ZOO101-Assignment 01

Sample Solution

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Note:

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Part A

What is Microscope

A microscope is an instrument that is used to magnify small objects. Some microscopes can even be used to observe an object at the cellular level, allowing scientists to see the shape of a cell, its nucleus, mitochondria, and other organelles. While the modern microscope has many parts, the most important pieces are its lenses. It is through the microscope's lenses that the image of an object can be magnified and observed in detail. A simple light microscope manipulates how light enters the eye using a convex lens, where both sides of the lens are curved outwards. When light reflects off of an object being viewed under the microscope and passes through the lens, it bends towards the eye. This makes the object look bigger than it actually is.

Over the course of the microscope's history, technological innovations have made the microscope easier to use and have improved the quality of the images produced. The compound microscope, which consists of at least two lenses, was invented in 1590 by Dutch spectacle-makers Zacharias and Hans Jansen. Some of the earliest microscopes were also made by a Dutchman named Antoine Van Leeuwenhoek. Leeuwenhoek's microscopes consisted of a small glass ball set inside a metal frame. He became known for using his microscopes to observe freshwater, single-celled microorganisms that he called "animalcules."

While some older microscopes had only one lens, modern microscopes make use of multiple lenses to enlarge an image. There are two sets of lenses in both the compound microscope and the dissecting microscope (also called the stereo microscope). Both of these microscopes have an objective lens, which is closer to the object, and an eyepiece, which is the lens you look through. The eyepiece lens typically magnifies an object to appear ten times its actual size, while the magnification of the objective lens can vary. Compound microscopes can have up to four objective lenses of different magnifications, and the microscope can be adjusted to choose the magnification that best suits the viewer's needs. The total magnification that a certain combination

of lenses provides is determined by multiplying the magnifications of the eyepiece and the objective lens being used. For example, if both the eyepiece and the objective lens magnify an object ten times, the object would appear one hundred times larger.

The dissecting microscope provides a lower magnification than the compound microscope, but produces a three-dimensional image. This makes the dissecting microscope good for viewing objects that are larger than a few cells but too small to see in detail with the human eye. The compound microscope is typically used for observing objects at the cellular level.

Part B

Types of Microscopes

Electron microscope

An **electron microscope** is a microscope that uses a beam of accelerated electrons as a source of illumination. As the wavelength of an electron can be up to 100,000 times shorter than that of visible light photons, electron microscopes have a higher resolving power than light microscopes and can reveal the structure of smaller objects. A scanning transmission electron microscope has achieved better than 50 pm resolution in annular dark-field imaging mode[1] and magnifications of up to about 10,000,000× whereas most light microscopes are limited by diffraction to about 200 nm resolution and useful magnifications below 2000×.

A modern transmission electron microscope

What are the Different Microscope Types and Their Uses?

There are a number of different types of microscopes and each of them solves unique problems. Below you will find information on the five different microscope types along with the applications for each microscope and just

who might use each instrument. Below each description of the microscope and its use is an image that was captured using that particular microscope.

5 Different Types of Microscopes:

1. ***Stereo Microscope***
2. ***Compound Microscope***
3. ***Inverted Microscope***
4. ***Metallurgical Microscope***
5. ***Polarizing Microscope***

Stereo Microscopes

Stereo microscopes are used to look at a variety of samples that you would be able to hold in your hand. A stereo microscope provides a 3D image or "stereo" image and typically will provide magnification between 10x - 40x. The stereo microscope is used in manufacturing, quality control, coin collecting, science, for high school dissection projects, and botany. A stereo microscope typically provides both transmitted and reflected illumination and can be used to view a sample that will not allow light to pass through it.

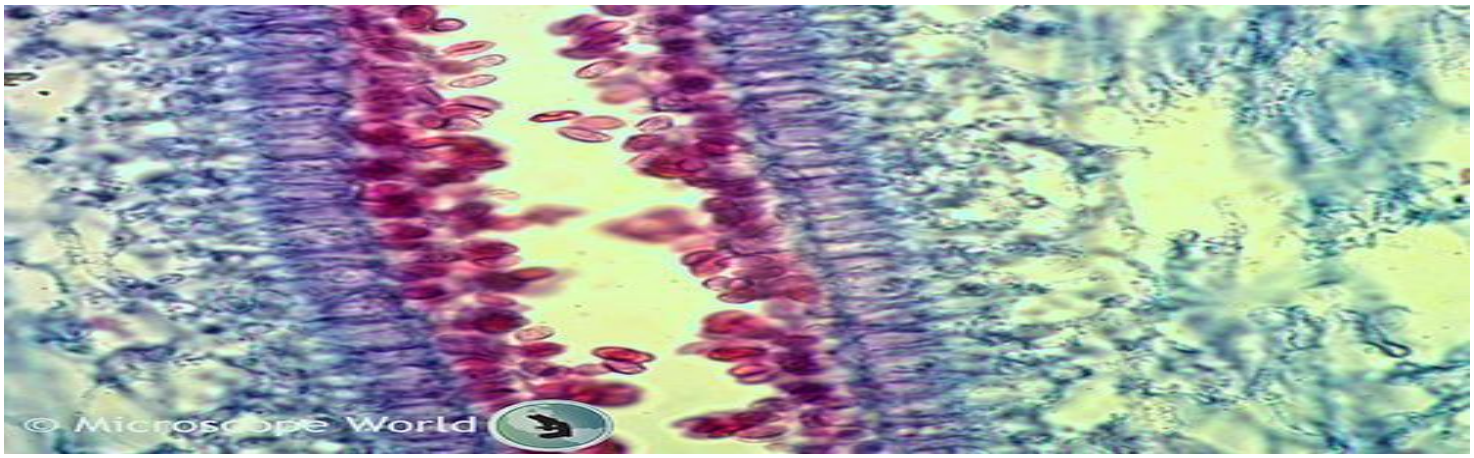
The following are samples often viewed under a stereo microscope: coins, flowers, insects, plastic or metal parts, printed circuit boards, fabric weaves, frog anatomy, and wires.

This image of a penny was captured under the a coin collecting stereo zoom microscope at 20x magnification.

Compound Microscopes

A compound microscope may also be referred to as a biological microscope. Compound microscopes are used in laboratories, schools, wastewater treatment plants, veterinary offices, and for histology and pathology. The samples viewed under a compound microscope must be prepared on a microscope slide using a cover slip to flatten the sample. Students will often view prepared slides under the microscope to save time by eliminating the slide preparation process.

The compound microscope can be used to view a variety of samples, some of which include: blood cells, cheek cells, parasites, bacteria, algae, tissue, and thin sections of organs. Compound microscopes are used to view samples that can not be seen with the naked eye. The magnification of a compound microscope is most commonly 40x, 100x, 400x, and sometimes 1000x. Microscopes that advertise magnification above 1000x should not be purchased as they are offering empty magnification with low resolution.



This image of mushroom spores was captured under a compound biological microscope at 400x magnification.

Inverted Microscopes

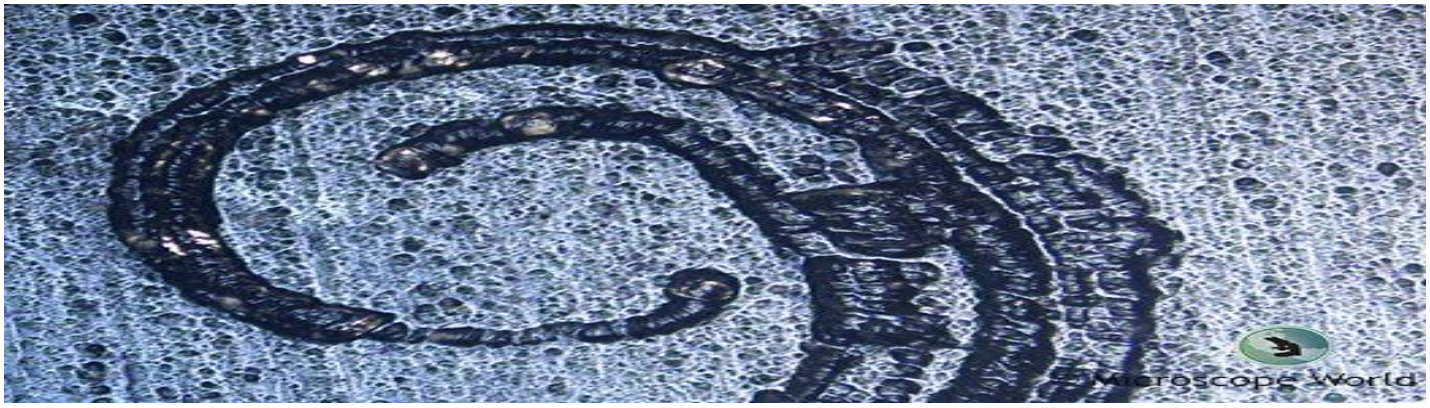
Inverted microscopes are available as biological inverted microscopes or metallurgical inverted microscopes. Biological inverted microscopes provide magnification of 40x, 100x and sometimes 200x and 400x. These biological inverted microscopes are used to view living samples that are in a petri dish. An inverted microscope allows the user to place the petri dish on a flat stage, with the objective lenses housed beneath the stage. Inverted microscopes are used for in-vitro fertilization, live cell imaging, developmental biology, cell biology, neuroscience, and microbiology. Inverted microscopes are often used in research to analyze and study tissues and cells, and in particular living cells.

Metallurgical inverted microscopes are used to examine large parts at high magnification for fractures or faults. They are similar to biological inverted microscope in the magnification provided, but one primary difference is that the samples are not placed in a petri dish, but rather a smooth side of the sample must be prepared so it can lay flat on the stage. This smooth sample is polished and is sometimes referred to as a puck.

Metallurgical Microscopes

Metallurgical microscopes are high power microscopes designed to view samples that do not allow light to pass through them. Reflected light shines down through the objective lenses providing magnification of 50x, 100x, 200x, and sometimes 500x. Metallurgical microscopes are utilized to examine micron level cracks in metals, very thin layers of coatings such as paint, and grain sizing.

Metallurgical microscopes are utilized in the aerospace industry, the automobile manufacturing industry, and by companies analyzing metallic structures, composites, glass, wood, ceramics, polymers, and liquid crystals.



This image of a piece of metal with scratches on it was captured under a metallurgical microscope at 100x magnification.

Polarizing Microscopes

Polarizing microscopes use polarized light along with transmitted and, or reflected illumination to examine chemicals, rocks, and minerals. Polarizing microscopes are utilized by geologists, petrologists, chemists, and the pharmaceutical industry on a daily basis.

All polarizing microscopes have both a polarizer and an analyzer. The polarizer will only allow certain light waves to pass through it. The analyzer determines the amount of light and direction of light that will illuminate the sample. The polarizer basically focuses different wavelengths of light onto a single plane. This function makes the microscope perfect for viewing birefringent materials.