# Posing A Question

## ***Types of Experiments*** (Adapted from M. Poarch, 2003 http://science-class.net)

Scientists ask questions and then try to answer them using the scientific method. Different kinds of questions need different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve researching more information; some involve doing a fair test or experimenting; some involve discovery of new objects and phenomena; and some involve making models. We can divide investigations into two general categories: descriptive or qualitative and experimental or quantitative.

1. Descriptive or qualitative investigations include building models, inventing, dissecting, making observations and describing them, interviewing, and collecting specimens among others. Although these are sometimes called experiments, they are not really experimental.
2. Experimental or quantitative investigations involve the control or manipulation of variables. Variables are the parts of the experiment that can change or vary.
   - Independent variable (One manipulated - CAUSE) - what the investigator is testing; the ONE thing that is changed or manipulated by the scientist.
   - Dependent variable (One responding - EFFECT) – the response to the independent variable that can be observed (qualitative) and measured (quantitative).
   - Constant variables (many) - variables (rules) that are kept the same or constant throughout the experiment. They could be changed, but the scientist keeps them constant so that they will not interfere with the investigation.
   - Control (the "norm") - A part of the experiment that is not being tested and is used for comparison. (Not all experiments have a control.)

***Example:***

How can we determine who has the greater right arm strength?

- Independent (manipulated) variable: Test group – human subjects
- Dependent (responding) variable: Right arm strength
- Constant variables: Begin with right arm/hand in position (upright, elbows on table, wrist straight); Stance - stay seated; Flat surface; Left hand placed behind back; Hand grip intertwined; Begin on the count of 3; No ties; Winning?

## ***Science Fair Project Ideas***

Projects are done individually and should be a question of high interest! Students are **highly** encouraged to select original projects. Students will not be allowed to duplicate projects. Students need to have a minimum of 3 possible choices listed in the order of preference in case their first choice has already been selected. Questions listed below may have to be reworded to reflect individual projects and to provide more details about the project. Brand comparison projects are not allowed.

Choose your question carefully. Some questions will require several weeks of experimentation. Other experiments may cost. Plant projects are usually the most costly and the most time consuming (6-week minimum; must be started over winter break). Projects involving any safety concerns (includes fire and electricity) and all chemicals (includes detergent and fertilizer) require a risk assessment form.

## ***Tips for Posing Questions:***

1. When selecting a topic, pick an area of science in which you have a particular interest, experience, or resources.
2. The answer to the question must not be common knowledge. "Do plants need light to grow?" is not a good question because most people know the answer to this.
3. Do not get too ambitious. Try something simple but elegant. It is better to do a great job on a simpler project than a mediocre job on a complex experiment.
4. The question should be a relevant question and have a real-world application if wanting to "compete" at science fair. Current science news is a great way to develop a competitive and relevant science question. Different levels of difficulty are available depending on your interests and time. You will be graded on how well you design your experiment and follow scientific method, as well as presentation skills. More difficult levels involve "required" extra credit.
5. Once you have found a topic that interests you, consider your **time constraints**, the rules and guidelines, the contacts you will need to make, the resources and mentors you will need, and finally, the expenses.
6. The question must be written in a way that allows you to numerically measure the results. All data will be measured using the **metric** system.
7. Eliminate questions that cannot be answered by gathering evidence. Word questions in a way that allows them to be answered by an investigation or experiment. Only one variable should be changed.

## ***Science Fair Resources – Internet***

Intel International Science and Engineering Fair
http://www.sciencebuddies.org/

Science Buddies (**HIGHLY** recommended)
http://www.sciserv.org/isef/

Spotlight on Science Fair
http://sln.fi.edu/qanda/spotlight1/spotlight1.html

Science Fair Primer
http://users.rcn.com/tedrowan/primer.html
http://users.rcn.com/tedrowan/ideapage.html

California State Science Fair
http://www.usc.edu/CSSF

Discovery Channel News
http://dsc.discovery.com/news/news.html

Science Fair Central
http://school.discoveryeducation.com/sciencefaircentral/scifairstudio/handbook/

Science CURRENT Events
http://whyfiles.org/
http://www.sciencenews.org/
http://www.sciencedaily.com/

# Science Fair Rubric Checklist – Question

| ***Expectations - Question*** | ***Points*** |
|---|---|
| ▪ Typed/Font 12/Times New Roman/Double-Spaced<br>▪ Heading (5 lines) – left of page<br>o Title "Science Fair Question"<br>▪ Three (3) questions listed numerically in order of preference (1–Top choice)<br>▪ Not a common knowledge question (Exception – Level 1)<br>▪ Testable experimental question; numerical data<br>▪ Variables (independent/dependent) clearly stated in question<br>▪ **NO** spelling/grammatical errors<br>▪ Interrogative sentence; correct punctuation; no contractions<br>▪ Rubric stapled on front (left corner)<br>▪ Parent signature | **10** |
| ***SCORE*** | |

## ***Category Descriptions***

| | | |
|---|---|---|
| ANIMAL SCIENCES<br>Development, Ecology, Animal Husbandry, Pathology, Physiology, Population Genetics, Systematics | ENGINEERING: Materials/Bioengineering<br>Bioengineering, Civil Engineering, Construction Engineering, Chemical Engineering, Industrial Engineering, Processing, Material Science | MATHEMATICAL SCIENCES<br>Algebra, Analysis, Applied Mathematics, Geometry, Probability and Statistics |
| BEHAVIORAL/SOCIAL SCIENCES<br>Clinical & Developmental Psychology, Cognitive Psychology, Physiological Psychology, Sociology | ENGINEERING: Electrical/Mechanical<br>Electrical Engineering, Computer Engineering<br>Controls, Mechanical Engineering, Thermodynamics, Solar, Robotics | MEDICINE & HEALTH SCIENCES<br>Disease Diagnosis and Treatment, Epidemiology, Genetics, Molecular Biology of Diseases, Physiology and Pathophysiology |
| CHEMISTRY<br>Analytical Chemistry, Inorganic Chemistry, Organic Chemistry, Physical Chemistry, General Chemistry | ENERGY & TRANSPORTATION<br>Aerospace and Aeronautical Engineering, Aerodynamics, Alternative Fuels, Fossil Fuel Energy, Vehicle Development, Renewable Energies | MICROBIOLOGY<br>Antibiotics, Antimicrobials, Bacteriology, Microbial Genetics, Virology |
| COMPUTER SCIENCE<br>Algorithms, Data Bases, Artificial Intelligence, Networking and Communications, Computational Science, Computer Graphics, Software Engineering, Programming Languages, Computer System, Operating System | ENVIRONMENTAL ANALYSIS<br>Air Pollution and Air Quality, Soil Contamination and Soil Quality, Water Pollution and Water Quality | PHYSICS AND ASTRONOMY<br>Astronomy, Atoms, Molecules, Solids, Biological Physics, Instrumentation and Electronics, Magnetics and Electromagnetics, Nuclear and Particle Physics, Optics, Lasers, Masers, Theoretical Physics, Theoretical or Computational Astronomy |
| EARTH SCIENCE<br>Climatology, Weather, Geochemistry, Mineralogy, Paleontology, Geophysics, Planetary Science, Tectonics | ENVIRONMENTAL MANAGEMENT<br>Bioremediation, Ecosystems Management, Environmental Engineering, Land Resource Management. Forestry, Recycling, Waste Management | BOTANY<br>Agriculture/Agronomy, Development, Ecology, Genetics, Photosynthesis, Plant Physiology (Molecular, Cellular, Organismal), Plant Systematics, Evolution |