

# Chemistry

The chemistry curriculum at Folsom Lake College consists of:

- A series of chemistry courses designed to meet transfer requirements for physical and biological science majors and allied health majors.
- A series of courses intended for students majoring in fields other than chemistry, biology, or physical science seeking to fulfill general education science requirements.
- An entry level course that provides preparation or review of more basic concepts.

All chemistry courses at FLC include a practical component where students conduct hands-on chemical experimentation in a modern, well-equipped laboratory.

## NOTE:

All chemistry students are required to wear closed-toe shoes at all times in the chemistry laboratory. Students are also required to wear indirect-vent safety goggles (safety glasses are not acceptable) while working in the laboratory.

## Career Options

- Allied Health
- Biologist
- Chemical Engineer
- Dentist
- Geochemist
- Geologist
- Nutritionist
- Oceanographer
- Pharmacist
- Physician
- Physicist
- Professional Chemist
- Veterinarian

*Some career options may require more than two years of college study. Classes beyond the associate degree may be required to fulfill some career options or for preparation for transfer to a university program.*

## Highlights

- An outstanding chemistry faculty striving to maintain an aggressive and well-respected chemistry program
- Ample contact with the instructor and the relaxed atmosphere that only a limited class size can offer

## Program Maps

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[Science, Technology, Engineering, and Mathematics Undecided Major \(/flc/main/doc/instruction/program-maps/STEM-Undecided.pdf\)](/flc/main/doc/instruction/program-maps/STEM-Undecided.pdf)


[Chemistry, CSU Transfer \(/flc/main/doc/instruction/program-maps/Chemistry-CSU-Transfer.pdf\)](/flc/main/doc/instruction/program-maps/Chemistry-CSU-Transfer.pdf)


[Chemistry, UC Transfer \(/flc/main/doc/instruction/program-maps/Chemistry-UC-Transfer.pdf\)](/flc/main/doc/instruction/program-maps/Chemistry-UC-Transfer.pdf)

Dean [Greg McCormac \(/about-us/contact-us/faculty-and-staff-directory/greg-mccormac\)](/about-us/contact-us/faculty-and-staff-directory/greg-mccormac)

Department Chair [Max Mahoney \(/about-us/contact-us/faculty-and-staff-directory/dr-max-mahoney\)](/about-us/contact-us/faculty-and-staff-directory/dr-max-mahoney)

Meta-Major [Science, Technology, Engineering, and Mathematics \(/academics/meta-majors/science-technology-engineering-and-mathematics\)](/academics/meta-majors/science-technology-engineering-and-mathematics)

 (916) 608-6615

 [mccormg@flc.losrios.edu \(mailto:mccormg@flc.losrios.edu\)](mailto:mccormg@flc.losrios.edu)

## Associate Degree

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### A.A. in Interdisciplinary Studies: Math and Science

The Interdisciplinary Studies degree is designed for students who wish to obtain a broad knowledge of arts and sciences plus additional coursework in a prescribed "Area of Emphasis". This program is a good choice for students planning on transferring to the California State University or University of California. The student will be able to satisfy general education requirements, plus focus on transferable course work that relates to a specific major and/or individual interest. This degree will have an "Area of Emphasis" in Math and Science. These courses emphasize the natural sciences which examine the physical universe, its life forms and its natural phenomena. Courses in math emphasize the development of mathematical and quantitative reasoning skills beyond the level of intermediate algebra. Students will be able to demonstrate an understanding of the methodologies of science as investigative tools. Students will also examine the influence that the acquisition of scientific knowledge has on the

development of the world's civilizations. Possible majors at a four-year institution include, but are not limited to: mathematics, biology, chemistry, and physical science.

It is highly recommended that students consult a counselor to determine the classes within each area that will best prepare them for their intended transfer major.

Catalog Date: June 1, 2020

## Degree Requirements

COURSE CODE	COURSE TITLE	UNITS
A minimum of 18 units from the following:		18
You must select courses from at least three different disciplines and complete courses from both math and science. If a course is cross-listed with another on the list, only one may apply to the degree.		
ANTH 300	Biological Anthropology (3)	
ANTH 301	Biological Anthropology Laboratory (1)	
ANTH 303	Introduction to Forensic Anthropology (3)	
ASTR 300	Introduction to Astronomy (3)	
ASTR 400	Astronomy Laboratory (1)	
BIOL 300	The Foundations of Biology (3)	
BIOL 307	Biology of Organisms (4)	
BIOL 310	General Biology (4)	
BIOL 323	Plants and People (4)	
BIOL 350	Environmental Biology (3)	
BIOL 400	Principles of Biology (5)	
BIOL 410	Principles of Botany (5)	
BIOL 420	Principles of Zoology (5)	
BIOL 430	Anatomy and Physiology (5)	
BIOL 431	Anatomy and Physiology (5)	
BIOL 440	General Microbiology (4)	
BIOL 442	General Microbiology and Public Health (5)	
CHEM 305	Introduction to Chemistry (5)	
CHEM 306	Introduction to Organic and Biological Chemistry (5)	
CHEM 400	General Chemistry I (5)	
CHEM 401	General Chemistry II (5)	
CHEM 410	Quantitative Analysis (5)	
CHEM 420	Organic Chemistry I (5)	
CHEM 421	Organic Chemistry II (5)	
GEOG 300	Physical Geography: Exploring Earth's Environmental Systems (3)	
GEOG 301	Physical Geography Laboratory (1)	
GEOG 306	Weather and Climate (3)	
GEOL 300	Physical Geology (3)	
GEOL 301	Physical Geology Laboratory (1)	
GEOL 305	Earth Science (3)	
GEOL 306	Earth Science Laboratory (1)	
GEOL 310	Historical Geology (3)	
GEOL 311	Historical Geology Laboratory (1)	
GEOL 330	Introduction to Oceanography (3)	
GEOL 345	Geology of California (3)	
MATH 300	Introduction to Mathematical Ideas (3)	
MATH 310	Mathematical Discovery (3)	
MATH 335	Trigonometry with College Algebra (5)	
MATH 341	Calculus for Business and Economics (4)	
MATH 343	Modern Business Mathematics (4)	
MATH 355	Calculus for Biology and Medicine I (4)	
MATH 356	Calculus for Biology and Medicine II (4)	

COURSE CODE	COURSE TITLE	UNITS
MATH 370	Pre-Calculus Mathematics (5)	
MATH 400	Calculus I (5)	
MATH 401	Calculus II (5)	
MATH 402	Calculus III (5)	
MATH 410	Introduction to Linear Algebra (3)	
MATH 420	Differential Equations (4)	
NUTRI 300	Nutrition (3)	
NUTRI 340	Nutrition and Metabolism (3)	
PHYS 310	Conceptual Physics (3)	
PHYS 311	Basic Physics (3)	
PHYS 350	General Physics (4)	
PHYS 360	General Physics (4)	
PHYS 411	Mechanics of Solids and Fluids (4)	
PHYS 421	Electricity and Magnetism (4)	
PHYS 431	Heat, Waves, Light and Modern Physics (4)	
PS 302	Introduction to Physical Science (4)	
PSYC 312	Biological Psychology (4)	
PSYC 330	Introductory Statistics for the Behavioral Sciences (3)	
STAT 300	Introduction to Probability and Statistics (4)	
Total Units:		18

The Interdisciplinary Studies: Math and Science Associate in Arts (A.A.) degree may be obtained by completion of the required program, plus general education requirements, plus sufficient electives to meet a 60-unit total. See FLC graduation requirements.

## Student Learning Outcomes

Upon completion of this program, the student will be able to:

- reason quantitatively and empirically (Math and Science).

## Chemistry (CHEM)

### CHEM 305 Introduction to Chemistry

<b>Units:</b>	5
<b>Hours:</b>	72 hours LEC; 54 hours LAB
<b>Prerequisite:</b>	MATH 100 with a grade of "C" or better
<b>Enrollment Limitation:</b>	Students must be 16 and at least sophomores in high school. Minor aged students who are not legally emancipated must have their parent(s)/guardian review laboratory safety protocols prior to attending class.
<b>Transferable:</b>	CSU; UC (UC credit limitation: CHEM 305, 306 and 400, 401 combined: maximum credit, one series. No credit for CHEM 305 if taken after CHEM 400. )
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>Catalog Date:</b>	June 1, 2020

This course introduces fundamental principles of chemistry including types of matter and physical states, physical and chemical transformations, chemical equations and stoichiometry, bonding, atomic and chemical structure, intermolecular forces, gas laws, solutions, colligative properties, acids and bases, nuclear chemistry, and includes a brief introduction of organic chemistry. It is primarily intended for general education and majors in allied health (nursing, dental hygiene, respiratory care), family and consumer science, physical education, physical therapy(\*), psychology(\*), natural resources(\*). Chem 305 can also be used as a preparatory course prior to enrolling in Chem 400. Students will require approved safety goggles for this course.

\*May require CHEM 400.

## Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply the basic terminology and nomenclature of introductory inorganic chemistry, and name the elements and compounds relevant to the human body and metabolism.
- evaluate macroscopic observations and apply fundamental properties and theories of matter.
- demonstrate critical thinking skills in solving quantitative problems.
- apply basic chemical principles to predict experimental outcomes.
- conduct a variety of qualitative and quantitative inorganic laboratory experiments that may include proposing hypotheses for these outcomes prior to performing the experiment.
- assemble molecules demonstrating an understanding of chemical bonding and molecular structure to predict their chemical behavior.

- demonstrate safe laboratory practices and proper materials handling.

## CHEM 306 Introduction to Organic and Biological Chemistry

<b>Units:</b>	5
<b>Hours:</b>	72 hours LEC; 54 hours LAB
<b>Prerequisite:</b>	CHEM 305 with a grade of "C" or better
<b>Enrollment Limitation:</b>	Students must be at least 16 and sophomores in high school. Minor aged students who are not legally emancipated require their parent(s)/guardian review laboratory safety protocols prior to attending class.
<b>Transferable:</b>	CSU; UC (UC credit limitation: CHEM 305, 306 and 400, 401 combined: maximum credit, one series )
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>Catalog Date:</b>	June 1, 2020

This course is the second semester of General, Organic and Biological chemistry (a continuation of Chemistry 305). This course is intended for students majoring in the Allied Health fields (nursing B.S.N degree), and dental hygiene). This course introduces students to the structure and function, as well as the physical and chemical properties of organic molecules. Emphasis is on the specific functional groups found in carbohydrates, proteins, lipids, and nucleic acids, the types of reactions they undergo and their relevancy to human physiology and health. Students will require approved safety goggles for this course.

Approved Safety Goggles, several pairs of disposable gloves. A lab coat or apron is advised but optional.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- construct and name organic molecules from several important classes of organic compounds.
- differentiate and evaluate the physical and chemical properties of several important classes of organic compounds.
- compare the structure, function, and uses of important carbohydrates, lipids, proteins, and nucleic acids.
- apply reactions covered in organic chemistry portion to processes found in physiology and metabolic pathways.
- perform basic organic laboratory experiments including synthesis, as well as classifying molecules using wet-chemistry techniques.
- demonstrate safe laboratory practices and proper materials handling.

## CHEM 400 General Chemistry I

<b>Units:</b>	5
<b>Hours:</b>	54 hours LEC; 108 hours LAB
<b>Prerequisite:</b>	CHEM 300, CHEM 305 or CHEM 310 (taken at any Los Rios College) with a grade of "C" or better; or one year in High School Chemistry with a lab earning a grade of "C" or better; and MATH 120.
<b>Transferable:</b>	CSU; UC (UC credit limitation: CHEM 305, 306 and 400, 401 combined: maximum credit, one series )
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>C-ID:</b>	C-ID CHEM 110; Part of C-ID CHEM 120S
<b>Catalog Date:</b>	June 1, 2020

This is a first semester general college chemistry course intended for students majoring in the scientific disciplines including chemistry, biology, nutrition, physics, geology and engineering. This course emphasizes the fundamental principles of chemistry. Topics include chemical measurement; physical and chemical processes; nomenclature; stoichiometry; atomic structure; quantum theory; molecular structure; bonding theory; physical properties of gases, liquids, and solids; thermochemistry; and properties of solutions. Students are required to purchase indirect vent safety goggles, closed toe shoes, and a bound quad-ruled notebook for the laboratory.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply basic terminology and nomenclature of inorganic chemistry.
- solve quantitative problems and relate the basic properties and theories of matter to macroscopic observations.
- conduct a variety of qualitative and quantitative inorganic laboratory experiments utilizing a variety of chemistry equipment and prepare written laboratory reports.
- demonstrate safe laboratory practices and proper materials handling.

## CHEM 401 General Chemistry II

<b>Units:</b>	5
<b>Hours:</b>	54 hours LEC; 108 hours LAB
<b>Prerequisite:</b>	CHEM 400 with a grade of "C" or better
<b>Transferable:</b>	CSU; UC (UC credit limitation: CHEM 305, 306 and 400, 401 combined: maximum credit, one series )
<b>General Education:</b>	CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>C-ID:</b>	Part of C-ID CHEM 120S
<b>Catalog Date:</b>	June 1, 2020

This course is a continuation of the two-semester series in general college chemistry, General Chemistry I (Chem 400) and General Chemistry II (Chem 401). CHEM 401 is intended for students majoring in the scientific disciplines including chemistry, biology, physics, and geology. Topics presented in the course include kinetics, equilibrium, acid/base chemistry, thermodynamics, electrochemistry, nuclear chemistry, and coordination chemistry. A brief introduction to Organic Chemistry is included. Laboratory experiments include qualitative and quantitative analysis.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- evaluate and solve qualitative problems using the basic principles of kinetics, equilibrium, thermodynamics, electrochemistry, coordination chemistry, and nuclear chemistry.
- solve quantitative problems in kinetics, equilibrium, thermodynamics, electrochemistry, coordination chemistry, and nuclear chemistry through the mathematical application of basic principles.

- conduct a variety of qualitative and quantitative inorganic laboratory experiments utilizing a variety of chemistry equipment (such as a UV-Vis spectrophotometer, a pH meter, and an atomic absorption spectrometer); and prepare written laboratory reports.
- demonstrate safe laboratory practices and proper materials handling.

## CHEM 410 Quantitative Analysis

<b>Units:</b>	5
<b>Hours:</b>	54 hours LEC; 108 hours LAB
<b>Prerequisite:</b>	CHEM 401 with a grade of "C" or better
<b>Transferable:</b>	CSU; UC
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3
<b>Catalog Date:</b>	June 1, 2020

This course focuses on the principles and techniques utilized in modern quantitative analysis. Gravimetric, volumetric, electroanalytical, spectrophotometric, and chromatographic analytical methods will be studied theoretically and with practical laboratory experiments. Emphasis throughout the course will be on sampling, calibration, statistical analysis, and method validation procedures. This course is intended for science majors, including chemistry, chemical engineering, biochemistry, biology, forensic science, and microbiology, as well as students interested in careers in winemaking and brewing other alcoholic beverages.

Students will be required to supply goggles, gloves, a labcoat, and a laboratory notebook for the laboratory.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- describe and utilize some basic analytical methods in common use in today's analytical laboratories and be able to list some limitations.
- draft an accurate and clear laboratory notebook record of experimental methods, data, and data analysis.
- solve quantitative analysis problems with basic chemical and statistical principles.
- evaluate analytical data using statistical methods to determine its validity.
- demonstrate safe laboratory practices and proper materials handling.

## CHEM 420 Organic Chemistry I

<b>Units:</b>	5
<b>Hours:</b>	54 hours LEC; 108 hours LAB
<b>Prerequisite:</b>	CHEM 401 with a grade of "C" or better
<b>Transferable:</b>	CSU; UC
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>C-ID:</b>	C-ID CHEM 150; Part of C-ID CHEM 160S
<b>Catalog Date:</b>	June 1, 2020

This is a lecture/laboratory course designed to introduce students to the basic concepts of organic chemistry. This course is designed for science majors, pre-med, pre-dental, and pre-pharmacy majors. Lecture topics will include acid/base chemistry, pushing electrons, organic nomenclature, alkane chemistry, alkene chemistry, alkyl halides, alcohols, ethers, physical properties of alkanes and cycloalkanes, SN1, SN2, E1, E2 mechanisms. Laboratory work will include characterization of organic molecules using modern analytical instrumentation such as (GC, GC/MS, NMR, FTIR, polarimetry, and HPLC) and the measurement of their physical properties. Separation and purification of organic compounds will also be covered in the lab section; these techniques include distillation, recrystallization, preparative chromatography, liquid-liquid extraction and thin-layer chromatography. This course requires that students purchase additional supplies such as a Gas Chromatography micro-syringe and safety goggles. Students will need to purchase a lab journal to record students experimental information. Students will also need to check with the instructor for supplemental lab supplies that may not be provided during check-in.

### Student Learning Outcomes

Upon completion of this course, the student will be able to:

- calculate mathematically the outcome of a recrystallization in grams and as a percent yield.
- combine compounds with C-C double bonds and / or C-C triple bonded compounds with hydrogen / transition metal catalysis. Predict the outcome of the reactions' stereochemical consequences.
- deduce the reactive intermediate from a reduction of an ester functional group via a hydride reagent.
- operate modern, analytical equipment to confirm experimental outcomes and goals using instrumental analysis such as GC, HPLC, GC/MS, NMR, FTIR, polarimetry, and UV-Vis Spectroscopy.
- analyze, and predict the outcome of a multi-step organic synthesis based on simpler, more common reactions learned throughout this course.
- name common organic compounds. Students should also be able to name more complicated molecules using IUPAC rules.
- conceive the outcome of a bromination followed by a Grignard carbon-carbon coupling reaction.

## CHEM 421 Organic Chemistry II

<b>Units:</b>	5
<b>Hours:</b>	54 hours LEC; 108 hours LAB
<b>Prerequisite:</b>	CHEM 420 with a grade of "C" or better
<b>Transferable:</b>	CSU; UC
<b>General Education:</b>	AA/AS Area IV; CSU Area B1; CSU Area B3; IGETC Area 5A; IGETC Area 5C
<b>C-ID:</b>	Part of C-ID CHEM 160S
<b>Catalog Date:</b>	June 1, 2020

This course is a lecture-laboratory course and is a continuation of Chemistry 420, Organic Chemistry I, thereby concluding a one year introduction to organic chemistry. This course is designed for science majors, pre-medical, pre-dental, and pre-pharmacy majors. Topics covered include the chemistry of ethers, epoxides, conjugated dienes, aromatic compounds, carbonyl compounds, enolate condensation, amines, phenols, condensation-polymerization reactions, and the chemistry of selected biologically important compounds such as proteins, lipids and carbohydrates. The course also includes continued application of spectroscopic methods (IR, NMR (theory and practice), and MS) applied to organic chemistry. Laboratory emphasis is on synthesis of organic compounds and their work-up and analysis. Experiments include the preparation, isolation, quantitation, purification, identification and mechanism elucidation of the molecules synthesized. Students will continue to expand their ability to operate and

utilize a variety of modern chemical instrumentation - gas chromatography, high performance liquid chromatography, Fourier transform - infrared spectroscopy, gas chromatography-mass spectrometry, and polarimetry. Students must purchase instructor produced supplements; Study guide for the approved lecture text; Stitch-bound, page-numbered laboratory notebook(s); model kit, American Chemical Society Study Guide for Organic Chemistry, approved safety goggles, gloves, gas chromatography syringe. a pair of approved safety goggles.

## Student Learning Outcomes

Upon completion of this course, the student will be able to:

- utilize and apply the fundamental concepts of general chemistry and introductory organic chemistry to second semester organic chemistry.
- understand and apply the theories of structure and reactivity to the important functional groups. Conceive mechanistic pathways illustrating a reaction process.
- perform basic organic chemistry laboratory techniques, operate a variety of modern chemical instruments including GC, NMR, IR, GC/MS, and polarimetry. Accurately interpret NMR, IR, mass spectral and chromatographic data.
- apply the rules of nomenclature for organic compounds.
- propose multi-step synthesis based on common, simpler reactions learned in Chemistry 420 and this course.
- apply organic functional group knowledge to biological molecules such as amino acids and proteins, lipids, and carbohydrates.

## CHEM 495 Independent Studies in Chemistry

<b>Units:</b>	1 - 3
<b>Hours:</b>	54 - 162 hours LAB
<b>Prerequisite:</b>	None.
<b>Transferable:</b>	CSU
<b>Catalog Date:</b>	June 1, 2020

This course involves an individual student or small groups of students in study, research, or activities beyond the scope of regular offered courses, pursuant to an agreement among college, faculty members and students. Independent studies in chemistry offers students a chance to do research and/or experimentation that is more typical of industry and graduate student work. Student must fill out an application with sponsoring instructor to participate.

## Student Learning Outcomes

Upon completion of this course, the student will be able to:

- produce work independently on chemistry related topics.
- debate chemistry topics with other professionals in the field.

## CHEM 498 Work Experience in Chemistry

<b>Units:</b>	1 - 4
<b>Hours:</b>	60 - 300 hours LAB
<b>Prerequisite:</b>	None.
<b>Enrollment Limitation:</b>	Student must be in a paid or non-paid internship, volunteer opportunity, or job related to career interests.
<b>Advisory:</b>	ENGWR 101 or ESLW 320
<b>Transferable:</b>	CSU
<b>General Education:</b>	AA/AS Area III(b)
<b>Catalog Date:</b>	June 1, 2020

This course provides students with opportunities to develop marketable skills in preparation for employment or advancement within the field of Chemistry. Course content will include understanding the application of education to the workforce; completing required forms which document the student's progress and hours spent at the work site; and developing workplace skills and competencies. During the semester, the student is required to attend orientation. Students must complete 75 hours of related paid work experience, or 60 hours of related unpaid work experience, for one unit. An additional 75 hours of related paid work experience or 60 hours of related unpaid work experience is required for each additional unit. The course may be taken for a maximum of 16 units. Students should have access to a computer, the Internet, and some computer media such as a USB drive to store data files. Online students must have an email account. Only one Work Experience course may be taken per semester.

## Student Learning Outcomes

Upon completion of this course, the student will be able to:

- apply industry knowledge and theoretical concepts in a field of study or career as written in the minimum 3 learning objectives created by the student and his/her employer or work site supervisor at the start of the course.
- manage personal career plans and decision making using industry & workforce information and online resources.
- behave professionally and ethically, exhibit adaptability, initiative, self-awareness and self-management as needed.
- exhibit effective communication, collaboration, and leadership skills at work with consideration to workplace dynamics and social and diversity awareness.
- demonstrate critical and creative thinking skills as they apply to the workplace.

## Faculty

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### Ted Foster

Professor

**Office:** El Dorado Center, Building B, B-236  
**Email:** [fostert@flc.losrios.edu](mailto:fostert@flc.losrios.edu) (<mailto:fostert@flc.losrios.edu>)  
**Phone:** (530) 642-5610

### Laura Gillies-Doherty

Adjunct Professor

**Office:** FLC Main  
**Email:** [gilliel@flc.losrios.edu](mailto:gilliel@flc.losrios.edu) (<mailto:gilliel@flc.losrios.edu>)

**Web:** [Ted Foster's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/ted-foster\)](#)

**Web:** [Laura Gillies-Doherty's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/laura-gillies-doherty\)](#)

## Dr. Dominik Green

Assistant Professor

**Office:** FLC Main, Aspen Hall, FL1-140

**Email:** [greend@flc.losrios.edu \(mailto:greend@flc.losrios.edu\)](mailto:greend@flc.losrios.edu)

**Phone:** (916) 608-6826

**Web:** [Dr. Dominik Green's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/dr-dominik-green\)](#)

## Tanya Hilger-Estrada

Adjunct Professor

**Office:** FLC Main

**Email:** [hilgert@flc.losrios.edu \(mailto:hilgert@flc.losrios.edu\)](mailto:hilgert@flc.losrios.edu)

**Web:** [Tanya Hilger-Estrada's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/tanya-hilger-estrada\)](#)

## Dr. Max Mahoney

Professor

**Office:** FLC Main, Cypress Hall, FL2-124

**Email:** [mahonem@flc.losrios.edu \(mailto:mahonem@flc.losrios.edu\)](mailto:mahonem@flc.losrios.edu)

**Phone:** (916) 608-6917

**Web:** [Dr. Max Mahoney's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/dr-max-mahoney\)](#)

## Dr. Christa Oberth

Professor

**Office:** FLC Main, Cypress Hall, FL2-223

**Email:** [oberthc@flc.losrios.edu \(mailto:oberthc@flc.losrios.edu\)](mailto:oberthc@flc.losrios.edu)

**Phone:** (916) 608-6663

**Web:** [Dr. Christa Oberth's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/dr-christa-oberth\)](#)

## Lizeth Perez

Adjunct Professor

**Office:** FLC Main

**Email:** [perezl@flc.losrios.edu \(mailto:perezl@flc.losrios.edu\)](mailto:perezl@flc.losrios.edu)

**Web:** [Lizeth Perez's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/lizeth-perez\)](#)

## Angela Romo

Adjunct Professor

**Office:** FLC Main

**Email:** [romoa@flc.losrios.edu \(mailto:romoa@flc.losrios.edu\)](mailto:romoa@flc.losrios.edu)

**Web:** [Angela Romo's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/angela-romo\)](#)

## Dr. Marjorie Samples

Professor

**Office:** El Dorado Center, Building B, B-262

**Email:** [samplesm@flc.losrios.edu \(mailto:samplesm@flc.losrios.edu\)](mailto:samplesm@flc.losrios.edu)

**Phone:** (530) 642-5641

**Web:** [Dr. Marjorie Samples's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/dr-marjorie-samples\)](#)

## James Stark

Adjunct Professor

**Office:** FLC Main

**Email:** [starkj@flc.losrios.edu \(mailto:starkj@flc.losrios.edu\)](mailto:starkj@flc.losrios.edu)

**Web:** [James Stark's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/james-stark\)](#)

## Joshua Tolopilo

Adjunct Professor

**Office:** FLC Main

**Email:** [tolopij@flc.losrios.edu \(mailto:tolopij@flc.losrios.edu\)](mailto:tolopij@flc.losrios.edu)

**Web:** [Joshua Tolopilo's Profile Page \(/about-us/contact-us/faculty-and-staff-directory/joshua-tolopilo\)](#)