PEDAGOGY OF BIOLOGICAL SICENCE PART – 2

(PONDICHERRY UNIVERSITY)

STUDY MATERIAL

UNIT -4

Dr. THANDAVAMOORTHY. M,

ASSISTANT PROFESSOR,

VASAVI COLLEGE OF EDUCATION,

MADAGADIPET, PUDUCHERRY,

CONTACT: 9489391166.

Unit – 4

BIOLOGY LABORATORY

Syllabus: Location, planning, organization and maintenance-practical preparation – laboratory registers – safety in the lab – common accidents and first aid – practical ethics.

Biology is essentially a practical subject and that the young students always like doing something rather than listening or observing. Experimental study is indispensable to create scientific method of thinking among students. The laboratory is commonly regarded as the heart of science teaching. The science laboratory provides opportunities to the pupil to understand the concepts and different ideas of science.

"As the central place where students get an opportunity to conduct experiments and search principles of science" **-----J.K. SOOD**

Location

A science laboratory should be located preferably on the ground floor and on the extreme side of the school building if possible so that there is no disturbance to the laboratory. The open space outside the laboratory will be of much use to conduct some experiments outside in sun light. Biology and general science laboratory should have north – south orientation to provide adequate sun light exposure.

Planning

Before constructing the biology laboratory the following factors should be taken in to consideration at the planning stage.

- The number of pupils working as a time
- The minimum space necessary for each pupil for comfortable working
- Limitation of number of biology teachers in secondary schools
- Need for ancillary accommodation for storage
- Designing the science classroom and laboratory in such a way that it could be used for science teaching for middle as well as for high school classes.
- Imperative need for economy

Organization of biology laboratory

Furniture

Leaving the space occupied worktables and almiarahs in the laboratory there must be at least 1.5 sq. m. of space for each student to do the experiments. For a total of 20 students the laboratory must be of 20mx10 m size.

Worktable

- The chairs and tables must be placed in such a way that the students face teacher in the laboratory. It is advisable to have worktables that allow the students to do the experiment form one side only, which will make the supervision of the teacher easier.
- The arrangement should be in such a way that it is easy for both teacher and student to contact each other.
- The upper part of the table must be made of teakwood
- The sinks must be attached to work
- A large demo table with water gas and electricity facilities must be placed in the laboratory
- Drawers need not be placed in students' worktable

Ventilation and light

There must be at least two doors for the lab in order to make it convenient for the sudden to go out at the time of emergency. They can be either on one side or on the opposite sides and they must open outside. In order to get free air and light the windows must be placed at a height of 1 meter from the ground level. Tube light of mercury lamp is preferable than the ordinary lamp.

Flooring

The cemented floor is more convenient for the hot countries. Cold countries have a floor of wooden pieces. If the cement flooring is sloping towards one direction it will be easy for cleaning. Round corners are preferred than straight corners.

Sinks

The biology lab is to contain 2 common sinks and on in demonstration table. There must be canals to take out the water that comes out of the sinks. Soap with box must be kept in each sink. The holes in the sink can be closed with plug that contains many small holes so that water

can pass through the holes in the plug. There must be 2 bins in the lab to collect the waste materials.

Water facility

A tank can be constructed on the topmost part of the lab in order to supply water for the lab. The capacity of the tank must be at least 1000 liters. Water must be taken to the sinks through the PVC pipes. The water coming out of the sinks must be out by separate canals and these canals must be closed with wooden planks.

Gas

Petrol gas is more convenient than coal gas. The equipment that prepares the gas can be set up separately outside the lab. The gas coming out from this equipment must be taken to the worktables through pipes. The Bunsen burners used for the coal gas cannot be used for the petrol gas. Nowadays LPG gas is used in the laboratory.

- A large blackboard or the size of the demonstration table should be behind the table.
- Notice board can be placed in verandha outside the lab. This can be used to exhibit photos, scientific information and instruction and rules for the students.
- There should be a Teachers staff room to spent their leisure time usefully
- Museum room, aquarium room and animal room, projection room is preferable

Preparation room

This room is used for the teacher to do the experiment before actually conducting it in the classroom to keep the often required apparatus and to keep apparatus of the incomplete experiments. So this room must be adjacent to the lab. This must contain a long worktable with sink and water facility. It is better to have the storeroom.

Storeroom

All the apparatus and materials can be sorted in this room. Important acids can be kept in a separate almirah inside the room itself because the poisonous gas and material coming out of chemicals may spoil the sophisticated equipments in the room. The required amount of the chemicals is taken to the lab or class whenever needed.

Poisonous materials and chemicals should be kept in a separate cupboard with lock and key. The key must be always with the teacher.

Darkroom

To conduct experiments on photosynthesis it is necessary to remove starch from the leaves by keeping the plant in the darkroom. The room should be always supplied with sage lights, free air and water. There should be a cupboard setup in such a way that it will not allow the light to pass through it.

Maintenance of laboratory

Before purchasing various articles for the lab the teacher should make adequate arrangement to buy shelves or almirahs to arrange those articles. If they are glass almirahs the articles arranged in them can be seen from outside.

All the articles in the lab should be cleaned daily. The teacher should check all the articles in the lab once in a week. He must have knowledge about the method of cleaning certain articles.

- **Iron articles**: To avoid rusting, these articles should be cleaned often with oil for example stand, pinch, cocks, bone cutters, hammer etc. may be cleaned in this way.
- **Wooden articles:** These should be polished often to avoid termites entering them. The upper portion of these articles may be coated with wax so that accidentally falling acid will not spoil them.
- **Stainless steel articles:** The articles like scissors, knife, and needles in the dissection set have to be wiped and cleaned with cotton and with oil after use.
- **Glass articles:** These can be cleaned by using potassium dichromate or soap powder. Lens of the microscope and magnifying glass can be cleaned with chamois leather.
- **Rubber tubes:** These should be kept in a ventilated dark room after applying French chalk on them.
- **Microscope:** They can be kept in the cases safely. The objective and eyepiece lenses should be cleaned regularly. The teacher should check all the parts of the microscope while giving it of the students as well as taking it back from the students.

- **Chemical substances**: Should be filled in the bottles. Generally narrow mouthed bottles are used for liquids and wide mouthed for solids. Inflammable substances and chemicals should be placed in one almirah. It is better to place the poisonous substances alone in a separate almirah, which can be kept under lock and key. All chemicals should be placed in bottles only. These bottles should bear the name of the substance.

Preparation of indent

Indent gives a clear idea about the name and number of equipments. The teacher has to prepare the indent. Preparation of indent needs some basic ideas. The indent can be prepared by the teacher after studying all the biology lessons of different classes in school.

Practical preparation

- Check with your course information to see if you are expected to do any preparatory work before the first class
- Plan ahead - read the schedule or protocol through before you start (ideally before you go to class) so you know what is required next and can be ready with equipment or materials when they are needed.
- Check the guidance that your school / course provides about the safety equipment (such as lab coats or safety spectacles) or equipment that you are expected to buy and bring to your first class (such as a dissecting kit or drawing pencils)
- Health and Safety procedures in laboratory and practical environments are strictly adhered to and you will not be allowed to participate in the class if you are not correctly dressed or prepared. For example, if you have long hair you will be expected to tie it back.
- Turn up for your laboratory class in good time and be ready to work with a colleague or be assigned to a working group (this is common in laboratory classes)
- Listen and take notes from any initial briefing given at the start of the class. The demonstrator or teacher for the session may well try to steer you away from common difficulties or give you advice on how best to tackle the experiment.

Laboratory registers

The materials received should be properly checked and entered in the stock registers the same day. A correct and properly maintained record of articles it important to check any article at any time. The following registers are to be maintained in every laboratory.

1. Accession register:

The materials received from the companies should be entered in this register. This register will give an idea whether the amount allotted for the year has been spent, about the amount spent for the buying the equipments and the amount paid to a particular company

2. Non-consumable register:

Articles of metal, wood or any other thing of permanent nature which are not liable to broken or consumed should be entered in this register. All the articles should be entered in the alphabetical order in this register. Each article should be allotted a separate page.

3. Consumable register:

Articles that are liable to break, chemicals and other materials that are consumable should be entered in this register. Chemicals can be written in the first portion of the register and other materials can be written after that.

4. Breakage register:

Apparatus are liable to break accidentally while arranging for the practical class or while doing the practical. The apparatus broken during such occasions should be entered in a separate register.

5. Issue register:

The laboratory in-charge should enter the articles given to the other teachers in this register and get their signatures. When the articles returned he should make a note of its return.

6. Requirement Register

This includes items required for this priority should be given to those of immediate need. The most appropriate method of collecting suggestions for new resources for the science staff, is to note the ideas in a required register

Safety in the lab

Laboratory is a place where students and teachers do experiments in order to prove the theories in the textbooks. When the students do the experiments some accidents may occur.

These accidents may not occur in well organized and maintained laboratories. Students inexperience they may come across accidents. We cannot give guarantee that accidents may not occur in a laboratory. But the occurrence of the accidents can be avoided or prevented.

Safety measures

The following articles should be kept in a place in the lab, which could be easily taken by anybody. These articles should be checked in the beginning of every term of the academic year.

- A carpet or rug should be kept in order to put ort fire on the dress.
- A bucket full of sand
- A fire extinguisher
- A first aid box. A handbook regarding the procedure for the first aid.
- An asbestos sheet to prevent fire in the inflammable articles.
- The doors of the laboratory should not be locked when the students are inside the lab
- The students should not enter and remain inside the lab without the permission of the teacher
- Concentrated acids, alcoholic, highly inflammable things should be kept in a separate storeroom.
- All poisonous substances should be kept in a separate almirah, locked and the key should be with the teacher

In order to minimize the accidents some safety rules should be followed both by the teacher as well as by the students

Guidelines for the teacher

- ❖ Students should not be allowed in the lab unless a teacher is present
- ❖ The teacher should maintain discipline among the students. Discipline is required in lab than the classroom
- ❖ The principles to be followed by the students in a lab should be neatly typed and exhibited in a place where all students can see it.
- ❖ Lab should be near and clean and all the articles should be in the respective places.
- ❖ The apparatus and materials required for the students practical work should be placed on the tables much before the students' arrival

- ❖ The procedure for handling new apparatus should be informed to the students and the precautions to be taken while doing experiments should also be told to them
- ❖ The experiments which involve some danger and require some skill, should be explained to the students
- ❖ The students must know the technique of handling gas and electricity during emergency situations
- ❖ Fire extinguishers should be provided and the teacher and students must know how to operate them.
- ❖ Each lab should possess a first aid box filled with required first aid materials. The teacher must know the basic principles of first aid.

Rules to be followed by the students

- ➢ Students should not take the lab materials out of the lab
- ➢ The apparatus should be used by the student to conduct the experiment told by the teacher. He should not use it to do in a different manner or different experiment
- ➢ Breakages or accidents must be reported immediately to the teacher
- ➢ They should not lift the bottles by the neck or cork
- ➢ The stopper of particulars bottle should replaced on that particular bottle
- ➢ Only small quantities of chemicals should be used
- ➢ Chemicals should not be tasted and smelled without care
- ➢ If any chemical has been put into the mouth that should be removed and the mouth should be washed with plenty of water
- ➢ When acid or alkali is poured on the body or cloth accidentally that part should be washed with water thoroughly
- ➢ Solids should not be put in sinks
- ➢ After use, all apparatus must be cleaned and replaced and the bench left clean
- ➢ Water and gas must not be wasted and should be turned off before leaving in the laboratory

Common accidents and first aid

1. Burns

Due to acids

When the skin is contact with corrosive acid the immediate first is to flood the part with water. The rest of the acid in the can be neutralized with $NaHCo_3$ solution. But this solution should be applied only after washing the part with water since neutralization produce heat.

Due to alkali

When alkalis like sodium hydroxide, potassium hydroxide come in contact with body they produce burns. The burn can be washed first with water and then with 2% acetic acid or saturated boric acid. Lime juice can also be used.

Due to Phosphorous

This has to first washed with water and the sticking phosphorous be removed. Then dilute silver nitrate or 1%sodium bicarbonate can be applied.

Due to sodium and potassium

The particles of these can be removed by the cotton dipped in spirit and then washed with much water.

2. Cuts and Scratches

Cleanliness is essential to prevent infection of wounds. In the majority of cases simple injuries can be treated with an antiseptic solution and covered with an adhesive dressing of suitable size. If there is any possibility of pieces of glass remaining in the wound then they can be removed with forceps and then tincture benzoic be applied.

3. Eye injuries

These cases should be immediately sent to the doctor. A drop of castor oil can be put in eye and then the eye can be tied with much cotton.

Copious irrigation of the eye with water is loudly recommended first aid while hospital aid is being summoned.

Acid in eye

The eye should be washed in gently flowing water for a long time and then 1% sodium bicarbonate solution or lime water can be added.

Alkali in eye

Washed with water and the with 1% boric acid

4. Poisoning

In the mouth: poisonous materials got in the mouth the student should be instructed to spit the material and rinse the mouth repeatedly with water. Neutralizing substance, $NaHCo_3$ for acids and acetic acid for alkali should then be used to rinse the mouth.

Swallowed: Acid, alkali or salts of heavy metals. Students should be encouraged to drink large amount of water but neutralizing solution or emetics should not be given without medical advice.

Inhalation of poisonous gas : it is possible for the students to inhale poisonous gases like carbon monoxide, H_2S, chlorine etc in the lab. On such cases they may cause a feeling of sickness or headache or result in irritation of the mucous membranes of the mouth, nose and throat. The student should be taken to the open place. In the event of the patient becoming unconscious artificial respiration in the fresh air is necessary.

5. Fainting

The patient should be laid flat and legs raised above the level of the head, clothing round the neck and waist should be loosened. Hot drinks can be given. After recovery the patient should be made to rest and be kept ward.

6. Electric shock

The main switch should be put off immediately. Then the person should be taken out and treated for the burns if there is any. If he has fainted, he should be taken out and given first-aid as that for fainting.

7. Fire accidents

- If he caught an individual student, the fire proofed rug or blanket should be used to put it off
- If the fire is in beaker or flask, asbestos sheet can be used to put it off
- If oil or phosphorous is burning the sand can be used
- If the gas tube is burning the main gas switch can be closed.
- If it is due to electricity, the connection can be cut off

- Fire extinguishers can be used if the entire lab is in fine. Before that all the students should be sent out and then only the fire extinguisher can be used. After that free air must be allowed to pass through the lab by opening all the doors and windows.

Recording of accidents

All accidents should be recorded in the record notebook with the nature of accident, the name of the person involved and the type of first aid given, date and time.

Practical ethics

We derive humongous benefits from the sacrifice of millions of animals around the world. Yes, food is the obvious thing here, but there's more. Everything from makeup, to glue, to life-saving medication is in one way, shape, or form derived from the sacrifices of animals, including biological studies on animals. Here you're going to learn about the basic ethical guidelines and regulations regarding the humane procurement and treatment of animals involved in such studies.

Procurement

Animals that will be used in biological science have to be ethically and lawfully procured, or obtained. There are many layers as to why this is important. They could be someone's lost pet. Animal species that are obtained for studies must also be cross-checked as to their conservation status. Those species that are threatened or endangered should not be used in biological studies simply because there are so few of them left.

Animals that are procured for laboratory studies should also be sourced from certified vendors that purpose-breed animals for such studies. Not only does this ensure that no pets are accidentally obtained but this is also important for the studies themselves as these kinds of animals are of a known genetic quality and their medical history is well-documented. Genetics and medical history can greatly influence the outcome of a biological study, and this is why obtaining animals from such vendors is often preferred. This way, a second study that sacrifices even more animals may be avoided if the first study uses appropriate animals that do not bring the study's results into question.

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