



## 35

## SOME AIDS IN BIOLOGY

Learning and teaching of Biology is complete only when the student is able to see active living and preserved variety of organisms. Learning Biology also becomes easier by observing organisms closely rather than merely reading about them. Preserved animals and plants, duly classified are kept in museums. Charts and models are displayed there. Living animals are kept in animal house, frogs in a specially constructed froggery, fish in aquarium. Plants are grown in the botanical garden or specially maintained in a green house. Preparation of a herbarium is an integral part of learning Botany. Some such aids in learning and teaching Biology are outlined in this lesson.



## OBJECTIVES

After reading this lesson you will be able to :

- *describe the need for a zoological museum;*
- *explain the ways in which specimens such as wet, dried specimens, embalmed specimens, models, pictures, photographs and skeletons can be displayed in the zoological museum;*
- *explain the need for a botanical garden;*
- *list the categories of plants need to be grown in the botanical garden;*
- *describe a green house;*
- *explain need for a green house;*
- *describe herbarium and list the steps followed in making a herbarium;*
- *explain the steps involved in setting up an aquarium;*
- *list the fishes suitable for an aquarium*
- *explain the need for maintaining suitable temperature, proper light and proper aeration in the aquarium*
- *list different kinds of fish food.*



Notes

**35.1 ZOOLOGICAL MUSEUM**

A zoology museum or an animal museum houses (i) preserved animals, (ii) their skeletons (iii) fossils (iv) models (v) charts and (vi) photographs. The person incharge of maintaining the museum is called **museum curator**.

**1. Preservation and display of specimens**

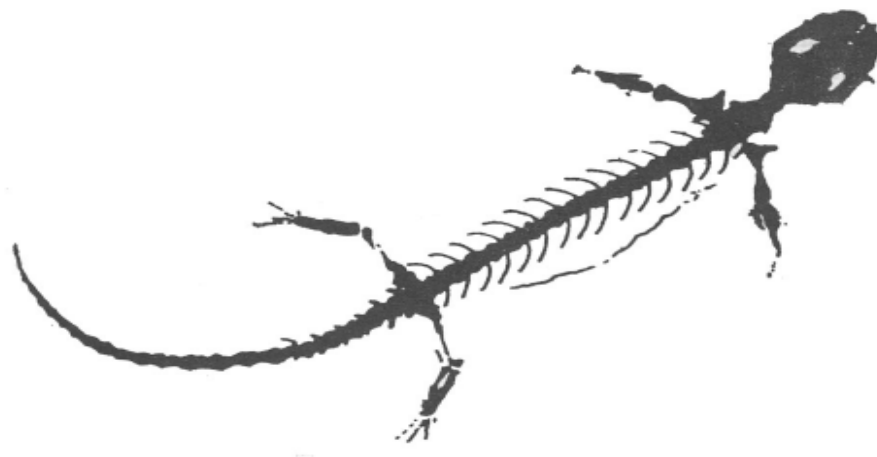
**(a) Wet Preservation**

Invertebrates and small and medium sized vertebrates can be preserved intact in glass or transparent plastic jars of appropriate size called specimen jars (Fig. 35.1). The jars have a flat, firm base and a lid. A solution of 10% formalin fills the jar. The specimen is mounted on a glass slab of appropriate size which is then placed inside the jar and covered with the lid. The lid may then be screwed on to the jar or sealed on it. From time to time fresh formalin has to be added or replaced according to need. The specimen remains intact for years if handled properly. The specimens retain their shape and morphology. Only the natural colour is lost.



**Fig. 35.1** Museum jars with preserved specimens

Wet Preservation can be done for (i) intact specimens; (ii) vertebrate embryos; (iii) organs such as heart and eye; (iv) specimens dissected out to display organ systems e.g. nervous system of an animal; and (v) in situ skeletons of small vertebrates such as fish or frog or lizard. In situ (retained in actual position in the



**Fig. 35.2** Alizarin stained skeletal preparation of a lizard



animal) skeleton can be prepared in the following manner and mounted and kept in bottles containing glycerine. Chloroformed animal is kept in 90% alcohol in a covered jar for two days. Alcohol is then removed and animal dipped in 1% aqueous solution of Potassium hydroxide till it becomes transparent. The animal is then placed in Alizarin Red Stain (0.1 gm of Alizarin Red in a litre of 1% aqueous solution of KOH). The bones get stained (Fig. 35.2). The animal is then transferred to a specimen jar containing glycerine.

### (b) Dry preservation

Exoskeletons (Skeletons covering the body) such as shell of molluscs, star fish, sea urchins, corals, cocoons of insect sloughed off (cast off) skin of snakes or insects (exuviae), feathers and nests of birds, honey combs and wasp or termite nests, mammalian skin with furs, dried sponges etc. can be displayed in the museum intact for many years provided they are prevented from breaking or from attack by insect parasites or microorganisms.

Apart from the above (i) vertebrate skeletons and (ii) pressed insects also form part of dry presentation.

### (c) Skeleton preparation

Skeletons may be prepared in the following way. Chloroformed vertebrate is dissected to remove organs and as much muscle as possible. Boil the animal so that muscles become tender and remove them. When only the skeleton remains, dip it in Hydrogen Peroxide for bleaching (optional). Mount on a cardboard or wooden board with the help of adhesive like araldite or fevicol and display.

Skull or bones of dead animals collected from the fields may be cleaned with water, disinfected with a disinfectant, dried and displayed in a museum. Stuffed animals are also kept in the museum. Skinning, preserving, stuffing and mounting vertebrates is called **TAXIDERMY**.

### (d) Insect collection and preservation

Insects are found everywhere - cockroaches abound near the kitchen drains, butterflies roam among flowers while grasshoppers hop and crickets chirp in the grass. Flies are where sweets are and fruit flies hover around vegetables and fruits. Insects are the most numerous and diversified group of animals.

#### Collection of Insects

Insect collection is an activity which combines fun and study. The equipment required is (i) collecting jar, (ii) a net (iii) fine wire sieves (iv) insect trap.

#### The collecting jar can be of three types

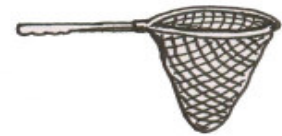
- Cyanide bottle** : in which sodium cyanide is placed in small lumps in a wide mouthed jar with a well fitting lid. Plaster of paris is made to set on the sodium cyanide. When dry, the bottle is stoppered. Since sodium cyanide is a deadly poison, it has to be handled with care.
- Carbon tetrachloride bottle** is efficient and harmless. A glass tube is inserted in a small hole bored in the cork of a bottle. A cotton wad is fastened to the cork.



**Notes**

(c) **Chloroform bottle** has rubber bands placed at the bottom of a bottle and some chloroform put in it. Rubber has the capacity to absorb chloroform. After sometime unabsorbed chloroform is thrown away and a cardboard placed to cover the rubber bands. Fumes of chloroform absorbed by rubber fill the bottle.

A **net** made of cotton or nylon can be stitched to a handle as shown in the Fig. 35.3.

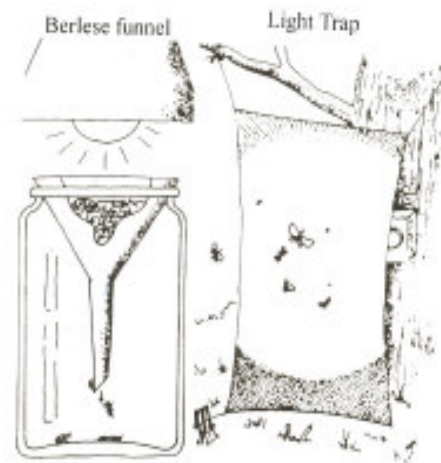


**Fig. 35.3** Net for catching insects

The **fine wire sieves** are required to strain the mud which comes with the collected insects or to wash them. Flying insects or walking and hopping insects can be collected from their natural surrounding.

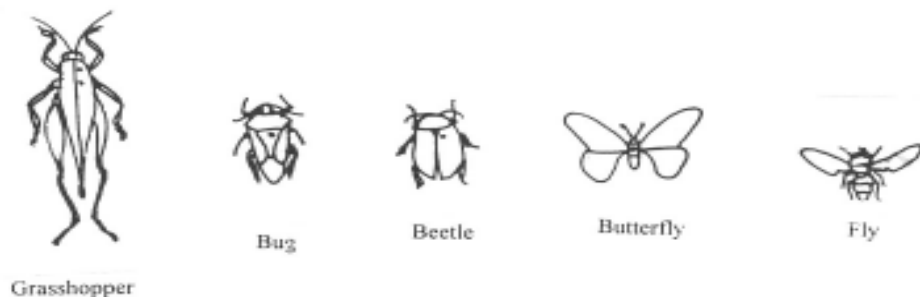
Insects may be trapped with the use of **insect traps**. A simple trap has a large funnel placed on the mouth of a wide mouthed jar containing chloroform or alcohol.

A **Berlese funnel** traps small insect. A funnel is soldered at the end of a large can with a hole at its bottom. A false bottom made of wire mesh is placed in the can, filled with leaves and grass and covered with cheese cloth. The stem of the funnel ends in a wide mouthed bottle sealed with cotton plug. This collecting bottle may contain alcohol or chloroform for preserving the insects. (Fig. 35.4)



**Fig. 35.4** Insect traps

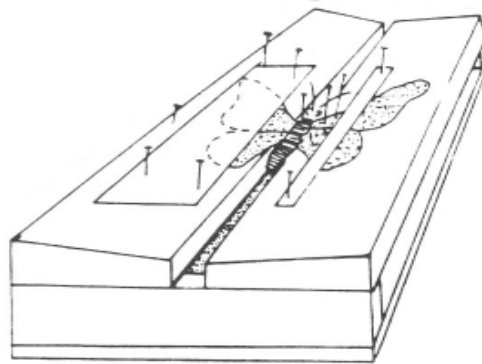
Insects are caught by the net or in the trap and placed in the collecting jar. Then they have to be preserved.



**Fig. 35.5** Where to place the insect pin through the body when mounting insects Push through area indicated by the black dot



Notes

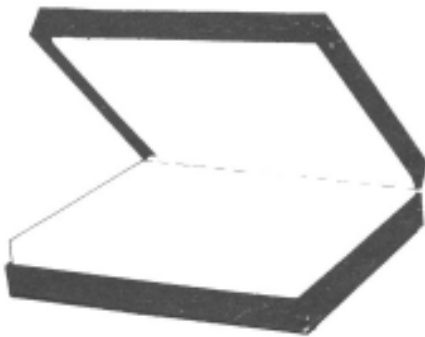


**Fig. 35.6** How to spread pinnea butterflies and moths.

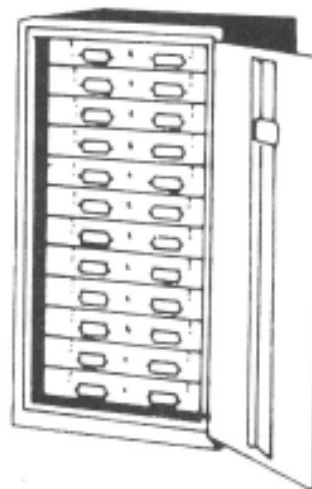
### Insect preservation

Material required for the preservation of collected insects are (i) Pins of various sizes (ii) hard paper (iii) insect spreading board (iv) insect collection box (v) insect cabinet.

Before collected insects dry up, pin has to be thrust through the thorax or wings (Fig. 35.5). Very small insects are mounted on a triangular piece of hard paper. Wings of butterflies, dragonflies have to be spread out as shown in (Fig. 35.6). Spreading of wings is done by first fixing the pin carrying the insect in the groove of the spreading board, wings spread out and strips of paper pinned across wings of either side (Fig. 35.6). Once such mounted insects are dry, they are removed to the insect collection box (Fig. 35.7). The insects are then classified and arranged in an insect cabinet. (Fig. 35.8).



**Fig. 35.7** Standard cardboard insect box



**Fig. 35.8** Insect cabinet



**Notes**

**2. Visual aids - Charts, models, photographs**

Charts and models depicting morphology of organisms, phylogeny showing taxonomic relationships, internal structure of plants and animals, life history of social insects, evolution of horse and humans etc. should be available for students.

The advantages of charts and models are

- (i) they substitute for live specimens which are not available;
- (ii) charts are self explanatory if well prepared and students can revise from them;
- (iii) the teacher can carry the chart to class while explaining the theory on black board.

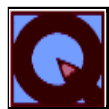
Good charts prepared by students can also be put up on the wall which not only encourages the student who made it but also other students. Photographs of great biologists may also be hung up with their names and contribution written clearly.

Visual aids ought to be (i) accurate (ii) relevant (iii) comprehensible (iv) realistic (v) properly labelled and (vi) title should be clearly written. The models should have a three dimensional effect and the proportions should be correct. Students can make models with wood, fibre, thermocole and any other material. Charts and pictures should be hung on the wall which is well lit. They should be within the level of the eyes of children using the museum.

**Maintenance of the Museum**

The museum requires constant care. The museum curator has the following duties :

- 1. to change the charts and pictures from time to time;
- 2. to make new visual aids;
- 3. to be available to help students. The curator should have a Biology background;
- 4. to change formalin of preserved specimens; and
- 5. to be involved in overall maintenance of the museum.



**INTEXT QUESTIONS 35.1**

- 1. What is the person incharge of museum called?  
.....
- 2. What is the Berlese funnel used for?  
.....
- 3. Name the stain used for in-situ skeleton preparation.  
.....
- 4. Name a visual aid used in teaching Biology.  
.....



5. Name the

- (i) common chemical used for preserving specimens

.....

- (ii) art and science of skinning, stuffing and preserving animals.

.....

### 35.2 BOTANICAL GARDEN

A well maintained garden where plants are classified and grown with care and where plants may even be multiplied for the purposes of observation and research is called a BOTANICAL GARDEN. A garden full of plants, both flowering and non flowering is indeed a treat to see. But a botanical garden is not for entertainment alone but associated with Botany teaching and research.

In our country we have the main national botanical gardens in Lucknow and Kolkata. The one in Lucknow is called National Botanical Garden and has plants of Uttar Pradesh and those from the hilly regions of Uttaranchal. Indian Botanical garden is in Shibpur near Kolkata. It has more than a hundred year old Banyan tree.

A school botanical garden is, developed on a much smaller scale. The plants grown in it are mostly the ones which form the study material for Botany. A patch of ground within the school premises where ample sunlight comes is the ideal place where botanical garden may be developed. Plants of different kinds as also those required for practical study need to be grown. An ideal situation is when (i) new plants are added from time to time and (ii) plants are labelled with labels carrying the botanical names as well as common names. (iii) A catalogue has to be prepared giving a number and concise description.

### 35.3 GREEN HOUSE

A greenhouse is a special enclosure made of glass or plastic in which plants are grown and maintained at a specified temperature and humidity. In countries, where freezing temperature obtains in winter, a green house is made with roof and walls made of glass. Plants get adequate light and they can be watered. At the same time heat trapped by the glass enclosure keeps the greenhouse warm. Temperature, however, is also regulated by a specialised system. Greenhouses are permanent structures.

Temperature of greenhouse is regulated through an automatically controlled heating and ventilation system. A central coal or oil furnace supplies the heat. More common is a peripheral steam heating system. Ventilation is provided at the sides and top. In summer, when temperature goes up fan and pad cooling is used to lower temperature. Water is circulated through pipes. Cooling pads draw cooled air across greenhouse. It is more effective when humidity is low.

Instead of glass, plastic films are used to make the wall and roof of glasshouse. Light absorbing qualities of plastic are similar to those of glass. Rigid plastic or





**Notes**

ultraviolet resistant polythene is used. During summer a shade made of cloth is used to cover the greenhouse.

In an institute where Biology is taught, a greenhouse of smaller dimensions can be constructed to house delicate plants. Plants would provide material for botanical studies and students would also be trained in growing, maintaining and propagating plants under controlled conditions. (See Fig. 3.9).



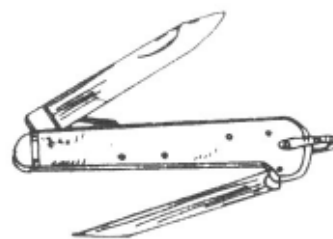
**Fig. 35.9 Green house**

**35.4 HERBARIUM**

A herbarium is defined as a collection of plants that have been dried, pressed and preserved on sheets of hard paper. The dried plants are classified and arranged for future reference especially for taxonomic studies.

A plant collector needs to have the following equipment :

- (i) a gardener’s knife, (Fig. 35.10a)
- (ii) a plant press or vasculum, (35.10b)
- (iii) blotting papers to dry plants,
- (iv) trowel to dig and uproot the plant,
- (v) collecting and mounting sheets,
- (vi) gum tape, labels, waterproof ink and pen.



**Fig. 35.10(a)** Gardener’s knife – one should carry such knife in field trips

**1. Collecting botanical specimens**

Fleshy plants lose their diagnostic features when dried so they are preserved in 4% formalin in glass containers. Gymnosperm cones and dry fruits are collected and preserved as such.

Plants should be collected from various localities for the preparation of a herbarium. The herbarium should also have representative specimens from various groups of plants.



**Fig. 35.10(b)** A plant press (Vasculum) with sheets





Notes

A complete specimen when collected, should have all the parts including the root system. It is better to collect a plant at its flowering stage. A tag should give the location from where collected. About five or six specimens of each kind of plant should be collected. The collected plant should either be pressed then and there or collected in a vasculum and pressed later. Vasculum is a metal cylinder with a sliding door in which plants are collected (Fig. 34.10b).

## 2. Pressing, Drying and Preserving

The collected plant should be pressed between sheets of blotting paper. One plant is arranged on one sheet so that its parts do not overlap. Specimens longer than the sheets can be folded in the form of 'V' or 'N'.

The plant between the sheets is put in a press for 24 to 48 hours. The press is then opened, blotting sheets changed and plants rearranged again and put back in the press for another 2 or 3 days. The pressed specimen is then dried in sunlight or heat from some other source.



Fig. 35.10(c) Holding of specimen for poisoning

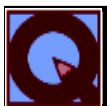
To prevent the abscission layer formation and decay, plants are killed (poisoned) with formalin or Mercuric chloride ( $\text{HgCl}_2$ ) or Carbon Tetra chloride ( $\text{CCl}_4$ ). Also dipping in Mercuric chloride ( $\text{HgCl}_2$ ) saves them from attack by museum pests such as beetles. Fig. 35.10(c).

## 3. Mounting and Labelling

After drying, specimens are mounted on mounting papers or herbarium sheets which are usually of a standard size of 11.5" × 16.5" and sturdy enough to support the dried plants. Glue or adhesive tape or adhesive paste is used to stick the specimens on to the sheets.

Each sheet should carry a label pasted on the lower right hand corner giving the (i) the site of collection, locality and altitude (ii) name of plant (iii) family (iv) habit (v) date of collection (vi) ecological notes and (vii) name of collector.

Herbarium sheets should be stored in herbarium cases or steel almirahs. They should be arranged according to the system of classification. Moth balls, naphthalene flakes or 2% of Mercuric chloride should be sprayed to keep away mould, fungi and insects.



### INTEXT QUESTIONS 35.2

1. Where are the national botanical gardens situated in our country?

.....

2. What is a greenhouse?

.....



**Notes**

3. Define herbarium.

.....

4. What is a vasculum?

.....

5. Mention the steps for preparation of a herbarium in a sequence.

.....

**35.5 AQUARIUM**

An aquarium is a glass container in which live fish are kept along with aquatic plants. A well maintained aquarium helps students to learn many biological principles. Some of these are –

- (i) dependance of animals on green plants for (a) food and (b) oxygen,
- (ii) relationship of carbon-dioxide and light to photosynthesis,
- (iii) food ingestion, storage, respiration, digestion, growth, reproduction and development in plants and animals,
- (iv) relationship of bacteria to Nitrogen, Phosphorus and Sulphur cycle,
- (v) parasitism,
- (vi) food cycles,
- (vii) temperature and water relation,
- (viii) ecological succession.

**1. How to prepare a balanced aquarium**

Materials required for an aquarium are :

- (i) **Aquarium tank** approximately of five gallon capacity. Aquarium water is static and changes its composition due to activities of fish and plants. Hence, it has to have enough surface area for adequate gas exchange. It may be made of plastic or glass with silicon adhesive (Fig. 35.11).

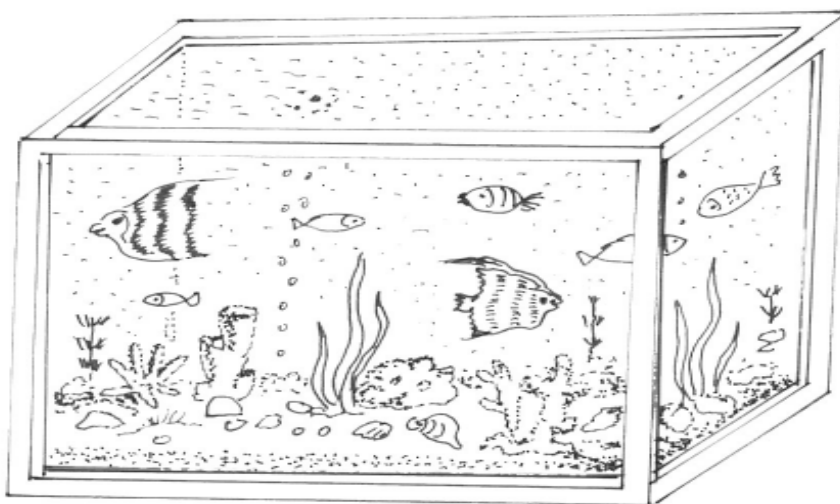
The tank should be placed on firm, level and smooth surface. It is best located near the window but direct sunlight should be avoided as it leads to excessive algal growth in summer. The side towards window may be covered with paper or painted. If light is not enough electric light may be used.

The situation of the tank should have easy access for maintenance and for power sockets for heat and light.

- (ii) **Substratum in the tank** can be constructed by putting one inch of sand on soil. The substratum (a) forms the source of minerals; (b) plants can anchor in the substratum; (c) animals can burrow in it, (d) it forms the spawning site of fish; (e) floor bed of the aquarium and (f) a biological filter.



Notes



**Fig. 35.11** An aquarium

- (iii) **Water** can be procured from tap, well, spring or pond to fill the tank. The lid of the aquarium prevents excessive evaporation.
- (iv) Aquarium plants and fish

## 2. Temperature of the aquarium

The temperature of the aquarium needs to be maintained at an optimum of 24°C (75°F). To maintain the temperature, a thermostat controlled heating device may be used. In case of power failure, tank may be covered by a blanket in winter or suitably hot water added. A floating or adhesive type of thermometer can record the temperature. These days a combined heater and thermostat enclosed in a water tight glass tube is used and kept in place by special clips made of non toxic plastic. Thermostat with microchip (computerised) circuit is fixed for accurate temperature control. All electric connections, however, should be outside the tank.

## 3. Lighting of the aquarium

Lighting arrangement not only makes the aquarium attractive but it also forms an essential stimulus to plants for photosynthesis. In nature fish are lit by sunlight. Light in the aquarium may be provided by lamps (tube or bulb of 40 Watts) mounted in aquarium cover called hood or reflector. Tungsten lamps and fluorescent tubes are used for every 30 centimeters (12 inches) length of the tank. Aquarium has to be lit at least for ten hours a day.



**Notes**

**4. Biological filtration**

The gravel in the substratum acts as a filter bed. Aquarium water passes through the gravel and bacterial colonies develop on the gravel and convert the waste of the fish into ammonia and nitrates by *Nitrosomonas* bacteria and nitrites into nitrates by *Nitrobacter*. Nitrates are taken up by plants.

**5. Aquarium Plants**

There are many species of aquatic plants which provide shade, refuge, spawning sites, food, water and source of oxygen for the aquaria fish. Plants may be of the floating type such as *Hydrilla*, *Elodea* or rooted such as *Vallisneria* which grow rapidly (Fig. 35.11). To many plants may be avoided.

**6. Aquarium Fish**

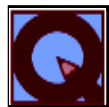
A number of small fish with unique shapes and beautiful designs are appropriate for keeping in the aquariums. They are variously coloured. However, care has to be taken to assure the absence of predatory varieties in the aquaria. The common aquaria fish are (i) angel fish (2) molie (3) guppy. (Fig. 35.11)

**7. Fish Feed**

Food of aquaria fish are either live feed such as waterborne insects, worms, crustaceans such as water flea. *Daphnia*, cyclops earthworms. However, if any of these are not eaten by the fish, they should be removed and not permitted to increase in number. Lettuce, spinach, peas, wheat grain may be given for herbivorous fish.

With progress in technology, a balanced diet with special formula is commercially prepared in the form of flakes, granules, powder or liquid food. Freeze dried fish food such as *Daphnia*, *Tubifex* and other worms are packed. It is convenient to just open the packet and sprinkle in the aquarium for fish to eat. But never should too much food be put as the left over food may decompose and pollute the aquarium.

For fish to develop best colours, size and a healthy constitution, the diet should be varied. The best food, however, is live food.



**INTEXT QUESTION 35.3**

1. What is an aquarium?  
.....
2. Name two plants which are grown in an aquarium.  
.....
3. What do plants provide the fish in the aquaria?  
.....
4. What is biological filtration?  
.....

**WHAT YOU HAVE LEARNT**

- In a Zoology museum preserved animals, skeletons, fossils, charts, models dry specimens are kept.
- 10% formalin is used to preserve small animals in glass jars.
- Mollusc shells, corals, dried sponges, nests, feathers are dry preservations. They are also kept in the museum.
- Skeletons can be prepared and kept in the museum.
- Insect collection requires pinning properly and drying insects after catching them and killing them. They can be trapped in Berlese funnel or simple traps.
- Charts, models can be made by students or bought from the market and kept in the museum. They should be properly displayed.
- Museum should be looked after by a museum curator.
- A botanical garden should be maintained in the school and plants for study grown there. Plants should be labelled.
- A greenhouse is a special enclosure made of glass or plastic where plants are maintained at a constant temperature and humidity.
- Herbarium is a collection of dried and pressed plants preserved on paper sheets. Plants are collected undamaged and then pressed in a press and dried. They are then mounted on herbarium sheets and labelled and classified.
- An aquarium is a glass or plastic container in which fish are grown and maintained. It also has aquatic plants which provide food and Oxygen for the fish.
- An aquarium has to be well lit and temperature has to be maintained. *Elodea*, *Hydrilla*, *Vallisneria* are some aquatic plants kept in the aquarium.
- Substratum of the aquarium is a filter bed in which bacteria can grow and convert waste into nitrates for the use of plants.
- Aquarium fish are of many colours. Some of these are angel fish, black mollie, guppy etc.
- Aquarium fish can be given live food such as worms and crustaceans or dried food.

**TERMINAL EXERCISES**

1. How is wet preservation done for museum specimens?
2. What are the ways in which skeletons can be prepared for displaying in the museum?

**Notes**

**Notes**

3. Name the equipment items required for insect collection and mention their utility.
4. What is a Berlese trap?
5. Write notes on (a) Botanical garden (b) green house
6. How is a herbarium prepared?
7. Mention three biological principles which can be learnt by maintaining an aquarium. How can temperature, light and fish food be arranged for an aquarium?

**ANSWERS TO INTEXT QUESTIONS**

- 35.1**
1. museum curator
  2. trapping small insects
  3. Alizarine
  4. chart/model/photograph/living museum specimens/dry specimens in the museum
  5. (i) Formalin (ii) Taxidermy
- 35.2**
1. Lucknow and Kolkata
  2. A special enclosure made of glass or plastic in which plants are grown and maintained at a specific temperature and humidity
  3. A collection of plants which are dried, pressed and preserved on sheets
  4. A metal cylinder with a sliding door in which plants are collected
  5. Collection, pressing, preserving, mounting, labelling.
- 35.3**
1. a glass tank in which live fish are grown and maintained.
  2. *Elodea*, *Vallisneria*, *Hydrilla* (any two)
  3. Oxygen and food
  4. Conversion of waste of the fish into nitrates to be taken up by the aquarium plants