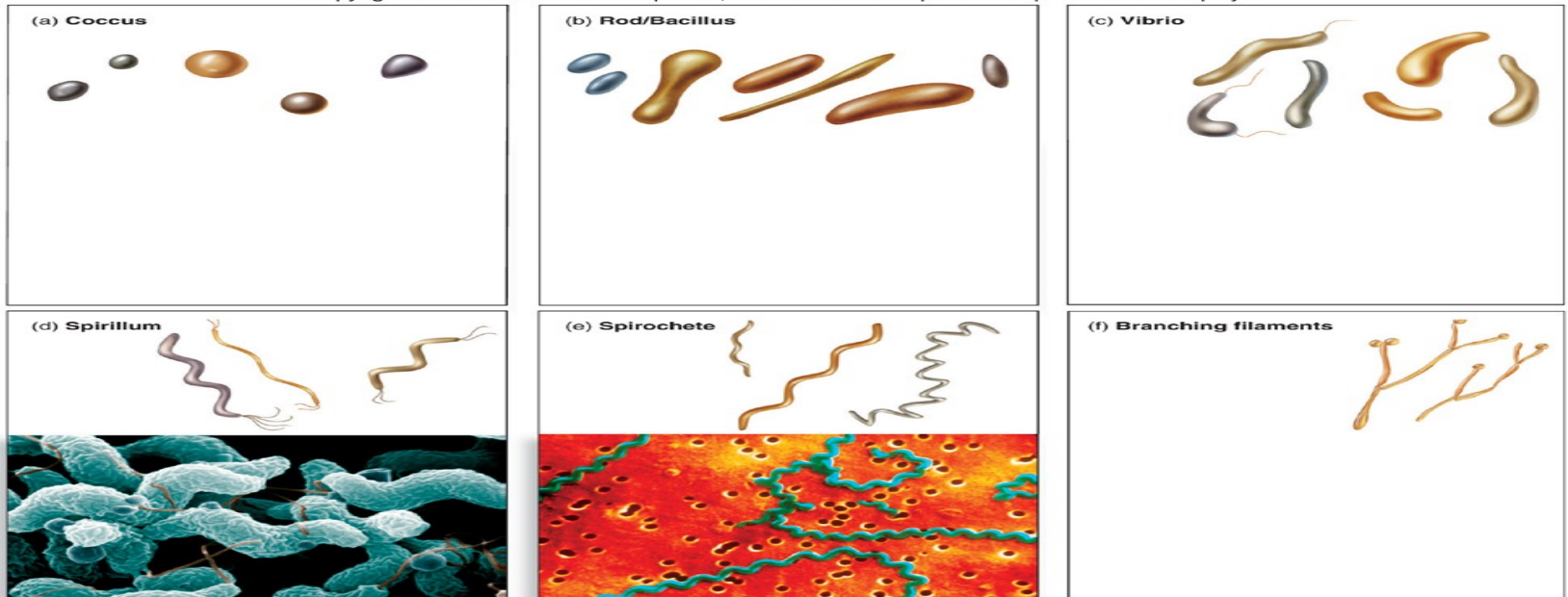


Bacterial Classification and Nomenclature

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Key to Micrographs

(a) *Deinococcus* (2,000×) (b) *Lactobacillus bulgaricus* (5,000×) (c) *Vibrio cholerae* (13,000×) (d) *Aquaspirillum* (7,500×)
(e) Spirochetes on a filter (14,000×) (f) *Streptomyces* (1,500×)

© Photo by De Wood. Digital colorization by Chris Pooley. VEM/Photo Researchers

Bacterial classification

- it is important to organize microorganisms in systematic way with logical relationship
- Bacteria are classified and identified
 - to distinguish one organism from another and
 - to group similar organisms by criteria of interest to microbiologists or other scientists
- Bacterial cell can be classified based on
 - 1. Phenotypic classification
 - 2. Analytical classification
 - 3 .Genotypic classification

Bacterial classification

1. Phenotypic classification

- based on microscopic and macroscopic morphology of the bacterial cell
- Corner stone for classification
 - ✓ **Microscopic morphology** (G+,G-,Cocci, rods, curved and spiral)
 - ✓ **Macroscopic appearance of colony bacteria** (hemolytic rxn ,pigmentation, shape &size of colony, odour of colony)
 - ✓ **Biotyping** (fermentation of CHO, specific protease, lipases, nucleases)
 - ✓ **Antibiogram pattern** (susceptibility to antibiotics)
 - ✓ **Phage** typing

Phenotypic Characteristics

➤ Morphologic Characteristics

- Gram reaction of the organism;
- acid-fast staining ;
- its motility; the arrangement of its flagella;
- the presence of spores, capsules,
- its shape.

■ Antigens and Phage Susceptibility

- Cell wall (O),
- flagellar (H), and capsular
- Phage typing

■ Growth Characteristics

- O₂ requirement
- pH
- Temperature
- Nutrient

■ Biochemical Characteristics

- CHO fermentation
- Nitrate reduction
- aa degrading enzyme

Bacterial classification

2. Analytical classification

- used to classify bacteria **at genus ,species and subspecies level**
- Based on different composition of the cell
 - ✓ **Cell wall fatty acid** analysis
 - ✓ **Whole cell lipid** analysis
 - ✓ Multifocus **enzymatic electrophoresis**
- Accurate but expensive

Classification of bacteria...

3. Genotypic classification

- Most accurate method which based on genetic material analysis
 - **Guanine plus cytosine ratio**
 - **DNA hybridization**
 - **Nucleic acid sequence analysis**
 - **Plasmid**
 - **Chromosomal DNA fragment analysis**

Classification below Species Level

- Particularly for epidemiological purposes
- For example, serotype **O157:H7 *E coli*** are identified in stool specimens because of their association with bloody diarrhea and subsequent hemolytic uremic syndrome.
- Below the species level, strains are designated as groups or types on the basis of common
 - serologic or biochemical reactions,
 - phage or bacteriocin sensitivity,
 - pathogenicity, or other characteristics

Binomial Nomenclature

- ***Bergy's Manual of Determinative Bacteriology***
- Bacteria are named according to the **binomial system** of nomenclature devised by **Linnaeus** in 1753.
- This system of scientific naming uses two names for every organism; ***genus and species***,
- Each distinct kind of bacterium is recognized as a species.
- So, according to the binomial system of classification, each species is given a two word name.
- The first word is a genus, the second a species.
- the genus and species names tell a great deal about the organism.
- Only the genus name is capitalized.
 - Genus =staphylococcus, species= aureus
- *Staphylococcus aureus* or *S. aureus*

Bacterial classification

- Based on the organization of their cellular structures, all living cells can be divided into two groups:

- ☐ eukaryotic and
- ☐ prokaryotic

- **Eukaryotic cells.**

- ☐ (Eu- means true)
- ☐ (Karyote- means nucleus)
- ☐ The Eukaryotic cell is more complex
- ☐ has membrane bound nucleus,
- ☐ many organelles.

Eukaryotes include

- protozoa,
- fungi,
- algae, (green, brown and red algae) and
- plant and animal cells.

C

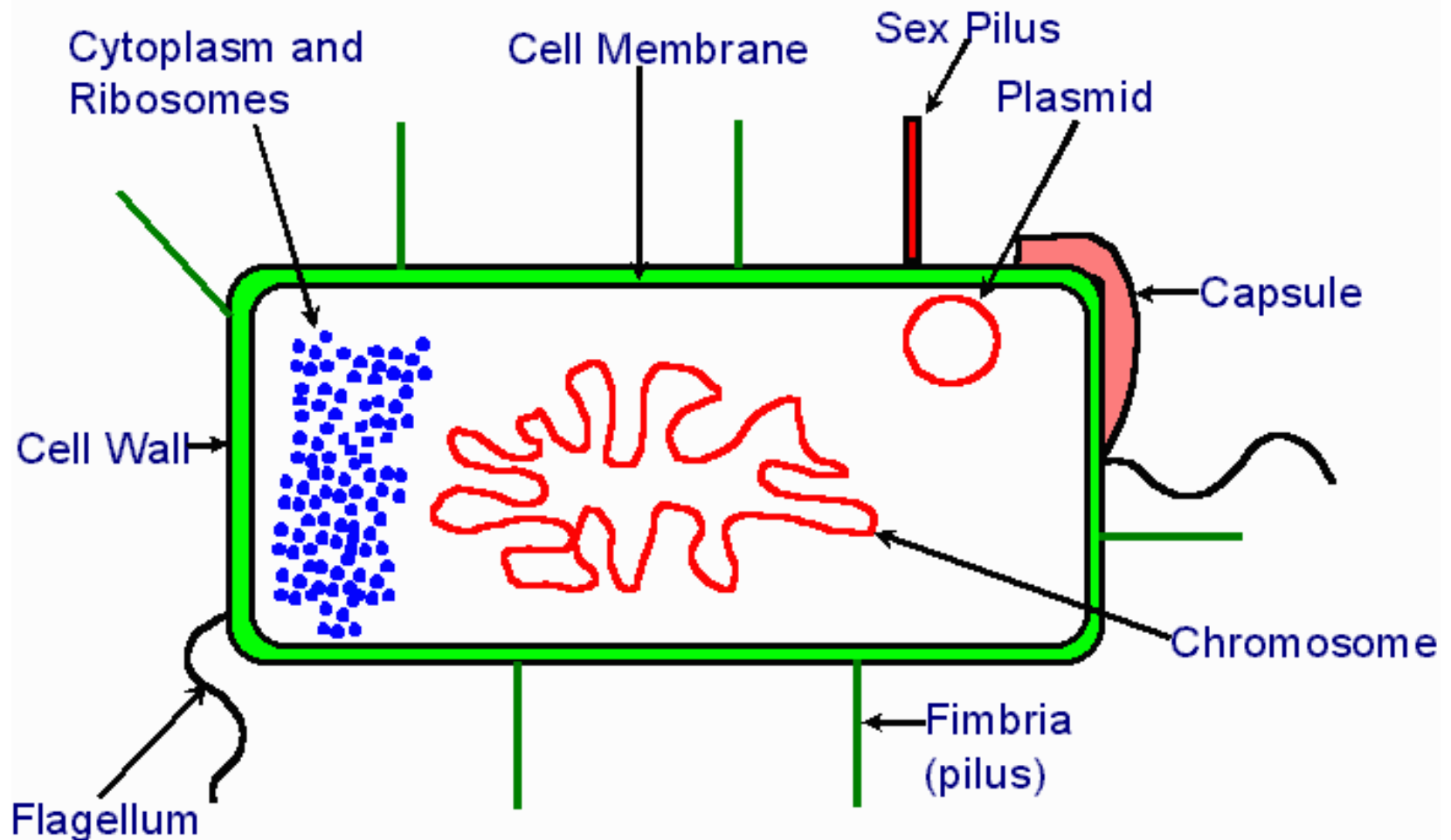
A detailed cross-section diagram of a eukaryotic cell. The cell is bounded by a plasma membrane (1) and contains various organelles. The nucleus (2) is a large, spherical structure with a nucleolus (1) inside. The endoplasmic reticulum (3) is a network of membranes, with rough ER (4) studded with ribosomes (5) and smooth ER (6) without. Mitochondria (7) are bean-shaped with internal folds (cristae). Golgi apparatus (8) is a stack of flattened sacs. Lysosomes (9) are small, spherical vesicles. Peroxisomes (10) are smaller, spherical organelles. Centrioles (11) are cylindrical structures. The cytoskeleton (12) is a network of fibers. The cell wall (13) is the outermost layer. The cytoplasm (14) is the fluid-filled space. The vacuole (15) is a large, clear space. The chloroplast (16) is a green, oval-shaped organelle with internal stacks of thylakoids. The flagellum (17) is a long, whip-like structure. The cilia (18) are short, hair-like structures. The microvilli (19) are small, finger-like projections. The cell is shown in a 3D perspective.

07.09.08

Prokaryotic Cells

- Prokaryotic cell
 - (**Pro** -means **primitive**)
 - (**Karyote** - means nucleus)
- Prokaryotic cells are less complex cells.
- Which posses naked (unbound) DNA without associated basic proteins, they divide by binary fission are bounded by a semi rigid cell wall.
- they lack a true nucleus and don't have membrane bound organelles like mitochondria
 - *bacteria*
 - *cyanobacteria (blue- green algae)*

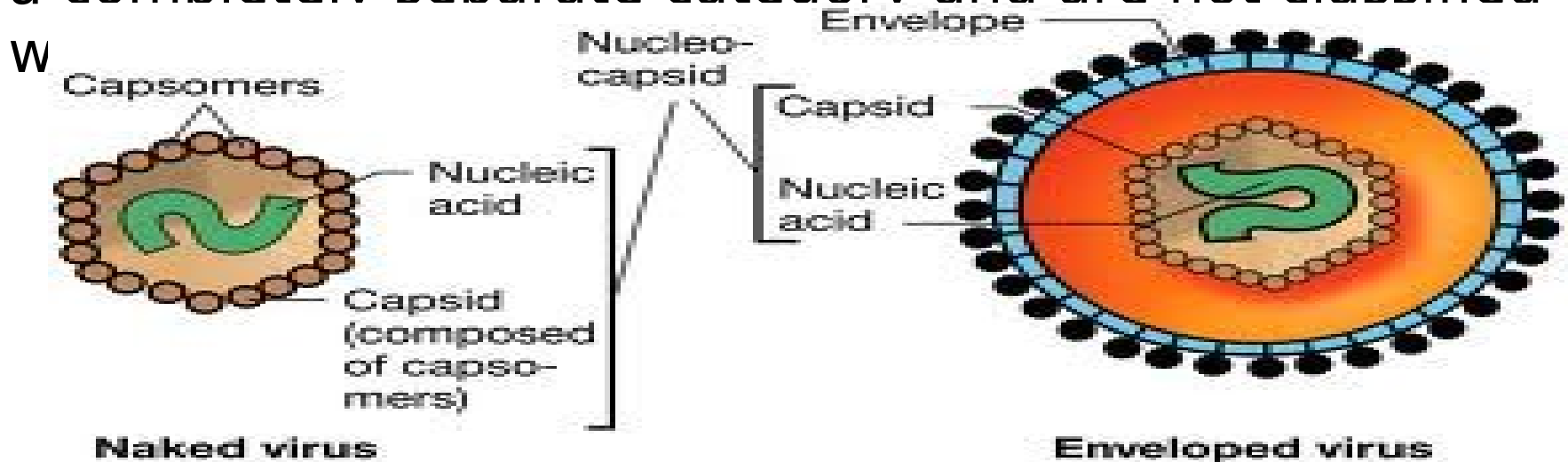
Bacterial structure



Characteristic	Eukaryote(>5u m)	Prokaryote(.05- 3.0um)
Major groups	Algae, fungi, animals, plants, prot-ozoa	bacteria
Nucleus	Bounded by membrane	No nuclear membrane
Chromosome	Strand of DNA Diploid genome	Single, circular DNA Haploid
Mitochondria	Present	Absent
Golgi bodies	Present	Absent
Ribosome	80s	70s
Respiration membrane	via mitochondria	cytoplasmic
Cytoplasmic membrane	Contain sterols	No sterols
Cell wall present	absent except fungi	and plant

Viruses:

- are composed of only a few genes protected by a protein coat,
- a few enzymes and little other material and depend on the energy and metabolic machinery of the host cell to live and reproduce.
- are not truly viable cells, they are usually, placed in a completely separate category and are not classified



Classification of bacteria -

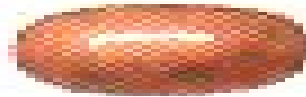
Morphologic

Morphology and arrangement of bacterial cells are criteria used for classification of bacteria into following groups:

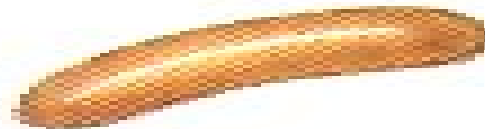
1. Cocci (Singular: coccus).
2. Rods (bacilli), (Singular: rod, bacillus).
3. Vibrios (Singular: vibrio).
4. Spirilla (singular :Spirillum)
5. Spirochetes. (Singular: Spirochaete).



Coccus



Coccobacillus



Vibrio



Bacillus



Spirillum



Spirochete

Classification based upon staining

Gram Positive vs Gram Negative

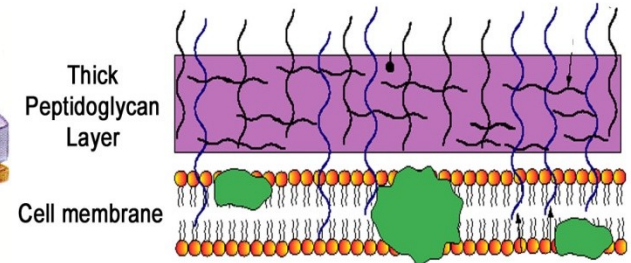
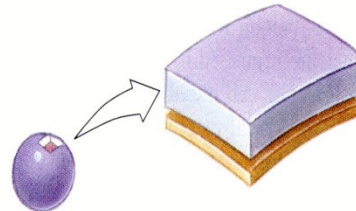
Hans Christian Gram -- 1884

-- Crystal violet

Gram positive structure

-- thick layer of **peptidoglycan**

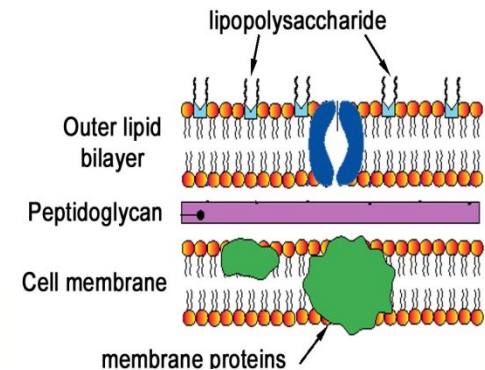
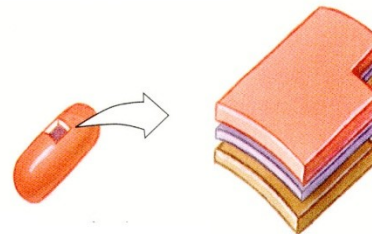
Gram-positive cells



Gram negative structure

-- inner vs outer membranes
-- lipopolysaccharides and endotoxins

Gram-negative cells



Acid fast staining

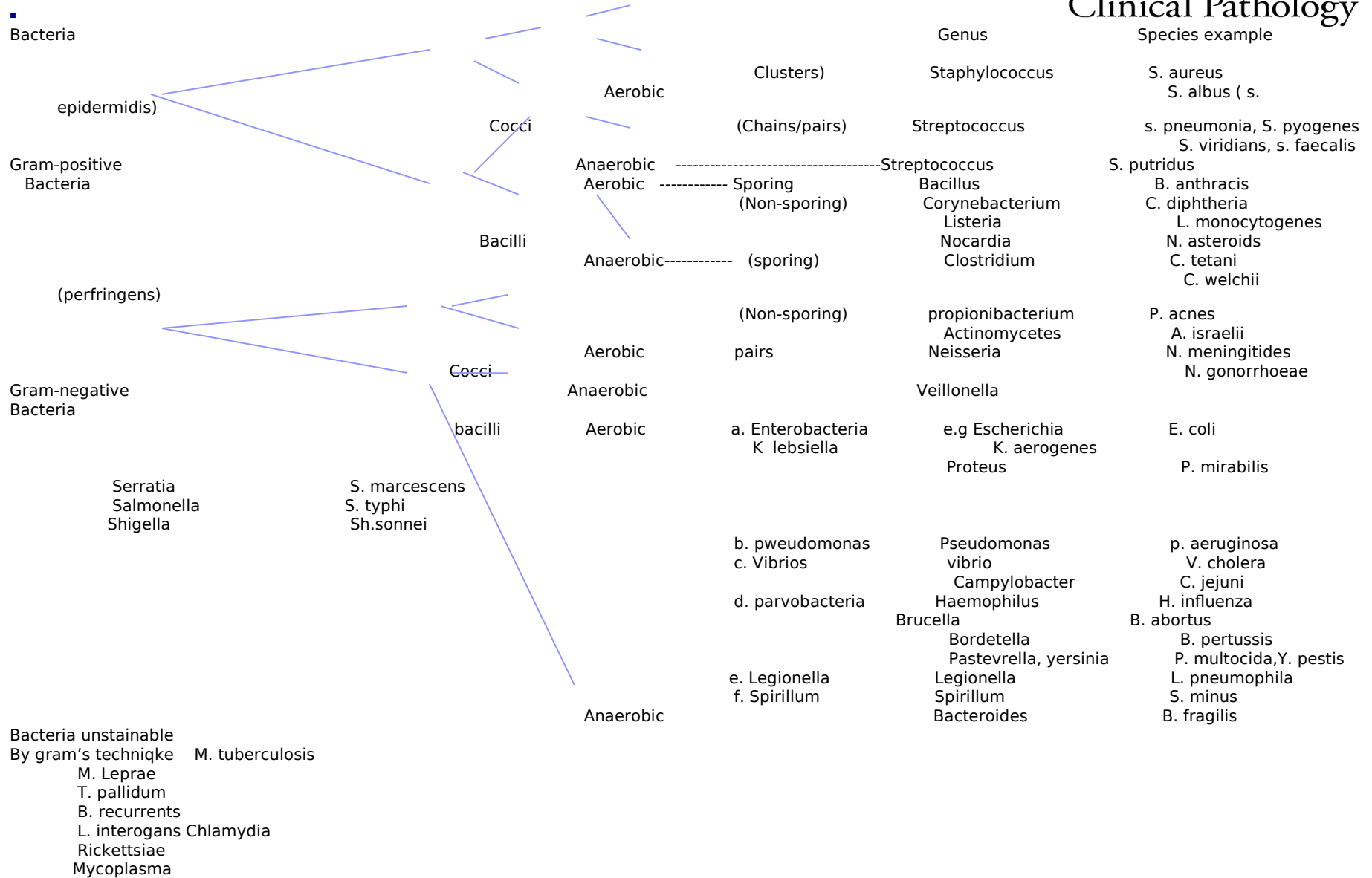
-- *Mycobacterium*

Penicillin
action

Effect of penicillin



American Society for Clinical Pathology



Any Last questions ???

