

Experimental Design Project Spring Packet: A High School Head Start for PreAP Science

Every student that is enrolled in a preAP science class is required to do an experimental design project. This involves a student applying scientific method procedures to investigate a question of interest. Often, the most difficult aspect of this assignment is to decide on a project that is interesting, do-able, grade-level appropriate, and with real-world applications. When school starts, students will have the opportunity to do an experiment of their choice that will be entered into the school science fair or a content-related experiment proposed by the teacher.

This packet is designed to provide students a greater amount of time to think of possible projects. No experimentation should take place without prior approval. Students may do the entire project in the summer with prior approval from current teacher or from Terri Berry.

If you have questions during the summer concerning the project, please contact:

Terri Berry
CCISD Secondary Science Coordinator
Tberry@ccisd.net
281-284-0089

CCISD RATIONALE FOR EXPERIMENTAL DESIGN PROJECT

Science is a way of learning about the natural world. Students should know how science has built a vast body of changing and increasing knowledge described by physical, mathematical, and conceptual models.

Investigations are used to learn about the natural world. Students should understand that certain types of questions can be answered by investigations, and that methods, models, and conclusions built from these investigations change as new observations are made.

The Texas Essential Knowledge and Skills (TEKS) for all grades begin with an explanation of processes and skills required for investigation of the nature of science. CCISD has a strong commitment to experimental design and student exploration of these mandates. Therefore, CCISD requires a student-designed project to enrich and extend the Texas TEKS throughout our advanced science programs.

Through this project the student will demonstrate mastery of the following science process skills:

- The student conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:
 - (A) demonstrate safe practices during field and laboratory investigations; and
 - (B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.
- The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
 - (A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology;
 - (B) collect data by observing and measuring;
 - (C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;
 - (D) communicate valid conclusions; and construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.
- The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
 - (A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
 - (B) represent the natural world using models and identify their limitations;
 - (C) evaluate the impact of research on scientific thought, society, and the environment; and
- The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to collect, analyze, record information and identify patterns in collected information using percent, average, range, and frequency.

Possible Project Idea Sources

Library Databases

- Librarian
- library@ccisd.net
- Intermediate school: Net Trekker on Library database

Check <https://e4.ccisd.net> for your campus passwords. They are listed under the library tab.

There are many databases containing experimental data collected by scientists around the world. You may ask a question and use existing data to answer the question. For example, the GLOBE project (<http://www.globe.gov/r>) contains meteorological data from around the world. Ozone readings from around the state can be found at http://www.tceq.state.tx.us/cgi-bin/compliance/monops/site_info.pl. Earthquake data is available at <http://neic.usgs.gov/neis/qed/>. Hurricane model maps can be found at <http://ww.wunderground.com/>. Statistics on many aspect of health can be found at the Center for Disease Control (www.cdc.gov). Many other Internet sites contain data that you can use to answer a question that you have posed.

Resources: Search your interest areas, not Science Fair Ideas

- Examples of Science Journals & Magazines
 - Popular Science
 - Scientific American
 - Parks and Wildlife
 - Ranger Rick
 - National Geographic
 - Popular Mechanics

TIPS:

Do you already know the results or the answer to the questions/problem?

- Is the question/problem testable?
- Is this an experiment or just research?
- Has someone else already done the project?
- Is the project grade level appropriate?
- What impact does the project have on society?
- Can you go further with it? (possible extension project for the next year)
- Is it safe enough to be approved by the Scientific Review Committee (SRC)?
- Is it a topic that you are interested in and will be for the entire year?

Most human subject experiments require informed consent (parental permission).

**CCISD EXPERIMENTAL DESIGN PROJECT APPROVAL
GUIDELINES**

All students in Pre-AP classes must conduct an experimental design project. All projects must receive pre-approval from their teacher and the campus Science Research Committee (SRC). The following information must be considered when selecting a project.

Project Approval:

- _____ Appropriate for student grade/ability level
- _____ Must involve experimentation, not simply be a demonstration
- _____ Data should be collected by some form of measurement with SI units (timed, weighed, counted, etc.)
- _____ Large sample size and/or multiple trials. Surveys should have no fewer than 100 participants.
- _____ Controlled testing (changing a variable then running the experiment again) when appropriate. When in doubt, check with your teacher.
- _____ Not a “canned project” from Internet, science fair database, or science fair project book of one of the projects listed at these sites
- _____ Unique and personal as opposed to topic seen numerous times
- _____ Real-world application
- _____ Availability and cost of necessary laboratory equipment and supplies
- _____ Time

Some topics have been overused in the past. Careful thought should be taken before selecting a project involving one of the following topics:

- memory (both people and vertebrates)
- exercise
- crystals
- gear ratios
- comparison of products (no consumer products)
- insulation
- acid rain
- growth of microorganisms, including bacteria, molds, and other fungi (cannot be grown at home; must be in an approved lab)
- plant growth
- computer games and ...
- music and...
- dangerous equipment and activities

Project Idea Sources Checklist

_____ Circle three of the following project categories that interest you

Engineering/Physical Sciences

Chemistry
Computer Science
Earth/Space Sciences
Energy & Transportation
Engineering
Mathematics
Physics

Life Sciences

Animal Science
Behavioral/Social Sciences
Biochemistry/Microbiology
Environmental Science
Medicine/Health
Plant Science

_____ Find your three interest categories below and circle topics in each category that interest you

Listed are possible topics related to your interest:

Animal Science – Includes animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy, paleontology, cellular physiology, animal biorhythms, animal husbandry, cytology, histology, animal physiology, neurophysiology, invertebrate biology, etc.

Behavioral/Social Sciences – Includes psychology, sociology, anthropology, archeology, ethiology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, gerontology, reading problems, public opinion surveys, and education testing, etc.

Biochemistry/Microbiology – Includes molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Chemistry – Includes physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, material, plastics, metallurgy, soil chemistry, etc.

Computers – Includes new developments in software or hardware, information systems, computer systems organization, computer methodologies, and data (including structures, encryption, coding and information theory), etc.

Earth/Space Sciences – Includes geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speleology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

Energy/Transportation – Aerospace, aeronautical engineering and aerodynamics, alternative fuels, fossil fuel energy, green energy science & technology, vehicle development, renewable energies, etc.

Engineering – Includes civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, power transmission and generation, electronics, communications, architecture, bioengineering, lasers, etc.

Environmental Science – Includes pollution (air, water, land), pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

Mathematics – Includes calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics.

Medicine/Health – Includes medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutrition, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry, etc.

Physics – Includes solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

Plant Science – Includes agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

_____ Read “Project Idea Sources”

_____ Read the “CCISD Experimental Design Project Approval Guidelines”

_____ Brainstorm ideas for your experimental design project.

_____ Fill out “Experimental Design Research Project Ideas Under Consideration”.

_____ Have parent review entire packet and sign below with student signature.

_____ Have the entire packet ready to turn in Sept. 1, 2009

Student Signature

Parent Signature

Date

EXPERIMENTAL DESIGN RESEARCH PROJECT
IDEAS UNDER CONSIDERATION

Using your previous work and brainstorming, list two possible problems that would meet the criteria for the experimental design research project. Prioritize (rank order) problems. Place the most interesting first.

Plan 1:

Problem: _____

Brief design description: _____

Independent Variable (variable you are changing in your experiment) _____

Dependent Variable (what you are measuring in your experiment): _____

Measurable Unit(s): _____

What preparation would need to be done prior to beginning? (ordering, purchasing, obtaining)?

*	*	*
*	*	*
*	*	*

Basis/source of idea: _____

Plan 2:

Problem: _____

Brief design description: _____

Independent Variable (variable you are changing in your experiment) _____

Dependent Variable (what you are measuring in your experiment): _____

Measurable Unit(s): _____

What preparation would need to be done prior to beginning? (ordering, purchasing, obtaining)?

*	*	*
*	*	*
*	*	*

Basis/source of idea: _____

Name _____ Date _____ Per. _____

Experimental Design Project Approval Form (Form due week of Oct. 7)

Check one:

Science Fair Project _____

Content Project _____

Topic _____

Question _____

Hypothesis _____

How will you test your hypothesis? _____

What will your control(s) be? _____

What will your independent variable be? _____

What will your dependent variable be? _____

Provide information regarding sample sizes you will use. _____

What type of measurable data will you collect? _____

Science fair only: What category do you expect your project to fit into? Please check the appropriate category.

Behavioral/Social Science

Biochemistry

Botany

Chemistry

Computers

Earth/Space

Engineering

Environmental

Mathematics

Medicine/Health

Physics

Zoology

Energy and Transportation

I UNDERSTAND THAT MISSING THIS DEADLINE OR ANY FUTURE DEADLINE WILL RESULT IN A ZERO FOR THAT PORTION OF THE PROJECT.

Parent signature

Student signature

Teacher Comments:

APPROVED !!

DISAPPROVED

Resubmit by _____

MUST BE REVISED
and RESUBMITTED

by _____

Project, as stated, is not feasible

Too simple

Too general, be more specific

Restate your hypothesis

Revise procedure to match hypothesis