MICROSCOPIC LIFE

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Learning outcomes

- Know all about a Microscope
  - Parts
  - Uses
- Microscopic life forms
- Usefulness of some important microscopic life forms
- Earn Microscopic Life Honour
- Pre-requiste for 'Blood and the Body's Defenses' Honour
- Health Master Award

Did you know that you can identify diseases by just looking down the microscope?

Common diseases/Causuative organisms

Disease	Caused by
Food poisoning	Salmonella, Shigella, E. coli
Common cold	Influenza virus
Malaria	Plasmodium species
Filaria	Nematode – Wuchereria bancrofti
Iron deficiency anaemia	Hypochromic microcytes & pencil cells
Blood cancer	Blast cells – most immature blood cells
Bleeding disorder	Thrombocytopenia – lack of platelets
COVID-19	SARS-COV2

1. Types of Microscopes

1. Compound Microscope

2. Electron Microscope

1. Types of Microscopes

3. Dark Field Microscope

- Uses optical microscopy illumination technique to enhance the contrast in unstained samples
- Principle - illuminating the sample with light (not collected by the objective lens)
- Produces classic appearance of a dark, almost black, background with bright objects on it

4. Fluorescence Microscope

- Light microscope using the phenomena of fluorescence & phosphorescence instead of reflection and absorption
- used to study properties of organic or inorganic substances

1. Types of Microscopes

- **Fluorescence** is the emisision of light by a substance that has absorbed light or other electromagnetic radiation.

- **Phosphorescence** is a specific type of photoluminescence
- Does not immediately re-emit radiation it absorbs
- Most familiar form is "glow-in-the-dark". Ex:- hands of a watch

1. Types of Microscopes

5. Phase Contrast

- A contrast-enhancing optical technique
- Produces high-contrast images of transparent specimens
  - Does not require staining
- Uses: to study living cells, microorganisms, thin tissue slices & sub-cellular particles (including nuclei & other organelles)

2. Parts of a Microscope

- There are three structural parts of the microscope i.e. head, base and arm
- Eyepiece or ocular
    - The part of a microscope that a user looks into
    - Contains a lens called the ocular
    - Standard magnification is 10x
- Bodytube
    - Eyepiece holder
    - Connects the ocular lens to the objective lens
- Nosepiece
    - Part of the microscope that the objective lenses attach to

2. Parts of a Microscope

- Objective lens
  - •Objectives produce most of the magnification
  - •Various lenses are attached to the nosepice
  - • 10x (lower power)
  - • 20x (lower power)
  - • 40x (higher power)
  - • 100x (highest power – oil immersion lens)
- Stage
  - •Holds the slide and contains an opening
  - •The opening allows light to pass through the specimen

2. Parts of a Microscope

- Diaphragm
  - Located beneath the stage
  - Controls the passage of light onto the specimen
- Coarse adjustment knob
  - Moves the stage up and down quickly
  - Makes large changes in the focus
  - Used to find the specimen using the low power objective lens (10x or 20x)
- Fine adjustment knob
  - Used to make smaller focus adjustments
  - Brings specimen into sharp focus
  - Usually used while using high power objective lens (40x or 100x)

2. Parts of a Microscope

Light source

The light source illuminates the specimen by shining bring light

Base

Supports the microscope

Rest of the instrument rests

Power switch

Turns the light on and off

Parts of a Microscope

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3. How do you calculate the magnification?

- The magnification of the microscope is simply -
  - Magnification of the ocular lens times the magnification of the objective lens
- Magnification = Ocular X Objective
- Example
  - What is the total magnification of the microscope while using a 20x objective lens?
  - Eye piece = 10x
  - Objective = 20x
  - Magnification = 10 X 20
    = 200x

3. What is the total magnification of the microscope while using a 100x objective lens?

- Eye piece = 10x
- Objective = 100x
- Magnification = 10 X 100
  = 1000x

- Total magnification is 1000x

4. Define the following microscopic terms:

- Slide
  - •A slide is a small piece of rectangular glass upon which the specimen to be viewed is placed.
- Coverslip
  - The coverslip is a piece of glass the same shape as a slide (but often thinner) used to cover the specimen.
  - The specimen is sandwiched between the slide and the coverslip.
- Wetmount
  - Wetmounting is when the user smears a wet specimen onto a slide.

4. Define the following microscopic terms:

- Fixing
  - Fixing preserves a specimen so that it does not decompose. Once a specimen has been fixed, it can be stored away and looked at again later.
- Staining
  - Stainingcolorsthe specimen so that it has a higher contrast and can be more easily seen under the microscope.
- Oil immersion
  - In order to get a sharp focus at magnifications above 400X, light must be coupled between the specimen and the objective by a layer of oil. If the light travels through air it gets too distorted.

4. Define the following microscopic terms:

- Unicellular
  - A unicellular organism has only one cell.
  - Unicellular organisms include bacteria, protists, and yeast. For example, a paramecium is a slipper-shaped, unicellular organism found in pond water.

4. Define the following microscopic terms:

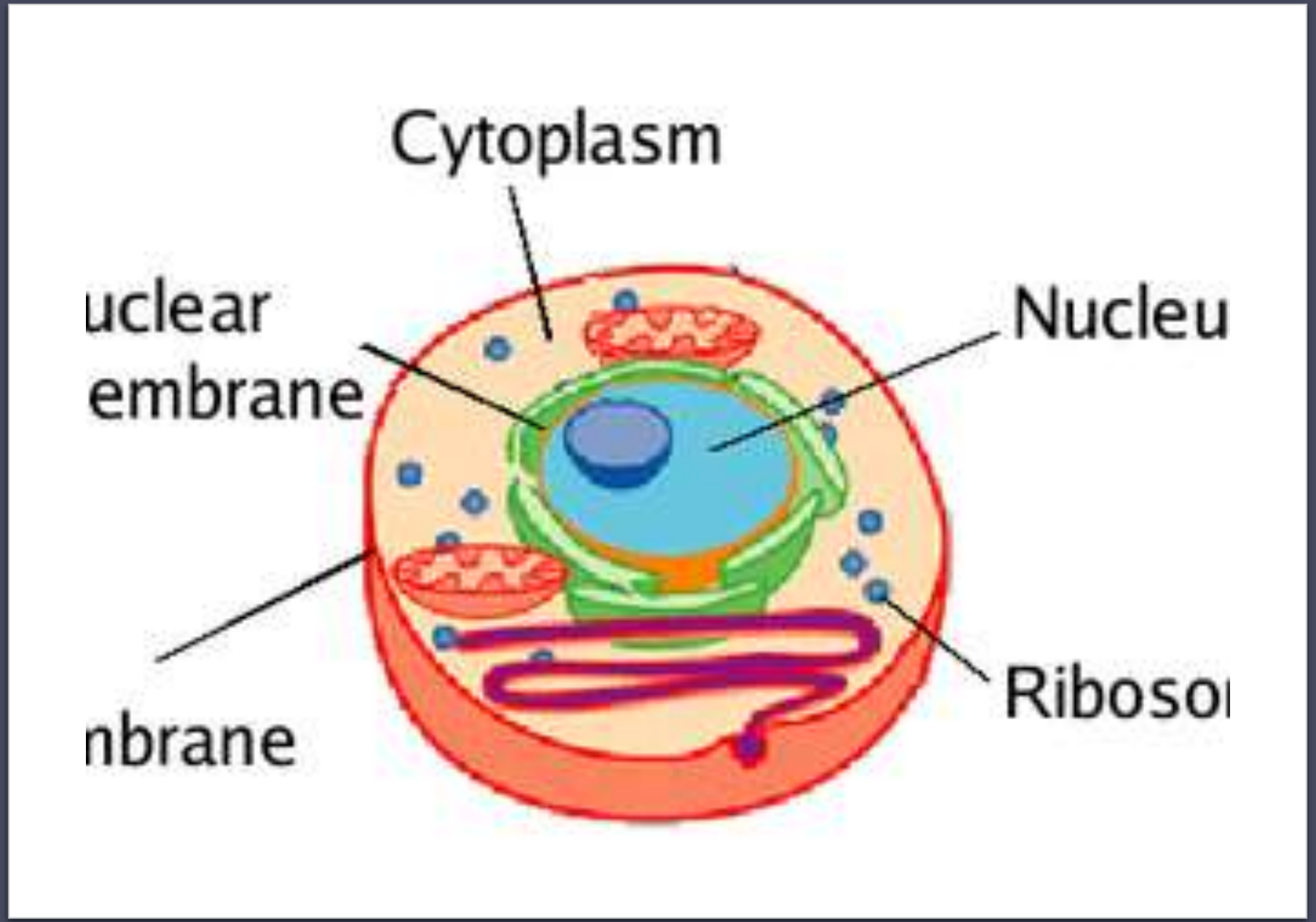
- Multicellular
  - A multicellular organism is made up of more than one cell.
  - Multicellular organisms are composed of more than one cell, with groups of cells differentiating to take on specialized functions.
  - nerve cells, skin cells, muscle cells, blood cells, and other types of cells

4. Define the following microscopic terms:

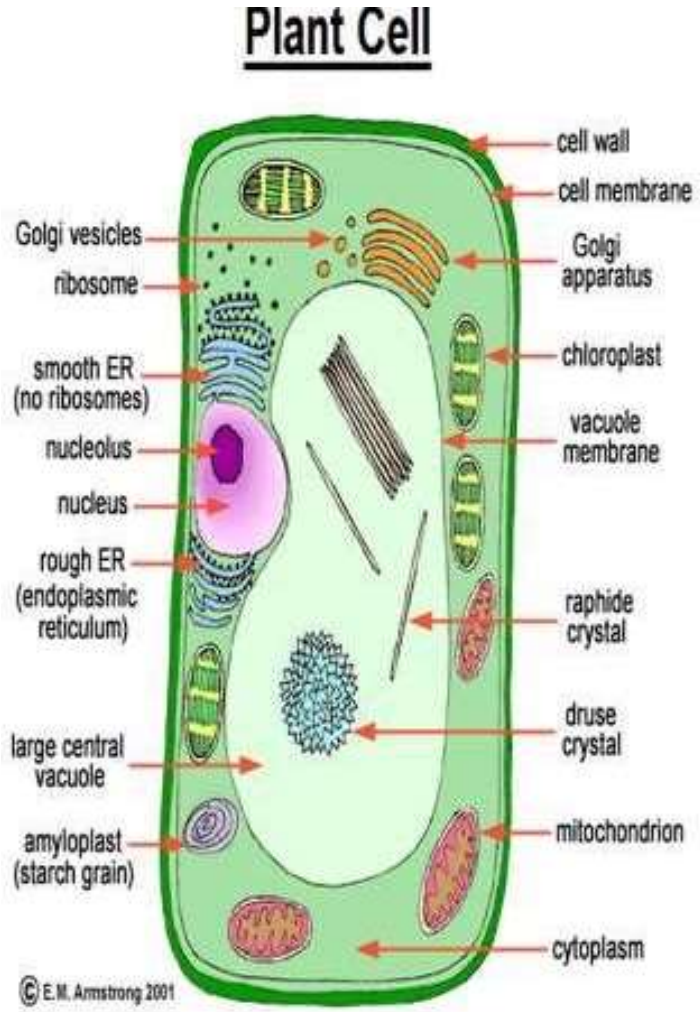
- Cilia
  - Cilia are small hair-like appendages around the edge of a cell which allows the cell to propel itself through water.
- Flagella
  - A flagella is a whip-like structure at the end of a cell that allows it to swim through the water.
- Plankton
  - Plankton are any type unicellular marine organism at the bottom of the food chain.

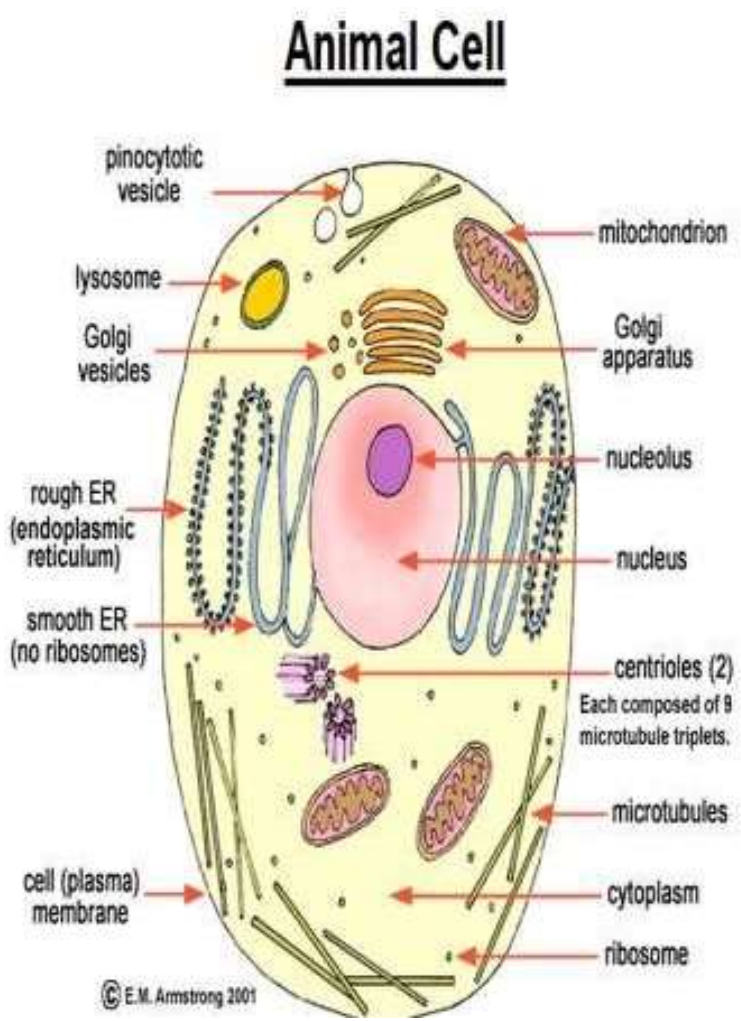
5. Activity

- Collect samples of water (from ponds, streams, ditches or puddles etc)
- Search for living organisms using a microscope
- Use at least 100x magnification
- Identify five organisms
- Draw five organisms and label them
- Expect to see algae, hydras, protozoa, bacteria & some artropods too



6. Draw and label a cell





6. Plant cell vs Animal cell

The Six Kingdoms

When Linnaeus developed his system of classification, there were only two kingdoms, **Plants and Animals.** But the use of the microscope led to the discovery of new organisms and the identification of differences in cells. A two-kingdom system was **no** longer useful.

Today the system of classification includes six kingdoms.

The Six Kingdoms:
Plants, Animals, Protists, Fungi, Archaebacteria, Eubacteria.
How are organism placed into their kingdoms?

- Cell type, complex or simple
- Their ability to make food
- The number of cells in their body

7. Kingdoms of Microscopic Life

Plants

You are probably quite familiar with the members of this kingdom as it contains all the plants that you have come to know - **flowering plants**, mosses, and ferns. Plants are all **multicellular** and consist of complex cells.

With over 250,000 species, the plant kingdom is the second largest kingdom. Plant species range from the ***tiny*** green mosses to ***giant* trees.**

In addition plants are **autotrophs,** organisms that make their own food.

Without plants, life on Earth would not exist! Plants feed almost all the heterotrophs (organisms that eat other organisms) on Earth. Wow!

Kingdoms of Microscopic Life

ls

l kingdom is the largest kingdom with
ion known species.

Tiger - Kingdom: Animalia, Phylum,
Class Mammalia, Order Carnivora, Family
dae, Genus *Pathera,* Species *tigris*

All animals consist of many comple
cells. They are also **heterotrophs.**

Members of the animal kingdom are found in the most diverse environments in the world.

Kingdoms of Microscopic Life

Archaebacteria

In 1983, scientists tool samples from a spot deep in the Pacific Ocean where hot gases and molten rock boiled into the ocean form the Earth's interior. To their surprise they discovered unicellular (one cell) organisms in the samples. These organisms are today classified in the kingdom, **Archaebacteria.**

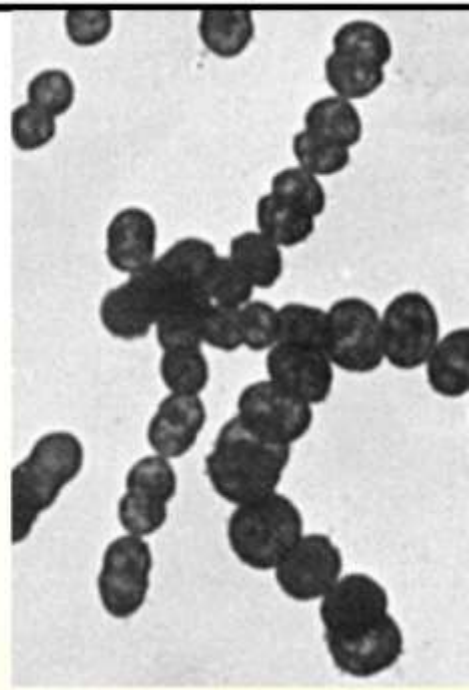
Archaebacteria are found in extreme environments such as hot boiling water and thermal vents under conditions with no oxygen or highly acid environments.

Finding Archaebacteria: *The hot springs of Yellowstone National Park USA, were among the first places Archaebacteria were discovered. The biologists pictured above are immersing microscope slides in the boiling pool onto which some archaebacteria might be captured for study.*

Kingdoms of Microscopic Life

Eubacteria

Like archaebacteria, **eubacteria** are complex and single celled. Most bacteria are in the **EUBACTERIA** kingdom. They are the kinds found everywhere and are the ones people are most familiar with.



Eubacteria are classified in their own kingdom because their chemical makeup is different.

Most eubacteria are helpf
produce vitamins and foo
However, these eubacteri
pictured above, can give y

Kingdoms of Microscopic Life

Fungi

Mushrooms, mold and mildew are all examples of organisms in the kingdom **fungi**.

Most fungi are **multicellular** and consists of many complex cells.

Fun Facts about Fungi

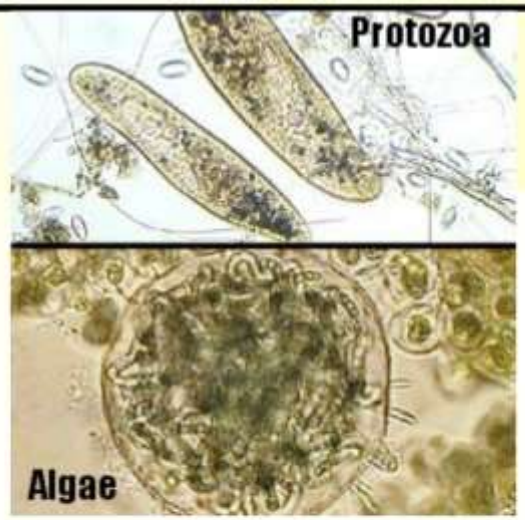
Fungi are organisms that biolog
*once confused with plants, **howe***
unlike plants, fungi cannot ma
***their own food.** Most obtain th*
food from parts of plants that ar
decaying in the soil.

Some fungi taste great and others can kill you!

Kingdoms of Microscopic Life

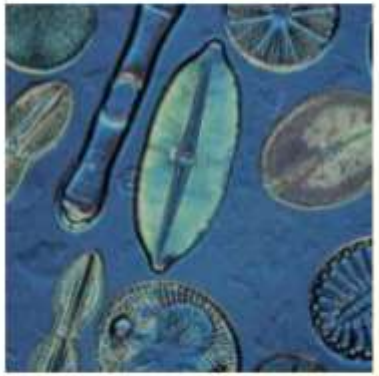
Protists

Slime molds and algae are protists. Sometimes they are called the odds and ends kingdom because its members are so different from one another. **Protists** include all microscopic organisms that are ***not*** bacteria, ***not*** animals, ***not*** plants and ***not*** fungi.



Most **protists** are **unicellular.** You may be wondering why those protists are not classified in the Archaebacteria or Eubacteria kingdoms.

It is because, unlike bacteria, protists are complex cells.



These delicate looking diatoms are classified in the protist kingdom.

Kingdoms of Microscopic Life

8. Uses of Microscopic Life

- Human food
  - Leavened bread and cheese would not be possible without microscopic fungi.
- Human health
  - Intestinal bacteria play crucial role in human health
  - Maintains immunity, homeostasis & protection against pathogens
  - Dysregulation of gut flora leads to host inflammatory & autoimmune conditions ex: Inflammatory Bowel Disease (IBD), Irritable Bowel Syndrome (IBS)
  - Many bacteria cause illness Ex: Streptococcus, Staphylococcus, Salmonella & Escherichia coli

Uses of Microscopic Life

- Viruses can cause disease, few examples:
  - Common flu
  - Hepatitis
  - MMR
  - Chickenpox
  - HIV-AIDS
- Parasites can cause infections too...
  - Malaria

Uses of Microscopic Life

- Medicine
  - **Penicillin** grown from common moulds (fungus) is a powerful anitibiotic
  - Used to treat many bacterial infections
  - Vaccination is an effective way to protect us against certain infectious disease
    - A process of administering weakened or dead disease-causing microscopic lifeforms to a healthy person to build immunity against a targeted disease
    - Ex: Chicken pox vaccine, MMR, DPT, BCG, Pneumococcal, Men B, Men C, Flu vaccine etc
    - **Yet to figure out COVID-19 vaccine**

Uses of Microscopic Life

- Other Organisms

Lichens

- Symbiotic association of fungus and a photosynthetic partner (Cyanobacteria)
- Plant like but not plants
- Come in many colours, sizes and forms
- Occur in sea level to high alpine mountains
- Grow rock, trees and in extreme environments

9. Health habits established as a result of harmful microscopic life

- Hand-washing
  - Frequent hand washing hleps remove disease causing germs away from body
  - Wash your hands before eating
  - Wash hands after you using the toilet
- Tooth-brushing
  - Brushing your teeth checks bacteria in the mouth
  - Prevents cavities and gum disease

9. Health habits established as a result of harmful microscopic life

- Vaccinations
  - Helpe develop immunity to deadly diseases
  - Polio and smallpox were both eradicated
  - World's most pressing need is an effective vaccine against COVID-19 virus
- Clean clothing
  - Chaninging into clean clothing every day, particularly socks and underwear, can prevents ailments like athelet's foot & jock itch

Summary

- Learnt about different microscopes
- Parts of the microscope
- Calculate total magnification
- Different microscopic life around us
- Uses of microscopic life in health and disease

Question time?

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