

# **Introduction to Microbiology**

## Lecture 3

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# Objectives

By the end of this lecture the students will be able to:-

i) Classification

ii) **Nomenclature**

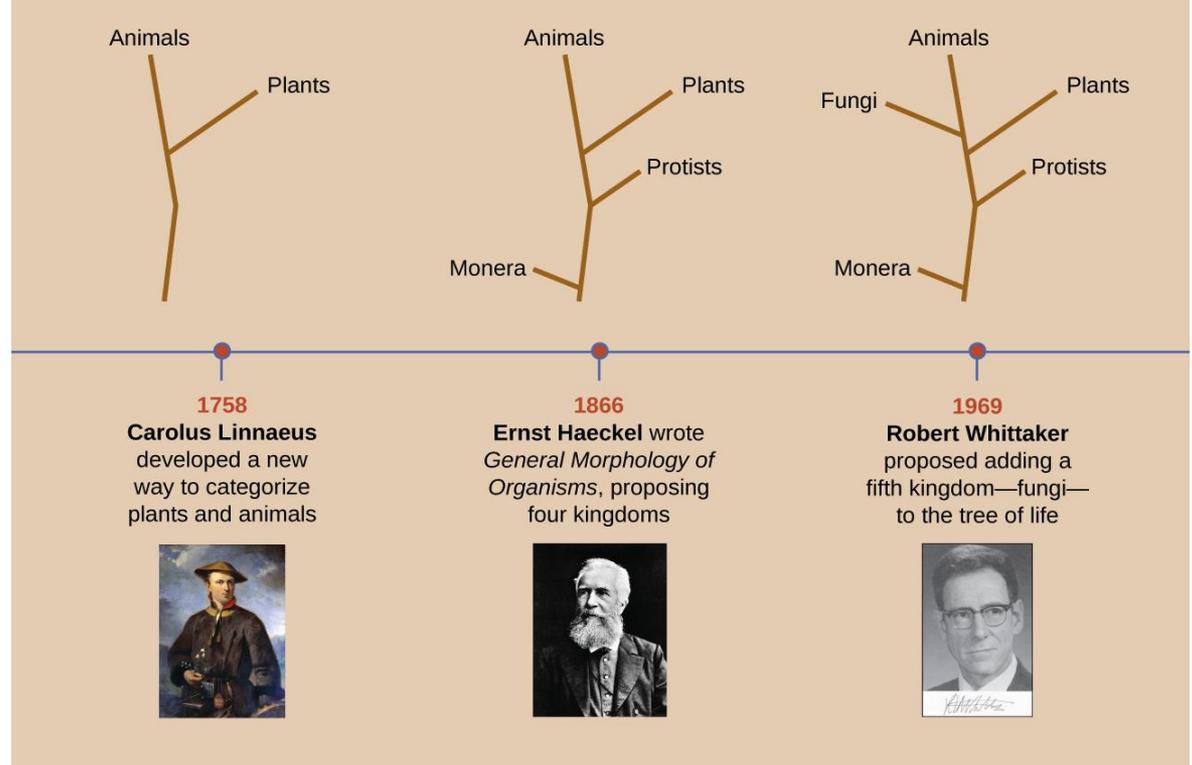
A) Eukaryotic

B) Prokaryotic

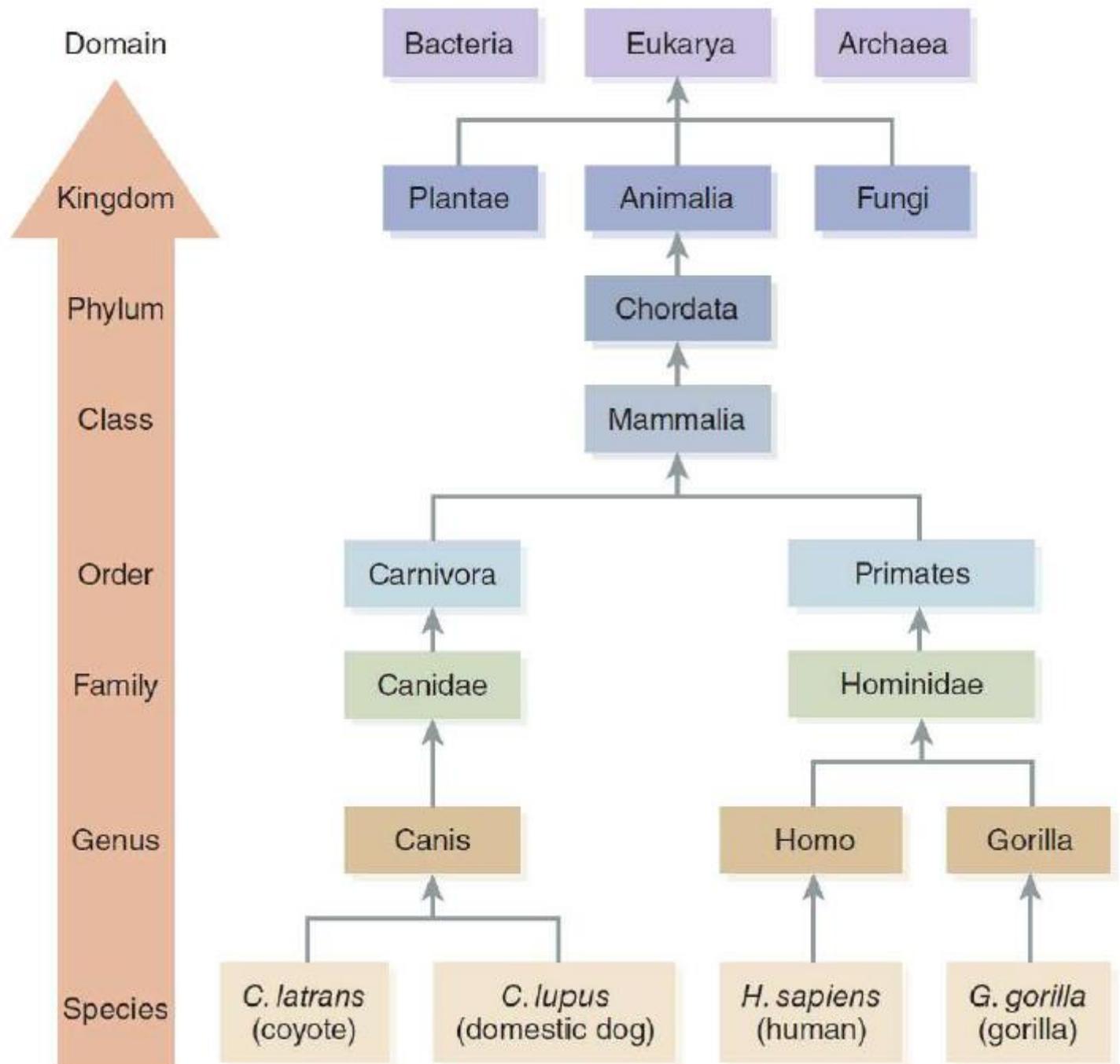
C) Viruses



# Taxonomy



- **Taxonomy:** organizing, classifying, and naming living things
  - Formal system originated by **Carolus Linnaeus** (1758)
  - His Book *Systema Naturae*
- Concerned with:
  - **Classification** – orderly arrangement of organisms into groups: : **Domain, kingdom, phylum, class, order, family, genus, species.**
  - **Nomenclature** – assigning names
  - **Identification** – determining and recording traits of organisms for placement into taxonomic schemes



# Phylogenetic vs. Phenetic Classification Systems

## Phylogenetic Classification System:

- Groups reflect genetic similarity and evolutionary relatedness.

## Phenetic Classification System:

- Classify organisms based on overall similarity, usually with respect to morphology or other observable traits, regardless of their phylogeny or evolutionary relation

**Modern taxonomy** based on genetic sequence information  
(Molecular biology)

# Phylogeny The Three Domain System

## The Tree of Life (TOL)

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**Domain:** In 1978 Carl Woese proposed this level of classification **above kingdom**.

There are three domains based on the following distinguishing criteria:

- ◆ Cell wall composition
- ◆ Membrane lipids
- ◆ RNA sequence
- ◆ Protein synthesis
- ◆ Antibiotic sensitivity

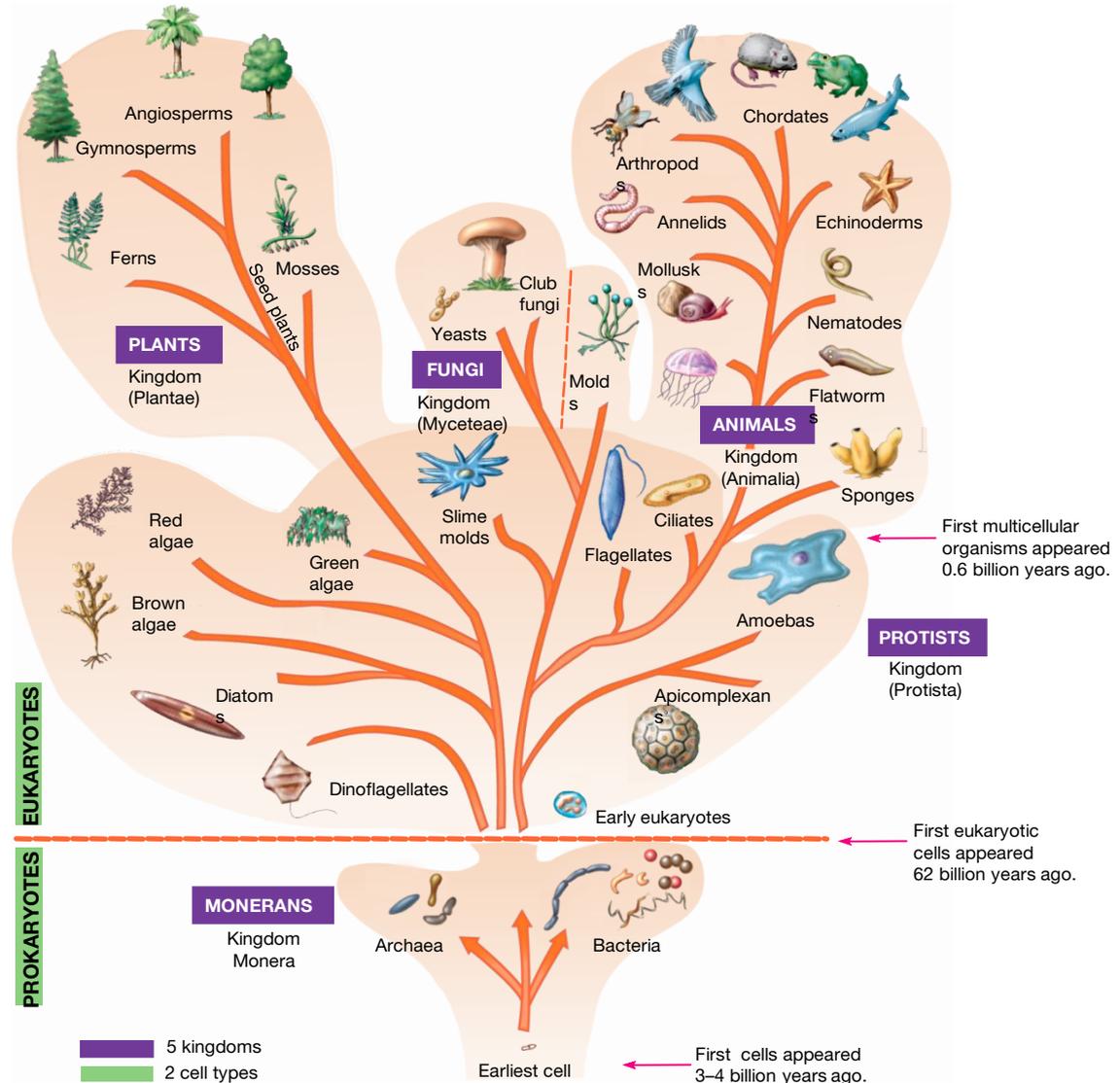
**I. Domain Eubacteria:** “True bacteria”.

**II. Domain Archaeobacteria:** “Ancient bacteria”

**III. Domain Eukarya:** All eucaryotes: **Protista, Fungi, Plantae, and Animalia.**

# Three Domains of Life

- **Bacteria** - true bacteria
- **Archaea** - odd bacteria that live in extreme environments, high salt, heat, etc.
- **Eukarya** - have a nucleus and organelles



## The Microbial Groups based on cell types

- ✓ Beside the remarkable unity of characteristics, the cells of all organisms are of two differing types:
  - ❖ **Prokaryotic** (pro = “before”; karyo = “nucleus”)
    - Have their genetic information in the form of DNA, but it is not localized within nucleus.
    - They also lack most of the specialize internal cell structures.
  - ❖ **Eukaryotic** (eu = “true”)
    - Have a distinct cell nucleus and numerous specialized internal structures called **organelles**

# Assigning Specific Names

- Binomial (scientific) nomenclature
- Gives each microbe 2 names:
  - **Genus (plural:genera)** - capitalized
  - **species** - lowercase

Exp. *Alqaraleh samer* or Alqaraleh samer
- Both italicized or underlined
  - *Staphylococcus aureus* (*S. aureus*)

## How did the organisms get those names?

### ❖ Species Named After **Individuals** and **Location**

#### **Exp1: *Escherichia coli*:**

- Named after Theodore Escherich, who isolated the bacterial cells from infant feces.
- It commonly is found in the colon, thus its presence in feces.

#### **Exp2: *Salmonella enterica*:**

- Named after David Salmon, who studied the bacterium.
- The organism affects the digestive (**enteric**) system.

❖ **Species Named for a Microbe's Shape, Disease, Attributes of the Microbe**

**Exp1: *Vibrio cholerae*:**

- ***Vibrio*** means “comma shaped,” which describes the **shape** of the bacterial cells that cause the **disease called cholera**.

**Exp2: *Staphylococcus epidermidis*:**

- ***Staphylo*** means “cluster” and *coccus* means “spheres,” so these bacterial cells form **clusters of spheres** that are found on the **skin surface (epidermis)**.

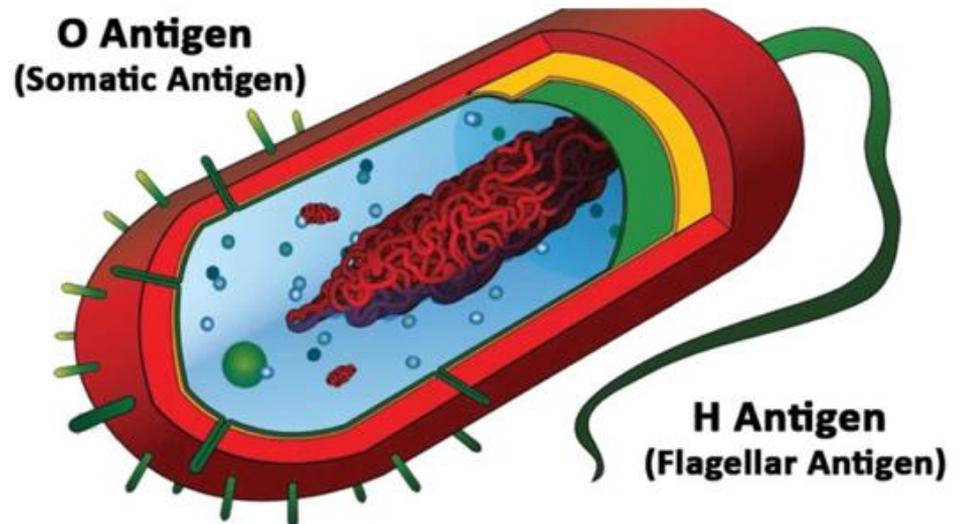
**Exp3: *Saccharomyces cerevisiae*:**

- Theodor Schwann observed yeast cells and called them ***Saccharomyces*** (saccharo = “sugar”; myce = “fungus”) because the yeast converts grape juice (sugar) into alcohol; ***cerevisiae*** (cerevisia = “beer”) refers to the use of yeast since ancient times to make beer.

- ❖ Within one microbial species there are several types that have different infection or disease properties. These are assigned a **strain** name.

**Exp1: *E.coli* O157: H7** is a foodborne strain that can cause serious urinary tract infections. **O157:H7** called **subspecies**

- The "**O**" and "**H**" refer to **antigens** (molecules that can trigger immune responses)
- This bacterium has the **O157** type of **cell wall antigen** and the **H7** type of **flagellar antigen**.



## ❖ “Species” vs. “Strain”

❖ **Species**: A specific or defined type of organism, defined by similarity with known species.

*Escherichia coli* (E. coli) is another example of a bacterial species.

❖ **Strain**: Genetic variation within a species.

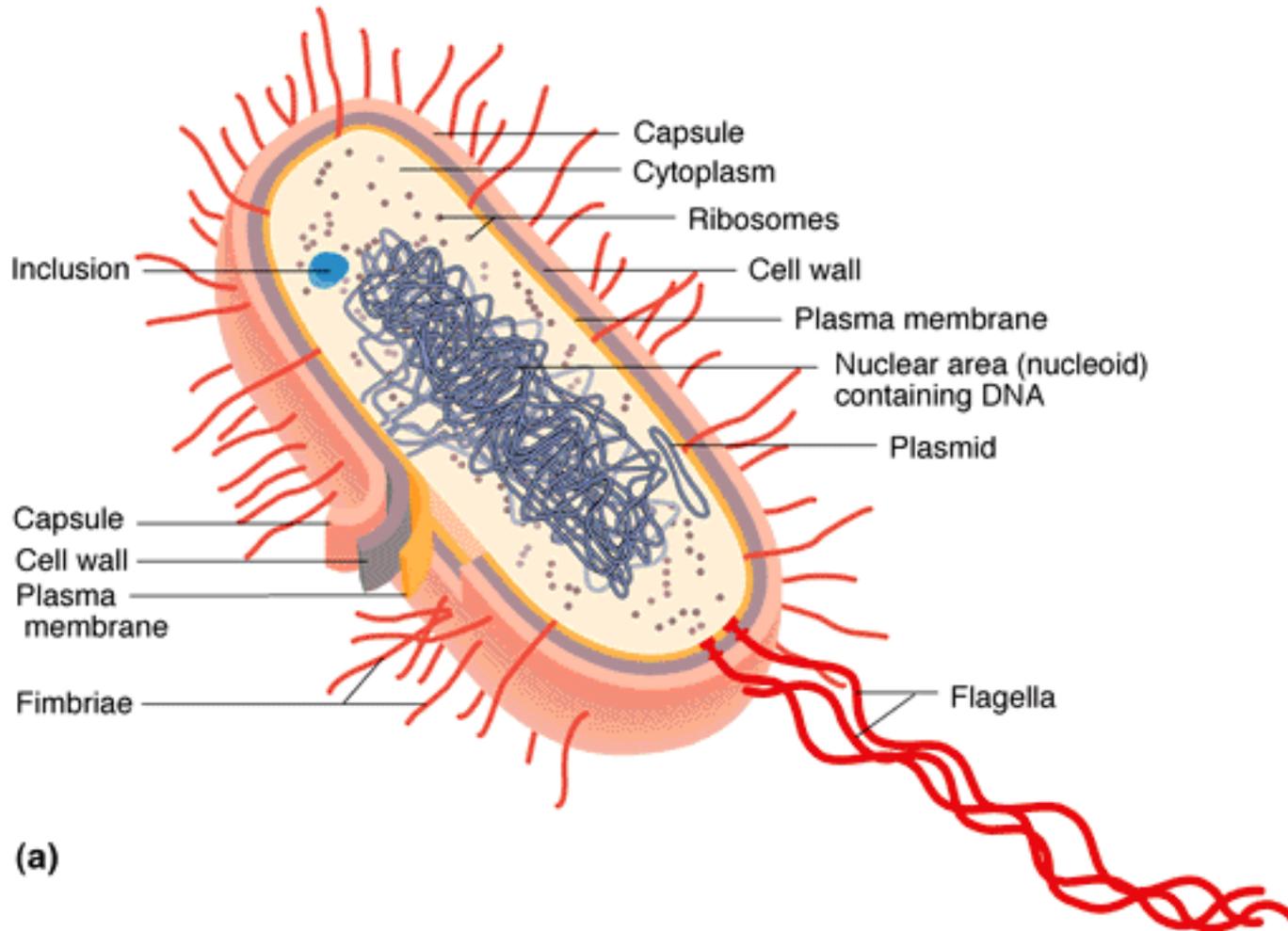
***E. coli* strains**: Some strains of *E. coli* can be beneficial probiotics in the human gut, while others are pathogenic and can cause disease.

# Differences Between Eukaryotic and Prokaryotic Cells

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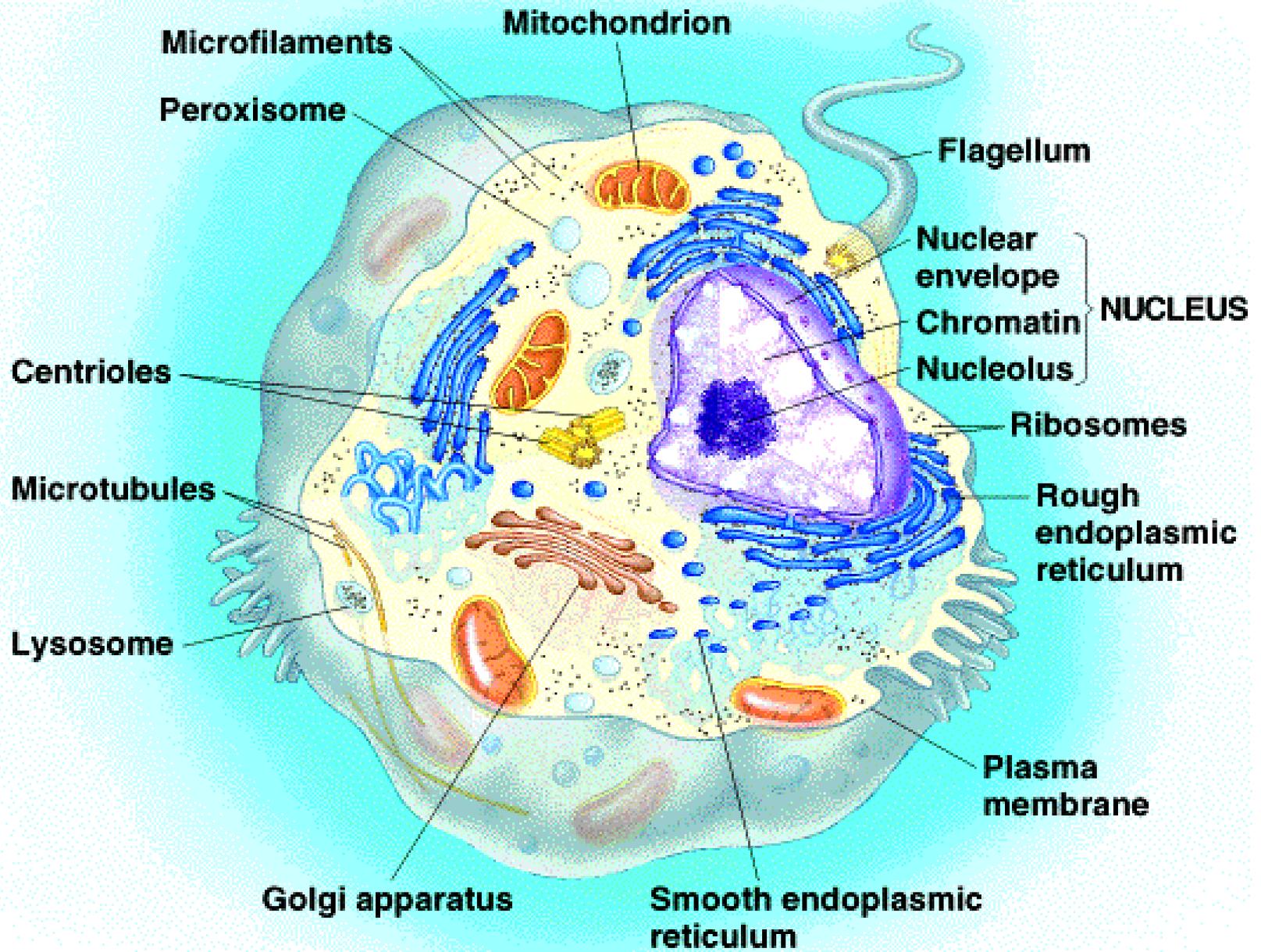
	<u>Prokaryotes</u>	<u>Eukaryotes</u>
<b>Cell size</b>	0.2-2 um in diameter	10-100 um in diameter
<b>Nucleus</b>	Absent	Present
<b>Membranous organelles</b>	Absent	Present
<b>Cell Wall</b>	Chemically complex	When present, simple
<b>Ribosome</b>	Smaller (70S)	Larger (80S) in cell 70S in organelles
<b>DNA</b>	Single circular chromosome	Multiple linear chromosomes (histones)
<b>Cell Division</b>	Binary fission	Mitosis or Meiosis
<b>Respiration</b>	Plasma membrane	Mitochondria

# Prokaryotes: Lack Nucleus and Membrane-Bound Organelles



(a)

Figure 7.7 An animal cell



# Phylogeny: Prokaryotic Domain System

Recent developments in molecular biology and biochemistry have revealed that there are **two types of prokaryotic cells**, based on differences in their **ribosomes, cell walls, and metabolism**.

## 1. Eubacteria: “True bacteria”.

- ◆ Cell wall contains peptidoglycan.
- ◆ Sensitive to antibiotics.

## 2. Archaeobacteria: “Ancient bacteria”

- ◆ Cell walls lack peptidoglycan, resistant to antibiotics.
- ◆ Live in extreme environments
- ◆ Three kingdoms:

**1. Methanogens**: Strict anaerobes that produce methane.

**2. Extreme Halophiles**: Require high salt concentrations.

**3. Thermoacidophiles**: Live in hot, acidic environments.

# Classification of Viruses

## Viruses, Viroids, Prions

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Viruses are not considered living organisms by most biologists, because they lack cells and their own anabolic machinery.

- ◆ Obligate intracellular parasites.
- ◆ Must have evolved after their host cell evolved.
- ◆ Infectious units
- ◆ **Viral species:** Population of viruses with similar characteristics that occupies a particular ecological niche.
  - ◆ Morphology
  - ◆ Genes
  - ◆ Enzymes