KINGDOM MONERA -- BACTERIA

A. Classification
1. Hetertrophic Bacteria
   a. Eubacteria
   b. Actinomycetes (filamentous bacteria)
2. Autotrophic Bacteria
   a. Cyanobacteria (Blue Green Algae)
   b. Purple and Green Photosynthetic Bacteria
   c. Chemoautotrophic Bacteria

B. HETEROTROPHIC BACTERIA--General Characteristics
1. About 2000 species
2. Ubiquitous in distribution--everywhere!
   --in soil
   --several thousands of feet in air
   --in both fresh and salt water
3. Usually associated with diseases--many do cause diseases
4. Many are beneficial--major organisms of decay--recycling
5. Smallest living cells--0.1 - 60 u
6. Three major morphological shapes
   --spherical--**COCCUS**
   --rod--**BACILLUS**
   --spiral shape--**SPIRILLUM**
7. Because of small size and morphological simplicity, necessary to use physiological characters to study bacteria--especially THE KIND OF ENZYMES THEY PRODUCE:
   --digest starch? --use lactose?
   --turn acid to base? --turn base to acid?
   --produce gas? --how they stain?

C. ACTINOMYCETES--the filamentous bacteria
1. Natural occurring organisms in soil--very abundant
2. Orginally classified with fungi but because of prokaryotic nature considered to be bacteria
3. Differ from Eubacteria in that they are filamentous and produce external spores
4. Produce antibiotics that they secrete in soil to compete with other organisms for food source
5. Streptomyces is major genus. Most broad-spectrum antibiotics are obtained from species in this genus:

--streptomycin --aureomycin
--tetramycin

D. AUTOTROPHIC BACTERIA
--capable of fixing CO_2 into organic compounds
1. PHOTOSYNTHETIC BACTERIA
--use light as external energy source
a. CYANOBACTERIA (BLUE GREEN ALGAE)
--contain chlorophyll a
--photosynthesize much like eukaryotic cells
--discussed in more detail with algae
b. GREEN AND PURPLE PHOTOSYNTHETIC BACTERIA
--contain special chlorophyll--**bacteriochlorophyll**
--use light as energy source, but live in anaerobic conditions
--do not get H from H_2O but from H_2S or organic acids or alcohols
--usually occur in places that have lots of decaying vegetation
c. CHEMOAUTOTROPHIC BACTERIA
--instead of light as an energy source, obtain energy from oxidation of inorganic molecules: iron --iron oxide; sulphur --sulphur dioxide.
--one group produces methane from CO_2 and H_2
--from these processes they obtain energy to convert CO_2 into organic compounds

E. GENETIC RECOMBINATION IN BACTERIA
No sexual reproduction but some methods of DNA exchange occurs
1. CONJUGATION--temporary fusion of two bacteria cells during which special DNA fragment (not part of bacterial "chromosome") passes from one cell to another
a. fragment called **plasmid**
b. Plasmid becomes incorporated into DNA molecule of recipient bacterial cell.
c. Plasmids very important in genetic engineering to move genes of higher organisms around in higher organisms (good summarization in textbook, p. 194)

2. TRANSDUCTION--bacterial DNA moved from one bacterial cell to another by incorporation of a segment of the bacterial DNA into a virus and then transmitted to the second bacterial cell by the

virus.

3. TRANSFORMATION--bacteria cells killed, DNA extracted, placed in growing medium, other bacteria grown on medium pick up and incorporate some of the DNA from the medium into their cells

KINGDOM PROTISTA

A. THE ALGAE

1. Pigments in Algae--very important to understand the different groups of algae.
   a. **Chlorophyll**--several different kinds
      --Chlorophyll a, b, c, d, e
   b. **Carotenes** (several kinds)
   c. **Xanthophylls** (about 20 kinds)

--chlorophylls, carotenes, and xanthophylls are fat soluble--

   d. **Phycobilins**--water soluble pigments
      1. **phycoerythrins**--red pigments
      2. **phycocyanins**--blue pigments

2. Using kinds of pigments present, the algae may be separated into four informal groupings
   --the Blue Green Algae (Cyanobacteria) which are really prokaryotic Monerans will be included here because of their traditional and ecological association with "true" algae.

A. BLUE-GREEN GROUP--
includes only the Blue Green Algae (Cyanobacteria)

1. Pigments:
   chlorophyll a
   carotenes
   xanthophylls (18 kinds)
   phycobilins
      phycocyanin
      phycoerythrin

B. GREEN GROUP--
includes Green Algae, Euglenoids

1. Pigments:
   chlorophyll a, b
   carotenes
   xanthophylls

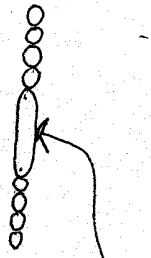
C. BROWN GROUP--
includes: Golden Algae, Yellow Green Algae, Dinoflagellates, Brown Algae

1. Pigments:
   chlorophyll a, c (or a, e)
   carotenes
   xanthophylls (**fucoxanthin**)

D. RED GROUP--
includes only the Red Algae

1. Pigments:
   chlorophyll a, (d ?)
   carotenes
   xanthophylls
   phycobilins
      phycoerythrin
      phycocyanin

1. BLUE GREEN ALGAE (CYANOPHYTA)
   a. Cell wall-polysaccharide amino acid complex--
      --no cellulose
   b. Reserve food--cyanophycean starch (glycogen)
   c. General characteristics:
      --no locomotion--except gliding motion
      --no sexual reproduction
   d. Distribution
      --fresh and salt water
      --in soil (> 1 meter)
      --hot springs (80° C)
      --base of glaciers (0° C)
      --hair of two-toed sloth
      --roots of water ferns and cycads (nitrogen fixers)
   e. Nitrogen fixation--some b.g's can fix atmospheric nitrogen
      --filamentous forms with special cells called **heterocysts**
   f. Some species are indicators of pollution



2. GREEN ALGAE (CHLOROPHYTA)
   a. chlorophyll a, b
   b. cell wall--cellulose
   c. reserve food--starch
   d. Ancestral group of multicellular plants
   e. Examples:
      Chlamydomonas
      Spirogyra
      Oedogonium

3. EUGLENOIDS (EUGLENOPHYTA)
   a. chlorophyll a, b
   b. no cell wall--cell membrane with protein fibers underneath (=**pellicle**)
   c. reserve food--**paramylon**
   d. Only thing in common with green algae is same pigments otherwise more closely related to dinoflagellates.
   e. Examples: Euglena

4. YELLOW GREEN ALGAE (XANTHOPHYTA)
   a. chlorophyll a, e
   b. cell wall--**pectin**, some **cellulose** or **silicon** dioxide
   c. reserve food--**chrysolaminarin**
   d. Examples: Vaucheria

5. GOLDEN ALGAE (CHRYSOPHYTA)
   a. chlorophyll a, c; fucoxanthin
   b. cell wall--**pectin with SiO_2**
   c. reserve food--chrysolaminarin sometimes oil droplets
   d. mostly unicellular or colonial
   e. Examples: Diatoms, Synura

6. DINOFLAGELLATES (PYRROPHYTA)
   a. chlorophyll a, c; fucoxanthin
   b. cell wall-- cellulose in plates, probably under cell membrane
   c. reserve food--**starch, oil**
   d. very important phytoplankton in oceans; cause **"red tide"**
   e. Example: Peridinium

Plankton (phytoplankton zooplankton)

7. BROWN ALGAE (PHAEOPHYTA)
   a. chlorophyll a, c; fucoxanthin
   b. cell wall--**cellulose** with alginic acid (source of algin)
   c. reserve food--**laminarin**,

mannitol (alcohol)
d. grows as deep as 110 M
e. 99% marine group
f. Example: Ectocarpus, kelps

8. RED ALGAE (RHODOPHYTA)
a. chlorophyll a, d (?); phycobilins: phycoerythrin, phycocyanin
b. cell wall--cellulose with pectin
c. reserve food--floridean starch
d. cell walls produce agar and carrageenin, collodial gels that, along with algin from the browns have commercial value as emulsifying agents
e. grow more than 200 m deep;

1. SLIME MOLDS (MYXOMYCOTA)
   a. heterotrophic
   b. sophisticated colonial amoeboid life form
   c. vegetative body--plasmodium --no cell wall, channelized protoplasm
   d. reproductive phase--stationary upright fruiting body with cellulose, spores have cellulose
   e. Example: Physarum

2. CHYTRIDS (CHYTRIDIOMYCOTA)
   a. cell wall mostly chitin
   b. coenocytic hyphae
   c. motile cells-1 posterior whip-lash flagellum
   d. saprotrophs on plants, etc.
   e. Example--Allomyces

3. DOWNY MILDEWS AND WATER MOLDS (OOMYCOTA)
   a. cell wall mostly cellulose
   b. coenocytic hyphae
   c. motile cells--two flagella: 1 whiplash, 1 tinsel both attached laterally
   d. Examples: Saprolegnia Late Blight of Potatoes, Downy Mildews

haplontic life cycle

4. BREADMOLDS (ZYGOMYCOTA)
   a. hypha walls chitin
   b. no motile spores
   c. sexual reproduction--con-jugation; gametangia function as gametes
   d. Examples: Rhizopus, Phyco-myces
   e. coenocytic hyphae

least complex

5. SAC FUNGI (ASCOMYCOTA)
   a. hyphae septate, 1 nucleus/ compartment
   b. sex organs present
   c. spores produced in sac-like sporangium (ascus, asco-spores)
   d. Examples: yeasts, morels and truffles, powdery mildews, ergot, blue-green molds

6 CLUB FUNGI (BASIDIOMYCOTA)
   a. hypha septate, 1-2 nuclei/ compartment (primary and secondary mycelium)
   b. no sex organs
   c. spores produced at ends of horn-like protrusions from club shaped sporangium (basidium)
   d. Examples: Gill, pore, coral, tooth fungi, stinkhorns, puff-balls, smuts, rusts

no motile cells

7. IMPERFECT FUNGI (DEUTERO-MYCETES)
   a. septate hyphae
   b. no sexual reproduction
   c. reproduce only by conidia
   d. usually forms of either sac or club fungi whose sexual phase is not known.
   e. cause several diseases of humans: ringworm, athelete's foot

KINGDOM PLANTAE -- MULTICELLULAR PLANTS

A. General Characteristics
1. Skeletal system--lignified tissue
2. Radial symmetry
3. Absorptive and Anchorage organs
   a. Rhizoids
   b. Roots
4. Conducting system for translocation of food and water
   a. Xylem--water
   b. Phloem--food
5. Protection from dessication by epidermis with waxy cuticle
   --stomata present to provide gas exchange
6. Reproduction
   a. Multicellular sex organs and sporangia
   b. Male sex organ -- Antheridium
   c. Female sex organ -- Archegonium
   d. Diplohaplontic life cycle

1. BRYOPHYTES (BRYOPHYTA)
--the Mosses and Liverworts
   a. Lack vascular system, no xylem or phloem
   b. Usually low growing, near water source or able to stay dormant until rain or dew
   c. Ecological pioneers
   d. Gametophyte dominant phase in life cycle

2. FERNS (PTEROPHYTA)
   a. In general, low growing plants
   b. Large, complex leaves
   c. Stem, a rhizome (horizontal underground)
   d. Circinate vernation

3 WHISK FERNS (PSILOPHYTA)
   a. Most primitive vascular plants
   b. No true roots or leaves
   c. Underground rhizome with aerial branches
   d. Dichotomous branching
   e. Large sporangia at ends of short lateral branches
   f. 5 - 7 species in two genera
   g. ***Psilotum*** is common genus

4. HORSETAILS (SPHENOPHYTA)
   a. Only one genus, ***Equisetum*** with 23 species
   b. Remnant of prehistoric group of plants
   c. Stems "jointed" with leaves present as a sheath around each node
   d. Stems contain silicon dioxide

5. CLUB MOSSES (LYCOPHYTA)
   a. Possess recognizable

roots, stems and leaves
b. Leaves small, only have one vein (midrib)
c. Two main genera:
1. ***Lycopodium*** -- Club Moss
2. ***Selaginella*** --Spike Moss

6. CYCADS (CYCADOPHYTA)
a. Called Sago Palms
b. Small group of only 85 species
c. Remnant of prehistoric times
d. Have swimming sperm
e. Dubious honor of the largest sperm cells in the plant kingdom

7. GINKGO (GINKGOPHYTA)
a. Only one species -- ***Ginkgo biloba*** the Maidenhair Tree
b. Fan shaped leaves, open venation
c. Swimming sperm
d. Seeds large, plum-sized contain butyric acid and smell unpleasant (to say the least)
e. Living fossil, not known to grow "in the wild"

8. CONIFERS (CONIFEROPHYTA)
a. The evergreens
b. All woody plants
c. No vessel elements in xylem only tracheids
d. Phloem only sieve cells, no sieve tube elements
e. Have special, sticky, gummy sap, called resin, in special cells
f. Important plants commerically as lumber, Christmas trees, etc.