

Intro to Microbiology

The History and Scope of
Microbiology - Chapter 1

Introduction to Microbiology



What is microbiology?

- ❖ Historically defined as the study of organisms too small to be observed with the naked eye.
 - ❖ Not a proper definition.
 - ❖ Exception: Eukaryotic microbes
- ❖ Microbiology study:
 - ❖ - Fungi, protists, bacteria, archaea, viruses, viroids, prions

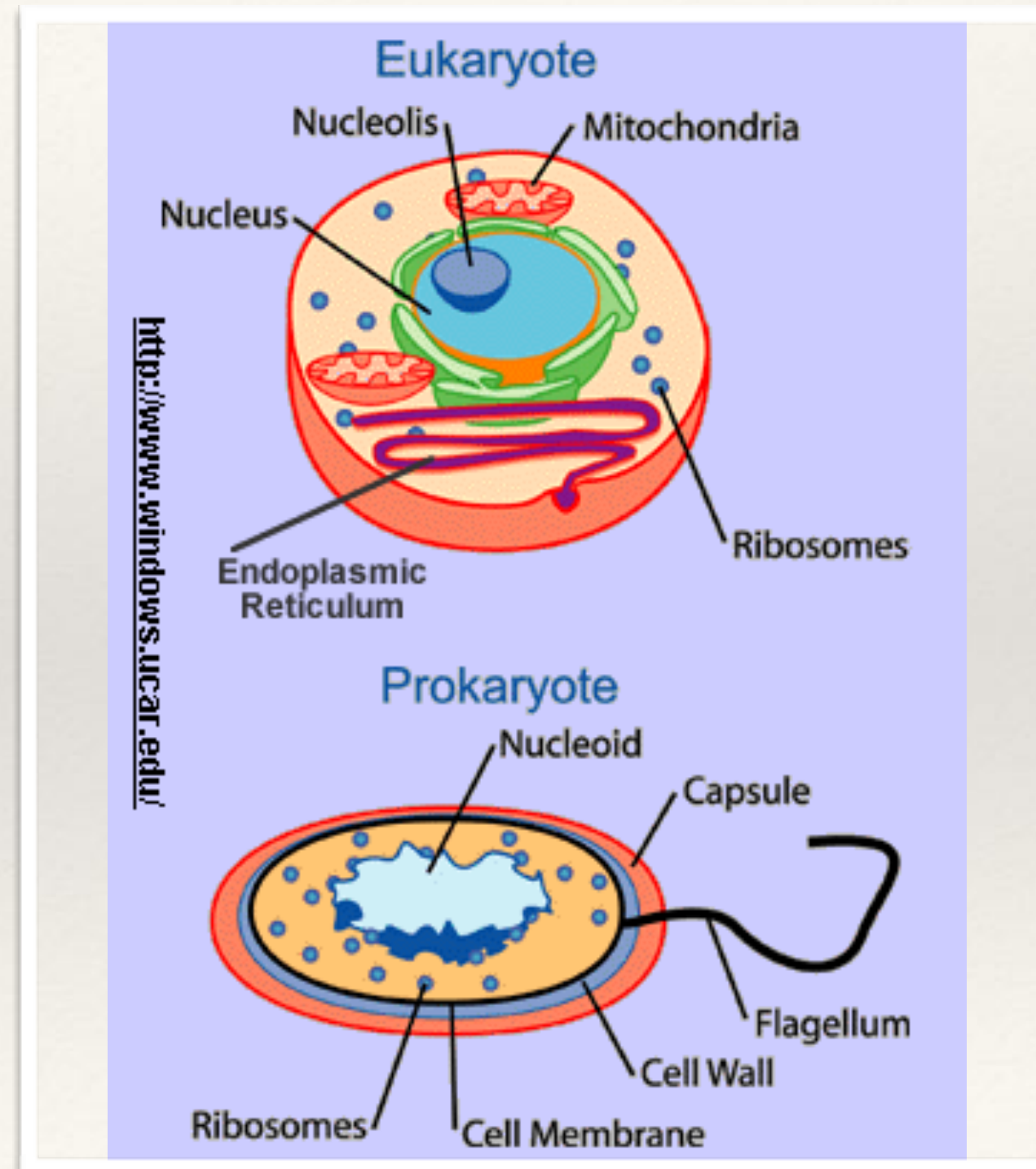
Why take microbiology?

- ❖ Average life span:
 - ❖ Bronze age - 26 years
 - ❖ Medieval Europe (400-1500) - 30 years
 - ❖ Early 20th century - 50-64 years
 - ❖ Now - 67.2 years
 - ❖ US - 78 years



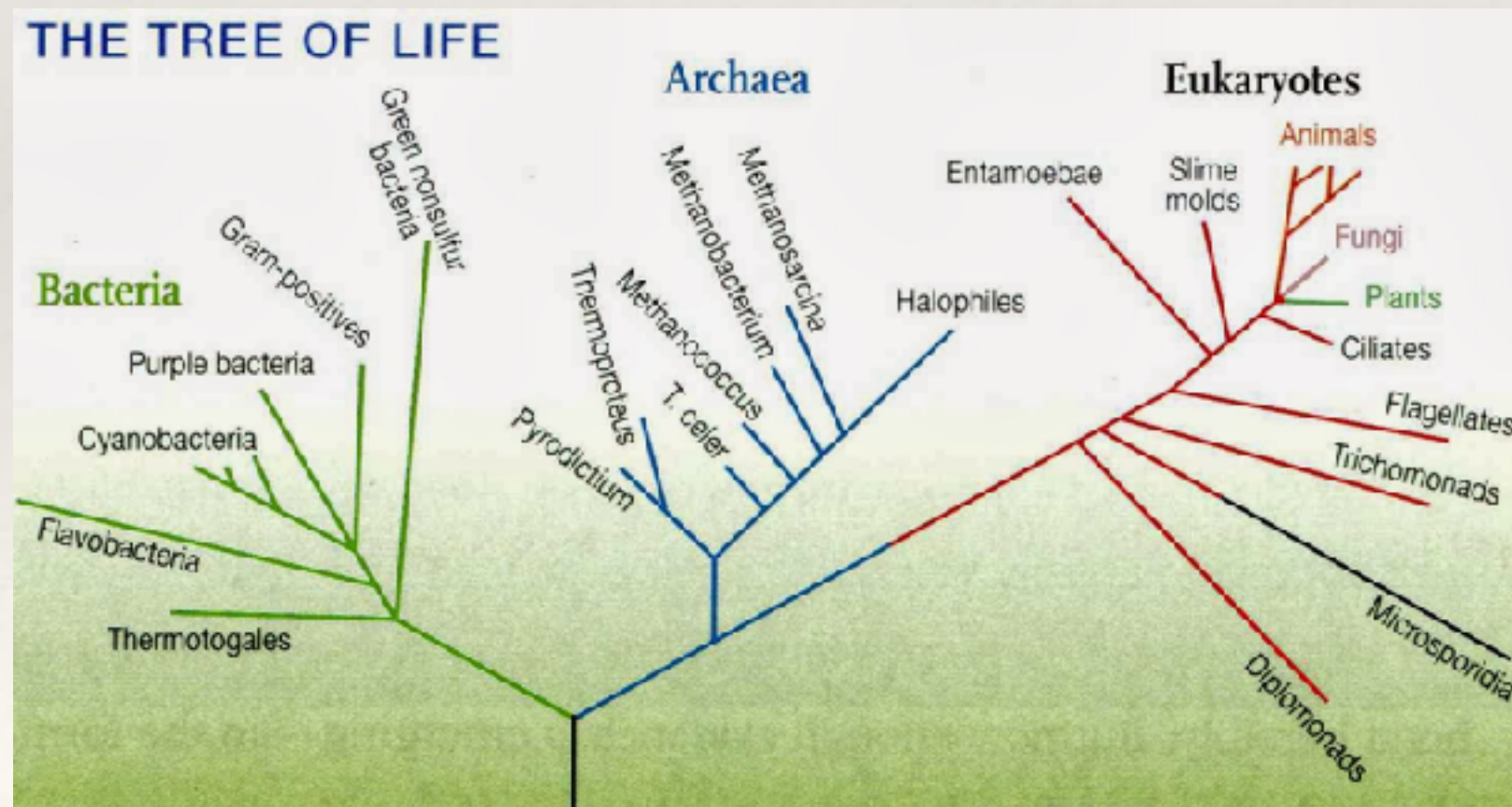
Define Prokaryotes vs. Eukaryotes

- ❖ Microbes include both prokaryotes and eukaryotes
 - ❖ Prokaryotes: lack true membrane-enclosed nucleus
 - ❖ Eukaryotes: have a complex membrane-enclosed nucleus and are more complex and larger than prokaryotes



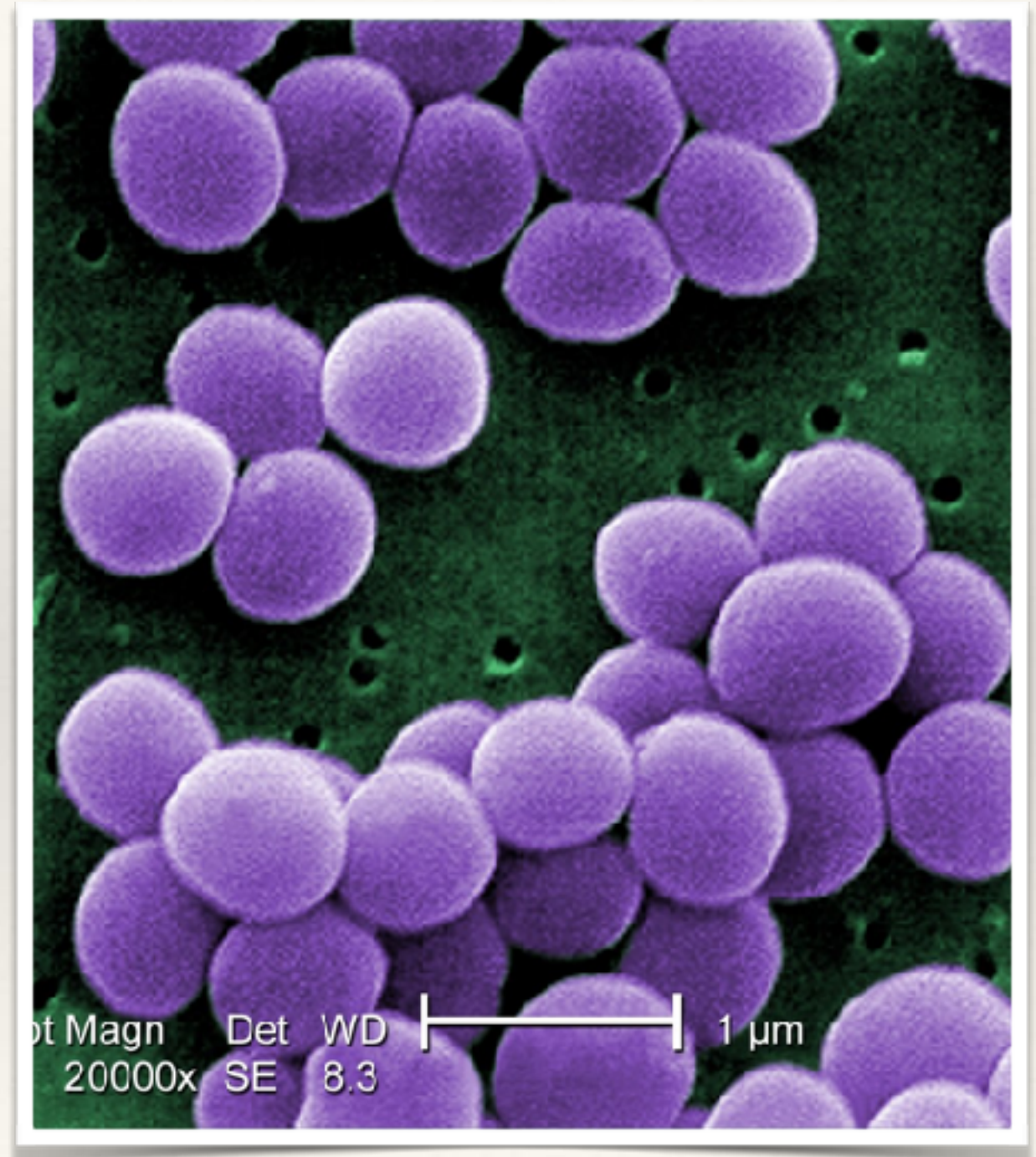
❖ Classification scheme

- ❖ Original 5 kingdom scheme was based on *Monera*, *Protista*, *Fungi*, *Animalia*, and *Plantae* with microbes placed in the first three kingdoms.
- ❖ Now 3 domain scheme, based on 16S ribosomal RNA comparisons divides organisms into Bacteria, Archaea, and Eukarya.



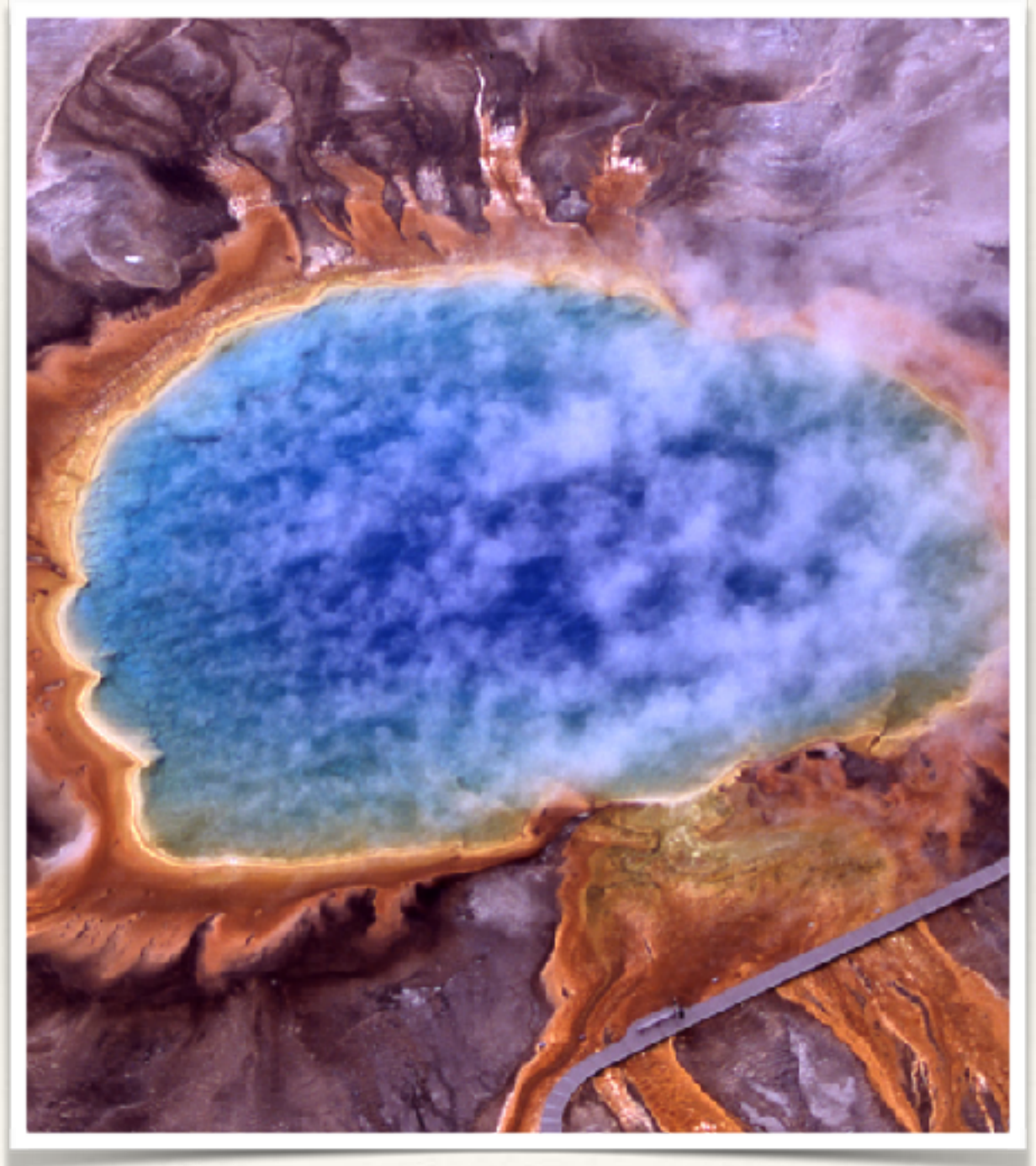
Domain Bacteria

- ❖ Prokaryotic cells
- ❖ Single celled
- ❖ Cell wall contains peptidoglycan
- ❖ Almost all bacteria are non-pathogenic and play a major role in nutrient cycling
- ❖ Cyanobacteria produce oxygen as a result of photosynthesis



Domain Archaea

- ❖ Prokaryotic cells
- ❖ Distinguishable from bacteria by comparing ribosomal RNA
- ❖ Cell wall lacks true peptidoglycan
- ❖ Most are found in extreme environments - Extremophiles



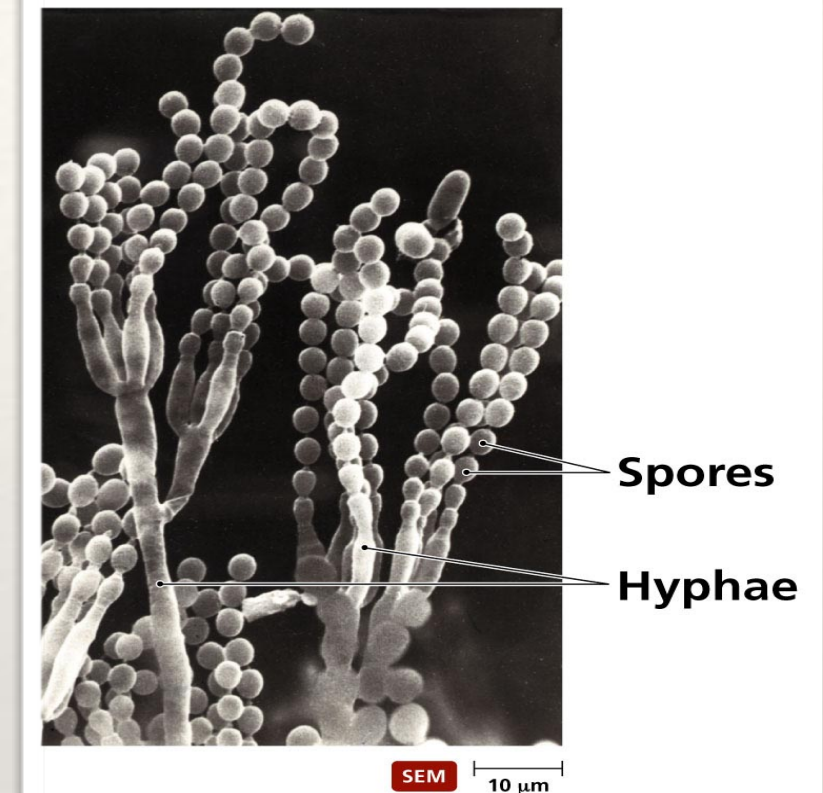
Domain Eukarya

- ❖ Eukaryotic cells
- ❖ Microbes in this domain include protists, algae, and fungi
- ❖ Animals and plants are also in this domain
- ❖ Most are larger than prokaryotic cells

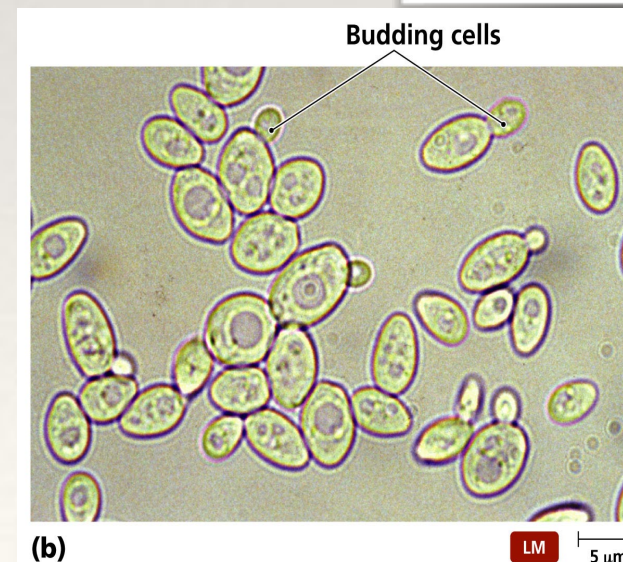


Fungi – Molds and Yeasts

- ❖ Eukaryotic organisms either multi- or unicellular, pathogenic or beneficial
- ❖ Many are microscopic
- ❖ Fungi contain cell walls but are not photosynthetic
- ❖ Molds are typically multicellular and have sexual and non-sexual reproduction by spores
- ❖ Yeasts are unicellular and reproduce sexually by budding or via sexual spores



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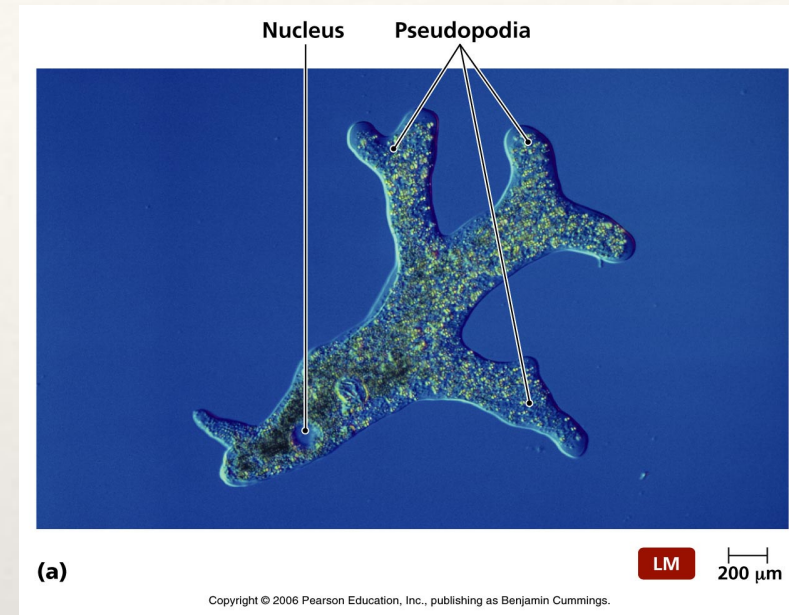


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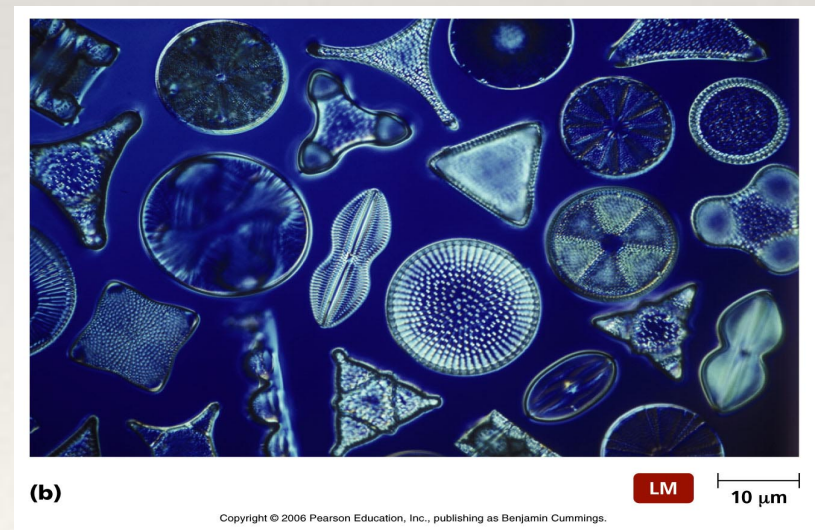
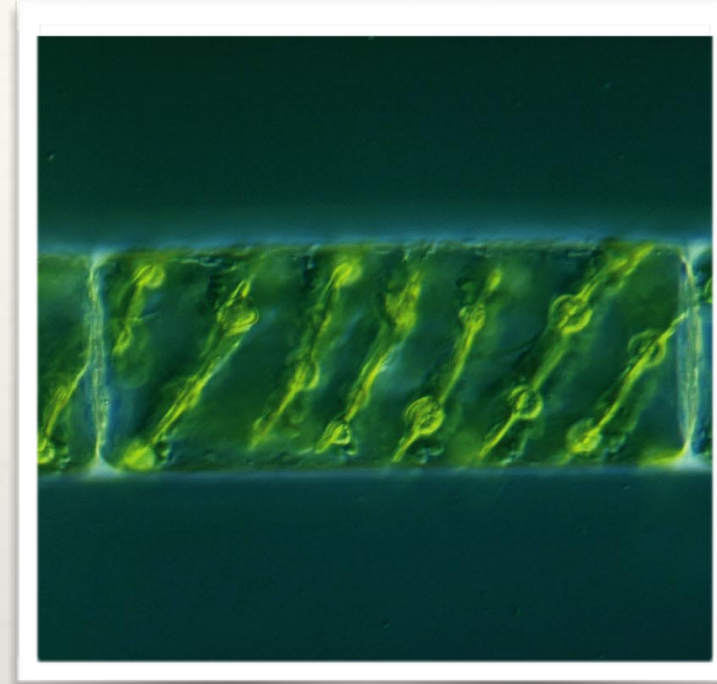
Protozoa

- ❖ Eukaryotic single-celled organisms similar to animal cells
- ❖ Most are motile and are classified by means of locomotion (cilia, flagella, or pseudopodia)
- ❖ Many species are pathogenic



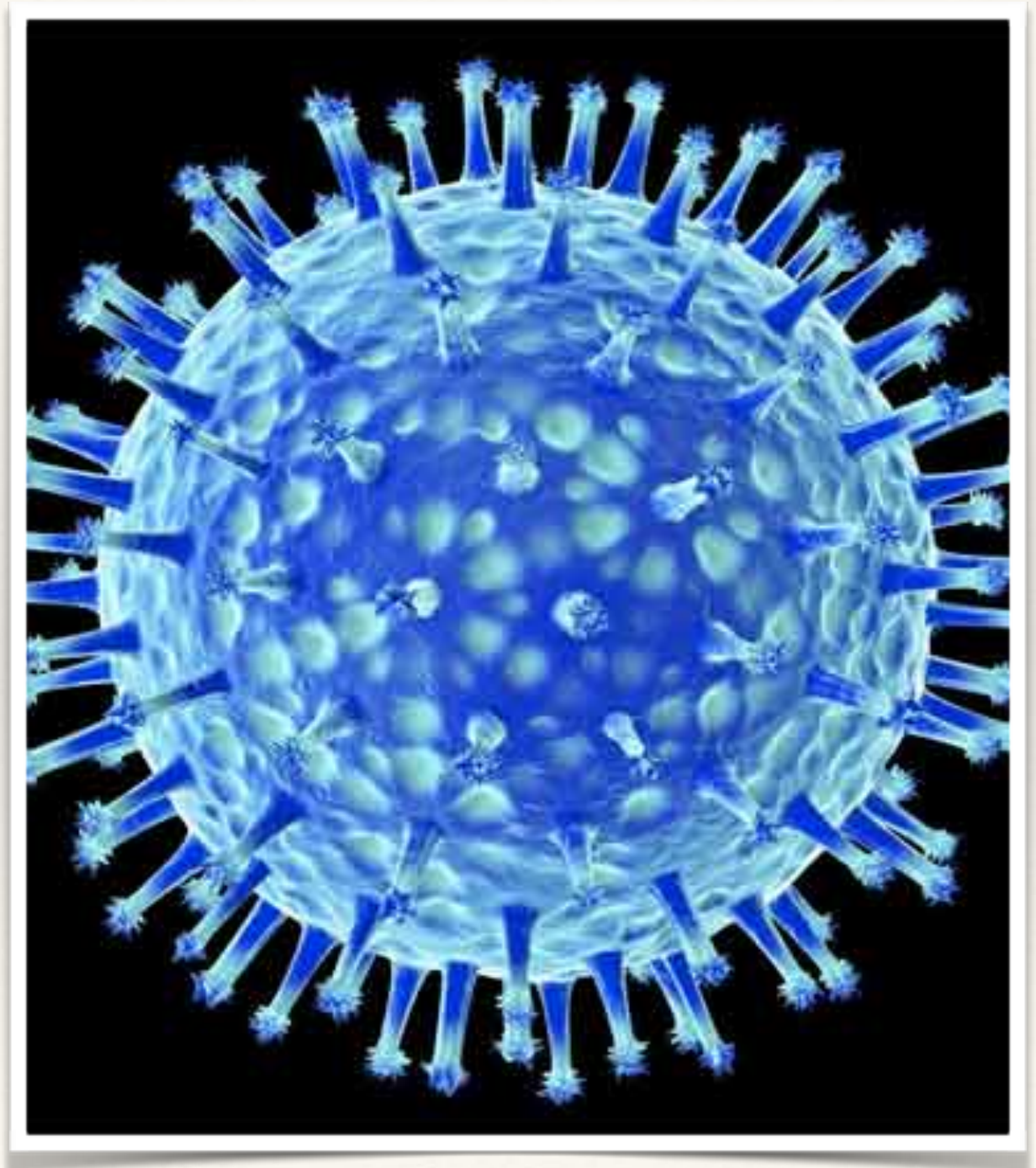
Algae

- ❖ Unicellular or multicellular eukaryotes
- ❖ All are photosynthetic
- ❖ Have cell walls
- ❖ Classification based on cell wall composition and composition of photosynthetic proteins
- ❖ Large multicellular forms include seaweed and kelp
- ❖ Diatoms contain silicates (glass) in cell walls



Viruses

- ❖ Acellular
- ❖ Smallest of all microbes
- ❖ Cause a range of diseases and cancers
- ❖ Are they life?



Discovery of Microbes



- ❖ Robert Hooke
- ❖ Built the first compound microscope
- ❖ Looked at piece of cork under the microscope
- ❖ First to describe cells, but never observed single-celled organisms
- ❖ Published findings in 1665

Anton van Leeuwenhoek, 1632-1723



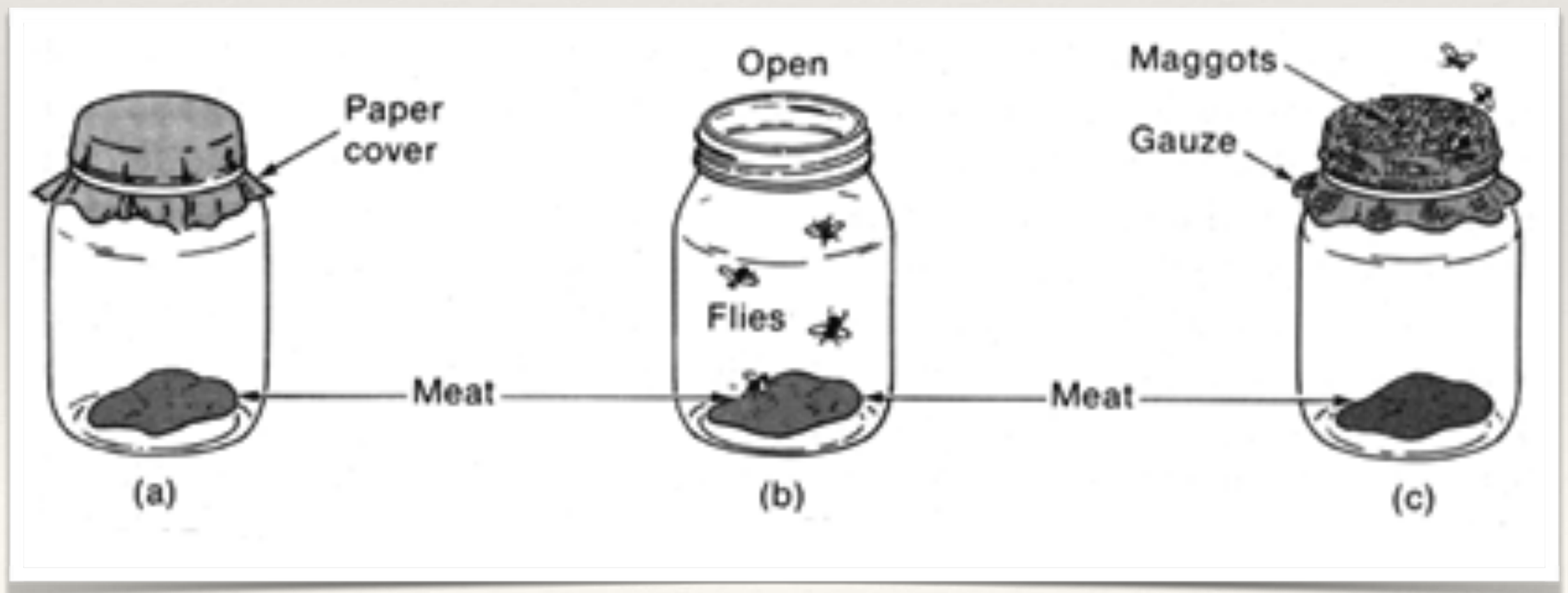
- ❖ “Father of Microbiology”
- ❖ Improved the microscope to be able to observe single-celled organisms
 - ❖ referred to them as “animalcules” What does “cules” mean?
- ❖ First to describe how heat can kill microbes
- ❖ Died from bacteria he was observing

These findings from van Leeuwenhoek lead to the question of “Where do these microbes come from?”

- ❖ Aristotle thought that life was spontaneously generated. Maggots / flies appeared from rotting meat, etc.
- ❖ Church became involved to disprove spontaneous generation: theory that living organisms could develop from nonliving matter.
- ❖ Key people in proving microbes arise from other microbes:
 - ❖ Francesco Redi
 - ❖ Lazzaro Spallanzani
 - ❖ Louis Pasteur

Francesco Redi, 1626-97

- ❖ Italian priest that showed maggots did not spontaneously appear on decaying meat
- ❖ Show that maggots only appeared when meat was exposed to flies

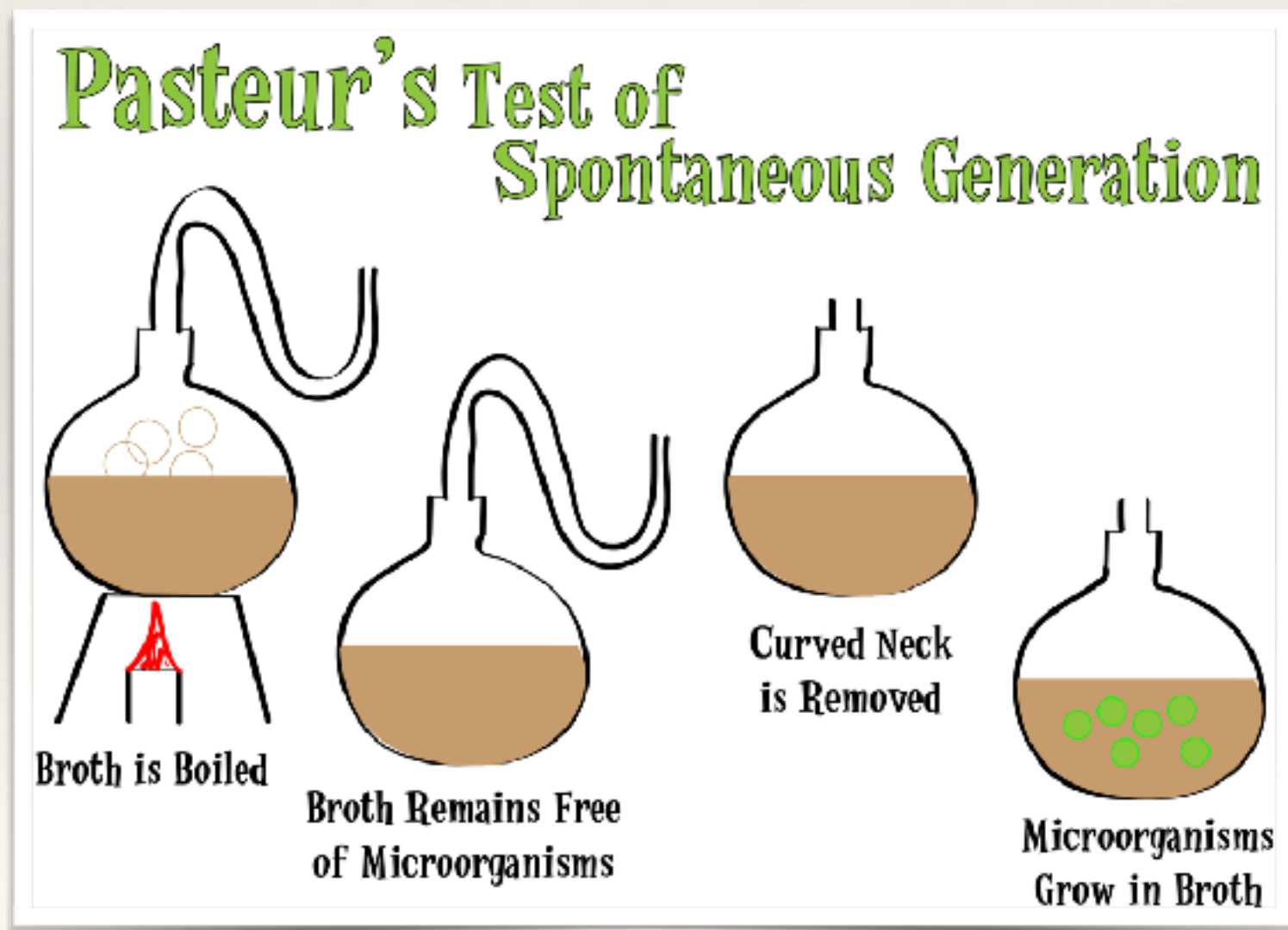


Lazzaro Spallanzani, 1729-99

- ❖ Italian priest who disproved spontaneous generation of microbes
- ❖ Sealed flask of sterilized meat did not produce microbes
- ❖ Critics argued that his experiment did not contain air, so results weren't valid

Louis Pasteur, 1822-95

- ❖ Took Spallanzani's results one step further: Boiled broth then placed in swan necked flasks
- ❖ Flasks allowed air in, but no microbes



John Tyndall 1820-1893

- ❖ Demonstrated that dust carries microbes.
 - ❖ Showed that if dust was absent, broth remains sterile even if directly exposed to air.
- ❖ Also provided evidence for heat-resistant forms of bacteria.
 - ❖ When he did Pasteur's experiment, he sometimes had growth.
 - ❖ Discovered that some organic matter can contain heat-resistant **spores**



Role of Microbiology in Disease

Golden Age of Microbiology (1857-1914)

- ❖ Many disease-cause microbes were discovered
- ❖ Microbial metabolism studies conducted
- ❖ Techniques refined
- ❖ Led to a better understanding of the role of immunity and ways to control and prevent infections by microbes

Aseptic Technique

- ❖ Dr. Oliver Wendell Holmes observed that mothers had fewer infections if they gave birth at home
- ❖ Dr. Semmelweis found that women became infected by physicians coming from the autopsy room!
- ❖ Lister noticed and came up with **aseptic techniques**

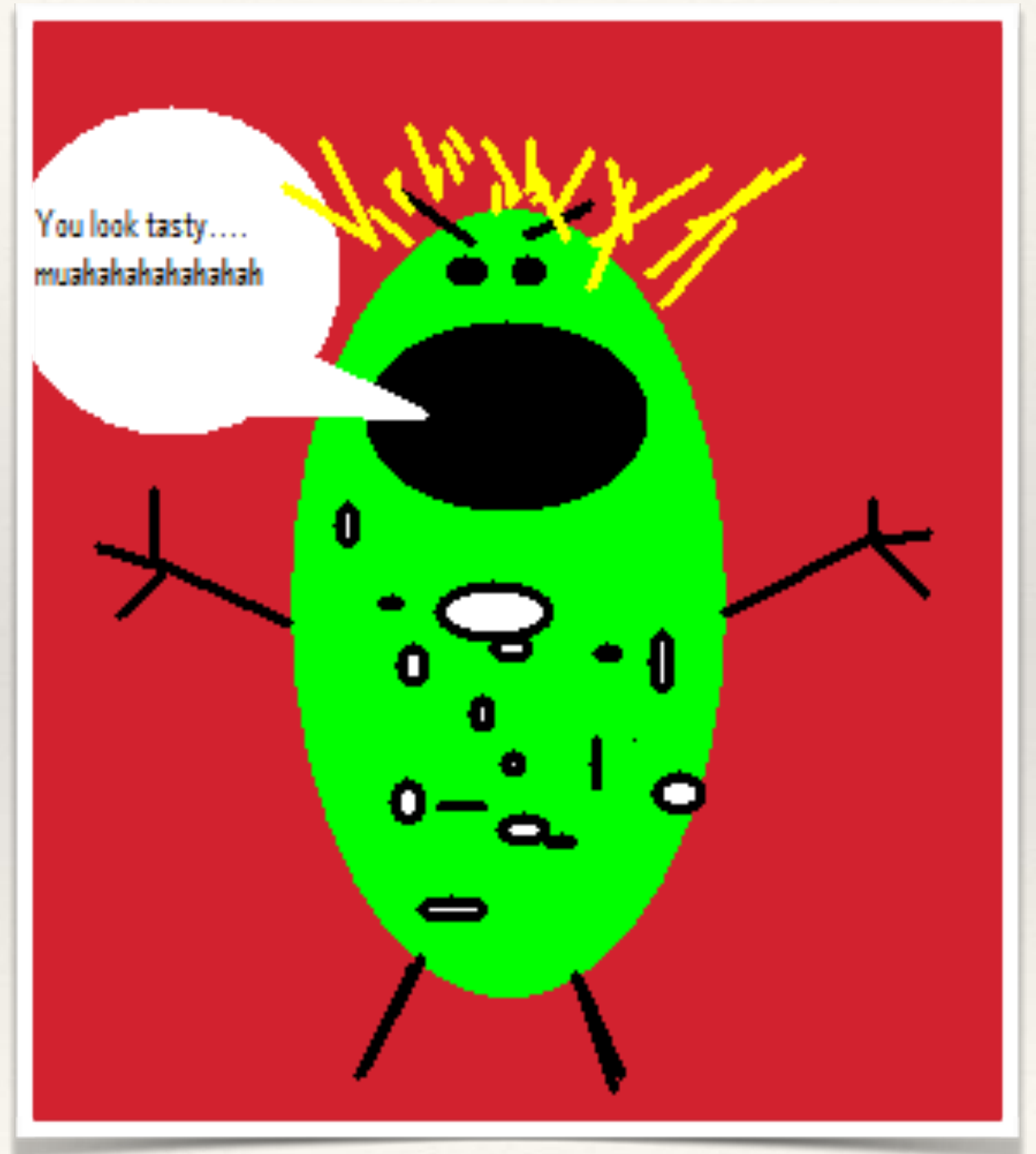
Joseph Lister

- ❖ Aseptic Technique
 - ❖ actually cleaned his hands
 - ❖ began cleaning wounds after surgery
 - ❖ Used antibacterial bandages



Robert Koch

- ❖ Germ Theory of Disease - simply: microbes cause disease
- ❖ Robert Koch came up with a series of proofs that verified the germ theory
- ❖ We still use this method to identify pathogens



Koch's Postulates

Koch's Postulates

Evidence required to establish etiologic relationship between microorganism and disease:

1. Microorganism must be observed in every case of the disease
2. It must be isolated and grown in pure culture
3. The pure culture, when inoculated in animals, must reproduce the disease
4. Microorganism must be recovered from the diseased animal

