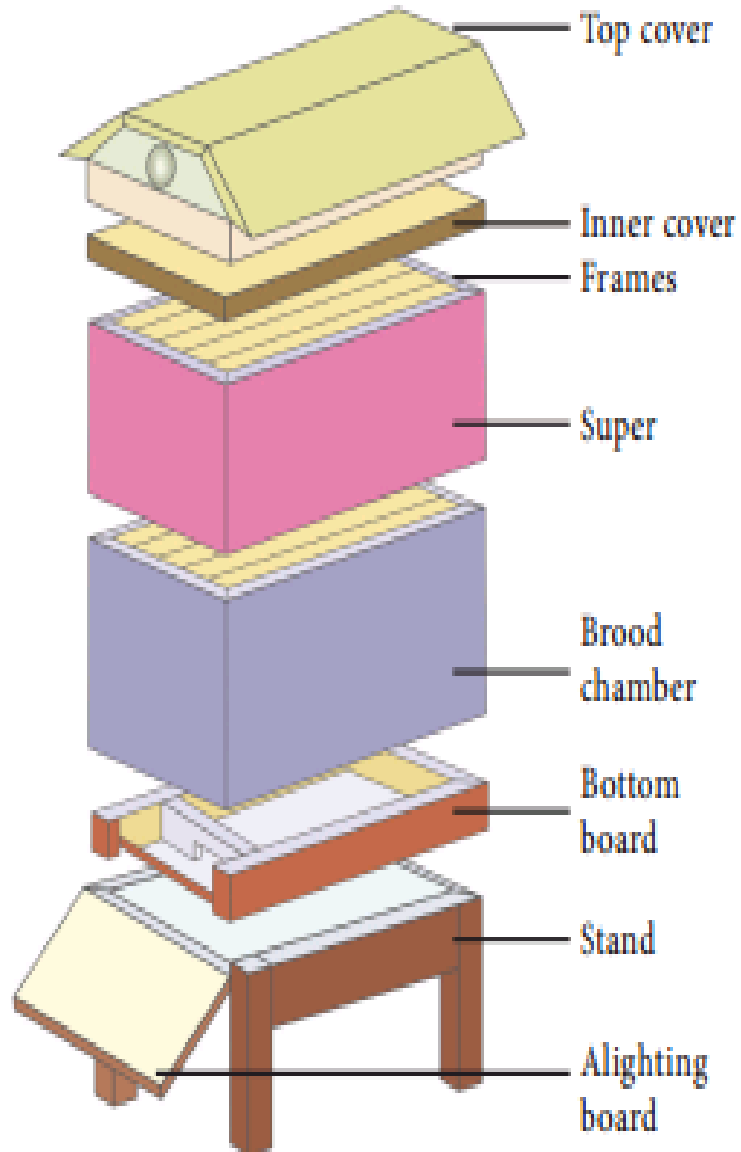
It is covered with a sheet which is **plain and sloping**.

METHODS OF BEE KEEPING



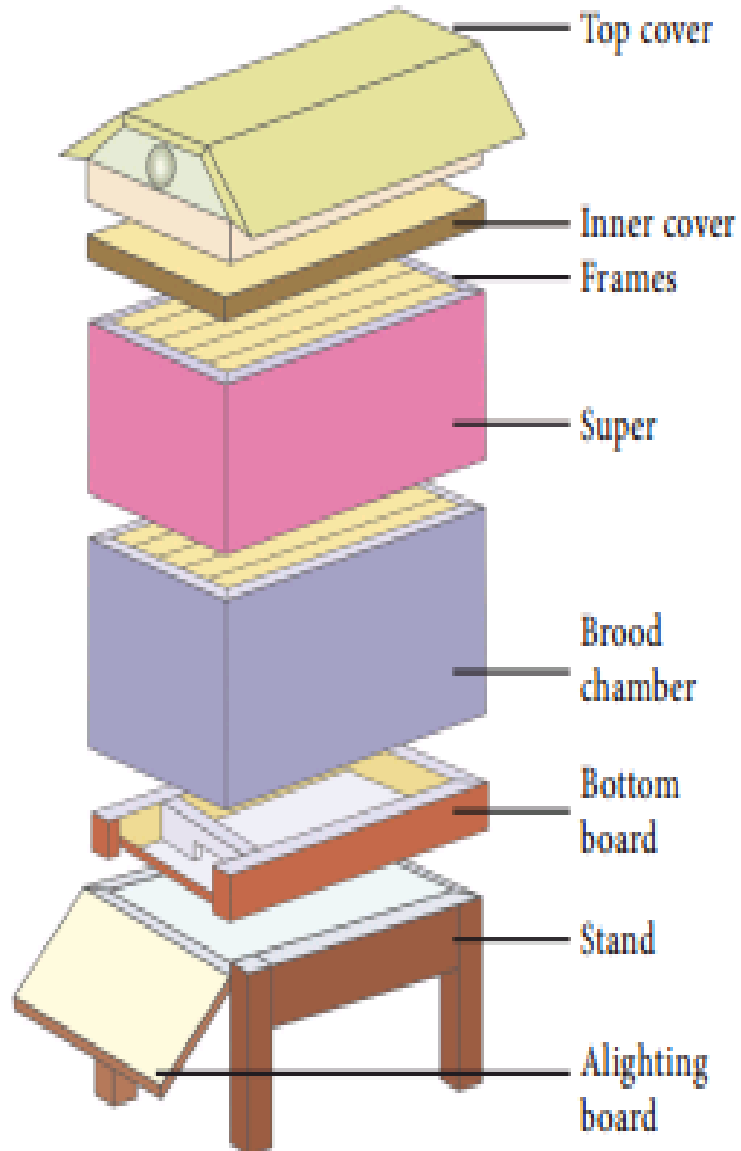
- Besides the above primary equipments, other accessory equipments are used in **beekeeping Queen Excluder** is utilized to **prevent the entry of queen bee from the brood chamber into the super chamber.**
- **Comb foundation** is a **sheet of bee wax**, on both sides of which the exact shape of **different cells of the comb** is made in advance.
- **Bee gloves** are used by bee keepers for protecting their hands while inspecting the hives.
- **Bee veil** is a device made of fine nettings to **protect the bee-keeper from bee sting.**
- **Smoker** is used to scare the bees during hive maintenance and **honey collection by releasing smoke.**

METHODS OF BEE KEEPING



- **Hive Tool** is a flat, narrow and long piece of iron which helps in scraping excess propolis or wax from hive parts.
- **Uncapping knife** is a long knife which helps in removing the cap from the combs as a first step in honey extraction.
- **Bee brush** is a large brush often employed to brush off bees from honey combs particularly at the time of extraction.
- **Queen introducing cage** is a pipe made of wire nets used for keeping the queen for about 24 hours for acquaintance with the hive and worker bees.

METHODS OF BEE KEEPING



- **Feeder is a basin with sugar syrup covered by grass to feed the bees during drought season.**
- **The grass prevents the bees from sinking into the syrup.**
- **Honey Extractor is a stainless-steel device which spins the combs rapidly to extract honey.**
- **Hive Entrance Guard is a device similar to queen excluder in front of the hive entrance which prevents the escape of queen during warming season.**

PRODUCTS OF BEE KEEPING AND THEIR ECONOMIC IMPORTANCE

* The chief products of bee keeping industry are *

1. Honey



2. Bee wax



PRODUCTS OF BEE KEEPING AND THEIR ECONOMIC IMPORTANCE

1.Honey



- Honey is the **healthier substitute** for sugar.
- The major constituents of honey are, **levulose, dextrose, maltose, other sugars, enzymes, pigments, ash and water.**
- It is an **aromatic sweet material derived from nectar of plants.**
- It is a **natural food, the smell and taste depends upon the pollen taken by the honey bee.**
- It is used as an **antiseptic, laxative and as a sedative.**
- It is generally used in **Ayurvedic and Unani systems of medicine.**
- It is also used in the **preparation of cakes, breads and biscuits.**

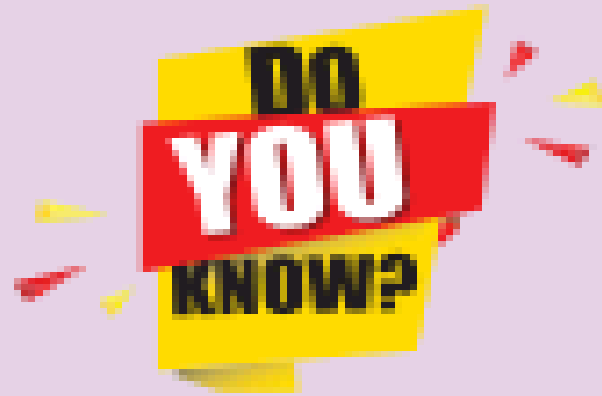
PRODUCTS OF BEE KEEPING AND THEIR ECONOMIC IMPORTANCE

2. Wax



- I. Bee wax is secreted by the **abdomen of the worker bees** at the **age of two weeks**.
- II. The wax is masticated and mixed with the secretions of the cephalic glands to convert it into a **plastic resinous substance**.
- III. The resinous chemical substance present in the wax is called **propolis** which is derived from **pollen grains**.
- IV. The **pure wax is white in colour** and the **yellow colour is due to the presence of carotenoid pigments**.
- V. It is used for making **candles, water proofing materials, polishes for floors, furniture, appliances, leather and taps**.
- VI. It is also used for the **production of comb foundation sheets in bee keeping** and **used in pharmaceutical industries**.

APICULTURE

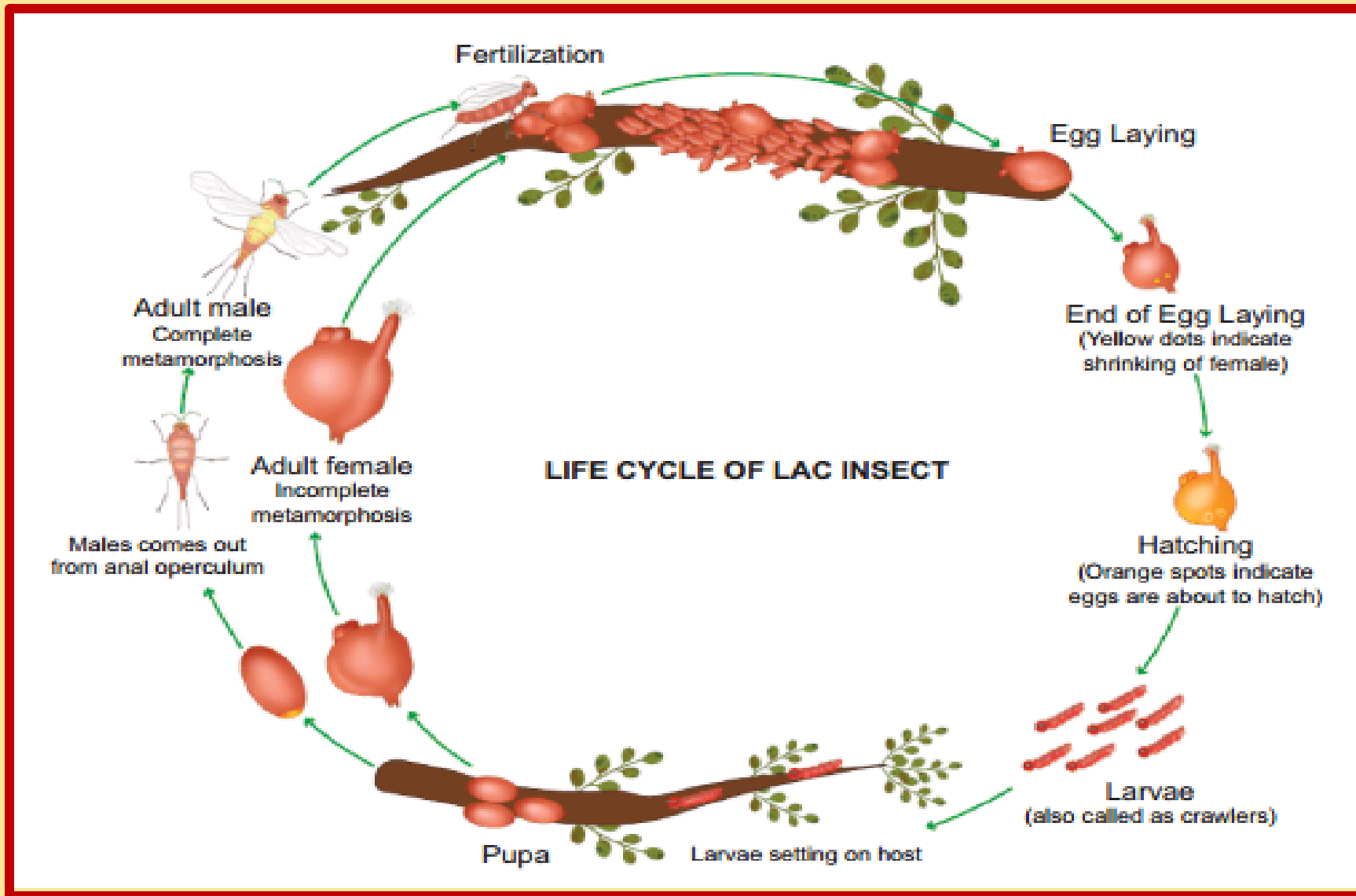


Bees teach us a lesson to work with cooperation. Imagine the hardwork of the bees! A single honey bee travels about double the distance of the circumference of the earth's globe for preparing 453.5ml of honey.

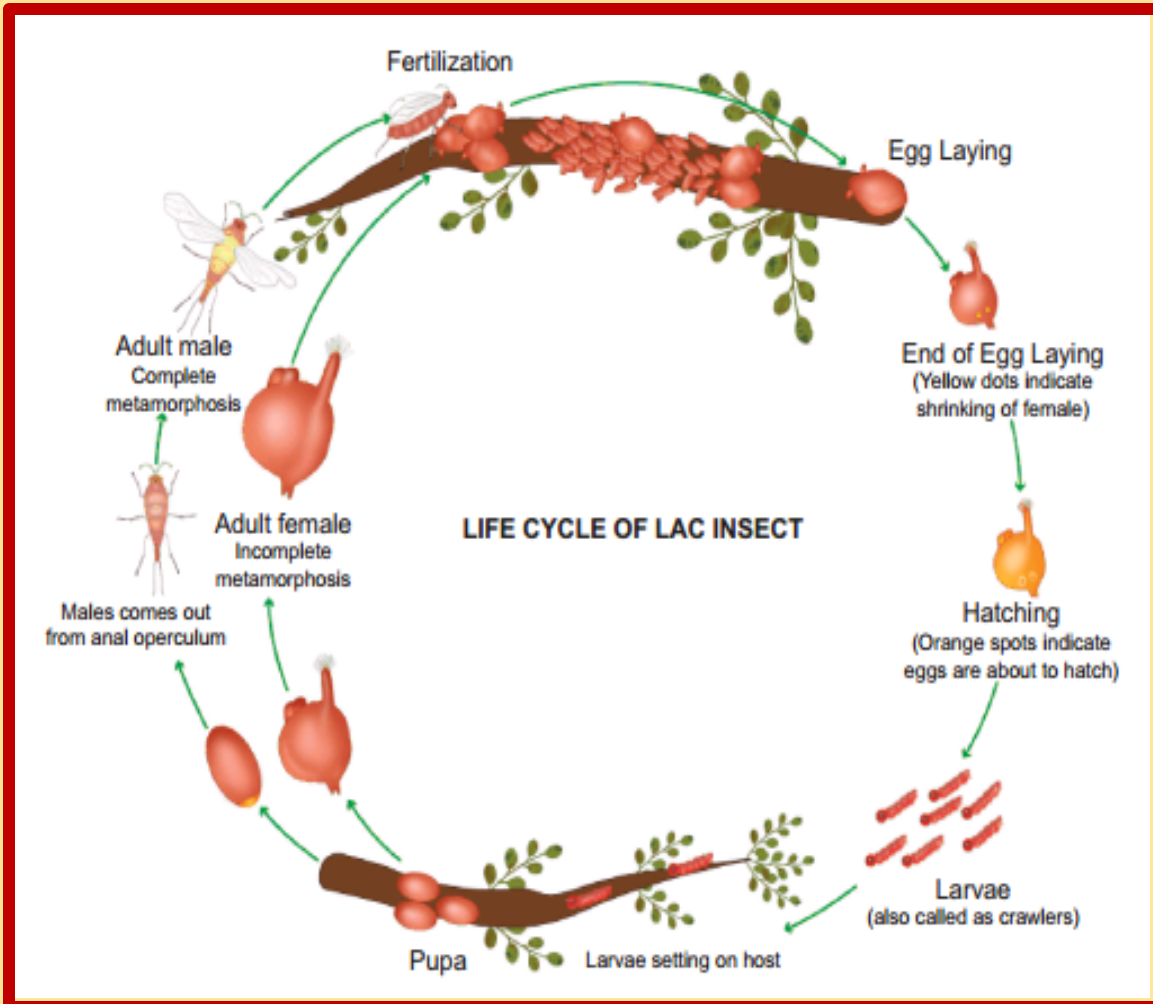
LAC CULTURE

- The culture of lac insect using techniques for the procurement of lac on large scale is known as **Lac culture**.
- Lac is produced by the lac insect **Tachardia lacca** previously known as **Laccifer lacca**.
- It is a minute, **resinous crawling scale insect** which inserts its proboscis into the plant tissues and sucks juice, grows and **secretes lac from the hind end** of the body as a **protective covering for its body**.
- Moreover the insect is a **parasite on host plants** i.e., **Karanagalli** (Acacia catechu), **Karuvelai** (Acacia nilotica) and **Kumbadiri** (Schleichera oleosa).
- The **quality of lac depends** upon the **quality of the host plant**.
- The **female lac insect is responsible for large scale production of lac**, which is larger than the male lac insect.

Life cycle of lac insect

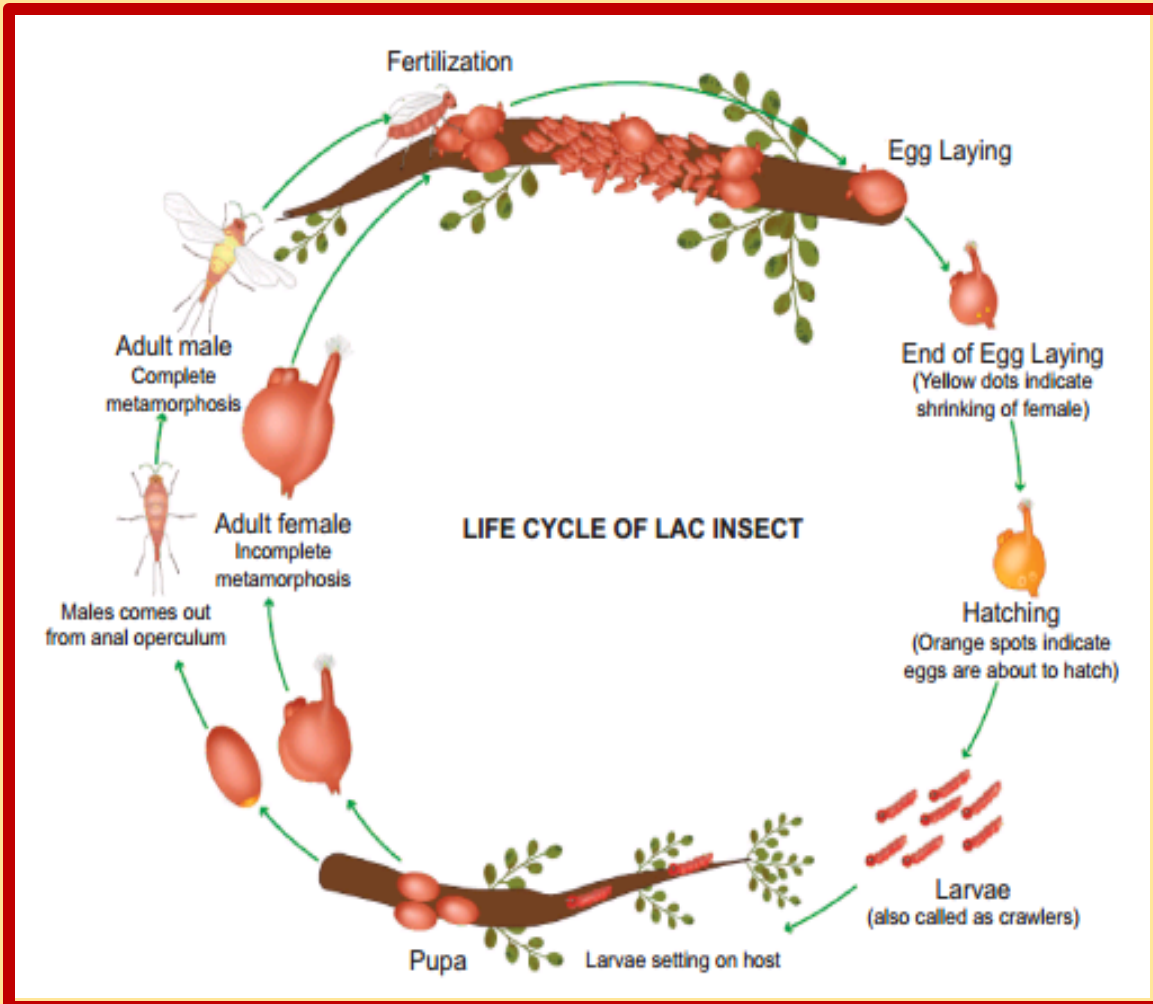


Life cycle of lac insect



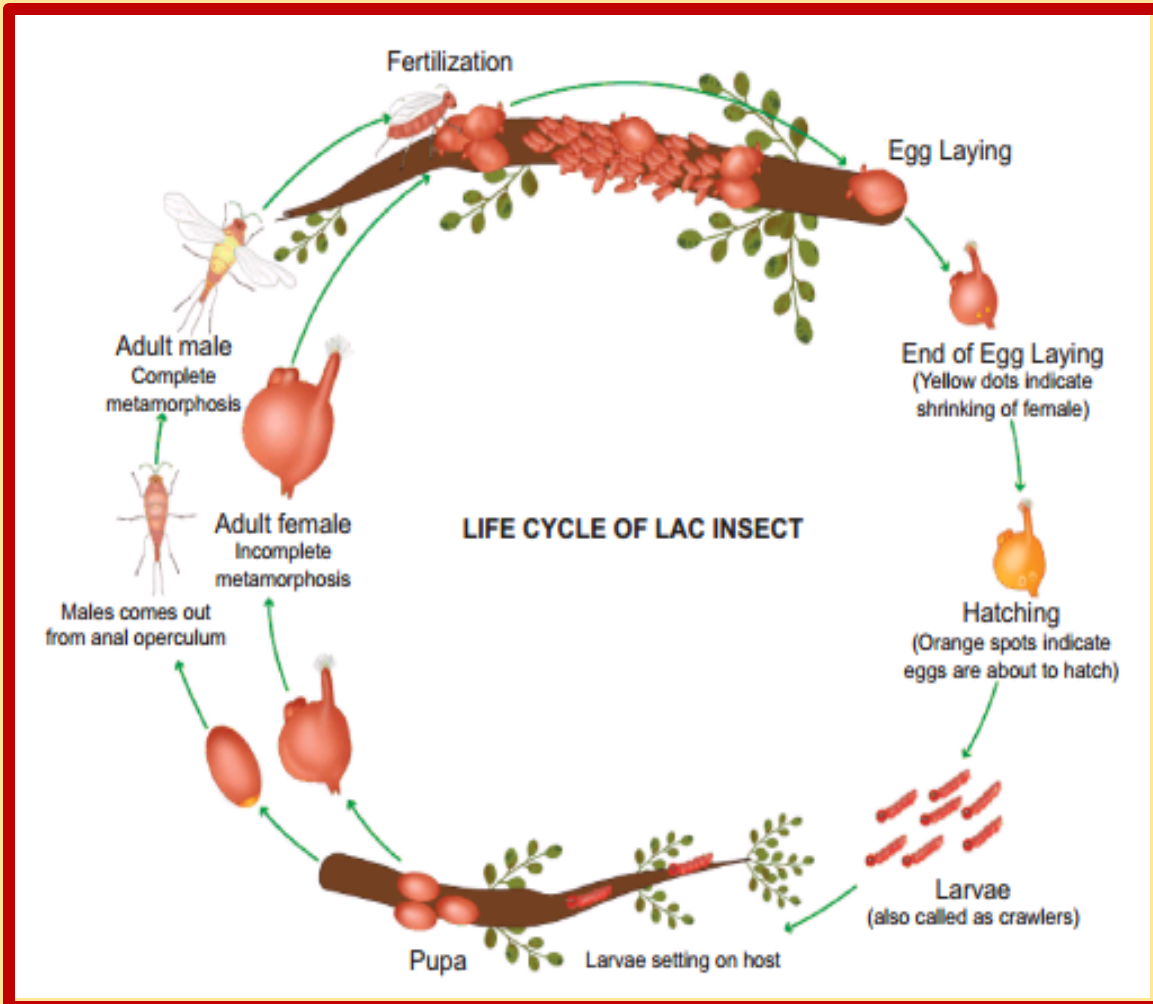
- After copulation, the **male insect dies**.
- The female develops very rapidly after fertilization and **lays about 200 to 500 eggs**.
- Eggs hatch into **larvae after six weeks**.
- The mass emergence of larvae from the egg in search of a host plant is called '**swarming**'.
- After settling on the host, the larvae start feeding continuously and the **secretion of lac also starts simultaneously**.

Life cycle of lac insect



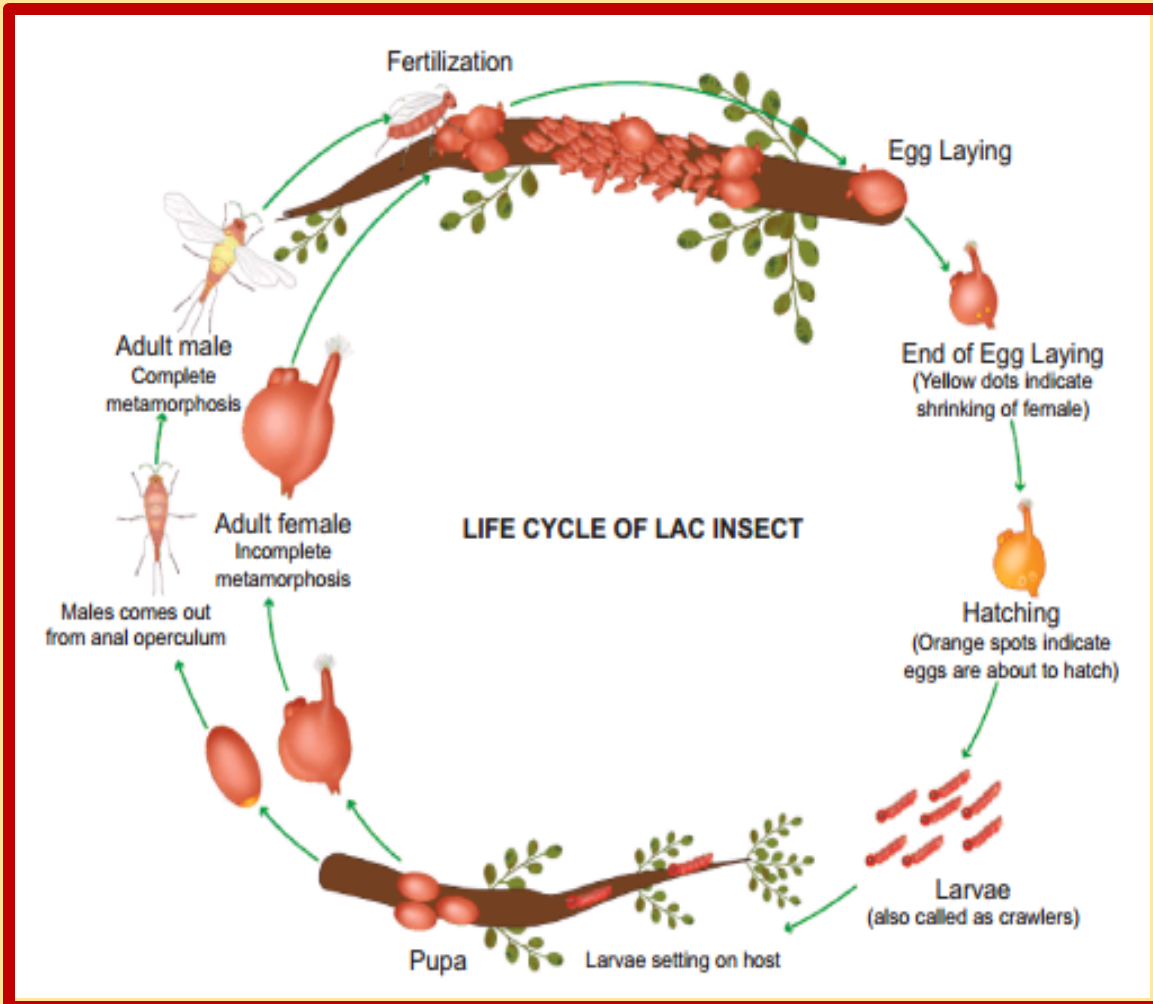
- Gradually the **larvae** become **fully covered by lac**.
- Then the larvae **moult** in their respective cells (chamber).
- The shapes of the cells are different for male and female insects, **males are elongated** whereas and the **female are oval**.
- Some insects are **natural predators of lac insects**.
- The caterpillars of these parasites feed upon lac insects showing **hyper-parasitism**.

Life cycle of lac insect



- Lac cultivation is a complicated process, so the cultivators should know well about the **inoculation, swarming period and harvesting of lac.**
- The process of introducing lac insect on the host plant is called **inoculation.**
- Before inoculation, **pruning of the host plant is done.**
- The twigs having brood lac, i.e., **lac insect about 20 cm in length** are attached to fresh host plants.
- The lac insect then **repeats its life cycle.**
- The collection of lac from the host plant is known as **harvesting.**

Life cycle of lac insect



- Harvesting may be done **before swarming** (immature) or **after swarming** (mature).
- Immature harvesting produces '**Ari lac**' whereas mature harvesting produces the **mature lac**.
- Lac cut from the host plant is called '**Stick lac**'.
- The lac present on the **twig is scraped and collected**.
- After grinding, the **unnecessary materials** like dusts and fine particles are **removed**.
- The resultant lac is called '**seed lac**'.
- The seed lac is sun dried and then melted to produce '**shellac**'.

Economic importance of Lac

1. Lac is largely used as a **sealing wax** and **adhesive for optical instruments**. It is used in **electric industry**, as it is a **good insulator**.
2. It is used in **preparations of shoe and leather polishes** and as a **protective coating of wood**.
3. It is used in **laminating paper board, photographs, engraved materials** and **plastic moulded articles**.
4. Used as a **filling material for gold ornaments**.

LAC



Hyper-parasitism - A condition in which a secondary parasite develops within a previously existing parasite or a hyperparasite is the parasite whose host is also a parasite.

AQUAPONICS

- Aquaponics is a technique which is a combination of **aquaculture** (growing fish) and **hydroponics** (growing plants in non-soil media and nutrient-laden water).
- Aquaponics may also **prevent toxic water runoff**.
- It also **maintains ecosystem balance** by **recycling the waste and excretory products produced by the fish**.
- In India, **aquaponics was started in 2013**.
- Some primary methods of aquaponic gardening that are in use nowadays are as follows:
 - (i) **Deep water culture**
 - (ii) **Media based method**
 - (iii) **Nutrient Film technique**
 - (iv) **Aqua vertica**

AQUAPONICS



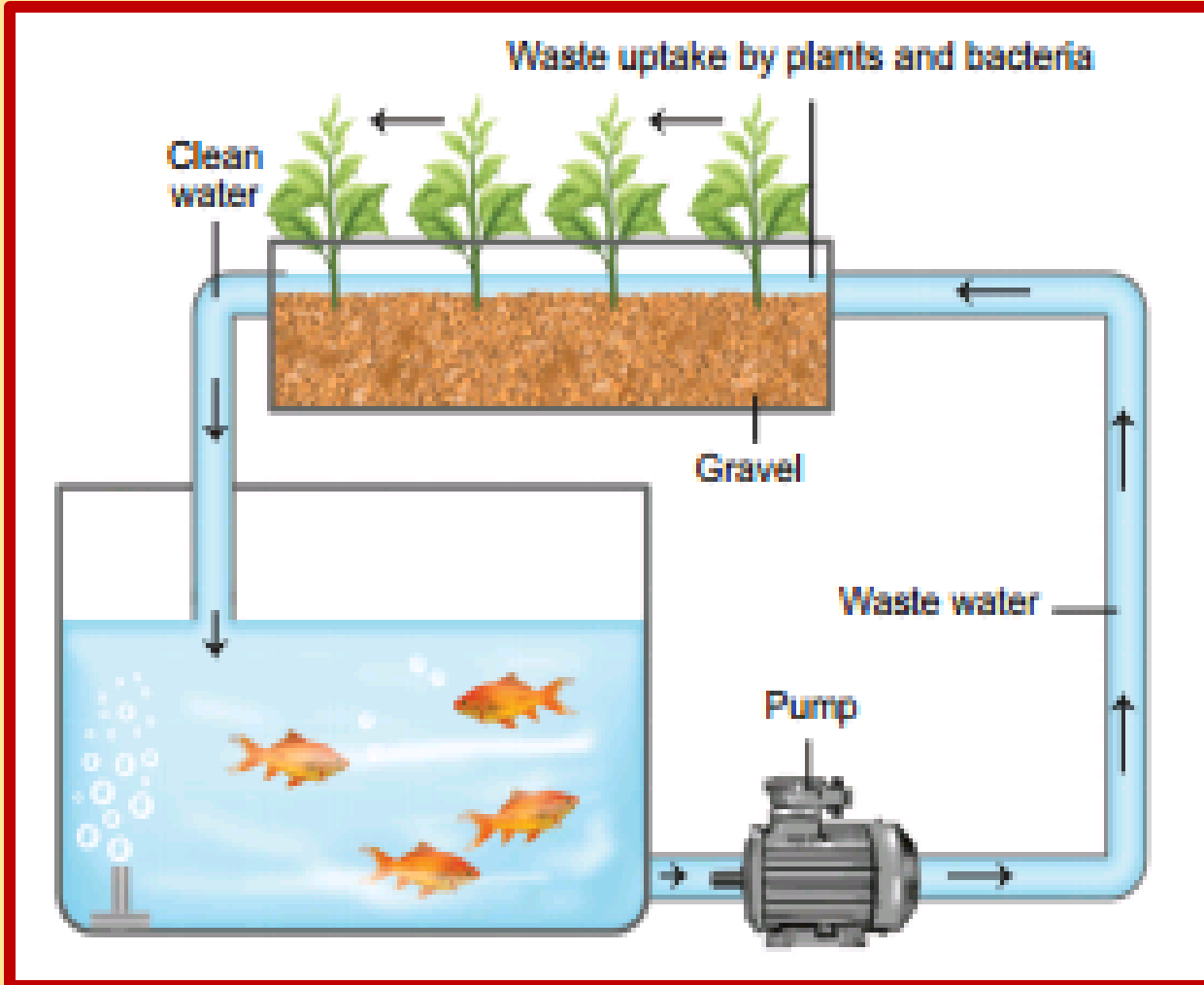
AQUAPONICS



1. Deep water culture

- Deep water culture is otherwise known as **raft based method**.
- In this method a **raft floats in water**.
- Plants are kept in the holes of raft and the **roots float in water**.
- This method is applicable for **larger commercial scale system**.
- By this method **fast growing plants are cultivated**.

AQUAPONICS



2. Media based method

- Media based method involves growing plants in **inert planting media like clay pellets or shales.**
- This method is applicable for **home and hobby scale system.**
- Larger number of **fruiting plants, leafy green plants, herbs and other varieties of plants** can be cultivated.

AQUAPONICS



3. Nutrient Film technique

- **Nutrient Film technique involves the passage of nutrient rich water through a narrow trough or PVC pipe.**
- **Plants are kept in the holes of the pipe to allow the roots to be in free contact with in the water stream.**

AQUAPONICS



4. Aqua vertica

- Aqua vertica is otherwise known as **vertical aquaponics**.
- Plants are stacked on the top of each other in **tower systems**.
- Water flows in through the **top of the tower**.
- This method is suitable for **growing leafy greens, strawberries** and other crops that **do not need supporting solid substratum to grow**.

Advantages of Aquaponic gardening

1. Water conservation:

- No need of water discharge and recharge as the **water is maintained by recycling process.**

2. Soil:

- Bottom soil may be loaded with **freshwater.**
- Microbes in water can **convert the waste materials into usable forms like ammonia into nitrates** which are used by the plants.
- Thus the **soil fertility is maintained.**

3. Pesticides:

- In this system **use of pesticides is avoided** and hence it is **ecofriendly.**

4. Weeds:

- Since the plants are cultured in confined conditions, **growth of weeds is completely absent.**
- The **utilization of nutrient by plants is high** in this method.

Advantages of Aquaponic gardening

5. Artificial food for fishes:

- In this system **plant waste and decays** are utilized by fishes as food.
- So, the need for the use of **supplementary feed** can be minimized.

6. Fertilizer usage:

- **Artificial or chemical fertilizers** is not required for this system since the plants in the aquaponics utilize the nutrients from the fish wastes dissolved in water.

7. Co-cultivated:

- Cultivable fishes like **tilapia, trout, koi, gold fish, bass** etc., are cultured in aquaponics.
- Common cultivable plants like **tomato, pepper, lettuce, cucumber, and rose** are co-cultivated in this method.

AQUACULTURE

- Aquaculture has been practiced in varying forms for centuries dating to the time of the **Phoenicians**.
- India offers a huge potential for **aquaculture development**.
- Fish culture received notable attention in **Tamil Nadu in 1911**.
- Aquaculture is a branch of science that deals with the farming of aquatic organisms such as **fish, molluscs, crustaceans and aquatic plants**.
- On the basis of source, aquaculture can be classified into **three categories**. They are
 - (a) **Freshwater aquaculture**
 - (b) **Brackish water aquaculture**
 - (c) **Marine water aquaculture**

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AQUACULTURE – FRESH WATER CULTURE



Catla



Mullet



Common carps

- Culturing of fishes is called **fish culture** or **pisciculture**.
- In land water bodies include freshwater bodies like rivers, canals, streams, lakes, flood plain wetlands, reservoirs, ponds, tanks and other derelict water bodies and ponds constructed for **fresh water aquaculture**.
- The pH of the freshwater should be around neutral and salinity below **5 ppt** (parts per thousand).

AQUACULTURE – BRACKISH WATER CULTURE



- Brackish water fishes spend most of its life in **river mouths** (estuaries) **back waters**, **mangrove swamps** and **coastal lagoons**.
- Estuarine fish are more common in **Bengal and Kerala**.
- Culturing of animals in the water having salinity range **0.5 to 30 ppt** are called as **brackish water culture**.
- Fishes cultured in brackish water are **Milk fish** (*Chanos Chanos*), **Sea bass** ('Koduva'), **Grey mullet** ('Madavai'), **Pearl spots** ('Kari'meen) etc,

AQUACULTURE – MARINE WATER CULTURE

- Marine Fisheries deal with fishing operations along **seacoasts**.
- The Indian subcontinent approximately has a **5600 kms long coastline**.
- About **80% of India's marine fish are supplied by the west coast** and the remaining **20% by the east coast**.
- The premier varieties are **mackerels, sardines, sharks, and catfish**.
- Marine edible fishes of Tamilnadu coast include both **cartilaginous and bony fishes**.
- Culturing of animals in the water salinity ranges from **30 - 35% is called Mariculture**.
- Some fishes like **Chanos sp, Mugil cephalus** are cultured here.
- Culturing of animals in the salinity ranges from **36 - 40% is called Metahaline culture**. Eg, **Brine shrimp (Artemia salina)**.
- **Artemia** is commonly known as the **brine shrimp**.
- It is a crustacean and **lives in high saline waters** because of its **high osmoregulatory capacity**.

FISH CULTURE

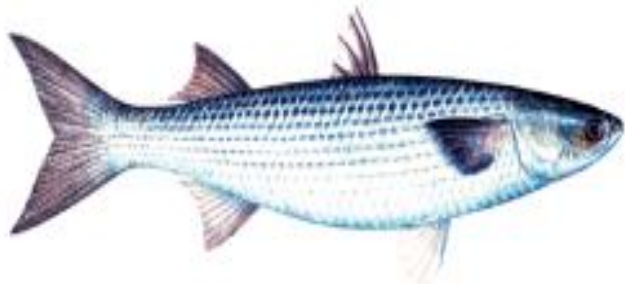
Characteristics of cultivable fishes

1. Fishes should have **high growth rate in short period** for culture.
2. They should **accept supplementary diet**.
3. They should be hardy enough to **resist some common diseases and infection of parasites**.
4. Fishes proposed for **polyculture should be able to live together without interfering or attacking other fishes**.
5. They should have **high conversion efficiency** so that they can **effectively utilize the food**.

TYPES OF CULTIVABLE FISH



Catla



Mullet



Common carps

Different types of freshwater cultivable fishes

• Cultivable fish are of **3 types**.

1. Indigenous or native fresh water fishes

(Major carps, Catla, Labeo, Clarias)

2. Salt water fishes acclimatized for fresh

water (Chanos, Mullet).

3. Exotic fishes or imported from other

counties (Common carps)

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MAJOR CARPS – CULTURE IN INDIA

- Major carps have **proved to be best suited for culture in India**, because the carps
 1. Feed on **zooplanktons and phytoplanktons, decaying weeds, debris and other aquatic plants.**
 2. They can **survive in turbid water with slightly higher temperature.**
 3. Can **tolerate O₂ variations in water.**
 4. Can be **transported from one place to other easily.**
 5. They are **highly nutritive and palatable.**

EXTERNAL FACTORS AFFECTING FISH CULTURE

• **The factors that affect fish culture are**

1. Temperature

2. Light rain

3. Water

4. Flood

5. Water current

6. Turbidity of water

7. pH hardness

8. Salinity and dissolved O₂

9. Light and temperature also play an important role in fish breeding.

MANAGEMENT OF FISH FARM

- To culture fish, one should have an idea about different stages of fish culture such as **topographic situation, quality, source, physical, chemical and biological factors of water.**
- **Breeding, hatching, nursing, rearing and stocking fishes in ponds** has to be managed properly.
- Keeping in view the various stages of fishes, the following **different types of ponds have been recommended to manage them.**

1. Breeding pond

2. Hatching pond

3. Nursery pond

4. Rearing pond

5. Stocking ponds

6. Harvesting ponds

BREEDING POND



1. BREEDING POND



- The **first step in fish culture** is the **breeding of fishes**, therefore, for proper breeding special types of ponds are prepared called **breeding ponds**.
- These ponds are **prepared near the rivers** or **other natural water resources**.

Types of breeding

- Depending on the mode of breeding, they are divided into
 - i. **Natural breeding**
 - ii. **Induced breeding**

Natural breeding - Bundh breeding



- These are special types of ponds where **natural riverine conditions** or any **natural water resources** are managed for breeding of **culturable fishes**.
- There bundhs are **constructed in large low-lying areas** that can **accommodate large quantity of rain water**.
- The shallow area of such **bundhs** is used as **spawning ground**.

Induced breeding

- The fish seed is commonly collected from breeding grounds but does not guarantee that all fish seeds belong to the same species.
- Hence advanced techniques have been developed to improve the quality of fish seed by artificial method of fertilization and induced breeding.
- Artificial fertilization involves removal of ova and sperm from female and male by artificial mechanical process and the eggs are fertilized.
- For artificial fertilization the belly of mature female fish is held upward.
- Stripping is done with the thumb of the right hand from the anterior to posterior direction for the ejection of eggs due to force.
- In this way eggs are collected separately.
- Further, the male fish is caught with its belly downwards.
- The milt of fish is striped and collected separately, and then the eggs are fertilized.

Induced breeding

- Induced breeding is also done by **hypophysation** (removal of pituitary gland).
- The **gonadotropin hormone** (FSH and LH) secreted by the pituitary gland influences the **maturation of gonads and spawning in fishes**.
- **Pituitary gland is removed** from a healthy mature fish.
- **Pituitary extract is prepared** by homogenising in 0.3% saline or glycerine and centrifuged for 15 minutes at 8000rpm.
- The **supernatant is injected intramuscularly at the base of the caudal fin or intra-peritoneally at the base of pectoral fin**.
- **Male and female fishes start to spawn (release of gametes) and eggs are fertilized**.
- The fertilized eggs are **removed from the spawning place and kept into hatching hapas**.

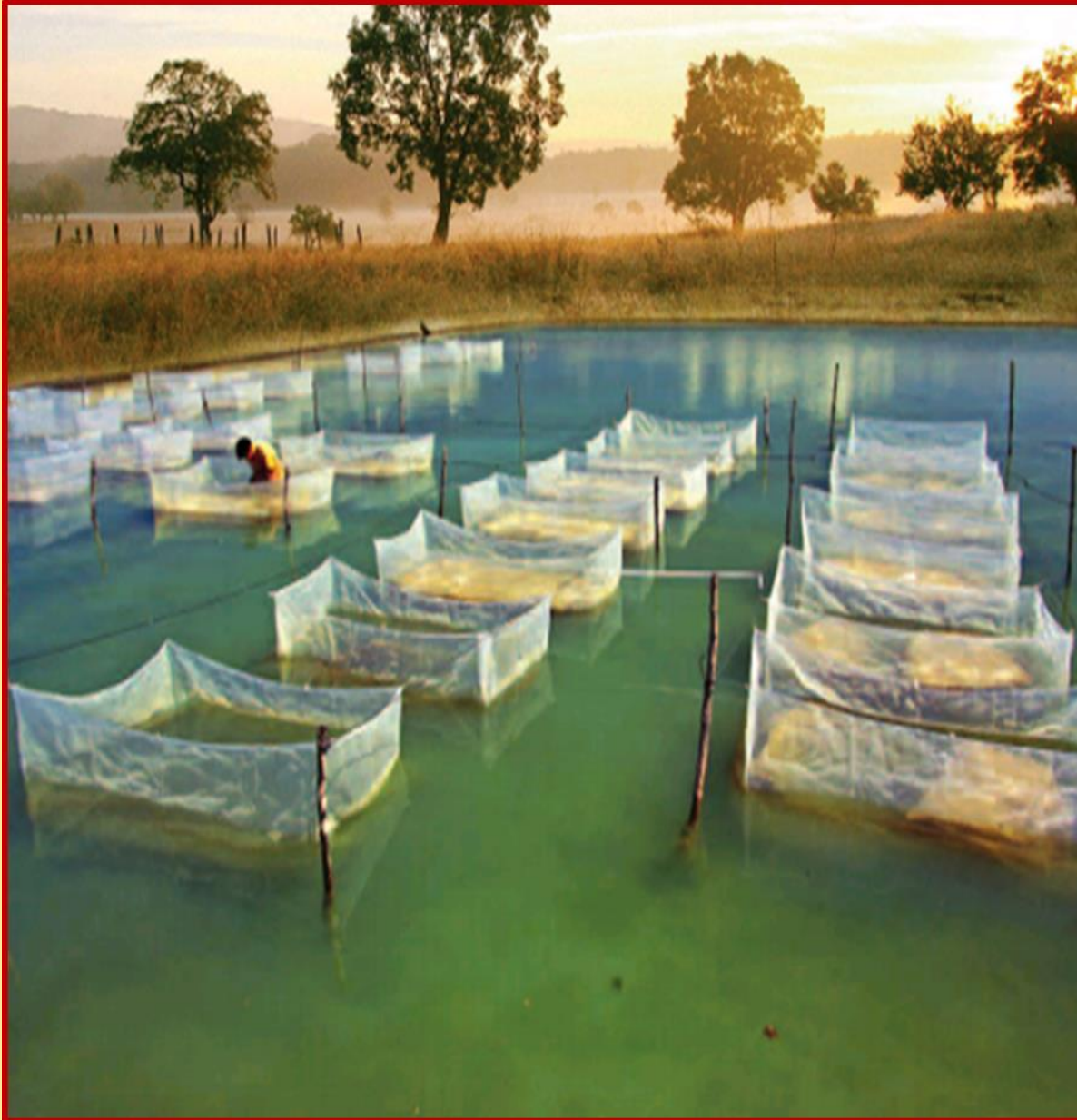
Fish seed

- Fish seed is collected from **breeding ponds**.
- The spawn collecting net is commonly called **Benchijal** (Shooting net) and **transferred to the hatching pits**.



Harvesting of fish seed

Hatching pit



- The **fertilized eggs are kept** in hatching pits.
- The **hatching pits should be nearer to the breeding grounds**, should be smaller in size with good quality water.
- There are **two types of hatching pits**, hatcheries are small sized pond in which **unfertilized eggs are transferred and hatching happens**.
- **Hatching hapas are rectangular trough shaped tanks** made up of mosquito net cloth supported by **bamboo poles and fixed in the river**.

Nursery pond

- The newly **hatched fries** are transported from the hatching happa to nursery ponds where they grow into **fingerlings**.

Nursery pond

- ✓ The pond which is used for growing hatchlings, spawn, fry to advanced fry or fingerlings for a period of about 40-60 days is called nursery pond.



Stocking ponds



- Stocking ponds should be devoid of **weeds and predatory fishes.**
- Proper organic manuring should be done to increase the production with **cow dung and chemical fertilizing should also be done.**

Harvesting



Harvesting fishpond using a seine net

- Harvesting is done to **capture the fishes from the water.**
- **Well grown fishes** are taken out for marketing.
- **Small sized fishes** are again released into the stocking ponds for further growth.
- **Different methods of fishing** are carried out to harvest fishes.
- These include **Stranding, Angling, Traps, Dipnets, Cast nets, Gill nets, Drag nets** and **purse nets.**
- The harvested fishes are preserved by **refrigeration, Deep freezing, freeze drying, sun drying, salting, smoking** and **canning.**

Composite fish farming

- Few selected fishes belonging to **different species are stocked together in proper proportion in a pond.**
- This mixed farming is termed **composite fish farming** or **polyculture**.

Advantages of Composite fish farming

1. All available niches are fully utilized.
2. Compatible species do not harm each other.
3. No competition among different species is found.
4. Catla catla, Labeo rohita and Cirrhinus mrigala (surface feeder) are the commonly used fish species for composite fish farming.

Exotic fishes

- The fishes imported into a country for fish culture are called **exotic fishes** and such fish culture is known as **exotic fish culture**.
- Examples of such exotic fishes introduced in India are **Cyprinus carpio** and **Oreochromis mossambicus**.



Disease Management

- Diseases can be of **viral or bacterial origin**.
- Regular monitoring of parameters like **water quality, aeration, regular feeding, observation for mortality should be checked**.
- **Parasitic infestations and microbial infections should be observed periodically**.

Economic importance of fish

1. Fishes form a **rich source of protein food** and **provide a good staple food** to tide over the **nutritional needs of man**.
2. Fish species such as **sardines, mackerel, tuna, herrings** have **high amino acids concentrations particularly histidine** which is responsible for the **meaty flavor of the flesh**.
3. It is **rich in fat such as omega 3 fatty acids**.
4. Minerals such as **calcium, magnesium, phosphorus, potassium, iron, manganese, iodine and copper**.
5. Some of the fish by - products are **Fish oil, Fish meal and Isinglass**.

Fish oil



- Fish oil is the **most important fish by product**.
- It is derived from **fish liver and from the fish body**.
- Fish liver oil is derived from the liver which is **rich in vitamin A and D**, whereas **fish body oil has high content of iodine**, not suitable for human consumption, but is **used in the manufacture of laundry soaps, paints and cosmetics**.

Fish meal



- Fish meal is prepared from fish waste after extracting oil from the fish.
- The dried wastes are used to prepare food for pig, poultry and cattle.
- The wastes obtained during the preparation of fish meal are widely used as manure.

Isinglass

OTHER FISH BY-PRODUCTS >

ISINGLASS

- ▶ It is product from the air bladder of certain fishes like the cat fishes, perches, scianids. Air bladder of such fishes are exported to prepare isinglass.



- Isinglass is a **high-grade collagen produced from dried air bladder or swim bladder of certain fishes viz. catfish and carps.**
- The processed bladder which is dissolved in hot water forms a **gelatin having adhesive property.**
- It is primarily used for clarification of **wine, beer and vinegar.**

Prawn Culture

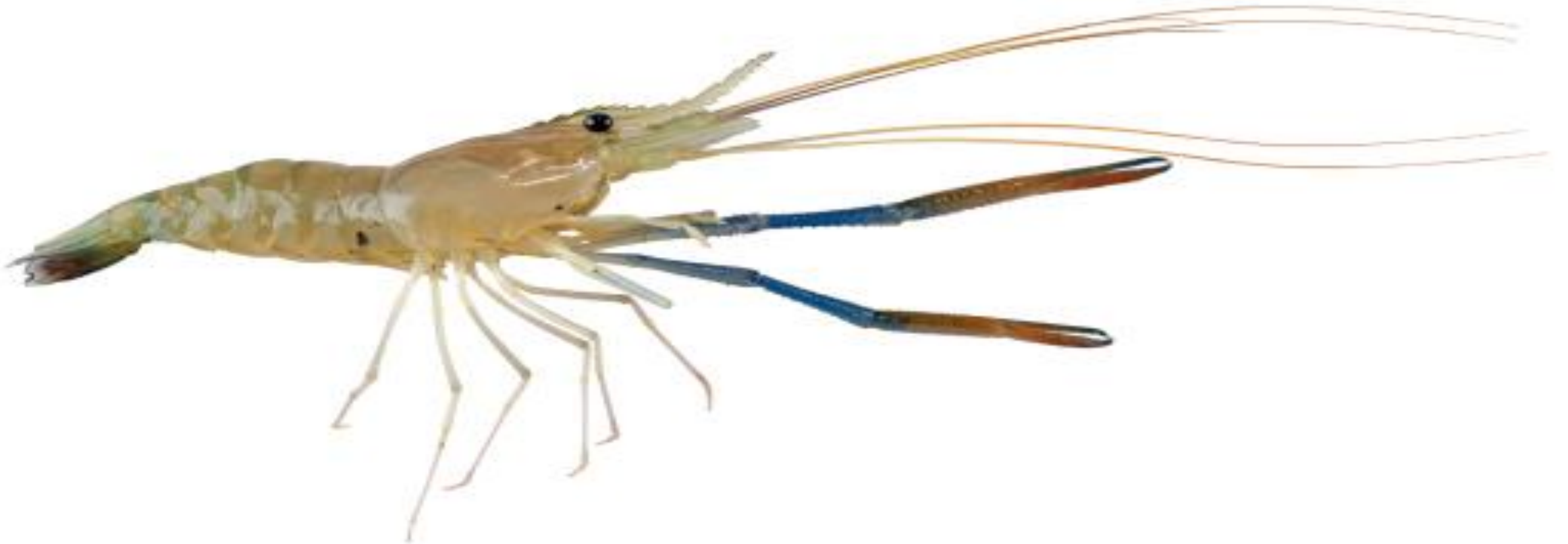


Prawn Culture

Macrobrachium rosenbergii

Prawn Culture

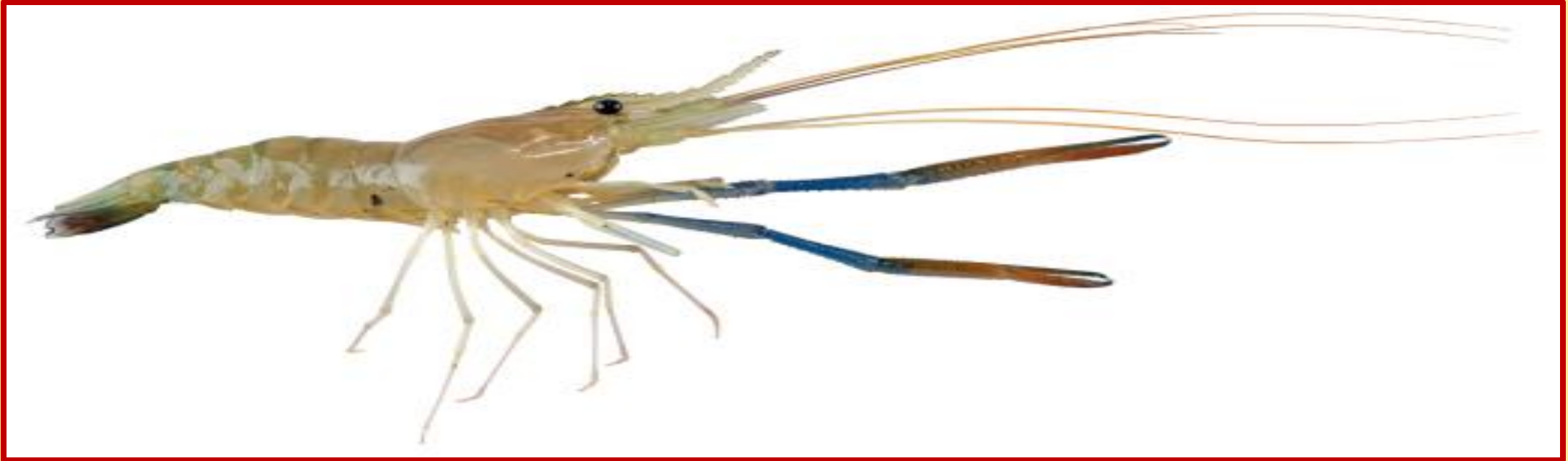
- Most important **aquatic crustacean is prawn**, which is widely cultured prawn flesh is palatable and **rich in glycogen, protein with low fat content**.



Types of prawn fishery

1. Shallow water prawn fishery – located on the west coast restricted to shallow waters.
2. Estuaries and back waters or saline lake prawn fishery - The area of production of prawns are the back waters seen along the Western coast, Ennur, Pulicat, Chilka lake and Estuaries of Ganga and Brahmaputra rivers.
3. Freshwater prawn fishery – Prawns are caught from the rivers and lakes throughout India.
4. Marine prawn fishery – Most of the marine prawns are caught along the Indian coast belonging to the family Penaeidae.

Species of prawn



- A number of **species of prawn** are distributed in water resources such as
 1. **Penaeus indicus,**
 2. **Penaeus monodon,**
 3. **Metapenaeus dobsoni**
 - 4, **Macrobrachium rosenbergii.**

Culture of freshwater prawn



- **Macrobrachium rosenbergii** is commonly seen in **rivers**, fields and **low-saline estuaries**.
- The prawn collected from **ponds, river, and paddy fields** are **transferred to the tanks** which are aerated.
- For fertilization, **one pair of prawn** are kept in a **separate tank**.
- After mating, **the eggs** are laid.
- **Spawning tanks** of different sizes should be prepared with proper aeration.
- **Temperature (24°C – 30°C)** and **pH (7-8)** should be maintained in the hatching tank.
- The **eggs hatch into first and second stage larva**.
- **Artificial feed** is supplied.
- Young ones of **5cm length** (60 days old) can be reared in fresh or slightly **brackish water ponds and rice fields**.
- Harvesting of **prawns** can be done **twice in a year**.

Culture of marine prawn

- Several factors that determine the **success of marine prawn**

culture includes

1. Selection of site

2. Water quality

3. Soil quality

4. Availability of seed

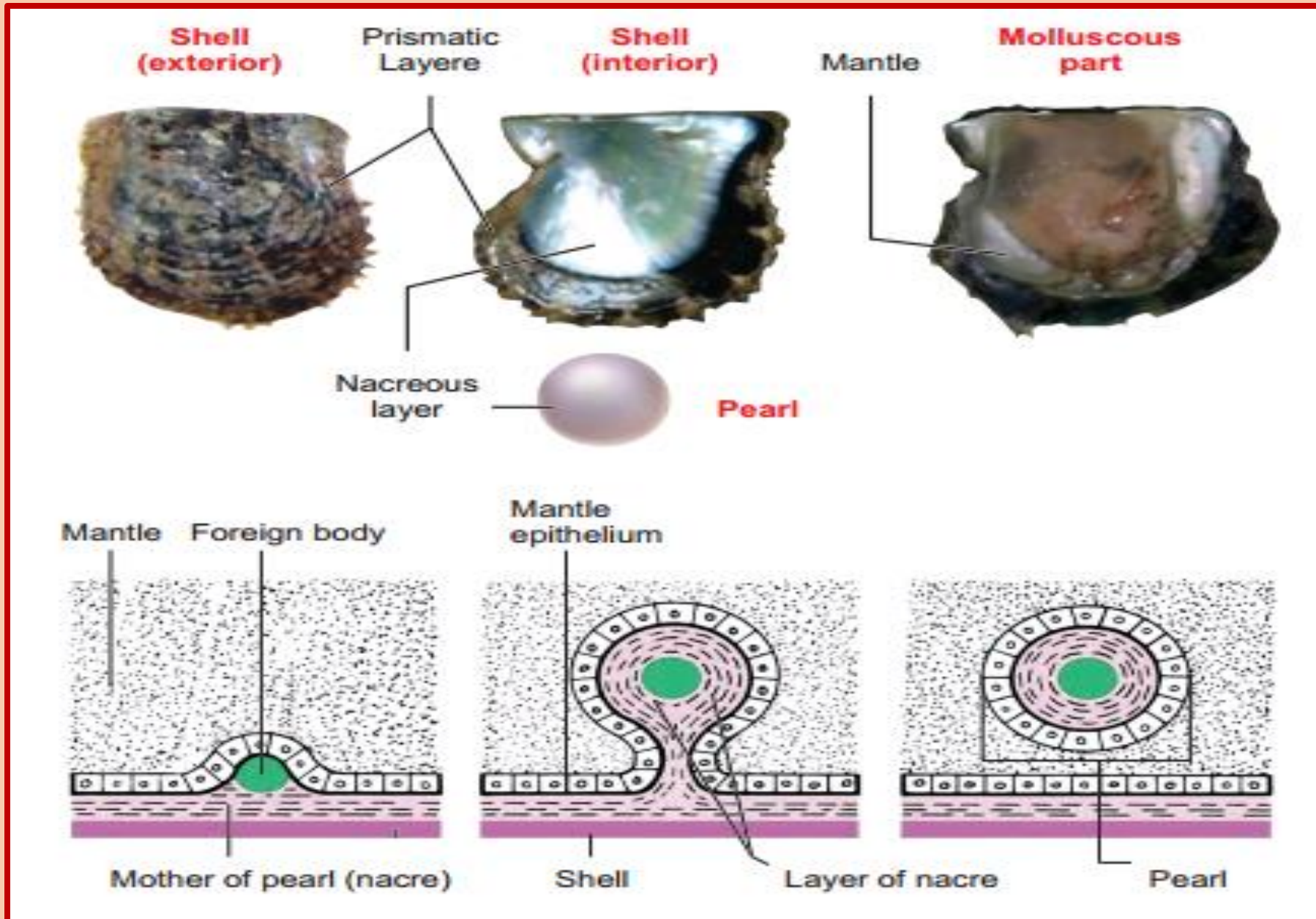


Preparation of farm

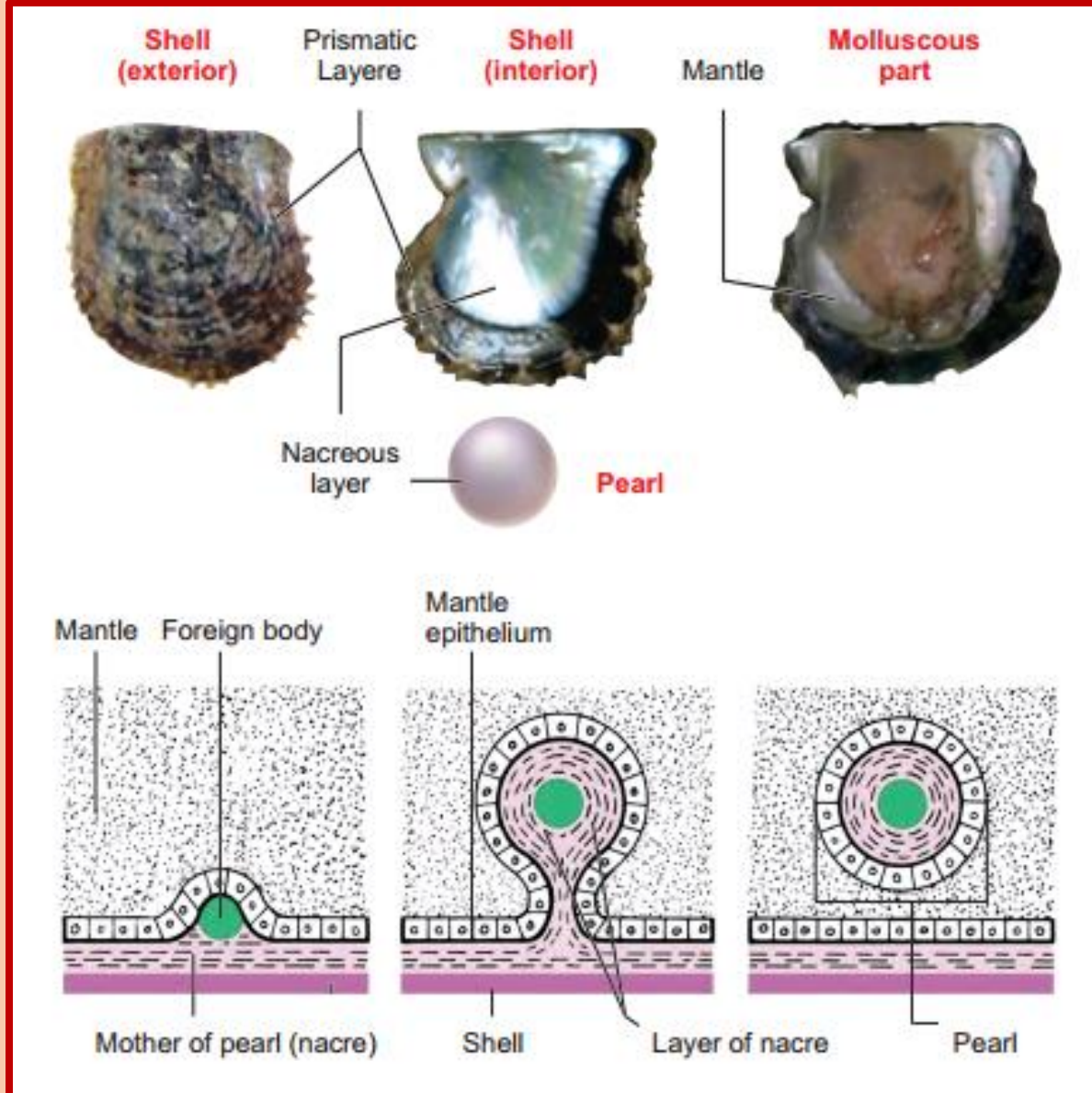


- For the preparation of ponds for algal growth and for the subsequent stocking of prawns it is **essential to drain off the water and sundry the bottom followed by light tilling.**
- Agricultural lime should be applied to **absorb excess CO₂ and to supply calcium** which is **required for moulting.**
- Fertilizers like **rice, bran, poultry, and cattle dung** are used to **increase the fertility of the soil.**
- Prawns are commonly caught in crafts and gears using different types of nets such as **cast nets, bag nets, drag nets, trawl nets and barrier nets.**
- **Preservation of prawns** is done by peeling and deveining or by cooking and peeling.

Pearl Culture

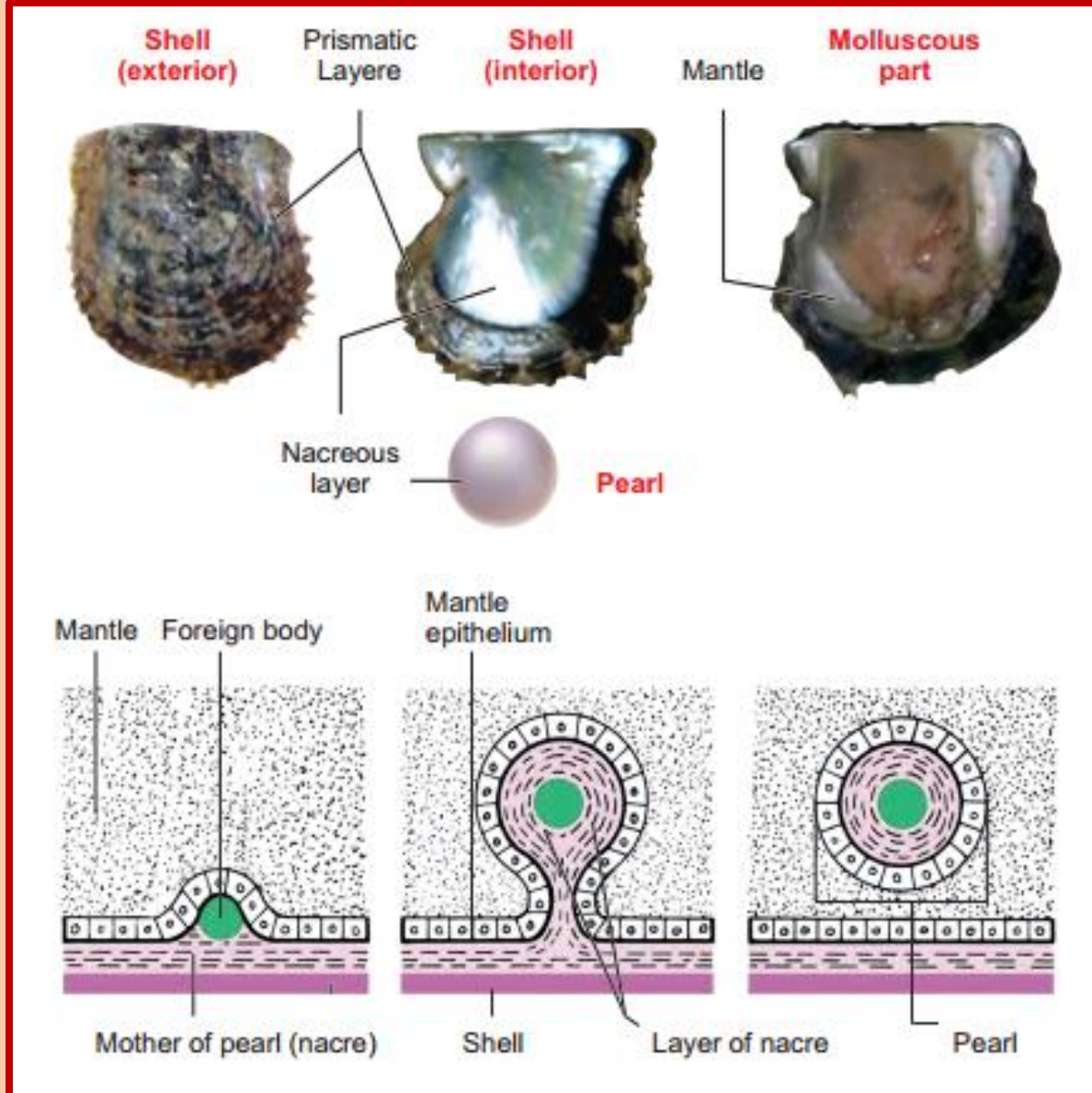


Pearl Culture



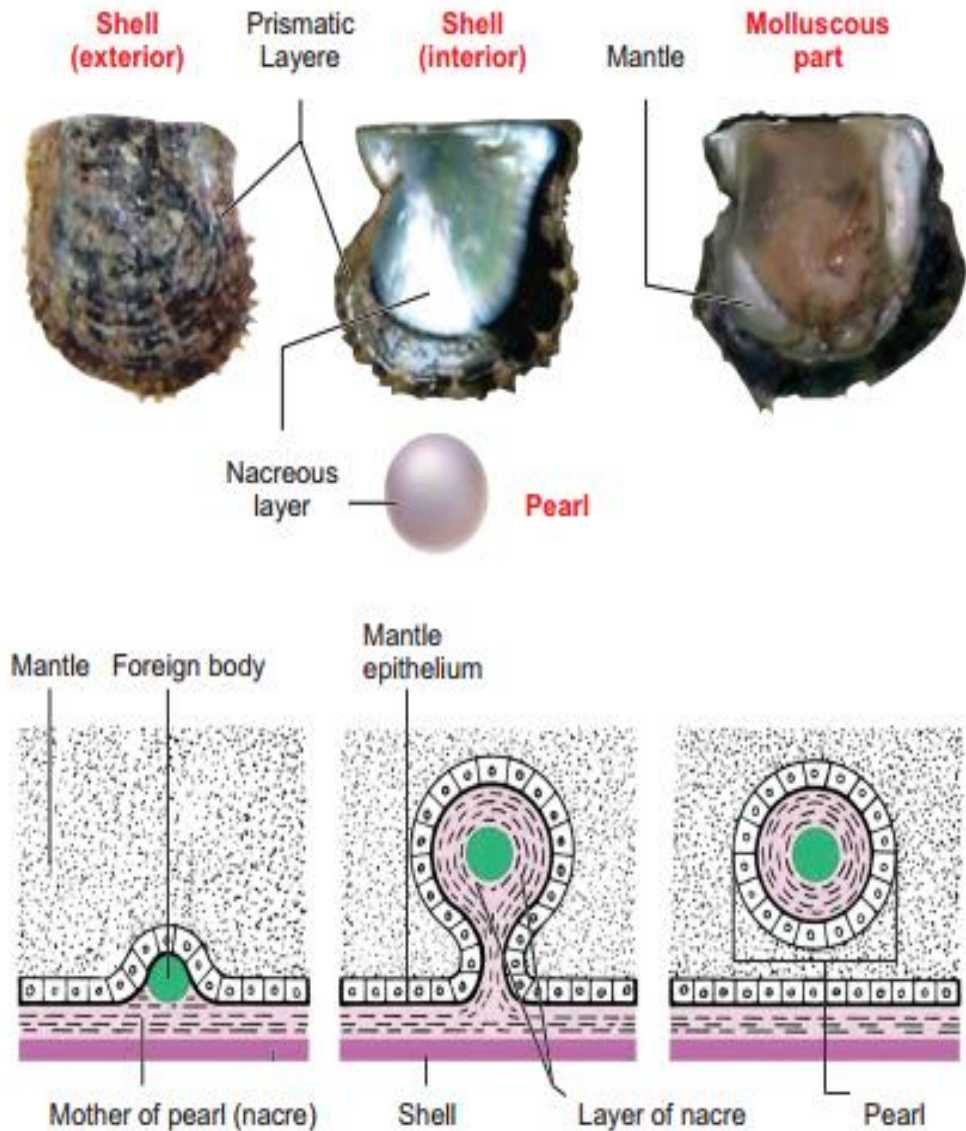
- Pearl is a **white, highly shining globular concretion** found within the shell of an Oyster.
- Pearl oysters are **sedentary animals**.
- In **India it was cultured for the first time in 1973 at Thoothukudi**.
- Pearl oysters are found along the **coast of Kanyakumari** and in the **Gulf of Kutch**.

Pearl Culture



- High quality pearls are obtained from pearl oysters of **Genus Pinctada** that can be cultured in the **salinity range of 30 ppt** in racks, raft and long line methods.
- Freshwater **bivalve Lamellidens** is also used in **artificial pearl culture**.
- Mostly the pearl oysters **inhabit the ridges of rocks or dead corals**, forming extensive pearl banks.
- These pearl beds produce best quality of pearls called as "**Lingha Pearl**".

Pearl Formation



- When a **foreign particle accidentally enters into the space between mantle and shell** of the oyster, it adheres to the mantle.
- The mantle epithelium encloses it like a sac and starts to **secrete concentric layers of nacre** around it as a defensive mechanism.
- Nacre is secreted continuously by the epithelial layer of the mantle and is deposited around the foreign particle and over a period time the **formation of repeated layers of calcium carbonate** makes the **hard and glossy pearl**.
- When the **pearl enlarges the oyster dies**.
- The shell is then carefully opened and the **pearls are manually separated and graded**.

Programming of Pearl Industry and Artificial Insertion of Nucleus

- This can be achieved by an **artificial device to insert the nucleus as foreign particle in the shell of oyster** has proved useful for the production of pearls in greater number.

1. Collection of oysters

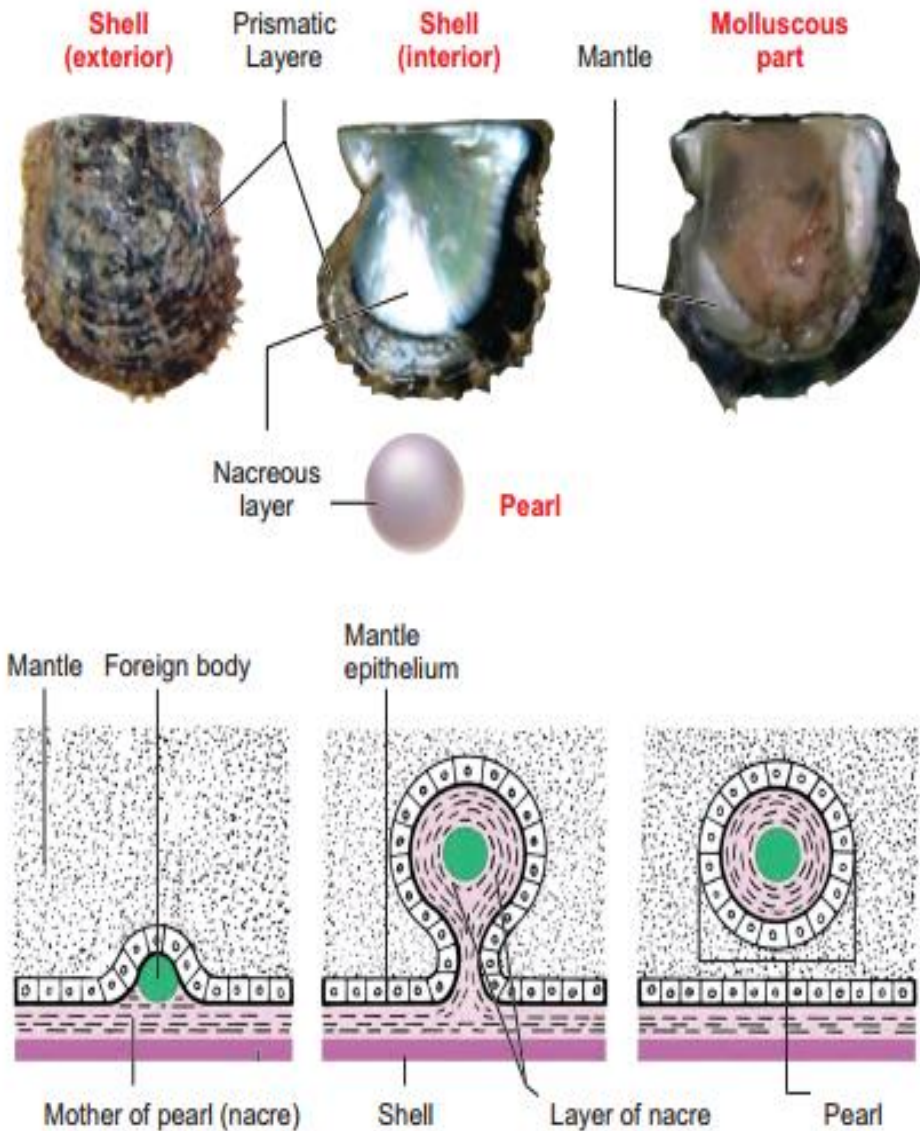
2. Rearing of oysters

3. Insertion of nucleus

4. Harvesting of pearl

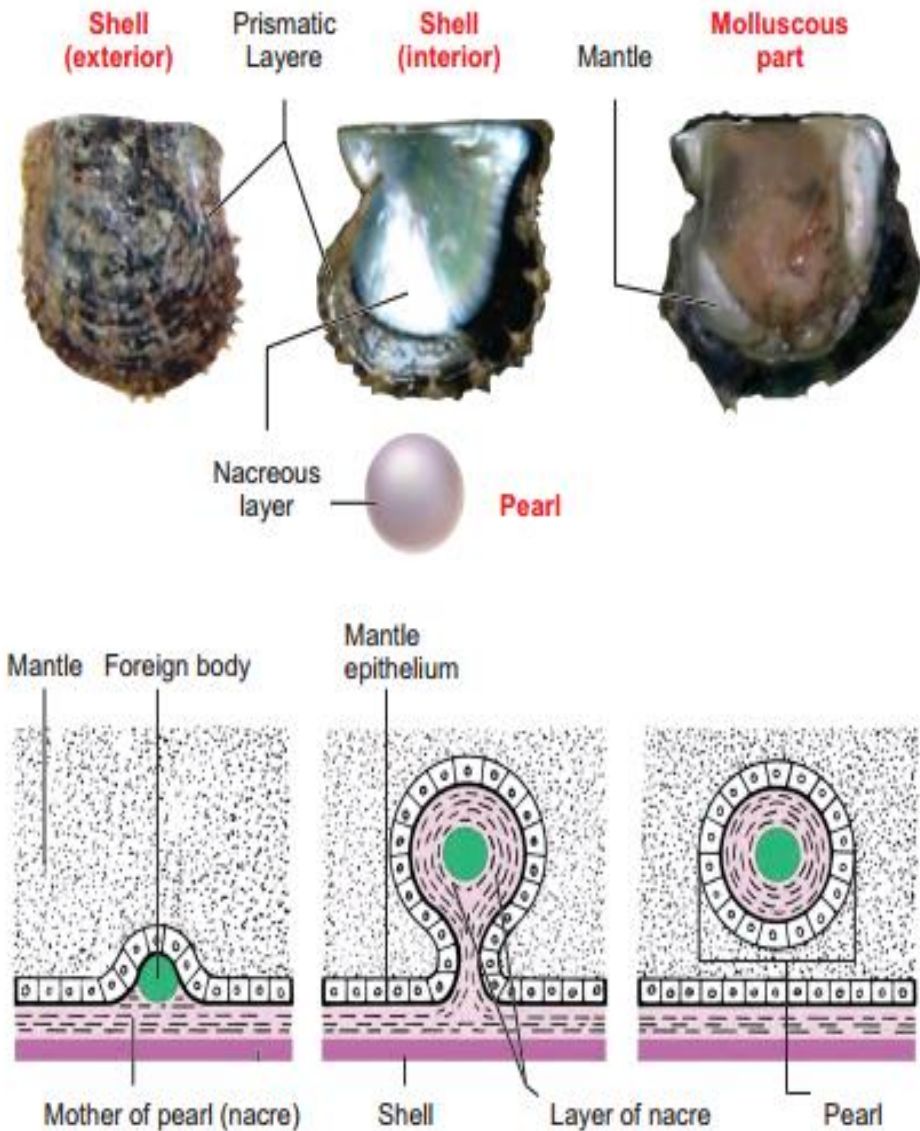
5. Clearing of pearls

1. Collection of oysters



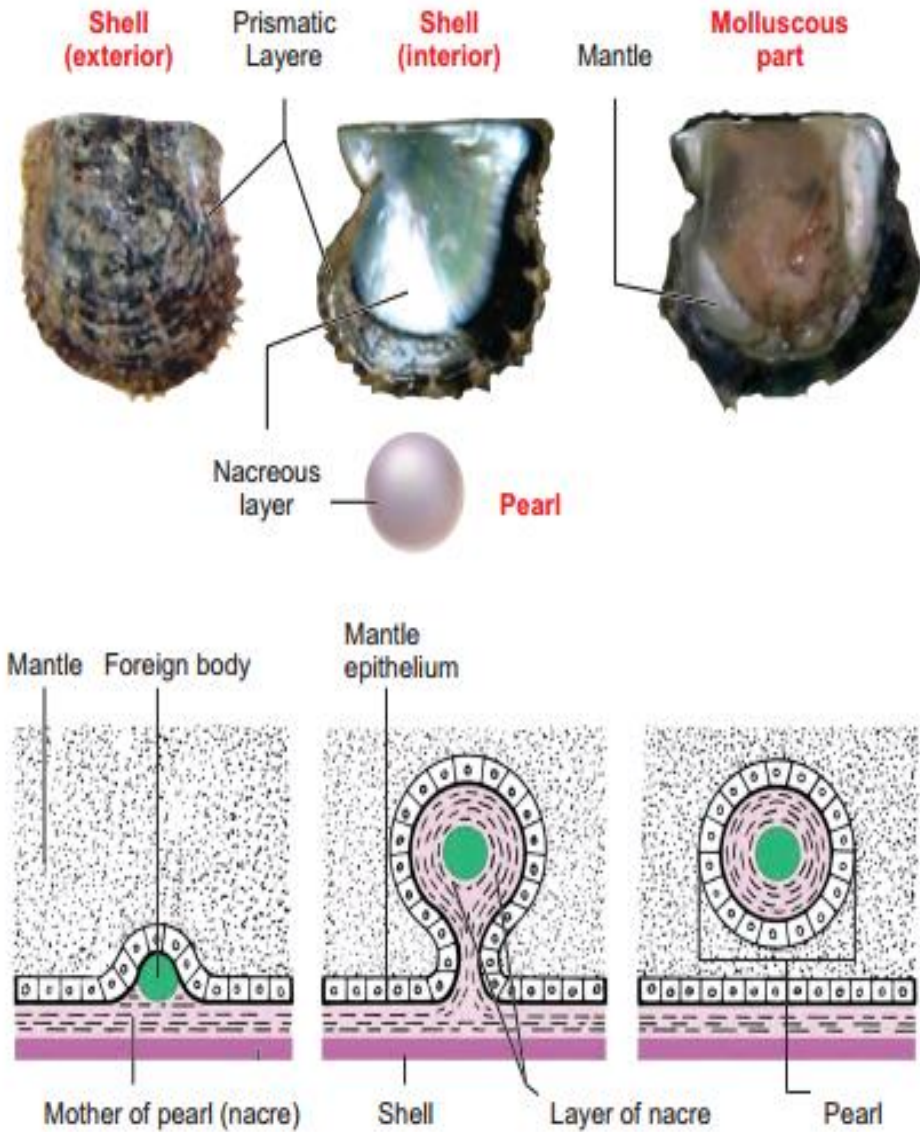
- Oysters are caught by special type of cages (84 x 54 x 20 cm) by covering a **heavy wire frame with two centimeter wire mesh**.
- This cage is dipped into a sandcement mixture providing rough surface to the cages to which **free swimming spat get easily stuck up**.
- These cages are suspended at a **depth of 6 meters**.
- From **July to November**, where spats are **easily available**.
- These collected oysters are now **transferred to rearing cages**.

2. Rearing of oysters



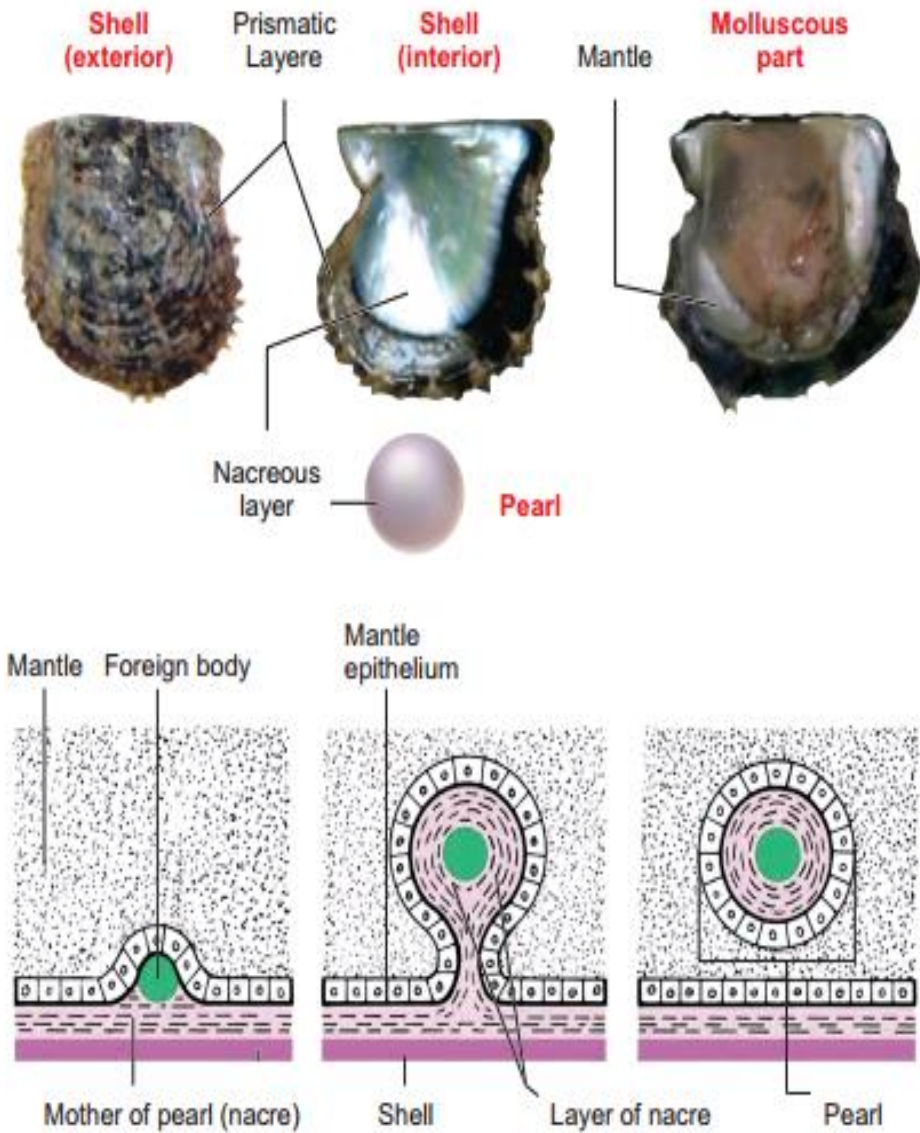
- The collected oysters are stocked and reared in special type of cage called as **rearing cage**.
- These cages are well **protected from enemies of oysters** like Octopus, Eel, Devil fishes etc.
- The collected **oysters are first cleaned and then placed into the culture cages for a period of about 10 to 20 days** to recover from the strain due to excessive handling and for the physiological adjustment to the shallow water conditions.

3. Insertion of nucleus



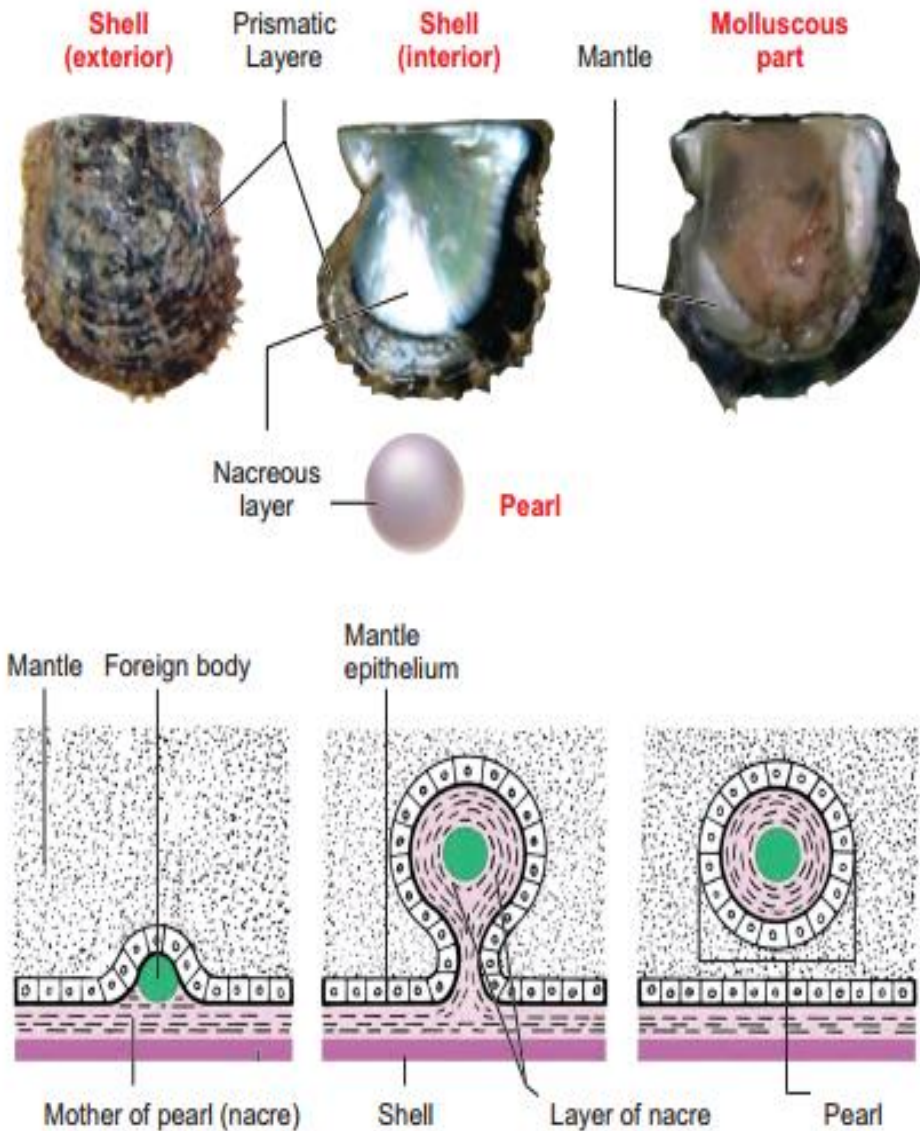
- In this method, a piece of mantle of living oyster is cut off and inserted together with a **suitable nucleus inside the living tissue of another oyster.**
- Following steps are taken for the **insertion of nucleus.**
 - a. Fitness of oyster for operation
 - b. Preparation of graft tissues
 - c. Preparation of nucleus
 - d. Insertion of nucleus
 - e. Post operation care

a. Fitness of oyster for operation



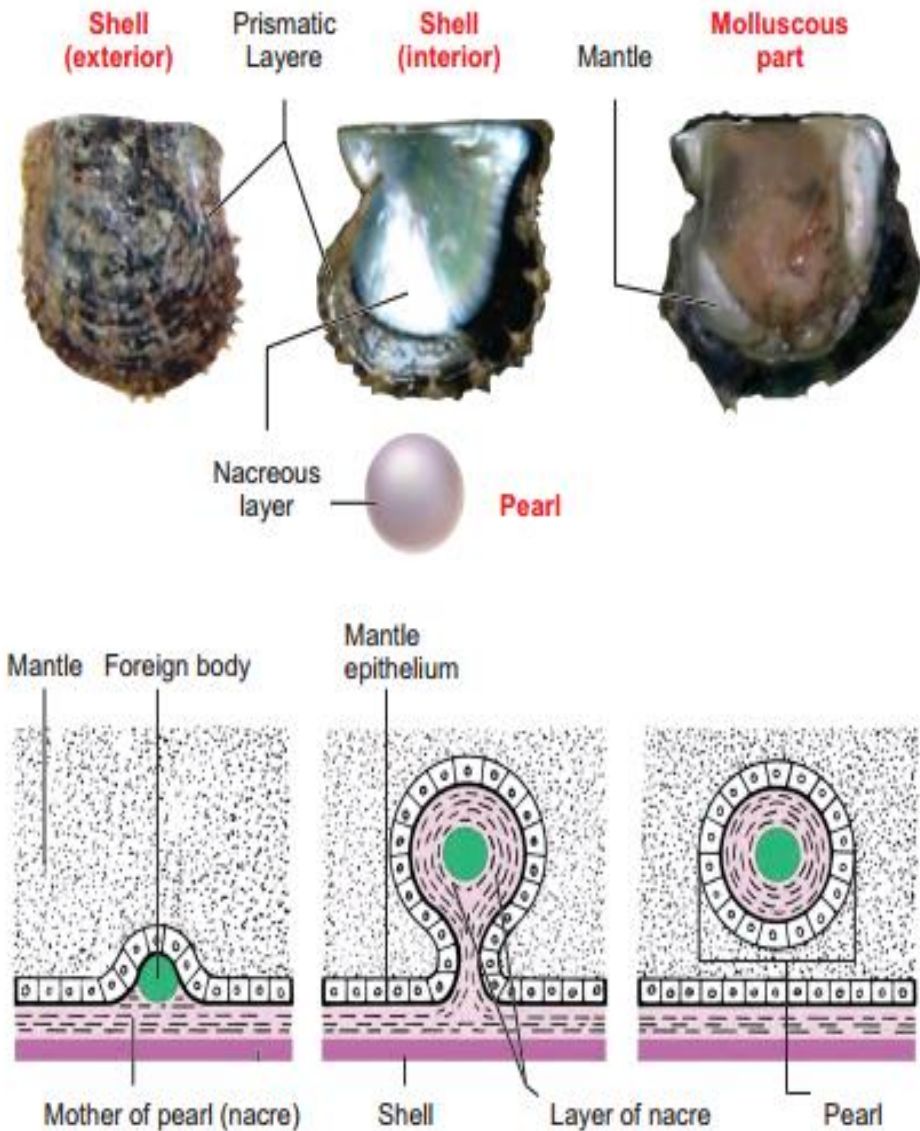
- The selected oysters for the **insertion of nucleus** should be **healthy and strong** enough to overcome the stress during operation.

b. Preparation of graft tissues



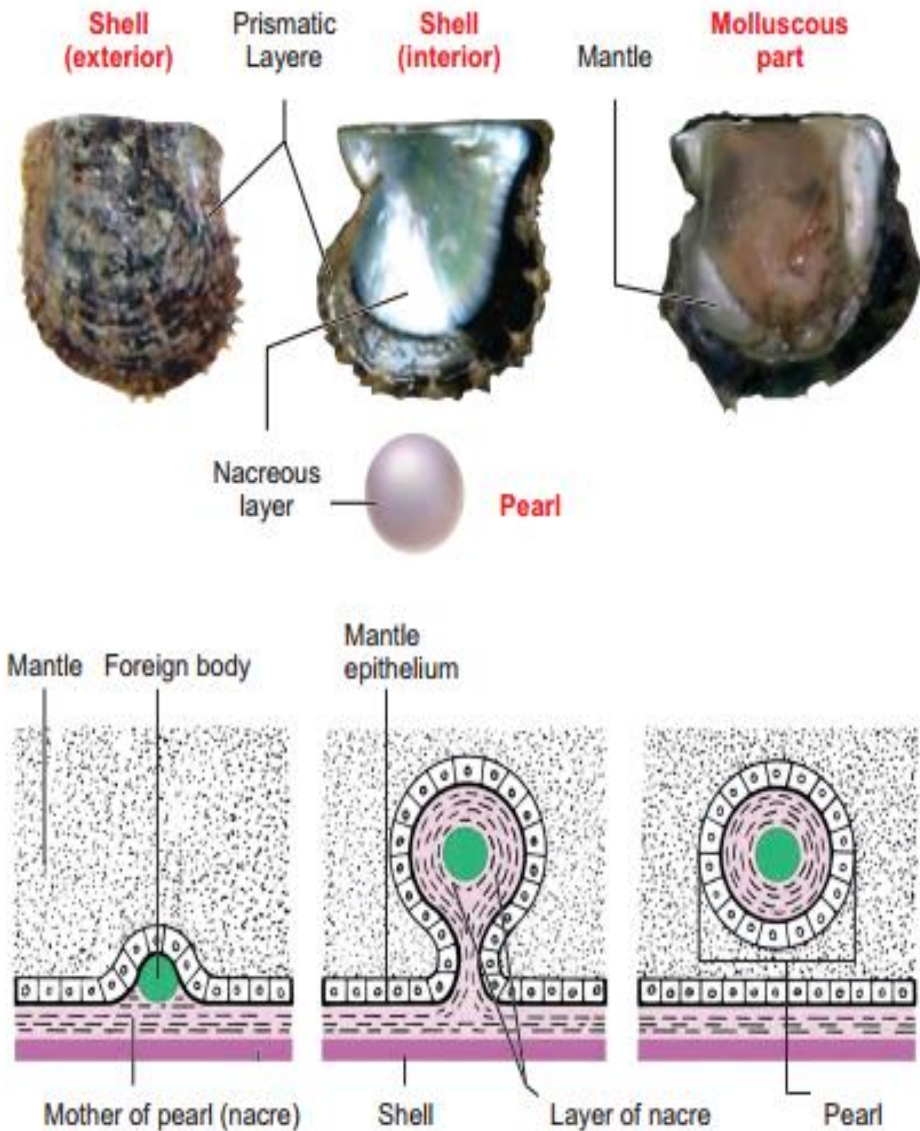
- The piece of tissue which is inserted inside the mantle is called as '**GRAFT**' tissue.
- The outer edges of these graft squares must be known because **nacre secreting cells are found only on the outer surface of the mantle so it is essential to keep the outer surface in contact with the inserted nucleus.**

c. Preparation of nucleus



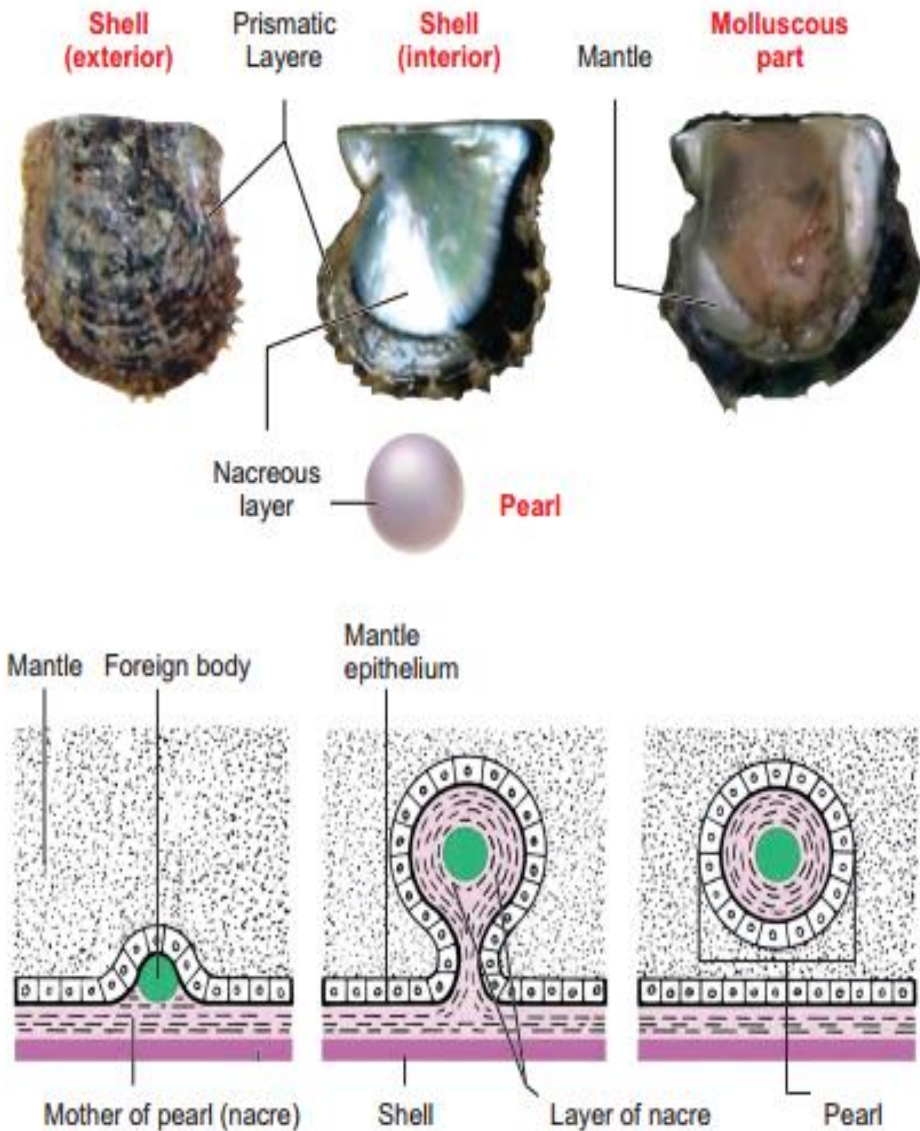
- **Any small particle may function as nucleus to initiate the pearl formation but it is reported that **calcareous nucleus is the best because the deposition of nacre was found to be more on calcareous nucleus.****

d. Insertion of nucleus



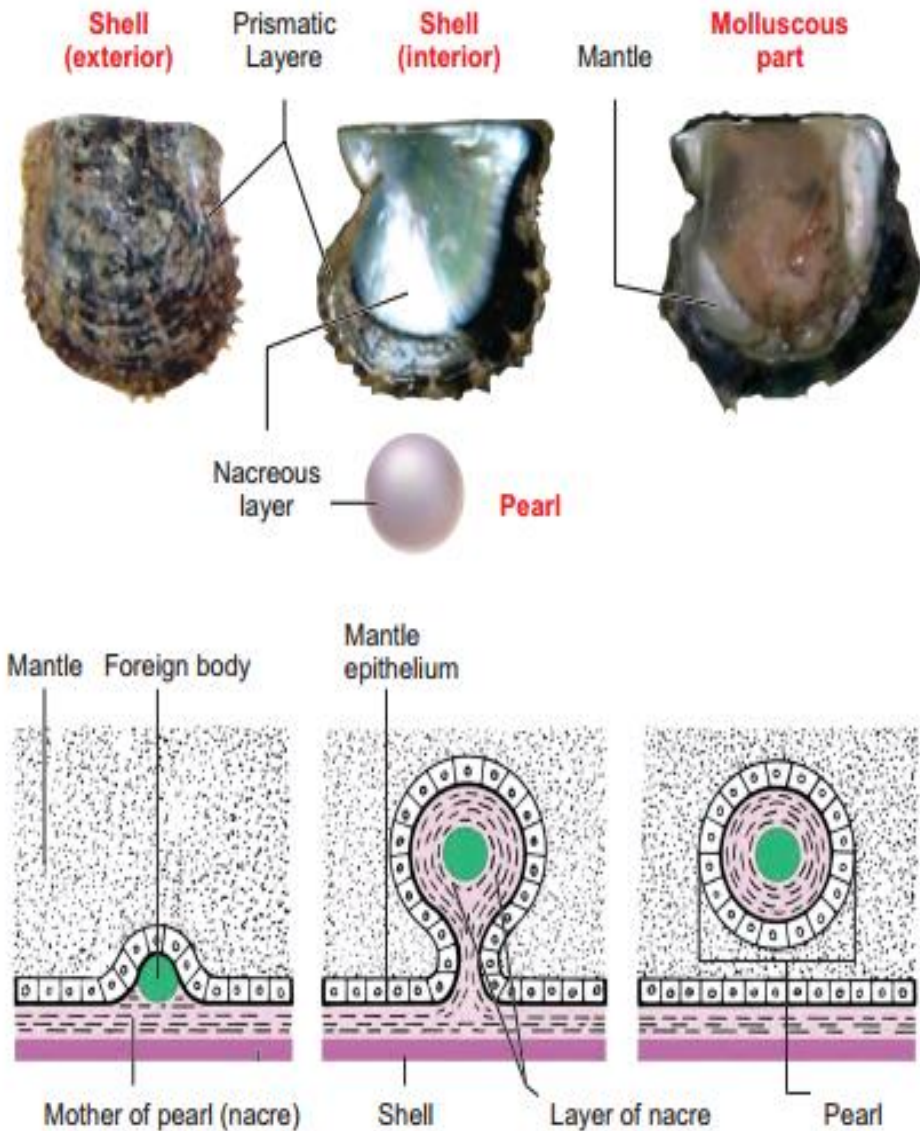
- For the insertion of nucleus, **oysters are fixed in a desk clamp in the position of right valve facing upward.**
- Mantle folds are smoothly touched to expose the foot and the main body mass, followed by an incision into the epithelium of the foot and a slender channel into the main mass one graft tissue which functions as a bed for the nucleus.

e. Post operation care



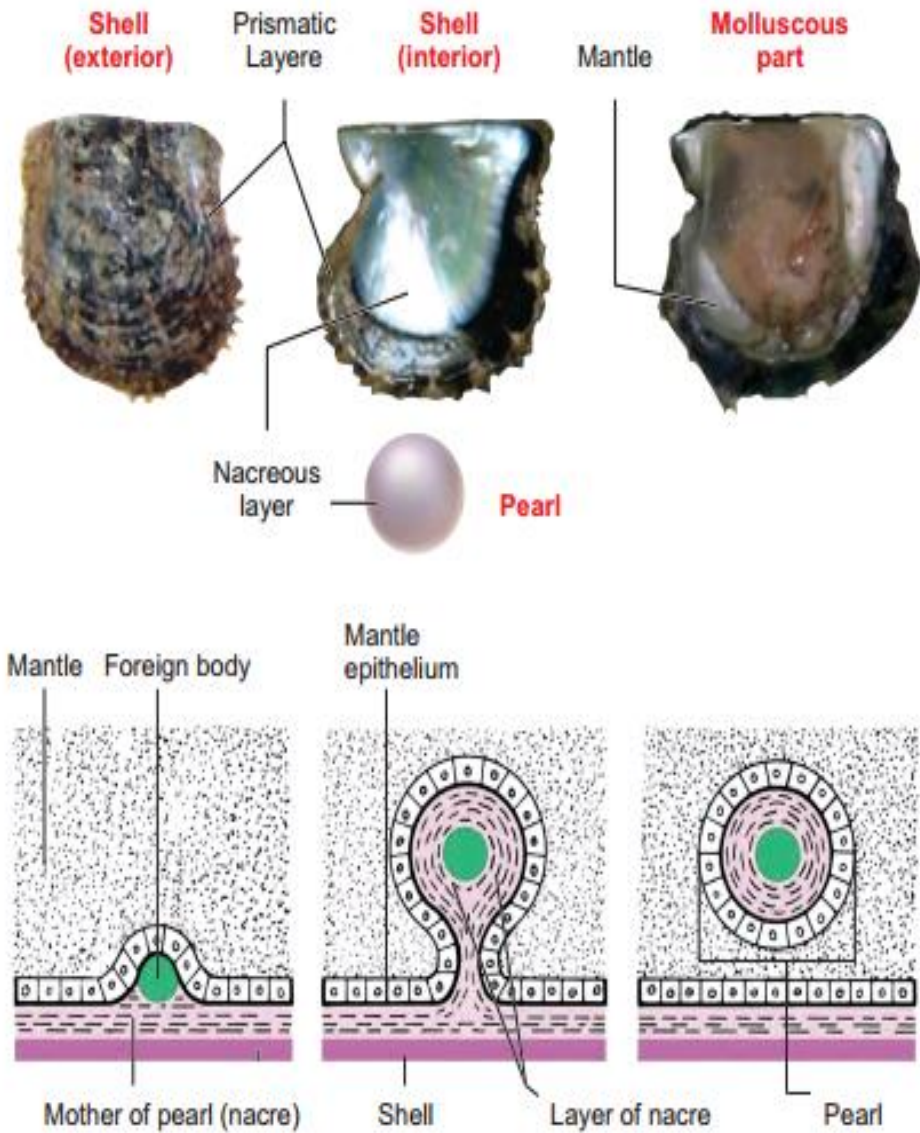
- Nucleated oysters are placed into cages and suspended into sea water and attached with floating rafts to a **depth of 2 to 3 metres** for about **6 to 7 days** to recover from the shocks due to operation.
- This **period of 6 to 7 days** is known as ‘**Recovery period**’.
- About **3000 to 3600 nucleated oysters** are kept in different cages suspended in sea water at **2 to 3 meters depth** for **3 to 6 years** and undisturbed except at the time of clearing and inspection.

4. Harvesting of pearl



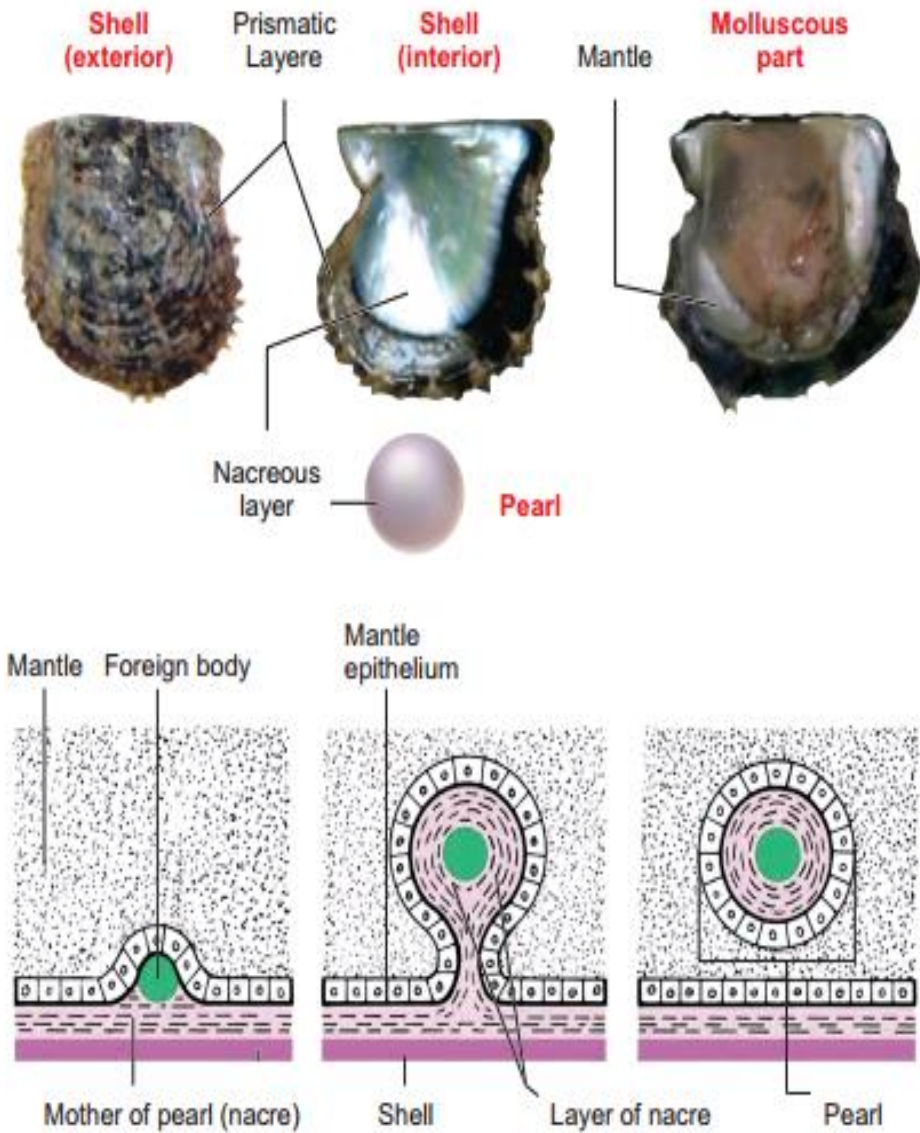
- Pearls are harvested in the month of **December to February** which may **slightly vary according to climatic conditions.**
- After the **completion of 3 years of the insertion of nucleus,** pearl oysters are harvested from the sea and the **pearls are taken out from the shell.**

5. Clearing of pearls



- After taking out the pearls from the oysters shell they are **washed properly, cleared with the soap solution.**

Composition of pearl



- Pearl comprises of **water, organic matter, calcium carbonate and the residue.**

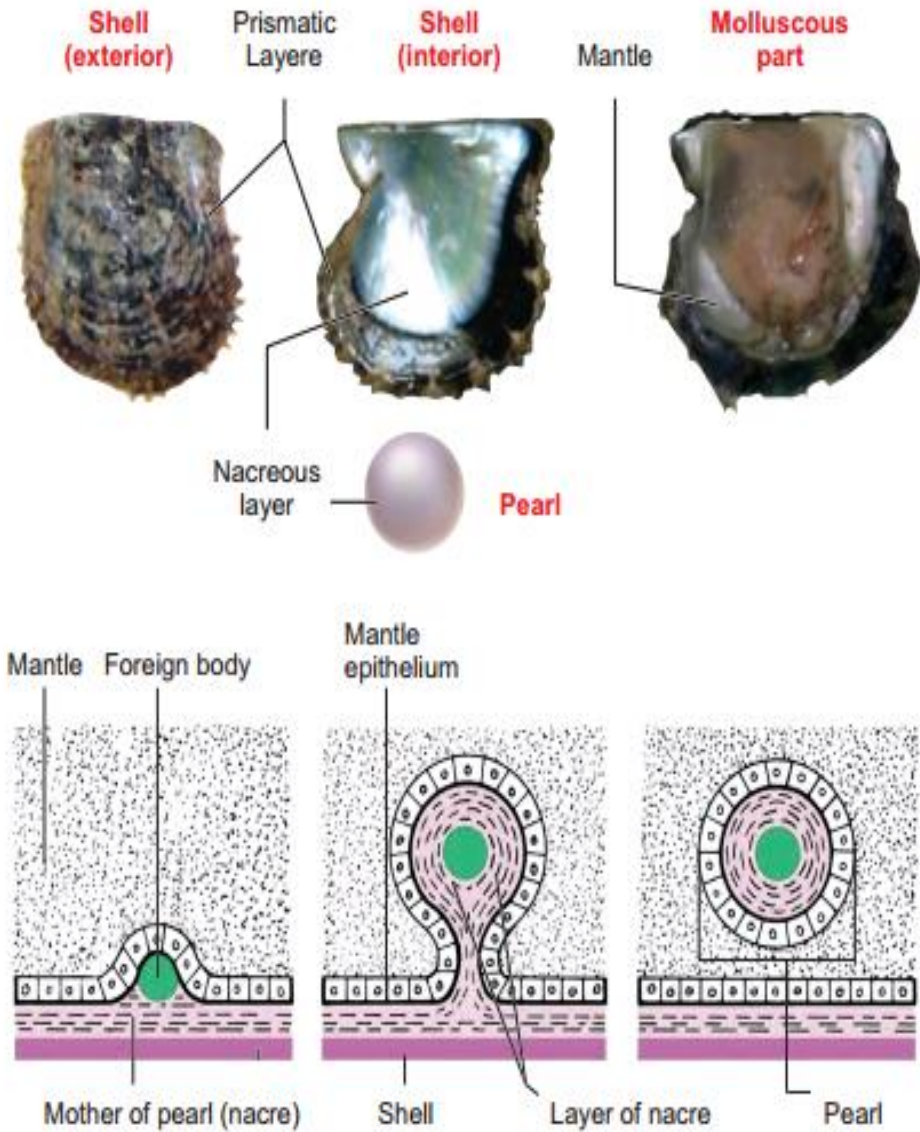
(1) **Water: 2-4%**

(2) **Organic matter: 3.5-5.9%**

(3) **Calcium carbonate: 90%**

(4) **Residue: 0.1-0.8%**

Quality of pearl



- The pearls obtained are of **variable shapes and sizes**.
- They may be **white**, or **cream red** or **pink red** in colour.
- The **spherical pearls of rainbow colour** are rarely found.
- The **best quality of pearl is obtained from marine oysters**.
- Pearl obtained from **freshwater bivalves** are not as valuable as those obtained from the **marine oysters** (Mishra, 1961).

Animal Husbandry and Management



- Animal husbandry is the practice of breeding and raising livestock cattles like **cows, buffaloes, and goats and birds etc.** that are **useful to human beings.**
- Parameters such as **adequate ventilation, temperature, sufficient light, water and proper housing accommodation** should be taken into account to **maintain dairy and poultry farms.**
- Animals should be **cared and protected from diseases.**
- Records should be maintained after the **regular visits by Veterinarian.**
- More over the **selection of good breeds** with high yielding potential combined and resistance to diseases is very important.

Animal Breeding

- **Human beings** have been **depending on animals and animal products** for food from very early times.
- Generally **high yielding animals produced by hybridization** are reared in **poultry and dairy farms**.
- In earlier days, animals were produced and **selected based on specific characters**.
- With the **gain in knowledge on the principles of heredity and genetics**, human beings have been successful in rearing animals with the superior qualities through hybridization experiments.
- **Complex issues are faced by the animal breeder** during hybridization experiments.
- Hence animals with **maximum desirable characters should be selected**.

Animal Breeding

- A group of animals related by descent and with similar characters like **general appearance, features, size etc.**, are said to belong to a breed.
- Why should we breed animals?
- Through animal breeding, **improved breeds of animals can be produced by improving their genotype through selective breeding.**

Objectives of Animal breeding

1. To improve **growth rate**
2. Enhancing the **production of milk, meat. Egg etc.,**
3. Increasing the **quality of the animal products**
4. Improved **resistance to diseases**
5. Increased **reproductive rate**

Methods of Animal breeding

- There are **two methods of animal breeding**, namely

1. Inbreeding

2. Outbreeding

1. Inbreeding

- Breeding between animals of the **same breed for 4-6 generations** is called **inbreeding**.
- Inbreeding increases **homozygosity and exposes the harmful recessive genes**.
- Continuous inbreeding **reduces fertility and even productivity**, resulting in “**inbreeding depression**”.
- This can be avoided by breeding selected animals of the breeding population and they should be **mated with superior animals of the same breed but unrelated to the breeding population**.
- It helps to **restore fertility and yield**.

2. Outbreeding

- The breeding between **unrelated animals is called outbreeding.**
- Individuals produced do not have **common ancestors for 4-6 generations.**
- Outbreeding helps to **produce new and favourable traits**, to produce hybrids with **superior qualities**
and helps to create new breeds.
- **New and favourable genes can be introduced** into a population through outbreeding.

i. Out crossing

- It is the breeding between **unrelated animals of the same breed but having no common ancestry.**
- The offspring of such a cross is called **outcross.**
- This method is suitable for breeding animals **below average in productivity.**

ii. Cross breeding

- Breeding between a **superior male of one breed with a superior female of another breed.**
- The cross bred progeny has **superior traits** (hybrid vigour or heterosis.)

iii. Interspecific hybridization

- In this method of breeding mating is between **male and female of two different species.**
- The progeny obtained from such **crosses are different from their parents, and may possess the desirable traits of the parents.**
- **Have you heard about Mule?**
- It was produced by the **process of interspecific hybridization between a male donkey and a female horse.**

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Controlled breeding experiments

Artificial insemination

- **Artificial insemination is a technique in which the semen collected from the male is injected to the reproductive tract of the selected female.**
- **Artificial insemination is economical measure where fewer bulls are required and maximum use can be made of the best sire.**

Thawing

Thawing means to melt or become liquid. When the semen collected for artificial insemination is taken to far off places/stored for a long time in frozen condition it should be brought to room temperature slowly before use. This process is called thawing.

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Advantages of artificial insemination

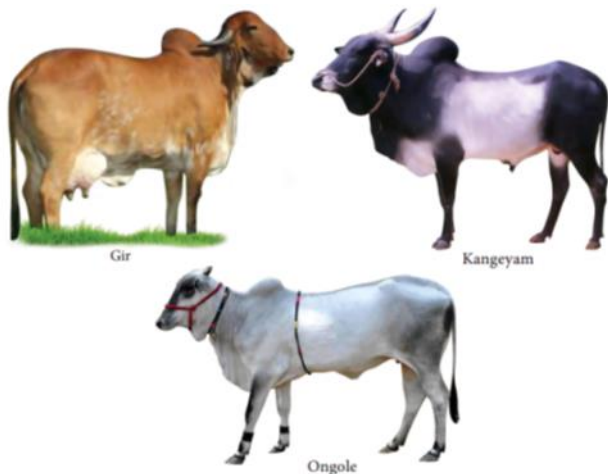
1. It increases the **rate of conception**
2. It **avoids genital diseases**
3. Semen can be **collected from injured bulls** which have desirable traits.
4. **Superior animals** located apart can be bred successfully.

Multiple ovulation embryo transfer technology (MOET)

- It is **another method of propagation of animals with desirable traits.**
- This method is applied when the **success rate of crossing is low even after artificial insemination.**
- In this method **Follicle stimulating hormone (FSH) is administered** to cows for inducing follicular maturation and super ovulation.
- Instead of one egg per cycle, **6-8 eggs can be produced by this technology.**
- The **eggs are carefully recovered non-surgically from the genetic mother** and fertilized artificially.
- The embryos **at 8-32 celled stages** are recovered and **transferred to a surrogate mother.**
- For another round of ovulation, the same genetic mother is utilized.
- This technology can be applied to **cattle, sheep and buffaloes.**
- Advantage of this technology is to **produce high milk yielding females and high-quality meat yielding bulls in a short time.**

Breeds of Dairy animals

- **Dairying is the production and marketing of milk and its products.**
- **Dairy operation consists of proper maintenance of cattle, the collection and processing the milk and its by products.**
- **There are 26 well defined breeds of cattle and 6 breeds of buffaloes in India.**
- **Cattles are classified under three groups based on the purpose they serve to man. They are**



i. Dairy breeds or Milch breeds

ii. Draught purpose breeds

iii. Dual Purpose breeds

i. Dairy breeds or Milk breeds



Gir

- They are **high milk yielders** with **extended lactation**.
- Eg.,
 1. Sindhi
 2. Gir
 3. Sahiwal
 4. Jersey
 5. Brown Swiss
 6. Holstein cattle.

ii. Draught purpose breeds



Kangayam

- Bullocks are good for **draught purpose**.
- Eg. **1. Kangayam**
2. Malvi

iii. Dual Purpose breeds

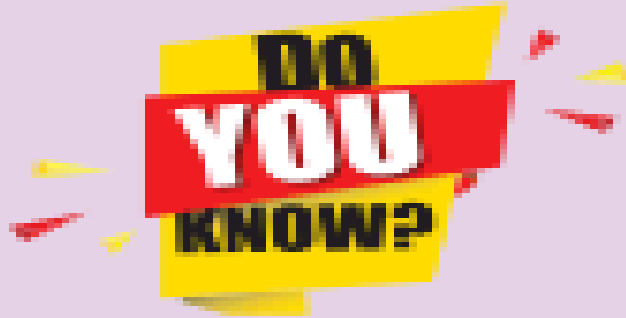


- Cows are meant for **yielding more milk** and bullocks are used for **better drought purpose.**
- Eg. **1. Ongole**
2. Hariana

Breeds of Dairy animals

- To meet the **milk demand of the growing population**, milk breeds are **preferred by farmers in small scale farms**.
- **Goats are also used** all over India for supplementing deficiencies in **milk production**.
- Some of the breeds of cattle that are **good milkers** are
 1. **Jamunapari in Ganga-Jamuna riverine tracts**
 2. **Beetal in Punjab**
 3. **Bar-bari in Uttarpradesh.**

Breeds of Dairy animals



Vechur breed is the smallest breed of Cow as per World Guinness Records.

Average length: 124cms

Average height: 87 cms

Origin: Vechur village, Kottayam District of Kerala

It produces large amount of milk in relation to the food consumption

Common diseases of cattle

- A healthy animal **eat, drinks and sleeps well regularly.**
- Healthy cattle appear **bright, alert and active in their movement with a shiny coat.**
- Cattle are **affected by a large number of diseases.**
- Cattle in ill health **appear dull, restless and change posture frequently with drop in milk yield.**
- The main diseases of dairy cattle are **rinderpest, foot and mouth disease, cow pox, hemorrhagic fever, anthrax.**

Uses of dairy products

1. Milk products

2. Meat

3. Land management

4. Manure

1. Milk products

- Milk is produced by dairy animals which is an **emulsion of fat and lactose**.
- Milk also contains **enzymes** which are **destroyed during pasteurization**.
- Milk is a **rich source of vitamin A, B2, B1, and deficient in Vitamin C**.
- Due to its **high nutrition value**, **it serves as a complete food for infants**.
- Dairy products such as **yoghurt, cheese, butter, ice cream, condensed milk, curd, and milk powder** processed from milk make dairy, a highly farming attraction.

2. Meat

- Meat is **rich in protein** and also contains **many minerals** like **iron, zinc, vitamins** and **selenium**.
- It also contains **vitamins** needed for human diet.

3. Land management

- **Grazing of livestock** is sometimes used as a way to **control weeds and undergrowth**.

4. Manure

- **Manure** can be spread on agriculture fields to **increase crop yields**.

Poultry Farming

- The word poultry refers to the **rearing and propagation of avian species** such as **chicken, ducks, turkeys, geese, quail** and **guinea fowls**.
- The most common and commercially farmed birds are **chicken** and **ducks**.
- Poultry farming is essential for the purpose of **meat, eggs** and **feather production**.
- Commercial poultry farming is also **profitable**.
- In this part we are discussing about an overview of the **chicken** and **duck breeds, farming practices** and its **advantages**.

Types of Chicken breeds

- There are more than **100 breeds**.
- The commonly farmed **chicken breeds are categorized into five based** on the purpose for which it is farmed. They are

1. Egg layers type



Leghorn-Hen and Cock

2. Broiler type



White plymouth rock Hen and Cock

3. Dual type



Light brahma Hen and cock

4. Games type



Silkie

5. Ornamental type



Aseel - Hen and cock

1. Egg layers



Leghorn-Hen and Cock

- These are farmed mainly for the production of egg. Eg: **Leghorn and Chittagong.**

Leghorn:

- This is the **most popular commercial breed in India** and **originated from Italy.**
- They are **small, compact** with a **single comb** and **wattles** with white, brown or black colour.
- They **mature early** and begin to lay eggs at the age of 5 or 6 months.
- Hence these are preferred in **commercial farms.**
- They can also thrive **well in dry areas.**

1. Egg layers



Leghorn-Hen and Cock

Chittagong:

- It is the breed chiefly **found in West Bengal.**
- They are **golden or light yellow** coloured.
- The **beak** is long and yellow in colour.
- Ear lobes and wattles are **small and red in colour.**
- They are **good egg layers** and are **delicious.**

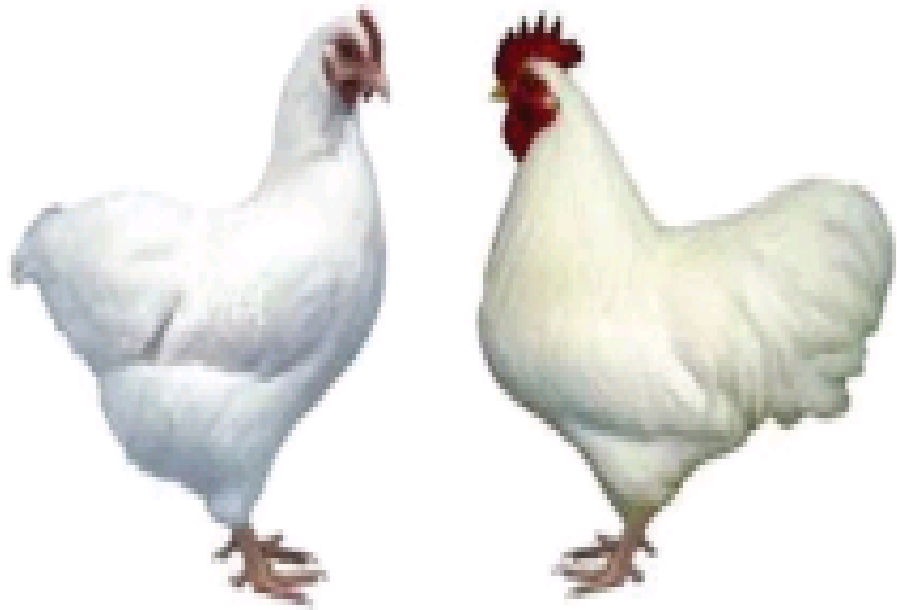
2. Broiler type

- These are well known for **fast growth** and **soft quality meat**.

Eg: **White Plymouth rock**.

White Plymouth rock:

- They have **white plumage** throughout the body.
- It is commonly used in **broiler production**.
- This is an **American breed**.
- It is a **fast growing breed** and well suitable for growing **intensively in confined farms**.



White plymouth rock Hen and Cock

3. Dual purpose breeds



Light brahma Hen and cock

- These are for **both meat and egg production purpose.**

Eg: **Brahma**

Brahma:

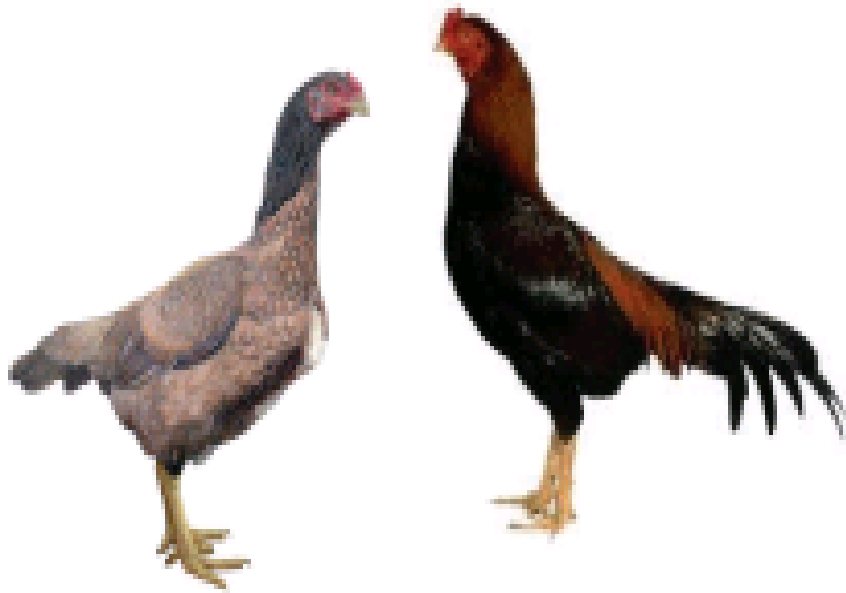
- It is a breed popularly known for its massive body having heavy bones, well feathered and proportionate body.
- **Pea comb** is one of the important breed characters.
- It has **two common varieties** namely, **Light Brahma** and **Dark Brahma.**

4. Game breeds

- Since ancient times, special breed of roosters have been used for the sport of cock fighting. Eg: **Aseel**

Aseel:

- This breed is **white** or **black in colour**.
- The hens are **not good egg layers** but are **good in incubation of eggs**.
- It is found in all states of **India**.
- Aseel is noted for its **pugnacity, high stamina, and majestic gait and dogged fighting qualities**.
- Although **poor in productivity**, this breed is **well-known for their meat qualities**.



Aseel - Hen and cock

5. Ornamental breeds

- Ornamental chicken are reared as **pets** in addition to their use for egg production and meat. Eg: **Silkie**.

Silkie:

- It is a breed of chicken has a **typical fluffy plumage**, which is said to feel like **silk and satin**.
- The breed has numerous additional special characters, such as **black skin and bones**, **blue earlobes**, and **five toes** on each foot, while the majority chickens only have four.
- They are exhibited in poultry shows, and come out in **various colours**.
- Silkies are well recognized for their **calm, friendly temperament**.
- Silkie chicken is especially **simple to maintain as pets**.



Silkie

Types of Poultry farming

- There are different methods used to rear both broiler and layer chicken.
- The types of poultry farming are
 1. Free range farming
 2. Organic method
 3. Yarding method
 4. Battery cage method
 5. Furnished cage method
- Among these, **Battery cage method** is widely used in large scale poultry farms.
- The Free range, Organic and Yarding methods are **eco-friendly** and the eggs produced by such farming practices are preferred in the market.

Stages involved in rearing

- **There are some steps involved in rearing of chicken. They are**

1. Selection of the best layer

2. Selection of eggs for hatching

3. Incubation and hatching

1. Selection of the best layer

- An active **intelligent looking bird**, with a **bright comb**, **not obese** should be selected.

2. Selection of eggs for hatching

- Eggs should be **selected very carefully**.
- Eggs should be **fertile, medium sized, dark brown shelled and freshly laid eggs** are preferred for rearing.
- Eggs should be **washed, cleaned and dried**.

3. Incubation and hatching

- The maintenance of **newly laid eggs in optimum condition till hatching** is called **incubation**.
- The **fully developed chick** emerges out of egg after an **incubation period of 21 – 22 days**.
- There are **two types of incubation** namely **natural incubation** and **artificial incubation**.
- In the **natural incubation method**, **only a limited number of eggs can be incubated** by a mother hen.
- In **artificial incubation**, **more number of eggs can be incubated** in a chamber (Incubator).

3. Brooding

- Caring and management of young chicks for 4 – 6 weeks immediately after hatching is called **brooding**.
- It can also be categorized into **two types** namely **natural** and **artificial brooding**.

4. Housing of Poultry

- To protect the poultry from **sun, rain and predators** it is **necessary to provide housing to poultry.**
- Poultry house should be **moisture - proof, rat proof** and it should be **easily cleanable and durable.**

5 Poultry feeding

- The diet of chicks should contain adequate amount of **water, carbohydrates, proteins, fats, vitamins and minerals.**

Poultry products

- The main products of poultry farming are **eggs and meat**.
- In India, the **primary aim** of poultry farming is to **obtain eggs**.
- The eggs and poultry meat are the **richest sources of proteins and vitamins**.

Poultry byproducts

- The feathers of poultry birds are used for making pillows and quilts.
- Droppings of poultry can be used as manure in fields.
- The droppings are rich in nitrogen, potash and phosphates.
- A number of poultry byproducts like blood-meal, feather meal, poultry byproduct meal and hatchery by-product meal are used as good sources of nutrients for meat producing animals and poultry.
- These byproducts supply proteins, fats, vitamins and good amount of minerals.

Poultry diseases

- **Ranikhet, Coccidiosis, and Fowl pox are some common poultry diseases.**

Benefits of Poultry farming:

- **The advantages of poultry farming are**
 1. **It does not require high capital** for construction and maintenance of the poultry farming.
 2. **It does not require a big space.**
 3. **It ensures high return of investment within a very short period of time.**
 4. **It provides fresh and nutritious food and has a huge global demand.**
 5. **It provides employment opportunities for the people.**

Poultry farming

Chickens communicate with more than 24 vocalizations, each with a distinct meaning, including warning their friends about different types of predators or letting their mothers know whether they're comfortable

Duck Farming

- Duck is an aquatic bird and forms **only 6% of our country's poultry population.**
- There are about **20 breeds of ducks.**
- The native one includes **Indian Runner** and **Syhlet meta.**
- The exotic breeds include **Muscori, Pekin, Aylesbury** and **Campbell.**
- Domesticated ducks have been derived from the **wild duck** named **Mallard** (Anas boscas).
- Farming ducks is profitable as it can be combined with **aquafarming practices.**

Peculiarity of ducks

- The body is fully covered with **oily feathers**.
- They have **a layer of fat under their skin which prevents it from getting wet**.
- They **lay eggs at night or in the morning**.
- The **ducks feed on rice bran, kitchen wastes, waste fish and snails**.

Types of breeds

- There are **three types of ducks** depending on the purpose for which it is formed.
- They are
 1. Meat productive duck breeds
 2. Egg productive duck breeds
 3. Breeds for both meat and egg production

Advantages of duck farming

- They can be reared in **small backyards** where water is available and **needs less care** and **management** as they are very hardy.
- They can **adapt** themselves to **all types of environmental conditions** and are **breed for feed efficiency, growth rate** and **resistance to diseases**.

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