TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

Independent Science Research

I. INTRODUCTION

Independent Science Research is a year-long online course that will allow talented and committed students to pursue independent experimental projects and/or research in the sciences. This course is intended for students who are passionate about an area of science and want an in-depth exploration of how that discipline functions.

Working individually or in teams, students will design, research, implement and present their experimental work. Participants will work with science faculty and community mentors to develop a project suitable for entry into a wide range of science competitions. Students must be willing to commit substantial amounts of time to see their own project through to completion.

As an online course, students must be capable of managing their own time and meeting deadlines. Weekly check-ins and submission of work will be required as well as occasional in-person meetings.

This course addresses the district Mission Statement as follows:

- Independent Science Research contributes to "…the development of creative, passionate, and self-motivated learners."
- Independent Science Research provides students a "… meaningful learning experience(s) to enable them to access and critically analyze information, pose substantive questions, and communicate effectively."

This course addresses the following Tam 21st Century goals:

- Students will acquire, manage and use knowledge and skills
- Students will think critically and creatively
- Students will practice self directed learning, decision making, and problem solving

This course addresses the following Student Learning Outcomes:

- Outcome 1: Communicate articulately, effectively and persuasively when speaking and writing.
- Outcome 2: Read and analyze material in a variety of disciplines.
- Outcome 3: Use technology as a tool to access information, analyze and solve

problems, and communicate ideas.

- Outcome 5: Apply mathematical knowledge and skills to analyze and solve problems.
- Outcome 6: Demonstrate scientific literacy.

This course is designed to help students attain the state Content Standards in Investigation and Experimentation.

II. STUDENT LEARNING OUTCOMES AND STATE STANDARDS

A. As a result of instruction in this course, students will demonstrate the following enduring understandings:

Scientific knowledge is constantly changing. New information is acquired by the process of posing a question, designing an experiment to test the question, collecting and analyzing quantitative and qualitative data to answer the question, and presenting the findings for review.

B. Students will cover the following state Content Standards:

Investigation and Experimentation.

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands (Earth Science, Biology, Chemistry, Physics), students should develop their own questions and perform investigations. Students will:

a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
b. Identify and communicate sources of unavoidable experimental error.
c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
d. Formulate explanations by using logic and evidence.
e. Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
f. Distinguish between hypothesis and theory as scientific terms.
g. Recognize the usefulness and limitations of models and theories as scientific representations of reality.
j. Recognize the issues of statistical variability and the need for controlled tests.
k. Recognize the cumulative nature of scientific evidence.
l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
n. Know that when an observation does not agree with an accepted scientific

theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

III. UNITS OF INSTRUCTION

1. Topic and Competition Selection
2. Mentors and Community Resources
3. Background Research
4. Project/Experimental Design
5. Experimental Work
6. Data Analysis
7. Visual or Written Presentations
8. Oral Presentations

IV. UNDERSTANDINGS AND ESSENTIAL QUESTIONS

Enduring Understandings

- Scientists discover new information about the world around us by asking good questions
- Scientists do not work in isolation, but rely on prior research and often work in collaborative teams
- Scientists answer questions by thoughtfully designing and carefully conducting controlled experiments
- Scientists answer questions by collecting and analyzing quantitative and qualitative data
- Scientists communicate findings in written, visual and oral formats
- Scientists engage in an ongoing process that evaluates old information in light of new findings.

Essential Questions

- How do we discover what we don't know?
- How do we change what we already know?
- How do we know when we know?

- Is a new discovery that is not communicated or shared really a new discovery?

V. ASSESSMENT

Performance Task(s):

To demonstrate mastery of the enduring understandings for this course, students will:

- Design and conduct an experimental research project.
- Enter the project in a judged competition.
- Report the project results in formal scientific symposium.

Other Evidence:

- Regular online check-ins.
- Completion of weekly/bi-weekly online assignments.

VI. METHODS, MATERIALS, AND RESOURCES

A. Methods

This is an online course. As such, students will participate in subject specific lessons and activities but these will be posted and conducted in an online environment.

Students will work in collaboration with their project partners, other students in the class and community mentors.

Online activities will include: research; forums; chats; wiki discussions; video posting; video critique and analysis; data analysis; Power Point development and critique.

Students will make formal, oral presentations of their finished project work.

There will also be occasional in-person meetings – both whole group and individual.

This course can be differentiated to meet the needs of a wide range of students, primarily by student choice of topic and/or competition.

B. Materials

This course currently uses Moodle as its online platform. It does not require a textbook or other instructional materials.

C. Technology

As an online course, students will be required to make extensive use of personal computers.

As part of their final oral presentations, students will need to develop Power Point presentations and use video technology to record and upload practice presentations for class critique.

As part of their individual research, student may be working in a laboratory setting that requires work with specific scientific instruments/technology.

D. School to Career Goals

This course is rich in school to career applications. Students minimally are required to find a mentor from the scientific community for advice on their project. Many will actually work with their mentor, in an academic or industrial setting, on their actual research.

E. Suggested Instructional Time Allocation

1. Topic and Competition Selection (5%)
2. Mentors and Community Resources (5%)
3. Background Research (10%)
4. Project/Experimental Design (10%)
5. Experimental Work (30%)
6. Data Analysis (10%)
7. Visual or Written Presentations (10%)
8. Oral Presentations (20%)

VII. GENERAL INFORMATION

This course will be open to all junior and seniors district-wide. Sophomores may sign up with approval of their current science teacher. Five units of credit per semester will be awarded based upon progress towards, and successful completion, of the project.

A. Prerequisites

Students must have completed the core curriculum of Integrated Science 1-4.

Students concurrently enrolled in Integrated Science 3-4 may enroll with the approval of their current science teacher.

B. Requirements Met

This course may be used as elective credit towards graduation but does not meet any specific graduation requirement.