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BIOLOGICAL TERMINOLOGY & LITERATURE (3303403)

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Biological terminology is a special vocabulary used by science professionals to facilitate communications.

It is based mainly on Greek and Latin words.

Parts of a biological term:

A biological term may be composed of four parts as follows:

Prefix

The word or element attached to the beginning of a word root to modify its meaning.

Word root

The meaning or core part of the word.

Suffix:

A suffix is a word part or element attached to the end of a root word to modify its meaning.

Prefixes pertaining to numbers

Prefix	Meaning	Example
Prim/i-	First	Primitive
Uni	One	Unicellular
Mono-	One	Monocotyledon
Bi-	Two/Twice	Bisexual
Di	Two -Twice	Dicotyledon
Diplo	Two (double) Twice	Diplococcus
Tri-	Three	Triglyceride
Tetra	Four	Tetrad
Penta	Five	Quentavalent
Hexa-	Six	Hexoses
Multi	Many (more than one)	Multicellular
Poly-	Many, much	Polyribosomes
Semi-	Half	Semipermeable
Hemi	Half, one side	Hemithorax

Prefixes pertaining to color

Prefix	**Meaning**	**Example**
Alb	White	Albino
Chlor/o	Green	Chlorophyll
Chrom/o	Color	Chromoplast
Cyan/o	Blue	Cyanophyta
Erythr/o	Red	Erythrocyte
Leuc/o	White	Leucoplast
Luteo	Yellow	Lutein
Rhod/o	Red	Rhodophyta
Xanth/o	Yellow	Xanthophyll

Prefixes pertaining to Position and Directions and time

Prefix	Meaning	Example
Ab-	Away from	Abnormal
Dia-	Through	Dialysis
Ecto-	Out, outside	Ectoderm
Endo-	In, within	Endoderm
Epi-	Upon, over	Epiderm
Extra	Outside	Extracellular

Negative prefixes

Prefix	Meaning	Example
A-, an-	Not, without	Aerobic, Anaerobic
Anti-	Against	Antibiotic
De-	Removal, without	Detoxify
Dis-	Removal, absence	Disinfect
In-,	Not	Indirect
Un-	Not	Unusual

Prefixes pertaining to degree

Prefix	Meaning	Example
Hyper-	Over, excess, high,	Hypertonic
Hypo-	Under, below, low	Hypotonic
Olig/O-	Few, deficiency of	Oligosaccharide
Super-	Above, excess	Superoxide

Prefixes pertaining to size and comparisons

Prefix	Meaning	Example
Eu-	True	Eukaryote
Hetero-	Different, unequal	Heterophytes
Homo-	Same, unchanged	Homologous
Macro-	Large	Macroscopic
Mega-	Large	Megaspores
Micro-	Small	Microelements
Pseudo-	False	Pseudopodium
Re-	Again, back	Reflux

Miscellaneous Prefixes

Prefix	Meaning	Example
Ana-	Up, apart	Anabolism
Cata-	Down	Catabolism
Hydro-	Water	Hydrolysis
Mal-	Bad	Malfunction

Suffix

Sufffix	Meaning	Example
-ase	enzyme	amylase
-static	Inhibition	bacteriostatic
-cidal	Killing	bacteriocidal
-cyte, cyto-	Cell	cytoplasm
-dermic	Skin	hypodermic
-emia	Blood	anemia
-itis	inflammation	appendicitis
-ology	science, knowledge	physiology

Microorganisms and Their Environments

In nature, microbial cells live in populations in association with populations of cells of other species. *A population* is a group of cells derived from a single parental cell by successive cell divisions. The immediate environment in which a microbial population lives is called its *habitat*. Populations of cells interact with other populations in *microbial communities*. The diversity and abundance of microorganisms in microbial communities is controlled by the *resources (foods)* and *conditions (temperature, pH, oxygen content, and so on)* that prevail in their habitat.

Microbial populations interact with each other in *beneficial*, *neutral*, or *harmful* ways. For example, the metabolic waste products of one group of organisms can be nutrients or even poisons to other groups of organisms. Habitats differ markedly in their characteristics, and a habitat that is favorable for the growth of one organism may actually be harmful for another. Collectively, we call all the living organisms, together with the physical and chemical components of their environment, an *ecosystem*. Major microbial ecosystems are *aquatic* (oceans, ponds, lakes, streams, ice, hot springs), *terrestrial* (surface soils, deep subsurface), and *other organisms*, such as plants and animals.

An ecosystem is greatly influenced and, in some cases, even controlled by microbial activities. Microorganisms carrying out metabolic processes remove nutrients from the ecosystem and use them to build new cells. At the same time, they excrete waste products back into the environment. Thus, microbial ecosystems expand and contract, depending on the resources and conditions available. Over time, the metabolic activities of microorganisms gradually change their ecosystems, both chemically and physically. For example, molecular oxygen (O_2) is a vital nutrient for some microorganisms but a poison to others. If aerobic (oxygen-consuming) microorganisms remove O_2 from a habitat, rendering it anoxic (O_2 free), the changed conditions may favor the growth of anaerobic microorganisms that were formerly present in the habitat but unable to grow. In other words, as resources and conditions change in a microbial habitat, cell populations rise and fall, changing the habitat once again.

Abbreviations of Units& Measures

1.Size

Measure	Symbol	Relative Length	Exponential Notation
Meter	M	1	10^0
Decimeter	dm	.1	10^{-1}
Centimeter	cm	.01	10^{-2}
Millimeter	mm	.001	10^{-3}
Micrometer (micron)	µm	.000001	10^{-6}
Nanometer	nm	.000000001	10^{-9}
Angstrom	Å	.0000000001	10^{-10}

2.VOLUME Volumes are measured relative to **a liter**

Measure	Symbol	Relative Volume	Exponential Notation
Liter	L	1	10^0
Deciliter	dl	.1	10^{-1}
Millilitre	ml	.001	10^{-3}
Microliter	µl	.000001	10^{-6}

3.Weight

The most common measurements of weight at the **gram**

Measure	Symbol	Relative Weight	Exponential Notation
Gram	g	1	10^{0}
Milligram	mg	.001	10^{-3}
Microgram	µg	.000001	10^{-6}

4.Concentration

Name	Abbreviation	Concentration	Concentration (SI unit)
Millimolar	mM	10^{-3} mol/L	10^{-3} mol/m^3
micromolar	µM	10^{-6} mol/L	10^{-6} mol/m^3
nanomolar	nM	10^{-9} mol/L	10^{-9} mol/m^3
picomolar	pM	10^{-12} mol/L	10^{-12} mol/m^3

One **mole** is equal to the **molecular weight in grams dissolved in liter** of diluent and is expressed as **mole/l**

5.Time

Measure	Symbol
Second	Sec
Minute	Min
Hours	Hrs
Day	D
Week	wk.
Month	mo.
Year	yr.
Century	cent.
ante meridiem	a.m
post meridiem	p.m

The Impact of Microorganisms on Humans

Through the years microbiologists have had great success in discovering how microorganisms work, and application of this knowledge has greatly increased the beneficial effects of microorganisms and curtailed many of their harmful effects.

Microbiology has thus greatly advanced human health and welfare. Besides understanding microorganisms as agents of disease, microbiology has made great advances in understanding the role of microorganisms in food and agriculture, and in exploiting microbial activities for producing valuable human products, generating energy, and cleaning up the environment.

Beginning of the twentieth century, the major causes of death in humans were infectious diseases caused by microorganisms called **pathogens**. Children and the aged in particular succumbed in large numbers to microbial diseases.

Today, however, infectious diseases are much less deadly, at least in developed countries. Control of infectious disease has come from an increased understanding of disease processes, improved sanitary and public health practices, and the use of antimicrobial agents, such as antibiotics.

Although many infectious diseases can now be controlled, microorganisms can still be a major threat, particularly in developing countries. In the latter, microbial diseases are still the major causes of death, and millions still die yearly from other microbial diseases such as malaria, tuberculosis, cholera, African sleeping sickness, measles, pneumonia and other respiratory diseases, and diarrheal syndromes.

In addition to these, humans worldwide are under threat from diseases that could emerge suddenly, such as bird or swine flu, or Ebola hemorrhagic fever, which are primarily animal diseases that under certain circumstances can be transmitted to humans and spread quickly through a population.

In fact, most microorganisms cause no harm but instead are beneficial and in many cases even essential to human welfare and the functioning of the planet.

Agriculture benefits from the cycling of nutrients by microorganisms. For example, a number of major crop plants are legumes. Legumes live in close association with bacteria that form structures called nodules on their roots. In the root nodules, these bacteria convert atmospheric nitrogen (N_2) into ammonia (NH_3) that the plants use as a nitrogen source for growth.

Also of major agricultural importance are the microorganisms that inhabit ruminant animals, such as cattle and sheep. These important domesticated animals have a characteristic digestive vessel called the rumen in which large populations of microorganism's digest and ferment cellulose, the major component of plant cell walls, at neutral pH. Without these symbiotic microorganisms, cattle and sheep could not thrive on cellulose rich (but otherwise nutrient-poor) food, such as grass and hay. Many domesticated and wild herbivorous mammals including deer, bison, camels, giraffes, and goats are also ruminants.

In the human digestive tract, large microbial populations occur only in the colon (large intestine), a structure that comes after the stomach and small intestine and which lacks significant numbers of cellulose degrading bacteria. However, other parts of the human body can be loaded with bacteria.

In addition to the large intestine, the skin and oral cavity contain a significant normal microbial flora, most of which benefits the host or at least does no harm. In addition to benefiting plants and animals, microorganisms can also cause major economic losses in the agricultural industry every year. In some cases, a food product can cause serious human disease, such as when pathogenic Escherichia coli or Salmonella is transmitted from infected meat, or when microbial pathogens are ingested with contaminated fresh fruits and vegetables. Thus microorganisms significantly impact the agriculture industry both positively and negatively.

Scientific terms

Adenosine triphosphate (ATP) An important intracellular energy source.

Aerobe An organism requiring oxygen (O_2) for growth.

Aerobic respiration Respiration in which the final electron acceptor in the electron transport chain is oxygen (O_2).

Aflatoxin A carcinogenic toxin produced by Aspergillus flavus.

Agar A complex polysaccharide derived from a marine seaweed and used as a solidifying agent in culture media.

Anabolism All synthesis reactions in a living organism; the building of complex organic molecules from simpler ones.

Anaerobe An organism that does not require oxygen (O_2) for growth.

Antibiotic An antimicrobial agent produced naturally by a bacterium or fungus.

Antimicrobial drug A chemical that destroys pathogens without damaging body tissues.

Antisepsis A chemical method for disinfection of the skin, mucous membranes, or other living tissues; the chemical is called an antiseptic.

Antitoxin A specific antibody produced by the body in response to a bacterial exotoxin or its toxoid.

Asepsis The absence of contamination by unwanted organisms; aseptic means free of pathogens.

Autotroph An organism that uses carbon dioxide (CO_2) as its principal carbon source; also called lithotroph.

Bacillus (plural: **bacilli)** (1) Any rod-shaped bacterium. (2) When written as a genus, refers to rod-shaped, endospore-forming, facultatively anaerobic, gram-positive bacteria.

Bacteremia A condition in which there are bacteria in the blood.

Bactericide A substance capable of killing bacteria.

Bacteriocin A toxic protein produced by bacteria that kills other bacteria.

Bacteriophage (phage) A virus that infects (multiplies in) bacterial cells.

Bacteriostasis A treatment capable of inhibiting bacterial growth.

Binary fission Bacterial reproduction by division into two daughter cells.

Binomial nomenclature The system of having two names (genus and specific epithet) for each organism; also called scientific nomenclature.

Biological transmission The transmission of a pathogen from one host to another when the pathogen reproduces in the vector.

Bioremediation The use of microbes to remove an environmental pollutant.

Broad-spectrum antibiotic An antibiotic that is effective against a wide range of both gram-positive and gram-negative bacteria.

Carcinogen Any cancer-causing substance.

Catabolism All decomposition reactions in a living organism; the breakdown of complex organic compounds into simpler ones.

Cell culture Animal or plant cells grown in vitro.

Chemoautotroph An organism that uses an inorganic chemical as an energy source and carbon dioxide (CO_2) as a carbon source.

Chemoheterotroph An organism that uses organic molecules as a source of carbon and energy.

Chemotherapeutic agent A chemical (drug) used in the treatment of disease.

Chemotroph an organism that uses oxidation-reduction reactions as its primary energy source.

Chloroplast The organelle that performs photosynthesis in photoautotrophic eucaryotes.

Chromosome The structure that carries hereditary information, chromosomes contain genes.

Coccobacillus (plural: **coccabacilli)** A bacterium that is an oval rod.

Coccus (plural: **cocci)** A spherical or ovoid bacterium.

Codon A sequence of three nucleotides in mRNA that specifies the insertion of an amino acid into a protein.

Coliforms Aerobic or facultatively anaerobic, gram-negative, nonendospore-forming, rod-shaped bacteria that ferment lactose with acid and gas formation within 48 hours at 35°C; used as an indicator organism for tests of bacteriological purity.

Colony A clone of bacterial cells on a solid medium that is visible to the naked eye.

Commensalism A symbiotic relationship in which two organisms live in association and one is benefited while the other is neither benefited nor harmed.

Culture medium The nutrient material prepared for growth of microorganisms in a laboratory.

Cytolysis The destruction of cells, resulting from damage to their cell membrane, that causes cellular contents to leak out.

Cytopathic effect (CPE) A visible effect on a host cell, caused by a virus, that may result in host cell death (cytocidal effect) or damage (noncytocidal effect).

Cytotoxin A bacterial toxin that kills host cells or alters their functions.

Microbial Growth Control

The goal of microbial growth control is to either *reduce* or *eliminate* the microbial load and limit microbial effects. A few agents eliminate microbial growth entirely by *sterilization* the killing or removal of all viable organisms from a growth medium or surface. In certain circumstances, however, *sterility* is not attainable or practical, as in fresh foods. Microorganisms can be effectively controlled by limiting or inhibiting their growth. For example, we inhibit microbial growth on body surfaces by washing. Methods for inhibiting rapid microbial growth include *decontamination* and *disinfection*.

Decontamination is the treatment of an object or surface to make it safe to handle. For example, simply wiping a table after a meal removes contaminating microorganisms and their potential nutrients. *Disinfection,* in contrast, directly targets pathogens, although it may not eliminate all microorganisms. Specialized chemical or physical agents called disinfectants can kill microorganisms or inhibit microbial growth. Bleach (sodium hypochlorite) solution, for example, is a disinfectant used to clean and disinfect food preparation areas. Under certain circumstances, it may be necessary to destroy all microorganisms. Such measures are necessary, for instance, when making microbiological media or preparing surgical instruments.

Sterilization completely eliminates all microorganisms, including endospores, and also eliminates all viruses. Microbial control in vivo is much more difficult: Clinically useful *bacteriocidal* (bacteria killing) agents or *bacteriostatic* (bacteria inhibiting) agents must selectively prevent or reduce bacterial growth, while causing no harm to the host.

Physical methods are used in industry, medicine, and in the home to achieve microbial decontamination, disinfection, and sterilization. Heat, radiation, and filtration are commonly used to destroy or remove microorganisms. These methods prevent microbial growth or decontaminate areas or materials harboring microorganisms.

Perhaps the most widespread method used for controlling microbial growth is

The use of heat as a sterilization method. Factors that affect a microorganism's susceptibility to heat include the temperature and duration of the heat treatment and whether the heat is moist or dry.

All microorganisms have a maximum growth temperature beyond which viability decreases. Microorganisms lose viability at very high temperatures because most macromolecules lose structure and function, a process called denaturation. The effectiveness of heat as a sterilant is measured by the time required for a 10-fold reduction in the viability of a microbial population at a given temperature. This is the decimal reduction time or D.

Sterilization of a microbial population takes longer at lower temperatures than at higher temperatures. The time and temperature, therefore, must be adjusted to achieve sterilization for each specific set of conditions. The type of heat is also important: *Moist heat* has better penetrating power than dry heat and, at a given temperature, produces a faster reduction in the number of living organisms.

An easier way to characterize the heat sensitivity of an organism is to measure the thermal death time, the time it takes to kill all cells at a given temperature. To determine the thermal death time, samples of a cell suspension are heated for different times, mixed with culture medium, and incubated. If all the cells have been killed, no growth is observed in the incubated samples. The thermal death time depends on the size of the population tested; a longer time is required to kill all cells in a large population than in a small one. When the number of cells is standardized, it is possible to compare the heat sensitivities of different organisms by comparing their thermal death times at a given temperature.

Some bacteria produce highly resistant cells called endospores. The heat resistance of vegetative cells and endospores from the same organism differs considerably. For instance, in the autoclave a temperature of 1218C is normally reached. Under these conditions, endospores may require 4–5 minutes for a decimal reduction, whereas vegetative cells may require only 0.1–0.5 min at 658C. To ensure adequate decontamination of any material, heat sterilization procedures must be designed to destroy endospores.

Deep-freezing Preservation of bacterial cultures at -20°C to -80°C.

Differential medium A solid culture medium that makes it easier to distinguish colonies of the desired organism.

Differential stain A stain that distinguishes objects on the basis of reactions to the staining procedure.

Dimorphism The property of having two forms of growth.

Diplobacilli (singular: **diplobacillus)** Rods that divide and remain attached in pairs.

Diplococci (singular: **diplococcus)** Cocci that divide and remain attached in pairs.

Disinfection Any treatment used on inanimate objects to kill or inhibit the growth of microorganisms; a substance used is called a disinfectant.

DNA sequencing A processes by which the nucleotide sequence of DNA is determined.

Enrichment culture A culture medium used for preliminary isolation that favors the growth of a particular microorganism.

Enterotoxin An exotoxin that causes gastroenteritis, such as those produced by Staphylococcus, Vibrio, and Escherichia.

Eucaryote A cell having DNA inside a distinct membrane-enclosed nucleus.

Exotoxin A protein toxin released from living, mostly gram-positive bacterial cells.

Halophilic An organism that requires a high salt concentration for growth.

Thermophilic An organism whose optimum growth temperature is at least 80°C; also called hyperthermophile.

Facultative anaerobe An organism that can grow with or without molecular oxygen (O_2).

Facultative halophile An organism capable of growth in, but not requiring, 1–2% salt.

Fermentation The enzymatic degradation of carbohydrates in which the final electron acceptor is an organic molecule, ATP is synthesized by substrate-level phosphorylation, and oxygen (O_2) is not required.

Filtration The passage of a liquid or gas through a screenlike material; a 0.45-µm filter removes bacteria.

Flaming The process of sterilizing an inoculating loop by holding it in an open flame.

Gene A segment of DNA (a sequence of nucleotides in DNA) that codes for a functional product.

Generation time The time required for a cell or population to double in number.

Genotype The genetic makeup of an organism.

Germicide A substance capable of killing microorganisms.

Germination The process of starting to grow from a spore or endospore.

Heterotroph An organism that requires an organic carbon source; also called organotroph.

Host An organism infected by a pathogen.

Host range the spectrum of species, strains, or cell types that a pathogen can infect.

Hot-air sterilization Sterilization by the use of an oven at 170°C for approximately 2 hours.

Antimicrobial Agents

Antibacterial agents can be classified as *bacteriostatic*, *bacteriocidal*, and *bacteriolytic* by observing their effects on bacterial cultures. Viable cells are measure by *plate counts*. The number of viable cells for a given organism is proportional to culture turbidity during the log phase of growth.

Bacteriostatic agents are frequently inhibitors of protein synthesis and act by binding to ribosomes. If the concentration of the agent is lowered, the agent is released from the ribosome and growth resumes. Chemical antimicrobial agents are divided into two categories. The first category contains antimicrobial products used to control microorganisms in industrial and commercial environments. These include chemicals used in foods, air-conditioning cooling towers, textile and paper products, fuel tanks, and so on; some of these chemicals are so toxic that exposure can affect human health. The second category of chemical antimicrobial agents contains products designed to prevent growth of human pathogens in inanimate environments and on external body surfaces. This category is subdivided into *sterilants*, *disinfectants*, *sanitizers*, and *antiseptics*.

Chemical *sterilants*, also called *sterilizers* or *sporicides*, destroy all forms of microbial life, including endospores. Chemical sterilants are used in situations where it is impractical to use heat or radiation for decontamination or sterilization. Hospitals and laboratories, for example, must be able to decontaminate and sterilize heat-sensitive materials, such as thermometers, lensed instruments, polyethylene tubing, catheters, and reusable medical equipment such as respirometers. *Cold sterilization* is performed in enclosed devices that resemble autoclaves, but which employ a gaseous chemical agent such as ethylene oxide, formaldehyde, peroxyacetic acid, or hydrogen peroxide. *Liquid sterilants* such as a sodium hypochlorite (bleach) solution or amylphenol are used for instruments that cannot withstand high temperatures or gas. *Disinfectants* are chemicals that kill microorganisms, but not necessarily endospores, and are used on inanimate objects. For example, disinfectants such as ethanol and cationic detergents are used to disinfect floors, tables, bench tops, walls, and so on. These agents are important for infection control in, for example, hospitals and other medical settings. General disinfectants are used in households, swimming pools, and water purification systems. *Sanitizers* are agents that reduce, but may not eliminate, microbial numbers to levels considered to be safe. Food contact sanitizers are widely used in the food industry to treat surfaces such as mixing and cooking equipment, dishes, and utensils. Non–food contact sanitizers are used to treat surfaces such as counters, floors, walls, carpets, and laundry. *Antiseptics* and *germicides* are chemical agents that kill or inhibit growth of microorganisms and that are nontoxic enough to be applied to living tissues. Most of the compounds in this category are used for handwashing or for treating surface wounds. Under some conditions, certain antiseptics are also effective disinfectants; they are effective antimicrobial agents when applied to inanimate surfaces. Ethanol, for example, is categorized as an antiseptic, but can also be a disinfectant. This depends on the concentration of ethanol used and the exposure time, with disinfection generally requiring higher ethanol concentrations and exposure times of several minutes. Several factors affect the efficacy of chemical antimicrobial agents. For example, many disinfectants are neutralized by organic material. These materials reduce effective disinfectant concentrations and microbial killing capacity.

Immunity The body's defense against particular pathogenic microorganisms; also called specific resistance.

Incubation period The time interval between the actual infection and first appearance of any signs or symptoms of disease.

Indicator organism A microorganism, such as a coliform, whose presence indicates conditions such as fecal pollution of food or water.

Infection The invasion or growth of microorganisms in the body.

Inflammation A host response to tissue damage characterized by redness, pain, heat, and swelling; and sometimes loss of function.

Intermediate host An organism that harbors the larval or asexual stage of a helminth or protozoan.

Intoxication A condition resulting from the ingestion of a microbially produced toxin, or effects from the formation of toxin by bacterial growth in the body.

Lyophilization Freezing a substance and sublimating the ice in a vacuum; also called freeze-drying.

Maximum growth temperature The highest temperature at which a species can grow.

Mechanical transmission the process by which arthropods transmit infections by carrying pathogens on their feet and other body parts.

Membrane filter A screen like material with pores small enough to retain microorganisms.

Mesophile An organism that grows between about 10°C and 50

a moderate-temperature–loving microbe.

Metabolism The sum of all the chemical reactions that occur in a living cell.

Microaerophile An organism that grows best in an environment with less molecular oxygen (O_2) than is normally found in air.

Minimal bactericidal concentration (MBC) The lowest concentration of a chemotherapeutic agent that will kill test microorganisms.

Minimal inhibitory concentration (MIC) The lowest concentration of a chemotherapeutic agent that will prevent growth of the test microorganisms.

Minimum growth temperature The lowest temperature at which a species will grow.

Mitosis A eucaryotic cell division process in which the chromosomes are duplicated, followed by division of the cytoplasm of the cell.

Mutagen An agent in the environment that brings about mutations.

Mutation Any change in the nitrogenous base sequence of DNA.

Mutation rate The probability that a gene will mutate each time a cell divides.

Mutualism A type of symbiosis in which both organisms or populations are benefited.

Mycosis A fungal infection.

Mycotoxin A toxin produced by a fungus.

Necrosis Tissue death.

Nomenclature The system of naming things.

Noncommunicable disease A disease that is not transmitted from one person to another.

Normal flora The microorganisms that colonize an animal without causing disease.

Prokaryotic and Eukaryotic Cells

Examination of the internal structure of cells reveals two distinct patterns: prokaryote and eukaryote. Eukaryotes house their DNA in a membrane-enclosed nucleus and are typically much larger and structurally more complex than prokaryotic cells. In eukaryotic cells the key processes of DNA replication, transcription, and translation are partitioned; replication and transcription (RNA synthesis) occur in the nucleus while translation (protein synthesis) occurs in the cytoplasm. Eukaryotic microorganisms include algae and protozoa, collectively called protists, and the fungi and slime molds. The cells of plants and animals are also eukaryotic cells.

A major property of eukaryotic cells is the presence of membrane-enclosed structures in the cytoplasm called organelles. These include, first and foremost, the nucleus, but also mitochondria and chloroplasts (the latter in photosynthetic cells only), the nucleus houses the cell's genome and is also the site of RNA synthesis in eukaryotic cells. Mitochondria and chloroplasts are dedicated to energy conservation and carry out respiration and photosynthesis, respectively.

In contrast to eukaryotic cells, prokaryotic cells have a simpler internal structure in which organelles are absent. However, prokaryotes differ from eukaryotes in many other ways as well. For example, prokaryotes can couple transcription directly to translation because their DNA resides in the cytoplasm and is not enclosed within a nucleus as in eukaryotes. Moreover, in contrast to eukaryotes, most prokaryotes employ their cytoplasmic membrane in energy-conservation reactions and have small, compact genomes consisting of circular DNA. In terms of cell size, a typical rod-shaped prokaryote is 1–5

µm long and about 1 µm wide, but considerable variation is possible. The range of sizes in eukaryotic cells is quite large. Eukaryotic cells are known with diameters as small as 0.8 µm or as large as several hundred micrometers.

Viruses are a major class of microorganisms, but they are not cells. Viruses are much smaller than cells and lack many of the attributes of cells. Viruses vary in size, with the smallest known viruses being only about 10 nm in diameter. Instead of being a dynamic open system, a virus particle is static and stable, unable to change or replace its parts by itself. Only when a virus infects a cell does it acquire the key attribute of a living system—replication. Unlike cells, viruses have no metabolic capabilities of their own. Although they contain their own genomes, viruses lack ribosomes. So to synthesize proteins, viruses depend on the biosynthetic machinery of the cells they have infected. Moreover, unlike cells, viral particles contain only a single form of nucleic acid, either DNA or RNA (this means, of course, that some viruses have RNA genomes). Viruses are known to infect all types of cells, including microbial cells.

Obligate aerobe An organism that requires molecular oxygen (O) to live.

Obligate anaerobe An organism that is unable to use molecular oxygen (O_2).

Obligate halophile An organism that requires high osmotic pressures such as high concentrations of sodium chloride.

Oncogenic virus A virus that is capable of producing tumors; also called oncovirus.

Opportunistic pathogen A microorganism that does not ordinarily cause a disease but can become pathogenic under certain circumstances.

Optimum growth temperature The temperature at which a species grows best.

Pandemic disease An epidemic that occurs worldwide.

Parasite An organism that derives nutrients from a living host.

Parasitology The scientific study of parasites (protozoa and parasitic worms).

Parasitism A symbiotic relationship in which one organism (the parasite) exploits another (the host) without providing any benefit in return.

Pasteurization The process of mild heating to kill particular spoilage microorganisms or pathogens.

Pathogen A disease-causing organism.

pH The symbol for hydrogen ion (H^+) concentration; a measure of the relative acidity or alkalinity of a solution.

Photoautotroph An organism that uses light as its energy source and carbon dioxide (CO_2) as its carbon source.

Photoheterotroph An organism that uses light as its energy source and an organic carbon source.

Photosynthesis The conversion of light enery from the sun into chemical energy; the light-fueled synthesis of carbohydrate from carbon dioxide (CO2).

Phototroph An organism that uses light as its primary energy source.

Plasmid A small circular DNA molecule in bacteria that replicates independently of the chromosome.

Pleomorphic Having many shapes, characteristic of certain bacteria.

Polymerase chain reaction (PCR) A technique using DNA polymerase to make multiple copies of a DNA template in vitro.

Predisposing factor Anything that makes the body more susceptible to a disease or alters the course of a disease.

Prion A self-replicating protein with no detectable nucleic acids.

Prokaryote A cell whose genetic material is not enclosed in a nuclear envelope.

Provirus Viral DNA that is integrated into the host cell's DNA.

Psychrotroph An organism that is capable of growth between about 0°C and 30°C.

Reservoir of infection A continual source of infection.

Resistance The ability to ward off diseases through nonspecific and specific defenses.

Sanitization The removal of microbes from eating utensils and food preparation areas.

Saprophyte An organism that obtains its nutrients from dead organic matter.

Secondary infection An infection caused by an opportunistic microbe after a primary infection has weakened the host's defenses.

Selective medium A culture medium designed to suppress the growth of unwanted microorganisms and encourage the growth of desired ones.

Sepsis A toxic condition resulting from the growth and spread of bacteria in blood and tissue.

Septicemia The proliferation of bacteria in the blood, accompanied by fever; sometimes causes organ damage.

Serum The liquid remaining after blood plasma is clotted; contains antibodies (immunoglobulins).

Sterile Free of microorganisms.

Sterilization The killing of all microorganisms, including endospores.

Strain A group of cells derived from a single cell.

Subclinical infection An infection that does not cause a noticeable illness; also called inapparent infection.

Symbiosis The living together of two different organisms or populations.

Thermal death point (TDP) The temperature required to kill all the bacteria in a liquid culture in 10 minutes.

Thermal death time (TDT) The length of time required to kill all bacteria in a liquid culture at a given temperature.

Thermoduric Heat resistant.

Thermophile An organism whose optimum growth temperature is between 50°C and 60°C; a heat loving microbe.

Toxemia The presence of toxins in the blood.

Toxigenicity The capacity of a microorganism to produce a toxin.

Toxin Any poisonous substance produced by a microorganism.

Toxoid An inactivated toxin.

Vaccination The process of conferring immunity by administering a vaccine; also called immunization.

Vaccine A preparation of killed, inactivated, or attenuated microorganisms or toxoids to induce artificially acquired active immunity.

Vegetative Referring to cells involved with obtaining nutrients, as opposed to reproduction or resting.

Viremia The presence of viruses in the blood.

Zoonosis A disease that occurs primarily in wild and domestic animals but can be transmitted to humans.

Arrangement of DNA in Microbial Cells

The genomes of prokaryotic and eukaryotic cells are organized differently. In most prokaryotic cells, DNA is present in a circular molecule called the chromosome; a few prokaryotes have a linear instead of a circular chromosome. The chromosome aggregates within the cell to form a mass called the nucleoid, visible in the electron microscope. Most prokaryotes have only a single chromosome. Because of this, they typically contain only a single copy of each gene and are therefore genetically haploid. Many prokaryotes also contain one or more small circles of DNA distinct from that of the chromosome, called plasmids.

Plasmids typically contain genes that confer a special property (such as a unique metabolism) on a cell, rather than essential genes.

This is in contrast to genes on the chromosome, most of which are needed for basic survival. In eukaryotes, DNA is arranged in linear molecules within the membrane-enclosed nucleus; the DNA molecules are packaged with proteins and organized to form chromosomes. Chromosome number varies by organism. For example, a diploid cell of the baker's yeast Saccharomyces cerevisiae contains 32 chromosomes arranged in 16 pairs while human cells contain 46 chromosomes (23 pairs). Chromosomes in eukaryotes contain proteins that assist in folding and packing the DNA and other proteins that are required for transcription. A key genetic difference between prokaryotes and eukaryotes is that eukaryotes typically contain two copies of each gene and are thus genetically diploid. During cell division in eukaryotic cells the nucleus divides (following a doubling of chromosome number) in the process called mitosis. Two identical daughter cells result, with each daughter cell receiving a full complement of genes.

The diploid genome of eukaryotic cells is halved in the process of meiosis to form haploid gametes for sexual reproduction. Fusion of two gametes during zygote formation restores the cell to the diploid state.

Reference:

Madigan, Martinko, Stahl and Clark. 2012. Brock Biology of Microorganisms. 13th Edition. (Pearson).

Good Luck