**THE BIG BOOK OF SCIENCE FAIR**

**IDEAS**

**Table of Contents**

**Topic Page #**

Choosing a winning topic 3

Project ideas by category

 Animal Science 4

 Behavioral and Social Sciences 5

 Biochemistry 5

 Chemistry 6

 Computer Science 7

 Earth Science 7

 Energy and Transportation

 Engineering – Electrical/Mechanical

 Engineering – Materials and Bioengineering

 Environmental Sciences

 Health Sciences

 Mathematics

 Microbiology

 Physics and Astronomy

 Plant Sciences

ISEF Category sheet

**CHOOSING A WINNING TOPIC:**

**How to pick a science fair topic that can win at the State (or national) level**

In order to win at the state or national level, there are two things that your project **must** have:

1. An original idea (one that the judges have not seen before)
2. Real-world application

**Coming up with an original idea:**

The original idea is something that you need to come up with yourself – it sounds obvious, but it is very important that your topic is something YOU are passionate about!

Figure out something that excites or interests you, and figure out what has already been researched on that topic, as well as what is still being researched. From there, you can figure out what questions still remain on the subject. For example, if you are interested in plants and agriculture, you should look to recent agricultural research journals for ideas.

The most important thing you can do as you come up with ideas is to KEEP YOUR MIND OPEN. Don’t think “I can’t do that” just because you think a project might be too hard, or you don’t know where to start. Talk to your teacher about your options first.

**Real-World Application**

The projects that do best at the State fair are the ones that have real-world significance. If you don’t know where to start, try looking into one of the following “hot button issues”, which tend to do very well at the state fair:

1. Human impacts on the environment
	1. Effects of pesticides/herbicides
	2. Effects of chemicals used in agriculture
	3. Genetically modified organisms
	4. Effects of pollution
2. Water testing (water quality, water purity, well water analysis, etc)
3. Engineering –identify a problem and build or create something to solve the problem
4. Computer Science
5. Renewable energy
	1. Wind energy
	2. Solar energy
	3. Biodiesel production/use
6. Medicine
	1. Genetic testing
	2. Genetic engineering
	3. Medical treatments

**Project Ideas by Category:**

**Animal Science**

**Description:** The study of animals and animal life, including their structure, function, life history, interactions, classification, and evolution.

**Subcategories:**

Animal Behavior - The study of animal activities, on the level of the intact organism or its neurological components. This includes rhythmic functions, learning, and intelligence, sensory preferences, and environmental effects on behaviors.

Development- The study of an organism from earliest stages through birth or hatching and into later life. This includes cellular and molecular aspects of development, regeneration, and environmental effects on development.

Ecology - The science of the interactions and relationships among animals and animals and plants with their environments.

Genetics - The study of organismic and population genetics.

Nutrition and Growth - The study of natural and artificial nutrients on animal growth and reproduction. This also includes the effects of biological and chemical control agents on reproduction and populations.

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

Physiology - The study of functions in systems of animals, their mechanisms, and how they are affected by environmental factors or natural variations.
ces that select for particular genes.

Systematics and Evolution - The study of classification of organisms and their evolutionary relationships. This includes morphological, biochemical, genetic, and modeled systems.

Other - Studies that cannot be assigned to one of the above categories.

**General topic ideas:**

 -Insect control

 -Animal behavior

 -Animal genetics or reproduction

 -Treating animal illnesses or injuries (veterinary medicine)

 -Ecology/evolution

**Project examples:**

**Effect of *capsicum frutescen* on *Gryllus assimilis* (the common black cricket)**
This science project was conducted to determine if Bird's Eye chili can be used as a form of deterrent against Gryllus assimilis (the common black cricket). The experiment was done by spraying various concentrations of Bird's Eye chili extract on crickets.
Source: <http://www.all-science-fair-projects.com/project1137_39.html>

**Determining the effectiveness of cinnamon oil as a natural insect repellent**
The objective of this science fair project is to determine the effectiveness of using a natural pesticide such as cinnamon, through observing the effect of cinnamon oil on insects such as ants, cockroaches, mosquitoes and flies.

Source: <http://www.all-science-fair-projects.com/project1261_39.html>

**Natural insect repellant**
This science fair project was done to compare the effectiveness of using a natural versus synthetic mosquito repellant. The science project experiment involved lemon grass oil and DEET (Diethylmetatoluamide) mosquito repellent spray.

Source: <http://www.all-science-fair-projects.com/project1423_38.html>

**Red Bull and Daphnia**

This experiment was performed to study the effect an energy drink has on the heartbeat rates of Daphnia. The experiment was done by exposing Daphnia to different concentrations of Red Bull energy drink mixed with water and counting their heartbeats per minute.

Source: <http://www.all-science-fair-projects.com/project1450_39.html>

**Comparing the learning abilities of hamsters and mice**
This experiment was performed to find out if hamsters and mice are able to learn and recall what is learnt. The experiment also compares the speed of learning of hamsters and mice.

**Source:** http://www.all-science-fair-projects.com/project1101\_78.html

**Behavioral and Social Sciences**

**Description:** 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.

**DISCLAIMER: If you choose to do a project in this category, you MUST write a proposal to get your study approved with a human subjects committee, or you will not be allowed to compete at the regional or state fairs.**

**Subcategories:**

Clinical and Developmental Psychology - The 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, Brain and Cognition, Neuro-psychology - The study of cognition, the mental processes that underlie behavior, including thinking, deciding, reasoning, and to some extent motivation and emotion. Neuro-psychology studies the relationship between the nervous system, especially the brain, and cerebral or mental functions such as language, memory, and perception.

Physiological Psychology - The study of the biological and physiological basis of behavior.

Sociology and Social Psychology; Industrial/Organizational Psychology - The 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.

Other: Any project on psychology/behavior that does not fit into one of the other categories

**Possible research topics include:**

-Test-taking strategies

-Effect of music on emotion

-The Stroop effect

-The psychology behind stereotypes and prejudice

-Choice blindness

-Criminology

-Population studies

-ANYTHING that you can find in the news about recent findings in psychology or sociology!

**Project Examples:**

**The Correlation between physical activity and academic performance**
This experiment was done to investigate the benefits of doing physical activity before students sit for an examination.

**Subliminal messages - do they really work?**
This experiment was conducted to find out whether subliminal messages can be effectively used to influence the decisions that the person makes.

**Source:** http://www.all-science-fair-projects.com/project1285\_28.html

**Does the gender of a baby affect its preference for toys?**
This science fair project was done to find out if babies prefer toys based on gender. The science project was performed on 4 to 8 month old babies by comparing their preferences for toy trucks or Barbie dolls.

**Source:** http://www.all-science-fair-projects.com/project1352\_28.html

**Improving one's memory by story linking**
This science fair project was performed to find out if memory retention can be improved by linking facts with a story. It is intended to show that students can improve their memory retention by applying some simple techniques.

**Source:** http://www.all-science-fair-projects.com/project1378\_28.html

**Biochemistry**

**Description:** The study of chemical substances, interactions, and processes relevant to living organisms.

**Subcategories:**

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.

Other - Studies that cannot be assigned to one of the above categories.

**General topic ideas:**

 -DNA extraction from fruits and vegetables

 -Cellular genetics

 -Effects of pH

 -Enzymes

 -Cellular respiration

 -DNA coding or replication

 -Antioxidants

 -Nutritional analysis

**Project examples:**

**Effect of carbonated drinks on meat**
This science fair project was performed to find out if the acidity in Coca Cola can dissolve meat. The testing was done by placing pieces of steak, chicken breast and salmon into bowls filled with Coca Cola, and observing the meat for 5 days.

Source: <http://www.all-science-fair-projects.com/project1168_39.html>

**Levels of carbohydrates in different varieties of milk**This science fair project was done to find out the amounts of lactose carbohydrates contained in various types of milk. The tests were done using low fat milk, powdered milk and soy milk.

Source: <http://www.all-science-fair-projects.com/project1150_39.html>

**Turmeric as an antioxidant**

This science fair project was performed to study the effectiveness of turmeric as an antioxidant. The test was done using Perchlorate as an oxidant on Daphnia, and countering its effect using turmeric juice.

**Source:** [**http://www.all-science-fair-projects.com/project1394\_39.html**](http://www.all-science-fair-projects.com/project1394_39.html)

**Does Controlled Atmosphere Storage Affect the Malic Acid and Starch Levels in Apples?**
The purpose of this experiment was to determine if controlled atmosphere apple storage would affect the amount of malic acid and starch levels in apples. I became interested in this idea when one day I bit into an apple and it was crisp, mild, smooth and tart, while a week later the same batch was grainy and had a not-so-good taste.

Source:

**Cellular and Molecular Biology**

**Description:** The study of the structure and formation of cells.

**Subcategories:**

Cellular Biology - The study of the organization and functioning of the individual cell.

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

Immunology - The study of the structure and function of the immune system, innate and acquired immunity, and laboratory techniques involving the interaction of antigens with antibodies.

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.

Other

**Chemistry**

**Description:** The science of the composition, structure, properties, and reactions of matter.

**Subcategories:**

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

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 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.

Other - Studies that cannot be assigned to one of the above subcategories, such as nuclear chemistry, surface chemistry and theoretical chemistry.

**General topic ideas:**

* Metallurgy
* Chemical reactions
* Freezing point depression
* Water purification
* Renewable energy sources
* Combustion analysis
* Pollution experiments
* Chemical engineering

**Project examples:**

**Electrolysis**
This science fair project was done to investigate the effect of increasing DC voltage and the concentration of electrolyte salt on the rate of production of hydrogen gas during the process of electrolysis.

Source: <http://www.all-science-fair-projects.com/project1146_38.html>

**Single displacement reaction in metals**
This science project was performed to compare the reactivity of different types of metal. The experiment involved comparing copper, zinc, magnesium, iron, lead and silver.

Source: <http://www.all-science-fair-projects.com/project1306_38.html>

|  |
| --- |
| **Corrosion of different metals**This science fair project was conducted to find out the corrosiveness of different types of metals. The experiment involved using copper, aluminum, iron and zinc plates.Source: <http://www.all-science-fair-projects.com/project1360_38.html> |

**Can water be split into oxygen and hydrogen?**

If an electrical current is passed through water between electrodes (the positive and minus poles of a battery), the water is split into its two parts: oxygen and hydrogen. This process is called electrolysis and is used in industry in many ways, such as making metals. If one of the electrodes is a metal, it will become covered or plated with any metal in the solution.

Source: <http://www.all-science-fair-projects.com/project819_38.html>

**Can lettuce seeds be used as a bioassay medium for testing toxicity?**

The idea behind a reference toxicity test is that the test organism, in this case lettuce seeds, will respond in a predictable manner to varying concentrations of a particular chemical compound. At some threshold concentration, all of the test organisms will be killed (or in this case, none of the lettuce seeds will sprout). In solutions that are more dilute, some level of inhibition will occur in seed germination and/or radicle length. If the concentration is low enough, no response will be detectable.

**Source:** [**http://www.all-science-fair-projects.com/project440\_38.html**](http://www.all-science-fair-projects.com/project440_38.html)

**What are the different methods of purifying water?**

In this experiment, we examine different methods of purifying water including distillation, filtration and reverse osmosis

**Source:** [**http://www.all-science-fair-projects.com/project432\_38.html**](http://www.all-science-fair-projects.com/project432_38.html)

**The most effective antacid**

This experiment was conducted to find out how effective different types and brands of antacids are at neutralizing acid. The experiment was done using 4 brands of antacid.

**Source:** [**http://www.all-science-fair-projects.com/project1327\_39.html**](http://www.all-science-fair-projects.com/project1327_39.html)

**Effects of Chlorine Concentration on Carbon Filters**

The purpose of this experiment was to determine whether the efficiency of a carbon filter decreases faster at higher concentrations of chlorine.

Source:

**How do different cooking alternatives affect the Vitamin C content in vegetables?**
This experiment is conducted to find out how different cooking methods affect the vitamin C content in vegetables. Vitamin C is an essential mineral to the human body and vegetables are the main source of it in our diet. In order to preserve the Vitamin C concentration in the vegetable, the vegetables have to be cooked in the best way possible.

Source: http://www.all-science-fair-projects.com/project1111\_50.html

**Computer Science**

**DISCLAIMER:** Last year only 3 students in the whole state competed in computer science. Prizes are always awarded to the top 4 winners in each category. If you are even remotely interested in computer science, please consider this category!!!

**Description:** The study of information processes, the structures and procedures that represent processes, and their implementation in information processing systems. It includes systems analysis and design, application and system software design, programming, and datacenter operations.

**Subcategories:**

Algorithms, Data Bases - The study of algorithms and databases. Software developed to manage any form of data including text, images, sound and video.

Artificial Intelligence - The study of the ability of a computer or other machine to perform those activities that are normally thought to require intelligence, such as solving problems, discriminating among objects, and/or responding to voice commands. This also includes speech analysis and synthesis.

Networking and Communications - The study of systems that transmits any combination of voice, video, and/or data among users.

Computational Science, Computer Graphics - The study of the use of computers to perform research in other fields, such as computer simulations. Also includes the study of computer graphics or the transfer of pictorial data into and out of a computer by various means (analog-to-digital, optical scanning, etc), such as in computer image processing.

Software Engineering, Programming Languages - The study of software designed to control the hardware of a specific data processing system in order to allow users and application programs to make use of it. This sub-category includes web technologies, programming languages and human-computer interactions.

Computer System, Operating System - The study of system software responsible for the direct control and management of hardware and basic system operations of a computer.

Other

**General topic ideas:**

* Coding
* Data storage and use
* Internet speeds and connections

**Project Examples:**

**Earth Science**

**Description:** The study of sciences related to the planet Earth (Geology, minerology, physiography, oceanography, meteorology, climatology, speleology, sesismology, geography, atmospheric sciences, etc.)

**Subcategories:**

Climatology, Meteorology, Weather - the scientific study of the atmosphere that focuses on weather processes and forecasting.

Geochemistry, Mineralogy - The study of the chemical composition of the earth and other planets, chemical processes and reactions that govern the composition of rocks and soils. Mineralogy is focused around the chemistry, crystal structure and physical (including optical) properties of minerals.

Historical Paleontology - The study of life in the geologic past as recorded by fossil remains.

Geophysics - Branch of geology in which the principles and practices of physics are used to study the earth and its environment.

Planetary Science - The study of planets or planetary systems and the solar system.

Tectonics - The study of the earth's structural features as related to plate structure, plate movement, volcanism, etc.

Other

**General topic ideas:**

**Project Examples:**

**Energy and Transportation**

**Description:** the study of renewable energy sources, energy efficiency, clean transport, and alternative fuels.

**Subcategories:**

Aerospace and Aeronautical Engineering, Aerodynamics - The design of aircraft and space vehicles and the direction of the technical phases of their manufacture and operation.

Alternative Fuels - Any method of powering an engine that does not involve petroleum (oil). Some alternative fuels are electricity, hythane, hydrogen, natural gas, and wood.

Fossil Fuel Energy - 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.

Vehicle Development - Engineering of vehicles that operate using energy other than from fossil fuel.

Renewable Energies - Renewable energy sources capture their energy from existing flows of energy, from on-going natural processes such as sunshine, wind, flowing water, biological processes, and geothermal heat flows.

Other

**General topic ideas:**

* Renewable energy sources
* Energy efficiency
* Types of energy
* Energy Use
* New forms of transportation

**Project Examples:**

**Hydropower versus wind power**
This science fair project was performed to compare the efficiency of hydro-electric generated power and wind generated power.

**Source:** http://www.all-science-fair-projects.com/project1393\_29.html

**How to build your own electric motor**

This home page features award-winning, easy-to-build, and inexpensive electric motors. If you are looking for a simple science project, or if you wish to learn about electricity, magnetism, and electric motors, this web site has it all! Including assembly instructions, a section devoted to how these motors work, and I even provide all parts necessary to build them! The reed switch motor is the easiest electric motor anyone can build. These brushless DC motors represent my 3 year school science project. All of them are extremely simple, and at the same time very stable, reliable, and efficient.

**Source:** http://www.all-science-fair-projects.com/project367\_29.html

**How to build a wind turbine generator**
These plans are for the construction of a machine called a Savonius wind turbine. Wind turbines come in two general types, those whose main turning shaft is horizontal and points into the wind, and those with a vertical shaft that points up. The Savonius is an example of the vertical axis type. It consists of two simple scoops that catch the wind and cause the shaft to turn.

Source: http://www.all-science-fair-projects.com/project370\_29.html

**Engineering – Electrical/Mechanical**

**Description:** The application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, processes, and systems.

**Subcategories:**

Electrical Engineering, Computer Engineering, Controls - Electrical engineering is the branch of engineering that deals with the technology of electricity, especially the design and application of circuitry and equipment for power generation and distribution, machine control, and communications. A computer engineer is an electrical engineer with a focus on digital logic systems or a software architect with a focus on the interaction between software programs and the underlying hardware architecture.

Mechanical Engineering - The branch of engineering that encompasses the generation and application of heat and mechanical power and the design, production, and use of machines and tools.

Robotics - The science or study of the technology associated with the design, fabrication, theory, and application of robots and of general purpose, programmable machine systems.

Thermodynamics, Solar - Thermodynamics involves the physics of the relationships and conversions between heat and other forms of energy. Solar is the technology of obtaining usable energy from the light of the sun.

Other

**General topic ideas:**

**Project Examples:**

**Engineering – Materials/Bioengineering**

Description: the application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical machines and systems.

Subcategories:

Bioengineering - Involves the application of engineering principles to the fields of biology and medicine, as in the development of aids or replacements for defective or missing body organs; the development and manufacture of prostheses, medical devices, diagnostic devices, drugs and other therapies as well as the application of engineering principles to basic biological science problems.

Chemical Engineering - Deals with the design, construction, and operation of plants and machinery for making such products as acids, dyes, drugs, plastics, and synthetic rubber by adapting the chemical reactions discovered by the laboratory chemist to large-scale production.

Civil Engineering, Construction Engineering - Includes the planning, designing, construction, and maintenance of structures and public works, such as bridges or dams, roads, water supply, sewer, flood control and, traffic.

Industrial Engineering, Processing - Concerned with 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.

Material Science - A multidisciplinary field relating the performance and function of matter in any and all applications to its micro, nano, and atomic structure, and vice versa. It often involves the study of the characteristics and uses of various materials, such as metals, ceramics, and plastics and their potential engineering applications.

Other

**General topic ideas:**

**Project Examples:**

**Environmental Management**

**Description:** The application of engineering principals to solve practical problems of managing mans' interaction with the environment with the goal to maintain and improve the state of an environmental resource affected by human activities.

**Subcategories:**

Bioremediation - The use of biological agents, such as bacteria or plants, to remove or neutralize contaminants, as in polluted soil or water. Includes phytoremediation, constructed wetlands for wastewater treatment, biodegradation, etc.

Ecosystems Management - The integration of ecological, economic, and social principles to manage biological and physical systems in a manner that safeguards the long-term ecological sustainability, natural diversity, and productivity of the landscape. An ecological approach to managing the environment.

Environmental Engineering - The application of engineering principals to solve practical problems in the supply of water, the disposal of waste, and the control of pollution. Includes alternative engineering methodologies to meet society's needs in an environmentally sound and sustainable manner. Preservation of the environment by preventing the contamination of, and facilitating the clean up of, air, water, and land resources.

Land Resource Management and Forestry - A landscape approach to sustainable resource management, coastal management, biological diversity management, land use planning, or forest succession management. It often includes a resource planning component as well as implementation methodologies. An example would be the management of longleaf pine forests including controlled burns to imitate natural processes.

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.

Other

**General topic ideas:**

* Pollution
* Effects of using pesticides/herbicides
* Recycling

**Project Examples:**

**Activated Carbon and Pesticides**

This science fair project was done to observe the effect of using activated carbon to neutralize the effect of pesticides. The science project experiment involved using flies, the pesticide malathion and different concentrations of activated carbon.

Source:

**Environmental Science**

**Description:** The analysis of existing conditions of the environment.

**Subcategories:**

Air Pollution and Air Quality - The study of contamination of the air by such things as noxious gases, elements, minerals, chemicals, solid and liquid matter (particulates), etc. Air pollution is the study of such contaminates in concentrations that endanger the health of humans, plants, and/or animals.

Soil Contamination and Soil Quality - The study of contamination of the soil by such things as noxious elements, minerals, chemicals, solids, liquids, etc. Soil contamination is the study of such contaminates in concentrations that endanger the health of humans, plants, and/or animals.

Water Pollution and Water Quality - The study of contamination of the water by such things as noxious elements, minerals, chemicals, solids, etc. Water pollution is the study of such contaminates in concentrations that endanger the health of humans, plants, and/or animals.

Other

**Project Examples:**

**How does the PH level of rainwater differ from one place to another?**
What is the pH of rain in your area? Students take pH measurements for rain in their neighborhood and compare it with other students' findings. This activity is best when conducted over several weeks during a rainy time of year.

**Source:** [**http://www.all-science-fair-projects.com/project465\_38.html**](http://www.all-science-fair-projects.com/project465_38.html)

**What are the effects of Polyacrylamide and Polyacrylate on soil erosion?**
The purpose of this experiment was to determine the effects polyacrylamide or polyacrylate could halt erosion. I believe that polyacrylate will halt erosion the best because there is evidence that polyacrylate has halted erosion.

**Source:** [**http://www.all-science-fair-projects.com/project451\_38.html**](http://www.all-science-fair-projects.com/project451_38.html)

**Urban Effects On Inshore Plankton**

*Purpose: compare plankton counts from urban water samples to plankton counts from more isolated water samples.*

**Pollution and Depth of water**

Purpose: This project was conducted to determine how the depth of water can affect the concentration of pollution found in the water. The experiment was done by collecting water samples from a lake at depths of 1 meter, 2 meters 3 meters and 4 meters.

**The Effect of Development on Water Quality in Two Creeks Flowing From the Same Snowpack**

Determine whether the level of certain chemicals in the tributaries to a river are different in a rural area compared to an urban area.

Source:

**What is the relationship between turbidity levels in water and the level of dissolved oxygen?**

Purpose: Determine if the level of turbidity in water affected the amount of dissolved oxygen. Since dissolved oxygen keeps fish and other animals alive, it is important to find ways to improve dissolved oxygen levels. The information gained from this experiment could be useful to the fish and wildlife foundation and dam operators.

Source:

**Mathematical Sciences**

**Description:** 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 - The 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 - The 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.

Computer Mathematics - Branch of mathematics that concerns itself with the mathematical techniques typically used in the application of mathematical knowledge to other domains. Not every project that uses some mathematics belongs here; this category is for projects where the mathematics is the primary component.

Combinatorics, Graph Theory and Game Theory - The 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 - The 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 - The 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.

Other- Studies that cannot be assigned to one of the above categories.

**General topic ideas:**

**Project Examples:**

**Medicine and Health Sciences**

**Description:** The science of diagnosing, treating, or preventing disease and other damage to the body or mind.

**Subcategories:**

Disease Diagnosis and Treatment - The act or process of identifying or determining the nature and cause of a disease or injury through evaluation of patient history, examination, and review of laboratory data. Administration or application of remedies to a patient or for a disease or injury; medicinal or surgical management; therapy.

Epidemiology - The study of the causes, distribution, and control of disease in populations. Epidemiologists, using sophisticated statistical analyses, field investigations, and complex laboratory techniques, investigate the cause of a disease, its distribution (geographic, ecological, and ethnic), method of spread, and measures for control and prevention.

Genetics - The study of heredity, especially the mechanisms of hereditary transmission and the variation of inherited traits among similar or related organisms.

Molecular Biology of Diseases - The study of diseases at the molecular level.

Physiology and Pathophysiology - The science of the mechanical, physical, and biochemical functions of normal tissues or organs. Pathophysiology is the study of the disturbance of normal mechanical, physical, and biochemical functions that a disease causes, or that which causes the disease.

Other

**General topic ideas:**

* Preventative medicine
* Treatments for illnesses or injuries

**Project Examples:**

**Microbiology**

**Description:** The study of microorganisms, including bacteria, viruses, fungi, and pathogens.

**Subcategories:**

Antimicrobial Agents - The study of substances that kill or inhibit the growth of microorganisms.

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

Bacterial Microbiology - The study of bacteria and bacterial diseases.

Environmental Microbiology - The study of the structure, function, diversity and relationship of microorganisms with respect to their environment.

Microbial Genetics - The study of how genes are organized and regulated in microorganisms in relation to their cellular function.

Virology - The study the anatomy, physiology of viruses and the diseases they cause.

Other - Studies that cannot be assigned to one of the above categories, such as microbial cytology, physiology and pathogenesis.

**General topic ideas:**

* Food safety
* Bacteria
* Viruses

**Project Examples:**

**Effectiveness of garlic in fighting bacteria**

This experiment was done to find out if garlic is effective in killing bacteria. This will help us understand the effectiveness of home remedies such as the use of natural herbs (including garlic) for medicinal purposes.

Source: <http://www.all-science-fair-projects.com/project1098_39.html>

**Exposure of Baby food and the degree of contamination**
This experiment was done to find out if leaving baby food out of the refrigerator after it has been opened will result in bacterial contamination.

**Source:** [**http://www.all-science-fair-projects.com/project1099\_39.html**](http://www.all-science-fair-projects.com/project1099_39.html)

**Physics and Astronomy**

**Description:** 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 - 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.

Instrumentation and Electronics - 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. Electronics is the branch of physics that deals with the emission and effects of electrons and with the use of electronic devices.

Condensed Matter and Materials -The study of the preparation, properties and performance of materials to help understand and optimize their behavior. Topics such as superconductivity, semi-conductors, complex fluids, and thin films are studied.

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, and Masers - The study of the physical properties of light, lasers and masers.

Theoretical Physics, Theoretical or Computational Astronomy - The study of nature, phenomena and the laws of physics employing mathematical models and abstractions rather than experimental processes.

Other - Studies that cannot be assigned to one of the above categories.

**Project Examples:**

**How to build a homemade magnetometer to study how the earth's magnetic fields are affected by solar storms**

Solar storms can affect the Earth's magnetic field causing small changes in its direction at the surface which are called 'magnetic storms'. A magnetometer operates like a sensitive compass and senses these slight changes. The soda bottle magnetometer is a simple device that can be built for under $5.00 which will let students monitor these changes in the magnetic field that occur inside the classroom. When magnetic storms occur, you will see the direction that the magnet points change by several degrees within a few hours, and then return to its normal orientation pointing towards the magnetic north pole. Please refer to the attached primer Studying the magnetosphere in the Classroom for additional background information.
**Source:** http://www.all-science-fair-projects.com/project62\_7.html

**How to calculate the distance of the sun and the moon from earth, by understanding eclipses**
Hipparchus, who used an eclipse of the Moon to deduce the precession of the equinoxes (here), used a total eclipse of the Sun--probably in 129 BC--to estimate how far the Moon was. That distance had also been derived from a lunar eclipse by Aristachus--see here.

**Source:** http://www.all-science-fair-projects.com/project66\_7.html

**Understanding and identifying black holes**

Physicists have predicted that at the Big Bang, black holes with sizes from 10^-5 grams up to perhaps solar mass size might have been formed. Use the above formulae to predict the mass range of the black holes would have lasted as long as the present age of the universe, between 9 billion to 15 billion years, and which should just now be evaporating completely away. Predict what the final few thousand years of life would look like for such black holes, by computing their REMAINING mass, the temperature of the radiation they are producing, and their power.

**Source:** http://www.all-science-fair-projects.com/project74\_7.html

**The effect of temperature on conductivity and resistance**
This science fair project was conducted to find out how temperature affects the conductivity and resistance of a wire. The science project involved a copper wire of diameter 0.5 mm.

**Source:** <http://www.all-science-fair-projects.com/project1316_29.html>

**Plant Science**

**Description:** Study of plant life, including their structure and function, life history, growth, interactions with other plants and animals, classification, and evolution.

**Subcategories:**

Agronomy - The 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.

Development and Growth - 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.

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

Plant Physiology - The study of functions of plants, their mechanisms, and how they are affected by environmental factors or natural variations. This includes all aspects of photosynthesis.

Systematics and Evolution - The study of classification of organisms and their evolutionary relationships. This includes morphological, biochemical, genetic, and modeled systems.

Other - Studies that cannot be assigned to one of the above categories, such as the effects of plants or plant-derived substances on animal and human health.

**General topic ideas:**

* Agriculture
* Plant growth
* Genetic engineering in plants
* Plant uses
* Plant diseases/disease resistance
* Herbicides

**Project Examples:**

**Recycled water and plant growth**
This science fair project was performed to examine how watering plants with recycled water affects their rate of growth. The experiment involved watering radish plants with distilled water, tap water and recycled water.

Source: <http://www.all-science-fair-projects.com/project1398_38.html>

**The effect of nitrate levels in water on the growth of plants**

*Purpose: to ascertain the effect of water nitrate levels on plant growth. This will help us better understand how to use fertilizers to help plants grow better.*

Overview: Nitrogen is a very important element in the growth and survival of plants and animals. It is one of the basic elements found in proteins. Plants have both protein based and non-protein based compounds in them. Some of the non-protein based compounds in them are nitrates, amides, nitrides, peptides and free amino acids.  Decomposition of animal and plants will reduce oxygen levels and increase nitrate levels. Bacteria will help to break down protein molecules into ammonia, which will merge with oxygen to create nitrite and nitrates. Too much nitrates will cause plants to grow faster.  Nitrate levels are also increased due to excessive fertilizer use, septic tank leakages and poor waste water treatment. Normally phosphate levels also increase together with the level of nitrates. Phosphates will cause the growth and decomposition of algae to increase and this will further reduce the level of dissolved oxygen.

**The effect of vitamin D on plant growth**
This science fair project was done to observe the effectiveness of vitamin D on the growth of plants. The science project involved watering radish, green bean and chili plants with different concentrations of vitamin D solution.

**Source:** http://www.all-science-fair-projects.com/project1424\_50.html

**How are vegetables affected by the Tobacco Mosaic Virus?**
This particular project is inexpensive, safe, fosters student inquiry, and gives good results that students can discuss in their final assessment--a poster session that models a "Science Congress" The project lends itself to cooperative group work.

**Source:** http://www.all-science-fair-projects.com/project668\_50.html

**What is the best way of making sure that fertilizer is applied to a field of crops in a uniform and consistent manner?**

Mariotte siphons or Mariotte bottles are devices that provide a constant pressure that will deliver a constant rate of flow from closed bottles or tanks. The flow rate will depend upon the head as defined in figure 1 and not on the height of the free water surface. These devices find many uses where a nonchanging pressure is needed. One application in agriculture is for applying liquid fertilizer to field crops.

**Source:** <http://www.all-science-fair-projects.com/project822_50.html>