



Project Categories & Subcategories

Each GSEF project is entered in one of the twenty categories below. You may optionally also select a subcategory (listed in italics). Your school, local, or regional fair may use different categories. Please check with those fairs for the appropriate category listings at that level of competition. If you are not sure which category to choose, ask yourself which group of judges would be most qualified to understand your research. **Every category listed below also has a subcategory option of "Other".**

ANIMAL SCIENCES

Animal Behavior
Cellular Studies
Development
Ecology
Genetics
Nutrition & Growth
Physiology
Systematics & Evolution

BEHAVIORAL & SOCIAL SCIENCES

Clinical & Developmental Psychology
Cognitive Psychology
Physiological Psychology
Sociology & Social Psychology

BIOCHEMISTRY

Analytical Biochemistry
General Biochemistry
Medicinal Biochemistry
Structural Biochemistry

BIOMEDICAL & HEALTH SCIENCES

Cell, Organ, & Systems Physiology
Genetics & Molecular Biology of Disease
Immunology
Nutrition & Natural Products
Pathophysiology

CELLULAR & MOLECULAR BIOLOGY

Cell Physiology
Cellular Immunology
Genetics
Molecular Biology
Neurobiology

CHEMISTRY

Analytical Chemistry
Computational Chemistry
Environmental Chemistry
Inorganic Chemistry
Materials Chemistry
Organic Chemistry
Physical Chemistry

COMPUTATIONAL BIOLOGY & BIOINFORMATICS

Computational Biomodeling
Computational Epidemiology
Computational Neuroscience
Computational Pharmacology
Genomics

EARTH & ENVIRONMENTAL SCIENCES

Atmospheric Science
Climate Science
Environmental Effects on Ecosystems
Geosciences
Water Science

EMBEDDED SYSTEMS

Circuits
Internet of Things
Microcontrollers
Networking & Data Communications
Optics
Sensors
Signal Processing

ENERGY: CHEMICAL

Alternative Fuels
Computational Energy Science
Fossil Fuel Energy
Fuel Cells & Battery Development
Microbial Fuel Cells
Solar Materials

ENERGY: PHYSICAL

Hydro Power
Nuclear Power
Solar
Sustainable Design
Thermal Power
Wind

ENGINEERING MECHANICS

Aerospace & Aeronautical Engineering
Civil Engineering
Computational Mechanics
Control Theory
Ground Vehicle Systems
Industrial Engineering-Processing
Mechanical Engineering
Naval Systems

ENVIRONMENTAL ENGINEERING

Bioremediation
Land Reclamation
Pollution Control
Recycling & Waste Management
Water Resources Management

MATERIALS SCIENCE

Biomaterials
Ceramic & Glasses
Composite Materials
Computation & Theory
Electronic, Optical & Magnetic Materials

Nanomaterials
Polymers

MATHEMATICS

Algebra
Analysis
Combinatorics, Graph Theory, & Game Theory
Geometry & Topology
Number Theory
Probability & Statistics

MICROBIOLOGY

Antimicrobials & Antibiotics
Applied Microbiology
Bacteriology
Environmental Microbiology
Microbial Genetics
Virology

PHYSICS & ASTRONOMY

Atomic, Molecular, & Optical Physics
Astronomy & Cosmology
Biological Physics
Computational Physics & Astrophysics
Condensed Matter & Materials
Instrumentation
Magnetics, Electromagnetics & Plasmas
Mechanics
Nuclear & Particle Physics
Optics, Lasers, Masers
Quantum Computation
Theoretical Physics

PLANT SCIENCES

Agriculture & Agronomy
Ecology
Genetics & Breeding
Growth & Development
Pathology
Plant Physiology
Systematics & Evolution

ROBOTICS & INTELLIGENT MACHINES

Biomechanics
Cognitive Systems
Control Theory
Machine Learning
Robot Kinematics

SYSTEMS SOFTWARE

Algorithms
Cybersecurity
Databases
Human/Machine Interface
Languages & Operating Systems
Mobile Apps
Online Learning

ANIMAL SCIENCES

This category includes all aspects of animals and animal life, animal life cycles, and animal interactions with one another or with their environment. Examples of investigations included in this category would involve the study of the structure, physiology, development, and classification of animals, animal ecology, animal husbandry, entomology, ichthyology, ornithology, and herpetology, as well as the study of animals at the cellular and molecular level which would include cytology, histology, and cellular physiology.

Subcategories:

- ◆ **Animal Behavior:** Study of animal activities which includes investigating animal interactions within and between species or an animal's response to environmental factors. Examples are animal communication, learning and intelligence, rhythmic functions, sensory preferences, pheromones, and environmental effects on behaviors, both naturally and experimentally induced.
- ◆ **Cellular Studies:** Study of animal cells involving the use of microscopy to study cell structure and studies investigating activity within cells such as enzyme pathways, cellular biochemistry, and synthesis pathways for DNA, RNA, and protein.
- ◆ **Development:** Study of an organism from the time of fertilization through birth or hatching and into later life. This includes cellular and molecular aspects of fertilization, development, regeneration, and environmental effects on development.
- ◆ **Ecology:** Study of interactions and behavioral relationships among animals, and animals and plants, with their environment and with one another.
- ◆ **Genetics:** Study of species and population genetics at the organismal or cellular level.
- ◆ **Nutrition and Growth:** Study of natural, artificial, or maternal nutrients on animal growth, development, and reproduction including the use and effects of biological and chemical control agents to control reproduction and population numbers.
- ◆ **Physiology:** Study of one of the 11 animal systems. This includes structural and functional studies, system mechanics, and the effect of environmental factors or natural variations on the structure or function of a system. Similar studies conducted specifically at the cellular level should select the cellular studies subcategory.
- ◆ **Systematics and Evolution:** Study of animal classification and phylogenetic methods including the evolutionary relationships between species and populations. This includes morphological, biochemical, genetic, and modeled systems to describe the relationship of animals to one another.

BEHAVIORAL AND SOCIAL SCIENCES

The science or study of the thought processes and behavior of humans and other animals in their interactions with the environment studied through observational and experimental methods.

Subcategories:

- ◆ **Clinical and Developmental Psychology:** Study and treatment of emotional or behavioral disorders. Developmental psychology is concerned with the study of progressive behavioral changes in an individual from birth until death.
- ◆ **Cognitive Psychology:** Study of cognition, the mental processes that underlie behavior, including thinking, deciding, reasoning, and to some extent motivation and emotion.

- ◆ **Neuroscience:** Studies of the neural basis of cognitive processes, including learning and memory, language and thought, perception, attention, and affect. It investigates the human brain, from the functional organization of large scale cerebral systems to microscopic neurochemical processes.
- ◆ **Physiological Psychology:** Study of the biological and physiological basis of behavior.
- ◆ **Sociology and Social Psychology:** Study of human social behavior, especially the study of the origins, organization, institutions, and development of human society. Sociology is concerned with all group activities-economic, social, political, and religious.

BIOCHEMISTRY

The study of the chemical basis of processes occurring in living organisms, including the processes by which these substances enter into, or are formed in, the organisms and react with each other and the environment.

Subcategories:

- ◆ **Analytical Biochemistry:** Study of the separation, identification, and quantification of chemical components relevant to living organisms.
- ◆ **General Biochemistry:** Study of chemical processes, including interactions and reactions, relevant to living organisms.
- ◆ **Medicinal Biochemistry:** Study of biochemical processes within the human body, with special reference to health and disease.
- ◆ **Structural Biochemistry:** Study of the structure and or function of biological molecules.

BIOMEDICAL AND HEALTH SCIENCES

This category focuses on studies specifically designed to address issues of human health and disease. It includes studies on the diagnosis, treatment, prevention or epidemiology of disease and other damage to the human body or mental systems. Includes studies of normal functioning and may investigate internal as well as external factors such as feedback mechanisms, stress or environmental impact on human health and disease.

Subcategories:

- ◆ **Cell, Organ, and Systems Physiology:** These studies investigate mechanisms that are involved in maintaining health or when disrupted, cause disease. They could involve investigating such things as the role of cell signaling pathways both within the cell (intracellular) and/or between cells (extracellular). Studies in this subcategory could investigate the maintenance of homeostasis at the organ or whole body level (e.g., hormonal control and regulation). These studies may also be in areas such as disease-related, stress-related, biochemical, mechanical, or physical changes at the tissue, organ, and /or cellular level.
- ◆ **Genetics and Molecular Biology of Disease:** These studies investigate the genetic and molecular mechanisms involved in the regulatory pathways that maintain normal body and cellular function or if disturbed can lead to disease. Studies could include examining the activation and deactivation of genes (e.g., transcription factors or epigenetic regulation) or involve more classical genetic identification studies.

CATEGORY CONTINUES ON FOLLOWING PAGE

BIOMEDICAL AND HEALTH SCIENCES

CATEGORY CONTINUED FROM PREVIOUS PAGE

- ◆ **Immunology:** These studies will investigate any aspects of the immune system that are involved in maintaining health or when altered lead to pathology. These studies can include new investigations of normal immune function (e.g., immune cell interactions and signaling), or they may study diseases caused by disorders in regulation of the immune system (e.g., immunodeficiency or autoimmunity). Alternatively the studies could investigate problems such as graft vs host or host versus graft disease that arise during the treatment of other diseases or conditions.
- ◆ **Nutrition and Natural Products:** The study of food, nutrients and dietary need in humans, and the effects of food and nourishment on the body. These studies may include the effects of natural or supplemental nutrients and nutrition.
- ◆ **Pathophysiology:** Studies focused on determining specific causes of disease and on physiological mechanisms responsible for disease development. Investigations in this category will examine changes in the normal physiological balance, or homeostasis that cause a reaction(s) within the body leading to disease.

CELLULAR AND MOLECULAR BIOLOGY

An interdisciplinary field studying the structure, function, intracellular pathways, and formation of cells. Studies involve understanding life and cellular processes specifically at the molecular level.

Subcategories:

- ◆ **Cell Physiology:** Study of the cell cycle, cell function, and interactions between cells or between cells and their environment.
- ◆ **Cellular Immunology:** Study of the structure and function of the immune system at the cellular level. This includes investigations of innate and acquired (adaptive) immunity, the cellular communication pathways involved in immunity, cellular recognition and interactions between antigens and antibodies.
- ◆ **Genetics:** Study of molecular genetics focusing on the structure and function of genes at a molecular level.
- ◆ **Molecular Biology:** Study of biology at the molecular level. Chiefly concerns itself with understanding the interactions between the various systems of a cell, including the interrelationships of DNA, RNA and protein synthesis and learning how these interactions are regulated, such as during transcription and translation, the significance of introns and exons or coding issues.
- ◆ **Neurobiology:** Study of the structure and function of the nervous system at the cellular or molecular level.

CHEMISTRY

Studies exploring the science of the composition, structure, properties, and reactions of matter not involving biochemical systems.

Subcategories:

- ◆ **Analytical Chemistry:** Study of the separation, identification, and quantification of the chemical components of materials.
- ◆ **Computational Chemistry:** Study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Chemistry.

- ◆ **Environmental Chemistry:** Study of chemical species in the natural environment, including the effects of human activities, such as the design of products and processes that reduce or eliminate the use or generation of hazardous substances.
- ◆ **Inorganic Chemistry:** Study of the properties and reactions of inorganic and organometallic compounds.
- ◆ **Materials Chemistry:** Chemical study of the design, synthesis and properties of substances, including condensed phases (solids, liquids, polymers) and interfaces, with a useful or potentially useful function, such as catalysis or solar energy.
- ◆ **Organic Chemistry:** Study of carbon-containing compounds, including hydrocarbons and their derivatives.
- ◆ **Physical Chemistry:** Study of the fundamental physical basis of chemical systems and processes, including chemical kinetics, chemical thermodynamics, electrochemistry, photochemistry, spectroscopy, statistical mechanics and astro-chemistry.

COMPUTATIONAL BIOLOGY AND BIOINFORMATICS

Studies that primarily focus on the discipline and techniques of computer science and mathematics as they relate to biological systems. This includes the development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavior, and social systems.

Subcategories:

- ◆ **Computational Biomodeling:** Studies that involve computer simulations of biological systems most commonly with a goal of understanding how cells or organism develop, work collectively and survive.
- ◆ **Computational Epidemiology:** Study of disease frequency and distribution, and risk factors and socioeconomic determinants of health within populations. Such studies may include gathering information to confirm existence of disease outbreaks, developing case definitions and analyzing epidemic data, establishing disease surveillance, and implementing methods of disease prevention and control.
- ◆ **Computational Evolutionary Biology:** Study that applies the discipline and techniques of computer science and mathematics to explore the processes of change in populations of organisms, especially taxonomy, paleontology, ethology, population genetics and ecology.
- ◆ **Computational Neuroscience:** Study that applies the discipline and techniques of computer science and mathematics to understand brain function in terms of the information processing properties of the structures that make up the nervous system.
- ◆ **Computational Pharmacology:** Study that applies the discipline and techniques of computer science and mathematics to predict and analyze the responses to drugs.
- ◆ **Genomics:** Study of the function and structure of genomes using recombinant DNA, sequencing, and bioinformatics.

EARTH AND ENVIRONMENTAL SCIENCES

Studies of the environment and its effect on organisms/systems, including investigations of biological processes such as growth and life span, as well as studies of Earth systems and their evolution.

Subcategories:

- ◆ **Atmospheric Science:** Studies of the earth's atmosphere, including air quality and pollution and the processes and effects of the atmosphere on other Earth systems as well as meteorological investigations.
- ◆ **Climate Science:** Studies of Earth's climate, particularly evidential study of climate change.
- ◆ **Environmental Effects on Ecosystems:** Studies of the impact of environmental changes (natural or as a result of human interaction) on ecosystems, including empirical pollution studies.
- ◆ **Geosciences:** Studies of Earth's land processes, including mineralogy, plate tectonics, volcanism, and sedimentology.
- ◆ **Water Science:** Studies of Earth's water systems, including water resources, movement, distribution, and water quality.

EMBEDDED SYSTEMS

Studies involving electrical systems in which information is conveyed via signals and waveforms for purposes of enhancing communications, control and/or sensing.

Subcategories:

- ◆ **Circuits:** Study, analysis, and design of electronic circuits and their components, including testing.
- ◆ **Internet of Things:** Study of the interconnection of unique computing devices with the existing infrastructure of the Internet and the cloud.
- ◆ **Microcontrollers:** Study and engineering of microcontrollers and their use to control other devices.
- ◆ **Networking and Data Communications:** Study of systems that transmit any combination of voice, video, and/or data among users.
- ◆ **Optics:** Use of visible or infrared light instead of signals sent over wires. Study and development of optical devices and systems devoted to practical applications such as computation.
- ◆ **Sensors:** Study and design of devices that transmit an electrical response to an external device.
- ◆ **Signal Processing:** Extraction of signals from noise and their conversion into a representation for modeling and analysis.

ENERGY: CHEMICAL

Studies involving biological and chemical processes of renewable energy sources, clean transport, and alternative fuels.

Subcategories:

- ◆ **Alternative Fuels:** Any method of powering an engine that does not involve petroleum (oil). Some alternative fuels are electricity, methane, hydrogen, natural gas, and wood.
- ◆ **Computational Energy Science:** Study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Energy Science.

- ◆ **Fossil Fuel Energy:** Studies involving energy from a hydrocarbon deposit, such as petroleum, coal, or natural gas, derived from living matter of a previous geologic time and used for fuel.
- ◆ **Fuel Cells and Battery Development:** Study, analysis and development of fuel cells and batteries that convert and/or store chemical energy into electricity.
- ◆ **Microbial Fuel Cells:** Study of fuel cells that use or mimic bacterial interactions found in nature to produce electricity.
- ◆ **Solar Materials:** Study of materials used to convert and store solar energy through chemical changes. This includes topics such as thermal storage and photovoltaic materials.

ENERGY: PHYSICAL

Studies of renewable energy structures/processes including energy production and efficiency.

Subcategories:

- ◆ **Hydro Power:** Application of engineering principles and design concepts to capture energy from falling and running water to be converted to another form of energy.
- ◆ **Nuclear Power:** Application of engineering principles and design concepts to capture nuclear energy to be converted to another form of energy.
- ◆ **Solar:** Application of engineering principles and design concepts to capture energy from the sun to be converted to another form of energy.
- ◆ **Sustainable Design:** Application of engineering principles and design concepts to plan and/or construct buildings and infrastructure that minimize environmental impact.
- ◆ **Thermal Power:** Application of engineering principles and design concepts to capture energy from the Earth's crust to be converted to another form of energy.
- ◆ **Wind:** Application of engineering principles and design concepts to capture energy from the wind to be converted to another form of energy.

ENGINEERING MECHANICS

Studies that focus on the science and engineering that involve movement or structure. The movement can be by the apparatus or the movement can affect the apparatus.

Subcategories:

- ◆ **Aerospace and Aeronautical Engineering:** Studies involving the design of aircraft and space vehicles and the direction of the technical phases of their manufacture and operation.
- ◆ **Civil Engineering:** Studies that involve the planning, designing, construction, and maintenance of structures and public works, such as bridges or dams, roads, water supply, sewer, flood control and, traffic.
- ◆ **Computational Mechanics:** A study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Engineering Mechanics.

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ENGINEERING MECHANICS

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- ◆ **Control Theory:** The study of dynamical systems, including controllers, systems, and sensors that are influenced by inputs.
- ◆ **Ground Vehicle Systems:** The design of ground vehicles and the direction of the technical phases of their manufacture and operation.
- ◆ **Industrial Engineering-Processing:** Studies of efficient production of industrial goods as affected by elements such as plant and procedural design, the management of materials and energy, and the integration of workers within the overall system. The industrial engineer designs methods, not machinery.
- ◆ **Mechanical Engineering:** Studies that involve the generation and application of heat and mechanical power and the design, production, and use of machines and tools.
- ◆ **Naval Systems:** Studies of the design of ships and the direction of the technical phases of their manufacture and operation.

ENVIRONMENTAL ENGINEERING

Studies of renewable energy structures/processes including energy production and efficiency.

Subcategories:

- ◆ **Bioremediation:** The use of biological agents, such as bacteria or plants, to remove or neutralize contaminants. This includes phytoremediation, constructed wetlands for wastewater treatment, biodegradation, etc.
- ◆ **Land Reclamation:** The application of engineering principles and design techniques to restore land to a more productive use or its previous undisturbed state.
- ◆ **Pollution Control:** The application of engineering principles and design techniques to remove pollution from air, soil, and/or water.
- ◆ **Recycling and Waste Management:** The extraction and reuse of useful substances from discarded items, garbage, or waste. The process of managing, and disposing of, wastes and hazardous substances through methodologies such as landfills, sewage treatment, composting, waste reduction, etc.
- ◆ **Water Resources Management:** The application of engineering principles and design techniques to improve the distribution and management of water resources.

MATERIALS SCIENCE

The study of the characteristics and uses of various materials with improvements to their design which may add to their advanced engineering performance.

Subcategories:

- ◆ **Biomaterials:** Studies involving any matter, surface, or construct that interacts with biological systems. Such materials are often used and/or adapted for a medical application, and thus comprise whole or part of a living structure or biomedical device which performs, augments, or replaces a natural function.

- ◆ **Ceramic and Glasses:** Studies involving materials composed of ceramic and glass – often defined as all solid materials except metals and their alloys that are made by the high-temperature processing of inorganic raw materials.
- ◆ **Composite Materials:** Studies involving materials composed of two or more different materials combined together to create a superior and unique material.
- ◆ **Computation and Theory:** Studies that involve the theory and modeling of materials.
- ◆ **Electronic, Optical and Magnetic Materials:** Study and development of materials used to form highly complex systems, such as integrated electronic circuits, optoelectronic devices, and magnetic and optical mass storage media. The various materials, with precisely controlled properties, perform numerous functions, including the acquisition, processing, transmission, storage, and display of information.
- ◆ **Nanomaterials:** Study and development of nanoscale materials; materials with structural features (particle size or grain size, for example) of at least one dimension in the range 1-100 nm.
- ◆ **Polymers:** Study and development of polymers; materials that have a molecular structure consisting chiefly or entirely of a large number of similar units bonded together, e.g., many synthetic organic materials used as plastics and resins.

MATHEMATICS

The study of the measurement, properties, and relationships of quantities and sets, using numbers and symbols. The deductive study of numbers, geometry, and various abstract constructs, or structures.

Subcategories:

- ◆ **Algebra:** Study of algebraic operations and/or relations and the structures which arise from them. An example is given by (systems of) equations which involve polynomial functions of one or more variables.
- ◆ **Analysis:** Study of infinitesimal processes in mathematics, typically involving the concept of a limit. This begins with differential and integral calculus, for functions of one or several variables, and includes differential equations.
- ◆ **Combinatorics, Graph Theory, and Game Theory:** Study of combinatorial structures in mathematics, such as finite sets, graphs, and games, often with a view toward classification and/or enumeration.
- ◆ **Geometry and Topology:** Study of the shape, size, and other properties of figures and spaces. Includes such subjects as Euclidean geometry, non-Euclidean geometries (spherical, hyperbolic, Riemannian, Lorentzian), and knot theory (classification of knots in 3-space).
- ◆ **Number Theory:** Study of the arithmetic properties of integers and related topics such as cryptography.
- ◆ **Probability and Statistics:** Mathematical study of random phenomena and the study of statistical tools used to analyze and interpret data.

MICROBIOLOGY

The study of microorganisms, including bacteria, viruses, fungi, prokaryotes, and simple eukaryotes as well as antimicrobial and antibiotic substances.

Subcategories:

- ◆ **Antimicrobials and Antibiotics:** Study of a substance that kills or inhibits the growth of a microorganism.
- ◆ **Applied Microbiology:** Study of microorganisms having potential applications in human, animal or plant health or the use of microorganisms in the production of energy.
- ◆ **Bacteriology:** Study of bacteria and bacterial diseases and the microorganisms responsible for causing a disease.
- ◆ **Environmental Microbiology:** Study of the structure, function, diversity and relationship of microorganisms with respect to their environment. This includes the study of biofilms.
- ◆ **Microbial Genetics:** Study of how microbial genes are organized and regulated and their involvement in cellular function.
- ◆ **Virology:** Study of viruses and viral diseases.

PHYSICS AND ASTRONOMY

Physics is the science of matter and energy and of interactions between the two. Astronomy is the study of anything in the universe beyond the Earth.

Subcategories:

- ◆ **Atomic, Molecular, and Optical Physics:** Study of atoms, simple molecules, electrons and light, and their interactions.
- ◆ **Astronomy and Cosmology:** Study of space, the universe as a whole, including its origins and evolution, the physical properties of objects in space and computational astronomy.
- ◆ **Biological Physics:** Study of the physics of biological processes.
- ◆ **Computational Physics and Astrophysics:** Study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Physics and Astrophysics.
- ◆ **Condensed Matter and Materials:** Study of the properties of solids and liquids. Topics such as superconductivity, semi-conductors, complex fluids, and thin films are studied.
- ◆ **Instrumentation:** Process of developing means of precise measurement of various variables such as flow and pressure while maintaining control of the variables at desired levels of safety and economy.
- ◆ **Magnetics, Electromagnetics and Plasmas:** Study of electrical and magnetic fields and of matter in the plasma phase and their effects on materials in the solid, liquid or gaseous states.
- ◆ **Mechanics:** Classical physics and mechanics, including the macroscopic study of forces, vibrations and flows; on solid, liquid and gaseous materials.
- ◆ **Nuclear and Particle Physics:** Study of the physical properties of the atomic nucleus and of fundamental particles and the forces of their interaction.

- ◆ **Optics, Lasers, and Masers:** Study of the physical properties of light, lasers and masers.
- ◆ **Quantum Computation:** Study of the laws of quantum mechanics to process information. This includes studies involving the physics of information processing, quantum logic, quantum algorithms, quantum error correction, and quantum communication.
- ◆ **Theoretical Physics:** Study of nature, phenomena and the laws of physics employing mathematical models and abstractions rather than experimental processes.

PLANT SCIENCES

Studies of plants and how they live, including structure, physiology, development, and classification. Includes plant cultivation, development, ecology, genetics and plant breeding, pathology, physiology, systematics and evolution.

Subcategories:

- ◆ **Agriculture and Agronomy:** Application of various soil and plant sciences to soil management and agricultural and horticultural crop production. Includes biological and chemical controls of pests, hydroponics, fertilizers and supplements.
- ◆ **Ecology:** Study of interactions and relationships among plants, and plants and animals, with their environment.
- ◆ **Genetics and Breeding:** Study of organismic and population genetics of plants. The application of plant genetics and biotechnology to crop improvement. This includes genetically modified crops.
- ◆ **Growth and Development:** Study of a plant from earliest stages through germination and into later life. This includes cellular and molecular aspects of development and environmental effects, natural or manmade, on development and growth.
- ◆ **Pathology:** Study of plant disease states, and their causes, processes, and consequences. This includes effects of parasites or disease-causing microbes.
- ◆ **Plant Physiology:** Study of functions in plants and plant cells. This includes cellular mechanisms such as photosynthesis and transpiration, and how plant processes are affected by environmental factors or natural variations.
- ◆ **Systematics and Evolution:** Study of classification of organisms and their evolutionary relationships. This includes morphological, biochemical, genetic, and modeled systems.

ROBOTICS AND INTELLIGENT MACHINES

Studies in which the use of machine intelligence is paramount to reducing the reliance on human intervention.

Subcategories:

- ◆ **Biomechanics:** Studies and apparatus which mimic the role of mechanics in biological systems.
- ◆ **Cognitive Systems:** Studies/apparatus that operate similarly to the ways humans think and process information. Systems that provide for increased interaction of people and machines to more naturally extend and magnify human expertise, activity, and cognition.

CATEGORY CONTINUES ON FOLLOWING PAGE

ROBOTICS AND INTELLIGENT MACHINES

CATEGORY CONTINUED FROM PREVIOUS PAGE

- ◆ **Control Theory:** Studies that explore the behavior of dynamical systems with inputs, and how their behavior is modified by feedback. This includes new theoretical results and the applications of new and established control methods, system modelling, identification and simulation, the analysis and design of control systems (including computer-aided design), and practical implementation.
- ◆ **Machine Learning:** Construction and/or study of algorithms that can learn from data.
- ◆ **Robot Kinematics:** Study of movement in robotic systems.

SYSTEMS SOFTWARE

The study or development of software, information processes or methodologies to demonstrate, analyze, or control a process/solution.

Subcategories:

- ◆ **Algorithms:** Study or creation of algorithms - step-by-step procedure of calculations to complete a specific task in data processing, automated reasoning and computing.
- ◆ **Cybersecurity:** Studies involving the protection of a computer or computer system against unauthorized access or attacks. This can include studies involving hardware, network, software, host or multimedia security.
- ◆ **Databases:** Studies that create or analyze data organization for ease of access, management and update.
- ◆ **Human/Machine Interface:** Software application that presents information to a user about the state of a process and to accept and implement the operator's control instructions.
- ◆ **Languages and Operating Systems:** Studies that involve the development or analysis of artificial languages used to write instructions that can be translated into machine language and then executed by a computer or system software responsible for the direct control and management of hardware and basic system operations of a computer or mobile device.
- ◆ **Mobile Apps:** Study involving a software application developed specifically for use on small, wireless computing devices. These studies may include front-end development techniques, such as user interface design and cross-platform support, and/or back-end development techniques, such as data services and business logic.
- ◆ **Online Learning:** Studies that focus on utilizing electronic technologies to access educational curriculum outside of a traditional means. Studies explore the design of learning activities and programs with online technologies, as well as the effective use of e-learning systems.