

Overview and Purpose

I created the class Science Seminar so students would have a means to explore the world of science and address academic standards through scientific inquiry. My students may explore any science related topic they desire. They may take the course during any class period and experience the class any or all four years of their high school career.

Each student's project must include approved ISEF protocol forms, a research notebook, a research paper and abstract, an attractive display to "sell" the project, and prepared oral presentations. These presentations vary in length and depth as required for different audiences. All academic skills are developed in the process.

Although Science Seminar is a guided, individual study class which requires self discipline and dedication to task, students are encouraged to enlist help from their peers, the teacher, other high school staff members, and a mentor. In this way, the student builds skills in using the knowledge and abilities of others who act as a resource in the cooperative effort. For example, a student with good artistic skills might help another student with their display and in return, receive help with statistical manipulations.

ISEF rules and a student manual developed specifically for the course are provided for students. Instruction and formats are provided for the development of an experimental design; these formats for a preliminary and final experimental design are included with this lesson plan. A performance learning contract is required for all students. This contract includes all class requirements and is signed by the student, a parent, and the instructor.

Students are provided with a timetable of deadlines which helps them keep on track and progress in a timely manner. Weekly reminders are delivered to students for deadlines and encouragements. Every two weeks students are required to turn in a copy of their research notebook and a self evaluation. This helps monitor their progress.

2007

Winning Lesson Plan
from Monte Vista,
Colorado

Science Seminar

by Gary Wilkinson
Monte Vista High School

Subject: Any Science

Grade Level: NA

Duration: 50-Minute Class
Periods

Overview and Purpose (Cont'd)

Instruction on topic literature searches, including proper use of the Internet and professional journals, is delivered to all students. They are required to have a mentor for their project. Scholarly mentors are difficult to locate in our area, but the use of e-mail has enabled students to access information and assistance electronically. Their mentors help provide insight in the development of student experimental designs.

Two major critiques are provided for students during the two months prior to the regional science fair. Seminar students present and defend their projects, and successfully field random questions. These critiques allow the students input from other students, teachers, community members, and regional fair judges before the "real thing".

Where most science classes have difficulty properly accommodating individual differences, abilities, and confidence levels, Science Seminar is custom-designed for each student. The subject is one of the student's choosing and the level of difficulty is dictated by the student's abilities. Any deficiencies in academic skills are dealt with on a one-to-one basis and the necessary resources and personnel are made accessible. It is as close to an individualized education as is available in any public school.

State standards addressed in this program can include many of the science standards depending on the nature of the subject with which the student is working. However, the standards which are involved in all topics will be dealt with here. All students will research a problem or goal using the scientific method or engineering method, determine the statistical validity of their investigation, report the results of their investigation with a research paper following the APA, (American Psychological Association) format, report the results of their investigation with a visual display according to ISEF (International Science and Engineering Fair), rules, and report the results of their investigation with an oral presentation.

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Educational Standards

All students will meet the following Colorado Model Content Standards

Science:

Standard 1: *Students understand the processes of scientific investigation and design, conduct, communicate about, and evaluate such investigations.*

Standard 5: *Students know and understand interrelationships among science, technology, and human activity and how they can affect the world.*

Standard 6: *Students understand that science involves a particular way of knowing and understand common connections among scientific disciplines.*

Mathematics:

Standard 3: *Students use data collection and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.*

Reading and Writing:

Standard 2: *Students write and speak for a variety of purposes and audiences.*

Standard 3: *Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling.*

Standard 4: *Students apply thinking skills to their reading, writing, speaking, listening, and viewing.*

Standard 5: *Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological sources.*

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Experimental Design Plan (Preliminary)

The experimental design must be typed with the bolded words in the following order.

1. **Purpose:** State the goal(s) of your research.
2. **Research Question(s):** Write one or more questions that address unanswered aspects of your research topic.
3. **Independent Variable(s):** List the factor(s) that you can control or manipulate. Place a star by the one(s) that will most likely be relevant to your research.
4. **Dependent Variable(s):** List the factor(s) that respond to control or manipulation. These factors produce collectable data.
5. **Hypothesis (es):** Formulate one or more statements that predict the possible outcome(s) of your research. These statement(s) should describe how changing the independent variable(s) will affect the dependent variable(s).
6. **Control (if applicable):** Describe the standard of comparison you will use to assess experimental effects.
7. **Constants:** List factors that remain the same throughout the experimentation.
8. **Proposed Procedure:** Write as much detail as possible pertaining to experimental procedures and techniques. A well written and closely followed procedure should result in good data. This may be written in sequential paragraph form or use numbers to indicate sequential steps to gather data. The choice is yours.
9. **Safety Issues:** List any issues that may arise related to the treatment of the people, vertebrate animals, and/or other life forms and how you will conduct your experiment to ensure ethical treatment. Also, include techniques to properly and safely handle any hazardous chemicals or devices.
10. **Working Title:** Write a tentative title for your research project. One possible format is: the (effect of/relationship between) the independent variable (on/and the dependent variable. Other titles may simply attract attention and curiosity about your topic.

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Experimental Design Plan (Final)

1. **Title:** Write a title for your research project. One possible format is: the (effect of/relationship between) the independent variable (on/and) the dependent variable. Other titles may simply attract attention and curiosity about your topic.
2. **Problem or Question Being Addressed:** (Purpose and/or research question) Give the goal(s) of your research work and write one or more questions that address unanswered aspects of your research topic.
3. **Hypothesis (es):** Suggested format: If the (independent variable) is (describe how you intend to change it), then the (dependent variable) will (describe the predicted effect).
4. **Procedure:** Include materials and equipment, controls, constants, independent and dependent variables, number of samples/trials, and specific quantities, concentrations, etc. Experimental safety procedures could also be included. Remember that this is a proposed procedure and thus should be future tense, not past tense. This may be written in sequential paragraph form or use numbers to indicate sequential steps to gather data. The choice is yours. This section should be so detailed that another person should be able to do the research following your directions. You might consider proposed charts that you could use to collect data, (labels of rows and columns), and what statistical methods will be used to analyze data.
5. **Key Bibliographic References:** References on which your research is based. ISEF forms require at least 3; this program requires at least 7 , 2 of which must be professional journals. References include books, newspaper and magazine articles, professional journals, Internet sources, and personal interviews of individuals with expertise on the topic.

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