1.4 . Tools of a Biologist

Biologists use different types of tools in the laboratory and field for scientific investigations. Some of the tools are used for measuring, some are used for observation and some are used for culturing micro organisms.

1.4.1. Laboratory tools of biologist

Hand lens Most cells cannot be seen with the naked eye. A hand lens has a higher magnification than our naked eye. It consists of a convex lens fixed within a circular metallic loop and is attached to a metallic or wooden handle. The main function of hand lens is to provide an enlarged image of the object placed under it. But hand lens is not sufficient to observe the detail in cells. There is a need for providing high magnifications tools such as microscope.

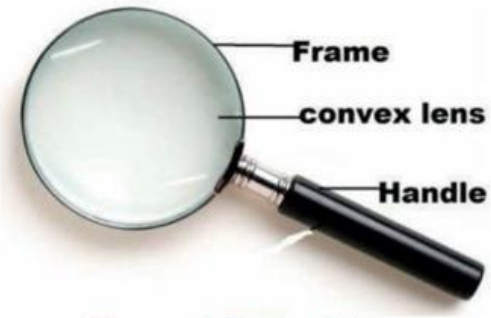

Figure 1.2 Hand lens

Attention

The important function of microscope is magnification and resolution. Magnification is the number of times larger an image is, than the real size of the object. Resolution can be defined as the ability to distinguish between two separate points.

The Microscope

Key terms

Microscope:

an instrument used to observe and study objects that are too small to be seen by the naked eye. It magnifies the image of small objects

Light microscope: the microscope uses a beam of light to view specimens

Electron microscopes: the microscope uses a beam of electrons (instead of a beam of light) and electromagnets (instead of glass lenses) to enlarge the image of an object

Figure 1.3. Light microscope

One of the most important tools of the biologist is a microscope. A microscope is an instrument used to study objects that are too small to be seen by the naked eye. The microscope magnifies the image of small objects making them visible to the human eye. For example, microscopes are used to observe the shape of bacteria, fungi and parasites.

There are several kinds of microscopes. The major types are:

- light microscope and
- electron microscope

A light microscope is called light microscope because it uses a beam of light to view specimens. There are two types of light microscopes, Simple light microscope which consists of a single lens while a compound light microscope consists of two or more glass lenses.

A compound light microscope is the most common microscope used in biology. It consists of two lens systems (a combination of lenses) to magnify the image of an object up to 2000x. Each lens has a different magnifying power. A compound light microscope with a single eyepiece is called monocular; one with two eye-pieces is said to be binocular.

Electron microscopes on the other hand use a beam of electrons (instead of a beam of light) and electromagnets (instead of glass lenses) to enlarge the image of an object. These microscopes provide a higher magnification than light microscopes and are used for observing extremely small micro-organisms such as viruses.

Glass slides and cover slips: The microscope slides are used to support an specimens being examined under the microscope.

Figure 1.4. Glass slide and cover slides

The cover slips are the small square or ircle shaped thin glass sheets that are used to cover specimens on the glass slide to protect from further addition of any chemical or dirt and it is also used to protect the microscope and prevent the slide from drying by locking the moisture. Cover slides provide better view under the microscope. Although the tool most closely associated with a biologist is the microscope, there are several common tools used by biologists in the laboratory and on field.

Figure 1.5. Autoclave

Autoclave: is the equipment used to sterilize (kill micro-organisms) different biological samples. An autoclave sterilizes contaminated materials including culture media, and bacterial spores by exposing them to high temperatures and highly pressurized steam.

Attention

Culturing is the procedure used to grow microorganisms in a controlled environment. Many microorganisms reproduce very quickly. Culturing of micro-organisms also have important function like in medicine (Penicillin) and for food (beverage) preparation.

Wine and beer making uses culturing on a large scale, as it does in cheese making, bio-fuel production, and many other endeavors. There are many ways of killing microorganisms,

including chemical disinfectants, flame, dry or wet heat, ultraviolet light, and ionizing radiation such as X-rays or gamma rays.

The problem is, some bacteria form spores, which are resistant to chemical disinfectants, including bleach. In these situations, it is very important to use autoclaving which kill microorganisms as well as their spores.

Incubator: is a device used to maintain a specific environment for culturing. An incubator is an instrument that maintains the temperature best suited for the growth of different types of micro organisms.

Petri dishes: are flat dishes with a matching cover of a slightly larger diameter. They are available in glass and plastic form. Petri dishes are used with gelling culturing media, such as agar, and placed in the autoclave to sterilize it.

Culture tubes: are available in a huge range of sizes, shapes, materials, and so on. They are used to culture micro-organisms. Culture tubes may be used with solid (gel) culturing media or with liquid (broth) culturing media, and then placed in the autoclave for sterilization.

Figure 1.6. A Bacteriological incubator

Figure 1.7. Petri dishes

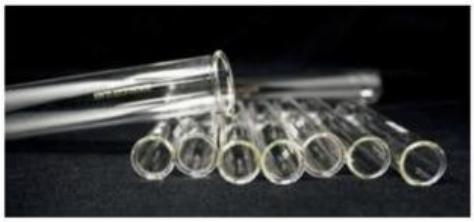

Figure 1.8. Test tubes

Flasks: is an apparatus having a flat bottom and a long narrow neck, which allows easy mixing of the solution without spilling out the content . it is also used to gently heat the content inside with a gentle swirling motion of the flask . It is essentially a large-volume culture tube that is used only with broth media and flasks are used to produce large populations of micro-organisms. They are available in a variety of shapes and sizes.

Figure 1.9. flasks

Figure 10. Balance

Balance: is useful for making up solutions accurately, weighing specimens, and so on.

Dropper: A dropper consists of a glass tube that has a small opening at one end and is attached to a vacuum rubber bulb at the other end. A dropper is used when it is required to control the amount of solution being added to a reaction.

Figure 1.11. Dropper

Tongs are metallic scissors-shaped laboratory instruments. It is used to Lifting or picking up hot objects such as heated crucible, beakers, dishes, or flasks.

Figure 1.12. Tongs

MCQs – Tools of a Biologist

1. **The main function of a hand lens is:**

   a) Sterilizing samples

   b) Measuring weight

   c) Providing an enlarged image of objects

   d) Distinguishing bacterial colonies

2. **Which of the following terms refers to the ability of a microscope to distinguish between** two separate points?

   a) Magnification b) Resolution

   c) Refraction d) Illumination

3. **The instrument most closely associated with biologists is:**

   a) Balance b) Microscope

   c) Autoclave d) Incubator

4. **Which microscope uses a beam of light to view specimens?**

   a) Light microscope b) Electron microscope

   c) X-ray microscope d) Gamma microscope

5. **The maximum magnification of a compound light microscope is about:**

   a) 200x b) 500x c) 2000x d) 5000x

6. **A compound light microscope with a single eyepiece is called:**

   a) Binocular b) Monocular

   c) Trinocular d) Double scope

7. **Electron microscopes use _____ instead of light.**

   a) Water waves b) Electrons

   c) Sound waves d) Lasers

8. **Electron microscopes are especially useful for observing:**

   a) Leaves b) Viruses

   c) Plant roots d) Skeletons

9. **Which part of the microscope supports the specimen during observation?**

   a) Cover slip b) Glass slide

   c) Petri dish d) Culture tube

10. **Cover slips are mainly used to:**

    a) Sterilize specimens

    b) Protect specimens and prevent drying

    c) Weigh microorganisms

    d) Heat slides evenly

11. **Which tool is used to sterilize materials including bacterial spores?**

a) Dropper

b) Autoclave

c) Incubator

d) Balance

12. **The main function of an incubator is:**

a) To magnify cells

b) To sterilize solutions

c) To maintain suitable temperature for microbial growth

d) To measure solutions accurately

13. **Which equipment is commonly used with agar as culturing medium?**

a) Test tubes

b) Flasks

c) Petri dishes

d) Tongs

14. **Culture tubes may contain:**

a) Only solid media

b) Only liquid media

c) Solid or liquid media

d) Powder only

15. **Flasks are mainly used for:**

a) Heating glass slides

b) Producing large populations of micro-organisms

c) Observing viruses

d) Sterilizing tools

16. **Which tool is essential for accurate preparation of solutions?**

a) Tongs b) Balance c) Petri dish d) Dropper

17. **A dropper is primarily used to:**

a) Pick up hot objects b) Add solution in controlled amounts

c) Culture bacteria d) Sterilize samples

18. **Tongs are used in the laboratory to:**

a) Lift or pick up hot objects b) Weigh chemicals

c) Sterilize bacteria d) Mix cultures

19. Culturing microorganisms is important in:

a) Making wine and beer b) Producing cheese

c) Producing bio-fuel d) All of the above

20. Which of the following can destroy resistant bacterial spores?

a) Bleach b) Dry heat

c) Autoclaving d) Ultraviolet light

21. **A simple light microscope consists of:**

a) Two or more lenses b) A single lens

c) Electron beams d) Convex mirrors

22. **A compound light microscope differs from a simple light microscope because it:**

a) Uses electron beams b) Has two or more lens systems

c) Uses no lenses at all d) Produces 3D images

23. **Which of the following is a metallic scissor-shaped tool?**

a) Balance b) Dropper c) Tongs d) Incubator

24. **Which tool helps prevent specimens from drying under the microscope?**

a) Petri dish b) Cover slip

c) Culture tube d) Flask

25. **Autoclaving sterilizes materials by using:**

a) Pressurized steam at high temperature b) Alcohol and flame

c) Gamma rays d) Ultraviolet light