# UNICELLS AND EVEN SMALLER BIOTAXA—
## THE BASICS ABOUT THE BASICS

### VIRUSES

1. Melnick and Parker (1982) include with Monera in Superkingdom (Domain) Prokaryota
2. Size ranges between 20 to 300 nanometers
3. Either RNA or DNA
4. May be encapsulated with a proteinaceous membrane
5. Grouped by structure
    - Helical symmetry
    - Cubic symmetry
    - Complex structures
6. International Committee on Taxonomy of Viruses
7. 47 families, grouped by host type
8. Probably polyphyletic, more related to hosts than to each other

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## MONERA (PROCARYOTA)--DOMAIN OR SUPERKINGDOM

1. Coccoidal, bacilliform, filamentous
2. Lack organelles, typically smaller than Eukaryota
3. Single loop-like chromosome
4. Absorptive nutrition (both heterotrophic and autotrophic)
5. Anaerobic and aerobic metabolism
6. Reproduce through both asexual fission and gene-streaming
7. movement (when present, is either motile gliding or flagellate)
8. habit is either solitary, filamentous, or colonial
9. Systematics based on simple morphology and biochemistry, somewhat confusing
10. 16 phyla proposed by Margulis and Schlatz (1982)
11. Classically grouped by behaviour, which is a reflection of their biochemistry

### Two kingdoms

#### *ARCHAEBACTERIA*

1. First recognized in last score
2. Taxonomy through molecular sequencing 16S rRNA (i.e. Ribosomal RNA)
    - Recognition of 400 species in 1987
    - Difference between Archaebacteria and Eubacteria as great as difference between Eubacteria and Eukaryota (Lipps, 1987; Stackenbrandt and Woese, 1984)
3. Three principal groups of archaebacteria
    - **METHANOGENIC OR METHANOCREATICES**--similar to fossils from Warawoona Cherts (3.5 Ga), Anaerobic chemotrophs
    - **HALOPHILES**--similar to fossils from Warawoona Cherts (3.5 Ga)
    - **THERMOACIDOPHILIC (THERMOPLASMS)--**sulfur-metabolizing and sulfate-reducing (found around hydrothermal vents)

#### *EUBACTERIA*

1. Divisible into ten groups based on 16S rRNA molecular sequencing
    - **MYCOPLASMS** (wall-less)
    - **SPIROCHETES**
    - **ANAEROBIC SULFATE OR SULFUR-REDUCING**
    - **CYANOBACTERIA**
    - **NITROGEN-FIXING AEROBES**, Pseudomonads, found in soils

- **OMNIBACTERIA**
  - aerobic heterotrophs
  - coliforms
  - enteroforms
- **CHEMOAUTOTROPHIC**
  - nitrobacteria
  - aerobic
    - sulfur-oxidizing
    - ammonia-oxidizing
    - iron-oxidizing

***Stromatolites***

1. Laminated accretionary organo-sedimentary structures
2. Formed from benthic mat-building mucilage-secreting, primarily filamentous photo- or chemoautotrophs
3. Include stratiform, columnar, spheroidal (oncolitic), thrombolitic (clotted fabrics) forms
4. Essentially microbial reefs
5. Genus=group and species=form
   - e.g. *Conophyton gaubitza*
   - *Conophyton* recognized by gross external morphology, *gaubitza* recognized through internal laminae shape, form, microscopic fabric, anmd structure
   - e.g. *Stratifera* sp. = stratiform
   - e.g. *Gymnosolen* (conical columnar, unbranched)
   - e.g. *Collenella* (domical columnar)
   - e.g. *Osagia* (spheroidal)
   - e.g. *Baicalia* (branching)
   - e.g. *Jacutophyton*

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# Superkingdom Eukaryota

1. Chromosomal organization, >1 per cell
2. Organelles, membrane-bound nuclei

## KINGDOM PROTOCTISTA: SINGLE-CELLED EUKARYOTA

- "Acellular" (not loose cells, but complete, complicated organisms
- Aminalcules of Leuwanhoek (1676)
- first named taxon is *Chaos* Linne, 1767 [*Ameoba* Ehrenberg 1830 = *Chaos* Linne 1767]

### A PLACE TO CALL HOME…

1676, Aminalcules, Anton Van Leuwanhoek
1767, Chaos, Linne
1830, Ameoba, Ehrenberg, (junior subjective synonym to Chaos)
1830, Amoebida, Ehrenberg, class of animalia
1845, Rhizopoda, von Siebold
1845, Protozoa, von Siebold, four classes = flagellata, rhizopoda, ciliata, sporozoa
1860, Protoctista, Hogg, includes single celled algae and protozoa, multicellular red and brown algae, and some fungi (acellular, not "loose" cells but complete complicated organisms)
1861, Lobosia, Carpenter
1866, Protista, Haeckel for single-celled organisms
1871, Sarcodina, Schmarde (with pseudopodia)

## Protozoa vs. Protista vs. Protoctista

*Protozoa* von Siebold 1845
- included four classes: Flagellata, Rhizopoda, Ciliata, Sporozoa

*Protoctista* Hogg 1860
- included all single cell algae and protozoa, multicellular red and brown algae, and fungii.

*Protista* Haeckel 1866
- included all single celled organisms

## General History

- 1.4 Ga = Origin (algal eukaryotoid & acritarchs)
  - theoretical origins
  - invagination of cell membranes of prokaryotes (e.g. endoplasmic reticulum)
  - endosymbiosis. (similarity of 16s rRNA of both chloroplasts and cyanobacteria)
  - perhaps result from invasion of planktonic world (Awramik and Valentine, 1985)
  - perhaps benthic as naked unfossilized cells
- 900 Ma = (lorica [flasks] of either protozoa or algae)
- 540 Ma = (oldest true protozoa = forams; (Lipps 1980)

## KINGDOM FUNGI OR THE MYCOPHYTA

1. Dikaryotic
2. Haploid spores
3. Chitinous cell walls
4. Hyphae (root-like branches of cell wall)
5. Includes single-celled and multicellular forms
6. Groups of fungal hyphae form a mycellium (vegetative body of most fungii)
7. Includes molds, yeasts, mushrooms, symbiotic fungii
8. Mycetozoa (slime molds) often classified as protists
9. Heterotrophic, nutrient adsorptive (digest food outside cell walls and adsorb nutrients directly)

Several mushrooms walk into a steak house.
The maître d' gruffly starts to throw them out.
"We don't serve mushrooms here" he yammers as he shows them the door.
"Why not?" shouts one, "I'm a fun guy!"

# Origins of eukaryotes

1. Endosymbiosis
   - Evidence includes 16s rRNA of cyanobacteria and chloroplasts
   - Symbiosis between living eukaryotes.
2. Invagination of cell membrane of prokaryotes (e.g. endoplasmic reticulum)
3. Perhaps associated with first exploitation of planktonic regime (Awramik and Valentine, 1985)
4. Perhaps from benthic, naked unfossilized cells

## KINGDOM ANIMALIA

1. Heterotrophic
2. Multicellular, differentiated cells, usually tissue grade
3. Sperm + egg →zygote →diploid blastula
4. Ediacaran Biota?, 680-540 Ma
5. Subkingdoms = Parazoa and Eumetazoa

## KINGDOM PLANTAE

1. Photoautotrophic
2. Tissue grade
3. Spores →haploid →fertilization →diploid