

Course Outline of Record

1. Course Code: CH-031
2.
  - a. Long Course Title: Undergraduate Research Experience
  - b. Short Course Title: RESEARCH EXPERIENCE
3.
  - a. Catalog Course Description:  
 Under the supervision of STEM faculty, students will select a project to be completed during the semester. Topics will include information retrieval, computer skills applied to laboratory research, time management and organizational skills, application of modern research methods, experimental design, data collection and analysis, presentation skills (written and oral), and applying for summer internship opportunities. This course is intended for students pursuing a STEM degree and who have completed a minimum of 35 college level units.
  - b. Class Schedule Course Description:  
 Under the supervision of science faculty, students will select a research project to be completed during the semester.
  - c. Semester Cycle (if applicable): *N/A*
  - d. Name of Approved Program(s):
    - LIBERAL ARTS with emphasis in Math and Science
4. Total Units: 2.00      Total Semester Hrs: 72.00  
 Lecture Units: 1      Semester Lecture Hrs: 18.00  
 Lab Units: 1      Semester Lab Hrs: 54.00  
 Class Size Maximum: 20      Allow Audit: No  
 Repeatability No Repeats Allowed  
 Justification 0
5. Prerequisite or Corequisite Courses or Advisories:  
*Course with requisite(s) and/or advisory is required to complete Content Review Matrix (CCForm1-A)*  
 Advisory: LIS 001  
 Prerequisite: CH 001B
6. Textbooks, Required Reading or Software: (List in APA or MLA format.) *N/A*
7. Entrance Skills: *Before entering the course students must be able:*
  - a.  
 Understand the differences between the various types of electronic information.
    - LIS 001 - Understand the differences between the various types of electronic information;
  - b.  
 Identify the concepts and tools needed to support a basic research project.
    - LIS 001 - Identify the concepts and tools needed to support a basic research project;
  - c.  
 Develop effective search strategies for locating a variety of relevant electronic information.
    - LIS 001 - Develop effective search strategies for locating a variety of relevant electronic information;
  - d.  
 Evaluate the quality of information available from the internet.
    - LIS 001 - Evaluate the quality of information available from the internet;
  - e.

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Locate and use appropriate citation format for citing a variety of information resources.

- LIS 001 - Locate and use appropriate citation format for citing to a variety of information resources.

f.

Apply methods to predict and understand the outcomes of chemical reactions.

- CH 001B - Predict the outcome of reactions based on the electrochemical activity series and perform related calculations.

g.

Apply the laws of thermodynamics to endothermic and exothermic reactions.

- CH 001B - Describe the laws of thermodynamics and compute energy changes in reactions.

h.

Apply rate laws to perform calculations of basic reaction mechanisms.

- CH 001B - Describe the kinetics of reactions, perform calculations using rate laws and describe basic reaction mechanisms.

i.

Describe the nature of electromagnetic radiation and the measurement of its properties.

- CH 001B - Describe the nature of radiation and its measurement, balance nuclear equations and explain the process of fission and fusion and their relationship to binding energy.

j.

Perform calculations involving equilibria, weak acids and bases and slightly soluble substances.

- CH 001B - Describe the nature of chemical equilibria, the Law of Mass Action and perform calculations involving equilibria, weak acids and bases, pH, buffers and slightly soluble substances.

### 8. Course Content and Scope:

#### Lecture:

The scientific method.  
The research process.  
Types of Library-specific databases.  
Online literature searches.  
Evaluation of online articles.  
Proper citation of information both written and online.  
Experimental design.  
Preparation of written, oral, and poster presentation using appropriate software.  
Time management skills and balancing coursework with research.  
Summer Research Internships, what are they, where are they found, and how to apply.

Lab: *(if the "Lab Hours" is greater than zero this is required)*

Laboratory safety with specific reference to working in a research lab.  
Introduction to Laboratory software, e.g. LabView and MatLab.  
Creating a laboratory notebook.  
Conduct research project.  
Summary and analysis of project results.  
Preparation of written, oral and poster presentations using appropriate software.

### 9. Course Student Learning Outcomes:

1.

Demonstrate the use of modern research methods.

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2.

Utilize skills relating to the process of conducting scientific research and applying the scientific method.

3.

Apply the basics of experimental design, data collection, data analysis and hypothesis testing.

4.

Analyze current research published in the scientific literature.

5.

Summarize ideas, scientific knowledge and experimental outcomes through written and oral communication.

6.

Apply time management and study skills to successfully complete a research project during the semester.

10. Course Objectives: *Upon completion of this course, students will be able to:*

- a. Demonstrate literature searches to assess previous work by others.
- b. Create proper citations for referencing the work of others.
- c. Demonstrate the skills necessary to collect and analyze data, and present results.
- d. Apply multiple software programs in a research environment.
- e. Develop a schedule that makes it possible to complete research projects and coursework.
- f. Propose a research project and present the proposal to others.
- g. Evaluate proposed work by others for goals, objectives, activities and feasibility.
- h. Write a paper describing research and results with proper formatting and literature citations.
- i. Prepare a poster for presentation that describes a research project.
- j. Present completed research project to a group utilizing PowerPoint or similar software.
- k. Locate and apply for summer research internship opportunities at national laboratories and universities.

11. Methods of Instruction: *(Integration: Elements should validate parallel course outline elements)*

- a. Collaborative/Team
- b. Experiential
- c. Journal
- d. Laboratory
- e. Lecture
- f. Supplemental/External Activity

12. Assignments: *(List samples of specific activities/assignments students are expected to complete both in and outside of class.)*

In Class Hours: 72.00

Outside Class Hours: 36.00

a. In-class Assignments

Notetaking Participation in discussion Presentation of project proposal Critique proposals of other students Conduct project Presentation of completed project (Oral and Poster)
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b. Out-of-class Assignments

Literature search Project design Complete project analysis and summarize results
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Prepare written document

13. Methods of Evaluating Student Progress: *The student will demonstrate proficiency by:*

- Portfolios
- Term or research papers
- Laboratory projects
- Presentations/student demonstration observations
- Group activity participation/observation
- Organizational/timelines assessment

14. Methods of Evaluating: Additional Assessment Information:

15. Need/Purpose/Rationale -- *All courses must meet one or more CCC missions.*

PO-GE C1-Natural Sciences

Explain concepts and theories related to physical, chemical, and biological natural phenomena.

Apply the scientific process and its use and limitations in the solution of problems.

Draw a connection between natural sciences and their own lives.

Make critical judgments about the validity of scientific evidence and the applicability of scientific theories.

Demonstrate knowledge of the use of technology in scientific investigation and human endeavors, and the advantages and disadvantage of that technology.

Use college-level mathematical concepts and methods to understand, analyze, and explain issues in quantitative terms.

PO-BS Critical Thinking

Assess relevant information and come to thought-out conclusions and solutions.

Communicate meaningfully with others.

IO - Scientific Inquiry

Identify components of the scientific method.

Collect and analyze data. Skills of data collection include an understanding of the notion of hypothesis testing and specific methods of inquiry such as experimentation and systematic observation.

Predict outcomes utilizing scientific inquiry: using evidence and assertions determine which conclusions logically follow from a body of quantitative and qualitative data.

Analyze quantitative and qualitative information to make decisions, judgments, and pose questions.

Recognize the utility of the scientific method and its application to real life situations and natural phenomena.

16. Comparable Transfer Course

University System	Campus	Course Number	Course Title	Catalog Year
UC	UC Riverside	CHM 095	Explorations in Molecular Science	2015
CSU	California Polytechnic University, Pomona	CHM 200	Special Studies for Lower Division Students	2015
UC	UC Riverside	CHM 092	Introduction to Undergraduate Research	2015

17. Special Materials and/or Equipment Required of Students:

All equipment, materials, and supplies will be provided to the students.

18. Materials Fees: none  Required Material?

**Material or Item**

**Cost Per Unit**

**Total Cost**

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19. Provide Reasons for the Substantial Modifications or New Course:

This course will provide STEM majors with the research experience necessary to prepare them to participate in research laboratories upon transfer to a four-year institution. This is recommended by the Presidential Council of Advisors on Science and Technology (PCAST)

20. a. Cross-Listed Course (*Enter Course Code*): N/A  
b. Replacement Course (*Enter original Course Code*): N/A

21. Grading Method (*choose one*): Letter Grade Only

22. MIS Course Data Elements

- a. Course Control Number [CB00]: CCC000569648  
b. T.O.P. Code [CB03]: 190500.00 - Chemistry, General  
c. Credit Status [CB04]: D - Credit - Degree Applicable  
d. Course Transfer Status [CB05]: A = Transfer to UC, CSU  
e. Basic Skills Status [CB08]: 2N = Not basic skills course  
f. Vocational Status [CB09]: Not Occupational  
g. Course Classification [CB11]: Y - Credit Course  
h. Special Class Status [CB13]: N - Not Special  
i. Course CAN Code [CB14]: N/A  
j. Course Prior to College Level [CB21]: Y = Not Applicable  
k. Course Noncredit Category [CB22]: Y - Not Applicable  
l. Funding Agency Category [CB23]: Y = Not Applicable  
m. Program Status [CB24]: 1 = Program Applicable

Name of Approved Program (*if program-applicable*): LIBERAL ARTS with emphasis in Math and Science  
*Attach listings of Degree and/or Certificate Programs showing this course as a required or a restricted elective.*

23. Enrollment - Estimate Enrollment

First Year: 20  
Third Year: 20

24. Resources - Faculty - Discipline and Other Qualifications:

- a. Sufficient Faculty Resources: Yes  
b. If No, list number of FTE needed to offer this course: N/A

25. Additional Equipment and/or Supplies Needed and Source of Funding.

None. Sufficient equipment exists at the present to conduct many research projects. However, additional equipment will be pursued through external funding sources.

26. Additional Construction or Modification of Existing Classroom Space Needed. (*Explain:*)

None.

27. FOR NEW OR SUBSTANTIALLY MODIFIED COURSES

Library and/or Learning Resources Present in the Collection are Sufficient to Meet the Need of the Students Enrolled in the Course: Yes

The most important Library materials will be the electronic database access that is already provided.

28. Originator Joana G Ciurash Origination Date 10/08/15