

Semantic MEDLINE

Semantic MEDLINE is a prototype Web application that integrates PubMed searching, advanced natural language processing, automatic summarization, and visualization into a single Web portal. The application is intended to help manage the results of PubMed searches by identifying semantic predications in the citations retrieved. These predications constitute computable knowledge accessible to further manipulation, including condensation by automatic summarization. Summarized predications are visualized as an informative graph with links to the original MEDLINE citations. Convenient access is also provided to additional relevant knowledge resources, including Entrez Gene, the Genetics Home Reference, and the Unified Medical Language System Metathesaurus.

Semantic MEDLINE is organized around two tabs: Search and Summarization. Begin at the Search tab by issuing a PubMed query; then move to the Summarization tab. Choose a summary type to specify content focus of the summary (Treatment of Disease, Substance Interactions, Diagnosis, or Pharmacogenomics). After selecting a topic, click the Summarize and then the Visualize button to display a graph. Click on an arc in the graph to display MEDLINE citation text.

Search Tab

You can issue any PubMed search in the Query box. Any date range can be entered between 01/01/1999 (in the Start Date box) and the end date (in the End Date box). The number of citations to be retrieved is specified in the Most Recent drop-down menu. The default is 500. PubMed Limits provides access to most of the PubMed options that are available to focus your search. After you enter the query (and specify search options), click the Search button. Clicking the Reset button erases all previously-set search options.

Search results appear at the bottom of the page as a brief display of the authors, title, and PMID (PubMed Unique Identifier.) Clicking on the list of authors takes you directly to an AbstractPlus display of the citation in PubMed. Clicking on Abstract (on the right) will display the text of the abstract. Search results are viewable in groups of 20. You can navigate through the search results by clicking the [Prev] group of 20 numbers [1 | 2, | 3 | 4 | 5] Next] options.

Summarization Tab

The top of the Summarization page shows a brief description of search parameters from the current search, including query, number of citations retrieved, and number of predications extracted.

A predication is a formal representation of a relationship asserted in text and consists of two arguments (subject and object) joined by a relation (or predicate). For example, the predication “Tamoxifen TREATS Breast Carcinoma” has subject “Tamoxifen,” object “Breast Carcinoma,” and relation “TREATS.” This predication could have been retrieved from a sentence such as “In this study, tamoxifen was used in the treatment of breast carcinoma” found in a MEDLINE abstract. Predications extracted from text serve as a representation of the content of that text and form the basis for further processing.

Summarization identifies key predications from the text being processed. These predications center around a main topic and are visualized as a graph. You select summarization options for your particular interests. Summary Type specifies the content focus of the summarization process and determines the kind of information contained in the summary. Summary Types available are: Treatment of Disease, Substance Interactions, Diagnosis, and Pharmacogenomics. The default is Treatment of Disease, which concentrates on the use of therapeutic interventions (drugs and procedures) for disorders. Substance Interactions refers to how substances (including drugs) affect other substances and relevant diseases. Diagnosis highlights procedures for identifying diseases by associated signs and symptoms. Pharmacogenomics refers to how genes affect a person's response to drugs.

The second summarization option is a checkbox to include or not include More Relations. Unchecked, the option omits less frequently occurring predications from the summary.

The final summarization option is to select a UMLS concept as the topic of the summary. This is chosen from a list of concepts from all predications extracted from the text being processed. The list appears in descending order of frequency of occurrence. The semantic class of available concepts changes depending on the Summary Type specified:

- Treatment of Disease: Disorders
- Substance Interactions: Substances
- Diagnosis: Disorders
- Pharmacogenomics: Disorders and Substances

Click the Summarize button to display the predications representing the summarized information. Predications are displayed at the bottom of the page as a list that includes the PMID and the sentence from which the predication was extracted, followed by the Subject, Predicate, and Object that constitute the predication. Clicking the PMID in this list takes you to the text of the MEDLINE citation (title or abstract). Predications are viewable in groups of 20 by clicking on the navigation aids under the message reporting on the number of predications found. Individual predications can be inspected with this facility, but an overview of the summarized predications can be seen in the graph generated by clicking the Visualize button that appears under the Summarize button.

Visualization Page

Clicking the Visualize button displays the visualization page, which includes a graph representing the summarized information contained in the predications. (Install the Adobe Flash plug-in from www.adobe.com/products/flashplayer if the graph doesn't display in your browser.) Other panes on the page include one for information on the right and another for controlling the graph, at the bottom.

Graph Control Pane

The overall shape of the graph can be changed using the Layout pull-down menu. There are four choices available: Spring, Node-Link Tree, Circle, and Radial. The default is Node-Link Tree.

- Spring: The nodes push on each other until they stabilize around the topic of the summary. (This format should be avoided for large graphs.)

- Node-Link Tree: The nodes and arcs extend in a tree to the right. The summary topic is on the left.
- Circle: The nodes are arranged in a circle.
- Radial: Similar to Spring, although more stable. The topic of the summary is centrally located.

Magnifying Glass

Use the magnifying glass button to increase or decrease the size of the graph. You can also use the wheel on your mouse to change the graph size. (Note: If the graph seems to disappear, reduce the size of the graph until it reappears, and then move it to the center of the page.)

Stop/Restart

Stop/Restart toggles the movement of the nodes when the Spring graph layout is displayed. Stop/Restart is useful when large graphs are displayed.

Graph Pane

The graph represents the summarized predications from the titles and abstracts of the citations retrieved. Nodes represent arguments (subject and object), and arcs represent relations (or predicates). The direction towards which the arc points indicates the direction of the relation between the two arguments. Both nodes and arcs are color coded to represent semantic information inherent in the predication. Nodes are colored-coded into 15 high-level semantic groups representing the biomedical categories of the arguments. These include, for example, Chemicals and Drugs and Disorders (Figure 1).

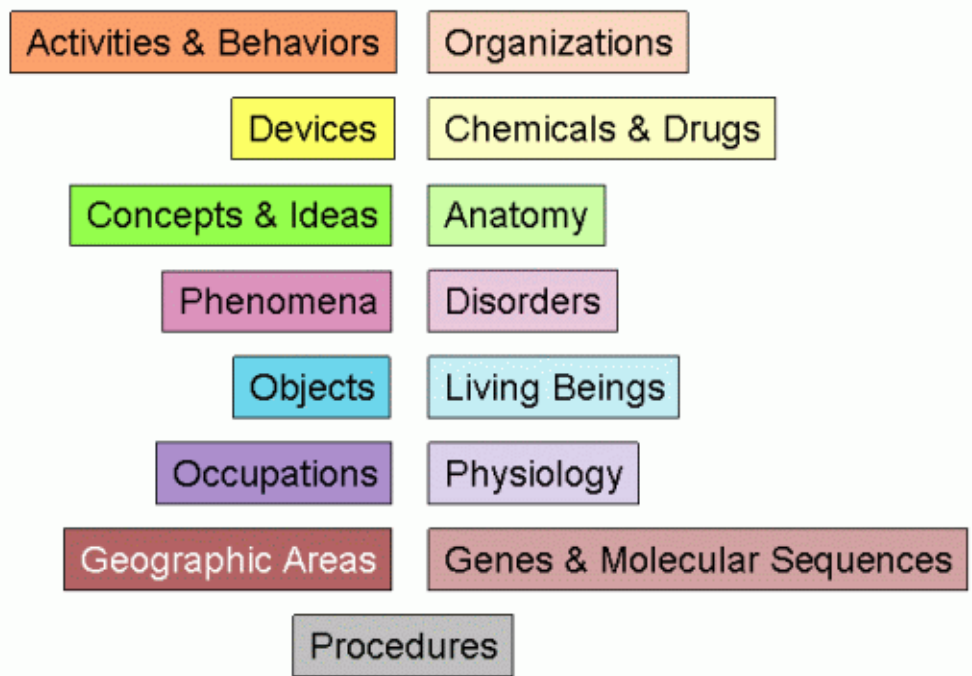


Figure 1. Colors of High Level Groups for Concepts

The arcs representing relations between arguments are color-coded to indicate the name of the relation (see Relation Labels pane below). For example, the relation “Tamoxifen TREATS

Breast Carcinoma” will have a light yellow node for Tamoxifen (Chemicals & Drugs) and a light pink node for Breast Carcinoma (Disorders). A blue arc representing the relation TREATS will point from Tamoxifen to Breast Carcinoma.

Clicking on a node (when the cursor appears as a hand) displays additional information about the argument in the upper part of the Information pane (see Concept Information below). Clicking on an arc (when the cursor appears as a hand) provides more information about the predication, including the text from which it was extracted. The graph can be moved by clicking on white space outside a node or arc. Individual nodes can be moved by clicking on them; this is useful if the names of the nodes overlap. The layout of the graph can be changed by making a choice in the Graph Control pane at the bottom of the page.

Information Pane

Concept Information

Clicking on a node displays information about the node (argument) in the upper right of the Information Pane. The Concept Information comes from the UMLS (Unified Medical Language System, <http://www.nlm.nih.gov/research/umls/documentation.html>): CUI (Concept Unique Identifier) and Semantic Type (UMLS category the concept belongs to). See below for definitions of UMLS semantic types. The number of times the concept appears in the graph is also given.

Buttons under Concept Information display active links to other National Library of Medicine resources, such as the UMLS Metathesaurus, GHR (Genetics Home Reference), OMIM (Online Mendelian Inheritance in Man), and Entrez Gene. To use these links, allow pop-ups in your Web browser. Links are unavailable if grayed out.

Relationship Information

Clicking on an arc in the graph causes information about the relation to appear in the Information pane (lower right.) The Relationship Information displays the subject, relation (predicate) and object of the predication selected as well as number of occurrences. “No. Predications:” gives the overall frequency of the predication in the text being processed, while “No. Citations:” indicates the number of citations in which the predication appears. A selected predication may appear in more than one citation.

Clicking the Citations button opens a window containing the text from which the predications were extracted. The PMID, title, and abstract are displayed. The PubMed ID is linked to PubMed. The specific sentence from which the predication was extracted is highlighted in orange.

Relation Labels

Clicking on Relation Labels at the bottom of the Information pane provides a legend for the colors of the arcs representing relations in the graph (see Relation Definitions below). You can toggle relations on and off in the graph by clicking the check box in the Relations section of the Relation Labels pane. If you toggle a relation off, the corresponding arcs in the graph disappear along with associated nodes.

Search

Clicking Search (bottom right) allows you to locate a specific concept in the graph. Type in a term (or substring) and click the Search button. Concepts matched with the search terms are listed in the box below the search box. When a matched term is selected, the graph repositions so that the selected term is central.

SEMANTIC RELATION (PREDICATE) DEFINITIONS

ADMINISTERED_TO: Given to patient, when no assertion is made that the substance is being given as treatment.

AFFECTS: Produces a direct effect on. Implied here is the altering or influencing of an existing condition, state, situation, or entity. This includes has a role in, alters, influences, predisposes, catalyzes, stimulates, regulates, depresses, impedes, enhances, contributes to, leads to, and modifies.

ASSOCIATED_WITH: Has a relationship to (gene-disease relation).

AUGMENTS: Expands or stimulates a process.

CAUSES: Brings about a condition or an effect. Implied here is that an agent, such as for example, a pharmacologic substance or an organism, has brought about the effect. This includes induces, effects, evokes, and etiology.

COEXISTS_WITH: Occurs together with, or jointly.

CONVERTS_TO: Changes from one form to another (both substances).

COMPLICATES: Causes to become more severe or complex, or results in adverse effects.

DIAGNOSES: Distinguishes or identifies the nature or characteristics of.

DISRUPTS: Alters or influences an already existing condition, state, or situation. Produces a negative effect on.

INHIBITS: Decreases, limits, or blocks the action or function of (substance interaction).

INTERACTS_WITH: Substance interaction.

ISA: The basic hierarchical link in the UMLS Semantic Network. If one item “is a” another item, then the first item is more specific in meaning than the second item.

LOCATION_OF: The position, site, or region of an entity or the site of a process.

MANIFESTATION_OF: That part of a phenomenon which is directly observable or concretely or visibly expressed, or which gives evidence to the underlying process. This includes expression of, display of, and exhibition of.

METHOD_OF: The manner and sequence of events in performing an act or procedure.

OCCURS_IN: Has incidence in a group or population.

PART_OF: Composes, with one or more other physical units, some larger whole. This includes component of, division of, portion of, fragment of, section of, and layer of.

PRECEDES: Occurs earlier in time. This includes antedates, comes before, is in advance of, predates, and is prior to.

PREDISPOSES: To be a risk to a disorder, pathology, or condition.

PREVENTS: Stops, hinders or eliminates an action or condition.

PROCESS_OF: Disorder occurs in (higher) organism.

PRODUCES: Brings forth, generates or creates. This includes yields, secretes, emits, biosynthesizes, generates, releases, discharges, and creates.

STIMULATES: Increases or facilitates the action or function of (substance interaction).

TREATS: Applies a remedy with the object of effecting a cure or managing a condition.

USES: Employs in the carrying out of some activity. This includes applies, utilizes, employs, and avails.

SEMANTIC TYPE DEFINITIONS (organized by node semantic groups)

Activities & Behaviors

Activity: An operation or series of operations that an organism or machine carries out or participates in.

Behavior: Any of the psycho-social activities of humans or animals that can be observed directly by others or can be made systematically observable by the use of special strategies.

Daily or Recreational Activity: An activity carried out for recreation or exercise, or as part of daily life.

Event: A broad type for grouping activities, processes and states.

Governmental or Regulatory Activity: An activity carried out by officially constituted governments, or an activity related to the creation or enforcement of the rules or regulations governing some field of endeavor.

Individual Behavior: Behavior exhibited by a human or an animal that is not a direct result of interaction with other members of the species, but which may have an effect on others.

Machine Activity: An activity carried out primarily or exclusively by machines.

Occupational Activity: An activity carried out as part of an occupation or job.

Social Behavior: Behavior that is a direct result or function of the interaction of humans or animals with their fellows. This includes behavior that may be considered anti-social.

Anatomy

Anatomical Structure: A normal or pathological part of the anatomy or structural organization of an organism.

Body Location or Region: An area, subdivision, or region of the body demarcated for the purpose of topographical description.

Body Part, Organ, or Organ Component: A collection of cells and tissues which are localized to a specific area or combine and carry out one or more specialized functions of an organism. This ranges from gross structures to small components of complex organs. These structures are relatively localized in comparison to tissues.

Body Space or Junction: An area enclosed or surrounded by body parts or organs or the place where two anatomical structures meet or connect.

Body Substance: Extracellular material, or mixtures of cells and extracellular material, produced, excreted, or accreted by the body. Included here are substances such as saliva, dental enamel, sweat, and gastric acid.

Body System: A complex of anatomical structures that performs a common function.

Cell: The fundamental structural and functional unit of living organisms.

Cell Component: A part of a cell or the intercellular matrix, generally visible by light microscopy.

Embryonic Structure: An anatomical structure that exists only before the organism is fully formed; in mammals, for example, a structure that exists only prior to the birth of the organism. This structure may be normal or abnormal.

Fully Formed Anatomical Structure: An anatomical structure in a fully formed organism; in mammals, for example, a structure in the body after the birth of the organism.

Tissue: An aggregation of similarly specialized cells and the associated intercellular substance. Tissues are relatively non-localized in comparison to body parts, organs or organ components.

Chemicals & Drugs

Amino Acid, Peptide, or Protein: Amino acids and chains of amino acids connected by peptide linkages.

Antibiotic: A pharmacologically active compound produced by growing microorganisms which kill or inhibit growth of other microorganisms.

Biologically Active Substance: A generally endogenous substance produced or required by an organism, of primary interest because of its role in the biologic functioning of the organism that produces it.

Biomedical or Dental Material: A substance used in biomedicine or dentistry predominantly for its physical, as opposed to chemical, properties. Included here are biocompatible materials, tissue adhesives, bone cements, resins, toothpastes, etc.

Carbohydrate: A generic term that includes monosaccharides, oligosaccharides, and polysaccharides as well as substances derived from monosaccharides by reduction of the carbonyl group (alditols), by oxidation of one or more terminal group to carboxylic acids, or by replacement of one or more hydroxy groups by a hydrogen atom, an amino group, a thiol group or similar heteroatomic groups. It also includes derivatives of these compounds. Included here are sugar phosphates. Excluded are glycolipids and glycoproteins.

Chemical: Compounds or substances of definite molecular composition. Chemicals are viewed from two distinct perspectives in the network, functionally and structurally. Almost every chemical concept is assigned at least two types, generally one from the structure hierarchy and at least one from the function hierarchy.

Chemical Viewed Functionally: A chemical viewed from the perspective of its functional characteristics or pharmacological activities.

Chemical Viewed Structurally: A chemical or chemicals viewed from the perspective of their structural characteristics. Included here are concepts which can mean either a salt, an ion, or a compound (e.g., "Bromates" and "Bromides").

Clinical Drug: A pharmaceutical preparation as produced by the manufacturer. The name usually includes the substance, its strength, and the form, but may include the substance and only one of the other two items.

Eicosanoid: An oxygenated metabolite from polyunsaturated 20 carbon fatty acids including lipoxygenase and cyclooxygenase products and their synthetic analogs. This includes the prostaglandins and thromboxanes.

Element, Ion, or Isotope: One of the 109 presently known fundamental substances that comprise all matter at and above the atomic level. This includes elemental metals, rare gases, and most abundant naturally occurring radioactive elements, as well as the ionic counterparts of elements (Na⁺, Cl⁻), and the less abundant isotopic forms. This does not include organic ions such as iodoacetate to which the type 'Organic Chemical' is assigned.

Enzyme: A complex chemical, usually a protein, that is produced by living cells and which catalyzes specific biochemical reactions. There are six main types of enzymes: oxidoreductases, transferases, hydrolases, lyases, isomerases, and ligases.

Hazardous or Poisonous Substance: A substance of concern because of its potentially hazardous or toxic effects. This would include most drugs of abuse, as well as agents that require special handling because of their toxicity.

Hormone: In animals, a chemical usually secreted by an endocrine gland whose products are released into the circulating fluid. Hormones act as chemical messengers and regulate various physiologic processes such as growth, reproduction, metabolism, etc. They usually fall into two broad classes, steroid hormones and peptide hormones.

Immunologic Factor: A biologically active substance whose activities affect or play a role in the functioning of the immune system.

Indicator, Reagent, or Diagnostic Aid: A substance primarily of interest for its use in laboratory or diagnostic tests and procedures to detect, measure, examine, or analyze other chemicals, processes, or conditions.

Inorganic Chemical: Chemical elements and their compounds, excluding the hydrocarbons and their derivatives (except carbides, carbonates, cyanides, cyanates and carbon disulfide). Generally inorganic compounds contain ionic bonds. Included here are inorganic acids and salts, alloys, alkalies, and minerals.

Lipid: An inclusive group of fat or fat-derived substances that are soluble in nonpolar solvents related to fatty acid esters, fatty alcohols, sterols, waxes, etc. Included in this group are the saponifiable lipids such as glycerides (fats and oils), essential (volatile) oils, and phospholipids.

Neuroreactive Substance or Biogenic Amine: An endogenous substance whose activities affect or play an important role in the functioning of the nervous system. Included here are catecholamines, neuroregulators, neurophysins, etc.

Nucleic Acid, Nucleoside, or Nucleotide: A complex compound of high molecular weight occurring in living cells. These are basically of two types, ribonucleic (RNA) and deoxyribonucleic (DNA) acids. Nucleic acids are made of nucleotides (nitrogen-containing base,

a 5-carbon sugar, and one or more phosphate group) linked together by a phosphodiester bond between the 5' and 3' carbon atoms. Nucleosides are compounds composed of a purine or pyrimidine base (usually adenine, cytosine, guanine, thymine, uracil) linked to either a ribose or a deoxyribose sugar.

Organic Chemical: The general class of carbon-containing compounds, usually based on carbon chains or rings, and also containing hydrogen (hydrocarbons), with or without nitrogen, oxygen, or other elements in which the bonding between elements is generally covalent.

Organophosphorus Compound: An organic compound containing phosphorus as a constituent. Included here are organic phosphinic, phosphonic and phosphoric acid derivatives and their thiophosphorus counterparts. Excluded are phospholipids, sugar phosphates, phosphoproteins, nucleotides, and nucleic acids.

Pharmacologic Substance: A substance used in the treatment or prevention of pathologic disorders. This includes substances that occur naturally in the body and are administered therapeutically.

Receptor: A specific structure or site on the cell surface or within its cytoplasm that recognizes and binds with other specific molecules. These include the proteins on the surface of an immunocompetent cell that binds with antigens, or proteins found on the surface molecules that bind with hormones or neurotransmitters and react with other molecules that respond in a specific way.

Steroid: One of a group of polycyclic, 17-carbon-atom, fused-ring compounds occurring both in natural and synthetic forms. Included here are naturally occurring and synthetic steroids, bufanolides, cardanolides, homosteroids, norsteroids, and secosteroids.

Vitamin: A substance, usually an organic chemical complex, present in natural products or made synthetically, which is essential in the diet of man or other higher animals. Included here are vitamin precursors, provitamins, and vitamin supplements.

Concepts & Ideas

Classification: A term or system of terms denoting an arrangement by class or category.

Conceptual Entity: A broad type for grouping abstract entities or concepts.

Functional Concept: A concept which is of interest because it pertains to the carrying out of a process or activity.

Group Attribute: A conceptual entity which refers to the frequency or distribution of certain characteristics or phenomena in certain groups.

Idea or Concept: An abstract concept, such as a social, religious or philosophical concept.

Intellectual Product: A conceptual entity resulting from human endeavor. Concepts assigned to this type generally refer to information created by humans for some purpose.

Language: The system of communication used by a particular nation or people.

Qualitative Concept: A concept which is an assessment of some quality, rather than a direct measurement.

Quantitative Concept: A concept which involves the dimensions, quantity or capacity of something using some unit of measure, or which involves the quantitative comparison of entities.

Regulation or Law: An intellectual product resulting from legislative or regulatory activity.

Spatial Concept: A location, region, or space, generally having definite boundaries.

Temporal Concept: A concept which pertains to time or duration.

Devices

Drug Delivery Device: A medical device that contains a clinical drug or drugs.

Medical Device: A manufactured object used primarily in the diagnosis, treatment, or prevention of physiologic or anatomic disorders.

Research Device: A manufactured object used primarily in carrying out scientific research or experimentation.

Disorders

Acquired Abnormality: An abnormal structure, or one that is abnormal in size or location, found in or deriving from a previously normal structure. Acquired abnormalities are distinguished from diseases even though they may result in pathological functioning (e.g., "hernias incarcerate").

Anatomical Abnormality: An abnormal structure, or one that is abnormal in size or location.

Cell or Molecular Dysfunction: A pathologic function inherent to cells, parts of cells, or molecules.

Congenital Abnormality: An abnormal structure, or one that is abnormal in size or location, present at birth or evolving over time as a result of a defect in embryogenesis.

Disease or Syndrome: A condition which alters or interferes with a normal process, state, or activity of an organism. It is usually characterized by the abnormal functioning of one or more of the host's systems, parts, or organs. Included here is a complex of symptoms descriptive of a disorder.

Experimental Model of Disease: A representation in a non-human organism of a human disease for the purpose of research into its mechanism or treatment.

Finding: That which is discovered by direct observation or measurement of an organism attribute or condition, including the clinical history of the patient. The history of the presence of a disease is a 'Finding' and is distinguished from the disease itself.

Injury or Poisoning: A traumatic wound, injury, or poisoning caused by an external agent or force.

Mental or Behavioral Dysfunction: A clinically significant dysfunction whose major manifestation is behavioral or psychological. These dysfunctions may have identified or presumed biological etiologies or manifestations.

Neoplastic Process: A new and abnormal growth of tissue in which the growth is uncontrolled and progressive. The growths may be malignant or benign.

Pathologic Function: A disordered process, activity, or state of the organism as a whole, of a body system or systems, or of multiple organs or tissues. Included here are normal responses to a negative stimulus as well as pathologic conditions or states that are less specific than a disease. Pathologic functions frequently have systemic effects.

Sign or Symptom: An observable manifestation of a disease or condition based on clinical judgment, or a manifestation of a disease or condition which is experienced by the patient and reported as a subjective observation.

Genes & Molecular Sequences

Amino Acid Sequence: The sequence of amino acids as arrayed in chains, sheets, etc., within the protein molecule. It is of fundamental importance in determining protein structure.

Carbohydrate Sequence: The sequence of carbohydrates within polysaccharides, glycoproteins, and glycolipids.

Gene or Genome: A specific sequence, or in the case of the genome the complete sequence, of nucleotides along a molecule of DNA or RNA (in the case of some viruses) which represent the functional units of heredity.

Molecular Sequence: A broad type for grouping the collected sequences of amino acids, carbohydrates, and nucleotide sequences. Descriptions of these sequences are generally reported in the published literature and/or are deposited in and maintained by databanks such as GenBank, European Molecular Biology Laboratory (EMBL), National Biomedical Research Foundation (NBRF), or other sequence repositories.

Nucleotide Sequence: The sequence of purines and pyrimidines in nucleic acids and polynucleotides. Included here are nucleotide-rich regions, conserved sequence, and DNA transforming region.

Geographic Areas

Geographic Area: A geographic location, generally having definite boundaries.

Living Beings

Age Group: An individual or individuals classified according to their age.

Alga: A chiefly aquatic plant that contains chlorophyll, but does not form embryos during development and lacks vascular tissue.

Amphibian: A cold-blooded, smooth-skinned vertebrate which characteristically hatches as an aquatic larva, breathing by gills. When mature, the amphibian breathes with lungs.

Animal: An organism with eukaryotic cells, and lacking stiff cell walls, plastids and photosynthetic pigments.

Archaeon: A member of one of the three domains of life, formerly called Archaeobacteria under the taxon Bacteria, but now considered separate and distinct. Archaea are characterized by: 1) the presence of characteristic tRNAs and ribosomal RNAs; 2) the absence of peptidoglycan cell walls; 3) the presence of ether-linked lipids built from branched-chain subunits; and 4) their occurrence in unusual habitats. While archaea resemble bacteria in morphology and genomic organization, they resemble eukarya in their method of genomic replication.

Bacterium: A small, typically one-celled, prokaryotic micro-organism.

Bird: A vertebrate having a constant body temperature and characterized by the presence of feathers.

Family Group: An individual or individuals classified according to their family relationships or relative position in the family unit.

Fish: A cold-blooded aquatic vertebrate characterized by fins and breathing by gills. Included here are fishes having either a bony skeleton, such as a perch, or a cartilaginous skeleton, such as a shark, or those lacking a jaw, such as a lamprey or hagfish.

Fungus: A eukaryotic organism characterized by the absence of chlorophyll and the presence of a rigid cell wall. Included here are both slime molds and true fungi such as yeasts, molds, mildews, and mushrooms.

Group: A conceptual entity referring to the classification of individuals according to certain shared characteristics.

Human: Modern man, the only remaining species of the Homo genus.

Invertebrate: An animal which has no spinal column.

Mammal: A vertebrate having a constant body temperature and characterized by the presence of hair, mammary glands and sweat glands.

Organism: Generally, a living individual, including all plants and animals.

Patient or Disabled Group: An individual or individuals classified according to a disability, disease, condition or treatment.

Plant: An organism having cellulose cell walls, growing by synthesis of inorganic substances, generally distinguished by the presence of chlorophyll, and lacking the power of locomotion. Plant parts are included here as well.

Population Group: An individual or individuals classified according to their sex, racial origin, religion, common place of living, financial or social status, or some other cultural or behavioral attribute.

Professional or Occupational Group: An individual or individuals classified according to their vocation.

Reptile: A cold-blooded vertebrate having an external covering of scales or horny plates. Reptiles breathe by means of lungs and are generally egg-laying.

Rickettsia or Chlamydia: An organism intermediate in size and complexity between a virus and a bacterium, and which is parasitic within the cells of insects and ticks. Included here are all the chlamydias, also called "PLT" for psittacosis- lymphogranuloma venereum-trachoma.

Vertebrate: An animal which has a spinal column.

Virus: An organism consisting of a core of a single nucleic acid enclosed in a protective coat of protein. A virus may replicate only inside a host living cell. A virus exhibits some but not all of the usual characteristics of living things.

Objects

Entity: A broad type for grouping activities, processes and states.

Food: Any substance generally containing nutrients, such as carbohydrates, proteins, and fats, that can be ingested by a living organism and metabolized into energy and body tissue. Some foods are naturally occurring, others are either partially or entirely made by humans.

Manufactured Object: A physical object made by human beings.

Physical Object: An object perceptible to the sense of vision or touch.

Substance: A material with definite or fairly definite chemical composition.

Occupations

Biomedical Occupation or Discipline: A vocation, academic discipline, or field of study related to biomedicine.

Occupation or Discipline: A vocation, academic discipline, or field of study, or a subpart of an occupation or discipline.

Organizations

Health Care Related Organization: An established organization which carries out specific functions related to health care delivery or research in the life sciences.

Organization: The result of uniting for a common purpose or function. The continued existence of an organization is not dependent on any of its members, its location, or particular facility. Components or subparts of organizations are also included here. Although the names of organizations are sometimes used to refer to the buildings in which they reside, they are not inherently physical in nature.

Professional Society: An organization uniting those who have a common vocation or who are involved with a common field of study.

Self-help or Relief Organization: An organization whose purpose and function is to provide assistance to the needy or to offer support to those sharing similar problems.

Phenomena

Biologic Function: A state, activity or process of the body or one of its systems or parts.

Environmental Effect of Humans: A change in the natural environment that is a result of the activities of human beings.

Human-caused Phenomenon or Process: A phenomenon or process that is a result of the activities of human beings.

Laboratory or Test Result: The outcome of a specific test to measure an attribute or to determine the presence, absence, or degree of a condition.

Natural Phenomenon or Process: A phenomenon or process that occurs irrespective of the activities of human beings.

Phenomenon or Process: A process or state which occurs naturally or as a result of an activity.

Physiology

Cell Function: A physiologic function inherent to cells or cell components.

Clinical Attribute: An observable or measurable property or state of an organism of clinical interest.

Genetic Function: Functions of or related to the maintenance, translation or expression of the genetic material.

Mental Process: A physiologic function involving the mind or cognitive processing.

Molecular Function: A physiologic function occurring at the molecular level.

Organ or Tissue Function: A physiologic function of a particular organ, organ system, or tissue.

Organism Attribute: A property of the organism or its major parts.

Organism Function: A physiologic function of the organism as a whole, of multiple organ systems, or of multiple organs or tissues.

Physiologic Function: A normal process, activity, or state of the body.

Procedures

Diagnostic Procedure: A procedure, method, or technique used to determine the nature or identity of a disease or disorder. This excludes procedures which are primarily carried out on specimens in a laboratory.

Educational Activity: An activity related to the organization and provision of education.

Health Care Activity: An activity of or relating to the practice of medicine or involving the care of patients.

Laboratory Procedure: A procedure, method, or technique used to determine the composition, quantity, or concentration of a specimen, and which is carried out in a clinical laboratory. Included here are procedures which measure the times and rates of reactions.

Molecular Biology Research Technique: Any of the techniques used in the study of or the directed modification of the gene complement of a living organism.

Research Activity: An activity carried out as part of research or experimentation.

Therapeutic or Preventive Procedure: A procedure, method, or technique designed to prevent a disease or a disorder, or to improve physical function, or used in the process of treating a disease or injury.