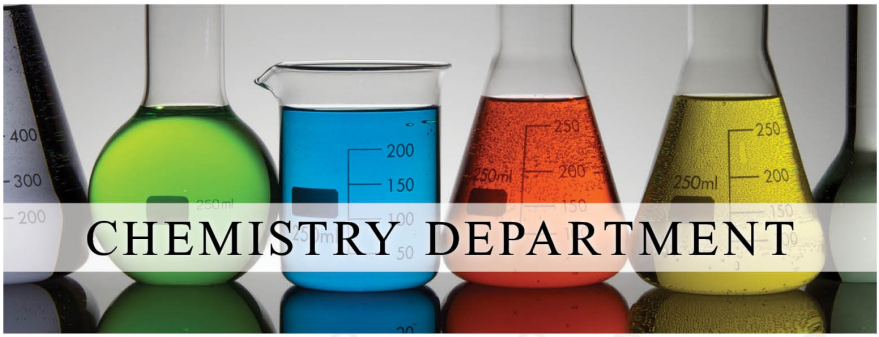
CWU Central Washington University



PROGRAMS IN CHEMISTRY

For more information contact the
Chemistry Department at
509-963-2811 or cwu.edu/chemistry

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I. Chemistry at Central Washington University

The Department of Chemistry at CWU is home to a dynamic and dedicated faculty whose common goal is to offer students the best possible education in the chemical sciences. Offering a variety of programs of study, we are large enough to offer students programs tailored to their own unique interests. However, one of our strengths is that we are also small enough to offer quality instruction with extensive interaction between students and instructors.

Our goals are:

- To provide quality education in chemistry through courses and programs on campus and off campus;
- To provide research opportunities for students entering the chemistry profession or pursuing advanced scientific training;
- To facilitate this learning experience with modern equipment and laboratories, computer technology, cooperative research and service to the local community, the region and the state;
- To provide fundamental knowledge and service courses in chemistry for other departments and programs;
- To provide a general understanding of chemistry as a fundamental science and as a means to deal with contemporary issues within our society.

II. Career Opportunities in Chemistry

After graduation, chemistry majors may continue their studies at the graduate level or be employed in teaching, sales or in laboratories working in such fields as environmental chemistry or forensic chemistry. The chemistry major helps prepare students for careers as professional chemists, teachers or for professions such as medicine, veterinary medicine and dentistry. Research careers in the chemical, pharmaceutical and biotechnology industries are also possible.

Students may choose a B.A. or B.S. degree program, including an option in biochemistry, depending on their career plans. Within these programs, students participate in seminars and have opportunities for supervised research. In addition, they may gain practical experience by doing an internship (contracted field experience) in a government or private laboratory. The Chemistry B.A. can be paired with the STEM Teaching Program Minor for students who wish to teach chemistry at the high school level.

III. The Undergraduate Program

A. General Description of the Program

The department offers a choice of the Bachelor of Science and Bachelor of Arts degrees to students. These programs provide foundations in descriptive and theoretical chemistry. During the first two years the various curriculum options emphasize fundamental topics in chemistry, mathematics and physics. After these foundation courses are completed, chemistry majors choose from a variety of advanced courses to fill the major requirements. In addition to the wide variety of course options, the department offers an active undergraduate research program; we encourage students to become involved in research activities early in their academic careers to augment the information they receive in their course work. Students are also encouraged to be a Teaching Assistant for the Chemistry Department to help them solidify fundamental concepts.

B. Declaring the Chemistry Major

Students may declare a chemistry major by submitting a Declaration of Major Form to the chemistry department. The department secretary will assign the student to an advisor based on the student's area of interest. The advisor will help direct the student to the most appropriate set of courses for completion of the degree requirements. Students should meet with their advisor at least once per quarter during pre-registration but are also encouraged to meet more frequently to discuss academic and career goals.

C. Requirements for the Chemistry Major

The course requirements for each of the three chemistry majors are listed in the following pages. All provide a solid foundation in chemistry, physics and math. They differ in the number and type of advanced courses, with the Bachelor of Science degree in Chemistry requiring several more chemistry courses than the Bachelor of Arts. The department strongly recommends that students who intend to enter a graduate program in chemistry pursue the Bachelor of Science degree. The Bachelor of Science degree is certified by the American Chemical Society if the nine department-approved electives come from a designated set of upper-division courses within Chemistry. Students should consult their major advisor about these electives. The Bachelor of Science Biochemistry degree is also certified by the American Chemical Society.

Information on prerequisite courses is available from the undergraduate course catalog. Students must have earned a grade of C– or higher in all prerequisites to be admitted to a course.

Bachelor of Science in Chemistry **Credits**

CHEM 181, 181L, 182, 182L, 183, 183L/193L General Chem…….15
CHEM 332, 332L Quantitative Analysis..……..5
CHEM 350 Inorganic……..…..3
CHEM 361, 361L, 362, 363, 363L Organic…….……..……..…13

CHEM 381, 382, 382L, 383, 383L Physical……...15
CHEM 431, 431L Biochemistry ..……5
CHEM 452, 452L Instrumental Analysis…..…….. 5
CHEM 488 Colloquium ..…….....1
PHYS 111, 111L, 112, 112L, 113, 113L -OR-
PHYS 121, 122, 123 –OR-
PHYS 181, 181L, 182, 182L, 183, 183L ……....15
MATH 172, 173, 272 Calculus..……...15
Department approved electives *...…….... 9
TOTAL…….101

* To receive a Bachelor of Science (BS) degree certified by the American Chemical Society, department approved electives must consist of a **total of 9 credits taken from this list including at least one (1) lab credit (+)**:

CHEM 345 Environmental Chemistry (lecture/lab +)……..…...5
CHEM 432 Biochemistry II…….3
CHEM 433 Biochemistry III……3
CHEM 433Lab Biochemistry Lab 2 +……...2
CHEM 473 Transition Metal Chemistry……..3
CHEM 492 Laboratory Experience in Teaching Chemistry +…2 max

CHEM 490 Cooperative Education +
CHEM 295, 395 or 495 Research +

A combined maximum of 6 credits may be applied from CHEM 295 395 490 or 495—for ACS approval, student is required to turn in a comprehensive research report before graduation.

Graduate chemistry courses (excluding Chem 503)

Other electives may be approved for the non-certified degree by working with a chemistry advisor.

Bachlor of Science in Biochemistry **Credits**

This degree is certified by the ACS (American Chemical Society)

CHEM 181, 181L, 182, 182L, 183, 183L/193L General Chem.……15
CHEM 332, 332L Quantitative Analysis…….....5
CHEM 350 Inorganic Chemistry…..……..3
CHEM 361, 361L, 362, 363, 363L Organic……...13
CHEM 381, 382, 382L Physical……..10
CHEM 431, 431L, 432, 433, 433L Biochemistry…..……...…13
CHEM 488 Colloquium ...…….……1
Select one of the following……..2-5
- CHEM 383, 383L Physical (5)
- CHEM 452, 452L Instrumental (5)
- CHEM 495, Senior Research (2-5)
- BIOL 323, Microbiology (5)
- BIOL 430, Cell Biology (5)
- BIOL 425, Molecular Biotech (5)

BIOL 181, 182, 183 Gen Biol.....15
BIOL 321 Genetics…….5
PHYS 111, 111L, 112, 112L, 113, 113L - OR - PHYS 121, 122, 123 - OR - PHYS 181, 181L, 182, 182L, 183, 183L……...……...15
MATH 172, 173, 272 Calculus……..……..15
TOTAL……..……112-115

Bachelor of Arts in Chemistry **Credits**

CHEM 181, 181L, 182, 182L, 183, 183L/193L General Chem…..……..…15
CHEM 332, 332L Quantitative Analysis ……...…..…….…….5
CHEM 350 Inorganic ……..…….…….…3
CHEM 361, 361L, 362 Organic ……..……8
CHEM 381 Physical……5
CHEM 431, 431L Biochemistry…….…….....5
CHEM 488 Colloquium……..…...….1
CHEM 492 Lab Experience in Teaching Chem……..…...….2
Select one of the following……..5-6
- CHEM 345, Environmental (5)
- CHEM 363, 363L Organic (5)
- CHEM 382, 382L Physical (5)
- CHEM 383, 383L Physical (5)
- CHEM 432, Biochemistry (3)
- CHEM 433, 433L Biochemistry (5)
- CHEM 452, 452L Instrumental (5)
- CHEM 473, Transition Metals (3)
- CHEM 295, 395, 495, Research (1-6 max)

PHYS 111, 111L, 112, 112L, 113, 113L - OR—PHYS 121, 122, 123 - OR - PHYS 181, 181L, 182, 182L, 183, 183L…..……...15
MATH 172, 173, 272 Calculus…....……...…15
TOTAL……..……...……...79-80

Chemistry Teaching Option

Adding a STEM Teaching Program Minor to the BA will prepare students to teach chemistry at the high school level. The coursework provides experiences in chemistry content and pedagogy including field experience and addresses the Washington State competencies for Chemistry Teachers. Students completing this major are required to demonstrate proficiency through a **program portfolio** prior to student teaching. Students who complete this major and receive a passing score on the NES exams for Chemistry will receive a WA State Chemistry Endorsement. There is a separate planning document for this major/minor combination that is available in the chemistry department office.

For more information please speak with the chemistry education advisor, Dr. Tim Sorey (soreyt@cwu.edu).

D. The Chemistry Minor

In addition to the chemistry major offerings, the department also has a minor program for students majoring in other fields such as biology, physics, or geology. The requirements for the minor program are listed below. Students pursuing the general minor have the flexibility to choose from among approved elective courses that best suit their own goals. All students pursuing a chemistry minor should see a chemistry advisor.

Chemistry Minor	**Credits**
CHEM 181, 181L, 182, 182L, 183, 183L/193L General Chem…..……..…..15	
Department approved electives * … …… ……..…...……...16	
TOTAL..……..31	

* Department approved electives include any upper-division chemistry course. Graduate classes with instructor permission also count as electives. Discuss these with an advisor if there are questions.

E. Typical Course Offerings

The following is a list of under-graduate courses taught by the CWU Chemistry Department showing which quarter(s) each course is typically offered during the academic year (not including summer session). This does NOT mean classes are always offered when stated, but will give a general idea of what to expect each quarter. A double asterisk (**) next to any course indicates the lab should be taken concurrently with the lecture:

Chem 111, intro to chemistry **	fall, winter
Chem 111, Lab, intro to chemistry laboratory	fall, winter
Chem 112, intro to organic chemistry **	winter, spring
Chem 112, Lab, intro to organic chemistry laboratory	winter, spring
Chem 113, intro to biochemistry **	spring
Chem 113, Lab, intro to biochemistry laboratory	spring
Chem 181, general chemistry I **	fall, winter
Chem 181, Lab, general chem lab I	fall, winter
Chem 182, general chemistry II **	winter, spring
Chem 182, Lab, general chem lab II	winter, spring
Chem 183, general chemistry III **	fall, spring
Chem 183, Lab, general chem lab III	fall spring
Chem 332, quantitative analysis **	fall, winter
Chem 332, Lab, quantitative analysis lab	fall, winter
Chem 345, environmental chemistry with lab	spring
(Next anticipated offering 2021)	
Chem 350, inorganic chemistry	fall
Chem 361, organic chemistry I	fall, winter
Chem 361, Lab, organic chem lab I	fall, winter

361 lab may be taken concurrently or after completion of Chem 361; must be taken prior to 363 Lab

Chem 362, organic chemistry II	winter, spring
Chem 363, organic chemistry III	spring
Chem 363, Lab, organic chem. lab II	spring
Chem 381, physical chemistry (thermodynamics)	fall
Chem 382, physical chemistry (quantum) **	winter
Chem 382, Lab, integrated physical/inorganic lab I	winter
Chem 383, physical chemistry (kinetics) **	spring
Chem 383, Lab, integrated physical/inorganic lab II	spring
Chem 431, biochemistry I	fall
Chem 431, Lab, biochemistry lab	fall, winter

431 lab may be taken concurrently or after completion of Chem 431

Chem 432, biochemistry II	winter
Chem 433, biochemistry III	spring
Chem 433, Lab, biochemistry lab II	spring
Chem 452, instrumental analysis **	spring
Chem 452, Lab, instrumental analysis lab	spring
Chem 473, transition metal chemistry	spring
(Next anticipated offering 2021)	
Chem 488, colloquium	winter, spring
Chem 492, lab experience in teaching chemistry	fall, winter, spring

students must APPLY to be a TA; department will register students for this course.

For chemistry students to be successful and graduate in a timely manner, the department encourages them to meet with a chemistry advisor every quarter!

F. Example of four-year plans

Chemistry advisors thought it would be beneficial to give students an idea of what a student's course schedule might look like in order to obtain a degree in chemistry in four years.

Here is an example of what a **BS in Chemistry** plan might look like:

	Fall	**Winter**	**Spring**
1st year	Chem 181 4 Chem 181 Lab 1 Math 154 5 Univ 101 1 Gen Ed. 3-6	Chem 182 4 Chem 182 Lab 1 Math 172 5 Gen Ed. 3-6	Chem 183 4 Chem 183 Lab 1 Math 173 5 Gen Ed. 3-7
2nd year	Chem 361 3 Chem 332 3 Chem 332 Lab 2 * Physics 5 Gen Ed. 3-4	Chem 362 3 Chem 361 Lab 2 * Physics 5 Gen Ed. 3-7	Chem 363 3 Chem 363 Lab 3 Math 272 5 * Physics 5
3rd year	Chem 431 3 Chem 431 Lab 2 Chem 381 5	Chem 382 3 Chem 382 Lab 2 Chem Electives	Chem 383 4 Chem 383 Lab 1 Chem 452 3 Chem 452 Lab 2
4th year	Chem 350 3 Chem Electives	Chem Electives	Chem 488 1 Chem Electives

** Students have the option of taking Physics 111 lecture and lab series -or– Physics 121 series—or—Physics 181 series.*

Important Notes: This plan assumes students enter the program qualified to take Math 154, which is <u>required</u> for enrollment in Chem 183; general education (Gen Ed) requirements must be satisfied by the quarter in which the student completes 75 credits; students who elect to serve as teaching assistants will be required to take Chem 492; Chem 361 lab and Chem 431 lab may be taken fall or winter quarter; Chem 488 is typically offered every quarter, and is ideally taken by a student during their **final year**.

Here is an example of what a **BS in Biochemistry** 4-year plan might look like:

	Fall		Winter		Spring	
1st year	Chem 181 Chem 181 Lab Math 172 Biol 181 & Lab Univ 101	4 1 5 5 1	Chem 182 Chem 182 Lab Math 173 Biol 182 & Lab	4 1 5 5	Chem 183 Chem 183 Lab Biol 183 & Lab Gen Ed.	4 1 5 4
2nd year	Chem 332 Chem 332 Lab Chem 361 Gen Ed.	3 2 3 8	Chem 362 Chem 361 Lab Gen Ed.	3 2 3-8	Chem 363 Chem 363 Lab Math 272 Biol 321	3 3 5 5
3rd year	Chem 431 Chem 431 Lab * Physics Gen Ed	3 2 5 4	Chem 432 Chem elective * Physics Gen Ed	3 5 5 3	Chem 433 Chem 433 Lab * Physics Gen Ed	3 2 5 4
4th year	Chem 381 Gen Ed Chem 350	5 8 3	Chem 382 Chem 382 Lab Gen Ed	3 2 4	Chem 488 Chem electives	1 5

** Students have the option of taking Physics 111 lecture and lab series -or– Physics 121 series—or—Physics 181 series.*

Important Notes: This plan assumes students enter the program having completed the equivalent of Math 154, which is required for Chem 183 enrollment; students who elect to serve as teaching assistants will be required to take Chem 492 as an elective; Chem 361 lab and Chem 431 lab may be taken fall or winter quarter; Chem 488 is typically offered every quarter, and is ideally taken by a student during their **final year**.

Here is an example of what a **BA in Chemistry** plan might look like:

	Fall	Winter	Spring
1st year	Chem 181 4 Chem 181 Lab 1 Math 172 5 Eng 101 4 Univ 101 1	Chem 182 4 Chem 182 Lab 1 Math 173 5 Eng 102 4 CS/IT 101 3-4	Chem 183 4 Chem 183 Lab 1 Math 272 5 CS 105 or Phil 201 4-5
2nd year	Chem 361 3 Chem 361 Lab 2 Chem 492 2 * Physics 5 Gen Ed 4-5	Chem 362 3 * Physics 5 Minor 5	* Physics 5 Gen Ed 4-5 Gen Ed 4-5
3rd year	Chem 350 3 Chem 381 5 Gen Ed 5	Chem 332 3 Chem 332 Lab 2 Gen Ed 4-5 Minor 5	Chem 473 3 Gen Ed 4-5 Minor 5
4th year	Chem 395 1 Chem 431 3 Chem 431 Lab 2 Gen Ed 4-5 Minor 5	Chem 395 1 Gen Ed 5 Minor 5	Chem 395 1 Chem 488 1 Gen Ed 4 Minor 5 Minor 5

** Students have the option of taking Physics 111 lecture and lab series -or– Physics 121 series —or— Physics 181 series.*

Important note: the BA in Chemistry can be paired with the STEM Teaching Program Minor for those interested in teaching at the high school level. More information on this option can be found on a separate handout in the chemistry department office.

For more information, please speak with the chemistry education advisor, Dr. Tim Sorey (soreyt@cwu.edu).

IV. Student Outcomes

Students completing any of the four chemistry major programs* will:

1. know the standard technical information and be able to perform experimental techniques of general, organic, analytical and physical chemistry.

2. be able to speak and write clearly in the language and style of the discipline.

3. demonstrate quantitative problem-solving skills. This includes having a firm foundation in the fundamentals and applications of the necessary mathematics, physics and statistics as it applies to experimental design and data analysis.

4. be able to use computers and the discipline specific software.

5. be able to retrieve and critically analyze chemical literature.

6. be aware of current health and safety protocols that are an integral part of the discipline.

7. be able to work effectively in group situations.

V. Program Assessment

All chemistry majors are required to maintain at least a 2.00 cumulative GPA and a 2.25 cumulative GPA in the courses required for the major.

American Chemical Society standardized exams are given to students when they complete the following courses: CHEM 183, 332 and/or 452, 363, 381, and 432.

Each student taking CHEM 488 will compile a portfolio for that course showing his or her accomplishments related to the program goals listed above. The portfolio will consist of (a) a copy of the student's transcript, plus courses they have not yet completed, (b) a listing of their ACS exam scores (obtained from the department secretary), (c) a copy of a lab report demonstrating their writing skills and use of the computer, (d) a copy of an abstract for their 488 seminar, including literature cited, (e) the student's resume, and (f) a copy of a research report if undergraduate research was conducted.

The department will periodically send out a survey to recently graduated chemistry majors, asking them to comment on the areas relating to the program goals listed here. The department will then read the responses and the portfolios collected since the last survey period, and write a report assessing how well we are meeting the program goals.

VI. Facilities and Services

The Department of Chemistry is located in the Science Facility on the CWU campus. Opened in September 1998, the building incorporates more computer-assisted learning as well as improved teaching and research laboratory facilities and state-of-the-art equipment.

The department has high quality instrumentation that is used for teaching and student research. Students get hands-on instruction on atomic absorption, ultraviolet-visible, infrared and nuclear magnetic resonance spectrometers, protein and DNA gel electrophoresis, environmental field equipment, and gas, ion and high performance liquid chromatographs.

The chemistry department provides the community, private companies and governmental agencies with professional consultation and chemical testing services. The environmental testing laboratory is state certified. Students are often involved in this work.

VII. Scholarships

Each year chemistry department faculty award several scholarships to chemistry majors. To be considered for most scholarships offered by CWU, including those awarded by this department, students must complete a Scholarship Central Application, available from the CWU Scholarship Office in Bouillon 232 or online at www.cwu.edu/scholarships

Here are some of the scholarships awarded by the chemistry department:

Dorothy Dean Memorial Chemistry Scholarship. Recipients are selected by Chemistry Department faculty. Must be of junior or senior status, have at least a 3.0 GPA and be a declared chemistry major.

Jerry and Gail Jones Alumni Scholarship. Recipients are selected by a committee from the Chemistry Department. Must be classified as an upper-division student and have a 3.25 GPA prior to receiving this scholarship and maintain a 3.0 GPA during the course of the scholarship.

VIII. Student Affiliate of the American Chemical Society (SAACS)

Our SAACS group, called the Chemistry Club, is an organization of undergraduate and graduate students who assume responsibility for a wide range of events and services of benefit to the students themselves, the department and the community. These have included: sponsoring seminar speakers, holding benefit fund raisers (Concert for the Cure for the American Cancer Society), going on field trips to places like the Iron Horse Brewery and Pacific Northwest National Laboratories, participating in the outreach program for local K-12 schools (such as performing a Magic Show at the Thorp School), as well as providing for social interactions.

The organization of the club changes yearly, reflecting the interests of each new group of students who elect to take active roles. The club is an essential part of the chemistry department. We encourage all chemistry majors and minors to participate as fully as possible.

IX. Chemistry Department Faculty

The Department of Chemistry prides itself on a close student/professor relationship and the availability of individualized instruction. This relationship helps account for the excellent achievement and placement records of our graduates.

All faculty members of the Chemistry Department hold Ph.D. degrees. Each is actively involved in classroom and laboratory instruction and conducts research or other scholarly activities. Fields of specialization include biochemistry, inorganic, analytical, organic, physical and environmental chemistry as well as chemistry education.

Each faculty member is listed below along with areas of expertise and research interests:

Gil Belofsky, Associate Professor, Organic Chemistry (Ph.D., The University of Iowa, 1996). Isolation and structural characterization of organic compounds from plants. Medicinal and pharmacological applications of natural products.

Timothy Beng, Associate Professor, Organic Chemistry (Ph.D., University of Arkansas, 2011). Development of synthetic methodology for the efficient and stereoselective construction and functionalization of nitrogen and oxygen-containing heterocycles

Anthony Diaz, Professor, Inorganic Chemistry (Ph.D., Oregon State University, 1996). Luminescence, energy transfer and degradation processes in solid state luminescent systems.

Levente Fabry-Asztalos, Professor, Organic Chemistry (Ph.D., Washington State University, 2001). Design and synthesis of inhibitors against therapeutically important enzymes.

Yingbin Ge, Professor, Physical Chemistry (Ph.D., University of Hawaii, 2004). Theoretical chemistry and computational studies of nano-clusters, nano-scale catalysts, astrochemical species, and biochemical molecules.

Anne Johansen, Professor, Environmental Engineering Science (Ph.D., California Institute of Technology, 1999). Chemical composition of ambient aerosol particles.

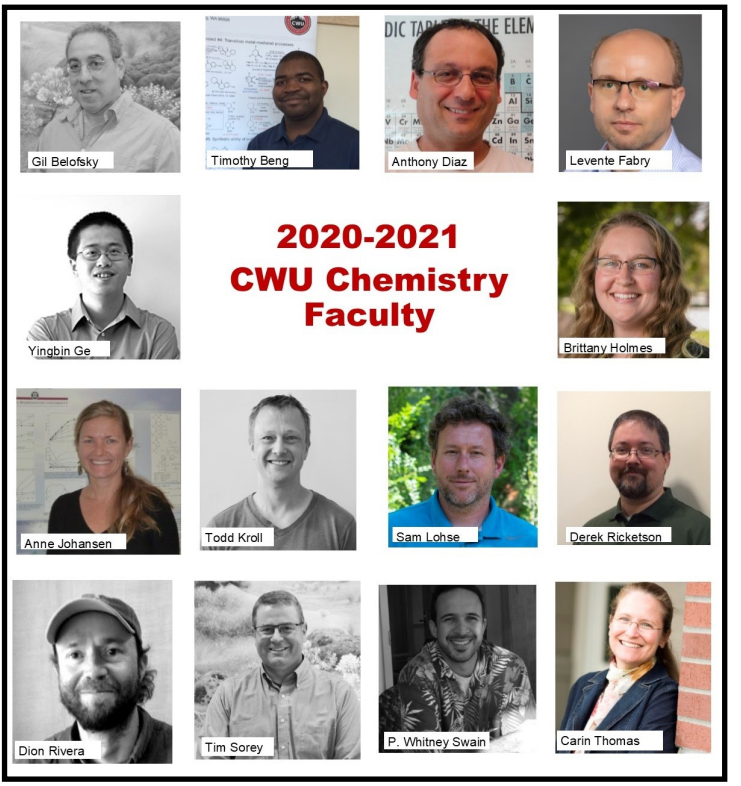
Todd Kroll, Associate Professor, Biochemistry (Ph.D., University of Notre Dame, 2002). Identification and characterization of protein-protein interactions that induce frontal cortical areas of the brain.

Sam Lohse, Assistant Professor, Analytical Chemistry (Ph.D., University of Oregon 2011). Behavior of engineered nanomaterials and microplastics in environmental and biological systems. Rapid detection and identification of material contaminants in aqueous environments.

Dion Rivera, Professor, Physical/Analytical Chemistry (Ph.D., University of Utah, 2000). Spectroscopic investigations of macromolecular complexes of polyelectrolytes and surfactants. Investigations of the effect of nanoparticle metal oxides on the optical properties of polyelectrolyte/surfactant formulations.

Timothy L. Sorey, Professor, Analytical and Educational Chemistry (Ph.D., Montana State University – Bozeman, 2005). Development and integration of instrumental measurement technology in educational laboratories and the synthesis of educational strategies that support their use.

Carin Thomas, Professor, Biochemistry (Ph.D., University of Nevada—Reno, 1991). Bioactivation and cytotoxicity of xenobiotics, oxygen toxicity and mitochondrial dysfunction.



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