Biology
Monera 9.1

"Nevertheless we, according to his promise, look for new heavens and a new earth, wherein dwelleth righteousness." Second Peter 3:13

Monera

1. Procaryotic, unicellular. All procaryotes are in kingdom Monera.
2. Ubiquitous: In the highest places that life has been found and in the lowest places. The coldest and the hottest. The most alkaline and the most acidic. They are everywhere.
3. Water, milk, skin, food, etc. Inside and outside, top and bottom.
4. Tiniest living organisms, but the largest in number.
5. 1 gram of soil: 1 to 100 million
6. 1 cubic meter of air: 100 to 200,000 of them.
7. 1 drop of water from a pond can contain over 50 billion bacterial cells.
8. There are more bacteria in one person's intestines than there are people on earth.
9. There are ten times more bacteria cells on your body than cells that make your body.
10. The total mass of all bacteria in the world is greater than all other living organism in the world
11. You carry about three to five pounds of bacteria on and in your body.
12. Over 1,400 different strains of bacteria have been found in human belly buttons.
13. Most are beneficial for food and health.
14. Bacteria in the gut help digestion.
15. Many cause disease from pimples to pneumonia, tetanus to sore throats.
16. The distinctive 'fresh' smell after rain in a forest is the smell of bacteria spores called Actinomyces.

Bacterial taxonomy

1. Monera are unicellular procaryotes: they do not have a true nucleus or membrane bound organelles.
2. Naming: often by shape, sometimes by finder, location, metabolism, or disease.
3. All bacteria have DNA, cell wall, cell membrane, ribosomes, and pili.
4. Grouped by morphology (shape and appendages), motility, chemical reactivity (Gram's stain), nutritional requirements, metabolic products, niche, pathogenicity, and genotype.
5. Multiple ways to group bacteria. There is no standard taxonomy.
6. *Bergey's Manual of Systematic Bacteriology* is most commonly used to classify bacteria.

Identification techniques

1. Microscopy physically identifies morphology and colony type.
2. Nutrient assays differentiate nutritional requirements and metabolic products.
3. Metabolic analysis.
4. Chemical reactivity.
5. Antibody reactions to identify proteins on cell surfaces.
6. DNA insertion sequences using polymerase chain reaction (pcr) technique.
7. Reflected light patterns: the Raman effect (SERS) is used to identify bacteria by measuring the energy difference of scattered photons from surface molecules of bacteria.

Morphology

1. Average size is 1 micrometer.
2. Three basic shapes or modifications of these three: coccus, bacillus, spirillum
3. All bacteria have cell membrane, cell wall, and pili (protein adhesions, conjugation, and pulling).
4. Some have capsules.
5. Some have fimbrae ('long' pili)

6. Some have one or more flagella.
7. Colony formation
    a. Individual cells
    b. Staph: Group together in bunches like grape clusters.
    c. Strep: link together in strands.

Motility

1. Motility occurs by whipping action of flagella, pulling action of pili, twisting action of spirals, gliding action of capsules.
2. Others are not motile. They stick to surfaces with pili.
3. Chemotaxis: move toward or away from chemical stimuli.
4. Phototaxis: move toward or away from light stimuli.
5. Magnetotaxis: move toward or away from magnetic stimuli.
6. Geotaxis: move toward or away from gravitational stimuli.

Chemical reactivity

1. Gram's stain used to classify all bacteria as Gram positive (blue) or Gram negative (red).
2. Ziehl-Neelsen Staining tests for acid-fast bacteria indicated by red color. Removal of Carbol-Fuchsin stain is by acid leaves blue color in bacteria.
3. Bacteria that exist in extreme conditions are most often grouped as Archaebacteria and subdivided into methanogens, extreme halophiles, and extreme thermophiles.

Nutrition

1. Autotrophs
    a. Self-feeders. 1. photosynthetic and 2. Chemosynthetic
    Use energy from sun (phototrophs) or from inorganic chemicals (chemotrophs).
    b. Photosynthetic bacteria use Bacteriochlorophyll (purple, red, brown).
    c. Methylomirabilis oxyfera (wonderful methane-eater making oxygen) uses two nitric oxide (NO2-) molecules to produce dinitrogen and oxygen
2. Heterotrophs
    a. Feed off of others
    b. Use energy from organic sources
    c. Saprophytes: dead organic matter. secret enzymes into environment
    d. Parasites: living organic matter
    e. Obligate parasites: require certain nutrients from living cells

Respiration

1. Obligate Aerobic: require O_2 as the final electron acceptor.
2. Obligate Anaerobic: cannot survive in the presence of O_2. Can use hydrogen sulfide, ammonia, or methane as the final electron acceptor.
3. Facultative Anaerobic: capable of aerobic respiration or anaerobic respiration.

Metabolism

1. IMViC test is used to distinguish enteric (intestinal) bacteria.
    a. Indole. Conversion from tryptophan to indole.
    b. Methyl red. Fermentation of glucose, peptone, and a phosphate buffer.
    c. Voges-Proskauer. Test for converting glucose to acetylmethylcarbinol.
    d. Citrate utilization: Determines if bacteria can use citrate as the sole source of carbon and energy.

Colonial characteristics

1. Identification by growing on nutrient defined agar plates or in broth.
   a. Colony color, size, and shape on plates help to identify bacteria.
   b. Selective media inhibits or kills bacteria sensitive to chemicals such as antibiotics or nutrients.

Endospores
1. Over eighty genera produce spores.
2. Spore coat enables bacteria to survive harsh conditions such as drying, freezing, pressure, and toxic gas.
3. *Clostridium botulinum* (Botulism), *Clostridium tetani* (tetanus), *Clostridium perfringens* (gangrene), and *Bacillus anthracis* (anthrax) form spores.

Reproduction and growth
1. Asexual binary fission involving mitosis.
2. Single cells multiply to form colonies.
3. "Gestational" time for most bacteria about 30 minutes under ideal conditions.
4. In 24 hours a single cell can produce a mass of 2,000 tons; in 48 hours weigh more than the earth.
5. Requires ideal conditions: use a shake bottle to aerate the culture.
6. Metabolism rate is determined by growing conditions: nutrients, temperature, and pH.

Genetic diversification
1. Conjugation: direct transfer of DNA from one cell to another cell, does not involve cell division.
2. Transformation: Absorption of exogenous DNA into the cell.
3. Transduction: DNA insertion via viral infections.

Cyanophyta
1. The blue-green bacteria.
2. *Cyan* is Greek meaning blue in color
3. Sometimes called blue-green algae. However, they are bacteria not algae.
4. Colonies form filaments, sheets, or hollow balls of cells.
5. Photoautotrophic: obtain their energy through photosynthesis

Schizomycophyta
1. "Fungus plant" is a misnomer. They are bacteria.
2. Digestion, decompostition (detritus cycle) prevents build up of dead things, garbage.
3. Oil spills, acidophilus, insulin production, interferon, etc.

Some good bacteria
1. Bacteria contribute to our nutrition, skin health, mental well-being, and flavoring of foods.
2. *Lactobaccilus Acidophilus.* Most commonly used probiotic (food bacteria that promote good health).
3. *Escherichia Coli*. Found in the intestines of animals.
4. *Bifidobacterium.* Found in the intestines of animals.