

The Sagemont School



MIDDLE SCHOOL SCIENCE FAIR GETTING STARTED MANUAL

A science fair project is the ultimate answer to the often asked student question:

"Why do I need to learn this stuff, anyway?"

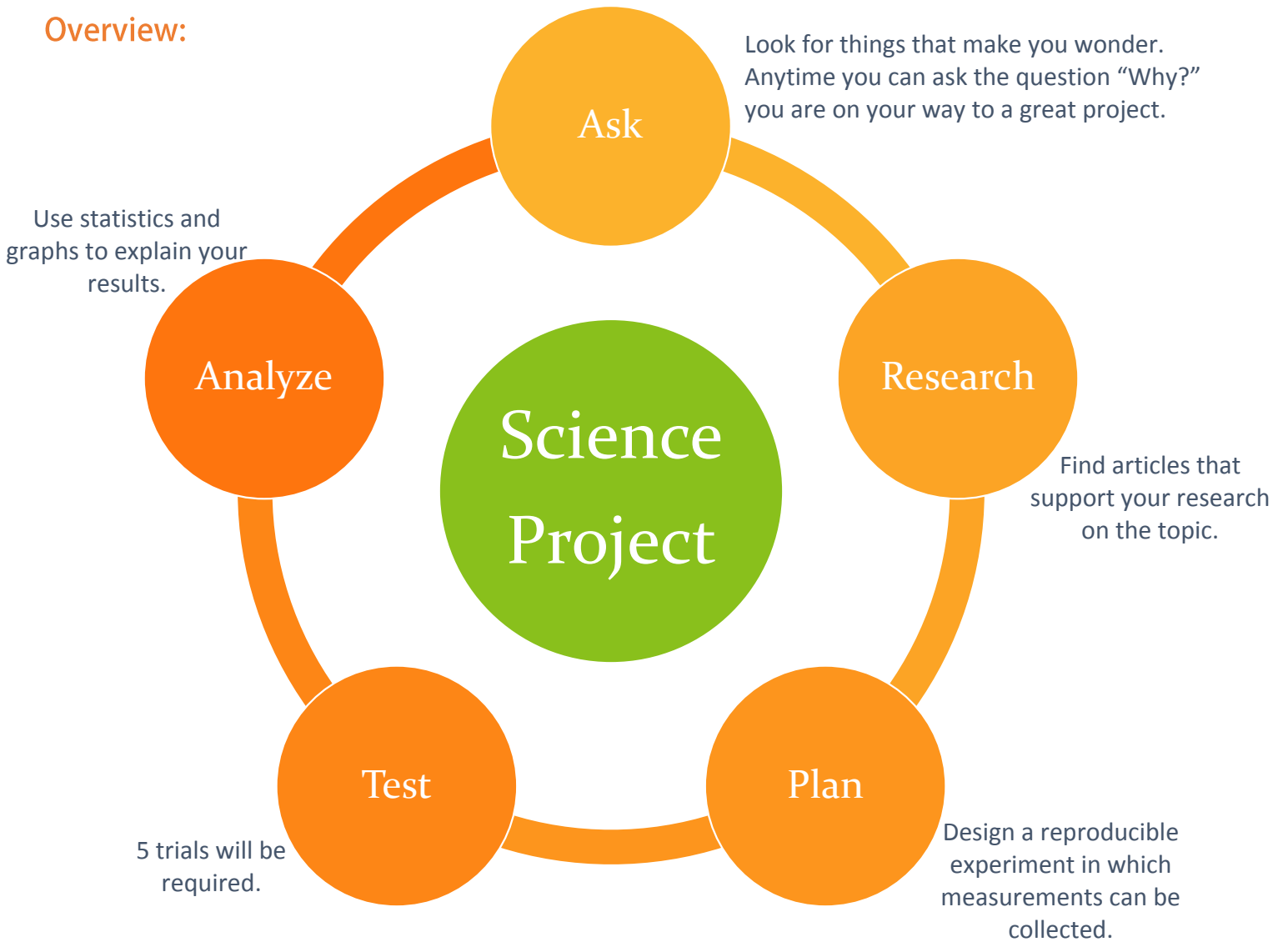
When brought to completion, the project is an amalgamation of reading, writing, spelling, grammar, math, statistics, ethics, logic, critical thinking, computer science, graphic arts, scientific methodology, self-learning of one or more technical or specialty fields, and public speaking and defense in front of judges.

It is, perhaps, the only educational activity that allows students to teach themselves, to take from the established information what they need to discover something exciting and new, and to identify and choose the tools that they need to conduct and conclude their project.

When a student completes a science fair project, year after year, the science fair process yields mature, self-confident, skilled, and competitive young leaders who have career goals and the preparation, discipline, and drive to attain them.

Excerpt from the Greater San Diego Science and Engineering Fair

Overview:



Choosing a topic:

The question you choose to answer has to be specific, yield measurements and the project needs to focus on how it can improve the world and its inhabitants.

Your research topic must:

- Have a clear and focused purpose
- Identify contribution to the field of study
- Be testable using scientific methods

Science Fair Categories:

The following category descriptions are from the State of Florida Science Fair Website:

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.

Animal Behavior: The 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: The 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: The 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: The study of interactions and behavioral relationships among animals, and animals and plants, with their environment and with one another.

Genetics: The study of species and population genetics at the organismal or cellular level.

Nutrition and Growth: The 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: The 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: The 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 & Social Sciences

Projects will not be accepted in this category.

Biomedical & Health Sciences

Projects will not be accepted in this category.

Cellular/Molecular Biology and Biochemistry

The studies the structure, function, intracellular pathways, and formation of cells. Studies involve understanding life and cellular processes specifically at the molecular level.

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.

Cell Physiology: The study of the cell cycle, cell function, and interactions between cells or between cells and their environment.

Genetics: The study of molecular genetics focusing on the structure and function of genes at a molecular level.

Molecular Biology: The 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: The study of the structure and function of the nervous system at the cellular or molecular level.

Analytical Biochemistry: The study of the separation, identification, and quantification of chemical components relevant to living organisms.

General Biochemistry: The study of chemical processes, including interactions and reactions, relevant to living organisms.

Medicinal Biochemistry: The study of biochemical processes within the human body, with special reference to health and disease.

Structural Biochemistry: The study of the structure and or function of biological molecules.

Chemistry

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

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

Analytical Chemistry: The study of the separation, identification, and quantification of the chemical components of materials.

Computational Chemistry: A study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Chemistry.

Environmental Chemistry: The 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: The study of the properties and reactions of inorganic and organometallic compounds.

Materials Chemistry: The 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: The study of carbon-containing compounds, including hydrocarbons and their derivatives.

Physical Chemistry: The study of the fundamental physical basis of chemical systems and processes, including chemical kinetics, chemical thermodynamics, electrochemistry, photochemistry, spectroscopy, statistical mechanics and astro-chemistry.

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: A 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: The study, analysis and development of fuel cells and batteries that convert and/or store chemical energy into electricity.

Microbial Fuel Cells: The study of fuel cells that use or mimic bacterial interactions found in nature to produce electricity.

Solar Materials: The study of materials used to convert and store solar energy through chemical changes. This includes topics such as thermal storage and photovoltaic materials.

Earth & Environmental Sciences

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

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.

Engineering

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.

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

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

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.

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.

Circuits: The study, analysis, and design of electronic circuits and their components, including testing.

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.

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.

Computational Mechanics: A study that applies the discipline and techniques of computer science and mathematics to solve large and complex problems in Engineering Mechanics.

Control Theory: The study of dynamical systems, including controllers, systems, and sensors that are influenced by inputs.

Electronic, Optical and Magnetic Materials: The 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.

Ground Vehicle Systems: The designing 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.

Internet of Things: The study of the interconnection of unique computing devices with the existing infrastructure of the Internet and the cloud.

Mechanical Engineering: Studies that involve the generation and application of heat and mechanical power and the design, production, and use of machines and tools.

Microcontrollers: The study and engineering of microcontrollers and their use to control other devices.

Nanomaterials: The 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.

Naval Systems: Studies of the design of ships and the direction of the technical phases of their manufacture and operation.

Networking and Data Communication: The study of systems that transmit any combination of voice, video, and/or data among users

Optics: The use of visible or infrared light instead of signals sent over wires. The study and development of optical devices and systems devoted to practical applications such as computation.

Polymers: The 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.

Sensors: The study and design of devices that transmit an electrical response to an external device.

Signal Processing: The extraction of signals from noise and their conversion into a representation for modeling and analysis.

Environmental Engineering

Studies that engineer or develop processes and infrastructure to solve environmental problems in the supply of water, the disposal of waste, or the control of pollution.

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.

Intelligent Machines, Robotics and Systems Software

Studies in which the use of machine intelligence is paramount to reducing the reliance on human intervention. The study or development of software, information processes or methodologies to demonstrate, analyze, or control a process/solution.

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.

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.

Robot Kinematics: The study of movement in robotic systems.

Machine Learning: Construction and/or study of algorithms that can learn from data.

Algorithms: The 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.

Operating Systems: The study of system software responsible for the direct control and management of hardware and basic system operations of a computer or mobile device.

Programming Languages: Studies that involve the development or analysis of the artificial languages used to write instructions that can be translated into machine language and then executed by a computer.

Mathematics and Computational Sciences

Mathematics, Computational Biology, and Bioinformatics

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.

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.

Biomedical Engineering: The application of engineering principles and design concepts to medicine and biology for healthcare purposes.

Computational Bio Modeling: 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 Evolutionary Biology: A 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: A 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: A study that applies the discipline and techniques of computer science and mathematics to predict and analyze the responses to drugs.

Genomics: The study of the function and structure of genomes using recombinant DNA, sequencing, and bioinformatics.

Microbiology

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

Antimicrobials and Antibiotics: The study of a substance that kills or inhibits the growth of a microorganisms.

Applied Microbiology: The study of microorganisms having potential applications in human, animal or plant health or the use of microorganisms in the production of energy.

Environmental Microbiology: The study of the structure, function, diversity and relationship of microorganisms with respect to their environment. This includes the study of biofilms.

Physics & 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.

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

Atomic, Molecular, and Optical Physics: The study of atoms, simple molecules, electrons and light, and their interactions.

Astronomy and Cosmology: The 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: The study of the physics of biological processes.

Computational Physics: A 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: The study of the properties of solids and liquids. Topics such as superconductivity, semi-conductors, complex fluids, and thin films are studied.

Instrumentation: Instrumentation is the 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: The 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: The study of the physical properties of the atomic nucleus and of fundamental particles and the forces of their interaction.

Optics, Lasers, Masers: The study of the physical properties of light, lasers and masers.

Quantum Computation: The 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: The study of nature, phenomena and the laws of physics employing mathematical models and abstractions rather than experimental processes.

Hydro Power: The application of engineering principles and design concepts to capture energy from falling and running water to be converted to another form of energy.

Solar: The application of engineering principles and design concepts to capture energy from the sun to be converted to another form of energy.

Sustainable Design: The application of engineering principles and design concepts to plan and/or construct buildings and infrastructure that minimize environmental impact.

Thermal Power: The application of engineering principles and design concepts to capture energy from the Earth's crust to be converted to another form of energy.

Wind: The application of engineering principles and design concepts to capture energy from the wind to be converted to another form of energy.

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.

Agronomy: Application of the 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.

Growth and Development: The 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.

Ecology: The study of interactions and relationships among plants, and plants and animals, with their environment.

Genetics/Breeding: The study of organismic and population genetics of plants. The application of plant genetics and biotechnology to crop improvement. This includes genetically modified crops.

Pathology: The study of plant disease states, and their causes, processes, and consequences. This includes effects of parasites or disease-causing microbes.

Physiology: The 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.

Important information to take into consideration when choosing your topic:

Projects to avoid:

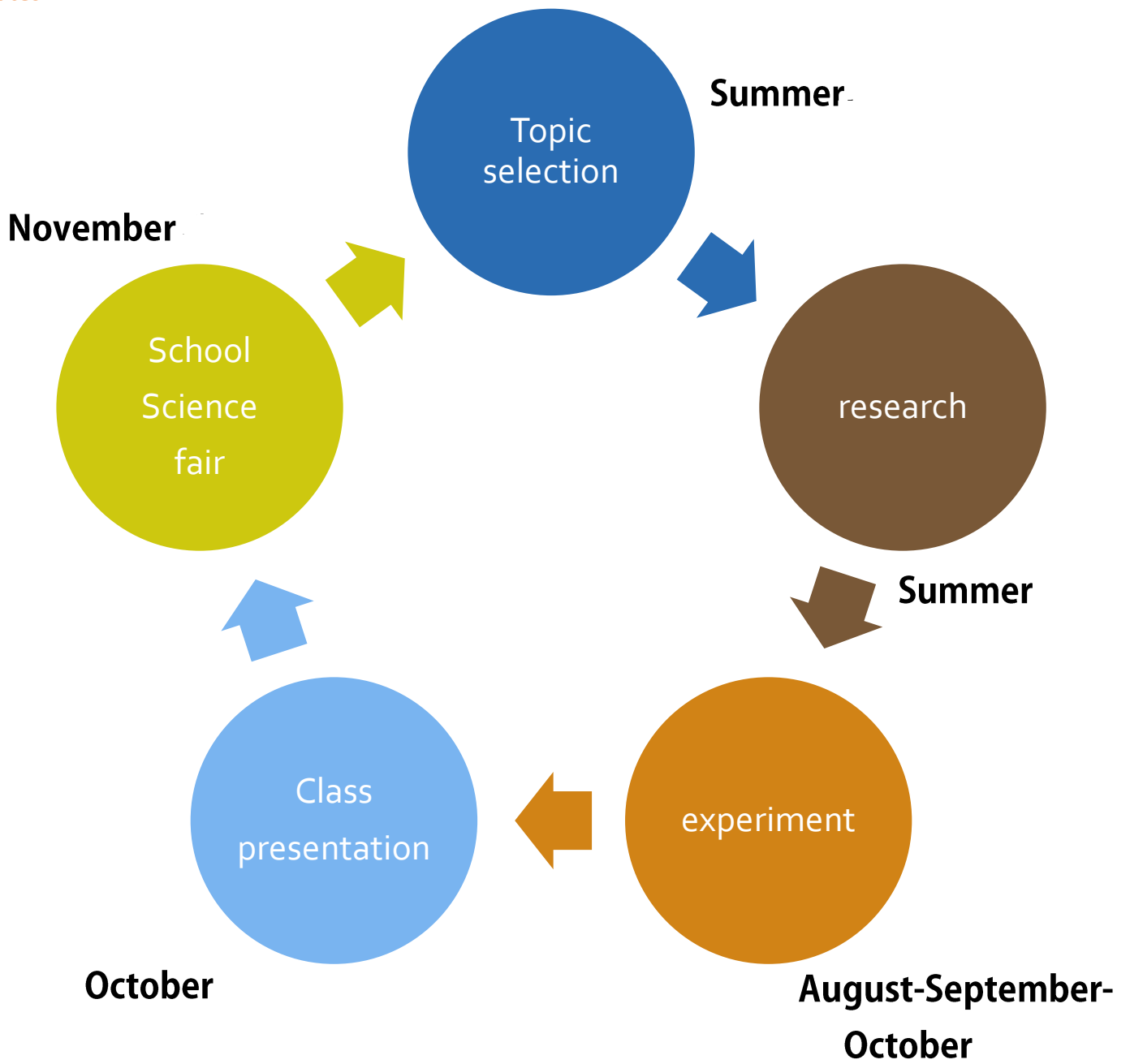
- Effect of colored light on plants (or anything else)
- Effect of music/talking on plants
- Effect of beverages (soda, coffee) on teeth
- Effect of running/music/videogames on blood pressure
- Do we eat balanced diets?
- Strength/absorbency of paper towels
- Most consumer product testing of the "Which is best?" type – approach generally without scientific merit
- Graphology
- Astrology

Design and methodology:

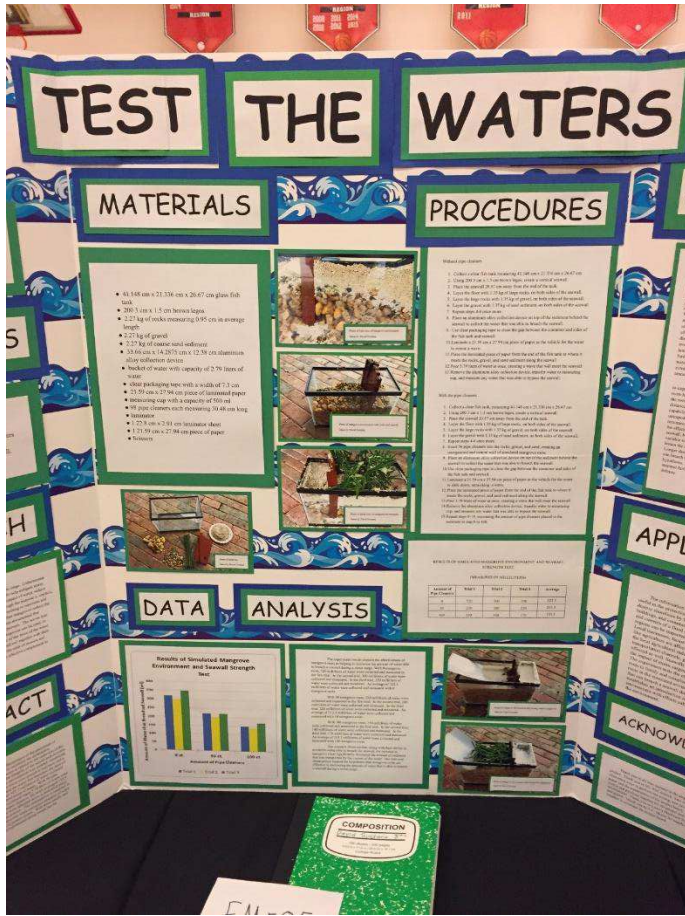
A well designed plan uses data collection methods and has defined variables and control.

- Students must design a reproducible experiment in which measurements can be collected.
- Students must follow the basic scientific method steps (hypothesis, variables, etc)
- All project work must be done at home under parental supervision or at an institutional site under the direction of a qualified scientist*.
- Students must complete all aspects of their own projects*.
- A minimum of 5 trials

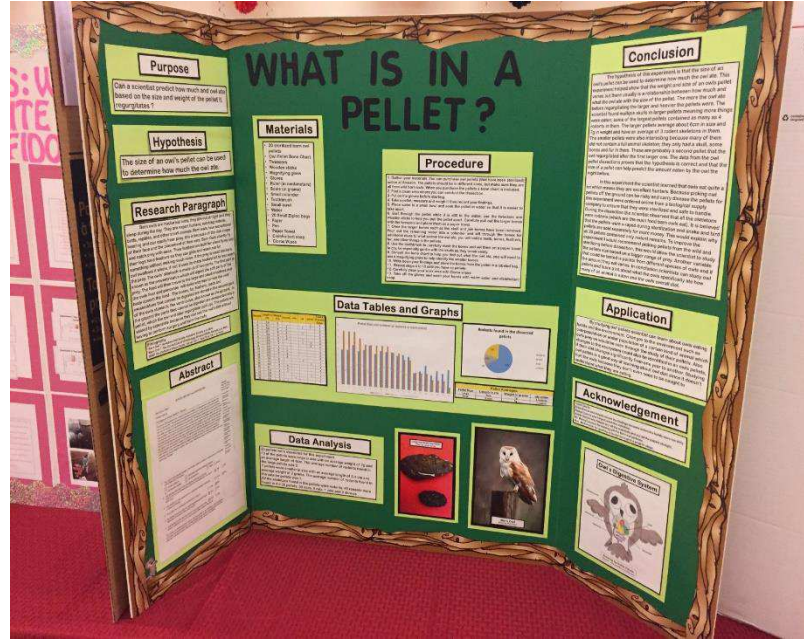
Dates:



School, Regional and State Science Fairs:



School Science Fair November



10 students will represent The Sagemont School at the Broward Regional Science and Engineering Fair

and have the chance to compete at the State Science Fair



Summer Assignment

Complete the Science Fair Project Proposal form and attach 2 articles that support your research on the topic.

Questions?

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