EVANGELICAL
CHRISTIAN SCHOOL

SCIENCE FAIR MANUAL

Issue 1992 • Revised: Summer 2022

LETTER
to
STUDENTS & PARENTS

This Science Fair Manual, based on the International Science and Engineering Fair Rules, is written to help you understand the steps to successfully complete a science fair project. Explanations are given in class, but many times questions arise while the work is being done away from the classroom. To provide the needed answers, this manual should be kept at hand throughout the project. The science project can be a tremendous learning experience as critical thinking and scientific experimentation skills are developed.

Although identical repetition of a previous year's work is not permitted, projects done in one year can be continued and exhibited the next year provided the project shows significant progress when compared to the previous year. Continued projects must include the previous year's abstract, logbook, and science project notebook as part of the current year's display in a separate notebook.

Put the science fair date and awards presentation time on your calendar now, and let's look forward to the best science fair ever.

CONTENTS

SCIENCE FAIR TIMETABLE

Week	Assignment	Manual Pages	Due Date
1	Topic Card	4 -11	___________
2	*Bibliography Cards (3-5)	13	___________
3	*Bibliography Cards (6-10)	13	___________
4	*Preliminary Outline	15	___________
5	*Notecards (300 words)		___________
6	*Notecards (600 words)		___________
7	*Rough Draft		___________
8	*Final Paper	13	___________
	Includes:		
	Title Page		
	Final Outline		
	Body of Paper		
	Works Cited Page		

NOTE: The Final paper is to be on typing paper, double spaced, and with references cited.

Week	Assignment	Manual Pages	
9	Research Plan, Teacher-Supervisor		
___________	Certification, and any other required forms (vary according to project)		

NOTE: Begin the experiment as soon as your Research Plan is approved.

Week	Assignment	Manual Pages	
9	Purpose	18	
___________	Logbook preparation		
	Includes:		
	Topic		
	Hypothesis	18	
	Materials and Methods	27,	28
___________	Materials and Methods (Two copies: one copy for Science Fair Notebook and one copy for back-board)	21	
10	Logbook: Notes on preparations and day-by-day	29	
___________	progress		
10	Results	22	
	Conclusions	23	
	Recommendations	24	
___________			
11	Abstracts	34-38	
	Title Page	16	

Table of Contents 17
Acknowledgements 19
Two copies of drawings, tables, charts, and graphs
(one for Science Fair Notebook, one for backboard)
Complete Science Fair Notebook
(If time permits, this assignment may be divided into two weeks.)

***Refer to your grammar/English textbook for help with these items**

1

Week Date	Assignment	Manual Pages	Due
11	Backboard and display designed and constructed	40-43	
12	ECS Science Fair		___________
	Awards Presentation		___________
	Regional Science Fair		___________

SELECTING A TOPIC

1. Help in finding a topic:

    Read in science books, magazines, and newspapers
    Talk to your teacher, family, and friends
    Visit professional people, museums, and zoos
    Look at the list of topics and science fair categories

2. Consider a topic you know nothing about (something new may arouse your curiosity). Or consider a topic that you know something about, but you want to investigate further. Select a topic that genuinely interests you.

3. Be sure the topic is small enough to cover thoroughly yet has enough material available to you for research.

4. Look for an original way to handle your topic. This shows creativity, which is an important part of any good science project.

5. Write your topic as a question to be investigated. This is called your research question or problem. Avoid a question with an obvious answer.

6. Note: 8^{th} graders are not allowed to do projects with human subjects.

GOOD TOPICS

1. What is the effect of Nu-earth on plants?

2. Which type of soil can make plants grow the tallest within a period of six weeks?

3. Do all leafy green vegetables contain the same-colored natural pigments?

POOR TOPICS

1. How do volcanoes erupt?

   This topic will not allow experimentation without visiting real volcanoes. Making a model that erupts is a demonstration not an experiment.

2. How do microscopes work?

   This topic is too general. Telling how microscopes work is not experimentation.

3. Do different brands of paper towels soak up different temperatures of water at the same rate?

This topic needs to be narrowed down to one investigation. Only one variable should be manipulated in an investigation.

AWARD-WINNING PROJECTS

THE EFFECT OF WRITTEN AND VERBAL STIMULI ON LEARNING
THE EFFECT OF NU-EARTH ON PLANTS
FUSELAGE DESIGN AND ITS EFFECT ON LIFT
LEFTIES VS. RIGHTIES. DO THEY VIEW OPTICAL ILLUSIONS DIFFERENTLY?
THE EFFECT OF GAMMA RADIATION ON THE GERMINATION AND GROWTH OF MARIGOLDS
THE EFFECTS OF TEMPERATURE ON THE ACTION OF YEAST
HOW MANY GRAMS OF DUST FALL ON YOUR LAWN IN A MONTH?
THE EFFECT OF A HEAVY RAIN ON WATER QUALITY
ARE STRETCHED OR UNSTRETCHED RUBBER BANDS MORE SENSITIVE TO OZONE?
THE RESISTANCE OF METAL ALLOYS TO POLLUTANTS
WHAT FABRICS ARE MOST READILY DAMAGED BY POLLUTANTS?
ELECTROSTATIC PRECIPITATION OF DUST PARTICLES
CARBON DIOXIDE PRODUCTION BY SOIL ORGANISMS
SOIL MODIFICATIONS BY EARTHWORMS
THE BURROWING HABITS OF GERBILS
BEHAVIOR OF CRICKETS IN AN ENCLOSED ENVIRONMENT
THE EFFICIENCY OF A SOLAR COLLECTOR
SCHOOLING BEHAVIOR IN FISH
THE EFFECT OF MAGNETISM ON SEED GERMINATION
THE REACTION OF TEETH EXPOSED TO CARBONATED BEVERAGES
THE PREFERENCE OF POND ORGANISMS FOR LIGHT VS. DARKNESS
DECOMPOSITION OF LEAF LITTER
REACTION OF MEALWORMS TO VARIOUS SURFACES
SOCIAL BEHAVIOR IN ANT COLONIES
RESPONSES OF SOIL ARTHROPODS TO LIGHT, MOISTURE, AND SOIL TYPES
SOIL PREFERENCES OF SEVERAL PLANT SPECIES
A COMPARISON OF DIFFERENT PACKAGING METHODS AND THEIR RELATIONSHIP TO BACTERIAL COUNTS FOUND ON SOFT DRINK CANS
A COMPARISON OF WASHING TECHNIQUES ON TABLE SILVERWARE TO REMOVE BACTERIA
AIRPLANE WING DESIGNS AND LIFT
AIRSPACE AS AN INSULATOR
THE EFFECTS OF PRESERVATIVES IN PREVENTING SPOILAGE
REGENERATION IN PLANARIA
WHICH SUBSTANCE IS THE BEST HOME INSULATOR?
OPTIMUM TEMPERATURE FOR STORING NON-HOMOGENIZED AND HOMOGENIZED MILK
A BEHAVIORAL STUDY OF HORSES’ SENSITIVITY TO COLOR
SIGHT OR TOUCH: WHICH DOMINATES? HOW THEY RELATE
THE DEVELOPMENT OF RESISTANCE TO INSECTICIDES IN DROSOPHILA MELANOGASTER
HOW DOES THE ORTHALICUS RESES NESODRYAS REACT TO ARTIFICIAL ENVIRONMENTS?
TRANSFER OF PASMID DNA FROM E. COLI (K-12) 184.1772 E. COLI (K-12) 600-C
AN INVESTIGATION OF THE PHOSPHATE CYCLE IN THE EUTROPHICATION PROCESS
BACTERIAL CULTURES IN INFRARED LIGHT
THE ECONOMIC FEASIBILITY OF SEAWEED AS A FERTILIZER FOR SOUTH FLORIDA
TISSUE CULTURING OF HIBISCUS ROSA-SINENSIS
CAN UNDESIRABLE AQUATIC PLANTS BE USED AS SOIL SUPPLEMENTS?
ESCHERICHIA COLI’S SUSCEPTIBILITY TO HYPOCHLORITE ION
MONOCOT AND DICOT SEED GROWTH

HORMONES AND PLANT REGENERATION
THE EFFECTIVENESS OF NITROGEN, PHOSPHOROUS, POTASSIUM, AND ADDITIVES UPON THE GROWTH PATTERNS LOLIUM PERENNE
PROPERTIES OF NONMONOTONIC ACTIVITY IN SELECTED CHEMICAL SYSTEMS
METALLIC ELECTROPLATING RATES
AMMONIUM IRONS AND FLAMMABILITY
THE EFFECT OF ph AND PROTEIN CONTENT ON CASEIN GLUE
ANALYSIS OF LEAD POLLUTION IN SEA WATER USING ATOMIC ABSORPTION
THE UTILIZATION OF R. ACIDOPHILIA IN THE PRODUCTION OF HYDROGEN
DISTILLATION OF WATER AND ITS EFFECT
PROTEIN CHEMISTRY OF DROSOPHILA MELANOGASTER
CHARACTERIZATION OF NUTRIENT RELEASE OF LAKE WASHINGTON SEDIMENTS
A MECHANICAL ARM
ANALYSIS OF LOAD MANAGEMENT ON ELECTRIC UTILITIES
COMPARATIVE STUDIES OF BI-VENTRICULAR FUNCTIONS
DOES TOOTHPASTE KILL MOUTH BACTERIA?
THE MATHEMATICAL ANALYSIS OF PATTERNS IN CELLULAR AUTOMATA
THE EFFECT OF SUGAR ON MERIONES UNGUICULATUS
OSSIFICATION IN SPECIFIED CHICK EMBRYO BONES FROM DAY SEVEN THROUGH DAY TWELVE BY THE USE OF AN ATOMIC ABSORPTION SPECTROPHOTOMETER
WHAT EFFECT DO COMMON BEVERAGES HAVE ON TEETH?
THE IMPORTANCE OF PROTEIN IN EGG PRODUCTION
TOOTH DECAY--CAUSE AND PREVENTION
EXTRACELLULAR DIGESTION: BIOCHEMICAL PROCESS OF BREAD MOLD
A SURVEY OF PLANKTON IN THE MOUTH OF ESCAMBIA BAY
IN SEARCH OF STAPH
IDENTIFICATION AND RECOMBINATION OF LAKE BACTERIA
WHAT IS THE PURIFICATION SYSTEM’S EFFECT ON PROTOZOAN LIFE?
THE GROWTH OF PENICILLIUM NOTATUM ON ALTERED MEDIA
THE EFFECTS OF ORTHODONTIC APPLIANCES ON ORAL MICROFLORA
RADIATION DETECTORS
THE EFFECT OF COPPER ON SHELL PIGMENTATION AND SIZE OF AVIAN EGGS
THE EFFECTS OF NUTRIENTS ON BIOLUMINESCENT BACTERIA
THE EFFECT OF MICROWAVE RADIATION ON THE GERMINATION OF THE SUNFLOWER
CITRUS POWER
VITAMIN C AND ACID CONTENT OF FRUIT JUICES--A COMPARISON OF FRESH VS. PROCESSED
AIR AND WATER CONTAMINANTS WITH VEGETATION
CHEMICAL CONTROL OF PLANT GROWTH
HYDROPONICS
THE EFFECT OF ALLELOPATHIC AGENTS ON GERMINATING SEEDS

POSSIBLE SCIENCE FAIR PROJECTS FROM ECHO*

SEEDS:

- Compare the ease and effectiveness of different methods of scarification (acid, mechanical, hot water, 10% chlorine, etc.).
- Determine the easiest and safest way to treat and store seeds from ECHO's seed bank so that they will store longer and stay free of insects and disease.
- Investigate the efficiency and effectiveness of treating seeds in the microwave for improved germination and resistance to disease.
- Compare seed viability after exposure to differing storage conditions (temperature and humidity).
- Check the effect of different seed pre-planting treatments on germination (scarification, vernalization, light, etc.).
- Experiment with different seed pelletizing treatments to ease establishment of seedlings (see One Straw Revolution).
- Develop and compare labor-saving ways of harvesting and processing seeds (i.e. Does drying velvet bean seeds in solar dryer adversely affect germination? How do you harvest roselle easily?).
- Develop new ways for ECHO to store and package seed.
- Compare how germination proceeds for two crops (one temperate and one tropical) at a cold and a warm temperature.
- Determine which seeds we can store in the freezer.

PLANTS:

- Develop and compare the growth of plants in different hydroponic solutions and media.
- How do factors such as soil temperature and depth of planting affect seed germination, seedling vigor, and disease resistance?
- Using plant debris and extracts mixed with soil in petri dishes, look at allelopathic properties of some food plants and how they affect seed germination.
- Determine critical weed-free period for specific weed and crop species.
- How many weeds are too many?
- Demonstrate and compare inter- vs. intra-specific competition.
- Determine at what stages weeds are easiest to control.
- Compare the salt tolerance of various crops and varieties.
- Compare use of living mulches as weed control strategies.
- Compare minimum tillage vs. conventional tillage to control weed seed germination.
- Try cross pollinating a self-pollinated crop and select offspring with superior traits from both parents.
- Screen various plants in a population for such things as: disease resistance, insect resistance, day length sensitivity, salt tolerances, seed characteristics, etc.
- Compare legume with and without inoculant (must sterilize sand and keep it covered)
- Using wrong inoculant, at what level of N does inoculant cease to help?
- What effect does harvesting leaves and other stresses have on health of plant? Does it matter at what stage of growth it's done?

- How is growth habit affected by nutrient balance?

* ECHO = Educational Concerns for Hunger Organizations

* You may contact ECHO as a resource if you are interested in botany.

- Look at effect of different colors of light on growth. Use red, blue, and green cylinders of colored plastic.
- How does day length affect growth habit?
- Demonstrate deficiency symptoms in plants.
- Try to demonstrate as many forms of plant propagation as possible (air layering, grafting, budding, etc.).

<u>PESTS</u>:

- Compare different forms of organic pest controls.

<u>HUMAN NUTRITION</u>:

- What crops that are, or could be, grown overseas provide a good balanced diet (i.e. complete protein combinations)?
- How do different food processing techniques affect taste, shelf life, and nutrient content?

<u>SOILS</u>:

- Test and select appropriate plant species for use in bioassay to test for adverse growing conditions (pH, salinity, nutrient deficiency).
- Compare foliar vs. soil applied fertilization.
- Compare and contrast organic and inorganic sources of fertilizer (including costs, nutrient content, and persistence in the soil).
- How much lime is needed to change the pH of different soils?
- How does soil structure affect management strategies?
- How does O.M. and texture affect the rate of herb that must be applied?
- Develop a good easy-to-make potting mix that uses readily available materials and promotes good plant establishment and growth.
- Is it better to incorporate organic matter or leave it on the surface?
- How can soil moisture be best preserved in the dry season (living mulch, dust mulch, weed mulch, etc.)?
- Compare efficiency of various appropriate tech nematode control techniques.
- Develop ways the structure of sodic soils may be improved such as the addition of gypsum.
- How does pH affect nutrient availability in soils?

<u>APPROPRIATE TECH</u>:

- Compare relative efficiencies of different plant residues as heat sources, and raw materials of biogas generation.
- Design appropriate systems for: solar energy production, hydroelectricity, wind generation, biogas production, wastewater processing, plant oil extraction, etc.

- Develop and compare different methods of filtering and purifying water (peat, charcoal, sand Moringa seeds).
- Compare methods of aerating hydroponic ponds.
- Develop and compare various post harvest storage techniques for various crops (suberization, cooling, drying).
- Investigate uses of sewage sludge (feeding algae, worms, larvae-growing medium).
- Develop creative uses for commonly disposed of items here and overseas (tires, 55-gallon drums, cans, bottles, etc.).
- Compare effectiveness of various mulching materials for: weed control, moisture conservation, persistence, and nutrient content.
- Compare and contrast cost and efficiency of various cookers and stoves.
- Design and build a solar food dryer or oven.
- Design and build a small-scale integrated aquaculture or hydroponics unit that would be able to be built and used by a subsistence farmer overseas.
- Identify by-products of plant and animal processing available overseas and develop uses for them.
- Develop simple and effective ways to preserve meat and fish overseas.

COMPUTERS:

- Develop programs that could be used to determine such things as stocking rates for animals, fertilizer amounts needed for a given type of fertilizer or plot of land, etc.

HIGH TECH:

- Evaluate the appropriateness and usefulness of Hach kits and plant disease test kits for use overseas by development workers.

MISCELLANEOUS:

- Develop new and compare with old, appropriate methods of composting.
- Determine or develop good methods of controlling bird damage to grain overseas.
- Contrast the advantages and disadvantages of composting vs. mulching.
- Determine the effectiveness of using reflective mulches to control aphids.
- Compare the relative effectiveness of several biological insect or disease methods with chemical control methods.
- Develop and compare various appropriate tech techniques for soil sterilization (flame, Clorox, etc.).

- Compare the efficiency of intercropping vs. traditional monocultures.
- Develop creative uses for items we usually throw away.
- Develop innovative approaches to urban agriculture (roof top gardens, wall gardens, appropriate animals).
- Compare the performance of rooftop growth plants in different growing media.
- Develop methods of storing forages in the dry season.
- Identify local waste products that could be recycled and used in agriculture in Lee County.

NOTE: A model or demonstration is not a science project. An experiment must be carried out. Use these ideas to design an experiment.

SCIENCE FAIR NOTEBOOK

(Includes Research Paper Guidelines)

RESEARCH PAPER REQUIREMENTS

All students will be required to write a research paper as the first part of the Science Fair project. Research is to be on general information about the topic chosen. This is not a paper about the experiment at this point.

SOURCES:	May be a combination of books, periodicals, and interviews. No more than one encyclopedia may be used. At least six of the sources should be scientific in nature.	6-10
PAGES IN BODY OF RESEARCH PAPER:	Numbers given are for typed, double-spaced pages.	3-5

BIBLIOGRAPHY CARDS

After the topic has been approved, students will begin to research their topic. Students will write one index card for each book, article or other source being used in research on their topic. Guidelines for this will be given in science class.

RESEARCH PAPER TITLE PAGE

TITLE

(of research related to your topic)

NAME
DUE DATE
SUBJECT

OUTLINE

I.
   A.
   B.

II.
   A. (Sample)
   B.
   C.
      1.
      2.

RELATED RESEARCH - BODY

Include:

- A paragraph that introduces your paper
- General information about your topic (not about your experiment)
- Descriptions of related experiments conducted by others, if available
- Last paragraph must include a summary of the main ideas of your paper

Carefully check to make sure your punctuation, spelling, and word usage are all correct. Avoid slang words and jargon. Write in the third person. Avoid the use of the word "I" and "you."

Remember, the research paper is about information related to your topic. It is <u>NOT</u> a paper about your experiment. It is written <u>PRIOR</u> to experimentation.

SCIENCE FAIR NOTEBOOK

<u>TITLE PAGE</u>

Put your title in the middle of the page.

Your title should <u>not</u> be in the form of a question. (Put this title on your Science Fair Notebook title page; logbook cover, and backboard.)

If your purpose is well worded, then you should have little difficulty in formulating a title. Your title should be sufficiently descriptive of your purpose. Try writing several titles on paper before you come to any decisions.

TABLE OF CONTENTS
(example)

(Most sections should be a page long or more with no two headings on the same page.)

PURPOSE

Now that you have chosen a topic, try to explain the purpose of the experimentation in one to three sentences. You can start this way: "The purpose of this project is ___________________________." Your purpose may include any hypotheses (scientific guesses) that you have as to the outcome of your experimentation.

Here is an example of one student's purpose:

Here is an example of one student's purpose:

The purpose of this project is to determine if earthworms, lumbricus terrestris, affect soil nutrients.

In one sentence, the student has described what he is attempting to find out experimentally and what his test subjects are going to be.

HYPOTHESIS

"I hypothesize that…"

(one sentence needed)

ACKNOWLEDGEMENTS

I would like to thank. . . .

List the people who helped you with your project.
Include what they did to help you.

MLA CITATION

(Taken from the website: http://www.unc.edu/depts/wcweb/University of North Carolina at Chapel Hill)

When writing a paper, we often use and build on the work other people hve researched and compiled. If you incorporate or refer to other people's work, you must give credit to those authors using parenthetical citation and a Works Cited list.

MLA documentation uses parenthetical citation to reference sources within the text of your research paper, noting the author's last name and page number where the information used in your paper can be found (Gibaldi 238). (🡐 Like that!)

When you use an author's ideas, quote material you've read, or paraphrase that material, you indicate the source in parentheses at the end of your sentence. For instance, I had to cite the first sentence above because it contains information from the MLA Handbook for Writers of Research Papers. A reader will look at the author's last name and then refer to the Works Cited list at the end of your paper to obtain bibliographic information.

The Works Cited list is your bibliography, but it includes only the sources you cite in your paper. Your grammar book will give you direction on how to present his information, but here is a basic example:

Book:
Author's Last Name, First Name. Book Title. Place of Publication: Publisher, Date.

Use easybib.com for Bibliography at end of paper.

MATERIALS AND METHODS OF PROCEDURE

1. List all materials used in your investigation.

   Include: What materials?
   What kinds of materials?
   How much?

   Quantities are important. Use only metric units.

2. Tell step by step what you did in your investigation.
   (See directions for materials and methods in the logbook section for examples.)

RESULTS

Include a written paragraph in addition to graphs, tables, or charts.

Tell exactly what you saw happen during and after your experiment. Be specific and detailed.

Use all the senses you can as they apply for your experiment.

Include graphs, charts, or diagrams. These must be labeled with a title and x and y axis labeled so judges know what the units are and what the numbers mean.

CONCLUSIONS

(Be sure your conclusions are related to your purpose.)

Your conclusions should include:

- Statement of support or non-support of the original hypothesis. (Do not use the words “proved” or “disproved.”)
- Description of any problems or unusual events that occurred during your investigation.

RECOMMENDATIONS

Include at least one paragraph stating the things you would suggest doing differently next time. Or, if no changes should be made, tell how you would add to your project for future study. Include helpful suggestions to anyone who might repeat your experiment.

WORKS CITED

List alphabetically all books, articles, people, or other sources used for researching and writing your paper. If more than one line is needed for an entry, indent second and any subsequent lines after the first line and double space throughout.

Book

Author's last name, first name. Title of Book. Place of Publication: Publisher, Date.

Magazine

Author's last name, first name. (Year published, month). Title of Article. Name of magazine. Volume Number. Page numbers.

Encyclopedia

Last name, first name (if given). Title of Article. Name of Encyclopedia. Edition year. Volume number or letter.

Interview

The person or group interviewed, place, date.

Internet References

See grammar book.

Note: Use MLA format.
A good reference site is: easybib.com

LOGBOOK

MATERIALS

List all materials used in your investigation. Include what, how much, and what kinds of materials you used. Keep in mind quantities are important. Be sure to use only metric units see pages 31-32. Try to use inexpensive materials or borrow rather than buy.

Good Listing	Poor Listing
3 - 15 x 15cm. sq. each of: Brawny, Gala, Scott, Generic paper towels	Paper Towels
250 ml graduated beaker	Measuring Cup
750 ml water 20°c	Water
1 - 20 x 20cm. sq. cake pan	Container
Celsius thermometer	Thermometer
Clock with a secondhand	Clock

METHODS

Your step-by-step directions are like a recipe. Anyone who reads them will be able to duplicate your investigation and get the same results. These must be numbered.

Example:

Do all leafy green vegetables contain the same-colored natural pigments?

1. Gather materials. (This will be **every** student's first step.)
2. Boil lettuce, kale, spinach, collard greens, and Swiss chard (each in its own pot) in water for 10 minutes.
3. Let the liquid cool to room temperature.
4. Strain out the greens.
5. Cut chromatography paper into five strips measuring 5cm wide by 18cm long.
6. Pour 5cm of each of the liquids into its own clear cup.
7. Using a pencil and tape, secure the chromatography strip inside the clear cup allowing it to hang into the liquid with only the bottom centimeter in the liquid.
8. Allow each strip to rest in the liquid for fifteen minutes.
9. Remove each strip and lay them flat to dry.
10. Record the pigments found on each strip.
11. Repeat steps 2-10 twice more.
12. Analyze and record results. (This will be **every** student's last step.)

DATA/LOGBOOK

Date refers to information gathered during your investigation. Writing in a 70-page spiral notebook is the most convenient way to keep a log.

Your logbook should include:

1. Title on cover “Logbook”

2. Hypothesis

3. Materials and Methods

4. Notes on all the preparations you made prior to starting your investigation.

5. Detailed day-by-day notes on the progress of your project with date and time for each entry.
    a. What you are doing
    b. Problems you have with your investigation
    c. Things you would change if you were doing this investigation again.

6. Any drawings that you feel might help explain your work.

QUANTIFICATION OF DATA

The data collected during your investigation needs to be quantifiable (measurable). All measurements in your investigation must be made in metrics.

TABLE OF METRIC MEASURES

Metric Prefixes

milli	1/1000 or .001
centi	1/100 or .01
deci	1/10 or .1
deka	10
hecto	100
kilo	1000

Capacity

10 milliliters (ml)	=	1 centiliter (cl)
10 cl	=	1 deciliter (dl)
10 dl	=	1 liter
10 liters	=	1 dekaliter (dal)
10 dal	=	1 hectoliter (hl)
10 hl	=	1 kiloliter (kl)

Length

10 millimeters (mm)	=	1 centimeter (cm)
10 cm	=	1 decimeter (dm)
10 dm	=	1 meter (m)
10 m	=	1 dekameter (dam)
10 dam	=	1 hectometer (hm)
10 hm	=	1 kilometer (km)

Weight

10 milligrams (mg)	=	1 centigram (cg)
10 cg	=	1 decigram (dg)
10 dg	=	1 gram (g)
10 g	=	1 dekagram (dag)
10 dag	=	1 hectogram (hg)
10 hg	=	1 kilogram (kg)

TABLE OF METRIC MEASURES

1 cm	=	.39 inch	1 inch	=	2.54 cm
1 m	=	3.28	1 foot	=	.305 m
1 m	=	1.09 yards	1 yard	=	.91 m
1 km	=	.62 mile	1 mile	=	1.61 km
1 sq cm	=	.16 sq in	1 sq in	=	6.5 sq cm
1 sq m	=	10.8 sq ft	1 sq ft	=	.09 sq m
1 sq m	=	1.2 sq yd	1 sq yd	=	.8 sq m
1 hectare	=	2.5 acres	1 acre	=	.4 hectare
1 cc	=	.06 cu in	1 cu in	=	16.4 cc
1 cu m	=	35.3 cu ft	1 cu ft	=	.03 cu m
1 cu m	=	1.3 cu yd	1 cu yd	=	.8 cu m
1 liter	=	2.1 pints	1 pint	=	.47 liter
1 liter	=	1.06 quarts	1 quart	=	.95 liter
1 liter	=	.26 gallon	1 gallon	=	3.79 liters
1 gram	=	.035 ounce	1 ounce	=	28.3 g

1 kg = 2.2 pounds

1 pound = .45 kg

Here's How to Convert the Measurements That You Use Now to Metrics....and Vice Versa

	When you know	Multiply by	And you'll find
LENGTH	inches	25	millimeters
	feet	30	centimeters
	yards	0.9	meters
	miles	1.6	kilometers
	millimeters	0.04	inches
	centimeters	0.4	inches
	meters	1.1	yards
	kilometers	0.6	miles
AREA	square inches	6.5	square centimeters
	square feet	0.09	square meters
	square yards	0.8	square meters
	square miles	2.6	square kilometers
	acres	0.4	square hectometers
	square centimeters	0.16	square inches
	square meters	1.2	square yards
	square kilometers	0.4	square miles
	square hectometers	2.5	acres
MASS	ounces	28	grams
	pounds	0.45	kilograms
	short tons	0.9	megagrams (metric tons)
	grams	0.035	ounces
	kilograms	2.2	pounds
	megagrams (metric tons)	1.1	short tons
LIQUID VOLUME	ounces	30	milliliters
	pints	0.47	liters
	quarts	0.95	liters
	gallons	3.8	liters
	milliliters	0.034	ounces
	liters	2.1	pints

liters	1.06	quarts
liters	0.26	gallons

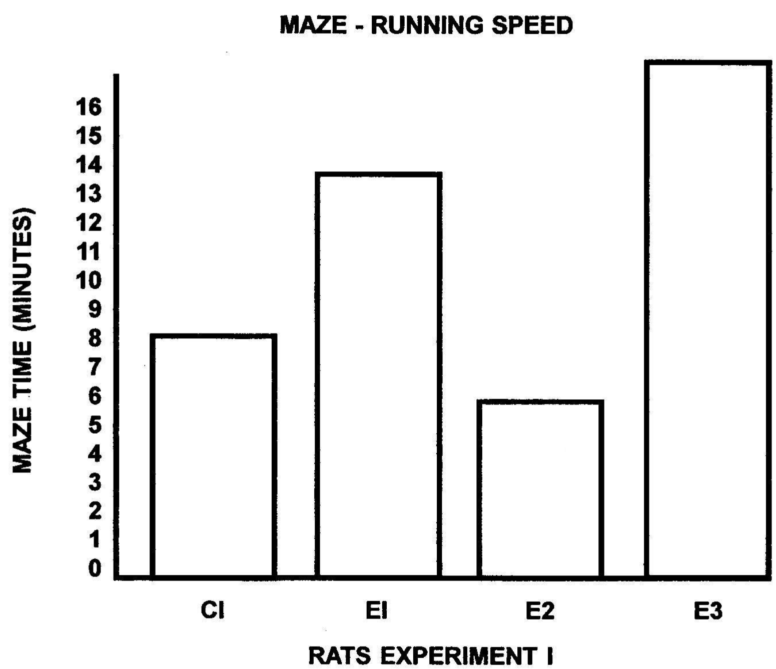
GRAPHS

You may use http://nces.ed.gov/nceskids/createagraph/ website to help make graph.

Make sure that graphs have labels and a title.

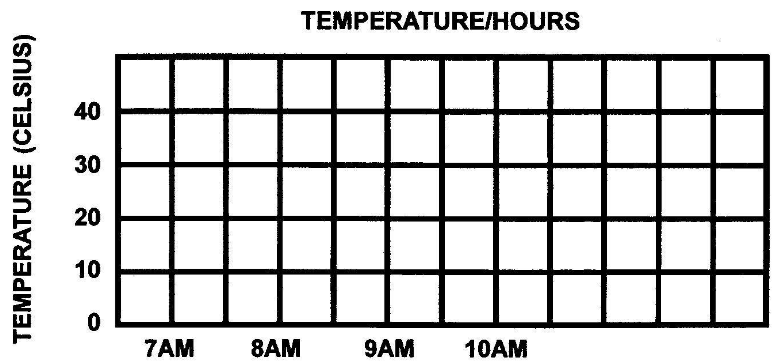
There are two main types of graphs: ________________________________

BAR GRAPH



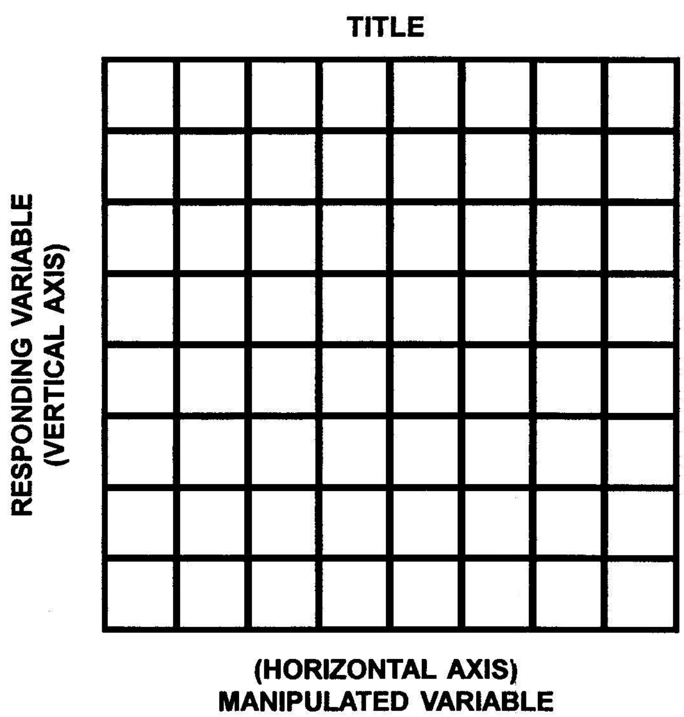
A bar graph is used to display data that does not occur in a continuous manner.

LINE GRAPH



A line graph is used to display data that occurs in a continuous manner.

MAKING A GRAPH



Title: The title is a short description of the data being displayed.

Horizontal Axis: The manipulated variable (what you changed on purpose) is displayed on the horizontal axis.

Vertical Axis: The responding variable (what happened because of what you changed) is displayed on the vertical axis.

Use graph paper. Type or stencil all labels. Or use a graphing program on your computer.

HOW TO WRITE AN ABSTRACT

Each student who completes a science fair project will be required to write an abstract to be displayed with the project. An abstract gives the essence of the project in a brief but complete form--it should not exceed 250 words. Judges and the public should have a fairly accurate idea of the project from reading the abstract. The abstract must focus on the current year's research and give only minimal reference to previous work as applicable. Details and discussions should not be included in the abstract but may be put in the longer, written research paper (if required), or given on the project exhibit board.

Write in paragraph form the following:

purpose of the experiment

- An introductory statement of the reason for investigating the topic or the project.
- A statement of the problem and/or hypothesis being studied.

procedures used

- A summarization of the key points and an overview of how the investigation was conducted.
- An abstract does not give details about the materials used unless it greatly influenced the procedure or had to be developed to do the investigation.
- An abstract should only include procedures done by the student. Work done by a mentor (such as surgical procedures) or work done prior to student involvement must not be included.

data

- This section should provide key results that lead directly to the conclusions you have drawn.
- It should not give too many details about the results nor include tables or graphs.

conclusions

- Conclusions from the investigation should be described briefly.
- The summary paragraph should reflect on the process and possibly state some applications and extensions of the investigation.

Following is a sample of the Abstract format required by the Thomas Edison Regional Science Fair. The Abstract <u>is</u> to be displayed on the display board.

Thomas Alva Edison Regional Science and Engineering Fair

Abstract

Project Title (as it appears on project and entry forms)

Division (Junior or Senior)

DO NOT use either the ISEF format or the SSEF format, they include personal identifying detail that is inappropriate at our Regional Fair.

Abstract Text
- single spaced
- 250 words or less
- 12-point type > only for the copy in your notebook (The Abstract mounted on the board can be a larger type).

The Abstract **should** include:
- purpose of the experiment
- overview of work done this current year
- procedures used this year
- data collected this year
- conclusions

The Abstract **may** include:
- possible applications of research
- minimal reference to previous work, only if necessary to an understanding of the current work

The Abstract **should not** include:
- acknowledgements of others
- acknowledgements you have received
- work or procedures done by the mentor or others
- bibliographic references

No pasted or taped text will be permitted.

Abstract

Title: Radiation Emitted from Granite Countertops
Name:
Division: Senior
Category: Medicine and Health

The purpose of my project is to help others realize the possible risk of getting lung cancer from being exposed to radiation in their granite countertops. Families can avoid being exposed to anymore radiation by getting their countertops checked. This project could possibly save someone's life, and determine if the level of radiation in granite countertops is harmful to humans.

In order to start my experimenting, I had to get fourteen granite samples of different types from various locations. I used a radiation detector which was plugged into a laptop. The radiation program on the computer showed me graphs of the granite. One of my fake samples of granite showed 0 counts per minute (cpm), and highest level of radiation was 13cpm in the Giallo Fiorito granite from Brazil.

To conclude my experiment, I found out that the levels of radiation in granite countertops are not high enough to harm people. Even though the levels of radiation aren't high enough to harm us, over a long period of time there could possibly be health problems. It's not very likely to have serious health problems unless you're exposed to exceeding amounts of radiation everyday. While I experimented, I discovered it doesn't just matter on the amount of radiation from granite. It depends on the size of the room the granite is in. Radon gas is released in low amounts and gets trapped in small, non-ventilated rooms, which causes radiation levels to rise. This rise could become a health hazard.

BIBLICAL ABSTRACT

A. Length and letter quality same as abstract

B. Definition: The Biblical abstract generally relates the overall philosophy of the project to Scripture. Examples of this would be as follows:

- Colossians 1:16-17 -- How does the project illustrate that God is "before all things"?
- Romans 1:20 -- How does the project show God as the Creator of the Universe?
- How is the omnipotence of God observed in the experiment?
- Explain how the experiment demonstrates the order of God.

TO PREPARE A BIBLICAL ABSTRACT

A. Find one or more Bible verses that relate directly to your project.

B. Explain how your project illustrates the verses.

C. Explain what you learned about God by doing your project.

D. Place the Biblical Abstract in your Science Fair notebook. Do NOT display it on your backboard.

SAMPLE
BIBLICAL ABSTRACT

HOW DO THE SALT TOLERANCES OF VARIOUS CROPS COMPARE?

Science is man's attempt to discover the laws of nature which God has established for the physical universe. Even though Scripture tells us that man cannot know or understand all things that God made (Ecclesiastes 3:11), it does stress that man should study and use God's creation for the benefit of mankind (Genesis 1:28). "God is not the author of confusion," (1st Corinthians 14:33). He created the universe, put it into motion, and set the laws which apply to its operation so that it may run in an orderly fashion (John 1:1, 3). If it were not for this order, science would be impossible. Because the universe obeys God's universal laws and works with exactness, man can strive for scientific knowledge that is precise.

Plants are found in all parts of the world. Each plant requires a special type life zone in order to survive. Through this project, I was reminded of the omnipotence of an all-wise God who created this world (Jeremiah 10:12) and provided the order and design to account for the adaptability of different plants.

Studying science for the benefit of mankind cannot help but glorify God. If God did not create and rule over all, man could master nothing.

SCIENCE FAIR CHECK SHEET

<u>SCIENCE PROJECT NOTEBOOK</u>

The following items, in order, are to be typed and placed in a notebook or binder labeled, <u>Science Project Notebook</u>.

- Title Page
- Table of Contents
- Purpose
- Acknowledgements
- Outline
- Related research (body of paper)
- Materials and methods of procedure
- Results
- Charts, graphs, or tables
- Conclusions
- Recommendations
- Biblical abstract
- Science Fair Abstract
- Bibliography

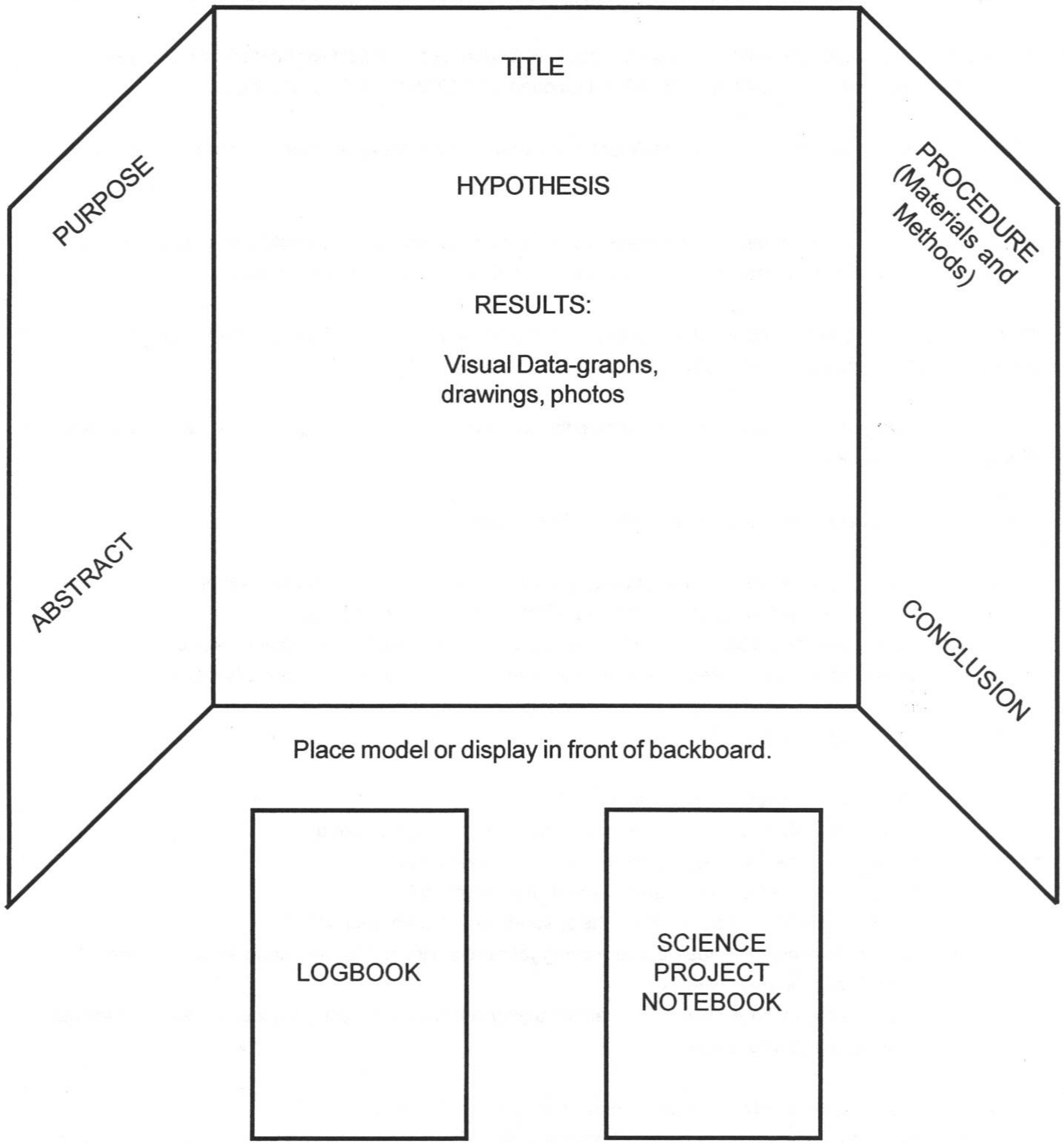
<u>LOGBOOK</u>

The following information is to be neatly handwritten into a spiral notebook labeled, <u>Logbook.</u>

- Title (may be placed on cover)
- Hypothesis
- Materials and methods of procedure
- Preparations made before starting the experiment
- Day-by-day progress log

On the back of your notebook and logbook write your name, grade, and school.

PHYSICAL DISPLAY



Your name and grade, go on the back of your notebook, logbook, and on the back of the <u>left side</u> of the display board as you face it.

HOW TO CONSTRUCT THE DISPLAY

1. Display boards are available for sale in the bookstore and area stores; however, exhibits can be made from a wide variety of materials, including wood paneling, heavy cardboard, pegboard, hardwood, plastic, styrofoam, etc.

2. There are definite sizes for the project that cannot be exceeded, or the project will be disqualified. The maximum space requirements are: 4 feet wide, 30 inches deep, and 12 feet high from the floor.

3. The exhibit must be able to fit on a card table or be set up as a floor model. Both models must be self-supporting.

4. Dangerous chemicals, open flames, explosives, dissections, or live animals may not be exhibited. See the following "Display and Safety Regulations" for more detailed list of items unacceptable for display.

5. Display objects can be fastened with nails, screws, wires, and staples. Use spray adhesive for fastening paper to the backboard. Using tape is not sufficient and it does not usually last very long.

6. When setting up your project at the fair, make sure that you bring along an emergency repair kit in case your project needs some work done on it.

7. One of the main parts of your science fair project is the backboard:

   A. The main purpose of your backboard is to attract the viewer's immediate attention and get his interest.
   B. Poster paper containing your work should be fastened onto the backboard.
   C. Your display board should be clearly lettered and easy to read. Always print--never use cursive writing. Always use plain paper--never use notebook paper. Do not write directly on the display board. Check from a distance to see if you can read the title and heading.
   D. What your display board should contain:

      1. Title--research question or problem
      2. Hypothesis--what you think will happen when you investigate your question
      3. Purpose--clear statement of what you are trying to find out
      4. Materials and methods (Procedure)--explain what you did
      5. Results--what happened. Use graphs or some other type of visual data
      6. Conclusions--what you learned from doing your project including statements of support or non-support of original hypothesis
      7. Abstract--copy without name or other identifying information must be placed in the bottom left corner as you face your project

   E. Your model or work will go in front of your blackboard on the table.
   F. Photos--every project does not need photos, but, if you have a camera, you might consider recording your progress. If photos are included in your science fair notebook, they should be placed at the end. Photos on your display board should be labeled.
   G. Color--careful use of color improves display appeal, but don't overdo.

DISPLAY AND SAFETY REGULATIONS

Unacceptable for Display

1. living organisms (e.g., plants, animals, microbes)
2. dried plant materials
3. taxidermy specimens or parts
4. preserved vertebrate or invertebrate animals (includes embryos)
5. soil or waste samples
6. chemicals including water
7. human/animal parts (Exceptions: teeth, hair, nails, dried animal bones, histological sections, and wet mount tissue slides)
8. human or animal food
9. sharp items (i.e., syringes, needles, pipettes)
10. poisons, drugs, controlled substances
11. dry ice or other sublimating solids
12. flames or highly flammable display materials
13. tanks that have contained combustible liquids
14. batteries with open top cells
15. awards, medals, business cards, flags, etc.
16. photographs or other visual presentations depicting vertebrate animals in other-than-normal conditions (i.e., surgical techniques, dissection, necropsies or other lab techniques)

Acceptable for Display & Operations With Restrictions

1. Class II lasers:
   a. must be student-operated
   b. posted sign must read, "Laser radiation: Do Not Stare into Beam"
   c. must have protective housing that prevents access to beam
   d. must be disconnected when not operating
2. Large vacuum tubes of dangerous ray-generating devices must be shielded properly.
3. Pressurized tanks that contained noncombustible may be allowable if secured.
4. Any apparatus producing temperatures that will cause physical burns must be adequately insulated.
5. High-voltage equipment must be shielded with a grounded metal box or cage to prevent accidental contact.
6. High-voltage wiring, switches, and metal parts must have adequate insulation and overload safety factors, and must be inaccessible to others
7. Electric circuits for 110-volt AC must have a nine-foot (min.) cord. The cord must have sufficient load-carrying capacity and be approved by Underwriters Laboratories.
8. Electrical connections in 110-volt circuits must be soldered or made with approved connectors. Connecting wires must be insulated.
9. Bare wire and exposed knife switches may be used only in circuits of 12 volts or less; otherwise, standard enclosed switches are required.

17. Glass or glass objects unless deemed by the Display and Safety Committee to be an integral and necessary part of the project

18. Any apparatus deemed unsafe by the Scientific Review Committee

Acceptable for <u>Display only</u>
(Cannot be operated)

1. Projects with unshielded belts, pullers, chains, and moving parts with tension or pinch points

2. Class III and IV lasers

Size

Project space limitations:
76 cm (30 in.) deep
122 cm (48 in.) wide
274 cm (108 in.) high

Tables are 76 cm high.

ORAL PRESENTATION GUIDE

Some students <u>may</u> be asked to discuss their projects at the school fair.

1. Introduce yourself.
2. Give the title of your project and its purpose.
3. Briefly explain why you became interested in this project.
4. Explain your procedure, relate the number of trials, and show your results using charts, graphs, or log.
5. Relate your conclusions. Explain what you've learned. If there were problems or errors in your experiment, relate these and their bearings on your outcome.
6. Tell what further experiments you might try in the future and what you would do differently if you were to do this experiment again.
7. Explain any applications of your study.

SUGGESTIONS

- Smile and be polite.
- Wear nice clothes and have a neat appearance.
- Stand straight and still. Try to keep from swaying and looking anxious.
- Pay attention to the judges and keep eye contact.
- Project your voice so all of the judges can hear you.
- Stand to the side of the exhibit.
- Point out charts, graphs, or other interesting features of your project.
- Show enthusiasm for your work.

Evangelical Christian School

____
Total Score

SCIENCE FAIR JUDGING FORM

______________________________	____________
Area of Classification	Student Number

______________________________	____________	____________
Project Title	Grade	Date

Judge's Comments — Points

SCIENCE FAIR NOTEBOOK (20%)
- research and development
- knowledgeable and logical presentation
- valid references

SCIENCE FAIR LOGBOOK (20%)
- clear, detailed explanations
- sufficient documentation
- use of metric system

EXPERIMENT (20%)
- scientific thought
- conclusions and findings
- validity

BACKBOARD DISPLAY (20%)
- clarity of message
- dramatic value
- technical skill

OVERALL EFFECTIVENESS (20%)
- creativity/originality of title, project, and display
- difficulty of project
- thoroughness/effort

Scale:		
	0-5	very poor
	6-10	needs improvement
	11-15	satisfactory
	16-20	very good to excellent

____

Signature of Judge

REGIONAL SCIENCE FAIR JUDGING CRITERIA

1. Creative Ability (30 points)

Is this an original idea or is it an original approach to an old idea? Both are good. Does the student show ingenuity in the materials, apparatus and techniques used? Does he buy all materials, or does he show the ability to improvise? Watch out for kits --they are not considered to be original. If the project is a collection, is it a purposeful one?

2. Scientific Thought (30 points)

Does the exhibit show some of the following: organized procedures, accurate observation, controlled experiment, or a cause and effect reasoning, theories, analysis and synthesis and making comparison by showing likenesses and differences. Give weight to probable amount of real study and effort which is represented in the exhibit. Make certain the project is not just a demonstration or an attractive display.

3. Thoroughness (15 points)

How completely has the problem or study been explored? Look for evidence as recorded in data in notebooks such as bibliographies, graphs, and charts. In addition to written evidence, look for experimental animals, plants, or apparatus.

4. Skill (15 points)

Is the workmanship good? Is there evidence of mastery or scientific techniques? Is the apparatus constructed by the student well-made? Overall construction of project should be sturdy and self-supporting.

5. Clarity (10 points)

Clarity of student's oral presentation--not just a memorized speech that reflects little understanding. Does the display explain what the student attempted to do, what he did, and how he did it, and what results, if any, were achieved? Does the explanation on the backboard follow a logical sequence? Things which insure clarity are guide marks, labels, descriptions, and proper emphasis to important items.

NOTE: MOST EMPHASIS IS PLACED ON SCIENTIFIC THOUGHT AND CREATIVE ABILITY.

JUDGING

a. Statements to be addressed under CREATIVE ABILITY/ORIGINALITY (30 points)
_____ there was a question asked
_____ it was an original question, and the answer was not known
_____ the approach to answering the question was creative
_____ the creativity of the study was within the creative ability of the student
_____ the student utilized the scientific method in experimentation rather than only descriptions and observations

b. Statements to be addressed under SCIENTIFIC THOUGHT (30 points)
_____ the scope of the study was within the student's ability
_____ the study was well thought out and the student showed initiative in thought and design
_____ the goals and objectives for doing the study were well defined
_____ a logical hypothesis was developed for the study
_____ the data collected relates to the hypothesis

c. Statements to be addressed under THOROUGHNESS (15 points)
_____ the student collected all data available
_____ the student identified all the controls
_____ the same sizes and population sources were carefully chosen
_____ the variable of each experiment was clearly defined
_____ replications and duplications were utilized
_____ the student anticipated the problems encountered
_____ the student related the work to that reported in the literature
_____ the data were collected in quantitative units
_____ several experiments were done, not just one
_____ the study was completed or brought to a logical stopping place
_____ the data were thoroughly analyzed

d. Statements to be addressed under SKILL (15 points)
_____ the experimental protocols were handled with skill
_____ the experiments were designed with care and anticipation
_____ data measurements were done precisely
_____ the study was skillfully designed and not too complicated
_____ technical problems were overcome and not merely avoided
_____ a detailed notebook or log was kept
_____ this study was the student's alone, and excessive help was not utilized

e. Statements to be addressed under CLARITY (10 points)
_____ the student can explain what was done
_____ the student clearly understands the research
_____ the student understands the meanings of the results obtained
_____ the student understands where the research can lead in the future
_____ it is clear to the student whether the data support or fail to support the hypothesis

f. Statements to be addressed under DISPLAY (Not be used for ranking projects)
_____ is the display well organized so that the component parts of the presentation are logical?
_____ is the display neat and uncluttered or are there items, pictures, machines, models, etc. that are not part of the science or relevant to the study performed?

_____ does the display stand alone--i.e., can one understand the study by reading the display
or is the student's presence required?
_____ is the display complete and are all necessary information sheets present?
_____ does the display communicate science or is it merely an exercise in artistry?

GLOSSARY

1. abstract	a brief statement of the main points, as of a book, science project, etc., a summary
2. affect	to influence or change (verb) as in "How does smoking affect health?"
3. bibliography	the description of books and manuscripts with dates, edition, volumes, pages, publisher, and author
4. conclusions	the answer obtained by reasoning about the results of an experiment
5. effect	result or outcome (noun) as in "What is the effect of smoking on health?"
6. equipment	apparatus used in doing an experiment (not consumed in the experiment)
7. experiment	an actual test or trial to find an answer to a problem
8. footnote	a note of reference, explanation, or comment
9. hypothesis	a proposed or possible answer to a problem
10. materials	items used in an experiment that are usually usable only once
11. observation	a way of getting information using the senses--It is the information of what happens during an experiment
12. procedure	the plan followed in doing an experiment
13. problem	a question for which you are trying to find the answer
14. research	critical study or investigation in seeking new knowledge, facts, or principles
15. science project	a planned step-by-step test to explain why and how something has occurred
16. scientific method	a careful plan for finding the answer to a problem usually consisting of: 1. Problem 2. Research 3. Hypothesis 4. Equipment and Materials 5. Procedure 6. Results (observations)

7. Conclusions

17. control	the part of an experiment that is not changed and is used for comparison with the variable
18. variable	the part of an experiment that is changed and is compared with the control

Intel ISEF Categories and Subcategories

The categories have been established with the goal of better aligning judges and student projects for the judging at the Intel ISEF. Local, regional, state and country fairs may or may not choose to use these categories, dependent on the needs of their area. Please check with your affiliated fair(s) for the appropriate category listings at that level of competition.

Please visit our website at student.societyforscience.org/intel-isef-categories-and-subcategories for a full description and definition of the Intel ISEF categories:

ANIMAL SCIENCES (ANIM)
Animal Behavior
Cellular Studies
Development
Ecology
Genetics
Nutrition and Growth
Physiology
Systematics and Evolution
Other

BEHAVIORAL AND SOCIAL SCIENCES (BEHA)
Clinical and Developmental Psychology
Cognitive Psychology
Neuroscience
Physiological Psychology
Sociology and Social Psychology
Other

BIOCHEMISTRY (BCHM)
Analytical Biochemistry
General Biochemistry
Medical Biochemistry
Structural Biochemistry
Other

BIOMEDICAL AND HEALTH SCIENCES (BMED)
Cell, Organ, and Systems Physiology
Genetics and Molecular Biology of Disease
Immunology
Nutrition and Natural Products
Pathophysiology
Other

BIOMEDICAL ENGINEERING (ENBM)
Biomaterials and Regen Medicine
Biomechanics
Biomedical Devices
Biomedical Imaging
Cell and Tissue Engineering
Synthetic Biology
Other

CELLULAR AND MOLECULAR BIOLOGY (CELL)
Cell Physiology
Cellular Immunology
Genetics
Molecular Biology
Neurobiology
Other

CHEMISTRY (CHEM)
Analytical Chemistry
Computational Chemistry
Environmental Chemistry
Inorganic Chemistry
Materials Chemistry
Organic Chemistry
Physical Chemistry
Other

COMPUTATIONAL BIOLOGY AND BIOINFORMATICS (CBIO)
Computational Biomodeling
Computational Epidemiology
Computational Evolutionary Biology
Computational Neuroscience
Computational Pharmacology
Genomics
Other

EARTH AND ENVIRONMENTAL SCIENCES (EAEV)
Atmospheric Science
Climate Science
Environmental Effects on Ecosystems
Geosciences
Water Science
Other

EMBEDDED SYSTEMS (EBED)
Circuits
Internet of Things
Microcontrollers
Networking and Data Communications
Optics
Sensors
Signal Processing
Other

ENERGY: CHEMICAL (EGCH)
Alternative Fuels
Computational Energy Science
Fossil Fuel Energy
Fuel Cells and Battery Develop
Microbial Fuel Cells
Solar Materials
Other

ENERGY: PHYSICAL (EGPH)
Hydro Power
Nuclear Power
Solar
Sustainable Design
Thermal Power
Wind
Other

ENGINEERING MECHANICS (ENMC)
Aerospace and Aeronautical Engineering
Civil Engineering
Computational Mechanics
Control Theory
Ground Vehicle Systems
Industrial Engineering-Processing
Mechanical Engineering
Naval Systems
Other

ENVIRONMENTAL ENGINEERING (ENEV)
Bioremediation
Land Reclamation
Pollution Control
Recycling and Waste Management
Water Resources Management
Other

MATERIALS SCIENCE (MATS)
Biomaterials
Ceramic and Glasses
Composite Materials
Computation and Theory
Electronic, Optical and Magnetic Materials
Nanomaterials
Polymers
Other

MATHEMATICS (MATH)
Analysis
Combinatorics, Graph Theory, and Game Theory
Geometry and Topology
Number Theory
Probability and Statistics
Other

MICROBIOLOGY (MCRO)
Antimicrobials and Antibiotics
Applied Microbiology
Bacteriology
Environmental Microbiology
Microbial Genetics
Virology
Other

PHYSICS AND ASTRONOMY (PHYS)
Astronomy and Cosmology
Atomic, Molecular, and Optical Physics
Biological Physics
Condensed Matter and Materials
Mechanics
Nuclear and Particle Physics
Theoretical, Computational and Quantum Physics
Other

PLANT SCIENCES (PLNT)
Agriculture and Agronomy
Ecology
Genetics/Breeding
Growth and Development
Pathology
Plant Physiology
Systematics and Evolution
Other

ROBOTICS AND INTELLIGENT MACHINES (ROBO)
Biomechanics
Cognitive Systems
Control Theory
Machine Learning
Robot Kinematics
Other

SYSTEMS SOFTWARE (SOFT)
Algorithms
Cybersecurity
Databases
Human/Machine Interface
Languages and Operating Systems
Mobile Apps
Online Learning
Other

TRANSLATIONAL MEDICAL SCIENCES (TMED)
Disease Detection and Diagnosis
Disease Prevention
Disease Treatment and Therapies
Drug Identification and Testing
Pre-Clinical Studies
Other