INTRODUCTION TO MICROBIOLOGY

Prepared for PHase III, Inc.

MICROBIOLOGY

A Branch of biology concerned with the study of microscopic forms of life, i.e. life forms too small to be seen with the unaided eye.

GENERAL OVERVIEW – TYPES OF MICROBES

Algae- Photosynthetic organisms that are both unicellular and multicellular. These organisms lack the structural differentiation of simple plants. The algae use light energy for growth and carbon dioxide as a carbon source, although some algae also use organic carbon sources.
(Size: 1um – many meters)

Protozoans – Simple organisms whose name indicates they are in the "first animals". These organisms are typically motile, unicellular, and vary widely in size, shape and complexity. These organisms are commonly found in surface water, sewage and mud. They feed on organic matter, algae, bacteria and other protozoans.
(Size: 2um-200um)

Fungi – Microscopic fungi include yeasts and molds while larger fungi include the "mushrooms". The microscopic fungi are not photosynthetic and utilize organic materials for nutrients and energy.
(Size: 2um – 20um)

Viruses – Viruses are too small to be seen with a light microscope, and are not living cells since they require a living host in order to replicate.
(Size: 0.02um – 0.2um)

Bacteria – typically unicellular life forms that are considerably smaller than protozoa, algae or fungi. Bacteria can be motile utilizing flagella as a whip like appendages. Many bacteria use organic carbon compounds for energy and growth.
(Size: 0.1 um – 15um)

1000 millimeters (mm) = 1 meter (m)
1000 micrometers (um) = 1 millimeter (mm)

BACTERIA

Shape

Bacteria occur in various shapes, predominantly:

- spheres (cocci)
- Rods (bacilli)
- Spirals

Other bacteria shapes include stalked, ensheathed, filamentous and platelets.

Growth Requirements

Element	Percentage of Dry Weight	Source	Function
Carbon	50	Organic compounds And Co_2	Main constituent of cellular material
Oxygen	20	Water, organic Compounds, CO_2 And O_2	Main constituent of cellular water and material, also electron acceptor in respiration
Hydrogen	8	Organic compounds And water	Main constituent of cellular water and material
Nitrogen	14	Ammonia, nitrate, Organic compounds, And atmospheric Nitrogen	Constituents of amino acids (proteins), DNA and enzyme helpers
Phosphorus	3	Inorganic Phosphates	Nucleic acids (DNA) and cell membrane constituents
Sulfur	1	Sulfates, sulfides organic sulfur compounds, elemental sulfur	Some amino acids and enzyme helpers
Potassium	1	Potassium salts	Cellular cations and enzyme Helpers

Bacterial Growth and Reproduction

Many bacteria reproduce by a simple division or splitting process resulting in two equal cells (binary fission). This division may occur as rapidly as every 20 minutes under laboratory conditions. Starting with only one cell and using a 20 minute generation time, the resulting population after 24 hours is 4.7 x 10 21 (4,700,000,000,000,000,000,000) cells.

Growth rates are not steady but depend on the availability of nutrients, production of bacterial enzymes, competition of other bacteria and build up to toxic by-products.

Spore Production – Bacterial endospores are produced in response to adverse growth conditions and are highly resistant to heat, dryness, irritation and toxic chemicals. These endospores may remain dormant for long periods of time (years) before germinating when growth conditions once again become favorable. Endospores are primarily formed by bacteria from the *Bacillus* or *clostridium*.

Growth Temperatures – Bacteria can be found growing and reproducing in environments with temperatures ranging from below freezing (0^o C) to above boiling point (100^o C). they are grouped into three general categories based on the temperature range for a given microorganism. These categories are as follows:

Psychrophiles: True psychrophiles grow best at temperatures of 15^o C or lower

Mesophiles: Optimal growth temperature between 25^o C and 40^o C
(Most microorganisms are mesophiles)

Themophiles: Optimal growth temperatures 45-50^o C or higher

Gram Stain – Bacteria are sometimes classified according to their "Gram reaction". This refers to the ability of a cell to retain the primary stain of a staining procedure (Gram positive, purple) or secondary stain (Gram negative, pink). The difference between these two staining reactions is due to structural differences in the outer wall of membrane of the bacterial cell.