

## Chapter 8.5

# Animal Husbandry

The rearing of animals for specific purposes is called domestication, and such animals are called domestic animals. Domestication of animals started during the 'hunting and gathering phase' of human civilization. Man domesticates a variety of animals for food transport agricultural operation, wool, fur, study, research and pleasure. Cow, buffaloes, goats, sheep and pigs for meat and honey bee for honey. Cattles, horses, mules, donkeys, camels, elephants and reindeer are used for transport. The domesticated animals play an important role in the economy of rural India. The first animals to be domesticated may have been the dog and goat. The various breeds of domestic animals we use today have evolved from wild ancestors through selective breeding. Pets, livestock, poultry, Fishery, Sericulture, apiculture and Lac culture are briefly discussed in this chapter. The branch of agriculture specializing in the breeding raising care and utilization of domestic animals is known as animal husbandry.

### Dogs and Cats

Dogs and cats are the closest pets of man. They are carnivores turned omnivores. They occur wild in various parts of the world.

(1) **Dogs** : Dog was among the earliest animals domesticated by man. A large number of breeds have been produced by intensive inbreeding and artificial selection of a single ancestral dog species. These vary in form colour, size and fur. It has proved to be a faithful companion and guard of its master. The domestic dog, *Canis familiaris*, is found in almost all countries. It is useful in many ways.

(i) It can be trained to protect flocks (sheep or goat) and herds (cattle).

(ii) It is helpful in tracking and running down the game such as hare and fox.

(iii) It is a very useful animal for hunting.

(iv) Some breeds, which have sharp sense of smell and sight, are employed to trace the criminals drug peddlers and prowlers.

(v) It can lead the blind persons.

(vi) Eskimos use dogs to pull sledges (wheel less vehicles used over snow or ice).

(vii) Dog raising is a profitable business. Pedigree dogs fetch high return.

(viii) Dog is a symbol of loyalty.

(2) **Cats** : Cat (*Felis domesticus*) is a small, furry mammal. It has many breeds. It is domesticated to eradicate rats and mice. It is also a nice pet.

### Livestock

**Meaning of livestock** : The word livestock refers to the domestic animals kept or dealt in for use or profit. It includes cattle, buffaloes, sheep, goats, pigs, horses, mules, donkeys and camels. The most important of these are cattle and buffaloes.

**Cattle (*Bos indicus*), Buffaloes (*Bos bubalus*)** : The word cattle includes cow (adult female), bull (uncastrated adult male), bullock or OX (castrated adult male) and steer (young castrated male).

**Importance of cattle and Buffaloes** : Cattle and buffalo are most important forms of domesticated animals. They are next to land in use for farmers. They are widely used for :

(1) **Agricultural Operations** : Cattle are used in agricultural operations such as ploughing, harrowing and levelling land; in harvesting and thrashing ripe crops; and in working wells, etc.

(2) **Milk** : Cows and buffaloes provide milk, an important human food with all the essential materials.

(3) **Transport** : Cattle are employed in cart driving to transport men and materials. However, they are being fast replaced by machines.

(4) **Manure and fuel** : The dung provided by them acts as a valuable manure for maintaining the fertility of the soil. It is also used for preparation of biogas or gobar gas. Dung cakes provide cheap fuel to the poor, but the fields get deprived of an important manure.

(5) **Leather** : Hides obtained from these animals are used for the preparation of leather goods.

(6) **Glue and gelatin** : Their bones, horns and hoofs yield glue and gelatin.

(7) **Meat** : Beef and buffalo meat are eaten by certain people

(8) **Hair** : Hair are used for making brushes.

**Breeds of cattle** : There are 26 breeds of cattle and 7 breeds of buffaloes in India. They differ in colour, general body build, form of horns, forehead and geographical distribution. The best cattle breeds occur in the drier regions of the country. The most important breeds of milk cows in the United States of America are Holstein-Friesian, Jersey, Quernsey, Ayrshire and Brown Swiss. Depending upon the utility, the cattle are classified into the following groups;

(1) Milch breeds that give good milk-producing cows,

(2) Draught breeds which give good working bullocks,

(3) General utility (dual-purpose) breeds the females of these breeds are good milk-producers and the bullocks are good draught animals.

**Table : 8.5-1 Some Breeds of Indian Cattle**

S.No.	Milch Breeds	Distribution
1.	Gir	Gujarat, Rajasthan
2.	Sahiwal	Punjab, Haryana, Uttar Pradesh
3.	Red Sindhi	Andhra Pradesh
4.	Deoni	Andhra Pradesh
	<b>Draught Breeds</b>	
1.	Malvi	Rajasthan, Madhya Pradesh
2.	Nageri	Delhi, Haryana, Uttar Pradesh
3.	Hallikar	Karnataka
4.	Kangayam	Tamil Nadu and other parts of South India
	<b>General Utility Breeds</b>	
1.	Haryana	Haryana, Punjab, Bihar, Madhya Pradesh, Gujarat
2.	Ongole	Andhra Pradesh
3.	Kankrej	Gujarat
4.	Tharparkar	Andhra Pradesh, Gujarat

**Table : 8.5-2 Some Breeds of Indians Buffaloes**

S.No.	Name	Distribution
1.	Murrah	Punjab, Haryana, Uttar Pradesh
2.	Bhadawari	Uttar Pradesh, Madhya Pradesh
3.	Jaffrabadi	Gujarat
4.	Surti	Rajasthan, Gujarat
5.	Mehsana	Gujarat
6.	Nagpuri or Ellichpuri	Central and South India
7.	Nili Ravi	Punjab, Haryana

**Feeding of cattle** : The cattle feed consists of two components (1) Roughage (2) Concentrates.

(1) **Roughage** : Roughage includes fodder, silage, hay and straw. They have a large amount of fibre contents and low nutritive value.

(2) **Concentrates** : The concentrates used in the cattle feed is a mixture of substance which are rich in nutrient contents. Cotton seeds, oil seeds, oil cakes, cereal grains like bajra, gram, rice polish, etc. are some important substances included in the concentrates in the cattle feed. In the winter season, cattle are given green fodder, mainly berseem and lucerns. In other seasons, cattle are given maize, bajra, jowar and dry fodder.

Cattle should be given sufficient water daily. Suckling calves also need water.

**Breeding of Cattle** : Cattle breeders select and mate best type of cattle for a particular purpose. The breeding of cattle is done by two methods i.e. natural and artificial.

(1) **Natural breeding** : It is further of two types i.e. random and controlled

(i) **Random breeding** : Here some pedigree bulls are kept along with the grazing cows. Bulls not selected for breeding are castrated and changed to bullocks.

(ii) **Controlled breeding** : In this type of breeding native cows are crossed with superior quality of imported bulls in natural breeding. Foreign dairy breeds like Jersey (England), Holstein Freisian (Holland), Brown Swiss (Switzerland), Ayrshire (Scotland) have been imported to give better results.

(2) **Artificial breeding** : The introduction of semen (sperm) in the body (vagina) of females by artificial means is called artificial insemination. This method is comparatively better and economical. Several cows can be inseminated by semen of a single bull.

(3) **Superovulation and Embryo transplantation** : This is a recent technique that has been introduced in India to produce super milch cows. In this procedure a pedigree bull and a high yielding cow is selected. Super ovulation is induced in the cow by a hormone injection. Fertilization is achieved by artificial insemination. Early embryos (4-10 in numbers) are collected. Each embryo is transplanted into a carrier cow for further development. The calf produced by this method may grow into a super milch cow or a high quality bull.

A week old embryo can be preserved by deep freezing at  $-196^{\circ}\text{C}$  for several years and transplanted when required.

**Breeding and Calving Season** : In India the breeding season commences from September and continues upto February, and the calving season from July to November. During this breeding period, the bulls have been found to be very active sexually and the quality and quantity of semen are very high, particularly during winter (November to February). The buffaloes show the maximum of ovarian activity and the largest percentage of them conceive during this period.

**Length of Gestation** : The length of gestation of buffaloes varies, influenced by breed and environment, between 276 and 340 days, but on an average, it lasts for 307 days or 10 months, in contrast to the cow with an average gestation of 284 days or 9 months.

Table : 8.5-3 Some breeds of Indian Sheep

S.No.	Breed	Distribution	Use
1.	Lohi	Punjab, Rajasthan	Good quality wool, milk
2.	Rampur-Bushair	Uttar Pradesh, Himachal Pradesh	Brown coloured fleece for superior cloth
3.	Nali	Haryana, Punjab, Rajasthan	Superior-carpet wool
4.	Bhakarwal	Jammu and Kashmir	Under-coat used for high quality woollen shawls
5.	Deccani	Karnataka	Mutton, no wool
6.	Nellore	Maharashtra	Mutton, no wool
7.	Marwari	Gujarat	Coarse wool
8.	Patanwadi	Gujarat	Wool for army hosiery

(i) Duration of lactation, Dry period and interval between calving : In milch buffaloes, the average period of lactation is 281 days, a dry period of 139 days and an interval between calving of 420 days is normal. This means that, on an average, a buffalo/cow produces a calf at 14 months intervals.

(ii) **Important livestock diseases** : Just like human beings, livestock like cow, buffalo, etc. suffer from various diseases. The diseases in livestock are mainly caused by the attack of micro-organisms like virus, bacteria or fungi, or by an attack of worm parasites. Some important livestock diseases are as follows.

- (1) Viral diseases : Foot and mouth diseases, pox.
- (2) Bacterial diseases : Rinderpest, tuberculosis, anthrax.
- (3) Fungal diseases : Ringworm.

## Sheep and Goats

There are many breeds of sheep (*ovis aries*) and goats (*Capra hircus*) in our country. Today sheep are raised in all parts of the world. Sheep provide us with wool, skin and mutton and goats provide us with milk, meat, skin and hair. The fine soft wool called pashmina is the underfur of Kashmir and Tibet goats. A sheep lives for about 13 years.

**Feeding of sheep and goats** : Sheep feed on green tender grass or weeds or other herbage. Goats feed on a variety of trees by browsing on the buds and foraging on a variety of plants. Oil cakes and mineral mixture are also fed to keep sheep in good condition.

**Breeding of sheep and Goats** : To improve the quality of a sheep, cross-breeding experiments are usually done. For this purpose, a good quality wool yielding or mutton producing sheep is chosen and cross breed with exotic breeds like Dorset, Horn and Merino. About 19% of world goat population occurs in India. These differ in body build, colour, horn size, ear size, hair texture, etc. The wild goat, *Capra hircus*, of Baluchistan and shind is the ancestral stock of all the breeds of domestic goat.

Table : 8.5-4 Important Breeds of Indian Goats

S.No.	Name	Distribution
1.	Gaddi and Chamba	Himachal Pradesh
2.	Kashmiri and Pashmina	Himachal Pradesh, Kashmir, Tibet
3.	Jamunapari	Uttar Pradesh, Madhya Pradesh
4.	Beetal	Punjab
5.	Marwari	Rajasthan
6.	Berari	Maharashtra
7.	Malabari	Kerala
8.	Bengal	Bihar, Orissa

**Shearing of wool** : The shearing of wool is essential to promote the health of sheep. The removal of hairs (wool) from the sheep is done very carefully in the mild weather. The recommended periods for shearing of wool are winter (February-March) and rainy (August-September) seasons when rich grazing ground is available. The sheep are washed properly before the removal of hairs.

The manufacture of wool from sheep hairs is a complicated process consisting of cleaning, drying, bleaching, dyeing, spinning and twisting.

### Common diseases of sheep and goats

(1) **Sheeps** : These include haemorrhagic septicaemia, anthrax, sheep-pox and black-quarter. The common signs of illness are high temperature, cessation of rumination, hard breathing, coughing, sneezing, diarrhoea and drooping gait. The sheep also suffer from external and internal parasites.

Timely inoculation prevents the diseases.

(2) **Goats** : The goats are less prone to serious diseases. They suffer from some contagious diseases such as anthrax, goat pox, pleuropneumonia and foot and mouth disease. The general signs of illness are as in the cows. Parasitic infection is common in goats.

## Pig

Pig, also called hog or swine, is an omnivorous, nonruminant, gregarious mammal of genus *Sus*. All breeds of pigs have descended from the European wild boar *sus scrofa* or a crossbreed of this and the Asiatic species, *S. indicus*. The care and management of pigs is called piggery.

Pigs are the most prolific breeders and quick growers among the domestic animals. A group of 10 sows (Female hog) and one boar may produce over 160 piglets in a year. Pigs are most useful domestic animals, especially of lower classes of society. They are most economical source of meat and animal fat. Pig meat, in general, is known as pork and the meat obtained from different parts of the body have been given different names, for example bacon obtained from the back and sides and ham from the back of the thigh.

**Feeding of pigs** : Indigenous pigs survive through scavenging on kitchen wastes and farm by products and human faeces. Pig keepers raise them on grass, straw roots and grains. As they can feed on human faeces, they serve as secondary host for tape worms.

**Breeds and breeding of pigs** : Pig breeding has now started on commercial scale. The improved exotic types, number of which is insignificant is maintained mostly at all the seven Regional Pig Breeding stations of the country. Some breeds of the pigs are given in table.



Table : 8.5-5 Important Breeds of Pigs

Breeds	Distribution
<b>Native Pigs</b>	
1. Desi	Uttar Pradesh, Bihar, Punjab, Madhya Pradesh
2. Ghor	Manipur, Assam, Meghalaya, Arunachal Pradesh
<b>Exotic pigs</b>	
1. Berkshire	U.K.
2. Large White Yorkshire	U.K.
3. Landrace	Switzerland, Denmark

**All India Co-ordinated research project :** The ICAR initiated an All India Co-ordinated research projects on pigs during the fourth five year plan. The project started functioning early in 1971. The main objective of the project is to develop suitable breeds using imported stock. The centres where this project is in operation are :

- (1) Indian Veterinary Research Institute, Izatnager
- (2) Assam Agricultural University, Khanapara,
- (3) Andhra Pradesh Agricultural University, Tirupathi
- (4) Jawaharlal Nehru Krishi Viswa Vidyalaya, Jabalpur.

**Diseases of Pigs :** These include swine fever, foot and mouth, swine-pox, swine-plague, anthrax, tuberculosis, infectious dysentery and piglet influenza. General signs of illness are as in sheep and goats.

## Horses

**Distinguishing Features :** The horses (*Equus caballus*) are solid- hoofed, non-ruminant quadrupeds with long, pendant mane and tail bearing long hair all over. They are intelligent animals. They learn fast, are faithful pets and can adapt to all sorts of climatic conditions. It was the first beast of burden. Polo is game played on horse back.

**Feeding :** Horses are fed on oats, barley, gram and hay. Common salt is also added to their diet. Green grass may also be given if available.

**Breeding :** If compared to other animals, horses have a low reproductive rate. Controlled natural mating in horses has been in practice in India for a long time. A high professional skill is required for rearing, training and medical care of race horses.

Table : 8.5-6 Important breeds of Indian Horses

S.No.	Name	Regions
1.	Kathiawari	Rajasthan and Gujarat
2.	Marwari	Rajasthan
3.	Bhutia	Punjab and Bhutan
4.	Manipuri	North-eastern mountains
5.	Spiti	Himachal Pradesh
6.	Zanskari	Ladakh

## Donkeys

**Distinguishing Features :** Donkeys (*Equus asinus*) are smaller than horses but have larger head, longer pinnae and narrower hoofs. Their mane is erect and tail has a tuft of hair at the tip.

**Feeding :** The donkeys mainly feed on straw and fodder. They are often let free to graze on the roadside.

**Breeding :** There are two breeds of donkeys in our country : small, dark grey and large, light grey to almost white. The grey donkey occurs in most parts of the country. The white donkey, also called wild ass, occurs in Rann of Kutch. Donkeys have descended from the wild ass *Equus asinus* of Abyssinia.

## Mule

Mule is the hybrid between male ass (jack) and female horse (mare). It has the stamina of ass and size of horse, but is sterile. Similarly, the cross between male horse (stallion) and female ass is called hinny.

Mules are known for their toughness. Since they are sexually sterile, they have to be produce every time a new.

**Feeding :** They are fed mainly on green fodder, crushed grams and barley. They are also given salt.

**Breeding :** Indian army has imported male donkeys from Europe for breeding mules. Army uses two type of mules : (a) General service type and (b) Mountain artillery type. The latter are firm footed and can carry heavy loads on steep terrain.

**Common Disease of Equines :** The horses, donkeys and mules suffer from many diseases. They include pink eye or influenza, strangles, tetanus, colic etc.

## Camels

The camel is a large, horn less, ruminant mammal of genus *Camelus*. It is popularly called "the ship of the desert" because of its great travelling power in a desert. It is a valuable beast of burden in hot desert and semidesert regions as it can live on minimum food and water when travelling with load.

**Types of camels :** There are two types of camels :

(1) **Arabian camels (*Camelus dromedarius*) :** With a single hump, short hair and found in north Africa to India. It does not occur in wild form.

(2) **Turkish or bactrian camel (*Camelus bactrianus*) :** With two humps, long hair and found in Gobi desert of central Asia. It occurs in wild form also.

**Feeding :** Camels are fed on dry fodder (barley, straw) supplemented with chopped green fodder made of pulses, mustard and green pees. They browse on trees, shrubs and bushes. The size of the hump is a good indicator of its health.

**Breeding :** There are four kinds of camels in India. These are Jaisalmeri, Sindhi and Bikaneri found in Rajasthan and Kutchi found in Gujarat. They have a well-defined breeding season. Camels breed in winter (November to March).

**Diseases :** Camels suffer from diseases such as anthrax, pneumonia, camel-pox and surra.

## Elephant

Elephants are chiefly found in forests with tall trees where bamboo's grow in profusion. They have very poor sight but sense of hearing and smell is highly developed.



**Feeding :** Daily food intake is considerable, but only partially digested and utilization is low. Natural food includes bamboo shoots, leaves and various fruits. Working elephant are fed on straw, hay and crushed grain as a supplement.

**Breeding :** Puberty occurs at between 8 and 12 years. The gestation period is 21 – 22 months. The calving interval is 4 years. Elephants may live for upto 90-100 years. Elephants are of two types : African elephants and Indian elephants.

**Table : 8.5-7 Differences between Indian Elephant and African Elephant**

S.No.		Indian elephant ( <i>Elephas maximus</i> )	African elephant ( <i>Laxodonta africana</i> )
1.	Physical Features	Small ears, High domed forehead with 2 prominence on top of skull. One process on trunk tip Convex backed. Tusks in males only, not always	Large ears convex sloping forehead.
2.	Mature at	25 years	25 years
3.	Weight at maturity	Male 3000 kg	Male 6000 kg
4.	Geographical distribution	Ceylon, India, Burma, Thailand, Vietnam, Laos, Malaysia, Indonesia	East, Central and West Africa
5.	Uses	Timber extraction and log moving in forested areas	Very limited. In small area of Zaire, used for timber transport.

## Yak

Yak (*Poephagus grunniens*) is found in Tibet, Ladakh, Lahaul, Spiti, Garhwal and Sikkim. It gives meat, hide and wool. Yak is also used for tilling land. The transport of people and goods in these regions would be impossible without this animal.

## Sericulture

Sericulture is the breeding and management of silk worms for the production of silk. It has been practiced in India since second era or century B.C. The silk which is produced by silk worm is of a valuable natural protein fibre. Silk worms are the larvae of silk moths. The rearing of silk worm for the production of silk is known as sericulture.

**History of silk :** Historical account of use of silk and rearing of silk worm eggs, larvae and cocoons are available from china. It was Lotzu the empress **kwang-Ti** who for the first time discovered the silk thread and its source the silk worm cocoon. The technique of sericulture was kept as a secret by the Chinese people. In about 550 B.C. the sericulture technique was diffused to European countries. The available mythological literature deals with facts rearing the use of silk in ancient India. By about 1000 A.D. the sericulture was in practice in China, Europe and India, China was the leading country in this field.

At present the sericulture is practiced in China, Japan, Korea, India, Brazil, Russia, France and Italy, some of the south East Asian countries. China is topmost country producing some 48% cocoons and 40.9% of raw silk. Next biggest silk producing country is Japan, India is placed in third position as far as the production of silk in term of quantity is concerned.

**Silk in India :** As far as silk as a fabric is concerned it is a matchless fabric second to none. Therefore, silk garments have been a favourite choice since ancient times. Use of silk clothes finds its mention from pre-historic period. There are description of use of silk clothes from vedic period. In Ramayana and Mahabharat period the silk clothes adored the bodies of royal princess, prince, kings and queens. It is the attire of rich people. The silk clothes were used to the superiority of social and economic status. It was given in gifts by rich people and royal families.

In the medieval period the silk was a recognised commodity of commerce. The silk clothes and raw silk were imported from China and Japan. Later on it was also imported from Europe. By the Mughal period India had a rich heritage of silk clothes. The silk was imported as raw silk. It was spun into silk thread and silk clothes were woven in handlooms. Silk clothes became almost a craze among royal families and rich persons. A number of such looms were in operation in Banaras, and different parts of Uttar Pradesh, Kashmir became centre for the production of cocoons and rearing of silk worm. Sporadic silk textile centres were also present in South India. It was in 1905-1906 that a scientific investigation in the field of sericulture was undertaken in India by the Indian Institute of Agricultural Research at Pusa, New Delhi. It was Lefroy who conducted research on the silk worm and potentialities of silk production in India. A series of exhibitions were organised to popularize silk and attract the attention of scientists and industrialists as well towards sericulture in India.

By 1910 India started regular production of raw silk. The rearing of *Bombyx mori* and *Autheraea* species was undertaken. Silk textile industry was finally established in Kashmir, U.P. and Karnataka. Silk garments were exported by this time. Silk clothes from Bengal, Banaras and karnataka were famous even in the European markets.

**Silk in Modern Age :** Sericulture as well as silk industry is firmly established in India. India at present is the third biggest country in the field of silk production and only next after China and Japan.

The reasons for the poor growth of sericulture in India were:

- (1) High cost of production.
- (2) Low yield.
- (3) Poor quality of raw silk.

But the recent efforts by the Government of India and various state governments such as research in sericulture and training in sericulture technique, development of silk worms marketing facilities and cultivation of plants, e.g. *Morus indica* or shahtoat *Norus alba* or 'Toot' castor sal etc. Central Sericulture Station, Berhampore, Central Research and Training Centre, Mysore and Ranchi have been established. Various states have undertaken a program of research, training and plantation of host plants under

their rural development programs. As a result of these efforts new varieties of mulberry plants have been developed and are being cultivated. These varieties are called as  $M_2$  and  $M_5$  varieties. They gave 100% increased yield of mulberry leaves upon which the silk worm feeds.

Different varieties of silk worm, *Bombyx mori* and *Autherea* have been developed which can be cultivated in various states. Existing races of silk worm are being improved Bivoltine species are being developed. Low production and higher yield have been achieved as a result of these efforts. India is producing 4200 metric tons of silk per annum (1980). This figure is even higher at present. India is exporting some 25% to 30% of its total silk production in the form of silk garments and fabrics. Karnataka is the biggest silk producing state followed by Jammu & Kashmir and Tamil Nadu, Madhya Pradesh is also emerging on the scene of silk production. India is producing China silk, Tasar silk or Cosa silk, Muga silk and Eri silk today.

#### Systemic position

Phylum -	Arthropoda
Class -	Insecta
Order -	Lepidoptera
Family -	Bombicidae and saturnidae

#### Family – Bombicidae

(1) **Bombyx mori** : It is known as China silk worm or mulberry silk worm. It is native of China. It has been fully domesticated for the production of silk. It produced quality of silk which is white silk or yellow silk.

(2) Other species of *Bombyx* are *B. texior*, *B. fortunatax* and *B. meridionles*. They are well Known in our country.

**Family – Saturnidae** : *Antheraea paphio* - It belong to the family saturnidae. It is widely distributed in India in the states of Karnataka, Tamilnadu, Madhya Pradesh, Uttar Pradesh, Bihar and West bengal. It feeds on fig plants. Its favourite host plant is Arjun (*Terminalia arjuna*), sol (*shorea robusta*). It has been recently domesticated for sericulture. It produced Tassar silk (kosa silk.)

**Habit and habitat** : The silk worm distributed in temperate regions are diapause type i.e. they remain inactive for some time in winter. The silk worms inhabiting some tropical regions.

**Adult Moth** : The moth measures about 25 mm in length and wing span measures about 40-50 mm in width. Female moths are larger than male moths. In general univoltine races are of larger size that multivoltine.

It has whitish colour with grey marks on wings in some races. The body is divisible into head, thorax and abdomen. Head contains a pair of eyes and a pair of pectinated antennae specially larger in males. Thorax contains three pairs of legs and two pairs of wings covered with scales. Female moths are without mouth. The abdomen is plump. Digestive system is poorly developed. The excretory system consists of three pairs of malpighian tubules present at the end of mid gut. The reproductive system is very well developed in females and males.

#### Life History

(1) **Copulation** : The copulation lasts for about three hours. During copulation the male sits over the female and holds her with the help of chitinous hooks. Both the moths acquire back to back' position. The female has a scent gland at the terminal end of the abdomen, which secretes volatile secretion called pheromones to attract the male.

(2) **Egg** : Copulation is immediately followed by egg laying. The eggs are small, oval and creamy white in colour. They become darker as they become older. Each moth lays about 300 to 500 eggs. The eggs are glued to the under-surface of the leaves of the host plant.

(3) **Larva** : After hatching a larva comes out of egg. It is called as caterpillar larva. It is 1.2 mm to 3 mm in length depending upon the race. It has grey or creamy-white colour.

The body of larva is divided into head, thorax and abdomen. The head consists of three fused segments. Mouth parts are biting and chewing type or strongly mandibulate. A pair of antennae and six pairs of are also present on head. Mandibulate mouth parts are used to cut and chew the leaves. The thorax consists of three segments. Each segment contains a pair of legs with recurved hooks. They are used for locomotion and manipulation of food during feeding. The abdomen consists of ten segments. The last and tenth segment is poorly developed. Five pairs of pseudo legs are present on 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 9<sup>th</sup> abdominal segments. These are used for locomotion.

**Silk gland** : Among other visceral organs larva contains well-developed paired glands called silk glands. When fully developed, these glands becomes five time larger than the length of the larva and there weight becomes 2/5<sup>th</sup> of the total body weight. Its secretion probably lubricates the silk. The silk is secreted in liquid form, which solidifies on coming in contact with air.

The larva is voracious eater. It feeds on mulberry leaves. It may ingest about 30,000 times more than its body weight during its complete larval period and increases about 10,000 times more than the body weight of its body from the time of hatching. As the larva grows, it sheds its cuticle. This is called as moulting. The form of larva between two successive moults is called as **instar**. The larva has five instars:

- I<sup>st</sup> instar - from hatching to I<sup>st</sup> moult
- II<sup>nd</sup> instar - between I<sup>st</sup> moult and II<sup>nd</sup> moult
- III<sup>rd</sup> instar - between II<sup>nd</sup> moult and III<sup>rd</sup> moult
- IV<sup>th</sup> instar - between III<sup>rd</sup> moult and fifth moult
- V<sup>th</sup> instar - between fifth moult and pupation

A fully-grown larva of V<sup>th</sup> instar attains the length of 7.5 cm. It stops feeding and starts spinning the cocoon. It secretes silk thread from its spinneret and forms covering in which it encloses itself completely. It takes about 3-4 days to spin the cocoon.

(4) **Pupa** : The cocoon consists of silk thread. The enclosed immobile larva in the cocoon is called as **Pupa**. The pupal stage is non- feeding and non-mobile. It remains inactive.



(5) **Cocoon** : The cocoon is white or yellow in colour. It is made up of about 1000-1200 metres long silk thread. The thread is wound around the cocoon in concentric circles. The weight of one cocoon is about 1.8 to 2.2 gms. The pupal period lasts for about 10 to 12 days. Alkaline fluid which makes the threads of cocoon to be soft. Soft threads are cut open by the imago. A young moth comes out of cocoon.

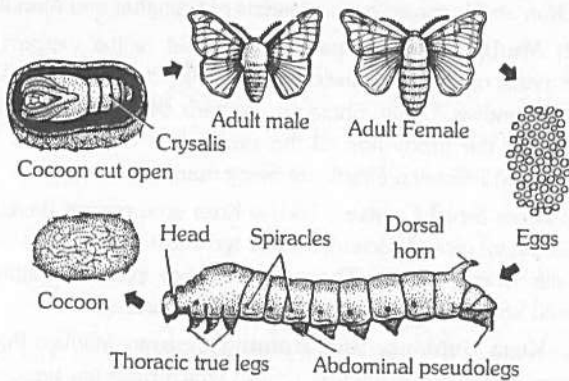


Fig : 8.5-1 Mature Caterpillar Life history of (*Bombyx mori*)

(6) **Fertilization** : After the moths emerge out from cocoons one female from one lot is kept with the male from another lot. They form pair and copulate. After copulation is over male is separated and kept with female of another lot. Thus one male can be used to fertilize at the most two females of different lots.

(7) **Egg laying** : After fertilization the female starts laying eggs. Egg laying is completed in about 24 hours. The laid eggs are called seeds. The eggs are transferred in sterilized tray and stored at 4°C.

**Factors influencing the life cycle** : The life cycle is influenced by the external environmental factors, such as, temperature, humidity and light. These factors control the growth of the larvae and also the quality of silk produced. The growth and moulting is controlled by hormones called juvenile hormone and ecdysone.

**Composition of silk** : The silk is a secretory product of silk glands of the larva. Silk is composed of proteins. It consists of an inner part made up of fibroin protein ( $C_{30}H_{46}N_{10}O_{12}$ ) and is covered with an outer envelope made up of sericin protein ( $C_{30}H_{40}N_{10}O_{12}$ ). The silk thread contains 75-80% fibroin and 20-25% of sericin.

**Sericulture industry** : Sericulture industry involves three steps,

(1) **Mulberry cultivation** : Mulberry is the only food of silkworms. Mulberry plants come up in any soil and in any climate. It is propagated by cuttings. The land is ploughed well 6 or 7 times in April-May and manured at the rate of 2 to 25 tons per hectare. Small pits are scooped out 2 or 3 cuttings are lanted in pit. Each cutting should be 20 to 23 cm in length with nodes. When the plants grow too high they are cut back and this is known as pruning.

**Pruning** : Pruning help in the production of a new flush of leaves. The plants can yield for 12 years. Every year 6 to 8 crops of leaves can be obtained and the average yield per hectare is 25 to 30 metric tons of green leaves.

(2) **Silk worm rearing** – Silk worm rearing needs the following:

- (i) Rearing house
- (ii) Rearing trays and stands
- (iii) Chandrikes as support to build the cocoon.

The hybrid eggs are obtained from the sericulture department. The larvae are hatched from the eggs. The newly hatched larvae are brushed into rearing trays and tender, chopped are provided to them. At the end of the final instar, fully grown mature larvae are transferred from the rearing trays to chandrikes and allowed to build cocoons. Cocoons are then collected and marketed.

**Grainage Management** : This is done to provide good quality of seed to rearers and also to maintain the original quality. With this aim grainage management is done by taking of caterpillar stage. They are protected from diseases and are provided good nutrition. An initial selection is made by observing pupal mortality rate. If the mortality rate is high, then such cocoons are rejected and are not kept for seed production. If the mortality rate is sufficiently low, their only such cocoons are selected and kept for seed production. The selected cocoons are kept for mass emergence. Before doing so the cocoons are examined and sexed. Males are kept separately and females are kept in separate lots.

(3) **Hatching** : The process by which larvae come out of the egg is known as hatching. After hatching larvae start eating mulberry leaves. The success of sericulture depends on the supply of good quality of mulberry leaves; therefore the hatching must coincide with good mulberry season. Now a days controlled hatching is done by placing the eggs in low temperature. The eggs are turned and moved with the help of a feather. Now -a-days the eggs are kept in mulberry leaves in sterilised trays. If hatching is to be delayed or controlled, the eggs are kept in separate trays and refrigerated for a suitable time.

The caterpillars which hatch out are kept in separate groups according to their age.

(4) **Supply of seeds to rearers** : Under this step they are supplied with seeds. The seeds are of two qualities, i.e., eggs and 2<sup>nd</sup> instar larvae. Beginner rearers are supplied with 2<sup>nd</sup> instar larvae, while experienced rearers can purchase egg. This is an important operation. For this purpose government has established many silk worm seed centres from where the rearers get their seeds at fair price.

(5) **Rearing of Caterpillars** : The caterpillars are reared at room temperature in shady places at about 60 to 70% humidity. The mulberry leaves supplied to 1<sup>st</sup> and 2<sup>nd</sup> instar larvae are well chopped, fresh and kept in wet clothes so as to keep them fresh. The caterpillars eat voraciously and grow in size and moult. The form of larvae between two successive moults is known as instars. Larvae have five instars. The last or 5<sup>th</sup> instar larvae stop feeding and undergo pupation.

(i) **Spinning of Cocoons** : Full grown 5<sup>th</sup> instar larvae secrete a pasty material from its silk gland. It moves its head to and fro, secreting a silk thread.

A good quality of cocoon is judged by the quantity of raw silk, filament length, strength and splitting power. The cocoons are marketed and sold.



(ii) **Post Cocoon Processing** : It includes following stages:

(a) **Stifling** : The process of killing the cocoons is termed as stifling. Eight to ten day-old cocoons are selected and dipped in hot water to kill the pupae in the cocoons.

(b) **Reeling** : The silk threads from the killed cocoons are removed and wound round a large wheel and then transferred to spools. This operation is called as reeling and the silk is called as reeled silk.

(c) **Spinning** : Damaged cocoons or the damaged outer layer of silk is separated and spun into threads. This is known as spun silk.

The raw silk is boiled, stretched, purified and washed again and again to shining lustre. Reeled silk or spun silk is marketed and sold.

**Problems of Sericulture** : The sericulture industry is facing a number of problems.

(1) **Need for Research** : There is a great need to better methods of rearing the silk worms. This is necessary to improve the yield of raw silk and reduce the cost of production.

(2) In order to improve the quality and yield of raw silk improved varieties of silk worm are developed by hybridization and breeding. There is a need for the improvement of genetic quality of the silk worm.

For research and training in sericulture the Government has opened Research and Service Station in many states. A Central Silk Board has been established at Bangalore the ministry of commerce.

#### Disease of silkworm

(1) **Pebrine** : It is the most important disease of silkworms. It is caused by a sporozoan called *Nosema bombycis*. The full grown caterpillar is attacked.

(2) **Muscardine** : It is a fungal disease caused by *Beauveria bassiana* and transmitted by spores carried by winds. All stages of caterpillar are attacked.

(3) **Flacherie** : It is a bacterial disease caused by *Bacillus bombysepticus*. Digestion in the affected caterpillar gets disturbed. Regular feeding of the larvae and maintaining hygienic conditions will prevent the disease.

(4) **Grasserie** : The causative agent of this disease is the nuclear polyheadrosis virus. The affected larvae become swollen and like a bag of granules, the body fluid becomes thick and cloudy and the larvae die.

**Economic Potentialities of Cultivating Silk in Madhya Pradesh** : Madhya Pradesh is the largest state with respect to land area and has rich subtropical vegetation. Thus Madhya Pradesh holds vast economic potentialities of cultivating silk. Sericulture is an important rural cottage industry. The tribal and other rural population in south east and east M.P. is favourably disposed for the cultivation of silk. Once M.P. was not a significant state in the list of silk producing states of India but due to the efforts of Madhya Pradesh Government in the direction of promoting sericulture today it, is the second largest state after Karnataka in the field of production of raw silk.

**Efforts made by Government of M.P. to Promote Sericulture in state** : A directorate of silk has been organised under the Panchayat and Rural Development Department to make concentrated efforts. These activities have been divided in two categories :

(1) **Kosa silk Area** : It extends in the eastern and south eastern parts of the state. This area is predominated by tribal population and is spread in the districts of Balaghat and Mandla.

(2) **Mulberry silk Area** : It is spread in the western and middle parts of the state including the districts of Indore, Dhar, Dewas, Khandwa, Ujjain, Shajapur, Raigarh, Mandsaur, Guna and Sehore. For the promotion of the production of Kosa silk (now Mulberry silk) following efforts are being made.

(i) **Kosa Seed Centre** : Twelve Kosa seed centres have been established to provide scientific and technical information to the Kosa silk worm rearers. These centres also provide disinfected improved kosa seeds and caterpillars to the rearers.

(ii) **Kosa Guidance and Training Centre** : Madhya Pradesh Government has established 67 centres which meet the basic needs of supplying disinfected improved seeds of Kosa silk and impart training and guidance to the rearers.

(iii) **Nursery** : To meet the needs of the host plant and supply of leaves to the rearers the government has established nurseries of *Terminalia tomentosa* and *Terminalia arjuna*. Plantation of host plants has been undertaken in 296 hectares of land and 1285 hectares of land is proposed to be covered under this scheme.

(iv) The construction of two grainage, one cold storage, one cocoon market and one reeling factory is being undertaken.

(v) Kosa Regional Research centre has been established to help the rearers to increase the yield and improve the quality of silk.

(3) **Mulberry silk Plans** : To promote the mulberry silk production in M.P. certain efforts have been made in the direction by the Madhya Pradesh Government. These are

(i) **Establishment of Nursery** : To increase the production of host plant Mulberry silk worm, the *Morus indica*, nurseries have been established.

(ii) Mulberry silk seed centres have been established.

(iii) Integrated rural development projects have prepared for the production of Mulberry silk.

(iv) Establishment of regional research centre and reeling factory.

(v) Demonstration and publicity plans.

Madhya Pradesh Government has allocated 476.22 lac of rupees for the development plans of silk. For the year 1985-86 a target of 80,000 kg. of Kosa silk and 8356 kg. of Mulberry silk.

#### Apiculture

Apiculture is the science of rearing honeybees for obtaining honey, wax and venom. It is a profitable money-making hobby. It forms a cottage industry, when carried out on a large scale.

Three species of honey bees are commonly found in India viz. *Apis indica* (The small indian bee), *Apis florea* (The little Indian bee) and *Apis dorsata* (the giant bee) other important species

include *Apis mellifera* (the common European bee) and *apis adamsoni* (the African bee). In India the commonly domesticated species are *Apis mellifera* and *Apis Indica*.

**Honeybee-Apis :** Like termites, honeybees are social insects known for producing honey and beeswax, and for living in very highly organized colonies. These feed upon nectar and pollen of flowers, possess "sucking and chewing" mouth parts, and undergo complete metamorphosis.

**Social Organisation of Honey Bee** A highly organised division of labour is found in the colony of honey bees. A good and well developed colony of bees had 40 to 50 thousand individuals consisting of 3 castes viz. queen, drone and worker.

(1) **The Queen :** It is a well developed fertile female provided with immensely developed ovaries. Commonly one queen is found to be present in each hive and feeds on Royal Jelly. The queen is 15 to 20 mm in length and can be easily distinguished by her long tapering abdomen, short legs and wings. Structurally she is unable to produce wax or honey or gather pollen nectar. By the combination of ovipositor-cum sting, a structure is developed which aids in egg laying. It is said that the queen gets mated only in her life but in a single chance of mating, drone releases two crore sperms which are sufficient for the fertilization of the eggs at the time of laying by the female throughout her life span.

One queen lays about 1,500 – 2,000 eggs in day. In the whole life span of 2-5 years a queen lays about 15,00,000 eggs. When the queen in a colony loses its egg laying capacity, another worker of the same colony starts feeding on queen's diet i.e., Royal Jelly and develops into a new queen and is provided with the facilities of real queen. At the same time old queen may be driven

out but sometimes some workers object that as to why the mother of the colony be driven out so ultimately they also come out with the mother. Sometimes when 2 to 3 queens are developed in a colony, only one takes the position of the real queen and the others come out with some workers to establish new colonies. This phenomenon is known as swarming.

(2) **The Drone :** The drone is the male member of the honey bee colony which fertilizes the queen so called as king of the colony. They are reared from an unfertile egg in large drone cell. Drone are totally dependent on the workers and have been seen begging for honey from the workers. The sole duty of the drone is to fertilize the virgin queen. At the time of mating flight the drone follows the queen, copulates and dies after copulation.

(3) **The Workers :** Although the workers are the smallest of the three castes but they function as the main spring of the complicated machinery like honey bee colony. Like the queen, they are also produced from the fertile eggs laid by the queen and live in a chamber called as 'worker cell'. It takes 21 days in the development from the egg to the adult and the total life span of a worker is about 6 weeks. That is why they are provided with some special structures for particular work.

- (i) Long proboscis for sucking the nectar.
- (ii) Strong wings for fanning.
- (iii) Pollen baskets for the collection of pollen.
- (iv) Powerful sting to defend the colony against any attack.
- (v) Wax gland for wax secretion.

Like all other insects the body of the honey bee is distinguished into three regions head, thorax and abdomen.

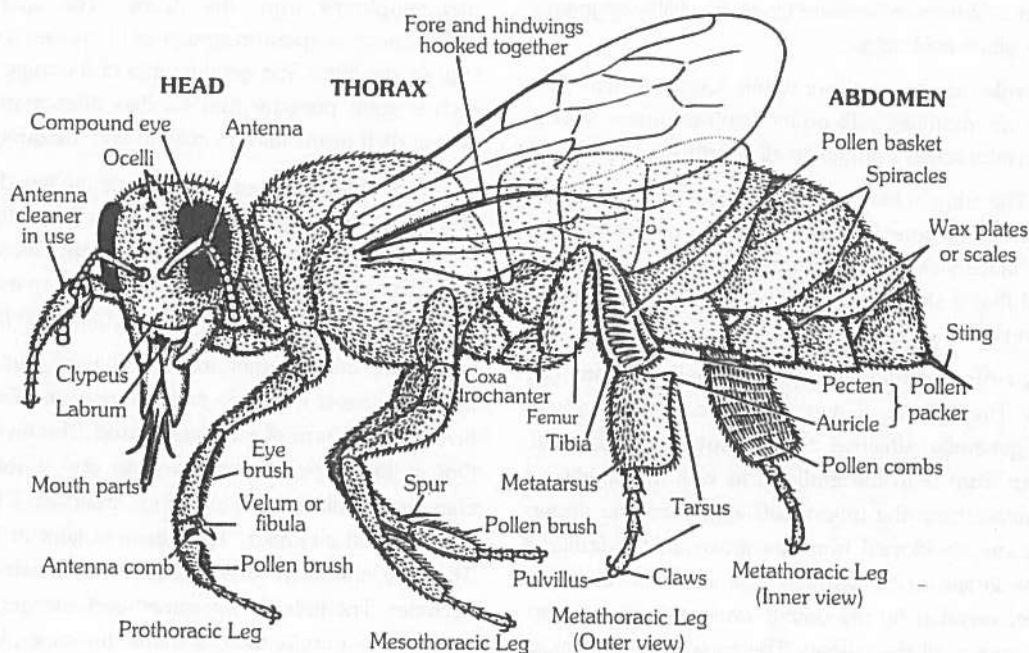


Fig : 8.5-2 *Apis* (Honey bee). Worker bee in lateral view

(1) **Head** : It is a wide triangular structure with the apex pointed below. It bears dorsolaterally a pair of large compound eyes and three ocelli on the middle of its top. From the bottom of the head project the specialized mouthparts. Mouthparts of honey bee are of chewing and lapping type, which is adapted for taking nectar from flowers and moulding the wax. The sugary fluid is sucked up by the sucking action of pharynx, it passes into the crop and regurgitated and stored in the cells of comb as honey. Sugary extract of flower is converted into honey by an enzyme which is produced by the glands.

(2) **Thorax** : The thorax is divided into three segments an anterior prothorax, a middle mesothorax and a posterior metathorax. Each of these segments bears a pair of legs and a pair of wings is borne by the mesothorax as well as metathorax. Legs are densely covered with hairs and are variously adapted.

(i) **Prothoracic legs** : The segments of the prothoracic are (a) an oblong coxa, (b) a short trochanter, (c) a long femur provided with pollen-carrying hairs, (d) a tibia with pollen-carrying stiff hairs, or pollen brush and a movable plate-like velum, and (e) a segmented tarsus, terminating in a pulvillus and a pair of claws.

(ii) **Mesothoracic leg** : The legs of mesothoracic segment have all the segments as foreleg. The tibia bears a pollen brush on its inner surface and a spine like pollen-spur on its distal end.

(iii) **Metathoracic leg** : Segments of the metathoracic legs are the same as prothoracic and mesothoracic legs. The tibia bears pollen basket on its outer concave surface which is partially covered by rows of long curved bristles arising from its margin. Distally the tibia is composed of rows of spines constituting the pecten. The proximal end of the metatarsus bears a concave lip-like structure, the auricle. The pecten and auricle together form a pollen packer to convey and pack pollen into, the pollen basket.

(3) **Abdomen** : Abdomen is made up of six visible segments and possesses wax gland and stings.

(i) **Wax glands** : On the last four visible segments, wax cells are situated, which are modified cells on the ventral surface. Wax is produced in the form of scales through small apertures.

(ii) **Sting** : The sting is the modified ovipositor of the insect and is used for injecting poison. It is composed of two straight grooved stylets or lancets. A pair of filiform poison glands secretes the acidic material that is stored in a sac-like poison sac located at the base of the sting.

**Life History** : After mating the queen generally lays one egg in one brood cell. The eggs are pinkish coloured, elongated with cylindrical body generally attached to the bottom of the cell. Larvae emerge out from both the fertilized as well as unfertilized eggs. Thus, the larvae from the unfertilized eggs form the drones while the workers are developed from the larvae of the fertilized eggs. Amongst the larvae of the workers one is fed on the royal jelly, a special diet secreted by the young workers in the colony, and becomes the queen of the colony. The royal jelly consists of digested honey and pollen, mixed with a glandular secretion into the mouth of the workers.

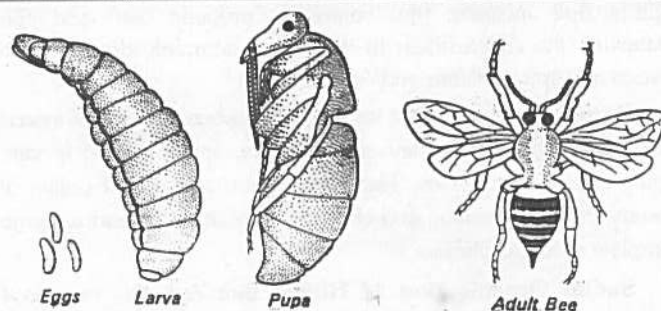


Fig : 8.5-3 Life history of *Apis indica*

(1) **Swarming** : The behaviour of the honey bee to come out of the hive in large number is called swarming. It takes place during the spring or early summer. It relieves the over crowding and provides a means of colony reproduction, i.e. founding of new colonies.

(2) **Supersedure** : When the egg laying capacity of the old queen is lost or it suddenly dies, a new young and vigorous queen takes the position of the old queen and is called as supersedure.

(3) **Abscinding** : The migration of the complete colony from one place to another takes place due to some unfavourable condition of life, such as destruction of the comb by termites or wax-moths and scarcity of nectar producing flowers around the hive. The phenomenon is quite different from that of swarming.

(4) **Nuptial or marriage flight** : The prime swarm is led by the old queen while the second swarm is accompanied by the newly emerged virgin queen. About a week after emergence, the new queen takes her first aerial flight followed by a swarm of drones. The queen flies very high and drones gradually drop out of the race. The last drone left in the race, mates with her. Mating occurs in the mid-air, during which the queen receives spermatophores from the drone. The sperms are stored in spermatheca or sperm-reservoir of the queen to fertilize her eggs as long as she lives. The genital parts of the male are forced out with such a great pressure that he dies after mating. Along with the queen, died drone falls on ground and the queen reaches the hive.

**Bee-Hive** : Honey bee is one of the few domesticated insects. In modern days bee colonies are reared in artificial wooden boxes for maximum production of honey and wax. The artificial box where the bee colony is maintained and managed is called **hive**. The place where hives are kept and managed is called apiary.

There are different models of hive; but the most common model in use is Newton's hive designed by Rev. Fr. Newton. The hive is in the form of a wooden stand. The hive has two chambers. One is the upper and the second one is the lower. The upper chamber is called super or honey chamber. The lower chamber is called brood chamber. The queen is kept in the brood chamber. The two chambers are separated by a wire grid called queen excluder. The holes in the queen excluder are so smaller that they prevent the entry of the queen into the super, but allows other bees to pass through. As a result the eggs are laid only in the brood chamber. The super chamber is meant for storing honey.



Honey mainly consist of monosaccharides

Both the chambers contain about 7 rectangular wooden frames called comb frames arranged vertically. The vertical frames are filled with comb foundation sheet. These sheets are made of wax and contain hexagonal imprints. They are detachable. They are available in the market.

**Honey extraction :** Honey is stored in combs of super frames. It is extracted from the comb by a simple machine called honey extractor. It has a drum containing a rack inside to hold the super frames. It is made to rotate by a set of two-gear wheels, operated by a handle.

The super frames are removed from the hive. The caps of the comb cells are cut off by a double edged knife. Then the frames are fixed in the rack and the rack is made to rotate by operating the handle. The honey is forced out into the drum from the comb cells. From the drum the honey is collected in vessels through an exit present in the drum.

**Location of Apiary :** The hives should be set, in places where there are plenty of flowering plants. The place should be neat and clean and free from any obnoxious smell. There should be clean drinking water near by because each bee colony requires two glasses of water per day for their survival

#### Protection

(1) Honey bees should be protected from garden lizard and snakes.

(2) Black ants steal honey. So water should be placed at the base of the stand.

(3) Wasps kill honey bees. So protection should be provided against wasps.

(4) Wax-moth damages the combs. So the combs must be " protected from wax-moths.

**Formation of honey :** Honey is a viscous sugary fluid formed from the nectar within the stomach of the honey bee. The bees visit flower, suck the nectar, store it in the stomach and return to the hive. In the stomach the nectar is processed. It is regurgitated and swallowed repeatedly for about 240 times. Then the processed nectar is deposited in the comb cells. This processed nectar is called unripe honey or green honey. It contains about 80% water. The unripe honey is converted into ripe honey by evaporation. The ripe honey contains less than 20% water. When the honey becomes ripe, the cells are capped or closed. The honey in the unsealed cell is unripe.

**Chemical composition :** Honey contains nearly 80 different substances of importance to human beings. The important chemical are as follows

(1) Levulose	-	38.9%
(2) Dextrose	-	21.28%
(3) Maltose & other sugars	-	8.81 %
(4) Enzymes & pigments	-	2.21%
(5) Ash	-	1.0%
(6) Water	-	17.20%
(7) Vitamins	-	A, B, B <sub>2</sub> , B <sub>3</sub> , B <sub>6</sub> , C, E, and K
(8) Minerals	-	Ca, Na, K, Mg, Fe, P, S etc.

**Value of Honey :** Honey is a valuable food and medicine. Its uses are summarised below:

(1) As it has high content of sugar it is used as a sweetener. Until last century before the discovery of sugar throughout most of human history honey was the only available sweetener.

(2) Honey has a high calorific value. One kilogram of honey has 3350 calories while 1 litre of milk contains only 310 calories.

(3) Many athletes drink honey before games and between events in order to restore the energy used up.

(4) Doctors prescribe honey for old people and children who need to build up their strength quickly.

(5) Honey is used to heal wounds.

(6) It is used to cause free urination.

(7) It is used as a means of easing the belly.

(8) It is a good tonic for ulcer.

(9) It facilitates digestion and improves appetite.

(10) It prevents a running nose. It is a sure remedy for cold and cough.

(11) Honey is used as medicines for children to treat complaints of the liver.

**Bee wax :** Bee wax is secreted by the abdominal gland of bees. It is used for the construction of comb. It is a yellowish solid insoluble in water. It is used for the preparation of paints, varnishes, candles, models, etc. It is used as a ground substance for the preparation of ointments, creams etc. It has many industrial uses. It is used extensively in engineering industries, railways, textiles, leather industries etc.

**Bee venom :** Bee venom is secreted by the poison-glands of stings. Bee venom is a curative toxin in humans. It is transparent and it has a bitter burning taste. It is acidic in nature. It contains formic acid, histamine, tryptophan, sulphur, many proteins, volatile oils, enzymes like hyaluronidase and phospholipase and magnesium phosphate. Clinically it has the following uses :

(1) It is an active remedy for rheumatism.

(2) It is used to treat certain eye diseases like keratoconjunctivitis (inflammation of cornea), iris (inflammation of iris), iridocytis (inflammation of iris and ciliary body).

(3) It is used to cure skin diseases like tuberculosis of the skin.

(4) The cholesterol level in blood falls by the treatment of bee venom.

(5) Bee venom controls blood pressure.

**Communication and Dance of honey bee :** Ernst Splytznr (1788) explained for the first time that honey bees communicate with each other by means of definite movements of their body, now called bee dance. Later on Prof Karl von Frisch (1946 – 1969) studied and decoded the language of the dance of honey bee and he was awarded Nobel Prize for his work. He explained that scout bee performs 2 types of dance :

(1) **Round dance** : Round dance is performed when a newly discovered food source is close (less than 75 metres) to the hive. There is no indication of direction of the new source in this dance; the smell of flower brought back by the scout bees tells the foragers the kind of flowers for which to search.

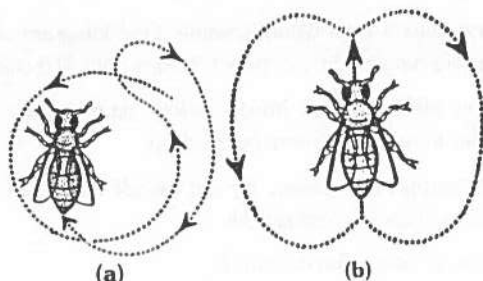


Fig : 8.5-4 Honey bee. Dances. (a) Round dance, (b) Tail wagging dance

(2) **Tail wagging dance** : It is performed for long distance (more than 100 metres) sources of food. It is also called shuffle dance. By this dance the scout bee conveys the direction of new source with reference to the position of the sun. In the tail wagging dance scout bee swiftly and repeatedly moves along a straight line and then makes two semicircles along the side of this line. If during this dance tail wagging is directly vertically upwards it indicates that the source is present towards the sun. If tail wagging is vertically downwards it indicates that the source is present opposite to the sun. If tail wagging is in oblique direction, it indicates that the source is located at an angle to the position of the sun.

**Bee keeping industry** : Before 1953 attention to bee-keeping was paid only by state governments but in the same year, all India Khadi and Village Industries Commission (KVIC) started to pay attention to it and it was controlled by Union Government itself. Due to the functioning of the central organisation, bee-keeping industry was spread in South India in some northern states also. Now-a-days bee-keeping industry is nation wide and is a good source of cottage industry.

### Lac Culture

Lac is the resinous secretion produced by lac insect as protective covering around its body. It belongs to genera *Laccifera* or *Tachardia*. *Laccifera lacca* is the common Indian lac insect. It lives on the trees of fig family namely kikar, ber (*Zizyphus mauritiana*), babul (*Acacia nilotica*), dhak or palas (*Butea monosperma*), kusum (*schleichera oleosa*), Katha or khair (*Acacia catechu*), peepal (*Ficus religiosa*) and gular (*Ficus glomerata*).

Lac insect feeds upon the sap of its host plant like any other sap sucking insect. It is found in India and Philippine islands.

**Male and female chambers** : The adult male and female insects live on the tree twigs enclosed in thick capsules or chambers separately. The male chamber are elongated and cigar-shaped. Each male chamber has a branchial aperture in its anterior part.

The female chamber is smaller and rounded. It has a branchial aperture in its anterior part and a tubercular or anal opening in the posterior part.

**Male and female lac insects** : The female is more degenerated. It has a bag-like body with a small reduced antenna. The eyes legs and wings are lost during metamorphosis. The male lac insect is red in colour. It has an incipient head with antennae and eyes. The thorax has three pairs of legs and abdomen carries genital sheath, penis and a pair of long caudal setae, one on either side of genital sheath.

The wings may be present or absent. Because of the absence of mouth parts, the insect is incapable of feeding.

**Life-cycle** : The male lac insect crawls out of its chamber by pushing open the operculum reaches the female chamber and fertilizes the female through the anal or tubercular opening of female shell. The male dies soon after copulation. The female secretes more resin forming a large sized chamber. Thus the secretion by females mainly contributes to lac.

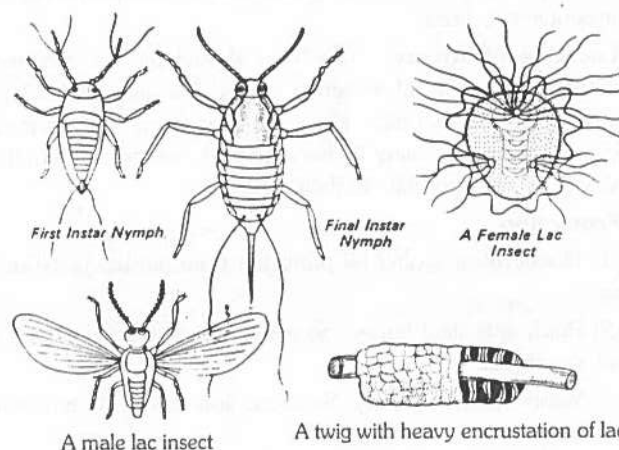


Fig : 8.5-5 (*Tachardia lacca*)

Oviposition takes place into a space inside the female chamber made by the contraction of the body of female. This space is called incubating chamber. Each female lays 200-300 eggs. The eggs hatch into red coloured larvae. These crawl out of the female's incubating chamber. The mass emergence of larvae is called swarming.

Each larva is boat-shaped in appearance and is about 1/2 mm in length. Its head bears paired antennae and the ocelli. The mouth parts are of piercing and Sucking type with maxillae and mandibles together forming the sucking tube or proboscis. Its thorax is three segmented and each thoracic segment carries a pair of walking legs. The abdomen bears a pair of long caudal setae.

**Attachment of larvae to new shoots** : The larvae on emergence crawl on the twigs of any one of the host trees mentioned earlier and settle down on the undersurface of new shoots. These prefer young succulent shoots. These force their proboscis through the bark and insert it into the phloem tissue and start feeding. Here these metamorphose into the adult insects and by secreting lac enclose themselves into the chambers.

**Secretion of Lac** : The secretion forms a shining layer over their bodies in the beginning but hardens and becomes opaque later on. The secretion is produced by the cutaneous glands of the

skin and is deposited around three openings the two branchial apertures at the anterior end and anal opening at the posterior end. The secretion is in the form of waxy filaments which have a woolly white appearance. On coming in contact with air, these join to form a continuous covering.

**Composition of lac :** Lac is a complex substance having large amount of resins, together with sugar, water and other alkaline substances. The percentages of various constituents are as given below

(1) Resin	– 68 to 90 %
(2) Dye	– 2 to 10 %
(3) Wax	– 6 %
(4) Albuminous matter	– 5 to 10 %
(5) Mineral matter	– 3 to 7 % and
(6) Water	– 3 %

**Lac Cultivation :** In order to obtain lac, lac insects are cultured and the technique of lac production is known as the *lac culture*. It involves proper care and regular pruning of the host plants, propagation of insects, and collection and processing of lac. For the purpose of propagation the older branches containing crusts are tied with new branches and this method is called *oculation*. When new crusts are formed, the old twigs are removed (approximately 20-30 cm long) and this is known as *harvesting*.

**Extraction of Lac :** The largest yield of lac and dye are obtained by harvesting the infested twigs while females are still living. The harvesting is done twice a year in June and November. The encrusted twigs are pruned and lac scrapped from them. This is known as *stick lac*. It is grounded and sieved. The resulting granular lac is called seed lac, and the fine particles the dust lack. The seed lac is washed, melted spread out in a thin layer and dried thus forming the shellac of commerce. The dust lac is used for making toys, shellac is used in the preparation of varnishes, paints and polishes; in making gramophone records and in filling ornaments like bangles and bracelets. It is used as insulating material.

#### Damages Caused to Lac Crop

(1) Lac crops is reported to be damaged by squirrels, rats, and monkeys.

(2) Certain insects also attack lac insect.

(3) **Parasites :** Eight species of chalcidoids live as parasites in the body of lac insects. These deposit their eggs into the body of insects through their anal opening.

(4) **Predators :** *Eublemma amabilis* and *Holcocerea pulvereana* are the two lepdoteran predators that damage about 35% of the lac cells. Their females lay eggs on or near the encrustation. The larvae that hatch out bore through the lac deposit and feed on lac insects.

#### Precautions to be Taken During Lac Culture

(1) Lac intended to be used as brood should be cut at or near the swarming period, never more than one week before.

(2) Lac to be used as brood must be healthy and resistant to the parasite and predator's attack.

(3) Lac used as brood should be removed after a maximum period of 3 weeks from the date of swarming.

(4) All brood lac after use and the lac cut from the tree should be scrapped from the sticks to destroy larvae and pupae of predators of parasites.

(5) Lac should not be stored after cutting. It should be treated as soon as possible.

(6) Fumigation and water immersion immediately after cutting are also helpful in the disinfection of Lac by insects.

**Economic importance of Lac :** Lac is used in the preparation of sealing wax (shellac), paints, varnish, the manufacture of photographic materials, electrical goods. Lac is also used in the preparation of bracelets, buttons, toys and in filling hollow gold ornaments. Lac is also utilized in confectionery trade and in artificial leather and pottery. Gramophone industry used to consume 30-40% of the annual production in the preparation of records.

**Cultivation of Lac in India :** India has monopoly in the production of lac. It is about 75% of the world's total output. Approximately 40 lakh ponds of lac is produced. Bihar M.P. and west Bengal are major lac producing states in India. Thailand is major competitor of India as it shares 25% of the total exports. India exports about 1,80,400 kg. of lac The use of lac is being gradually replaced by plastic.

#### Poultry

Poultry includes the birds like chicken (hen), ducks, geese and turkey. Poultry farming deals with the rearing of them for their eggs and meat. Fowls are widely distributed as domesticated animal since time immemorial, but in the present century, it has become an important small scale industry due to modern need for palatable and nutritive food which it provides in the form of eggs as well as adult animal. An egg laying poultry bird is called hen (layers) and the poultry birds groomed for obtaining meat are called chicken or broilers.

India and the neighbouring countries, like Burma, Sri Lanka are the original home of the red jungle fowl (*Gallus gallus*). It seems that Aseel or Malay fowl were carried to Europe through the Middle East about 2,000 years ago and have given rise to the present-day European breeds.

**Poultry farming v/s livestock rearing :** Poultry birds are easy to raise, can be acclimatised to a wide range of climatic conditions, have short life span and are prolific breeders and thus poultry farming is advantageous over livestock rearing. Hens have an average yield of 60 eggs per year, but high yielding varieties can produce more than 240 eggs in a year.

Poultry contributes about Rs. 7,500 crores to the gross national product (GNP) of India. India ranks fifth in the world's egg production. Egg is one such food commodity which cannot be adulterated. The average per capita consumption is about 32 eggs and 600 grams of poultry meat a year. At present poultry is estimated to provide employment to about seven lakh families.



### Raising of poultry

(1) **Fowl house** : Fowls can be reared in the hills of India without houses, but in the plains, well-ventilated and illuminated, dry houses are essential. A house of 1.8 x 1.5 x 1.5 m has sufficient accommodation for six fowls. An open shed or verandah must be attached to this house as run to the fowls for exercise. The fowl house may be either of wood or brick and the roof is made up of corrugated iron sheets, thatch or wood. The house and shed should be cleaned daily. Fowls of different ages are kept in separate houses. In regions with moderate climate, they are kept in cages (coops).

(2) **Feed** : The quality and balanced quantity of food material are the back-bones of poultry. The feed given to poultry birds should contain all the essential nutrients like carbohydrates, fats, proteins, minerals and vitamins. The feed usually consists of mashed cereals like bajra, wheat, maize, jowar, ragi, rice bran and oil cakes. The fish meal prepared from the wastes of fish processing industry and meat meal prepared from the wastes of meat processing industry is also used to feed poultry birds.

(3) **Breeds of fowls** : The whole poultry industry is centred round the fowls so the selection of good breed of birds for particular area is essential. The selection of fowl breed should be based on the object with which fowls are kept. Some important indigenous breeds of domestic fowl (desi hens) include Aseel, karaknath, Basara, Chittagong, Ghagus, Brahma and Cochin. Desi hens are hardy (strong) and possess natural immunity against common diseases, but they are small, slow growing, and lay small-sized and less number of eggs. The average egg production of a desi hen is about 60 eggs per annum, which is very poor. Keeping this fact in mind, a large number of poultry birds have been imported, breed and acclimatised to local conditions. Some of these are excellent egg layers while others are good meat producing birds. Some of the high egg-yielding exotic breeds of hens which have been successfully acclimatised in India include white Leghorn, Rhode Island Red, Black Minorca, Plymouth Rock, Light Sussex and New Hampshire. White Leghorn is one of the most popular egg breeds all over the world. The local varieties of hen (desi hens) have been cross breed with the high-yielding varieties of exotic breeds to obtain new breeds which combine the good characteristics of both the breeds. The new improved breeds (hybrid breeds) of poultry birds grow fast, take less feed, lay more bigger-sized eggs, and are more resistant to diseases. ILS - 82, B - 77 HH - 260 are some important improved, high yielding breeds developed in India by cross breeding. The ILS-82 and B - 77 breeds lay about 200 eggs, whereas HH - 260 breeds lay more than 260 eggs per annum.

(4) **Diseases of poultry** : The poultry keeper should always be careful against the diseases. Some important diseases of poultry birds are fowl pox, ranikhet (viral), fowl cholera, salmonellosis, diarrhoea, coryza (bacterial) and aspergillosis (fungal). However, the most common disease amongst fowls is Ranikhet disease, caused by a virus. The disease affects the fowls of all ages.

Mortality is very high about 98 to 100 per cent. But, with better management, proper housing and nutrition and timely vaccination of the chicks, the disease can be controlled very effectively.

**Other poultry birds** : Besides domestic fowl, other birds like ducks, turkeys, etc are also raised. Ducks comprise about 6 per cent of the total poultry population in India. They are more abundant in the southern and eastern parts of India. Muscori, pekin, Aylesbury, Campbell, Indian Runner and Syhlet meta are some important breeds ducks. Narfold, British white, Broad Breasted Bronze and Beltsville small white are some important breeds of turkeys in India.

**Poultry development in India** : Poultry is one of the important component of the farmer's economy as it provides additional income and job opportunities to a large number of rural population in the shortest possible time. Central poultry breeding farms at Bombay, Bhubaneshwar, Hessarghatta and Chandigarh engaged in scientific poultry breeding programme developed high egg producing hybrids and fast growing broiler breeds. Central Duck Breeding Farm at Hessarghatta is catering to requirements of high egg producing khaki campbell breeding stock duckling. The poultry industry has grown rapidly in India in the last twenty years from a backyard farming activity to a modern and highly scientific industry. As a result of government's efforts, during the seventh plan period, egg and broiler production registered a compound growth rate of 7.3 percent and 18 per cent respectively. The egg production is estimated to be about 26.1 billion in 1994-95.

### Fisheries

Fishes are a valuable and easily accessible source of food, rich in protein, highly nutritious and easily digestible. By the aquatic animals, they are abundantly available from sea, rivers, lakes, ponds and marshes.

Aquaculture is the production of useful aquatic plants and animals such as fishes, prawns, shrimps, lobsters, crabs, molluscs by the proper utilization of small and large bodies of water. Pisciculture is the production and breeding of fishes by man in ponds.

India has abundant marine and inland fish resources. It has a coast line extending to 4667 Km long and a continental shelf of 2,59,00 square Km offering good scope for fish production. The fish production has increased many folds since India got independence. During 1990-91 the annual fish production of our country has been 38.22 lakh tons. The *per capita* consumption of fish in India is estimated at 1.51 Kg/year. India is at present the 6<sup>th</sup> foremost seafood producing nations in the world.

**History** : From pre-historic period, fishes have used as protein rich diet for human beings. The popularity of fishes has been mentioned in our religious books like Ramayana and Mahabharata also.

In west Bengal, Bihar and orissa, the fish industry is about 1,500 years old. In Bengal every family traditionally has atleast one pond for fishes.

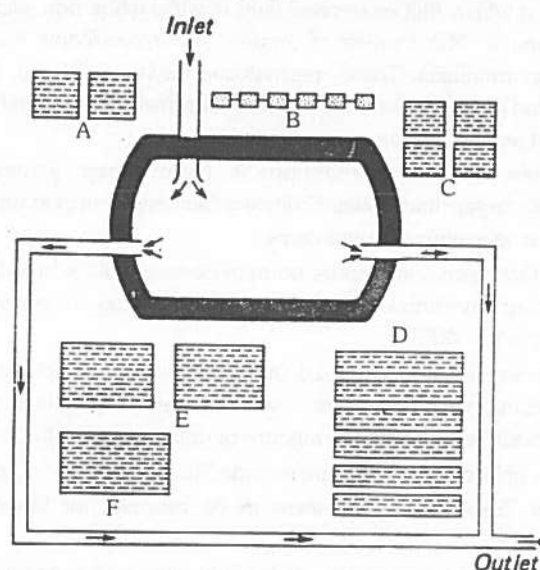
Table : 8.5-8 Cultivable fish species

S.No.	Zoological name	Common Name	Areas of availability
(a)	<b>Fresh water fishes</b>		
1.	<i>Catla catla</i>	Catla	All over India common in Krishna and Godavari rivers
2.	<i>Labeo rohita</i>	Rohu	North, East and South India
3.	<i>Labeo calbasu</i>	Calbasu	North and South India
4.	<i>Cirrhinus mrigala</i>	Mrigal	North and South India
5.	<i>Mystus singhala</i>	Singhara	All over India
6.	<i>Heteropneustes fossilis</i>	Singhi	All over India
7.	<i>Wallago attu</i>	Malli	North, east and South India
8.	<i>Clarius batrachus</i>	Fresh water shark magur	All over India
(b)	<b>Brackish water fishes</b>		
1.	<i>Chanos chanos</i>	Milk fish	A.P.coast
2.	<i>Mugil cephalus</i>	Grey mullet	East coast
3.	<i>Lates calcorifer</i>	Perch	East coast
(c)	<b>Marine fishes</b>		
1.	<i>Sardinella longiceps</i>	Oil sardine	West and south coasts
2.	<i>Harpodon heherius</i>	Bombay duck	Maharashtra coast
3.	<i>Hilsa ilisha</i>	Hilsa/ Indian shed	Coastal India
4.	<i>Stromateus sinensis</i>	Pomphret	Indo pacific coast
5.	<i>Anguilla anguilla</i>	Eel	Coastal India
6.	<i>Aluitheronema</i>	Salmon	East and west coast
7.	<i>Cyano-glossus semifasciatus</i>	Flat fish	East coast of India

**Culture method :** The success in fish culture and the high production of table - size fish through carp culture depends largely on the designing and construction of ponds. The basic principles involved in designing and construction of carp culture ponds are of very specialized nature and vary from region to region depending upon several factors like topography, soil types, water supply etc. The requirements with regard to the designing and construction of fish farm are entirely different from those attributed to agriculture and animal husbandry farms.

**Types of Ponds** Ponds for carp culture may be broadly classified into three types : (1) the nursery ponds, (2) the rearing ponds and (3) the stocking ponds. The ponds which are small and shallow are used for raising fry from spawn (4-5 mm to 25-30 mm) may be termed as Nursery ponds or Nurseries. Ponds used for rearing fry upto fingerling stage (50 mm and above) are known as Rearing ponds. The rearing ponds are slightly larger but not proportionately deep and are used for rearing fry upto fingerling (50 mm & above) stage. While ponds which are used for stocking

fry/fingerlings to obtain table-size fish may be called as stocking ponds. The stocking ponds are still larger and deeper (0.2 to 2.0 ha in size and 2 m to 2.5 m in depth).



- A- Breeding ponds      B- Hatching pits  
C- Nursery ponds      D- Rearing ponds  
E- Stocking ponds      F- Marketing ponds

Fig : 8.5-6 (A Fish Farm)

**Species Composition and Species Densities :** Rearing of dietetically compatible species is one of the fundamental principles in fish culture. The divergent feeding habits of the Indian major carps and of the exotic Chinese carps are therefore taken advantage of in mixed culture. This divergence of feeding habits develop, as stated earlier, from advance fry stage and yet limited over- lapping in feeding habits is but to be expected. In view of this, trials were made with two, three, four and six species compositions, within which variation in species densities or ratios were also attempted. Some of the combinations tried were as follows :

Silver carp + Grass carp	:: 1:1
Catla + Rohu + mrigal	:: 2:4:4
Silver carp + grass carp + common carp	:: 4:3:3
Catla + Rohu + Mrigal + common carp	:: 3:4:1:2
Catla + Rohu + mrigal + Grass carp	:: 8:3:1:4
Silver Carp + grass carp + common Carp + Rohu	:: 2.4:1.2:2:2.4
Catla + Rohu + Mrigal + Silver Carp + Common Carp	:: 2.4:4.8:1.0:2.4:2.4

#### Types of Breeding

(1) **Natural Breeding Habits :** Major carps are essentially river fishes. They normally do not breed in confined waters Major carps breed in rivers throughout monsoon month's i.e. June to August. Major carps exhibit local migration in monsoon months. After travelling some distance against current in flowing waters, they enter shallow marginal inundated waters, where they breed.

These fishes do not exhibit any parental care. Ova are small, numerous and fertilization is external. Females lay eggs and the males sprinkle its milt over the eggs which are fertilized by inter-mixing of water. Milt or seminal fluid is milky white non-sticky and non-granular. Milt consists of innumerable microscopic structures called spermatozoa. These spermatozoa have small head. During the period of their existence, they are extremely active inhabiting a constant jerking motion.

There is sexual dimorphism in major carps. Females are generally larger than males. Following factors are important which influence spawning of major carps.

(i) Optimum temperature seem to be essential for breeding but major carp have known to breed over a wide range of temperature between 4<sup>0</sup> C - 40<sup>0</sup> C.

(ii) Some have suggested that excessive dissolved oxygen is essential but carps have bred in water where the dissolved oxygen was actually reduced due to mixture of pollutants after the floods.

(iii) pH from 7.5 to 8.3 are recorded to be suitable for spawning.

(iv) Turbidity do not seem to be essential for breeding of major carps.

(v) Fish spawning induced by lightening and thunder is also doubtful. Cloudy day, however, seemed favourable for breeding of carps.

(vi) Endocrine and sex stimulating hormone of pituitary gland and series of subsequent physiological changes are important for spawning

(2) **Bundh Breeding of Indian Major Carps** : Indian major carps i.e. *catla catla*, *Labeo rohita* and *Cirrhinus mrigala* do not naturally breed in confined waters though they attain sexual maturity in these environments. Their natural breeding takes place in rivers, certain reservoirs and in artificially constructed bundh type tanks where favourable conditions stimulate than for spawning bundhs breeding contribute a lot to induce breeding of major carp fish.

The bundhs are of two types viz., Wet bundh and dry bundh.

(i) **Dry Bundh** : A dry bundh is a shallow depression enclosed by earthen walls, (locally known as bundh) on three sides and an extensive catchment area on the fourth. Bundhs get flooded during the south-west monsoon, but remain completely dry for a considerable period during the remaining part of the year.

The topography of the land has a great role to play in the location and distribution of the dry bundhs. In Bankura district of West Bengal, most of the dry bundhs, are fed with water from storage tanks, constructed in the upland area.

(ii) **Wet Bundh** : The wet bundh is a perennial pond located on the slope of a vast catchment area of undulating terrain, with proper embankments having an inlet facing towards the upland and an outlet towards the opposite lower ends. During summer, the deeper portion of the pond retains water containing breeders. The remaining portion is dry and is used for agriculture.

(3) **Induced breeding** : One of the dependable source of quality seed supply is by inducing major carps to breed in ponds by the use of pituitary hormone injections. Pituitary extract for inducing fish to breed is used extensively in many countries. Use of fish pituitary extracts for stimulating spawning of Indian Major carp is met with considerable success in recent years. The cost of seed

production by induced breeding is very low as compared to the collection made from natural resources.

**Hormone Injection** : Major carps do not breed in ponds due to the fact that the environmental factors which are responsible for spawning in natural habitats are absent in confined waters. Sex stimulating hormones of the pituitary gland play an important role in the maturation of gonads and spawning in fishes.

The pituitary extract can be kept effectively and utilized successfully in inducing spawning of major carps through injection.

The method of injection of pituitary extract are following types.

(1) Intramuscular (2) Intra peritoneal (3) Intracranial

### **Economic importance of fishes**

(1) **Oils** : Fish oils are employed in leather industry for chamoising.

Fish body oils are also employed in the manufacture of candles, lubricants, cutting oils etc. Liver oil is a valuable source of vitamin A and Liver oils are of medicinal use.

(2) **Fish protein** : It is used for edible and industrial purposes.

(3) **Fish Meal** : It is prepared from the wastes of fish oil or canning industry or from the whole fish of non-oil type. Wastes of cod industry are known as "**White fish meal**". The chemical composition of fish meal is.

(i) Proteins = 55 to 70 %

(ii) Minerals = 10 to 20 %

(iii) Moisture = 6 to 12 %

(iv) Calcium = 5.36 %

(v) Phospholipids = 3.42 %

(vi) Iodine = Traces

(vii) Vitamines = A, D and K

Fish meal is also used as major food of domestic animals like pigs, poultry, cattle, etc. It contains easily digestible proteins, calcium and phosphorus.

(4) **Fish glue** : It is a product mainly of tail regions of fishes such as cod, Haddock, pollack, Hake etc.

(5) **Ising glass** : It is a high grade collagen produced from the air bladder or swim bladder of certain fish viz., cat fishes and carps. The air bladder or swim bladder is firstly washed to remove the blood and other extra matter and then outer layer is scrapped off. The scrapped bladder is used for the preparation of purse, honey comb, book and ribbon.

(6) **Fish fins** : The fins of large sized sharks are used for the preparation of soups and further washed into sea water, dusted with wood ashes and lime and finally sun dried to get the cured shining product.

(7) **Fish flour** : It is highly nutritive food human beings, and prepared commercially by solvent extraction process. It is easily digested by the infants of 3 to 4 months also and is eaten in the form of biscuits, bread cakes, sweets and soup. It has particular odour so it has to be treated chemically to remove the bad smell.

(8) **Fish fertilizer** : The wastes obtained during the preparation of fish meal is widely used as manure for coffee, tea and tobacco plantation.



## Pearl Culture

**History of Pearl Industry :** For the first time the idea of pearl industry was evoked in Japan which was carried out in the Bay of Japan located at South coast of Hansoo. But in Japan, pearl culturists feel difficulty due to unfavourable climatic conditions. Kokichi Mikimoto (1858-1954) is referred to be the father of pearl industry. Pearl is a concretion formed by molluscs. It consists of nacre or mother of pearl. It is characterised by iridescence and translucence.

Pearls is produced by the marine molluscs such as pearl oyster and mussel.

**Types of pearls :** Pearls are of seven types. They are the following –

- (1) **Lingha pearl :** This is the best quality pearl obtained from marine oysters.
- (2) **Seed pearls :** The small pearls are called seed pearls.
- (3) **Baroque pearls :** These are spherical pearls formed inside the body.
- (4) **Blister pearls :** These are pearls attached to the shell. They are half-spherical in shape.
- (5) **Oriental pearls :** These are true pearls with a great lustre, beauty and a smooth surface.
- (6) **Natural pearls :** These are the pearls obtained from pearl oysters of deep oceans.
- (7) **Cultured pearls :** These are the pearls obtained from cultivated species of pearl oysters.

**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 % |

The pearl is formed of nacre. The nacre is formed of two substances namely a calcium carbonate which is in the form of argonite or calcite and an albuminoid substance called conchiolin/colchitin

**Pearl-producing animals :** Pearls are produced by bivalve molluscs. There are marine as well as fresh water animals.

- |                                   |                   |
|-----------------------------------|-------------------|
| (1) <i>Pinctada vulgaris</i>      | } Marine molluscs |
| (2) <i>Pinctada fucata</i>        |                   |
| (3) <i>Pinctada chemnitzii</i>    |                   |
| (4) <i>Pinctada margaritifera</i> |                   |
| (5) <i>Pinctada anomioidea</i>    |                   |
| (6) <i>Pinctada atropurpurea</i>  |                   |
| (7) <i>Haliotis</i>               |                   |
| (8) <i>Mytilus</i>                |                   |
| (9) <i>Placuna blacentia</i>      |                   |
| (10) <i>Placuna maxima</i>        |                   |
| (11) <i>Unio margaritifera</i>    |                   |

**Cultivable species :** Pearls are intensively produced by cultivating pearl oysters. The most important molluscs cultivated for pearls are *Pinctada vulgaris*.

**Biology of pearl oysters :** Pearl oysters are sedentary animals. They are attached to rocks. They have two valves. One valve is cemented to the rocks and the other free. They spawn twice in a year. The eggs are hatched into free swimming larvae. The larvae sink to the bottom of the water and develop into young oysters called spats. They grow to their maximum size in four or five years.

**Pearl formation :** The pearl oysters produce pearl as an adaptation against outside materials. When a foreign material such as a sand, grain or a parasite happens to enter the body it adheres with the mantle. The mantle epithelium at once grows over the material in the form of a sac and encloses it. This mantle epithelium starts secreting concentric layers of nacre around the foreign material. The completed structure is called pearl.

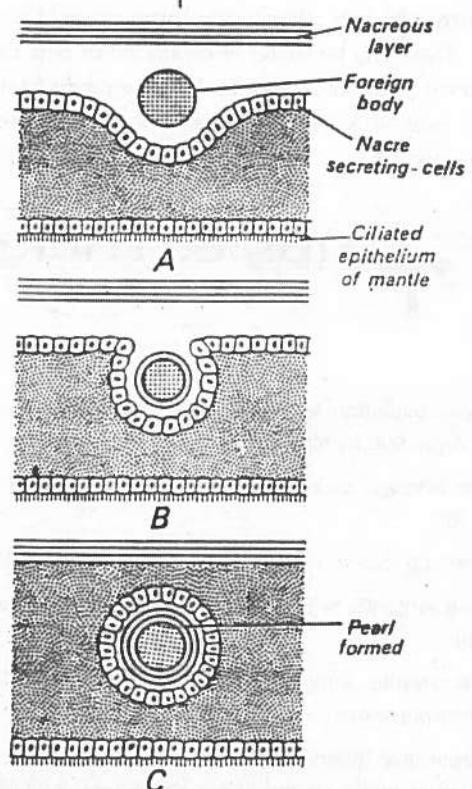


Fig : 8.5-7 Pearl formation

**Culture of pearls :** The culture of pearls is a complex but sensitive process. It involves the following steps.

(1) **Collection of oysters :** Oysters for pearl culture are obtained by three methods. They are as follows :

- (i) Pearl oysters are collected from the bottom of the sea.
- (ii) Spats (young oysters) are collected by placing cages in spat-falling areas of the sea.
- (iii) In the laboratory eggs of pearl oysters are fertilized and young ones are obtained.

(2) **Preparation of graft tissue :** The piece of tissue which is inserted into the oyster is called graft tissue. It is cut off from the mantle of another oyster. The graft must be in the form of a square of 2 × 2 mm in size.

(3) **Preparation of nucleus** : The nucleus is a foreign material which is inserted into the oyster. It is in the form of 2 mm in diameter. It is prepared from the shell of molluscs

(4) **Implantation** : The oyster is placed on a table. The foot is exposed. A small incision is made on the foot. On this incision the graft tissue is placed. The nucleus is placed on the tissue. Then the oyster is released in cages. The entire operation should be completed in 30 minutes.

(5) **Rearing of oysters** : The operated oyster are placed in cages and the cages are suspended from rafts in the sea. This type of culturing oysters is called raft culture.

(6) **Harvesting** : Pearls attain their maximum in three years. After three years, the oysters are removed from cages and the pearl is taken out. Chemically pearl is made up of  $\text{CaCO}_3$  and conchiolin.

**Quality of pearl** : The pearls obtained are of variable shape 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 known as 'lingha pearls' and obtained from marine oysters.

## T Tips & Tricks

✍ Super ovulation is a technique where a cow is made to ovulate more ova by injection of hormones.

✍ The average yield of buffalo is 495 kg. with 6.5 – 7.5 percent fat.

✍ Breeding season for buffaloes –September to February.

✍ Gastroenteritis is the second highest cause of buffalo calf mortality.

✍ The uterine and ovarian cycle of buffalo is 21 days (variations present).

✍ Karanswiss (hybrid breed of livestock) was developed at NDRI, Karnal, while sunandini was developed at NDRI Kerala.

✍ Lindane is an insecticide used to control external parasite like lice on cattle.

✍ Milk yield/cow/yr. in U.S.A. is 4250 kg. and 220 kg in India.

✍ Sex vigour in buffalo increases in colder season.

✍ Goat is also called 'Poor mans cow' because it yields only a small quantity of milk.

✍ Famous angora wool is obtained from a rabbit.

✍ Elephant is a source of ivory. It is obtained from tusks which are long, protruded upper incisors.

✍ Father of white revolution in India Vengrhes Kuriene.

✍ Operation flood started in 1970.

## OT Ordinary Thinking

### Objective Questions

#### Dogs and Cats

- The science of rearing, feeding, care, breeding and utilization of animals is called  
(a) Animism (b) Veterinary science  
(c) Animal husbandry (d) Dairy science
- The closest pets of human beings are  
(a) Elephant and sheep (b) Dog and sheep  
(c) Cattle and buffaloes (d) Dog and cat
- Earliest animal domesticated by primitive man was  
[CBSE PMT 1996]  
(a) Goat (b) Dog  
(c) Horse (d) Cat
- Which of the following animals is used for drawing sledges, tracing criminals, guarding sheep, leading the blind  
(a) Donkey  
(b) Horse  
(c) Dog  
(d) All these functions are not performed by any single animal
- The forward stereoscopic visual field will be the greatest in  
[AMU (Med.) 2010]  
(a) Cat (b) Deer  
(c) Rabbit (d) Horse

#### Cattles and Buffaloes

- Gelatin, a very important raw material for preparation of photographic emulsion, is a bi-product of  
[KCET 1998]  
(a) Chicken (b) Forest  
(c) Fish (d) Cattle
- Find out breedable form of animal (s)  
(a) Bull (b) Bullock  
(c) Mule (d) Both (a) and (b)
- From oldtimes cattle are being used for  
(a) Milk production (b) To draw water from wells  
(c) For production of biogas (d) All these purposes
- The milk of which one of these has more fat content  
(a) Cow (b) Buffalo  
(c) Sheep (d) Goat
- Which of the following country is lowest in milk yield per cow  
(a) India (b) U.K.  
(c) Switzerland (d) Netherlands
- Sunandini is  
(a) A famous dancer from Kerala  
(b) Name of a marine fish found at coasts of Tamil Nadu  
(c) A cow formed by hybridization of Indian breed and Jersey cow  
(d) None of the above
- Ongole cattle is the general utility breed of  
(a) Orissa (b) Andhra Pradesh  
(c) Gujarat (d) Bihar

8. Cattle fed with spoilt hay of sweet clover which contains dicumarol [AIIMS 2004]  
 (a) Are healthier due to a good diet  
 (b) Catch infections easily  
 (c) May suffer vitamin K deficiency and prolonged bleeding  
 (d) May suffer from Beri-Beri due to deficiency of B vitamins
9. Milch breeds produce  
 (a) Good milk producing buffaloes  
 (b) Good milk producing cows  
 (c) Good working bullocks  
 (d) None of these
10. Jaffrabadi breed is distributed in  
 (a) Gujarat (b) Malvi  
 (c) Hallikkee (d) None of these
11. The milk yielding capacity of Buffalo is  
 (a) Three times more than cows  
 (b) Double than cows  
 (c) Four times more than cows  
 (d) None of the above
12. The hormone injected to cows for excessive milk production is [AIIMS 1995]  
 (a) Oestrogen (b) Progesterone  
 (c) Oxytocin (d) Testosterone
13. To increase milk yield, cow is given [AIIMS 1997]  
 (a) Sorbitol (b) Stilbesterol  
 (c) Prolactin (d) Ganadotrophin
14. The yellow-coloured milk secreted by cattle soon after the birth of a calf is called [KCET 2004]  
 (a) Chyme (b) Chyle  
 (c) Cholesterol (d) Colostrum
15. Following are all breeds of cows except [MHCET 2015]  
 (a) Jersey (b) Nagpuri  
 (c) Sahiwal (d) Sindhi
16. Rinderpest is the disease of  
 (a) Buffaloes (b) Cattle  
 (c) Pigs (d) Horses
17. Select the group having only buffalo breeds of India from the following [Manipal PMT 2000; KCET 2012]  
 (a) Surti, Mehsana, Murrah, Nagpuri  
 (b) Mehsana, Murrah, Nagpuri, Haryana  
 (c) Murrah, Nagpuri, Haryana, Ongole  
 (d) Nagpuri, Haryana, Ongole, Sindhi
18. The injections and contagious bacterial disease that affects, cattle, buffaloes, horses, sheep and goats is [J & K CET 2010]  
 (a) Anthrax (b) Rinderpest  
 (c) Tick fever (d) Necrosis
19. The best milch breed in the world is [KCET 2001]  
 (a) Chittagong (b) Deoni  
 (c) Holstein-Friesian (d) Sindhi
20. Biggest drawback of draught animals is [CPMT 1995]  
 (a) More consumption of bioenergy than production  
 (b) Short life span  
 (c) Early retirement  
 (d) Less reliability
21. Zebu cattle is  
 (a) Water Buffalo (b) Indian Buffalo  
 (c) Cow (d) Sheep
22. Which of the following breed of buffaloes is mostly demanded  
 (a) Surti (b) Murrah  
 (c) Jaffrabadi (d) Bhadawari
23. On the basis of utility, Nagpuri buffaloes are categorised as [KCET 1997]  
 (a) Milkers (b) Draught cattle  
 (c) Dual purpose (d) Grazers
24. Human proteins can be produced in the milk or semen of farm animals. True or false [J & K CET 2012]  
 (a) True  
 (b) False, proteins cannot be produced in milk  
 (c) False, proteins cannot be produced in semen  
 (d) False, animals are not used for protein production
25. The number of calves produced during its whole reproductive period of a cow or buffalo is  
 (a) 8 – 10 Calves (b) 15 – 20 Calves  
 (c) 12 – 16 Calves (d) 5 – 7 Calves
26. Bovine spongiform encephalopathy is a disease caused by prions in a ..... [KCET 2010]  
 (a) Sheep (b) Cow  
 (c) Potato (d) Man
27. Read the following four statements (A – D) about certain mistakes in two of them  
 (A) The first transgenic buffalo, Rosie produced milk which was human alpha-lactalbumin enriched  
 (B) Restriction enzymes are used in isolation of DNA from other macromolecules  
 (C) Downstream processing is one of the steps of R-DNA technology  
 (D) Disarmed pathogen vectors are also used in transfer of R-DNA into the host  
 Which are the two statements having mistakes [CBSE PMT (Mains) 2011]  
 (a) Statements (A) and (C)  
 (b) Statements (A) and (B)  
 (c) Statements (B) and (C)  
 (d) Statements (C) and (D)

### Sheep and Goats

1. Sheep is sheared from [Pb. PMT 1997]  
 (a) May to December (b) August to September  
 (c) April to October (d) Whole of the year
2. The world's highly prized wool yielding Pashmina breed is [CBSE PMT 2005]  
 (a) Sheep  
 (b) Goat  
 (c) Goat-sheep cross  
 (d) Kashmir sheep- Afgan sheep cross
3. Lohi is  
 (a) A breed of sheep (b) A breed of goat  
 (c) A breed of Domestic Fowl (d) A breed of Geese



4. The feet with two toes forming cloven hoof is seen in  
[Kerala PMT 2004]  
(a) Horse (b) Elephant  
(c) Sheep (d) Zebra
5. Which endangered animal is source of the world's finest, lightest, warmest and most expensive wool the shahtoosh  
[CBSE PMT 2003]  
(a) Chiru (b) Nilgai  
(c) Cheetal (d) Kashmiri goat
6. Goats feed on  
(a) Low herbs (b) Grass  
(c) Low shrubs (d) Shrubs and low trees
7. Famous angora wool is got from a  
(a) Sheep (b) Rabbit  
(c) Goat (d) Yak
8. The richest sources of vitamin B<sub>12</sub> are [CBSE PMT 2004]  
(a) Rice and hen's egg  
(b) Carrot and chicken's breast  
(c) Goats liver and *Spirulina*  
(d) Chocolate and green gram
9. The breeds of sheep which give good quality wool are  
(a) Lohi and Nellore (b) Rampur and Deccini  
(c) Nellore and Deccini (d) Nali and Lohi
10. Which of the following is an exotic breed of sheep  
(a) Nali (b) Lohi  
(c) Merino (d) Bhakarwal

### Pigs

1. Ghorri is a breed of  
(a) Cow (b) Horse  
(c) Pig (d) Camel
2. Landrace is a breed of  
(a) Horse (b) Pig  
(c) Camel (d) Donkey
3. Which one of the animal having well-defined breeding seasons, from November to March  
(a) Camel (b) Pig  
(c) Mule (d) Donkey

### Horses, Donkey and Mules

1. There are two breeds of donkeys in India. These are small grey and large white. The large white is also called wild ass which occurs in  
(a) Rajasthan (b) Bihar  
(c) Assam (d) Rann of Kutch
2. Mule is a product of [NCERT; AFMC 2004]  
(a) Breeding (b) Mutation  
(c) Hybridisation (d) Interspecific hybridisation
3. The animal which is used by Indian army in mountain terrains  
(a) Horse (b) Mule  
(c) Donkey (d) Camel
4. A beast of burden which needs little care is  
(a) Pig (b) Donkey  
(c) Mule (d) Yak
5. Spiti breed of horse is found in  
(a) Ladakh (b) Himachal Pradesh  
(c) Rajasthan (d) Gujarat

6. Which of the following is a beast of burden  
(a) Donkey (b) Mule  
(c) Horse (d) All of these
7. Bhutia is a breed of  
(a) Chicken (b) Goat  
(c) Sheep (d) Horse
8. Horses are fed on  
(a) Dry fodder only  
(b) Oats, barley, gram and hay  
(c) Grass only  
(d) Roughage and concentrates
9. Compare to other animal which one has low reproductive rate  
(a) *Camelus dromedarius* (b) *Ovis sp*  
(c) *Capra hircus* (d) Horse

### Camel, Elephant and Yak

1. The camel's hump is composed of a tissue, which provides water when it is oxidised [AIIMS 1996]  
(a) Skeletal (b) Muscular  
(c) Areolar (d) Adipose
2. Indian camel is characterised by  
(a) 3 humps (b) 2 humps  
(c) 1 humps (d) Variable number of humps
3. Camels breed in  
(a) Summer (b) Winter  
(c) Rainy season (d) Night
4. Number of breeds of Indian Camels  
(a) Two (b) Three  
(c) Four (d) Five
5. Indian breeds of Camels are  
(a) Jaisalmeri (b) Sindhi  
(c) Bikaneri and Kutchi (d) All the above
6. A disease infecting camel is  
(a) Pullorum (b) Surra  
(c) Rinderpest (d) Encephalomalacia
7. There are two kinds of camel. Arabian and Bactrian. The Arabian camel have  
(a) One hump (b) Two hump  
(c) Three humps (d) None of these
8. The Bactrian camels possess  
(a) Two humps (b) One hump  
(c) Four humps (d) Variable number of humps
9. Elephants are sought after for  
(a) Skin (b) Hair  
(c) Meat (d) Ivory
10. There are two types of elephants, African and Indian. African elephants have  
(a) Larger ears (b) Convex sloping forehead  
(c) Tusks in both sexes (d) All the above
11. Yak gives  
(a) Meat (b) Hide  
(c) Wool (d) All of these
12. Yak is found in  
(a) Tibet (b) Ladakh, Lahaul and Spiti  
(c) Garhwal and Sikkim (d) All the above

**Animal breeding**

- Super-ovulation and embryo transplantation are meant for improving
  - Human race
  - Livestock
  - Poultry
  - Plants
- Artificial breeding of cattle is brought about by
  - Artificial insemination
  - Superovulation and embryo transplantation
  - Homozygotic twinning
  - All the above
- Llamas and Alpacas are
  - Breeds of buffaloes
  - Breeds of Horses
  - Breeds of Camels
  - Breeds of Sheep
- Selective breeding, progeny testing and improvement are taking place in
  - Cattle
  - Buffalo
  - Sheep
  - Annual food crops
- By deep freezing, it is possible to preserve foetus
  - 1- day old
  - 2- day old
  - 3- day old
  - 1- week old
- The transgenic animals are those which have  
[CBSE PMT 1995]
  - Foreign DNA in some of its cells
  - Foreign DNA in all its cells
  - Foreign DNA and RNA in some of its cells
  - Foreign DNA and RNA in all its cells
- The ova are released by hormone induction and fertilization by artificial insemination and then embryo is stored at 4°C for several years. This is the technique known as
  - Artificial insemination
  - Embryo transplantation
  - Super ovulation
  - Preservation of embryo
- Which of the following has been recently used for increasing productivity of super milch cow  
[CBSE PMT 1997]
  - Artificial insemination by a pedigreed bull only
  - Superovulation of a high production cow only
  - Embryo transplantation only
  - A combination of superovulation, artificial insemination and embryo transplantation into a 'carrier cow' (surrogate mother)
- Technique of cryopreservation is used for
  - Preservation of various tissues
  - Preservation of semen of good quality bulls
  - Preservation of very young foetuses
  - All of the above
- First artificial insemination was done in India at
  - National Dairy Institute, Karnal (Haryana)
  - Indian Veterinary Research Institute, Izatnagar (U.P.)
  - Punjab Agricultural University, Ludhiana (Punjab)
  - Allahabad Agricultural Institute, Allahabad (U.P.)
- The sperms employed for artificial insemination of cattle are stored in
  - Liquid oxygen
  - Dry ice
  - Liquid ammonia
  - Liquid nitrogen
- Name of sheep cloned for the first time is  
[AIIMS 1997]
  - Dolly
  - Polly
  - Molly
  - Holly

- Which one of the following is a breed of cattle

[AMU (Med.) 2012]

- Aryshire
- Ghagus
- Kadakanath
- Scampi

- Artificial selection to obtain cows yielding higher milk output represents  
[NEET 2017]

- Stabilizing selection as it stabilizes this character in the population
- Directional as it pushes the mean of the character in one direction
- Disruptive as it splits the population into two, one yielding higher output and the other lower output
- Stabilizing followed by disruptive as it stabilizes the population to produce higher yielding cows

**Sericulture**

- 'Sericulture' is native of
  - Japan
  - China
  - India
  - Korea
- Mulberry, munga, oak and tussar all the four varieties of silk are present in a single country. The country is  
[MP PMT 1997]
  - China
  - India
  - Japan
  - Korea
- Silk contains a protein known as  
[AFMC 2003; MP PMT 2012]
  - Fibroin
  - Casein
  - Sericin
  - Both (a) and (c)
- The larva of *Bombyx mori* is known as  
[DUMET 2009]
  - Nymph
  - Trochophore
  - Cocoon
  - Caterpillar
- The silk fibres are held together in cocoon by a substance known as
  - Sericin
  - Cement
  - Glue
  - None of the above
- An insect whose mouthparts are biting and chewing type in the larval condition, while they are siphoning type in the adult and this insect gives and economically important substance during yet another stage of its development. The insect is  
[EAMCET 2009]

Or

Which of the following insects is useful for us  
[CPMT 2005]

- Anopheles*
- Laccifer*
- Bombyx*
- Apis*

- Which of the following districts in Madhya Pradesh is mainly silk producing

- Indore
- Bhopal
- Raipur
- Ujjain

- A dorsal horn is present on the ..... of mulberry silk worm (caterpillar)  
[KCET 2009]

- Head
- 8<sup>th</sup> abdominal segment
- 5<sup>th</sup> abdominal segment
- 2<sup>nd</sup> thoracic segment

- In an egg laying of '*Bombyx mori*', the number of eggs are  
[BHU 1999; Kerala CET 2003]

- 200 to 300
- 300 to 500
- 400 to 600
- 500 to 700

10. Munga silk worm feeds on [WB JEE 2012]  
(a) Shorea (b) Terminalia  
(c) Machilus (d) Morus
11. Domestication of silk worm is called [CBSE PMT 1992]  
Or  
Obtaining silk from silkworms is called [MP PMT 2004]  
(a) Sericulture (b) Pisciculture  
(c) Apiculture (d) Horticulture
12. Percentage composition of fibroin and sericin in silk is [WB JEE 2010]  
(a) 50 : 40 (b) 80 : 20  
(c) 30 : 70 (d) 40 : 60
13. *Nosema bombycis* which causes pebrine in silk worms is a [KCET 2009, 10; AIIMS 2012]  
(a) Fungus (b) Virus  
(c) Bacterium (d) Protozoan
14. The insect that is not found in the wild state is  
(a) Lac insect (b) Cochineal insect  
(c) Honey bee (d) Silk moth
15. In which stage of its life cycle the silk moth begins to produce silk fibre [WB JEE 2008]  
(a) 3rd instar larva (b) 4th instar larva  
(c) 5th instar larva (d) Pupa
16. The eggs of silk moth are [BHU 2004]  
(a) Homolecithal (b) Telolecithal  
(c) Mesolecithal (d) Centrolecithal
17. *Bombyx mori* belongs to the class [MHCET 2000]  
(a) Insecta (b) Chilopoda  
(c) Arachnida (d) Crustacea
18. Which one is the best silk [MP PMT 1996]  
(a) Eri silk (b) Mulberry silk  
(c) Tassar silk (d) None of these
19. Silk worm is a [MP PMT 1998]  
(a) Fly (b) Worm  
(c) Moth (d) Beetle
20. The silkworm larva ceases to eat and starts spinning silk around its body [APMEE 1996; KCET 1999; MHCET 2000]  
(a) At random (b) From inside to outside  
(c) From outside to inside (d) All of these
21. Match the names given under Column -I with their relations given under column II, choose the answer which gives the correct combination of the alphabets of the two columns
- | Column - I<br>(Name) |                    | Column - II<br>(Relations) |   |
|----------------------|--------------------|----------------------------|---|
| A.                   | <i>Bombyx mori</i> | P.                         | Disease of mulberry                                 |
| B.                   | <i>Morus alba</i>  | q.                         | Centre where silkworm egg are produced and supplied |
| C.                   | Grainage           | r.                         | Silk moth   |
| D.                   | Powdery mildew     | s.                         | Mulberry plant                                      |
|                      |                    | t.                         | Freshly hatched silkworm                            |
- [KCET 2000]  
(a) A = q, B = r, C = s, D = t (b) A = r, B = s, C = q, D = p  
(c) A = r, B = q, C = t, D = s (d) A = s, B = r, C = q, D = t
22. The life-cycle of mulberry silk worm is completed [MP PMT 2000]  
(a) 20 days (b) 30 days  
(c) 35 days (d) 45 days
23. Silk consists of [MHCET 2004]  
(a) Central core of sericin  
(b) Central core of fibroin  
(c) Both 'a' and 'b'  
(d) A fine mixture of fibroin and sericin
24. Commercial silk is obtained from [MP PMT 1994, 2003; MHCET 2000]  
Or  
Which stage of silkworm secretes silk [MP PMT 2009]  
(a) Cocoon/pupa (b) Caterpillar  
(c) Adult moth (d) Both egg and adult moth
25. Which of the following statements is true [Wardha 2005]  
(a) Salivary glands of moth secrete silk  
(b) Larval form of moth secretes silk  
(c) Silk is extracted from cocoon of moth by boiling  
(d) Both (b) and (c)
26. Eri Silk worm is grown on [MP PMT 2005]  
(a) Mulberry leaf (b) Neem leaf  
(c) Khaire leaf (d) Castor leaf
27. Which is protein in nature [HPMT 2005]  
(a) Polyethylene (b) Silk and wool  
(c) Cellulose (d) Terylene

### Apiculture

1. A waxy substance produced by honey bee to repair combs is called [WB JEE 2008]  
(a) Propolis (b) Honey dew  
(c) Nectar (d) Ethylene
2. In honey the percentage of maltose and other sugar is [WB JEE 2009]  
(a) 9.2 (b) 8.81  
(c) 10.5 (d) 11.2
3. The life span of honey bee drone is [WB JEE 2009]  
(a) 3 – 5 months (b) 1 – 2 months  
(c) 6 – 7 months (d) 10 – 12 months
4. Worker bees are [CPMT 2009]  
(a) Sterile females  
(b) Fertile females  
(c) When queen is absent then acts as a fertile females  
(d) Sterile drones
5. *Apis dorsata* refers to [MHCET 2002]  
(a) Rock bee (b) Little bee  
(c) Indian bee (d) European bee
6. In which part of the body "Pollen basket" is found in the honey bee [MP PMT 1995]  
(a) Prothoracic leg  
(b) Mesothoracic leg  
(c) Metathoracic leg  
(d) At union of thorax and abdomen
7. In honey bee royal jelly is secreted from [MP PMT 2003]  
(a) Crop gland (b) Wax gland  
(c) Pharyngeal gland (d) Salivary gland



8. Nobel prize winner for the discovery of method of interpersonal communication in honey bee is  
[MP PMT 1994, 99; CBSE PMT 2000]  
(a) Von Fritsch (b) H.G. Khorana  
(c) Harvey (d) Darwin
9. Queen is specified for [MP PMT 2006]  
(a) Administration (b) Making hive  
(c) Egg laying (d) Collection of food
10. Apiculture is associated with which of the following groups of plants [AIIMS 2012]  
(a) Grapes, maize, potato  
(b) Sugarcane, paddy, banana  
(c) Guava, sunflower, strawberry  
(d) Pineapple, sugarcane, strawberry
11. Honey bee after discovering the new source of nectar/honey can convey this information but  
(a) Cannot convey the direction  
(b) Can convey the direction by round or tail wagging dance  
(c) Can convey the direction by round dance only  
(d) Can convey the direction by tail wagging dance only
12. Domestication of honey bee is called [HP PMT 2005; MP PMT 2010]  
(a) Sericulture (b) Apiculture  
(c) Tissue culture (d) Pisciculture
13. If a honey bee is conveying an information, by round dance then the distance of source will be about [MP PMT 2000]  
(a) 1000 meters (b) 50 meters  
(c) 2000 meters (d) 150 meters
14. Number of queens in a hive is  
(a) 10 (b) 15  
(c) 20 (d) 1
15. The most commonly maintained species of bee by bee-keepers is [AMU (Med.) 2010, 12]  
Or  
Which one of the following species of bees is used for the commercial production of honey [NCERT]  
(a) *Apis mellifera* (b) *Apis dorsata*  
(c) *Apis indica* (d) *Apis florea*
16. The stimuli through which a dancing scout bee communicates the location of a food source to other worker bees in a hive are  
(a) Visual (b) Acoustic  
(c) Contact (d) Contact and visual
17. Which of the following secretes honey [Bihar MDAT 1995]  
Or  
Which of the following animal can be formed without fertilization  
(a) Honey bee (b) Housefly  
(c) Lac insects (d) Mosquito  
(e) All of the above
18. In which bee barbless sting is found [MP PMT 1995]  
(a) Drone (b) Workers  
(c) Queen bee (d) In all the three
19. In which bee wax glands are found [NCERT; MP PMT 1995, 2000; BVP 2002]  
(a) Queen bee  
(b) Drone  
(c) Workers  
(d) Both in queen and worker bees
20. The honey bees exhibit a type of dance to communicate the location of food. This is known as [KCET 1994]  
(a) Waggle dance  
(b) Tap dance  
(c) Round dance and waggle dance  
(d) Break dance
21. Which among the following is the real product of the honey bee [NCERT; CBSE PMT 1994; MP PMT 2009]  
(a) Honey (b) Bee wax  
(c) Propolis (d) Both (b) and (c)
22. Honey bee is of greatest use to man due to which reason [CPMT 1996]  
(a) We get honey from them (b) Helps in cross pollination  
(c) Is of medicinal value (d) Entertains
23. Sting apparatus in honey bee is a modified form of [BHU 2001]  
(a) Ovipositor (b) Wax glands  
(c) Alkaline glands (d) Podical valves
24. In honey bees the drones (males) are produced from [MP PMT 1996, 99; CPMT 1999]  
(a) Unfertilized eggs (b) Fertilized eggs  
(c) Larvae fed by royal jelly (d) Fasting larvae
25. Choose the correct pair [NCERT; CPMT 2000; BHU 2006]  
(a) Apiculture – Honey bee (b) Sericulture – Fish  
(c) Pisciculture – Silk worm (d) Aquaculture – Lac insect
26. In which of the following is 'swarming' found [MP PMT 1998]  
(a) In mosquitoes (b) In house flies  
(c) In locust (d) In *Pyrilla*
27. Life span of worker bee is [CBSE PMT 1999; MHCET 2001]  
(a) 10 days (b) 15 days  
(c) 6 weeks (d) 10 weeks
28. Honey mainly consists of [CPMT 1999]  
(a) Monosaccharides (b) Disaccharides  
(c) Polysaccharides (d) Fats
29. Honey is [CBSE PMT 1997; VITEEE 2008]  
(a) Acidic (b) Neutral  
(c) Alkaline (d) Basic after some days
30. Which of the following species of honey bee is reared in artificial hives [KCET 2000]  
Or  
Which one of the following insects produces honey [AIEEE Pharmacy 2003]  
(a) *Apis indica* (b) *Apis dorsata*  
(c) *Apis florea* (d) None of these
31. Among the following colonial insects are [CPMT 2000]  
(a) Locusts (b) White ants  
(c) Bed bugs (d) Mosquitoes

### Lac culture

1. Lac insect is a  
(a) Symbiont insect (b) Commensal insect  
(c) Parasitic insect (d) Both (a) and (b)
2. Largest lac producing country is  
(a) Japan (b) Phillipines  
(c) India (d) China

3. Main composition of lac is
  - (a) Glue, pigment and sugar
  - (b) Wax, pigment and glue
  - (c) Resin, pigment, wax and glue
  - (d) Resin, sugar and wax
4. Order of lac insect is [MP PMT 1999; CBSE PMT 2001]
  - (a) Hymenoptera
  - (b) Lepidoptera
  - (c) Hemiptera
  - (d) Diptera
5. Lac is obtained from [MP PMT 2003]
  - (a) *Laccifer*
  - (b) *Bombyx*
  - (c) *Dactylopius*
  - (d) *Lytta*
6. Lac producing insect is [MP PMT 2004]
  - (a) *Lytta*
  - (b) *Tachardia lacca*
  - (c) *Bombyx mori*
  - (d) *Antheraea assama*
7. Lac is produced as [MP PMT 1996; CPMT 1996; BVP 2002]
  - (a) Faces of lac insect
  - (b) Secretion from body
  - (c) Excretion from body
  - (d) Excess food oozing out of body
8. Which of the following is an economically useful insect [CPMT 2010]
  - (a) *Mantis religiosa*
  - (b) Termites
  - (c) *Taccardia lacca*
  - (d) *Carausius*
9. Lac is the best
  - (a) Raw bangles material
  - (b) Cosmetic material
  - (c) Polishing material
  - (d) Sealing material
10. Chemical nature of lac is
  - (a) Protein
  - (b) Carbohydrate
  - (c) Metalloid
  - (d) Resin
11. Commercial lac is produced from
  - (a) The nest of a type of bird
  - (b) The exudation of a type of insect
  - (c) The scale of a type of fish
  - (d) The root of a plant
12. Indian Lac Research Institute is situated at [MP PMT 1994]
  - (a) Ranchi
  - (b) Mysore
  - (c) Dehradun
  - (d) Nagpur
13. Which lac secreting insect undergoes death after reproduction
  - (a) Male
  - (b) Female
  - (c) Worker
  - (d) None of the above
14. Palas and Ber produce a particular type of lac which is known as
  - (a) Khair lac
  - (b) Kusum lac
  - (c) Neelam lac
  - (d) None of the above
15. Lac contains how much percent resins
  - (a) 40%
  - (b) 50–55%
  - (c) 68–90%
  - (d) 90–95%
2. Which one of the following mollusc is cultured in fresh water for producing pearls [MP PMT 2001, 12]
  - (a) *Pinctada*
  - (b) *Haliotis*
  - (c) *Anodonta*
  - (d) *Mytilus*
3. Which of the following is detrimental to pearl industry [AFMC 1997]
  - (a) *Cliona*
  - (b) *Cheloina*
  - (c) *Pinctada*
  - (d) *Euspongia*
4. Whose secretion forms the pearl [MP PMT 1999; PET (Pharmacy) 2013]
  - (a) Prismatic layer
  - (b) Columnar epithelial cells of mantle
  - (c) Ciliated epithelial cells of mantle
  - (d) Connective tissue of mantle
5. Who stands first in the world for pearl production
  - (a) India
  - (b) China
  - (c) Korea
  - (d) Japan
6. Pearl is produced by the marine molluscs such as [MP PMT 1994]
  - (a) Pearl oyster and mussel
  - (b) Pearl oyster
  - (c) Marine mussel
  - (d) Fresh water mussel and other bivalvia
7. Which one of the following molluscan groups is primarily used in the pearl formation [MP PMT 1994]
  - (a) Monopalacophorans
  - (b) Cephalopods
  - (c) Gastropods
  - (d) Pelecypods
8. Who is referred to as 'father of pearl industry' [MP PMT 1998]
  - (a) Inovsky
  - (b) Louis Pasteur
  - (c) Kokichi Mikimoto
  - (d) Harvey
9. Shells of molluscs are used for preparing ointments because they are rich in
  - (a) Zinc
  - (b) Iodine
  - (c) Sodium
  - (d) Both (a) and (b)
10. A pearl oyster secretes pearls to [MP PMT 1997]
  - (a) Regenerate injured parts
  - (b) Protect itself against invading parasite
  - (c) Harden its mantle cavity
  - (d) Isolate damaged tissues of the body
11. Natural pearl is formed by
  - (a) A bivalve
  - (b) Prawn
  - (c) Crayfish
  - (d) Fish

### Fisheries

1. 'Gill rot' disease in fishes is caused by [WB JEE 2008]
  - (a) *Aeromonas* sp
  - (b) *Bacillus polymixa*
  - (c) *Bran sanguinis*
  - (d) *Bucillus subtilis*
2. Which one of the following is not a major carp [WB JEE 2008]
  - (a) *Cirrhinus mrigala*
  - (b) *Puntius ticto*
  - (c) *Ctenopharyngodon idella*
  - (d) *Labeo rohita*

### Pearl culture

1. The pearl bed which produces best quality is known as
  - (a) Lingha pearl
  - (b) Muktaghaphal
  - (c) Kusum
  - (d) None of the above

3. Estuarine fish culture is a culture of fish in  
(a) Marine water  
(b) Fresh water of river  
(c) Fresh water of pond  
(d) Aquatic medium where fresh and marine water get mixed together
4. Choose the minor carp from the following [WB JEE 2009]  
(a) *Cyprinus carpio* (b) *Labeo calbasu*  
(c) *Labeo bata* (d) *Ctenopharyngodon idella*
5. A lake with an inflow of domestic sewage rich in organic waste may result in [AIIMS 2004]  
(a) Drying of the lake very soon due to algal bloom  
(b) An increased production of fish due to lot of nutrient  
(c) Death of fish due to lack of oxygen  
(d) Increased population of aquatic web organism
6. The great fisher bank is situated at [AIIMS 2004]  
(a) The coast of new foundland  
(b) The chilean coast  
(c) The spanish coast  
(d) The coast of great Britain
7. Isinglass a type of by product of fish industry is principally used for [MP PMT 2001]  
(a) Feeding cattle, pigs and poultry  
(b) Preparation of paints and varnishes  
(c) Clarification of vinegar, wines and beer  
(d) Production of insulin
8. In India, the best aquarium is located at [MP PMT 1996]  
(a) Z.S.I. Calcutta (b) Tarapur, Bombay  
(c) Madras (d) Vishakhapatnam
9. *Gambusia* is a  
(a) Predator of mosquito larvae  
(b) Parasite on crab  
(c) Pathogenic protozoan  
(d) Pest on fishes
10. 'Cast nets' are used to catch [MP PMT 2012]  
(a) Marine fishes (b) Estuary fishes  
(c) Freshwater fishes (d) All of the above
11. Cod liver oil is extracted from [MP PMT 1994]  
(a) Bony fishes (b) Cartilagenous fishes  
(c) Buffaloes (d) Whales
12. Cod liver oil is a rich source of [Manipal 1995]  
(a) Iodine (b) Vitamin A  
(c) Vitamin B (d) Vitamin C
13. Induced breeding is effective in which of them [MP PMT 1995]  
(a) Pisciculture (b) Sericulture  
(c) Apiculture (d) Lac culture
14. Isinglass is prepared from [MP PMT 1998]  
(a) Ichthyophis (b) Musk deer  
(c) Fishes (d) Lizards
15. The fish food possesses the lowest level of [EAMCET 1998]  
(a) Actin (b) Myosin  
(c) Cholesterol (d) Tissue fluid
16. Which of the following two hormones are essential for induced breeding of fishes [WB JEE 2011]  
(a) TSH and ACTH  
(b) Oestrogen and progesterone  
(c) FSH and LH  
(d) Vasopressin and oxytocin
17. Fin rot of fish is caused by [WB JEE 2012]  
(a) *Aeromonas* (b) *Pseudomonas*  
(c) *Branchiomyces* (d) *Xenopsylla*

### Poultry

1. In poultry, first deworming is usually done around this age [EAMCET 2009]  
(a) 4 weeks (b) 8 weeks  
(c) 12 weeks (d) 16 weeks
2. Which one of the following is the American poultry breed [WB JEE 2009]  
(a) Australorp (b) Minorca  
(c) Aseel (d) Rhode Island Red
3. One of the following is a disease of poultry [NCERT; KCET 2004]  
(a) Abdominal gland  
(b) Salivary gland  
(c) Anthrax  
(d) Ranikhet (new castle disease) Aspergillosis
4. In poultry industry, production of hatching eggs is more expensive than the production of market eggs mainly because [CBSE PMT 2001]  
(a) Cost of males and their depreciation value is high  
(b) Mortality among females is usually lower when they are mated with males  
(c) Number of eggs produced by hatchery flock are to be sold only as market eggs  
(d) Some of the eggs produced by hatchery flocks are not acceptable for incubation
5. Ranikhet disease is found in [MP PMT 1995]  
(a) Honey bee (b) Hens  
(c) Fishes (d) Pigs
6. Birds specially chicken grown for meat only is known as [MP PMT 1994]  
(a) Hybrid (b) Broiler  
(c) Bird mangement (d) Bird culture
7. Which one of the following poultry birds is not an English breed [WB JEE 2012]  
(a) Sussex (b) Australop  
(c) Orpington (d) Minorca
8. Lymphoid lencosis is a poultry disease caused by [MP PMT 2012]  
(a) Virus (b) Fungi  
(c) Helminths (d) Bacteria
9. The fungal disease of poultry is [EAMCET 1998; MP PMT 2003]  
(a) Coccidiasis (b) Monilliasis  
(c) Coryza (d) Mareks
10. In India, which state occupies first position in poultry farming [MP PMT 2003]  
(a) Kerala (b) M.P.  
(c) Andhra Pradesh (d) U.P.



# NQ NCERT

## Exemplar Questions

- The chances of contracting bird flu from a properly cooked (above 100°C) chicken and egg are [NCERT]
  - Very high
  - High
  - Moderate
  - Negligible
- A group of animals which are related by descent and share many similarities are referred to as [NCERT]
  - Breed
  - Race
  - Variety
  - Species
- Inbreeding is carried out in animal husbandry because it [NCERT]
  - Increases vigour
  - Improves the breed
  - Increases heterozygosity
  - Increases homozygosity
- Which one of the following is a marine fish [NCERT]
  - Rohu
  - Hilsa
  - Catla
  - Common Carp
- Which one of the following products of apiculture is used in cosmetics and polishes [NCERT]
  - Honey
  - Propolis
  - Wax
  - Royal jelly
- More than 70 per cent of livestock population is found in [NCERT]
  - Denmark
  - India
  - China
  - India and China
- Long neck of camel is due to [BHU 1995; JIMPER 1997]
  - Number of neck vertebrae
  - Length of each neck vertebrae
  - Development of extra bony plates between successive neck vertebrae
  - Development of muscular pads between successive neck vertebrae
- Honey bee keeps the nectar for sometime in its
  - Stomach
  - Salivary gland
  - Crop
  - Mouth
- It is now possible to breed plants and animals with desired characters through [KCET 1994]
  - Ikebana technique
  - Tissue culture
  - Genetic engineering
  - Chromosome engineering
- The zoological name of common silk worm is or Silk is obtained from [MP PMT 1997]
  - Antheraea mylitta*
  - Bombyx mori*
  - Antheraea royalae*
  - Antheraea assamensis*
- Which one is not produced in aquaculture [BHU 2003]
  - Oyster
  - Silk worm
  - Singhara
  - Frog
- Compared to a bull a bullock is docile because of [CBSE PMT 2007]
  - Higher levels of thyroxine
  - Higher levels of cortisone
  - Lower levels of blood testosterone
  - Lower levels of adrenalin / noradrenalin in its blood
- Silk produced by *Antheraea mylitta* is also called [WB JEE 2011; KCET 2011; MP PMT 2013]
  - Munga silk
  - Tasar silk
  - Eri silk
  - Mysore silk
- The term 'aquaculture' means [CBSE PMT 1999]
  - Aspergillosis
  - Marine fisheries
  - Inland fisheries
  - Both (b) and (c)
- Silk is the product of [AIIMS 1993; CBSE PMT 1993, 94, 95, 98; MP PMT 1994, 2006; BHU 1999; AIEEE Pharmacy 2004]
  - Salivary gland of the larva
  - Cuticle of the adult
  - Cuticle of the larva
  - Salivary gland of the adult
- Secretion of silk gland comes through a small pore. This pore is situated on [MP PMT 1999]
  - Exopodite of 2<sup>nd</sup> maxilla
  - Endopodite of 1<sup>st</sup> maxilla
  - Protheca of mandible
  - Anterior part of hypopharynx
- Which of the following species of silk worm are found in India [BHU 2000; CPMT 2001]
  - Bombyx mori*
  - Anthera paphia*
  - Anthera assama*
  - All the above
- Pearl is secreted around the
  - Mantle layer
  - Foreign particle between prismatic and nacreous layer
  - Foreign particle between mantle and nacreous layer
  - The shell

# CT Critical Thinking

## Objective Questions

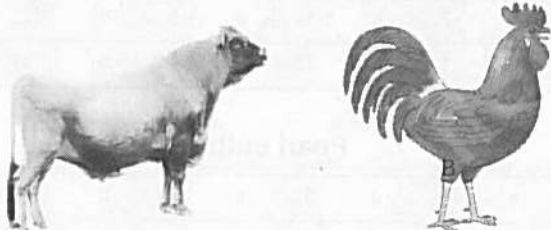
- Which one of these diseases in animals is caused by *Babesia bigemina* [Kerala PMT 2009]
  - Rinderpest
  - Tick fever
  - Anthrax
  - Diarrhoea
  - Canker
- Which one of the following is an exotic carp species [WB JEE 2011]
  - Barbus stigma*
  - Cyprinus carpio*
  - Labeo bata*
  - Cirrhinus mrigala*
- Foot- and-mouth disease in cattle is caused by [JIPMER 1994]
  - Pseudomonas*
  - Salmonella*
  - Virus
  - Anabaena*
- Gaddi breed of goat is distributed in
  - Punjab
  - Rajasthan
  - Himachal Pradesh
  - Kerala
- Hinny is a hybrid of male [KCET 1994]
  - Horse and female donkey
  - Donkey and female horse
  - Goat and female lamb
  - Sheep and female goat

18. Match the following and select the correct answer

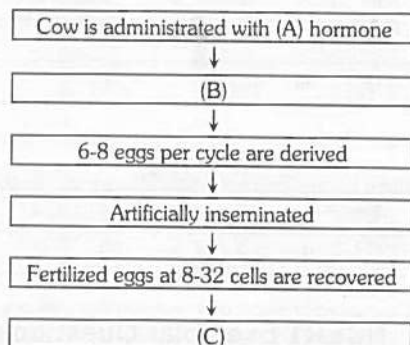
Column I		Column II	
A.	Bears	1.	Diapause
B.	Snail	2.	Hibernation
C.	Zooplanktons	3.	Dormancy
D.	Seeds	4.	Aestivation

[Kerala PMT 2011, 12]

- (a) A-3, B-4, C-1, D-2 (b) A-2, B-1, C-4, D-3  
(c) A-4, B-1, C-2, D-3 (d) A-1, B-4, C-2, D-3  
(e) A-2, B-4, C-1, D-3
19. If the source is opposite to the direction of sun, then honey bee will convey the direction by  
**Or**  
Convey the information of food source by  
(a) Clockwise round dance  
(b) Upright down tail wagging dance  
(c) Anticlockwise round dance  
(d) Opposite to (b)
20. Cantheridine is obtained from [MP PMT 2013]  
(a) Red ants (b) Ball weevils  
(c) Beetles (d) Honey bees
21. The following figure shown improved breed of animal and bird. Identify A and B [NCERT]



- (a) A - Beetal, B - Jamunapari  
(b) A - Marwari, B - Sirohi  
(c) A - Surti, B - Sangamneri  
(d) A - Jersey, B - Leghorn
22. The following flow chart shows methodology which has been used for cattle, sheep, buffaloes etc. Identify missing steps (A, B and C) [NCERT]



- (a) A - Estrogen, B - Super ovulation due to induced follicular maturation, C - Transfer to surrogate mother  
(b) A - Progesteron, B - Super ovulation due to induced follicular maturation, 3 - Transfer to surrogate mother  
(c) A - LH, B - Super ovulation due to induced follicular maturation, C - Transfer to surrogate mother  
(d) A - FSH, B - Super ovulation due to induced follicular maturation, C - Transfer to surrogate mother

23. Hisardale is obtained crossing

[KCET 2015]

- (a) Horse with Donkey  
(b) Marino ewes with Bikaneri Rams  
(c) Superior Bull with Superior Cow  
(d) Bikaneri ewes with Marino Rams

24. Find the correct match

	Column A	Column B	Column C
I.	Mackeral	Rastrelliger	Freshwater fish
II.	Honey bee	Apis	Wax
III.	Mirgala	Tacchardia	Marine waterfish
IV.	Silkworm	Bombyx	Mulberry silk

[MHCET 2015]

- (a) II and IV (b) I and II  
(c) IV only (d) I and III

25. Outbreeding is an important strategy of animal husbandry because it [AIPMT 2015]

- (a) Is useful in producing purelines of animals  
(b) Is useful in overcoming inbreeding depression  
(c) Exposes harmful recessive genes that are eliminated by selection  
(d) Helps in accumulation of superior genes

26. Homozygous purelines in cattle can be obtained by

[NEET 2017]

- (a) Mating of related individuals of same breed  
(b) Mating of unrelated individuals of same breed  
(c) Mating of individuals of different breed  
(d) Mating of individuals of different species

## Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion  
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion  
(c) If the assertion is true but the reason is false  
(d) If both the assertion and reason are false  
(e) If the assertion is false but reason is true

1. Assertion : Ranikhet disease is the disease of poultry.  
Reason : It is caused by a virus. [KCET 2009]
2. Assertion : The honey bee queen copulates only once in her life time.  
Reason : The honey bee queen can lay fertilized as well as unfertilized eggs. [AIIMS 2004, 09]
3. Assertion : Fish meal is a rich source of protein for cattle and poultry.  
Reason : Fish meal is produced from non-edible parts of fishes like fins, tail etc.

[AIIMS 2004]

4. Assertion : Cattle breeds can be improved by superovulation and embryo transplantaion.  
Reason : Superovulation in high milk-yielding cows is induced by hormonal injection.

[AIIMS 2004]

# Answers

## Dog and Cats

1	c	2	d	3	b	4	c	5	a
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## Cattles and Buffaloes

1	d	2	a	3	d	4	b	5	a
6	c	7	b	8	c	9	b	10	a
11	a	12	c	13	b	14	d	15	b
16	b	17	a	18	a	19	c	20	a
21	c	22	b	23	a	24	a	25	a
26	b	27	b						

## Sheep and Goats

1	b	2	b	3	a	4	c	5	a
6	d	7	b	8	c	9	d	10	c

## Pigs

1	c	2	b	3	b				
---	---	---	---	---	---	--	--	--	--

## Horses, Donkey and Mules

1	d	2	d	3	b	4	b	5	b
6	d	7	d	8	b	9	d		

## Camel, Elephant and Yak

1	d	2	c	3	b	4	c	5	d
6	b	7	a	8	a	9	d	10	d
11	d	12	d						

## Animal breeding

1	b	2	d	3	c	4	a	5	d
6	b	7	d	8	d	9	d	10	d
11	d	12	a	13	a	14	b		

## Sericulture

1	b	2	b	3	d	4	d	5	a
---	---	---	---	---	---	---	---	---	---

6	c	7	d	8	b	9	b	10	c
11	a	12	b	13	d	14	d	15	d
16	d	17	a	18	b	19	c	20	c
21	b	22	d	23	b	24	a	25	d
26	d	27	b						

## Apiculture

1	a	2	b	3	b	4	a	5	a
6	c	7	c	8	a	9	c	10	c
11	d	12	b	13	b	14	d	15	a
16	d	17	a	18	c	19	c	20	c
21	d	22	b	23	a	24	a	25	a
26	c	27	c	28	a	29	a	30	a
31	b								

## Lac culture

1	c	2	c	3	c	4	c	5	a
6	b	7	b	8	c	9	d	10	d
11	b	12	a	13	a	14	b	15	c

## Pearl culture

1	a	2	a	3	a	4	b	5	d
6	a	7	d	8	c	9	d	10	b
11	a								

## Fisheries

1	c	2	b	3	d	4	c	5	c
6	a	7	c	8	b	9	a	10	d
11	b	12	b	13	a	14	c	15	b
16	c	17	ab						

## Poultry

1	b	2	d	3	d	4	d	5	b
6	b	7	d	8	a	9	b	10	c

## NCERT Exemplar Questions

1	d	2	a	3	d	4	b	5	c
6	d								

## Critical Thinking Questions

1	b	2	b	3	c	4	c	5	a
6	b	7	a	8	c	9	b	10	b



11	c	12	b	13	d	14	a	15	d
16	d	17	c	18	e	19	b	20	c
21	d	22	d	23	d	24	a	25	b
26	a								

### Assertion and Reason

1	a	2	b	3	c	4	b		
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## AS Answers and Solutions

### Dogs and Cats

- (c) The branch of agriculture specializing in the breeding raising care and utilization of domestic animals is known as animal husbandry.
- (d) Dogs and cats are the closest pets of man.
- (b) Dog was among the earliest animals domesticated by man.

### Cattles and Buffaloes

- (d) Cattle bones, horns and hoofs yield glue and gelatin.
- (a) Only the Bull is breedable form of animals because he is uncastrated adult male.
- (d) Cattle are widely used for milk, manure, fuel and transport etc.
- (b) Buffalo's milk has about 50% more fat content than cow's milk.
- (a) According to 1982 cattle census, India had 192.45 million cattle and 69.7 million buffaloes. India rank fifth in the world in it's population of cattle and buffaloes, but figures very poorly in milk production.
- (b) The ongole cattle is the general utility breed of Andhra pradesh. The females of these breeds are good milk producers and the bullocks are good draught animals.
- (b) Milch breeds give good milk-producing cows.
- (a) The best known breed of Indian buffalo Jaffrabadi is found in Gujarat.
- (a) The average annual milk yield of a buffalo is 491 liters as against 173 liters of a cow in India.
- (b) The disease that commonly affect the farm animals is Rinderpest or cattle plague.
- (c) The most important breed of milch cattle in united states of America are Holstein-friesian.

- (c) The economy of a developing agricultures country, such as India, largely depends on the zebu cattle [*Bos indicus* (cow)]
- (b) The best known breeds of Indian buffaloes are the murrah, jaffrabadi, Nili, Bhadawari and surti but the most demanded breed is murrah in India.

### Sheep and Goats

- (b) The recommended periods for shearing of wool are winter (February-march) and rainy (August-September) season when rich grazing ground is available.
- (b) The world's highly prized wool yielding pashmina breed is goat.
- (a) Lohi is a breed of sheep and distributed in Punjab and Rajasthan. They are rearing for good quality wool and milk.
- (a) Chiru, is the source of shahtoosh.
- (d) Goat feed on leaves, young shoots, buds, fruits of many shrubs and trees.
- (d) Lohi and Nali gives the suitable wool for carpet making.
- (c) Dorset, Horn, and Merino are an exotic breeds of sheep.

### Pigs

- (c) Ghorri is an important native Breed of pigs.
- (b) Landrace is an important exotic Breed of pigs.
- (b) Generally pigs have two seasons for breeding : August to September and February to March.

### Horses, Donkey and Mules

- (d) The white donkey also called wild ass, occurs in Rann of Kutch.
- (d) Mule is an interspecific hybrid of the male ass and the mare.
- (b) Army uses two type of mule (i) General service type and (ii) Mountain artillery type.
- (d) Horses, donkeys and mules are used as beasts of burden for transporting men and material on their back and in the carts.
- (d) Bhutia is an important breed of Indian horse. They are distributed into Punjab and Bhutan.
- (b) Horses are fed on oats, barley, gram, and hay. Common salt is also added to their diet.
- (d) If compared to other animals, horses have a low reproductive rate.

### Camel, Elephant and Yak

- (c) Arabian camels with a single hump, short hair and found in north Africa and India.
- (b) Camels breed in winter (November to March).

5. (d) There are four breeds of camels in India : Jaisalmeri, Sindhi, Bikaneri and Kutchi, in Rajasthan and Kutchi found in Gujarat.
6. (b) Camels suffer from anthrax, pneumonia, camelpox, rabies and surra.
7. (a) Arabian camels (*camelus dromedarius*) with a single hump.
8. (a) Turkish or bactrian camel (*camelus bactrianus*) with two humps and found in Gobi desert of central Asia.
10. (d) Indian elephants have small ears, high domed forehead with 2 prominence on top of skull but the African elephants have large ears, convex sloping forehead and tusks in both sexes.
12. (d) Yak is found in Tibet, Ladakh, Lahaul spiti, Garhwal and Sikkim.

### Animal breeding

1. (b) Super-ovulation and embryo transplantation are the new techniques for cattle and other livestock improvement.
4. (a) Mature cattle (over 3 years of age) should be used for selective breeding.
8. (d) Superovulation (more ova and hence more embryo), Embryo transplantation and surrogate mothers also help improve breeds.
9. (d) Cryopreservation preservation at  $-196^{\circ}\text{C}$  (liquid nitrogen) can maintain tissues culture, embryos, animal cells/tissues, spermatozoa indefinitely. The cryopreserved material is revived through special technique when required.
10. (d) World's first buffalo calf produced by artificial insemination was born at the Allahabad. Agriculture Institute on August 21, 1943.
14. (b) Directional selection leads to change in phenotype of population in one direction, since we wish to achieve high milk yield, so directional selection operates

### Sericulture

1. (b) Historical account of use of silk and rearing of silk worms eggs, larvae and cocoons are available from China. It was Lo Shu the empress Kwan-Ti who for the first time discovered the silk thread and its source the silk worm cocoon.
3. (d) Silk is a pasty secretion of the silk worm produced by the silk gland. This secretion forms two cores of fibroin. A tough elastic insoluble protein consisting of 75% of the fibre's weight and cemented together with sericin from the middle region of the silk gland.
6. (c) *Bombyx mori* called as silk moth is a silk producing insect.
9. (b) Just after copulation, females *Bombyx mori* starts egg laying which is completed in 1-24 hours. One moth lays 400 to 500 eggs depending upon the climatic conditions and the supply of the food.
12. (b) Fibroin is the core silk protein and sericin is the surface gum like compound.

16. (d) In the centrolecithal eggs the yolk accumulates in the centre of the ooplasm e.g., silk moth (insect).
17. (a) *Bombyx mori* belongs to class insecta because it can fly but in adult age, female *Bombyx mori* is not able to fly due to its heavy weight.
19. (c) Silk is produced by silk worm insect called as silk moth.
20. (c) Silk worm larva after fourth moults, stops feeding, becomes inert and coil up into a spiral. Now it starts pouring out its sticky saliva through spinneret and solidifies into fine silk thread.
21. (b) *Bombyx mori* is the common silk moth.

*Morus alba* is the common variety of mulberry plant.

Disease free silkworm eggs are supplied by seed production centres, which are called the grainages.

Powdery mildew is the common disease of mulberry plant,

22. (d)	Life span –	3 or 4 days
	Hatching –	10 days
	Metamorphosis –	30 days
	Total –	44 days

23. (b) Silk is made up of fibroin protein silk fibres are soft and flexible. These are composed of  $\beta$ -pleated sheets.
24. (a) Cocoon/pupa stage of silk moth produces silk thread around cocoon by their skin gland.
25. (d) The caterpillars larva of moth secretes a sticky fluid through silk gland. The secrete fluid comes out through spinneret and takes the form of long fine thread of silk.
26. (d) Eri silk or arundi silk is grown on castor leaf (*Ricinus communis*).

### Apiculture

5. (a) *Apis dorsata* is the scientific name of rock bee.
8. (a) Karl Ritter Von Frisch of Germany was awarded Nobel prize in 1973 for his discovery in the field of organisation and elicitation of individual and social behaviour pattern in bees.
14. (d) Commonly one queen is found to be present in each hive and feeds on royal jelly. She is the queen in real sense as the mother of the colony.
17. (a) The chief products of honey bee keeping industry are (i) Honey (ii) bee wax.
21. (d) Propolis is a component of honey secreted by honey bee itself and Bee wax is real product of honey bees.
22. (b) The greatest value of the honey bee to man is in the pollination of flower. Another financial return is from the production of bee wax and honey.
23. (a) Sting apparatus in honey bee (worker bees) is a modified form of ovipositor. Which is made up of two straight grooves or lencets.
24. (a) The queen after fertilization lays fertilized and unfertilized eggs both. From unfertilized eggs male bees emerge which are known as Drones.

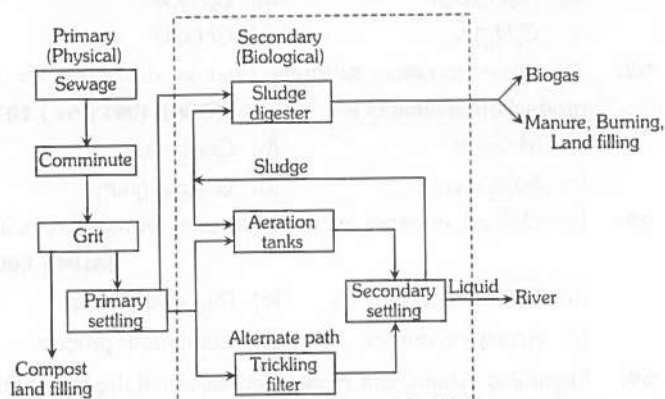
51. The drug streptomycin inhibits the process of [MP PMT 1996]  
 (a) Prokaryotic translation (b) Eucaryotic translation  
 (c) Prokaryotic transcription (d) Eucaryotic transcription
52. Which one of the following is the correctly matched pair of a product and the microorganism responsible for it [AIEEE Pharmacy 2004]  
 (a) Ethyl alcohol – Yeast  
 (b) Acetic acid- *Lactobacillus*  
 (c) Cheese - *Nitrobacter*  
 (d) Curd - *Azotobacter*
53. *Streptococcus thermophilus* and *Lactobacillus bulgaricus* are being used for the production of [MP PMT 1997]  
 (a) Cheese (b) Yoghurt  
 (c) Tempeh (d) Miso
54. Which one of the following pairs is **not** correctly matched [CBSE PMT 2004]  
 (a) *Spirulina* - Single cell protein  
 (b) *Rhizobium* - Biofertilizer  
 (c) *Streptomyces* - Antibiotic  
 (d) *Serratia* - Drug addiction
55. Antibiotics belong to the category of [MP PMT 2000, 04]  
 (a) Steroids (b) Toxins  
 (c) Medicines (d) Tonics
56. Which one of the following is used in the baking of the bread [MP PMT 2004]  
 Or  
 Baker's yeast is [Odisha JEE 2005; AMU (Med.) 2006]  
 Or  
 The dough used for making bread is fermented by  
 (a) *Rhizopus stolonifer*  
 (b) *Zygosaccharomyces*  
 (c) *Saccharomyces cerevisiae*  
 (d) *Saccharomycodes ludwigii*
57. Ethyl alcohol is commercially manufactured from [BHU 2004]  
 (a) Wheat (b) Grapes  
 (c) Maize (d) Sugarcane
58. Which among these are produced by distillation of fermented broth [NCERT; Kerala PMT 2011]  
 (i) Whisky (ii) Wine  
 (iii) Beer (iv) Rum  
 (v) Brandy  
 (a) (ii) and (iii) alone (b) (i) and (ii) alone  
 (c) (iii) and (v) alone (d) (i), (iv) and (v) alone  
 (e) (iii) and (iv) alone
59. Antibiotics are mostly obtained from [MP PMT 1997; AIEEE Pharmacy 2003]  
 (a) Fungi (b) Actinomycetes  
 (c) Cyanobacteria (d) Both (a) and (b)
60. Antibiotic flavicin is obtained from [MP PMT 1999]  
 (a) *Aspergillus flavus* (b) *Aspergillus clavatus*  
 (c) *Streptomyces griseus* (d) *Streptomyces fradiae*
61. Which of the molecules listed below is a product of fermentation of glucose by yeast [MP PMT 1999; BHU 2008]  
 (a)  $(C_6H_{10}O_5)_n$  (b)  $C_2H_5OH$   
 (c)  $C_6H_{12}O_6$  (d)  $CH_3OH$
62. The most common substrate used in distilleries for the production of ethanol is [CBSE PMT (Pre.) 2011]  
 (a) Molasses (b) Corn meal  
 (c) Soya meal (d) Ground gram
63. Immobilised enzymes are generally used for bioreactors in [AIIMS 2001]  
 (a) Batch process (b) Digestive process  
 (c) Activation process (d) Continuous process
64. Flemming, Chain, and Florey were awarded the Nobel Prize in 1945 for the discovery of [MHCET 2001; Pb PMT 2004; MP PMT 2010; Kerala PMT 2011]  
 (a) HIV (b) CT scan  
 (c) Penicillin (d) *Staphylococcus*  
 (e) Antibodies
65. Which one of the following is a wrong matching of a microbe and its industrial product, while the remaining three are correct [CBSE PMT (Mains) 2011]  
 (a) *Clostridium butylicum* – lactic acid  
 (b) *Aspergillus niger* – citric acid  
 (c) Yeast – statins  
 (d) *Acetobacter aceti* – acetic acid
66. Which of the following is wrongly matched in the given table [NEET (Phase-I) 2016]
- |     | Microbe                       | Product       | Application                       |
|-----|-------------------------------|---------------|-----------------------------------|
| (a) | <i>Trichoderma polysporum</i> | Cyclosporin A | Immunosuppressive drug            |
| (b) | <i>Monascus purpureus</i>     | Statins       | Lowering of blood cholesterol     |
| (c) | <i>Streptococcus</i>          | Streptokinase | Removal of clot from blood vessel |
| (d) | <i>Clostridium butylicum</i>  | Lipase        | Removal of oil stains             |

### Sewage Treatment

1. In the sewage treatment, bacterial flocs are allowed to sediment in a settling tank. This sediment is called as  
 (a) Inactivated sludge  
 (b) Activated sludge  
 (c) Primary sludge  
 (d) Secondary sludge



2. Refer the given flowchart of sewage treatment, accordingly match **Column I** with **Column II** and select the correct answer from the codes given below



[NCERT]

Column I		Column II	
A.	The stage in which physical treatment of sewage is done	(i)	Anaerobic digestion of activated sludge and production of biogas
B.	The stage in which biological treatment of sewage is done	(ii)	Activated sludge
C.	Name of the sediment in primary treatment	(iii)	Aeration tanks
D.	It is carried to aeration tanks from primary settling	(iv)	Primary effluent
E.	Name of the sediment in secondary treatment	(v)	Primary sludge
F.	Site of flocs growth	(vi)	Secondary treatment
G.	Function of sludge digester	(vii)	Primary treatment

- (a) A-(vii), B-(vi), C-(v), D-(iv), E-(ii), F-(iii), G-(i)  
 (b) A-(i), B-(iii), C-(v), D-(vii), E-(ii), F-(iv), G-(vi)  
 (c) A-(i), B-(ii), C-(iii), D-(iv), E-(v), F-(vi), G-(vii)  
 (d) A-(vii), B-(vi), C-(i), D-(ii), E-(iii), F-(iv), G-(v)
3. Study the following statements and select the incorrect ones
- Physical removal of large and small particles through filtration and sedimentation is called primary sewage treatment.
  - Secondary sewage treatment is mainly a mechanical process
  - Activated sludge sediment in a sewage treatment plant is a rich source of aerobic bacteria.
  - Biogas, commonly called as gobar gas, is pure methane.
- (a) (i) and (ii) (b) (ii) and (iv)  
 (c) (ii) and (iii) (d) (iii) and (iv)
4. Integrated Pest Management (IPM) discourages the excessive use of
- (a) Biological methods (b) Chemical pesticides  
 (c) Mechanical methods (d) All of these
5. The large vessels for growing microbes on an industrial scale are called [NCERT]
- (a) Petri dish (b) Digestors  
 (c) Biogas vessel (d) Fermentors
6. The primary treatment of sewage involves [NCERT]
- (a) Digestion  
 (b) Decomposition  
 (c) Sedimentation and Filtration  
 (d) None of these
7. The amount of oxygen required by the microbes in the decomposition of organic matter is called [NCERT]
- (a) Chemical oxygen demand  
 (b) Biochemical oxygen demand  
 (c) Total oxygen demand  
 (d) Dissolve oxygen
8. During which stage of sewage treatment microbes are used [NCERT]
- (a) Primary treatment (b) Secondary treatment  
 (c) Tertiary treatment (d) All of these
9. The solids which settle after primary treatment of sewage are called [NCERT]
- (a) Primary sludge (b) Activated sludge  
 (c) Flocs (d) Total solids
10. What gases are produced in anaerobic sludge digesters [NEET 2013; CBSE PMT 2014; KCET 2015]
- (a) Methane, hydrogen sulphide and  $O_2$   
 (b) Hydrogen sulphide and  $CO_2$   
 (c) Methane and  $CO_2$  only  
 (d) Methane, hydrogen sulphide and  $CO_2$
11. 'Flocs' refer to
- (a) Masses of bacteria associated with fungal filaments to form mesh-like structure  
 (b) Primary sludge formed in the ETP  
 (c) The remaining part of the sludge  
 (d) 'Biogases' formed from the fermentation of organic wastes
12. A sewage treatment process, in which a part of decomposer bacteria present in the wastes is recycled into the starting of the process is called [AIIMS 2007; DUMET 2009]
- (a) Cyclic treatment  
 (b) Activated sludge treatment  
 (c) Primary treatment  
 (d) Tertiary treatment
13. The purpose of biological treatment of waste-water is to [AMU (Med.) 2010]
- (a) Reduce BOD (b) Increase BOD  
 (c) Reduce sedimentation (d) Increase Sedimentation
14. Which of the following in sewage treatment removes suspended solids [NCERT; NEET 2017]
- (a) Tertiary treatment (b) Secondary treatment  
 (c) Primary treatment (d) Sludge treatment

# NCERT

## Exemplar Questions

- Activated sludge should have the ability to settle quickly so that it can [NCERT]
  - Be rapidly pumped back from sedimentation tank to aeration tank
  - Absorb pathogenic bacteria present in waste water while sinking to the bottom of the settling tank
  - Be discarded and anaerobically digested
  - Absorb colloidal organic matter
- Wastewater treatment generates a large quantity of sludge, which can be treated by [NCERT]
  - Anaerobic digesters
  - Floc
  - Chemicals
  - Oxidation pond
- Match the following list of bacteria and their commercially important products
 

Bacterium	Product
A. <i>Aspergillus niger</i>	i. Lactic acid
B. <i>Acetobacter aceti</i>	ii. Butyric acid
C. <i>Clostridium butylicum</i>	iii. Acetic acid
D. <i>Lactobacillus</i>	iv. Citric acid

Choose the correct match [NCERT]

  - A-ii, B-iii, C-iv, D-i
  - A-ii, B-iv, C-iii, D-i
  - A-iv, B-iii, C-ii, D-i
  - A-iv, B-i, C-iii, D-ii
- Match the following list of bioactive substances and their roles
 

Bioactive Substance	Role
A. Statin	i. Removal of oil stains
B. Cyclosporin A	ii. Removal of clots from blood vessels
C. Streptokinase	iii. Lowering of blood cholesterol
D. Lipase	iv. Immuno-suppressive agent

Choose the correct match [NCERT]

  - A-ii, B-iii, C-i, D-iv
  - A-iv, B-ii, C-i, D-iii
  - A-iv, B-i, C-ii, D-iii
  - A-iii, B-iv, C-ii, D-i
- Big holes in Swiss cheese are made by a [NCERT]
  - A machine
  - A bacterium that produces methane gas
  - A bacterium producing a large amount of carbon dioxide
  - A fungus that releases a lot of gases during its metabolic activities
- BOD of waste water is estimated by measuring the amount of [NCERT]
  - Total organic matter
  - Biodegradable organic matter
  - Oxygen evolution
  - Oxygen consumption

- Which one of the following alcoholic drinks is produced without distillation [NCERT]
  - Wine
  - Whisky
  - Rum
  - Brandy
- What would happen if oxygen availability to activated sludge flocs is reduced [NCERT]
  - It will slow down the rate of degradation of organic matter
  - The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs
  - Flocs would increase in size as anaerobic bacteria would grow around flocs
  - Protozoa would grow in large numbers

## Critical Thinking

### Objective Questions

- Which of the option shows following example in ascending order in terms of BOD [GUJCET 2014]
  - Distilled water
  - Tap water
  - Sewage wastes drained in river
  - i - ii - iii
  - ii - i - iii
  - iii - i - ii
  - iii - ii - i
- Broad spectrum antibiotic is that which
  - Acts on both pathogens and hosts
  - Acts on all bacteria and viruses
  - Acts on a variety of pathogenic micro-organisms
  - Is effective in very small amounts
- Antibiotics inhibit the growth of or destroy
  - Bacteria and fungi
  - Bacteria and viruses
  - Bacteria, algae and viruses
  - Bacteria, fungi and viruses
- The fruit juices turn bitter in taste if they are kept in open place for sometime, because of
  - Bacteria of the atmosphere react with the juice
  - Fermentation of the juice by yeast
  - Some internal factors
  - All the above three statements are correct
- Which one of the following pairs is wrongly matched [CBSE PMT 2007]
 

(a) Methanogens	- Gobar gas
(b) Yeast	- Ethanol
(c) Streptomycetes	- Antibiotic
(d) Coliforms	- Vinegar

## A R Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion  
 (b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion  
 (c) If the assertion is true but the reason is false  
 (d) If both the assertion and reason are false  
 (e) If the assertion is false but reason is true

1. Assertion : Yeasts such as *Saccharomyces cerevisiae* are used in baking industry.

Reason : Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion. [AIIMS 2003]

2. Assertion : The kneaded flour shows leavening, when yeast is added to it.

Reason : Enzymes secreted by yeast cause leavening.

3. Assertion : Extraction and purification of enzymes is laborious and expensive.

Reason : Protein engineering can be used to produce enzymes at large scale.

4. Assertion : Enzymes application in industry is enhanced by its immobilization.

Reason : Immobilization provides protection to enzymes without affecting their activity.

## Answers

### House Hold Food Processing

1	b	2	d	3	b	4	b	5	d
6	d	7	d	8	a	9	d	10	d
11	a	12	a						

### Industrial Production

1	b	2	c	3	a	4	d	5	b
6	d	7	d	8	b	9	c	10	a
11	d	12	a	13	a	14	b	15	c
16	d	17	b	18	c	19	c	20	d

21	d	22	c	23	a	24	b	25	b
26	d	27	c	28	b	29	c	30	d
31	c	32	d	33	b	34	b	35	d
36	d	37	a	38	c	39	d	40	b
41	b	42	a	43	c	44	b	45	c
46	b	47	b	48	c	49	a	50	d
51	a	52	a	53	b	54	d	55	c
56	c	57	d	58	d	59	d	60	a
61	b	62	a	63	d	64	c	65	a
66	d								

### Sewage Treatment

1	b	2	a	3	b	4	b	5	d
6	c	7	b	8	b	9	a	10	d
11	a	12	b	13	a	14	c		

### NCERT Exemplar Questions

1	a	2	a	3	c	4	d	5	c
6	d	7	a	8	b				

### Critical Thinking Questions

1	a	2	c	3	d	4	b	5	d
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### Assertion and Reason

1	a	2	a	3	b	4	a		
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## A S Answers and Solutions

### House Hold Food Processing

- (b) In old days, cheese was prepared by using the enzyme "rennet" from the lining of stomach of sheep and goat.
- (d) Lactic acid bacteria acts on lactose which present in milk and converts it into cheese.
- (b) Rennet is obtained from calf stomach and used in the preparation of cheese.
- (d) Cheese is prepared from milk with the help of *Streptococcus lactis*, *S. Cremoris*, *Leuconostoc citrovorum*, *Lactobacillus sp.* etc.
- (a) The dough which is used for making foods such as dosa, idli, jalebi, biscuits and bread etc. are fermented by bacteria or yeast (*Saccharomyces cerevisiae*). The puffed-up appearance of dough is due to the production of  $\text{CO}_2$  gas. Bacteria are present in the atmosphere and the yeast has to be added to the dough.



12. (a) Large holes in the swiss cheese are due to production of large amount of  $\text{CO}_2$  by a bacterium named *Propionibacterium sharmanii*. The Roquefort cheese is ripened by growing a specific fungus on them, which gives them a particular flavour.

### Industrial Production

6. (d) Lactic acid is produced from microbial fermentation of lactose (milk sugar). Fermenting agents are bacteria, e.g., *Streptococcus lactis* and *Lactobacillus* and fungi, e.g., *Rhizopus*.
7. (d) The term 'antibiotic' was given by Waksman (1942).
8. (b) Vinegar is most important acid being produced by two step fermentation of sugarcane juice by yeast and *Acetobacter bacilli* bacteria. Ascorbic acid (vitamin C) is produced by a complicated modification of glucose by different species of *Acetobacter*.
9. (c) First antibiotic isolated was penicillin (wonder drug), from *Penicillium notatum*.
12. (a) *Bacillus eubacteriales* / simple bacteria is main source (about 70%) of antibiotics production and 30% antibiotics produced from pseudomonas.
15. (c) Gluconic acid is produced, during glucose oxidation by most *Aspergillus* spp. and citric acid is obtained by the fermentation of sugar syrup by *Aspergillus niger*.
17. (b) Streptomycin is produced from *Streptomyces griseus*. Streptomycin inhibits the bacterial protein synthesis by affecting 30S subunit of ribosome.
20. (d) Payen and Persoz in 1933 identified diastase for the first time.
21. (d) By cross linking enzyme molecules or by covalently attaching them to a solid support or by entrapping them in gel, metabolic activities of enzymes are stopped.
22. (c) Beer is produced from *Hordeum vulgare* (barley seed) malt and alcohol content is 4-8%.
23. (a) Common food yeast is *Torulopsis utilis*. It is cultured over molasses and starchy materials like Potato at 5 pH.
24. (b) First organic acid (lactic acid) to be fermented, which obtained by the activity of a number of bacteria like *Streptococcus lactis*, *Lactobacillus delbreukii*, and *Rhizopus* fungus.
26. (d) This vitamin is now being produced during fermentation by *Propioni* bacteria (bacteria which synthesize propionic acid) and certain strains of *Pseudomonas*.
28. (b) First antibiotic penicillin from blue – green fungus *Penicillium notatum* in agar – agar medium, discovered by Sir Alexander Flemming in 1928.
31. (c) Cheese and yoghurt is nutritive product of milk which is formed by fermentation process.
35. (d) Brewing industry produces alcoholic beverages of several types depending upon the fermenting agent and the medium. Fermenting agents are *Saccharomyces cerevisiae*, *S. sake*, *S. ellipsoidens* (wine yeast) and *S. piformis*, (ginger yeast).
36. (d) Statins produced by the yeast *Monascus purpureus* have been commercialised as blood-cholesterol lowering agents. It acts by competitively inhibiting the enzyme responsible for synthesis of cholesterol.

39. (d) Because *Acetobacter aceti* is used in the production of vinegar.

41. (b) Penicillin is obtained from *Penicillium notatum* and *Penicillium chrysogenum*. (Sir Alexander Flemming 1928).

42. (a) Alcohol fermentation is carried out by a number of bacteria and yeast (*Saccharomyces*). The ethanol and carbon dioxide produced by *Saccharomyces* are useless for yeast but useful to humans.

**Acetic acid** is synthesized by the help of *Acetobacter* (bacterium).

**Citric acid**—is produced by the help of fungus *Aspergillus*.

47. (b) *Claviceps purpurea* is a fungus which causes ergotism in rye (*secale cereale*) and other plants. It also yields a hallucinogenic drug called LSD.
48. (c) Neomycin obtained from *Streptomyces fradiae*. It acts against acid-fast and gram negative bacilli but toxic to kidneys and ear.
49. (a) Interferons are active proteins (Antiviral proteins) that are effective against most viruses.
50. (d) Antibiotics are the substances which are produced by micro-organism for killing or inhibiting the growth of micro-organism.
53. (b) Yoghurt / yogurt produced by curdling of milk with the help of *Streptococcus thermophilus* and *Lactobacillus bulgaricus* at 40–46°C for four hours.
56. (c) Invertase enzyme is obtained from *Saccharomyces cerevisiae* and is used to bread baking is also called baker's yeast.
57. (d) Sugarcane (*Saccharum officinarum*) is the main source of commercial ethyl alcohol. Source is extracted from the juice of sugarcane as a commercial product, but this leaves a syrup called molasses which contains glucose and fructose. Ethanol is produced by the fermentation of molasses by using yeast *Saccharomyces cerevisiae*.
59. (d) Antibiotics are obtained from lichens, fungi, eubacteria, actinomycetes.
61. (b) 
$$\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \xrightarrow[\text{Invertase}]{\text{Yeast}} \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6$$

$$\text{C}_6\text{H}_{12}\text{O}_6 \xrightarrow[\text{Zymase}]{\text{Yeast}} 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$$
(Glucose) (Fructose) (Ethyl alcohol)
62. (a) Molasses are used commonly in distilleries for ethanol production
63. (d) Immobilisation of enzymes is the process of fixing enzyme to or enclosing it in a solid support so as to protect it from deactivation and attack from proteases, maintain enzyme purity, ability to recover it after reaction and perform continuous reaction.

### Sewage Treatment

1. (b) Once the BOD is reduced the effluent is then passed into a settling tank where the bacterial flocs are allowed to settle. This sediment is called activated sludge. A small part of the activated sludge is pumped back into the aeration tank to serve as inoculum. Remaining part is pumped into large tanks called anaerobic sludge digesters.

2. (a) Primary treatment remove floating and suspended solids from sewage through filtration and sedimentation. Secondary treatment is purely a biological treatment involving microbial activity. Most of the suspended material get concentrated and settles down. The sedimentation is called the primary sludge and supernatant is called effluent. The effluent is passed through a sedimentation tank where microbial flocs are allowed to settle down. The settled material is called activated sludge. A part of activated sludge is used as inoculum in aeration tank. The remaining is passed into a large tank called anaerobic sludge digester.
3. (b) The stage in which biological treatment of sewage is done is called secondary treatment. Biogas is a mixture of gases containing predominantly methane produced by microorganism. Which may be used as fuel type of gas produced depends on microbes and the organic substrate they utilize. Here the raw material is cellulose and the gases produced are methane along with  $\text{CO}_2$  and  $\text{H}_2$ .
4. (b) Integrated Pest Management (IPM) promotes minimized pesticide use, enhanced environmental stewardship and sustainable systems. This is achieved by protection of commodities with environmentally and economically sound practices and results in abundant and diverse supplies of food and fibre products.
5. (d) Production of products valuable to human beings on an industrial scale requires growing microbes in very large vessels called fermentors.
6. (c) It involves physical removal of particles – large and small from the sewage through filtration and sedimentation. Sequential filtration removes floating debris, then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle down forms the primary sludge, the supernatant forms the effluent.
7. (b) BOD refers to the amount of oxygen that would consume if all the organic matter in one litre of water is to be oxidized by bacteria. The sewage water is treated till BOD is reduced. The greater the BOD, greater is the polluting potential. Once the BOD is reduced the effluent is then passed into a settling tank where the bacterial flocs are allowed to settle.
8. (b) Secondary treatment / biological treatment the primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs.
9. (a) All solids that settle down forms the primary sludge the supernatant forms the effluent. The effluent from the primary settling tank is taken for sewage treatment.
10. (d) Marsh gas or Methane gas is mainly produced by the activities of anaerobic bacteria on sewage. Sewage contains large amounts of organic matter and microbes (bacteria and fungi) are digested during secondary treatment process of sewage by anaerobic bacteria. During digestion bacteria produce a mixture of gases such as methane, hydrogen sulphide and carbondioxide.
11. (a) The primary effluent is passed into large aeration tanks where it is constantly agitated Mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (Masses of bacteria associated with fungal filaments to form mesh like structure). While growing, these microorganisms consume the major part of the organic matter in the effluent.

### Critical Thinking Questions

1. (a) Domestic sewage mostly contains biodegradable organic matter which readily decompose by micro organisms for biodegradation of organic matter. Micro organism consume lot of  $\text{O}_2$ , resulting sharp decline of dissolved  $\text{O}_2$  in river/ water body. Thus BOD will increase.
2. (c) It is an antibiotic which can kill or destroy a number of pathogens that belong to different groups with different structure and cell wall composition.
3. (d) Clinically, an antibiotic is a substance produced by a micro-organism which in low concentration inhibits the growth and metabolic activity of pathogenic organisms without harming the host cell.

### Assertion and Reason

1. (a) Bakers yeast (*Saccharomyces cerevisiae*) is added to flour during kneading. Yeast secretes enzymes like amylase (change some starch to maltose), maltase (maltose to glucose) and zymase (glucose to ethyl alcohol and  $\text{CO}_2$ ). Leavened dough is baked and both alcohol and  $\text{CO}_2$  evaporate. The bread becomes soft and porous.
2. (a) A small quantity of yeast is added to wheat flour. The same is kneaded. The kneaded flour is kept at a warm temperature for a few hours. It swell up. The phenomenon is called leavening. Leavening is caused by secretion of three types of enzymes by yeast. They are amylase, maltase and zymase.
3. (b) Although thousands of proteins have been characterized in prokaryotes and eukaryotes, only few became commercially important. This is due to the high cost of isolating and purifying enzymes in sufficient quantities. Through recombinant DNA technology, a protein can be obtained in abundant quantity the objectives of protein engineering are to create superior enzymes to catalyze production of high value specific chemicals and to produce enzymes for large scale use.
4. (a) An immobilized enzyme is physically entrapped or covalently bonded by chemical means to an inert and usually insoluble matrix, where it can act upon its natural substrate. The matrix is usually a high molecular weight polymer such as polyacrylamide, cellulose, starch, glass, beads, etc. Because of its binding with a matrix the immobilized enzyme has better stability in many cases. Efficiency of immobilized enzyme is better. The enzyme can be recovered at the end of the reaction and can be used repeatedly.