



Biology 11

Unit 1: Fundamentals

Lesson 2: Cells & the Microscope

Objectives

In this lesson you will be learning about...

- Types of Cells
- Parts of a Compound Microscope
- Using the Compound Microscope
- Calculations Related to the Microscope

Cell Types

- As we learned in the last lesson, all living things are composed of one or more cells.
- All cells are basically the same in chemical composition and metabolic activities, but may be divided into two main groups:

PROKARYOTES & EUKARYOTES

- The difference between the two groups is the presence or absence of a **nucleus** surrounded by a nuclear membrane.

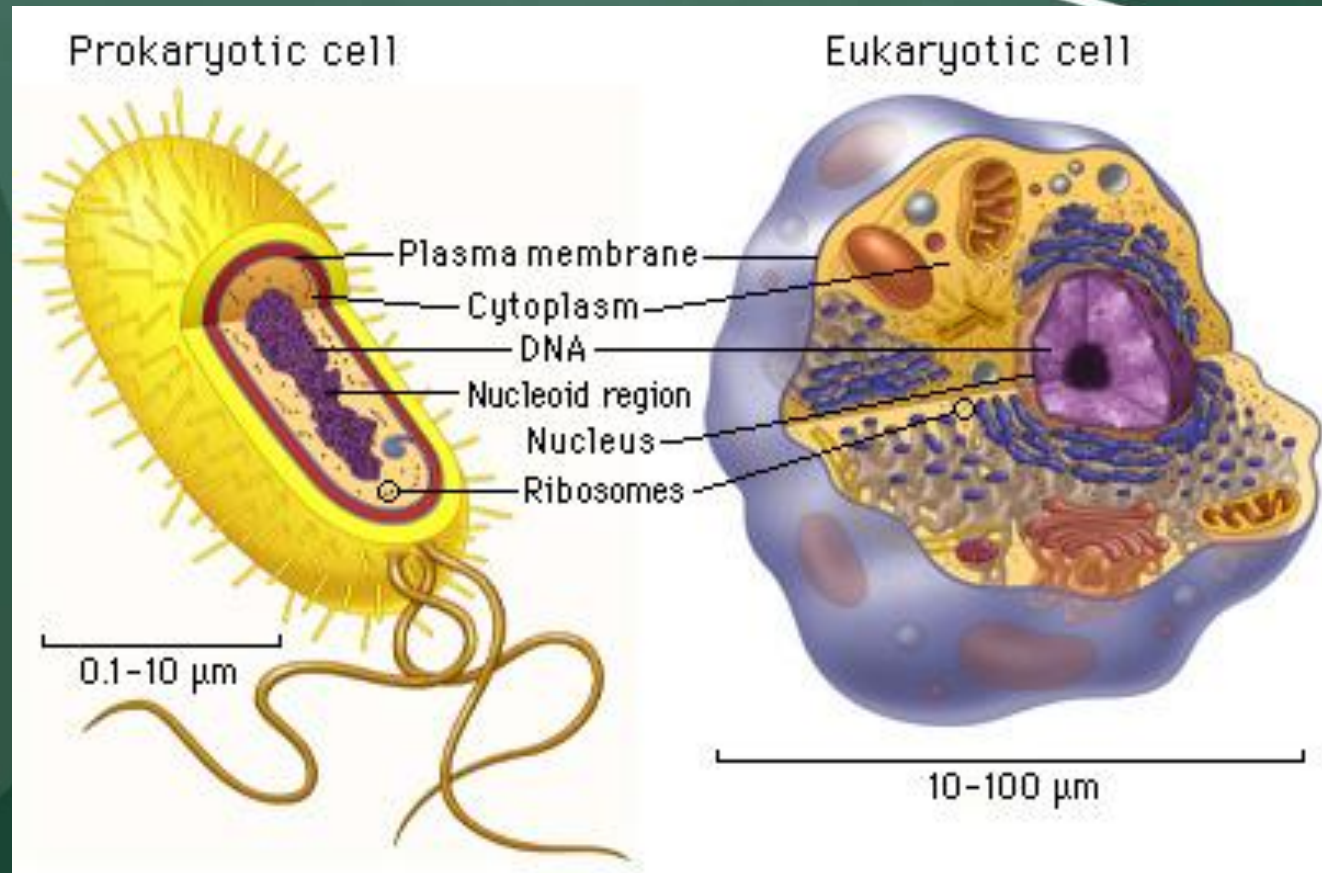
Prokaryotes

- Prokaryotic cells do not contain a membrane-bound nucleus.
- They are generally smaller and less complicated than eukaryotic cells.
- Bacteria are prokaryotic.

Eukaryotes

- Eukaryotic cells, contain a membrane-bound nucleus.
- They are generally larger and more complex than prokaryotic cells.
- The cells of protists, fungi, plants, and animals are all eukaryotic.

Eukaryotes vs. Prokaryotes

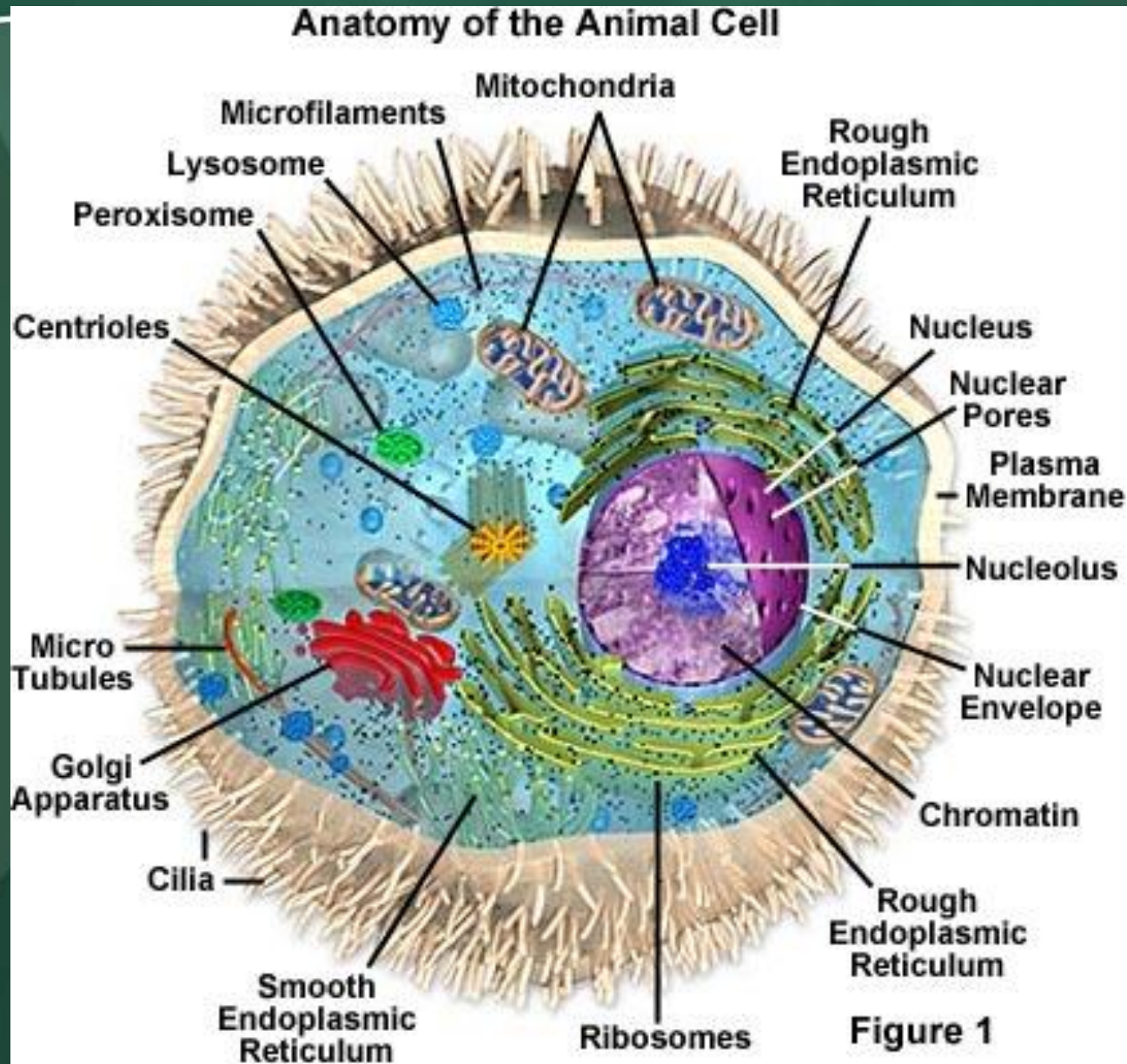


Note that the DNA in the Eukaryotic cell is contained within a membrane-bound nucleus.

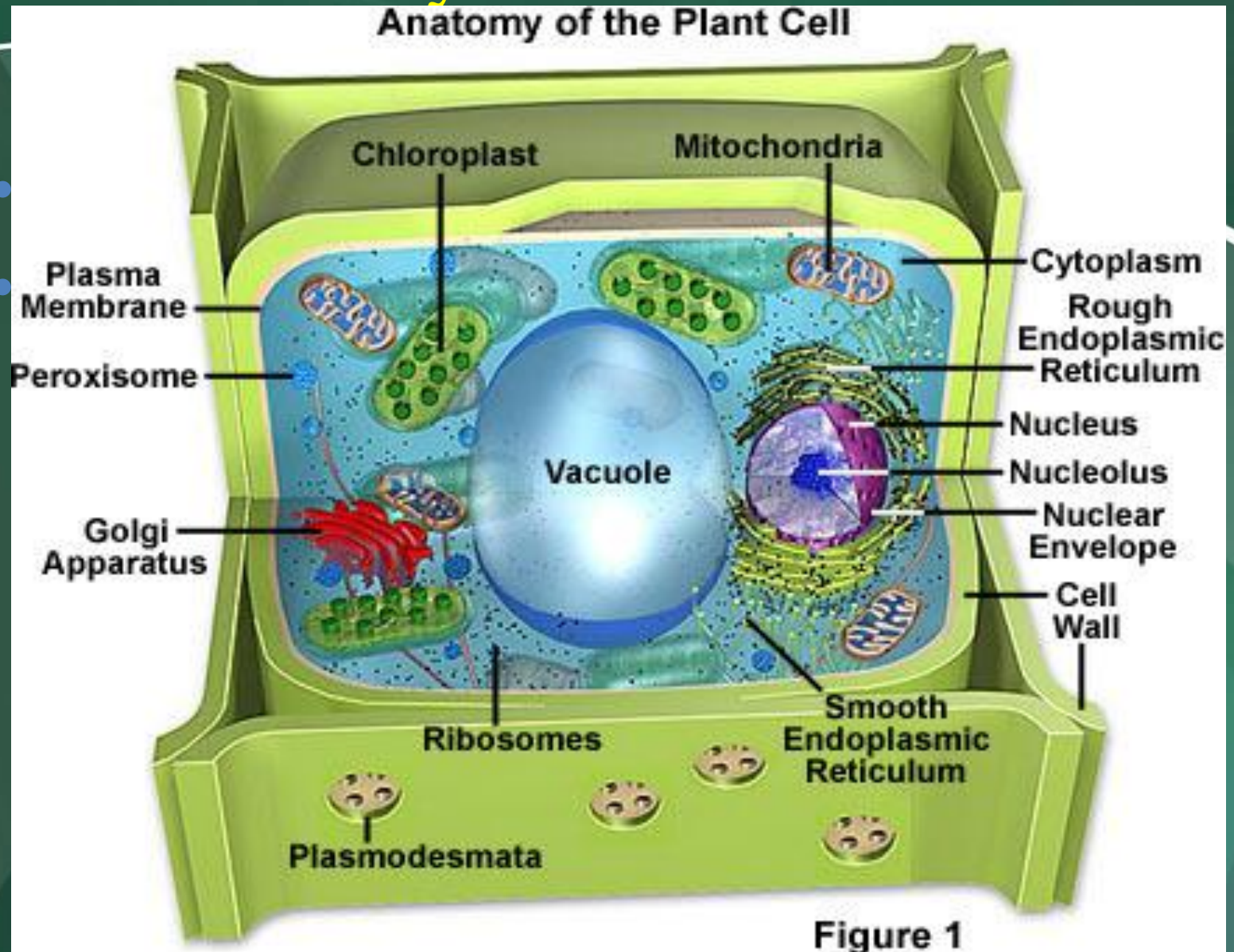
Animal vs.. Plant Cells

- Plant and animal cells are alike in that they are both eukaryotic (have a nucleus).
- Plant cells differ from animal cells in that they:
 - have a **cell wall** surrounding the cell membrane
 - have **chloroplasts** containing chlorophyll responsible for photosynthesis
 - have a **large central vacuole** that stores water
 - **lack cilia and/or flagella**

Eukaryotic Animal Cell



Eukaryotic Plant Cell



For more on cells...

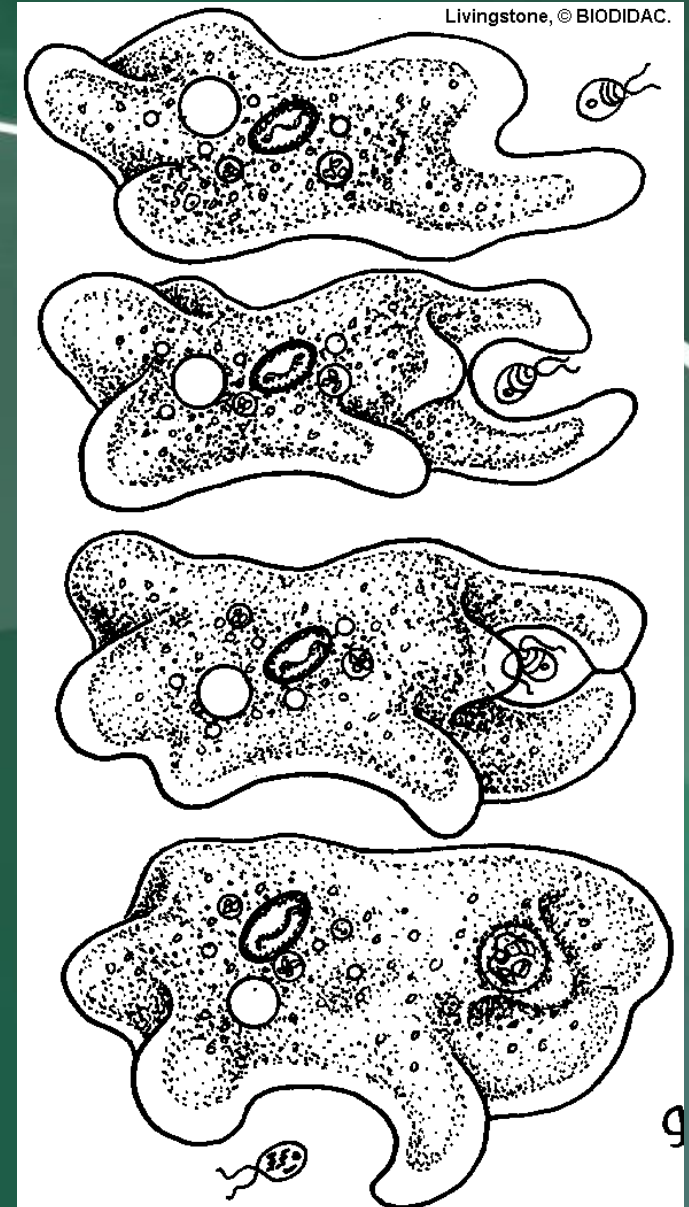
Visit : [Cells Alive](#)

Check out the Interactive Cell Models, and
Cell Photo Gallery.

- The illustration shown right shows the phagocytosis (eating) of a unicellular protist (*Chlamydomonas*) by a larger unicellular protist (*Amoeba*).
- Are these cells eukaryotic or prokaryotic?

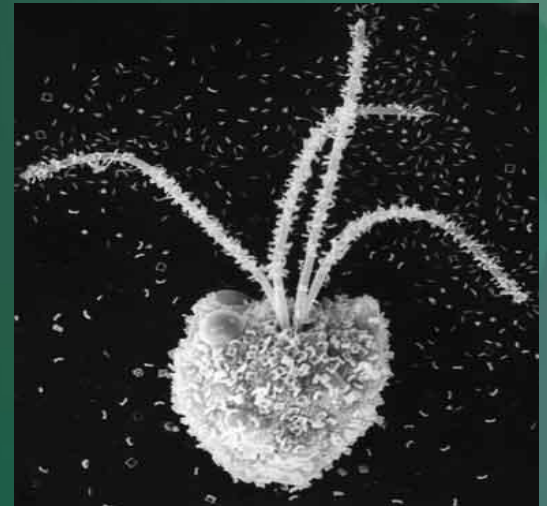
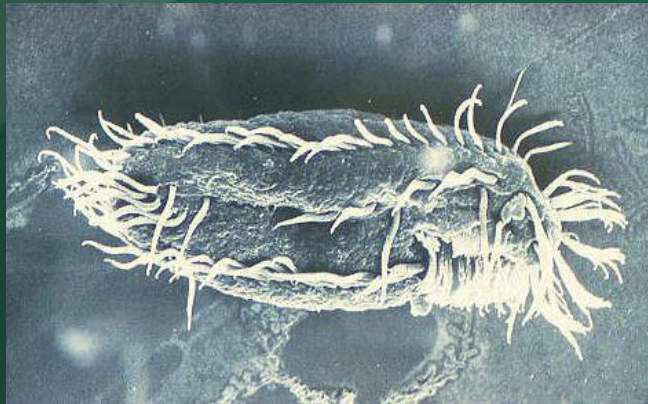


Read pages 169-176



Cilia & Flagella

- **Cilia** and **flagella** are long, thin structures extending from the surface of many types of eukaryotic cells. They are essentially the same except for number and length. They are used for movement.



The Compound Microscope



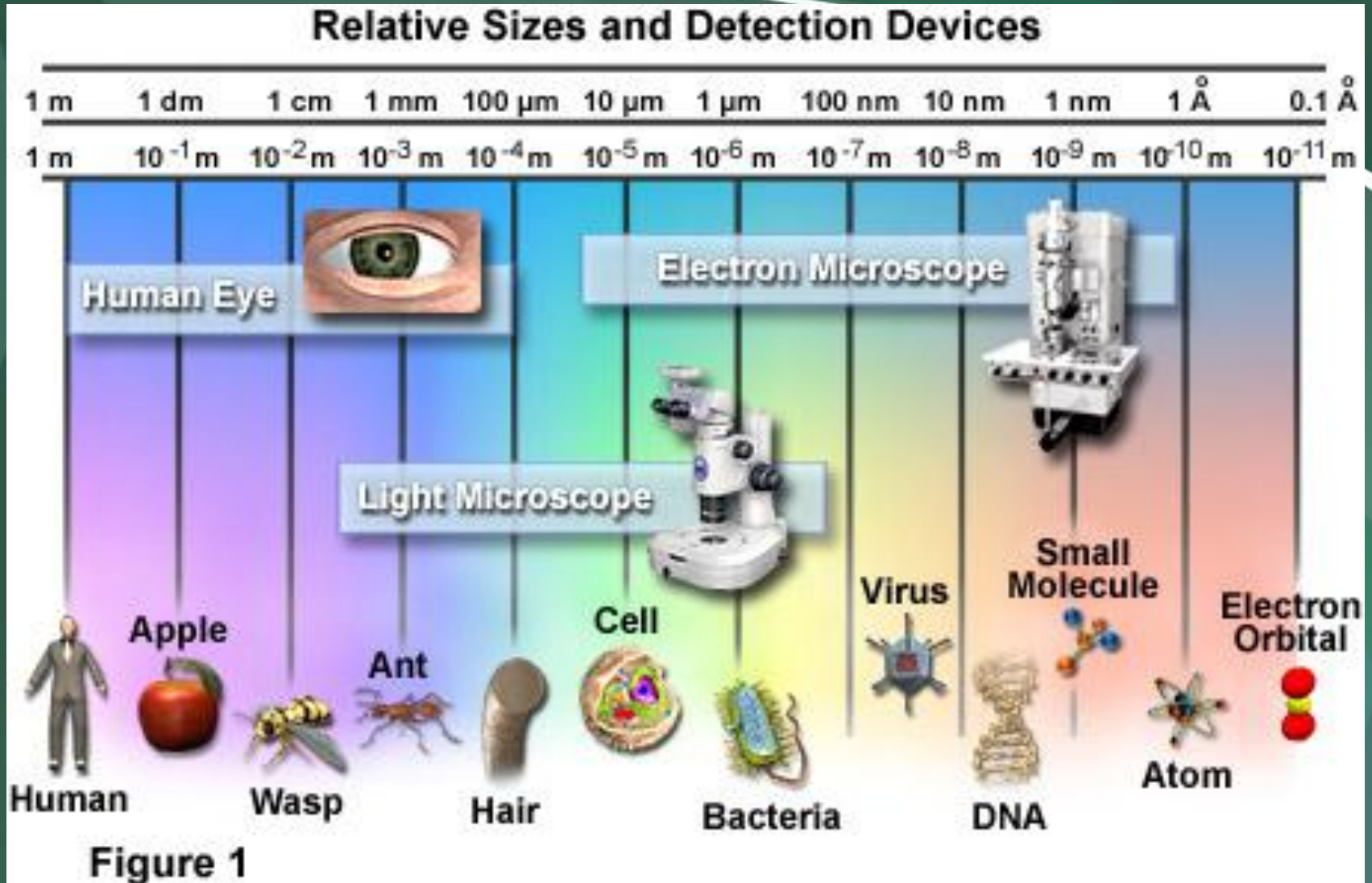
*"Of all the inventions none there is Surpasses
the noble Florentine's Dioptrick Glasses
For what a better, fitter guift Could bee
in this World's Aged Luciosity.
To help our Blindnesses so as to devize
a paire of new & Artificial eyes
By whose augmenting power wee now see
more than all world Has ever down Before."*

Henry Powers, 1664

Microscopes

- The development of the microscope at the end of the 16th century would lead to a great step forward for science, particularly in biology and medicine.
- The human eye has a resolution of 0.1 mm, which is about the thickness of a hair.
- The exploration of the micro cosmos has led to numerous discoveries, without which we would be left with the limited knowledge our eyes give us.

How Small is Small?



History of the Microscope

- If you are interested in the history of the microscope, visit the following sites:
- [Microscope Museum](#)
- [Microscope Timeline](#)



The Microscope

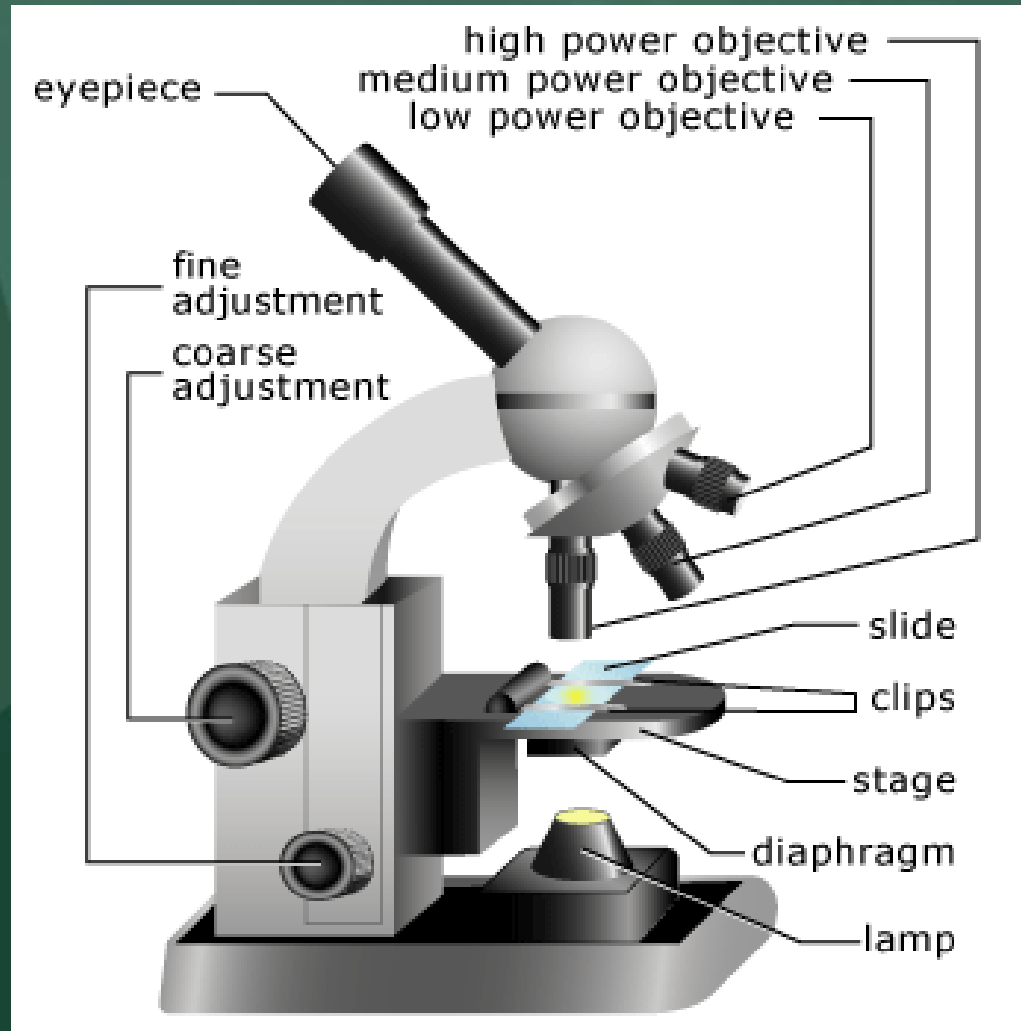
- The microscope is an important tool used by biologists to magnify small objects like cells.
- There are many types of microscopes. The ones most commonly used in high school biology classes are the dissection microscope and the compound light microscope.

Anatomy of a Dissection Microscope



Anatomy of a Compound Microscope

- All compound microscopes have the same basic parts.



The Compound Microscope

- You will be responsible for knowing the parts of the compound microscope and their functions.
- There are numerous websites on this topic. Have a look at a few and compare to the diagram in your textbook.
- To help you remember them, you might want to try this link: [Microscope Parts Flashcards](#)



Read pages 25-26 and 1070-1071

The Compound Microscope

- Here are a few important terms and concepts that you will need to know about microscopy:

Magnification

- **Magnification** is ratio between the size of the specimen and the size of the image.
- To calculate magnification we multiply the power of each lens through which the specimen is viewed. In a light microscope this is the ocular lens (located in the eyepiece) and objective lens.
- *Example:* if a microscope has a 10X ocular value and a 40X objective value, you would find the total magnification by multiplying $10 \times 40 = 400$, or 400X.

Try this Link

[Virtual Magnification](#)



Resolution

- **Resolution** is the clarity or sharpness of the image---the amount of detail that can be seen.
- Different types of microscope have different resolving powers. Light microscopes let us distinguish objects as small as a bacterium. Electron microscopes have much higher resolving power.

Resolution

- Objects such as a human hair appear smooth when viewed with the unaided eye.



Resolution

- However, put a hair under a microscope and it looks quite different!



Important Note

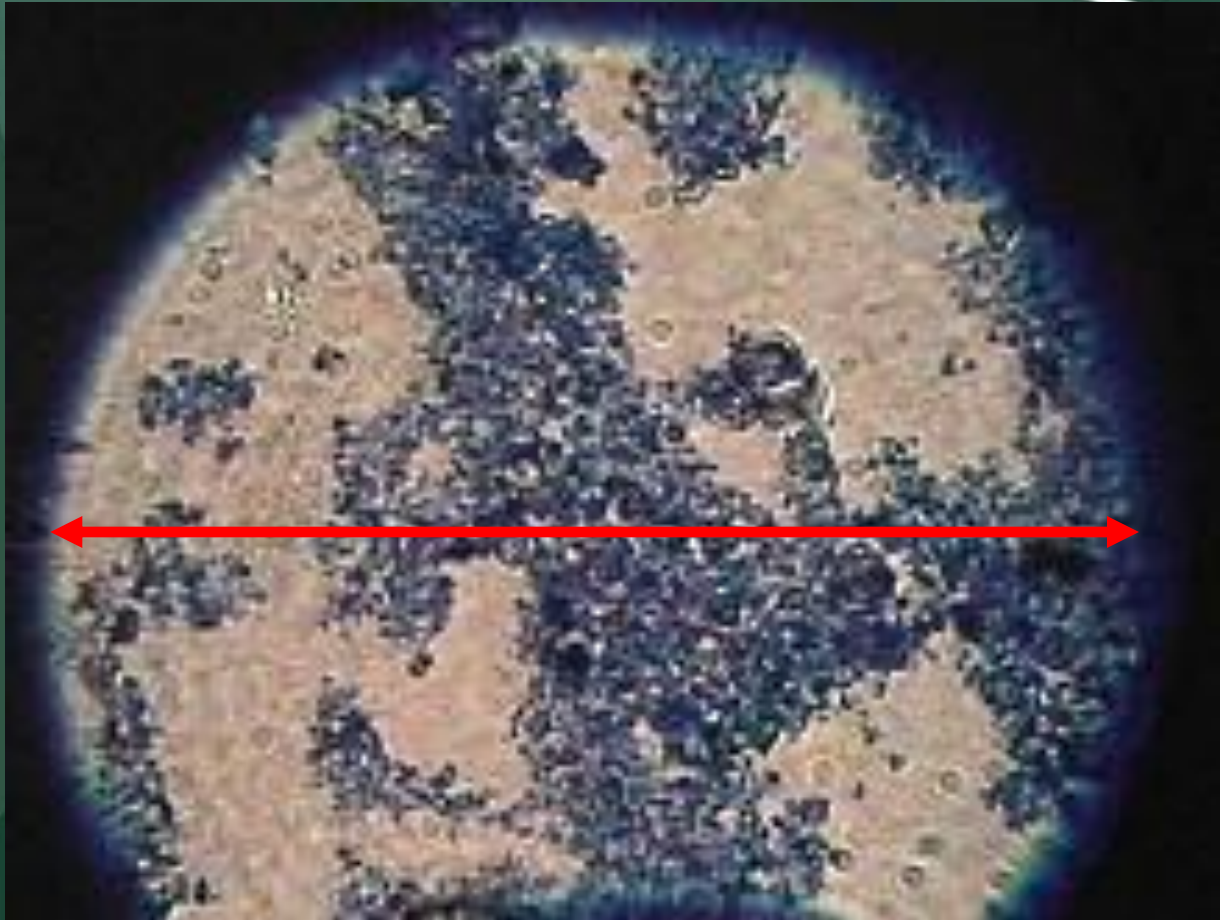
- It is important to realize that images viewed under the microscope are **inverted** (flipped top to bottom and left to right).



Field of View

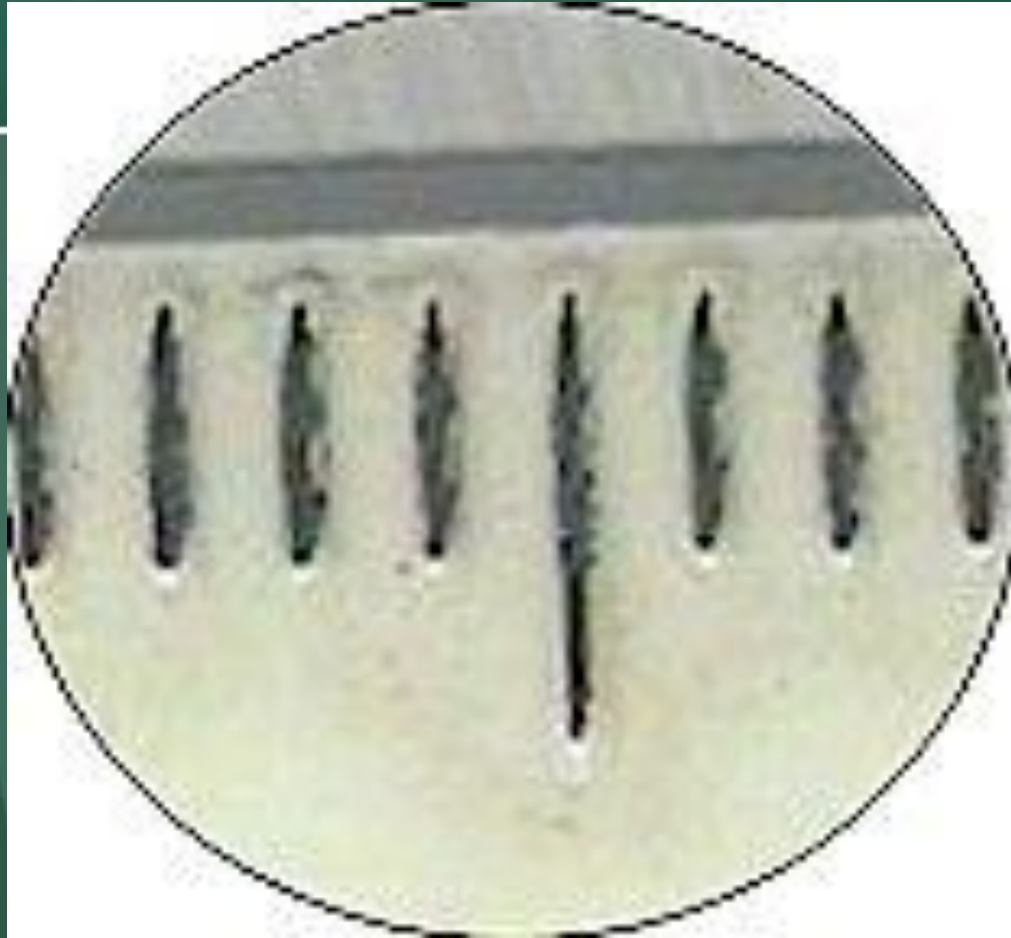
- **Field of View** is the 'circle' that you see when looking through a microscope.
- **Field Diameter** is the distance across the center of this circle.
- Since objects viewed under the microscope are very small, the **micrometer** is used in making such measurements.
- There are 1000 micrometers (μm) in 1 millimeter (mm).

Field Diameter



Field of View

- The field of view (and thus the field diameter) is different from microscope to microscope, therefore it must be calculated each time you use a new microscope.
- To do this, simply view a clear ruler using low power. Measure the distance across your field of view in millimeters and convert to micrometers by multiplying by 1000.



In this example, about 7 spaces are shown.

$$7 \text{ spaces} = 7 \text{ mm}$$

$$7 \text{ mm} \times 1000 = \mathbf{7000 \text{ } \mu\text{m}}$$

Field of View

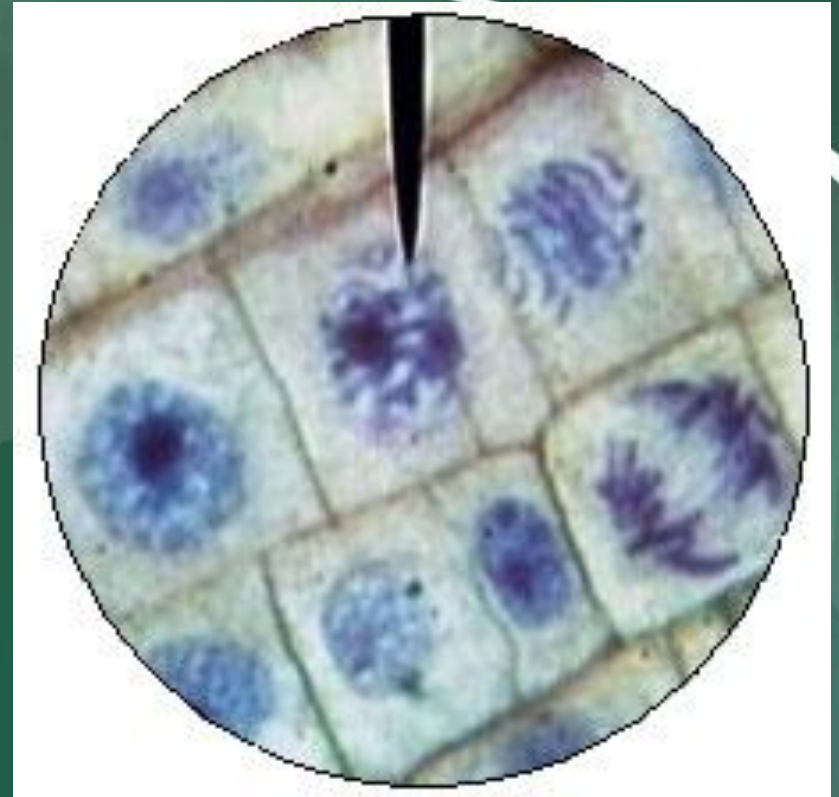
- Once the low power field diameter has been determined, you can now calculate the fields at higher powers.
- Using the previous example, calculate the field diameter under medium power (10 X).
 - Lower power field diameter (4 X) = 7000 μm
 - Medium power field diameter (10 X) = $(4 / 10) \times 7000 \mu\text{m} = \mathbf{2800 \mu\text{m}}$
 - In other words, the field diameter under medium power is 4/10^{ths} as big as the field diameter under low power.

Field Diameter

- When you increase the magnification, you are 'zooming in' on a smaller area, therefore the field diameter will decrease proportionately.
- For example, if the magnification is doubled (multiplied by 2), the field diameter will be half as large (divide by 2).
- Once you know the field diameter of your microscope, you can estimate the size of objects viewed under each objective lens.

Estimating Specimen Size

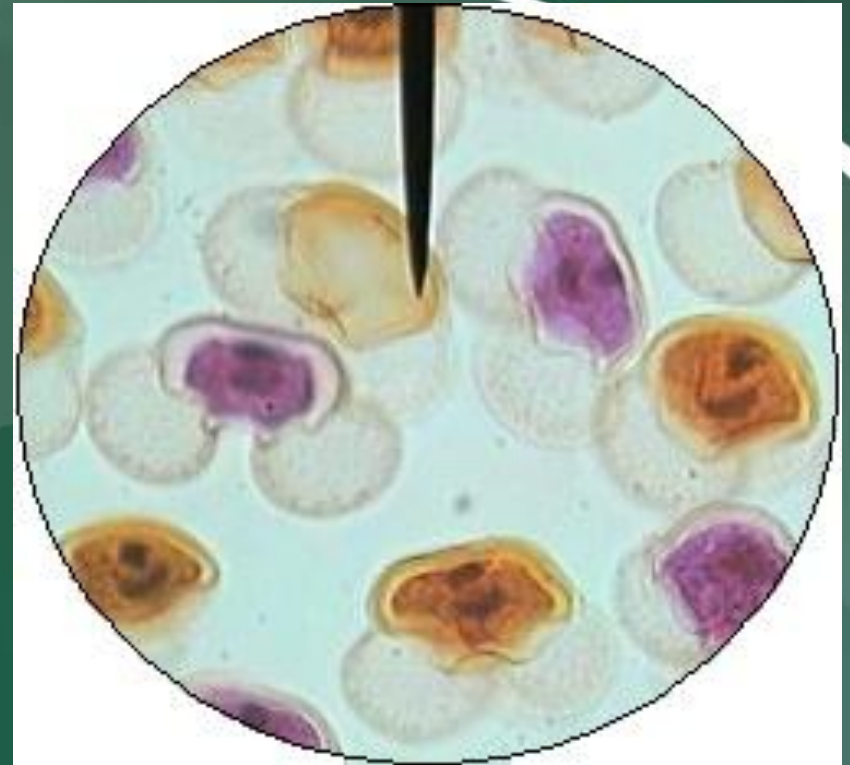
- To determine the size of a specimen, simply estimate how many times it would fit across the field of view.
- About 3 cells fit across the field of view in this example.
- Since the field diameter = $2000\text{ }\mu\text{m}$, the size of each cell would be $2000\text{ }\mu\text{m} / 3 = 667\text{ }\mu\text{m}$.



Field diameter = $2000\text{ }\mu\text{m}$

Try this one

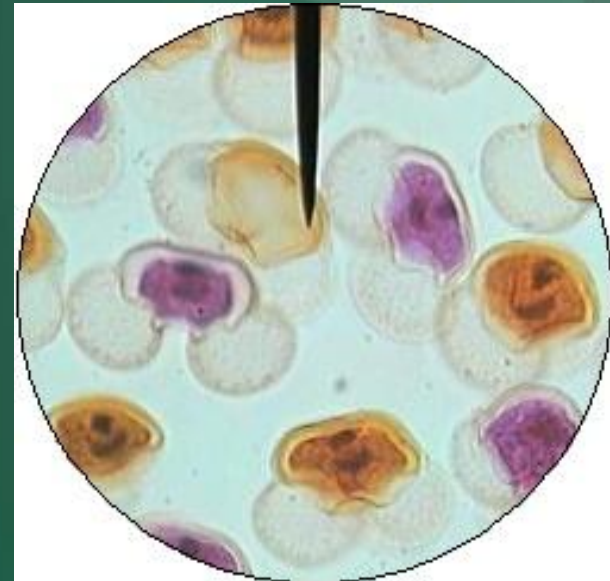
- Determine the approximate *length* and *width* of these pollen grains.



Field diameter = 4500 μm

Answer

- Widthwise about 5 pollen grains fit across the field of view.
- Since the field diameter = $4500\text{ }\mu\text{m}$, the width of each pollen grain would be $4500\text{ }\mu\text{m} / 5 = \mathbf{900\text{ }\mu\text{m}}$ approximately.



Answer cont.

- Lengthwise about 3 pollen grains fit across the field of view.
- Since the field diameter = $4500\text{ }\mu\text{m}$, the length of each pollen grain would be $4500\text{ }\mu\text{m} / 3 = \mathbf{1500\text{ }\mu\text{m}}$.
- Therefore, when estimating the size of a specimen, *you need to specify whether you are measuring its length or width.*

Electron Microscope Image

Staple through paper!!



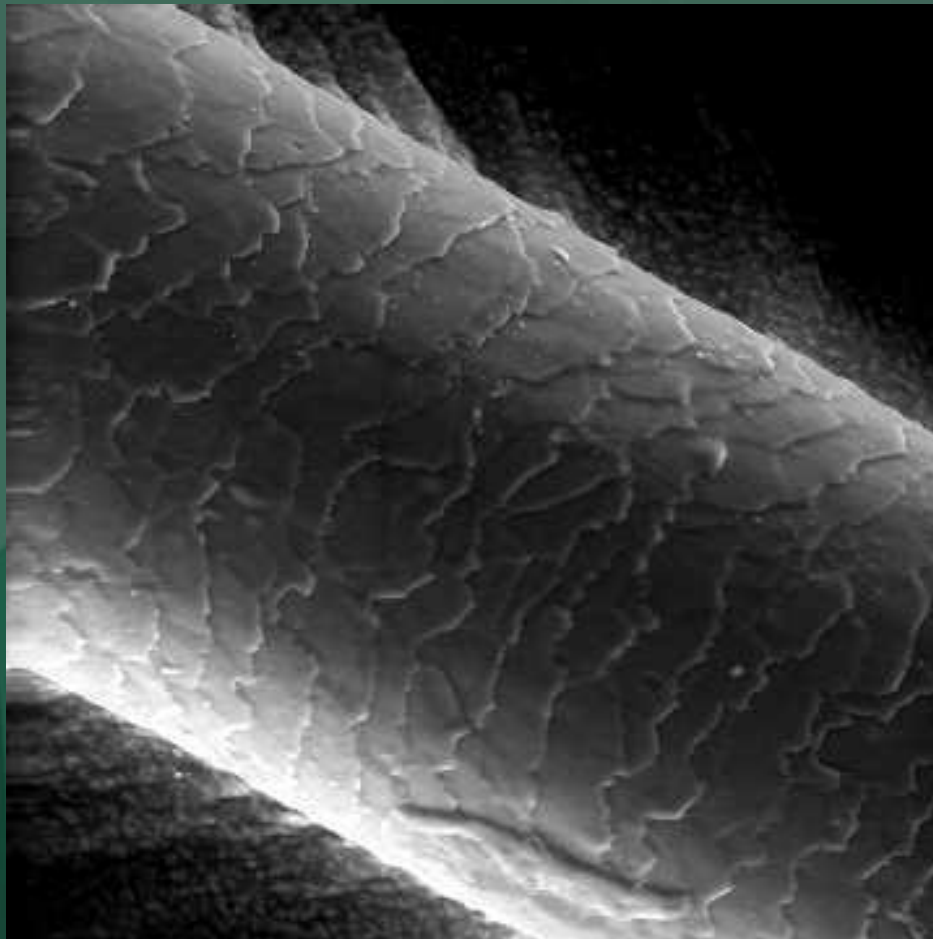
Electron Microscope Image

Foot of a House Fly



Electron Microscope Image

Human Hair





For your interest :

- [Virtual Electron Microscope](#)
- [National geographic Microscopy Images](#)
- [An Introduction to Microscopy](#)
- [Science Spot - Cells & Microscopes](#)

Contains links to numerous lessons, activities, games and quizzes on cells and microscopy.



Activity

- Open a new browser and click on the following link: [Virtual Microscope Lab](#)
- Complete the entire tour, including the ‘Try This’ section.
- **Important:** You will revisit this site in Lab 1 The Virtual Microscope (**COMING SOON**). Make sure that you are familiar with the workings of the virtual microscope and the four slide samples provided.

The background is a dark green color with several overlapping, semi-transparent circles of varying shades of green. A thin, white, curved line arcs across the upper portion of the image, starting from the left edge and ending on the right edge.

You are now ready to complete the First
Assignment: Scientific Method, Cells and
the Microscope.