

Trends in Economic Zoology

Chapter Outline

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

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*

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. **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 shall get avenues across the world. Channels like National Geographic, Animal Planet, and Discovery Channel are in constant need of Zoologists for research and documentaries. 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. 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.

12.1 Scope of Zoology

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.

12.2 Vermiculture

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. 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).

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**”. 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.

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. The second group, the humus feeders, are burrowing worms that are useful in making the soil porous, and



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.

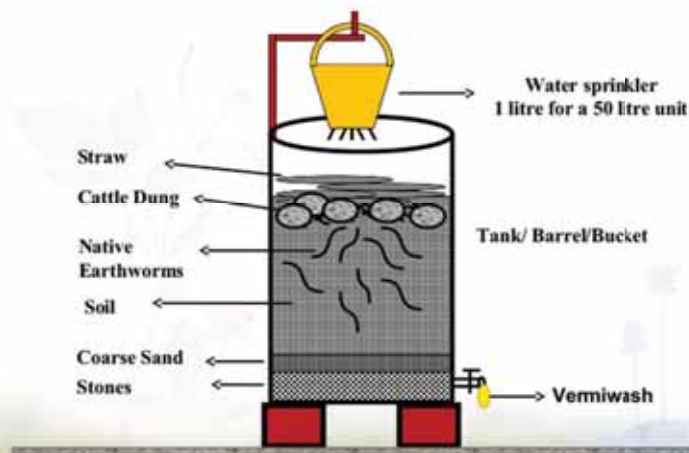


Aristotle

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.



mixing and distributing humus throughout 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. 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 (Figure. 12.1). 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.

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. 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.

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.

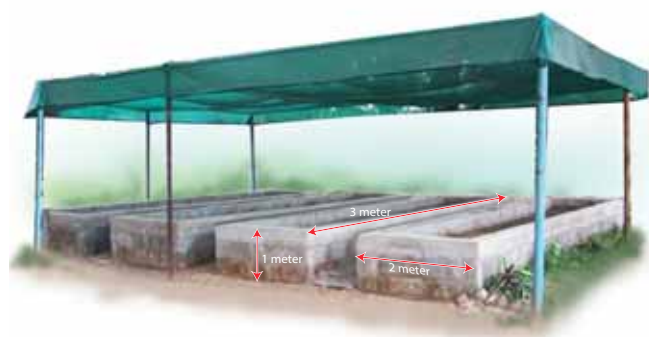


Figure 12.1 Vermiculture unit and Earthworms

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 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. 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.

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

12.3 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

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?

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. 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.

Production of silk from the silk worm, by rearing practices on a commercial scale is called sericulture. It is an agro-based industry comprising three main components: i) cultivation of food plants for the silkworms, ii) rearing of silkworms, and 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 (Table 12. 1 and Figure 12. 2).

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



Mulberry



Eri



Muga



Tassar

Figure 12.2 Different types of silkworms

Table 12.1 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

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. 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. 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.

After 1st, 2nd, 3rd and 4th moultings caterpillars get transformed into 2nd, 3rd, 4th and 5th instars respectively

(Figure 12.3). 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. 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 form 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. 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.

On the basis of the moults which they undergo during their larval life, *B. mori*

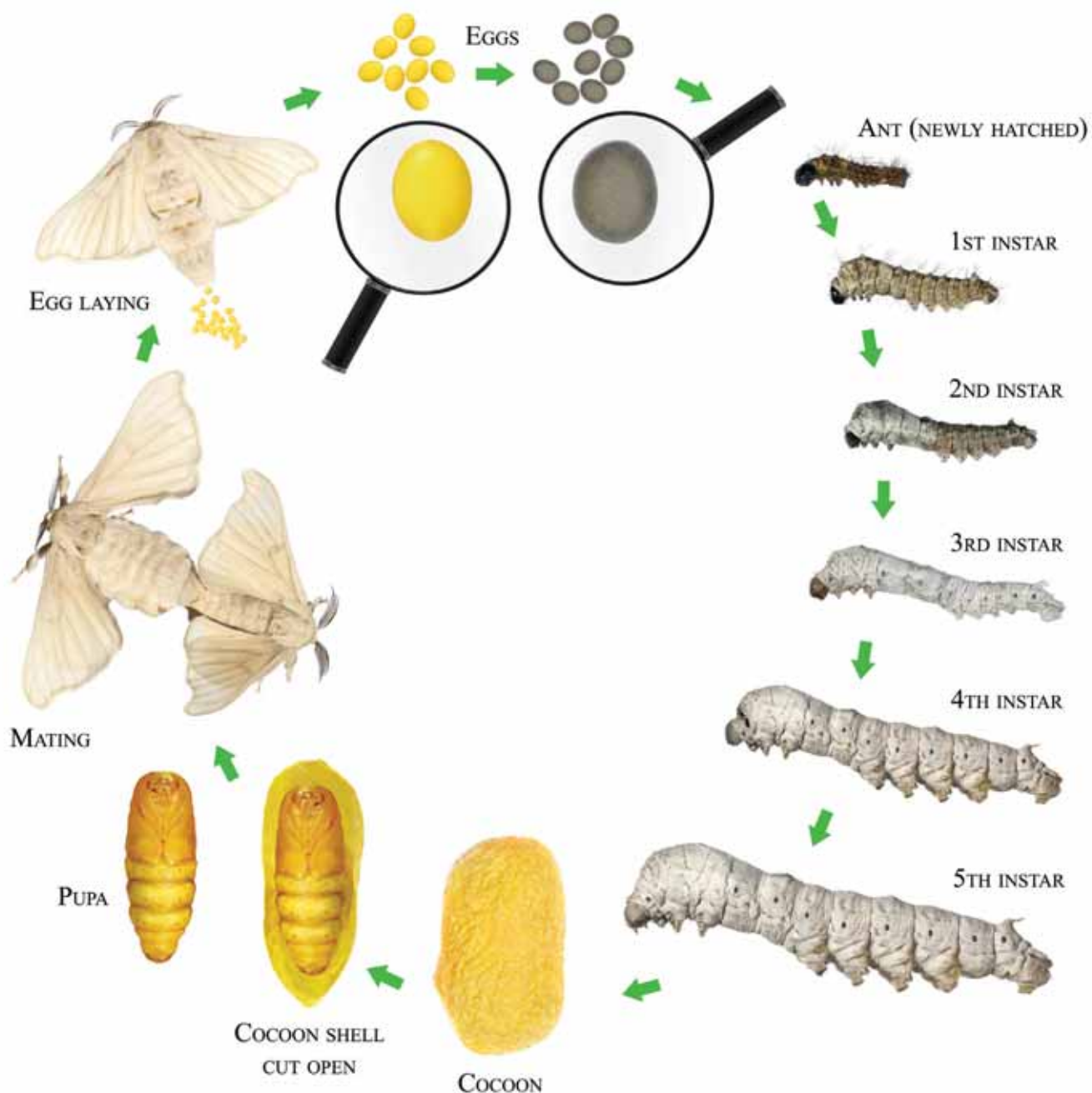


Figure 12. 3 Life cycle of *Bombyx mori*

is divided into three races – tri-moulters, tetra-moulters and penta-moulters. Based on voltinism (the number of broods raised per year), three kinds of races are recognized in mulberry silkworm – univoltines (one brood only), bivoltines (two broods only) and multivoltines (more than two broods).

India has the distinction of producing all the four types of silk i.e. (a) Mulberry silk (91.7%); (b) Tasar silk (1.4%); (c) Eri silk (6.4%); and (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* and 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. The mulberry crop production technology includes land preparation, preparation of cutting, planting techniques, maintenance of mulberry nursery, disease and pest management and 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. Apart from the specified area of the rearing house; the following appliances such as hygrometer, power sprayers, rearing stands, foam pads, wax coated paraffin papers, nylon nets,

baskets for keeping leaves, gunny bags, rotary or bamboo mountages and drier are needed for effective rearing of silkworms. The steps involved in rearing process of silkworm are disinfection of rearing house, incubation of eggs, brushing, young larval rearing and 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. 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 one-half 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.



New silkworm diet produces coloured silk. The Institute of Materials Research and Engineering (IMRE) in Singapore has developed a way to replace the traditional dying 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. 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*.

12.4 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. There are five well recognized types of bees in the world. They are *Apis dorsata* (Rock bee), *Apis florea* (Little bee), *Apis indica* (Indian bee), *Apis mellifera* (European bee) and *Apis adamsoni* (African bee).

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 Queen, Drones and Workers (Figure 12.4). 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.

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. 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.

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. During the first half of her life, she becomes a nurse bee attending to indoor duties such as secretion of royal jelly, prepares bee-bread to feed the larvae, feeds the queen, takes care of the queen



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.

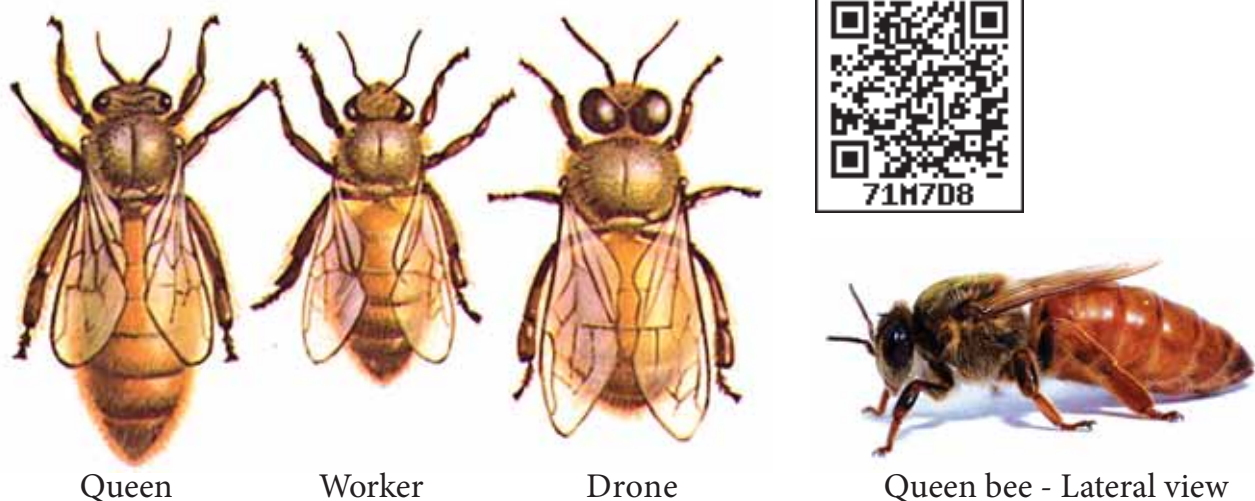


Figure 12.4 Social organization of honey bees

and drones, secrete bees wax, build combs, clean and fan the bee hive.

Then she becomes a soldier and guards the bee hive. In the second half of her life lasting for three weeks, she searches and gathers the pollen, nectar, propolis and water.

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 follow the queen, copulate and die after copulation.

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 (Figure.12.4). The young stages of honey bees accommodate the lower and central cells of the hive called the **brood cells**. In *Apis dorsata*, the brood cells are of similar size and shape but in other species, brood cells are of three types viz., queen cell for queens, worker cell for workers and drone cells for drones (Figure.12.5). 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

The main objective is to get more and more quality honey. There are two methods used by apiculturists. They



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.



Figure 12.5 Structure of a hive showing various cells

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**. The Langstroth bee hive is made up of wood and consists of six parts (Figure 12.6) 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. 3) **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. 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.

Besides the above primary equipments, other accessory equipments are used in beekeeping **Queen Excluder** is utilized to prevent the entry of queen

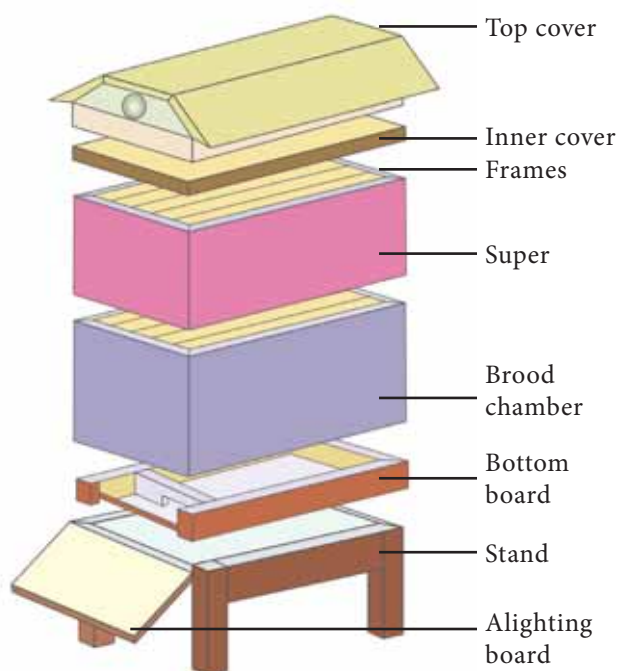


Figure 12.6 - Langstroth bee hive

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. **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. **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 honey and bee wax.

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

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

comb foundation sheets in bee keeping and used in pharmaceutical industries.

12.5 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.

After copulation, the male insect dies. The female develops very rapidly after fertilization and lays about 200 to 500 eggs (Figure. 12. 7). 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. 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

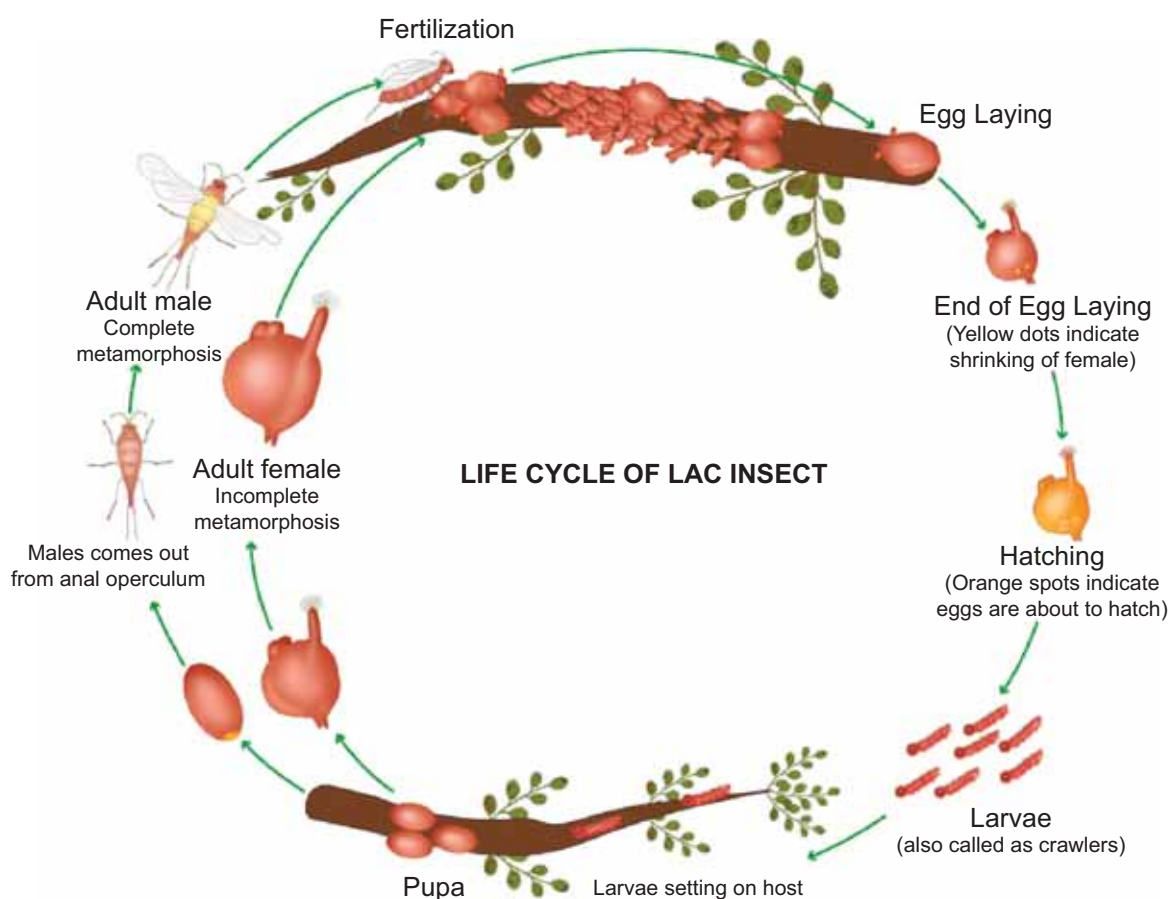


Figure 12. 7 – Life cycle of lac insect

predators of lac insects. The caterpillars of these parasites feed upon lac insects showing hyper-parasitism.



Hyperparasitism - 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.

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. 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

- a. 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.
- b. It is used in preparations of shoe and leather polishes and as a protective coating of wood.
- c. It is used in laminating paper board, photographs, engraved materials and plastic moulded articles.
- d. Used as a filling material for gold ornaments

12.6 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** 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. (ii) **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 (Figure 12. 8) (iii) **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. (iv) **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,

- Growing fish or other aquatic animals and plants together in an integrated system. The fish wastes provides nutrients for the plants and the plants filter the water. Additionally bacteria break down by-products such as ammonia.
- Growing plants in a nutrient solution instead of soil. Fish kept in the water provide the required nutrients.

Write the appropriate scientific terms for above (a) and (b) and differentiate between them..

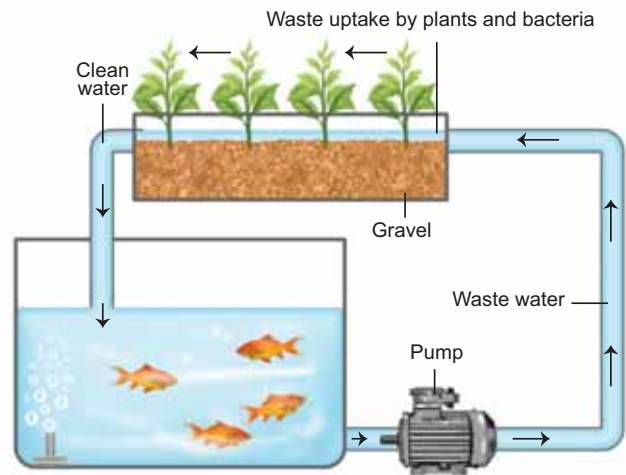
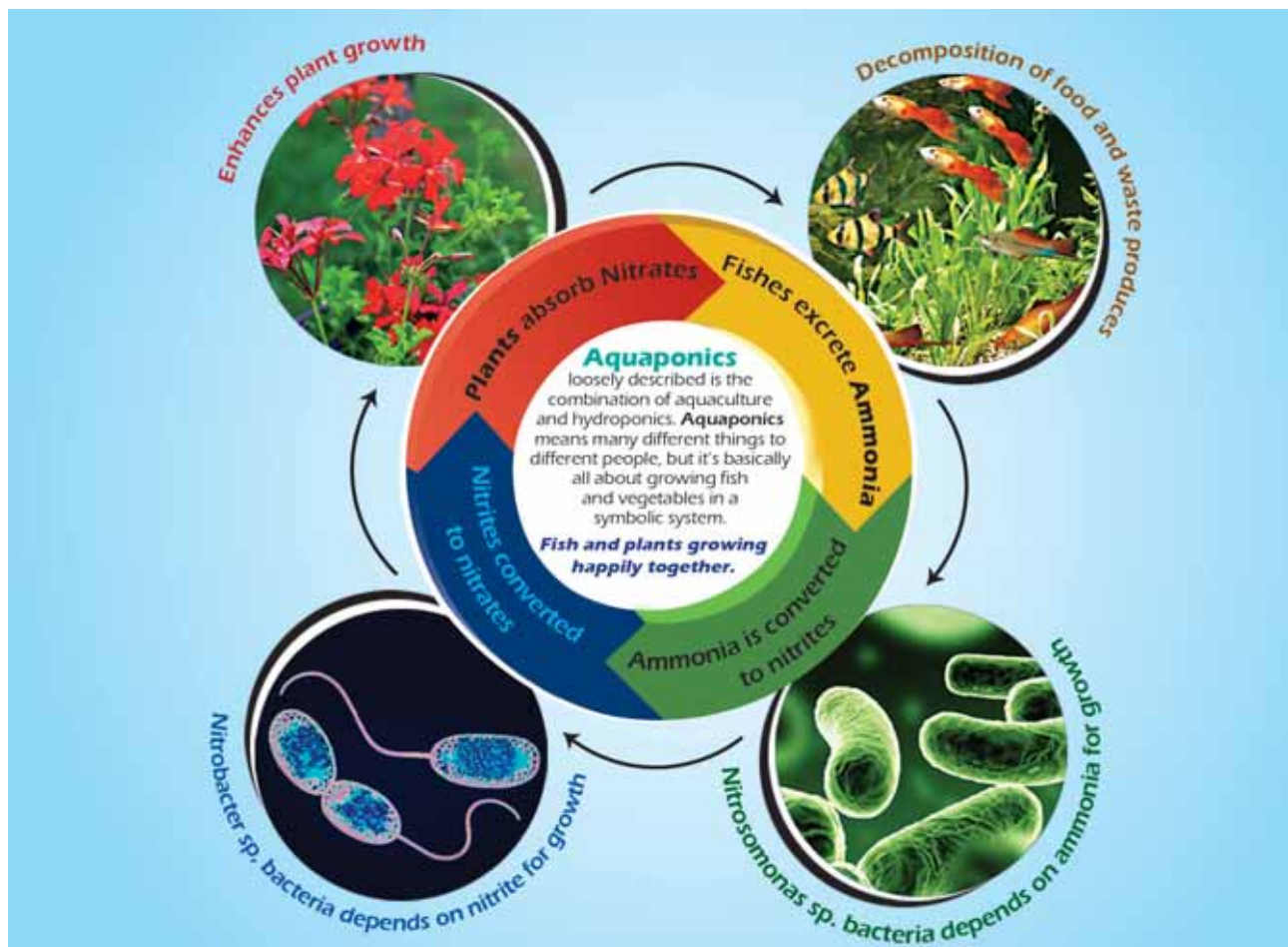


Figure 12.8 Aquaponics – Media based method

strawberries and other crops that do not need supporting solid substratum to grow.

Advantages of Aquaponic gardening

Water conservation: No need of water discharge and recharge as the water is maintained by recycling process.



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

Pesticides: In this system use of pesticides is avoided and hence it is eco-friendly.

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

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.

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

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.

12.7 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**. Culturing of fishes is called fish culture or pisciculture. Inland 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).

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 – 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,

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.

12.7.1 Fish culture

Characteristics of cultivable fishes

The special characteristic features of cultivable fishes are:

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

Types of cultivable fish

Cultivable fish are of 3 types (Figure 12. 9).

- a. Indigenous or native fresh water fishes (Major carps, *Catla*, *Labeo*, *Clarias*)

- b. Salt water fishes acclimatized for fresh water (*Chanos*, Mullet).
- c. Exotic fishes or imported from other countries (Common carps)

Among these, 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 temperature, light rain, water, flood, water current, turbidity of water, pH hardness, salinity and dissolved O₂. Light and temperature also play an important role in fish breeding.

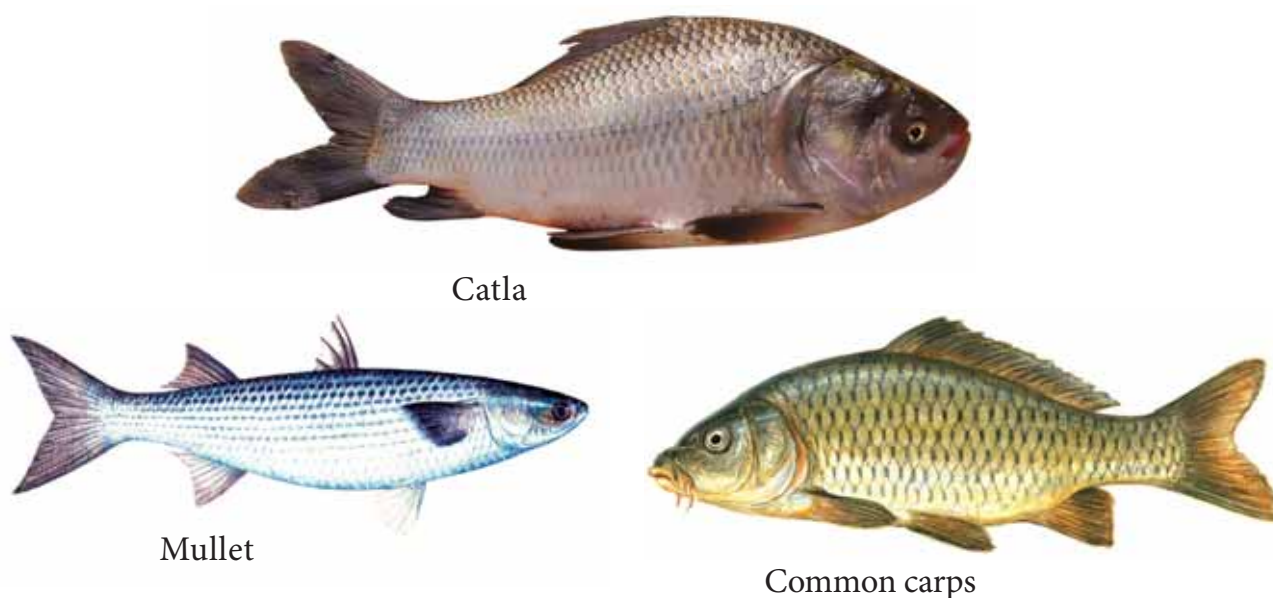


Figure 12. 9 Different types of freshwater cultivable fishes

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.

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

1. Natural breeding (Bund 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.

2. 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 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

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



Figure 12. 10 A fish pond-showing fish breeding hapas

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 (Figure 12.10).

Nursery pond

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

Rearing pond

Fingerlings are transferred to rearing ponds that is long and narrow and allows long distance swimming. The rearing pond should be free from toxicants and predators. Antibiotics are used for washing the fingerlings and then transferred to the stocking ponds.

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 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. The advantages include,

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

Fishes form a rich source of protein food and provide a good staple food to tide over the nutritional needs of man. 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. It is rich in fat such as omega 3 fatty acids. Minerals

such as calcium, magnesium, phosphorus, potassium, iron, manganese, iodine and copper. Some of the fish by-products are;

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 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 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.

Why are fish so efficient at converting feed to flesh?

12.7.2 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 *Penaeus indicus*, *Penaeus monodon*, *Metapenaeus dobsoni* and *Macrobrachium rosenbergii*.

Culture of freshwater prawn

Macrobrachium rosenbergii (Figure 12.11) 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 selection of site, water quality, soil quality and 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

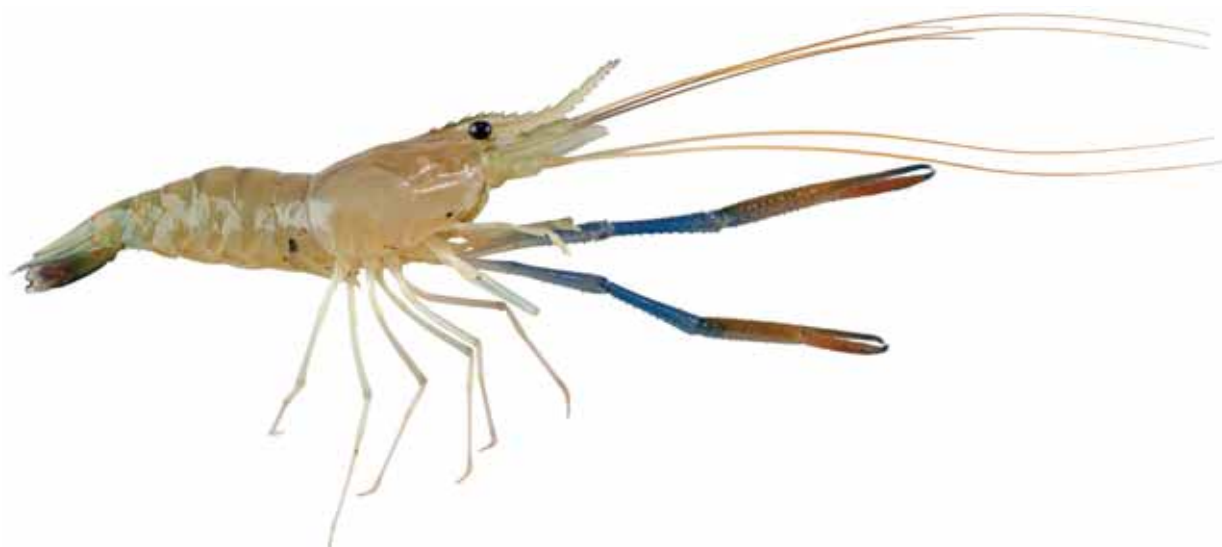


Figure 12. 11 *Macrobrachium rosenbergii*

and barrier nets. Preservation of prawns is done by peeling and deveining or by cooking and peeling.

12.7.3 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. 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.

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

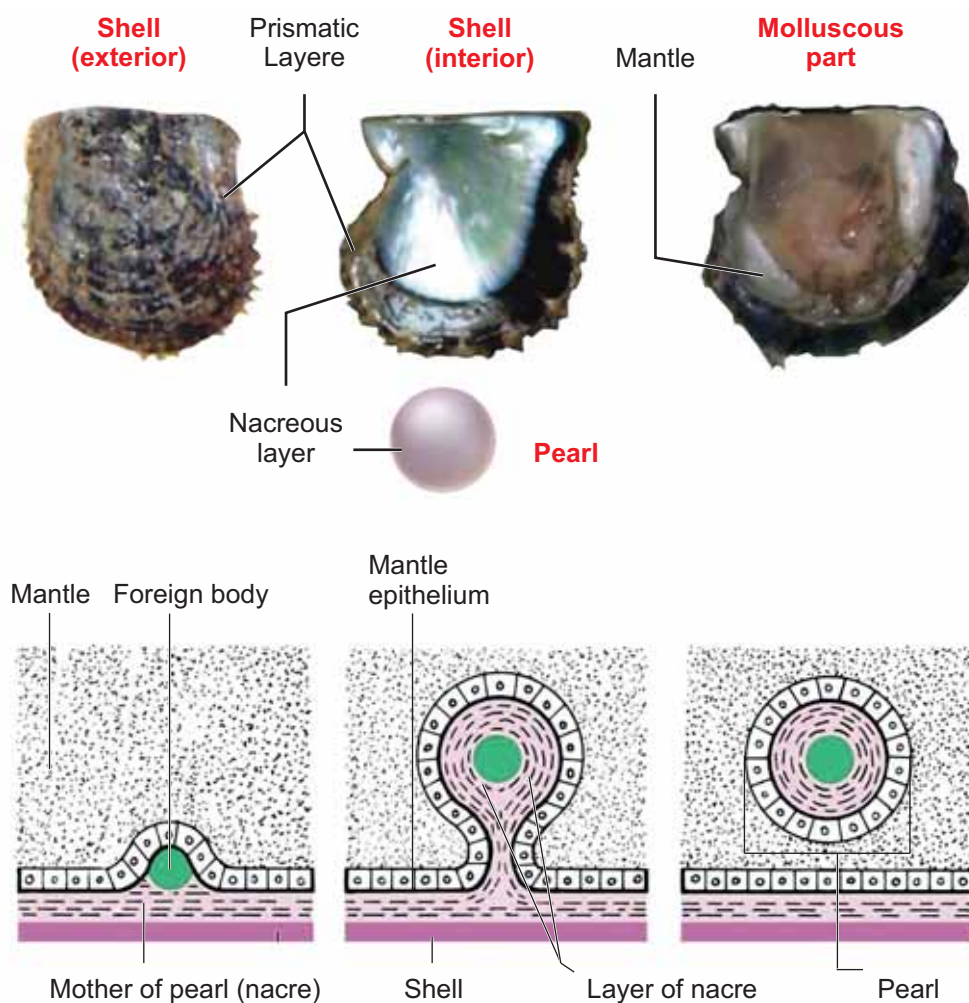


Figure 12.12 Pearl and Pearl Formation

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 (Figure 12. 12).

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.

i. 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 sand-cement 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.

ii. 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.

iii. 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

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 calcarious 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.

iv. 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.

v. 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% carbonate: 90% |

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).

12.8 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.

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:

- a. To improve growth rate
- b. Enhancing the production of milk, meat. Egg etc.,
- c. Increasing the quality of the animal products
- d. Improved resistance to diseases
- e. Increased reproductive rate

Methods of Animal breeding:

There are two methods of animal breeding, namely inbreeding and 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 that are 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.

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 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.

Advantages of artificial insemination

- i. It increases the rate of conception
- ii. It avoids genital diseases
- iii. Semen can be collected from injured bulls which have desirable traits.
- iv. 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 (Figure 12. 13). They are

- i. **Dairy breeds or Milch breeds:** They are high milk yielders with extended lactation. Eg., Sindhi, Gir, Sahiwal, Jersey, Brown Swiss, Holstein cattle.
- ii. **Draught purpose breeds:** Bullocks are good for draught purpose. Eg. Kangeyam, Malvi.
- iii. **Dual Purpose breeds:** Cows are meant for yielding more milk and bullocks are used for better draught purpose. Eg. Ongole, Hariana.



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

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 Jamunapari in Ganga-Jamuna riverine tracts, Beetal in Punjab, Bar-bari in Uttarpradesh.

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



Gir



Kangeyam



Ongole

Figure 12. 13 Different breeds of cattle

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:

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,

India is the largest producer of Milk, globally.

India has many popular indigenous breeds of cows and buffaloes.

Prominent indigenous cow breeds in India - Gir, Red sindhi, Sahiwal, Hallikar, Amritmahal, Khillari, Kangayam, Bargur, Umblachery, Pulikulam, Alambadi, Tharparkar, Haryana, Kankrej, Ongole, Krishna valley and Deoni.

condensed milk, curd, and milk powder processed from milk make dairy, a highly farming attraction.

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.

Land management: Grazing of livestock is sometimes used as a way to control weeds and undergrowth.

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 egg layers, broiler type, dual type, games and ornamental types (Figure 12.14).

1. **Egg layers:** These are farmed mainly for the production of egg.

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.

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.

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.

3. **Dual purpose breeds:** These are for both meat and egg production purpose.

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 cockfighting.

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.

5. **Ornamental breeds:** Ornamental chicken are reared as pets in addition to their use for egg production and meat.

Silkie: It is a breed of chicken has a typical fluffy plumage, which is said to feel like silk and satin. The breed has

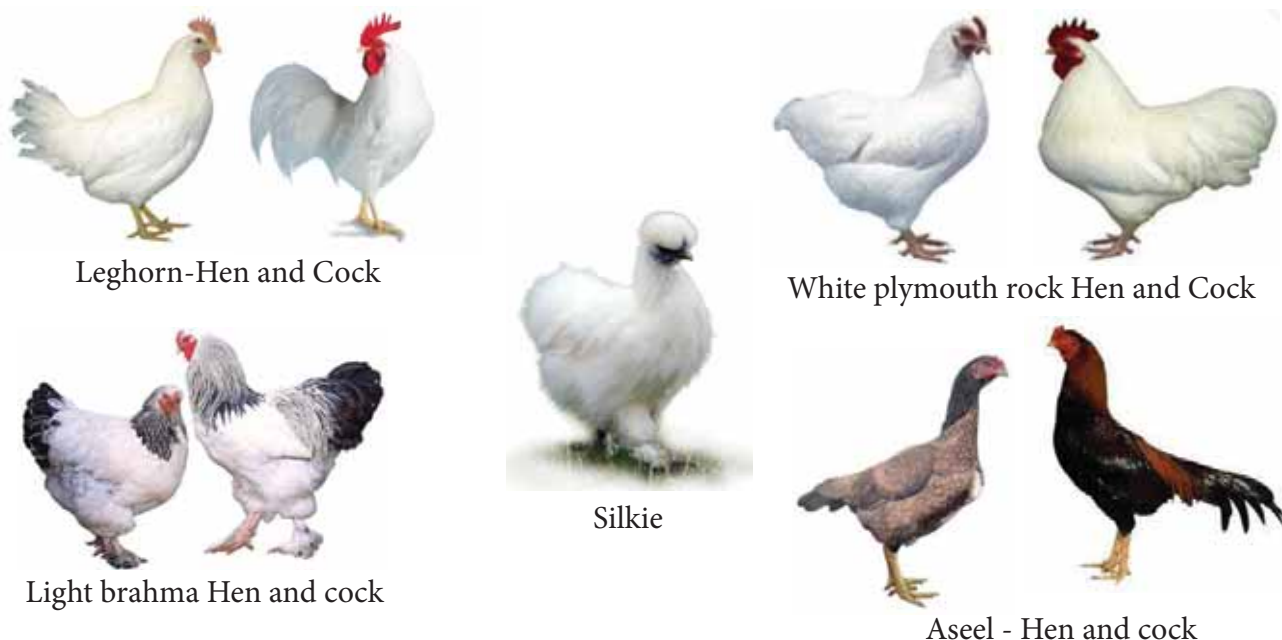


Figure 12. 14 Different types of chicken breeds

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.

Types of Poultry farming: There are different methods used to rear both broiler and layer chicken. The types of poultry farming are Free range farming, Organic method, Yarding method, Battery cage method and 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.

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 by-product 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

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

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 meat productive duck

breeds, egg productive duck breeds, and 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 bred for feed efficiency, growth rate and resistance to diseases.

Summary

Economic Zoology involves the study of application of animals for human welfare. The need of Zoology is to improve our economic condition, to provide food security and employment opportunities. Based on the economic importance, animals can be categorized as animals for food and food products, economically beneficial animals, Animals of aesthetic importance and Animals for scientific research. Vermiculture is the process of using earthworms to decompose organic food waste, into a nutrient-rich material capable of supplying necessary nutrients to sustain plant growth. Sericulture is the production of silk from the silk worm. It is an agro-based industry comprising three main components. They are cultivation of food plants for the silkworms, rearing of silkworms and reeling and spinning of silk. Care and management of honey bees for the production of honey is called Apiculture. Lac is produced by the lac insect.

Aquaponics is a combined technique of aquaculture and hydroponics. It prevents toxic water runoff and also maintains ecosystem balance by recycling the waste and excretory products produced by the fish. Aquaculture deals with the farming of aquatic organisms such as fish, molluscs, crustaceans and aquatic plants. On the basis of water resources, aquaculture can be classified into Freshwater aquaculture, brackish water aquaculture and Marine water aquaculture. It includes culture of fishes, prawn, crab and oyster.

Animal husbandry is the practice of breeding and raising livestock cattles like cows, buffaloes, and goats and birds

Activity

Students can construct their own aquaponic system with materials available in their laboratory. An old aquarium or any water tight container can be converted into simple aquaponics system

Materials Required:

Aquarium tank/ any water tight container, a floating Styrofoam platform (thermocool), growing medium-coconut fibre. An air pump and air stone, nutrient solution (vermiwash or can buy commercially available nutrient solution), plastic cups and seeds

Cut a floating thermocol platform to fit the tank. Make holes on the platform to insert plastic cups with the growing medium. Fill the aquarium tank with water and nutrients. An air pump supplies air to the air stone that bubbles the nutrient solution and supplies oxygen to the roots. Place the floating platform on top of the nutrient solution and place the plastic cups with plants into the holes in the platform

Now your simple hydroponics system is ready... to build a aquaponic system fishes can be introduced into the tank instead of nutrient solution.

etc. that are useful to human beings. Dairying is the production and marketing of milk and its products. Dairy operation consists of proper maintenance of cattle, collection and processing the milk and its byproducts. Poultry refers to the rearing and propagation of avian species such as chicken, ducks, turkeys, geese, quail and guinea fowls. The commonly farmed chicken breeds are categorized into five based on the purpose for which it is farmed. They are egg layers, broiler type, dual type, games and ornamental types.

Glossary

Biological indicator – refers to organisms, species or community whose characteristics show the presence of specific environmental conditions.

Endemism – is the ecological state of a species being unique to a defined geographic location, and not found elsewhere.

Drilosphere – is the part of the soil influenced by earthworm secretions, burrowing and castings.

Brood – a family of birds produced at one hatching or birth.

Hapa – is a cage like, rectangular or square net impoundment placed in a pond for holding fish for various purposes. They are made of fine mesh netting material.

Evaluation

- Which one of the following is not related to vermiculture?
 - Maintains soil fertility
 - Breakdown of inorganic matter
 - Gives porosity, aeration and moisture holding capacity

- Degradation of non biodegradable solid waste
 - a and b is correct
 - c and d is correct
 - b and d is not correct
 - a and c is not correct
- Which one of the following is not an endemic species of earthworm?
 - Perionyx*
 - Lampito*
 - Eudrillus*
 - Octochaetona*
- Match the following
 - Bombyx mori* -
 - Champa - I) Muga
 - Antheraea assamensis* -
 - Mulberry - II) Eri
 - Antheraea mylitta* -
 - Arjun - III) Tassar
 - Attacus ricini* -
 - Castor - IV) Mulberry

Select the correct one.

- A) 1 – b – IV B) 2 – a – I
C) 3 – c – III D) 4 – d – II

- Silk is obtained from
 - Laccifer lacca*
 - Nosema bombycis*
 - Attacus ricini*
 - Attacus mylitta*
- Assertion:** Nuptial flight is a unique flight taken the queen bee followed by several drones.
Reason: The queen bee produces a chemical substance called pheromone. The drones in that area are attracted to the pheromone and then mating takes place.

- a. Assertion and reason is correct but not related
 - b. Assertion and reason is incorrect but related
 - c. Assertion and reason is correct but related
 - d. Assertion and reason is incorrect but not related
6. Rearing of honey bee is called
 - a. Sericulture b. Lac culture
 - c. Vermiculture d. Apiculture
 7. Which of the statement regarding Lac insect is TRUE?
 - a. A microscopic, resinous crawling scale insect
 - b. Inserts its proboscis into plant tissue suck juices and grows
 - c. Secretes lac from the hind end of body.
 - d. The male lac insect is responsible for large scale production of lac.
 8. Aquaponics is a technique which is
 - a. A combination of aquaculture and fish culture
 - b. A combination of aquaculture and hydroponics
 - c. A combination of vermiculture and hydroponics
 - d. A combination of aquaculture and prawn culture.
 9. Prawn belongs to the class
 - a. crustacea b. Annelida
 - c. Coelenterata d. Echinodermata
 10. Pearl oyster belongs to the Class
 - a. Gastropoda b. Cephalopoda
 - c. Scaphapoda d. Pelecypoda
 11. Inland fisheries are
 - a. deep sea fishing
 - b. capturing fishes from sea coast
 - c. Raising and capturing fishes in fresh water
 - d. oil extraction from fish
 12. Induced breeding technique is used in
 - a. Marine fishery
 - b. Capture fishery
 - c. Culture fishery
 - d. Inland fishery
 13. Isinglass is used in
 - a. Preparation
 - b. Clearing of wines
 - c. Distillation of wines
 - d. Preservation of wines
 14. Animal husbandry is the science of rearing, feeding and caring, breeding and disease control of animals. It ensures supply of proper nutrition to our growing population through activities like increased production and improvement of animal products like milk, eggs, meat, honey, etc.
 - a. Poultry production depends upon the photoperiod. Discuss
 - b. Polyculture of fishes is of great importance.
 15. Assertion: The best quality of pearl is known as lingha pearl and obtained from marine oysters.
Reason: Nacre is secreted continuously by the epithelial layer of the mantle and deposited around the foreign particle
 - a. Assertion is true, Reason is false
 - b. Assertion and Reason are false
 - c. Assertion is false But Reason is true
 - d. Assertion and Reason are true

16. Choose the correctly matched pair
 1. Egg layers – Brahma
 2. Broiler types - Leghorn
 3. Dual purpose – White Plymouth rock
 4. Ornamental breeds – Silkie
17. Write the advantages of vermicomposting.
18. Name the three castes in a honey bee colony
19. Name the following
 - i. The largest bee in the colony
 - ii. The kind of flight which the new virgin queen takes along with the drones out of the hive
20. What are the main duties of a worker bee?
21. What happens to the drones after mating flight?
22. Give the economic importance of Silkworm
23. What are the Nutritive values of fishes?
24. Give the economic importance of prawn fishery
25. Give the economic importance of lac insect
26. List any three common uses of shellac.
27. Name any two trees on which lac insect grows.
28. What is seed lac?
29. Define cross breeding.
30. What are the advantages of artificial insemination?

31. Discuss the various techniques adopted in cattle breeding?
32. Mention the advantages of MOET.
33. Write the peculiar characters of duck.

References

1. Shukla, G.S. and Upadhyay V.B (1997) Economics Zoology, Rastogi Publication, Meerut.
2. Shailendra Singh, (2008) Economic Zoology, 1 st Edition, Campus books internationals, New Delhi.
3. Sultan Ismail, S A 1992, The Earthworm Book Other India Press India.

QUESTIONS FOR NATIONAL LEVEL ENTRANCE EXAMS FOR HIGHER STUDIES

COMPILED FROM PMT, AIPMT, NEET, AIIMS AND EXAMS OF SIMILAR KIND

CHAPTR 8 EXCRETION

1. Main function of uriniferous tubules (MP PMT 1990)
 - a. **Concentration of urine**
 - b. Passage of urine
 - c. Reabsorption of useful substances from glomerular filtrate
 - d. Removal of urea and other waste from blood
2. The mechanism of urine formation in nephron involves (CPMT 1992)
 - a. Ultrafiltration
 - b. Secretion
 - c. Reabsorption
 - d. **All of above**
3. Which hormone induced the process of reabsorption from glomerulus? (JKCMM 92)
 - a. Oxytocin
 - b. **Vasopressin**
 - c. Relaxin
 - d. Calcitonin
4. Glucose is reabsorbed from glomerular filtrate through (CBSE 1993)
 - a. **Active transport**
 - b. Passive transport
 - c. Osmosis
 - d. Diffusion
5. Part not belonging to uriniferous tubule is
 - a. Glomerules
 - b. Henle's loop
 - c. Distal convoluted tubule
 - d. **Connecting tubule**
6. The two kidneys lie (MP PMT 1995)
 - a. At the level of ovaries
 - b. At the same level
 - c. **Left kidney at a higher level than the right one**
 - d. Right kidney at a higher level than the left one
7. Which blood vessel takes blood away from kidney? (DPMT 1996)
 - a. Renal portal vein
 - b. **Renal vein**
 - c. Afferent arteriole
 - d. Efferent arteriole
8. Which hormone influences the activity of kidney? (BHU 1996)
 - a. Vasopressin
 - b. Thyroxin
 - c. **Vasopressin and aldosterone**
 - d. Gonadotrophin
9. Excretory product of birds and reptiles is (CPMT 1998)

a. Urea	b. Uric acid
c. Ammonia	d. Creatinin
10. Blood which leaves liver and passes towards heart has higher concentration of (BHU 1999)

a. Bile	b. Oxygen
c. RBCs	d. Urea
11. Urea is transformed through (AIIMS 2000)

a. RBCs	b. WBCs
c. blood plasma	d. All of above
12. A person undergoing prolonged fasting his urine will be found to contain abnormal quantities of (MP PMT 2005)

a. Fats	b. Amino acid
c. Glucose	d. Ketones
13. The net pressure gradient that cause the fluid to filter out the glomerulus into the capsule is (PMT 2005)

- a. 50 mm hg b. 75 mm hg
c. 20 mm hg d. 30 mm hg
14. In ornithine cycle which of the following waste are removed from the blood? (PMT 2005)
 a. CO₂ and urea
 b. Ammonia and urea
c. CO₂ and ammonia
 d. Urea and urine
15. Angiotensinogen is a protein produced and secreted by. (AIPMT 2006)
 a. Juxtaglomerular (JG) cells
 b. Macula densa cells
 c. Endothelial cells of blood vessels
d. Liver cells
16. A person who is in a long hunger strike and is surviving only on water will have (AIPMT 2007)
 a. Less amino acids in his urine
 b. More glucose in his blood
c. Less urea in his urine
 d. More sodium in his urine
17. Uric acid is the chief nitrogenous component of the excretory product of (AIIPMT 2009)
 a. Earthworm **b. Cockroach**
 c. Frog d. Man
18. The principal nitrogenous excretory compound in human is synthesized (AIIPMT 2010)
 a. in kidney but eliminated mostly though liver
 b. in kidney as well as eliminated by kidneys
c. in the liver but eliminated mostly though kidneys
 d. In the liver and also eliminated mostly by the same bile
19. Uricotelic mode of excreting nitrogenous waste is found in (AIIPMT 2011)
a. Reptiles and birds
 b. Birds and annelids
 c. Amphibians and reptiles
 d. Insects and amphibians
20. A fall in glomerular filtration rate (GFR) (AIPMT 2012)
a. Juxtaglomerular cells to release rennin
 b. Adrenal cortex to release aldosterone
 c. Adrenal medulla to release adrenaline
 d. Posterior pituitary to release ADH
21. Haemodialysis is also called as artificial (Har.PMT 2002,)
 a. Liver b. Lung
 c. Heart **d. Kidney**
22. Which one is an accessory excretory organ? (CET 2002)
a. Liver b. Stomach
 c. intestine d. Heart
23. Part of nephron involved in active reabsorption of sodium is (JIPMER 2002/NEET 2016)
 a. PCT
b. Ascending limb of Henle's loop
 c. Bowman's capsule d. DCT
24. Haemodialysis helps the patient having (JIPMER 2004)
 a. Goitre b. Anaemia
c. Uremia d. Diabetes
25. Lungs expel (MH 2005)
 a. CO₂ b. H₂O
 c. CO₂ and water **d. CO₂ and water vapour**

26. The glomeruli are continued to the (CPMT 88)
 a. Medulla b. Calyces
c. Cortex d. Renal Pelvis
27. The kidney of adult mammals is (MP PMT 99)
 a. Opisthonephron
 b. pronephros
 c. Mesonephros
d. Metanephros
28. A kidney stone is (CPMT 88,)
 a. Blockage by fats
 b. Deposition of sand in kidney
c. A salt such as oxalate crystallised in pelvis
 d. Blockage by proteins
29. Which of the following is both osmoregulator as well as nitrogenous product (DPMT 07)
 a. NH_3 **b. Urea**
 c. Uric acid d. All of these
30. Which of these is not a ketone body (CPMT 04)
 a. Acetoacetic acid
 b. Acetone
c. Succinic acid
 d. Betahydroxybutyric acid
31. Excretory organs of cockroach are
 a. Malpighian corpuscles
b. Malpighian tubules
 c. Hepetic caecae
 d. Green glands
32. Juxtaglomerular cells of renal cortex synthesize a hormone called: (BHU 2007)
 a. ADH b. Oxytocin
c. Renin d. Urochrom
33. Which blood vessel carries least amount of urea? (HAR PMT 2005)
 a. Pulmonary vein
 b. renal artery
c. renal vein
 d. Hepatic portal vein
34. Human urine is usually acidic because: (RE-AIPMT 2015)
a. hydrogen ions are activity secreted into the filtrate
 b. the sodium transporter exchanges one hydrogen ion for each sodium ion, in peritubular capillaries
 c. excreted plasma proteins are acidic
 d. potassium and sodium exchange generates acidity
35. Grafted kidney may be rejected in a patient due to (RE-AIPMT 2015)
 a. Innate immune response
 b. Humoral immune response
c. Cell-mediated immune response
 d. Passive immune response
36. Human urine is usually acidic because: (RE-AIPMT 2015)
a. hydrogen ions are actively secreted into the filtrate.
 b. the sodium transported exchanges one hydrogen ion for each sodium ion, in peritubuar capillaries.
 c. excreted plasma proteins are acidic
 d. potassium and sodium exchange generates acidity.
37. In mammals, which blood vessel would normally carry largest amount of urea?

(AIPMT/NEET 2016)

- a. Renal Vein
- b. Dorsal Aorta
- c. **Hepatic Vein**
- d. Hepatic Portal Vein

38. Which of the following statement is correct? (NEET 2017)

- a. The descending limb of loop of Henle is impermeable to water.
- b. The ascending limb of loop of Henle is permeable to water
- c. The descending limb of loop of Henle is permeable to electrolytes.
- d. **The ascending limb of loop of Henle is impermeable to water**

CHAPTER 9

LOCOMOTION AND MOVEMENT

1. Which is the longest bone of fore limb? (CPMT- 2002)

- a. **Humerus**
- b. Femur
- c. Carpals
- d. Fibula

2. In which bone triangular acromion is present? (CPMT- 2002)

- a. Radius
- b. **Scapula**
- c. Femur
- d. Humerus

3. Humerus bone is found: (DPMT- 1985)

- a. Radius
- b. Ulna
- c. **Arm**
- d. Fore arm

4. Hinge joint occurs between: (CPC – 2003)

- a. **Humerus and radio-ulna**
- b. Femur and pelvic girdle
- c. Humerus and Pectoral girdle
- d. Skull and atlas

5. Total number of vertebrae in human skeleton. (JIMERT 2002)

- a. 30
- b. 32
- c. **33**
- d. 35

6. Number of bones present in an arm is: (AFMC – 2004)

- a. **30**
- b. 32
- c. 35
- d. 40

7. Ribs are attached to: (Wardha- 2001)

- a. Scapula
- b. **Sternum**
- c. Clavicle
- d. Ilium

8. In humans, coccyx is formed by the fusion of vertebrae

- a. 3
- b. **4**
- c. 5
- d. 6

9. What is formed by the bones of pectoral girdle, pelvic girdle and limbs? (CPMT- 1987)

- a. Body skeleton
- b. External skeleton
- c. Axial skeleton
- d. **Appendiclr skeleton**

10. Number of floating ribs in human body is: (JIPMER- 2000)

- a. 6 pairs
- b. 5 pairs
- c. 3 pairs
- d. **2 pairs**

11. Ankle joint is: (Pb.PMT- 1997)

- a. Pivot joint
- b. Ball and socket joint
- c. Hinge joint
- d. **Gliding joint**

12. Sarcomere is distance between: (BHU-2001 , RPMT- 2002)

- a. Two I- bands
- b. A and I bands
- c. **Two consecutive Z- lines**

- d. Z and A bands
13. Which is the skull bone?
 a. Atlas b. Femur
 c. Tibia **d. Nasal**
14. How many bones are there in appendicular skeleton? (BV – 2003)
 a. 80 b. 120
c. 126 d. 206
15. Where is hinge joint found? (APMEE- 2002)
 a. Elbow and shoulders
b. Elbow and Knee
 c. Atlas and odontoid process
 d. Knee and ankle
16. Number of ball and socket joints present in human body is:
a. 2 b. 4
 c. 5 d. 8
17. Synovial joints is:
 a. Ball and socket joint
 b. Pivot joint
 c. Hinge joint
d. All the above
18. Give the number of Cranium bones? (JKCMEE – 2005)
a. 8 b. 10
 c. 14 d. 20
19. Cervical vertebrae are located in: (HPPMT – 2005)
 a. Thoracic region
 b. Abdominal region
c. Neck region
 d. Hip region
20. Lumbar vertebrae are located in: (HPPMT – 2005)
 a. region
 b. Thorax
 c. Abdominal region Neck
d. Hip region
21. Ratio of which is more in red muscle? (JIPMER -2002)
a. Myoglobin b. Actin
 c. Myosin d. Albumin
22. Friction is lessened in ball and socket joint by (MPPMT -1990)
 a. Coelomic fluid
b. Synovial fluid
 c. Pericardial fluid d. Mucin
23. Each half of pelvic girdle is made of (MPPMT -1998)
 a. Ischium b. Ilium
 c. Pubis **d. All the above**
24. Extremities of long bones possess cartilage
 a. Calcified b. Fibrous
 c. Elastic **d. Hyaline**
25. Glenoid cavity is found in (A.M.U.–2000)
 a. Pelvic girdle b. Skull
c. Pectoral girdle d. Sternum
26. An example of gliding joints is (MPPMT -1992)
 a. Humerus and glenoid cavity
b. Femur and tibio-fibula
 c. Occipital condyle and odontoid process
 d. Zygapophyses of adjacent vertebrae.
27. During muscle contraction
 a. Size of a-bands remains the same
 b. Size of H-zone becomes smaller
 c. Size of I-bands decreases
d. All the above

28. Substance that accumulates in a fatigued muscle is (Har.PMT 2003)
 a. Pyruvic acid **b. Lactic acid**
 c. CO₂ d. ADP
29. Lack of the relaxation between successive stimuli in sustained muscle contraction is known as (AIPMT /NEET 2016)
 a. Fatigue **b. Tetanus**
 c. Tonus d. Spasm
30. Which ion is essential for muscle contraction? (Pb.PMT 2000)
 a. Na b. K
c. Ca d. Cl₂
31. Ends of long bones are covered by (Bhi.P.M.T-2001)
 a. Ligaments **b. Cartilage**
 c. Muscles d. Blood cells
32. Acromion process is part of (B.V. 2003)
 a. Vertebral column
 b. Pelvic girdle
 c. Femur
d. Pectoral girdle
33. In mammals the lower jaw is made of
 a. Maxilla b. Dentary
c. Mandible d. Ethmoid
34. Inter-articular disc occur in (B.H.U. -1997)
 a. Wall of heart
 b. Wall of liver
 c. Pubic symphysis
d. In between two vertebrae
35. Acetabulum is part of (C.E.T. chd. 2000)
a. Pelvic girdle
 b. Pectoral girdle
 c. Form arm
 d. Upper arm
36. The functional unit of contractile system of a striated muscles is (C.M.E.E.-2004)
a. Sarcomere b. Z-band
 c. Cross bridge d. Myofibril
37. Fibrous joints are present between (M.P.P.M.T. -2000)
 a. Thumb and metatarsal
 b. Humerus and radio-ulna
c. Bones of skull
 d. Glenoid cavity and pectoral girdle
38. Joint of sternum and ribs is
a. Cartilaginous
 b. Fibrous joint
 c. Angular joint
 d. Hinge joint
39. During vigorous exercise, glucose is converted into (C.P.M.T.- 2000)
 a. Glycogen b. pyruvic acid
 c. Starch **d. Lactic acid**
40. Synovial fluid is present in (Har. P.M.T. – 2000)
 a. Spinal cavity
 b. Cranial cavity
c. Freely movable joints
 d. Fixed joints
41. Synovial fluid is secreted by (B.V.-2001)
 a. Blood b. Cartilage
 c. Bone **d. Synovial membrane**
42. Iliac of pelvic girdle is articulated with sacrum for (B.H.U-2001)
a. Bending b. Jumping
 c. Support d. Running
43. Anisotropic band are made up of (A.M.U.- 2001)
 a. Myosin filaments
 b. Actin filaments

- c. Elastin filaments
d. Both A and B
44. Socket in pelvic girdle in which head of femur articulates is formed by fusion of
 a. Ischium and pubis
 b. Ilium and pubis
c. Ilium and ischium
 d. Both a and b
45. The movable skull bone is
 a. Maxilla b. Vomer
c. Mandible d. All the above
46. Gliding joint occur between (B.V. – 2002)
 a. Prezygapophysis and postzygapophysis
 b. Acetabulum and femur
 c. Pelvis girdle and femur
d. Humerus and radius.
47. Red muscle are rich in (J.I.P.M.E.R.-2002)
 a. Golgi bodies
b. Mitochondria
 c. Lysosomes
 d. Ribosomes.
48. Joint between atlas and axis is (A.F.M.C. – 2003)
a. Pivot b. Hinge
 c. Angular d. Saddle
49. The longest bone amongst the following is (B.V – 2003)
 a. Radius b. ulna
 c. Humerus **d. Femur**
50. Joint between metacarpals and phalanges is (B.V – 2003)
 a. Ball and socket b. Pivot
 c. Saddle **d. Hinge**

51. ATP-ase needed for muscle contraction is present over
 a. Actin b. Troponin
c. Myosin d. Actin

52. Make correct pairs from the column - I and column – II. (Odisha JEE – 2010)

Column -I	Column – II
Types of synovial joint	Bones involved
(P) Ball and socket	(i) Carpal and metacarpal of thumb
(Q) Hinge	(ii) Atlas and axis
(R) Pivot	(iii) Frontal and parietal
(S) Saddle	(iv) Knee
	(v) Humerus and pectoral girdle

- a. (P-ii) (Q-iv) (R-ii)(S-v)
 b. (P-ii) (Q -iii) (R- i) (S – v)
 c. (P-iii)(Q-v) (R-iv)(S-ii)
d. (P-v) (Q -iv) (R- ii) (S – i)
53. Major protein in the thick filament of skeletal muscle fiber is (MP PMT 2011)
 a. Tropomyosin **b. Myosin**
 c. Actin d. Troponin
54. True joints are (Wardha 2005)
a. Synchondroses b. Syndesmoses
 c. Synovial d. Ball and socket
55. The pivot joint between atlas and axis is a type of (NEET-2016)
 a. cartilaginous joint
b. synovial joint
 c. saddle joint
 d. fibrous joint
56. Name the ion responsible for unmasking of active sites for cross-bridge activity during muscle contraction (NEET-2016)
 a. sodium b. potassium
c. calcium d. magnesium

57. Sliding filament theory can be best explained as (NEET 2015)
- when myofilaments slide pass each other actin filaments shorten while myosin filaments do not shorten
 - actin and myosin filaments shorten and slide pass each other
 - actin and myosin filaments do not shorten but rather slide pass each other**
 - when myofilaments slide pass each other myosin filaments shorten while actin filaments do not shorten
58. Osteoporosis is an age related disease of skeletal system, may occur due to (NEET 2016)
- decreased level of oestrogen**
 - accumulation of uric acid leading to inflammation of joints
 - immune disorder affecting neuromuscular junction leading to fatigue
 - high concentration of Ca^{++} and Na^{++}
59. Smooth muscles are (Re-NEET. 2016)
- involuntary, fusiform, non-striated**
 - voluntary, multinucleated, cylindrical
 - Involuntary, cylindrical, striated
 - Voluntary, spindle shaped, uninucleated,
60. Glenoid cavity articulates (AIPMT 2015)
- Scapula with acromion
 - clavicle with scapula
 - humerus with scapula**
 - clavicle with acromion

61. Which of the following joints would allow no movements? (AIPMT Retest 2015)
- Fibrous joint**
 - cartilaginous joint
 - synovial joint
 - ball and socket joint
62. Which of the following is not a function of the skeletal system? (AIPMT Retest 2015)
- Production of erythrocytes
 - storage of minerals
 - production of body heat**
 - locomotion

Chapter 10

Neural control and coordination

1. Given below is a table comparing the effects of sympathetic and parasympathetic nervous system for four features (1-4) which one feature is correctly described? (A.I.I.M.S.2006)

	sympathetic	parasympathetic
a. Salivary gland	inhibit secretion	stimulate secretion
b. pupil of the eye	dilate	constricts eye
c. heart	rate decreases	increases
d. intestinal	stimulates	inhibits peristalsis

2. Cranial nerves supplying eyes muscles are: (Pb.P.M.T.1997)
- 4, 5, 6
 - 3, 4, 5
 - 4, 6, 7
 - 3,4,6**
3. A cranial nerve with maximum branches in the body is (M.P.P.M.T.1997,A.P.M.E.E 1999)
- Auditory
 - Trigeminal**
 - Vagus
 - Facial
4. Bowman's glands are located in
- Olfactory epithelium of human nose**

- b. Female reproductive system of cockroach
c. Anterior pituitary
d. Proximal end of uriniferous tubules
5. Which of the following disorder is not hereditary (J.K.C.M.E.E 2005)
a. sickle cell anaemia
b. haemophilia
c. colour blindness
d. cataract
6. Glands responsible for secreting tears are: (H.P.P.M.T 2005)
a. glands of moll
b. lacrimal glands
c. meibomian glands
d. glands of zeis
7. Which of the following cranial nerves are mixed: (BHU 2007)
a. glossopharyngeal b. trigeminal
c. vagus d. auditory
a. A,B and C are correct
b. A and C are correct
c. A and B are correct
d. B and D are correct
8. To What the respiratory center of brain are sensitive?
a. High CO₂ Concentration in blood
b. Blood supply to brain
c. High O₂ Concentration in blood
d. More blood supply to lungs
9. Nasal epithelium is formed of: (C.M.C 2003)
a. columnar epithelium
b. keratinised epithelium
c. pseudostratified epithelium
d. glandular epithelium
10. Space between piamater and arachnoid is (J.K.C.M.E.E 2003)
a. subdural b. supra archnoid
c. eqidural **d. subarachnoid**
11. Which one is mixed nerve?
a. oculomotor b. trochler
c. hypoglossal **d. glossopharyngeal**
12. Visual area is located in (A.I.E.E.E 2004)
a. occipital lobe b. parietal lobe
c. frontal lobe d. temporal lobe
13. In hypothalamus are located various canters of (J.I.P.M.E.R 2004)
a. circulation b. sleep
c. memory **d. body temperature**
14. Which option is correct for the few statements are given for the function of cerebrum, which of few following option is shows all correct statements.
(i) to control the sensitivity, movement, memory, vocabulary etc. through the
(ii) to control the vision and adaptation through the occipital and frontal lobes
(iii) to control the contraction of voluntary muscles through the frontal lobe
(iv) to control the temperature, taste, touch, pain etc, through the parietal lobe
a. (i),(ii),(iii) b. (iii),(iv),(i)
c. (i),(iii),(iv) d. (i),(ii)
15. column I lists the part of the human brain and column II lists the functions. Match the two columns and identify the correct choice from those given. (K.C.E.T 2005)
- | | |
|-------------|-----------------|
| column I | column II |
| a. cerebrum | p. controls the |
| pituitary | |

- b. cerebellum vision and hearing q. control
- c. hypothalamus rate of heart beat r. control the
- d. midbrain intelligence s. seat of
- t. maintains body posture
- a. (a=s);(b=t);(c=p);(d=q)**
- b. (a=t);(b=s);(c=r);(d=q)
- c. (a=t);(b=r);(c=p);(d=q)
- d. (a=t);(b=s);(c=q);(d=p)
16. In the resting state of the neural membrane, diffusion due to concentration gradients, if allowed would drive:
- a. Na^+ out of the cell
- b. K^+ into the cell**
- c. Na^+ into the cell
- d. K^+ and Na^+ out of the cell
17. Injury vagus nerve in human is not likely to affect:
- a. gastrointestinal movements
- b. cardiac movement
- c. tongue movement**
- d. pancreatic movement
18. Which of the following is not strictly considered as a part of neuron? (C.P.M.T 1998)
- a. dendrites **b. myelin sheath**
- c. axon d. Nissle's bodies
19. Centers for sense of smell are located (M.P.P.M.T 1999)
- a. cerebellum b. midbrain
- c. olfactory lobes** d. cerebrum
20. Nerve related to diaphragm is (M.P.P.M.T 1999)
- a. trigeminal b. vagus
- c. glossopharyngeal **d. phrenic**
21. Node of ranvier is the place where (P.M.T 2002)
- a. myelin sheath and neurilemma are discontinuous
- b. axlemma is absent
- c. axlemma is discontinuous
- d. myelin sheath is discontinuous**
22. which of the following cranial nerve controls the movement of eye ball ? (B.H.U 2002)
- a. trocheclar
- b. oculomotor
- c. abducen
- d. all of the given**
23. Match the following human spinal nerves in column I with their respective number in column II and choose the correct option
- | column I | column II |
|--------------------|--------------|
| P. cervical nerves | i. 5 pairs |
| Q. thorocic nerve | ii. 1 pair |
| R. lumbar nerve | iii. 12 pair |
| S. coccygeal nerve | iv. 8 pair |
- a. (P-iv),(Q-iii),(R-i),(S-ii)**
- b. (P-iii), (Q-i), (R-ii), (S-iv)
- c. (P-iv),(Q-i),(R-ii),(S-iii)
- d. (P-ii), (Q-iv), (R-i), (S-iii)
24. How many pairs of spinal nerve are found in human? (Guj C.E.T 2006)
- a. 33 b. 32
- c. 31** d. 30
25. What is Nissl's granule consist of ?
- a. DNA b. RNA

- c. **protein** d. lipid
26. Which of the following is correct for motor nerve? (A.I.E.E.E 2004)
- a. trochlear b. hypoglossal
- c. oculomotor **d. All the given**
27. Four healthy people in their twenties got involved in injuries resulting in damage and death of a few cells of the following . Which of the cells are least likely to be replaced by new cells ?
- a. liver cells b. osteocytes
- c. neurons** d. malpighian layer of the skin
28. One of the examples of the action of the autonomous nervous system is :
- a. peristalsis of the intestines**
- b. knee-jerk response
- c. swallowing of food
- d. pupillary reflex
29. In mammalian eye, the 'fovea' is the center of the visual field, where: (RE-AIPMT 2015)
- a. more rods than cones are found
- b. high density of cones occur but has no rods
- c. the optic nerve leaves the eye
- d. only rods are present
30. Receptor site for neurotransmitters are present on (NEET 2017)
- a. Pre-synaptic
- b. Tips of axons
- c. Post-synaptic membrane
- d. Membrane of synaptic vesicles

CHAPTER 11

Chemical coordination and intergration

1. Match the list-I with list-II

- | list-I | list-II |
|--|------------------|
| p. Adenohypophysis | i. Epinephrine |
| q. Adrenal medulla | ii. Somatotropin |
| r. Parathyroid gland | iii. Thymosin |
| s. Thymus gland | iv. Calcitonin |
| a. (p : iv), (q : iii), (r : ii), (s : i) | |
| b. (p: iii), (q : i), (r : iv), (s : ii) | |
| c. (p : i), (q: ii), (r : iii), (s : iv) | |
| d. (p : ii), (q : i), (r : iv), (s : iii) | |

2. Which one of the following is not a second messenger in hormone action? (AIPMT 2006)

- a. cGMP b. Calcium
- c. Sodium** d. cAMP

3. Match item in column-I with those given in column-II

- | column-I | column-II |
|----------------|-----------------------|
| p. ADH | a. Pituitary |
| q. ACTH | b. mineralocorticoid |
| r. aldosterone | c. diabetes mellitus |
| s. insulin | d. diabetes insipidus |
| t. adrenaline | e. vasodilator |

- a. (p – d) (q – a) (r – c) (s – b) (t – e)
- b. (p – a) (q – d) (r – b) (s – c) (t – e)
- c. (p – d) (q – a) (r – b) (s – c) (t – e)**
- d. (p – d) (q – b) (r – a) (s – c) (t – e)

4. Which of the following indicates correctly matched pairs for column-I and column- II

- | column-I | column-II |
|----------------|------------|
| p leydig cells | (i) Tetany |

- q Hyperthyroidism (ii) GH
 r Adenohypophysis (iii) ACTH
 s Dwarfism (iv) Testosterone
- (p – iv) (q – i) (r – iii) (s – ii)
 - (p – i) (q – iv) (r – ii) (s – iii)
 - (p – i) (q – ii) (r – iii) (s – iv)
 - (p – iii) (q – i) (r – iv) (s – ii)
5. Mainly which of the following hormones control menstrual cycle in human being (CET, 1997)
- FSH, LH, Estrogen**
 - oxytocin
 - PTH
 - ACTH
6. On seeing a Tiger, the heart beat and blood pressure increase due to release of hormone: (A.I.I.M.S 2000)
- Corticoids
 - Thyroxine
 - Adrenaline**
 - Parathormone
7. Match the endocrine gland, given under column-I with their respective position in the body given under column-II choose the answer which gives the correct combination of alphabets of two columns: (K.C.E.T.1998)
- | column-I | column-II |
|-------------------------|-------------------------|
| (Endocrine glands) | (Position in body) |
| a. pituitary gland | p. Above kidney |
| b. Thyroid gland | q. Inside pancreas |
| c. Adrenal gland | r. On larynx |
| d. Islets of langerhans | t. At the base of brain |
- (a – t) (b – r) (c – p) (d – q)
 - (a – s) (b – t) (c – p) (d – q)
 - (a – p) (b – q) (c – r) (d – t)
 - (a – q) (b – s) (c – t) (d – p)
8. If Adenohypophysectomy is done in adult, then which of the followings is the correct statement : (CPMT 1996)
- Gigantism
 - Acromegaly
 - B.M.R will be affected**
 - It will affect growth of testis and ovary
9. The immediate cause of induction of ovulation in the human female is the large plasma surge of :
- LH**
 - Estrodiol
 - FSH
 - Progesterone
10. Glucagon and insulin are: (CMEET 1995)
- Secreted from same cell and are same in function
 - Secreted from same cells but are opposite in function
 - Antagonistic secretion action and similar function
 - Secreted from different cells but are opposite in function**
11. What is the function of enterogastrone?
- It stimulates the secretion of digestive juices in the stomach
 - It stimulates the flow of pancreatic juice
 - It regulates the flow of bile
 - It inhibits the secretion of gastric juice**
12. Ca⁺ metabolism is regulated by : (C.P.M.T 1997)
- ACTH
 - Thyroxine
 - Parathormone**
 - Epinephrine
13. Heavy jaws, long face, long extremities are caused by:
- under secretion of hormone of posterior lobe of pituitary

- b. over secretion of hormone of anterior lobe of pituitary after puberty
- c. under secretion of hormone of anterior lobe of pituitary
- d. over secretion of hormone of posterior lobe of pituitary
14. FSH and LH hormones together are called: (MPPMT 1997)
- a. **GTH**
- b. Stress removing hormones
- c. Emergency hormones
- d. Neurohormones
15. Deficiency of calciferol causes: (MPPMT 1996)
- a. Scurvy
- b. Leucopenia
- c. **Rickets**
- d. Leukaemia
16. Which one of the following pairs correctly matches a hormone with disease resulting from its deficiency ? (P.M.T 2003)
- a. Relaxin – Gigantism
- b. **Parathyroid hormone – Tetany**
- c. Insulin – Diabetes insipidus
- d. Prolactin – Cretinism
17. Which one of the following pairs correctly matches a hormone with a disease resulting from its deficiency?
- a. **Luteinizing hormone – failure of ovulation**
- b. Thyroxin – Titan
- c. Insulin – Diabetes insipidus
- d. Parathyroid hormone – Diabetes mellitus
18. Chemically the hormones are
- a. Steroids only
- b. **Proteins, steroids and biogenic amines.**

- c. Proteins only
- d. Biogenic amines only

19. Which of the following hormones is not a secretion product of human placenta?
- a. Progesterone
- b. HCG
- c. **Prolactin**
- d. Estrogens
20. Feeling the tremors of an earthquake a scared resident of seventh floor of a multistoried building starts climbing down the stairs rapidly. Which hormone initiated this action ?
- a. Gastrin
- b. Thyroxine
- c. **Adrenaline**
- d. Glucagon
21. Match list-I with list-II and select the correct option.

list-I	list-II
a) Adrenaline	1 Myxoedema
b) Hyperparathyroidism	2 Accelerates heart beat
c) Oxytocin	3 Salt – water balance
d) Hypothyroidism	4 Child birth
e) Aldosterone	5 Demineralization

- a. (a – 5) (b – 3) (c – 2) (d – 4) (e – 1)
- b. **(a – 2) (b – 5) (c – 4) (d – 1) (e – 3)**
- c. (a – 5) (b – 3) (c – 4) (d – 2) (e – 1)
- d. (a – 2) (b – 3) (c – 4) (d – 5) (e – 1)
22. Column-I lists the endocrine structure and column-II lists the corresponding hormones match the two column. Identify the correct option those given. (K.C.E.T 2006)
- | column-I | column-II |
|-----------------------|---------------|
| a. Hypothalamus | p. relaxin |
| b. anterior pituitary | q. estrogen |
| c. testis | r. FSH and LH |
| d. ovary | s. androgens |

- t. gonadotropin releasing hormones
- a. (a – r) (b – t) (c – s) (d – q)
b. (a – t) (b – r) (c – s) (d – q)
 c. (a – p) (b – q) (c – s) (d – r)
 d. (a – t) (b – r) (c – q) (d – s)
23. It is the parathyroid gland....
 (A.M.U 2006)
 a. decreases blood Ca^{+2} level
b. Increases blood Ca^{+2} level
 c. promotes collagen synthesis by osteoblasts
 d. All of the given
24. Which of the following is not a effect of hypothyroidism?
a. Mental stress b. edema
 c. Increases Ca^{+2} level in blood
 d. to be lethargic
25. The amino acid Tryptophan is the precursor for the synthesis of.
 (AIPMT /NEET-2016)
 a. Melatonin and Serotonin
b. Thyroxine and Triiodothyronine
 c. Estrogen and Progesterone
 d. Cortisol and Cortisone
26. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other?
 (AIPMT /NEET-2016)
 a. Parathormone – Calcitonin
 b. Insulin – Glucagon
 c. Aldosterone – Atrial Natriuretic Factor
d. Relaxin – Inhibin
27. GnRH, a hypothalamic hormone, needed in reproduction, acts on:
 (NEET-2017)
 a. anterior pituitary gland and stimulates secretion of LH and FSH
 b. posterior pituitary gland and stimulates secretion of oxytocin and FSH
 c. posterior pituitary gland and stimulates secretion of LH and relaxin
 d. anterior pituitary gland and stimulates secretion of LH and oxytocin
28. Which one of the following hormones though synthesized elsewhere, is stored and released by the master gland?
 (NEET-2015)
 a. Melanocyte stimulating hormone
b. Antidiuretic hormone
 c. Luteinizing hormone
 d. Prolactin
29. Which one of the following hormones is not involved in sugar metabolism?
 (RE-AIPMT 2015)
 a. Glucagon b. Cortisone
c. Aldosterone d. Insulin
30. Hypersecretion of Growth Hormone in adults does not cause further increase in height, because: (NEET-2017)
a. Epiphysis plates close after adolescence
 b. Bone lose their sensitivity to Growth Hormone in adults
 c. Muscle fibers do not grow in size after birth

- d. Growth Hormone becomes inactive in adults

CHAPTER 12

Basic Medical Instrument and techniques

1. Doctors use stethoscope to hear the sound; produced during each cardiac cycle. The second sound is heard when:
(RE-AIPMT-2015)

- a. AV node receives signal from SA node
b. AV valves
c. Ventricular wall vibrate due to gushing of blood from atria
d. **Semilunar valves close down after the blood flows into vessels from Ventricles.**