



## Request for Substantial Changes to an Existing Program

Complete this form and submit to the [Office of Curricular Affairs](#). You can review the route of approvals this form will go through [here](#). Committees only meet during the academic year and break for summer.

- I. Program Details
  - a) Name (and Degree Type) of Academic Program: Chemistry BS
    - i) Emphases (if applicable): None
  - b) Academic Unit(s)/College(s): Dept of Chemistry & Biochemistry, College of Science
- II. Primary Contact and Email: Dee Belle-Oudry, [dbelle@arizona.edu](mailto:dbelle@arizona.edu)
- III. Planned start term for changes: Fall 2024
- IV. Describe the proposed changes to the program as well as the rationale for making the specific changes and include any relevant supporting data.

The requirements for the chemistry BS degree at the UA have generally remained unchanged for the past several decades. There is a very specific path through the major that leaves little room for variation, choice, or specialization. Many students struggle to complete the degree within four years due to the rigidity of the program. Moreover, the coursework is very compartmentalized. During the first two years of the degree most students are only exposed to general and organic chemistry; other subdisciplines such as analytical, inorganic, physical, and biochemistry are usually deferred until the junior and senior years. This hampers their comprehension of the full breadth of the field. Earlier coursework in the various chemistry subdisciplines will provide students with a better view of the richness of the field and a more realistic picture of the interconnectedness of the specialty areas. One goal of this proposed program is to provide foundational-level understanding in all areas of chemistry as early as possible. A second goal is to allow students more choices for their in-depth coursework, based on the specific areas they found most interesting in their foundational courses and those that will best prepare them for their careers.

The new degree plan will be better aligned with the American Chemical Society (ACS) Committee on Professional Training (CPT) guidelines for chemistry degree programs (<https://www.acs.org/content/dam/acsorg/education/standards-guidelines/approval-program/guidelines-draft-sept2022.pdf>). The ACS CPT guidelines specify foundational coursework in five foundational areas (analytical, biochemistry, inorganic, organic, and physical (ABIOP)) of chemistry and four in-depth courses. Our existing CHEM BS coursework is very prescribed and requires **~550 hours of laboratory coursework** beyond general chemistry. By contrast, the ACS allows more choice in-depth coursework and requires a **minimum of 350 hours of laboratory work** beyond general chemistry. The new CHEM BS will include a minimum of ~450 hours of laboratory coursework and allow students to choose from a set of advanced lab courses, including directed research. The new curriculum will remain compliant with ACS guidelines, so students completing this program will have the option to receive an ACS-approved degree. It is incumbent upon us to ensure our degree program is relevant and meaningful to ensure that graduating BS chemistry

majors are best prepared for their future careers. The new degree plan is a crucial step in making this happen.

A summary side-by-side comparison of the existing and proposed degree plans is shown in Appendix A. The main changes to the BS chemistry program are as follows:

- a. Students will take three majors colloquium courses (CHEM 195a, 295a, and 395a)—one per year for the first three years of the program—rather than the single colloquium course (CHEM 395A) currently required. Each course will focus on topics relevant to their current year in the program, which will help students navigate the program, develop important skills for professional success, and prepare for their careers. These courses will also create cohorts of students and provide an important support structure that is currently lacking in the program.
- b. A new general chemistry sequence (CHEM 181 and CHEM 182) will replace the multiple general chemistry options (15X, 16X, 14X) in the old degree plan. CHEM 181/182 is specifically designed for chemistry and biochemistry majors. These courses will better equip chemistry students with the appropriate knowledge and skills to succeed in their field. The new sequence will also create *cohorts of majors* in their first year of the program, providing a better connection to CBC faculty and a sense of community among the students at a crucial stage in their academic journey. The intent is to improve student retention and success in chemistry. Note that CHEM 181/182 is the preferred general chemistry sequence, but completion of non-majors' general chemistry (CHEM 151 + 152) or honors general chemistry (CHEM 161/163 + 162/164) will also satisfy this requirement.
- c. The math requirement will change. In the existing degree plan all students are required to complete two semesters of calculus plus a third course (either MATH 223 or CHEM 380). With the new plan, only those students who opt to take advanced courses in physical chemistry will need to take the third math class. Otherwise, only two semesters of calculus will be required for the new degree.
- d. The new program includes one-semester *foundational* lecture courses in the five areas of chemistry: analytical, biochemistry, inorganic, organic, and physical (ABIOP). In general, students will take these courses in their second and third years, giving them a broad overview of the different subdisciplines earlier in the program. In the current BS degree, students typically concentrate only on organic chemistry coursework in their second year. This gives them a narrow view of chemistry—excluding a wide range of topics and activities in the various areas of chemistry—and could potentially lead to a loss of interest in the major. Early exposure to the *full breadth of the field* will help students develop a better understanding of the different subject areas. They may identify a particular area that appeals to them and decide to pursue further through advanced coursework and/or research in that area.
- e. The new curriculum includes two foundational laboratory courses (*Syntheses* and *Chemical Measurements*) that integrate topics from all areas of chemistry. These labs provide students with an awareness of the *interconnectedness of the chemistry subdisciplines*. The old degree program was very compartmentalized; students took separate courses and labs in organic, analytical, inorganic, and physical chemistry. This is not representative of how modern science is done. Solving problems of interest requires interdisciplinary understanding and effort. The new foundational lab courses impart a more realistic view of what chemists do in their careers.
- f. The new BS plan offers students more flexibility in upper-level coursework. For example, the existing CHEM BS degree requires three specific upper-level lab courses (CHEM 400A, 400B, 412). The new degree allows more choices; students choose three labs from a list of six options (CHEM 400A,

CHEM 400B, CHEM 412, CHEM 356L, BIOC 463A, or Directed Research). This will likely lead to an *increase in student participation in research*. The new plan will allow students to choose two options from a list of seven in-depth lecture courses, whereas the old BS plan had prescribed set of required 300- and 400-level lecture classes. The intent is to add flexibility to the degree and to offer students more choices to specialize in areas that appeal to them. In addition, we reconsidered and modified prerequisites for several courses to diminish the number of roadblocks in the program and reduce degree complexity (depending on which courses a student selects). This will lead to a decrease in the average time to degree compared to the existing BS plan, where the strict upper-level course requirements often hampered the progress of students who did not follow the prescribed sequence of coursework to the letter. Finally, we expanded the number and scope of elective courses (Appendix B) to allow students more choices. We expect the proposed changes to *markedly increase student satisfaction and success* in the chemistry program.

- V. Comparison Chart – complete the appropriate chart below (delete the unnecessary one) to compare your current requirements to the proposed modifications.

Tools for course lookup: UA Course Catalog or UAnalytics (Catalog and Schedule Dashboard)

UNDERGRADUATE	Existing Major Requirements	Requirements For Modified Major
Name of major, emphasis (if applicable) and degree*	Chemistry, BS	Chemistry, BS
CIP Code –lookup <a href="#">here</a> or contact <a href="#">the Office of Curricular Affairs</a> for assistance, if needed	40.0501	40.0501
Total units required to complete the degree* (Note: this is for the entire degree, not just the major)	120	120
Upper division units required to complete the degree	42	42
Total CC transfer units that may apply to this degree*	64	64
Foundation courses		
<a href="#">Math</a>	Substantial Math Strand	Substantial Math Strand
<a href="#">Second Language</a>	Second Semester Proficiency	Second Semester Proficiency
<a href="#">General Education</a>		
Introduction to General Education course (1 unit)	Introduction to General Education course (1 unit)	Introduction to General Education course (1 unit)
GE Exploring Perspectives: Choose one course from each domain. (12 units total)	Artist (1 course) Humanist (1 course) Natural Scientist (1 course) Social Scientist (1 course)	Artist (1 course) Humanist (1 course) Natural Scientist (1 course) Social Scientist (1 course)
GE Building Connections: Choose three courses (9 units) from two or more disciplines and/or perspectives.	GE Building Connections: Complete 3 courses, 9 units total.	GE Building Connections: Complete 3 courses, 9 units total.
GE Capstone course (1 unit)	GE Capstone course (1 unit)	GE Capstone course (1 unit)

Pre-major? (Yes/No)	No	No
List any special requirements to declare or gain admission to this major (completion of specific coursework, minimum GPA, interview, application, etc.)	None	None
Minimum # of units required in the major (units counting towards major units and major GPA)	55	54
Minimum # of upper-division units required in the major (upper division units counting towards major GPA)	37	34
<a href="#">Minimum # of residency units to be completed in the major</a>	18	18
Required supporting coursework (courses that do not count towards major units and major GPA, but are required for the major). Courses listed must include prefix, number, units, and title. Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses not owned by your department.	<p>-Physics I (mechanics), choose one from the following:  PHYS 141 (4) Introductory Mechanics  OR  PHYS 161H (4) Honors Introductory Mechanics</p> <p>-Physics II, choose from one of the following:  PHYS 241 (4) Introductory Electricity &amp; Magnetism  OR  PHYS 261H (4) Honors Introductory Electricity &amp; Magnetism</p> <p>-Calculus I, choose from one of the following:  (MATH 122A (1), Functions for Calculus + MATH 122B (4), First Semester Calculus)  OR  MATH 125 (3), Calculus I</p> <p>-MATH 129 (3), Calculus II</p> <p>-Third semester calculus, choose from one of the following:  CHEM 380 (3), Mathematical Physics for Chemistry  OR  MATH 223 (3), Vector Calculus</p>	<p>-Physics I (mechanics), choose one from the following:  PHYS 141 (4) Introductory Mechanics  OR  PHYS 161H (4) Honors Introductory Mechanics</p> <p>-Physics II, choose from one of the following:  PHYS 241 (4) Introductory Electricity &amp; Magnetism  OR  PHYS 261H (4) Honors Introductory Electricity &amp; Magnetism</p> <p>-Calculus I, choose from one of the following:  (MATH 122A (1), Functions for Calculus + MATH 122B (4), First Semester Calculus)  OR  MATH 125 (3), Calculus I</p> <p>-MATH 129 (3), Calculus II</p>
Major requirements. List all major requirements including core and electives. If applicable, list the emphasis requirements. Courses listed count towards major units and major GPA. Courses listed must include prefix, number, units, and	<p>-First semester General Chemistry with lab-choose from one of the following:  CHEM 151 (4) Chemical Thinking I  OR  (CHEM 161 (3) Honors Chemical Thinking I + CHEM 163 (1) Honors Fundamental Techniques of Chemistry)</p>	<p><b>-CHEM 181 (4) Majors General Chemistry I</b></p> <p>Note: this requirement may also be fulfilled by taking one of the following:  CHEM 151 (4) Chemical Thinking I  OR</p>

<p>title. Mark new coursework (New). Include any limits/restrictions in place/needed (house number limit, etc.). Provide email(s)/letter(s) of support from home department head(s) for courses being added and are not owned by your department. Recommend ordering requirements in the same order as your advisement report.</p>	<p>OR (CHEM 141 (3) General Chemistry Lecture I. Quantitative + CHEM 143 (1) General Chemistry Lab 1. Quantitative)</p> <p>-Second semester General Chemistry with lab-choose from one of the following:</p> <p>CHEM 152 (4) Chemical Thinking II OR (CHEM 162 (3) Honors Chemical Thinking II + CHEM 164 (1) Honors Fundamental Techniques of Chemistry) OR (CHEM 142 (3) General Chemistry Lecture II. Quantitative + CHEM 144 (1) General Chemistry Lab II. Quantitative)</p> <p>-First semester organic chemistry lecture, choose from one of the following: CHEM 246A (3) Lectures in Organic Chemistry OR CHEM 242A (3) Honors Lecture in Organic Chemistry</p> <p>-CHEM 247A (2) Organic Chemistry Laboratory</p> <p>-Second semester organic chemistry lecture, choose from one of the following: CHEM 246B (3) Lectures in Organic Chemistry OR CHEM 242B (3) Honors Lecture in Organic Chemistry</p> <p>-CHEM 247B (2) Organic Chemistry Laboratory</p> <p>-CHEM 325 (2) Analytical Chemistry</p> <p>-CHEM 326 (2) Analytical Chemistry Laboratory</p>	<p>(CHEM 161 (3) Honors Chemical Thinking I + CHEM 163 (1) Honors Fundamental Techniques of Chemistry)</p> <p>-CHEM 182 (4) Majors General Chemistry II</p> <p>Note: this requirement may also be fulfilled by taking one of the following: CHEM 152 (4) Chemical Thinking II OR (CHEM 162 (3) Honors Chemical Thinking II + CHEM 164 (1) Honors Fundamental Techniques of Chemistry)</p> <p>-(New) CHEM 195A (1) First Year Chemistry Colloquium</p> <p>-(New) CHEM 246 (3) Principles of Organic Chemistry</p> <p>-(New) CHEM 256L (2) Synthesis Laboratory</p> <p>-(New) CHEM 227 (3) Principles of Analytical Chemistry</p> <p>-(New) CHEM 330L (2) Measurements Laboratory</p> <p>-(New) CHEM 295A (1) Second Year Chemistry Colloquium</p>
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	<p>-CHEM 395A (1) Chemistry Majors Colloquium</p> <p>-CHEM 400A (3) Chemical Measurements Laboratory</p> <p>-CHEM 400B (3) Chemical Measurements Laboratory</p> <p>-CHEM 401A (3) Instrumental Analysis</p> <p><b>-CHEM 404A (3) Inorganic Chemistry</b></p> <p>-CHEM 412 (3) Inorganic Preparation</p> <p>-Biochemistry, choose one course:        BIOC 384 (3) Foundations in Biochemistry        OR        BIOC 462A (4) Biochemistry</p> <p><b>-CHEM 480A (3) Physical Chemistry</b></p> <p><b>-CHEM 480B (3) Physical Chemistry</b></p> <p>-Advanced Electives I: <b>choose 5 units</b> from the following list of courses:        ASTR 488A (3) Astrochemistry        BIOC 385 (3) Metabolic Biochemistry        BIOC/CHEM/ECOL/PLS/MCB 448A (3) Plant Biochemistry and Metabolic Engineering        BIOC 462B (4) Biochemistry  <b>CHEM 404B (3) Inorganic Chemistry II</b>        CHEE/CHEM/MSE 437 (3) Surface Science        CHEM 446 (3) Organic Preparations        CHEM 447 (3) Organic Structural Analysis Laboratory        CHEM 450 (3) Synthetic and Mechanistic Organic Chemistry        ENVS/GEOS/HWRS 340 (3) Environmental Chemistry        ENVS 462 (3) Environmental Soil and Water Chemistry        ENVS 464 (3) Environmental Organic Chemistry        GEOS 400 (3) Introduction to Geochemistry        MSE 460 (3) Materials Science of Polymers        PCOL 410 (5) Medicinal Chemistry        PHYS 426 (3) Thermal Physics        PHYS 431 (3) Molecular Biophysics</p>	<p>-CHEM 395A (1) Chemistry Majors Colloquium</p> <p><b>-(New) CHEM 310 (3) Principles of Inorganic Chemistry</b></p> <p>-Biochemistry, choose one course:        BIOC 384 (3) Foundations in Biochemistry        OR        BIOC 462A (4) Biochemistry</p> <p><b>-(New) CHEM 385 (3) Principles of Physical Chemistry</b></p> <p><b><i>In-depth coursework (minimum 6 units)</i></b>        -Choose a minimum of two courses from the following list:        CHEM 401A (3) Instrumental Analysis        (New) CHEM 485 (3) Advanced Physical Chemistry        CHEM 410/510 (3) Advanced Inorganic Chemistry        (New) CHEM 346 (3) Advanced Organic Chemistry        CHEM 423a/523a (3) Bioanalytical Chemistry        CHEM 450/550 (3) Synthetic and Mechanistic Organic Chemistry        CHEM 487/587 (3) Introduction to Molecular Spectroscopy</p> <p><b><i>Advanced laboratory coursework (minimum 9 units)</i></b>        -Choose three advanced lab courses from the following list:  <b>CHEM 400A (3) Chemical Measurements Laboratory</b>  <b>CHEM 400B (3) Chemical Measurements Laboratory</b>  <b>(New) CHEM 356L (3) Synthesis Lab II</b></p>
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	<p>PHYS 484 (3) Nuclear Magnetic Resonance Spectroscopy  PTYS 407 (3) Chemistry of the Solar System  PTYS 416 (3) Asteroids, Comets, and Kuiper Belt Objects</p> <p>-Advanced Electives II: choose 3 units from the following list of courses:</p> <p>ASTR 488A (3) Astrochemistry  BIOC 385 (3) Metabolic Biochemistry  BIOC/CHEM/ECOL/PLS/MCB 448A (3) Plant Biochemistry and Metabolic Engineering  BIOC 462B (4) Biochemistry  CHEM 392 (1-6) Directed Research  CHEM 392H (1-6) Honors Directed Research  CHEM 399 (1-5) Independent Study  CHEM 399H (1-5) Honors Independent Study  <b>CHEM 404B (3) Inorganic Chemistry II</b>  CHEM 405A (1) Basic Laboratory Safety  CHEM 405B (1) Advanced Laboratory Safety  CHEM 405C (1) Chemical Hygiene and Regulations  CHEE/CHEM/MSE 437 (3) Surface Science  CHEM 446 (3) Organic Preparations  CHEM 447 (3) Organic Structural Analysis Laboratory  CHEM 450 (3) Synthetic and Mechanistic Organic Chemistry  CHEM 491 (1-3) Preceptorship  CHEM 491H (1-3) Honors Preceptorship  CHEM 492 (1-6) Directed Research  CHEM 492H (1-6) Honors Directed Research  CHEM 493 (1-5) Internship  CHEM 496D (1) Chemistry Discovery  CHEM 498 (3) Senior Capstone  CHEM 498H (3) Honors Thesis  CHEM 499 (1-6) Independent Study  CHEM 499H (1-6) Honors Independent Study  ENVS/GEOS/HWRS 340 (3) Environmental Chemistry  ENVS 462 (3) Environmental Soil and Water Chemistry  ENVS 464 (3) Environmental Organic Chemistry  GEOS 400 (3) Introduction to Geochemistry  MSE 460 (3) Materials Science of Polymers</p>	<p>CHEM 412 (3) Inorganic Preparation  BIOC 463A (4) Biochemical Laboratory Techniques  Up to 3 units of the following directed research courses may count toward this requirement:  CHEM 492 (1-6) Directed Research  CHEM 492H (1-6) Honors Directed Research  CHEM 498 (3) Senior Capstone  CHEM 498H (3) Honors Thesis</p> <p><b>-Advanced Electives I</b>  Choose at least 6 units from the following list, or from approved 500-level CHEM courses:</p> <p>ASTR 488A (3) Astrochemistry  BIOC 385 (3) Metabolic Biochemistry  BIOC/CHEM/ECOL/PLS/MCB 448A (3) Plant Biochemistry and Metabolic Engineering  BIOC 462B (4) Biochemistry  <b>BIOC 463A (4) Biochemical Laboratory Techniques</b>  <b>BME 420 (3) Biophotonics</b>  <b>BME 447 (3) Sensors and Controls</b>  <b>BME 485 (3) Nanoscience and Nanotechnology for Biomedical Engineers</b>  <b>CHEE/MSE 432 (3) Organic Electronic Materials &amp; Devices</b>  CHEE/CHEM/MSE 437 (3) Surface Science  <b>(New) CHEM 346 (3) Advanced Organic Chemistry</b>  <b>(New) CHEM 356L (3) Synthesis Lab II</b>  <b>CHEM 380 (3) Mathematical Physics for Chemistry</b>  CHEM 400A (3) Chemical Measurements Laboratory  CHEM 400B (3) Chemical Measurements Laboratory  CHEM 401A (3) Instrumental Analysis  CHEM 410/510 (3) Advanced Inorganic Chemistry  <b>CHEM 412 (3) Inorganic Preparation</b>  <b>CHEM 418/518 (3) Computational Chemistry</b>  <b>CHEM 422/522 (3) Electroanalytical Chemistry</b>  <b>CHEM 423a/523a (3) Bioanalytical Chemistry</b>  <b>CHEM 425A/525A (3) Mass Spectrometry</b>  <b>CHEM 426B/526B (3) Analytical Molecular Spectroscopy</b>  <b>CHEM 427/527 (3) Separations</b></p>
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	<p>PCOL 410 (5) Medicinal Chemistry          PHYS 426 (3) Thermal Physics          PHYS 431 (3) Molecular Biophysics          PHYS 484 (3) Nuclear Magnetic Resonance Spectroscopy          PTYS 407 (3) Chemistry of the Solar System          PTYS 416 (3) Asteroids, Comets, and Kuiper Belt Objects</p>	<p>CHEM 428B/528B (3) Advanced Analytical Chemistry Laboratory          CHEM 442b/542b (3) Polymer Chemistry          CHEM 446 (3) Organic Preparations          CHEM 447 (3) Organic Structural Analysis Laboratory          CHEM 449A/549A Topics in Chemical Biology          CHEM 450/550 (3) Synthetic and Mechanistic Organic Chemistry          (New) CHEM 485 (3) Advanced Physical Chemistry          CHEM 487/587 (3) Introduction to Molecular Spectroscopy          ENVS 410 (3) Microbial Biogeochemistry and Global Change          ENVS 425 (3) Environmental Microbiology          ENVS/GEOS/HWRS 340 (3) Environmental Chemistry          ENVS 462 (3) Environmental Soil and Water Chemistry          ENVS 464 (3) Environmental Organic Chemistry          GEOS 400 (3) Introduction to Geochemistry          IMB 401 (4) Medical Microbiology &amp; Immunobiology          IMB 406 (3) Human Immunobiology          MSE 460 (3) Materials Science of Polymers          PCOL 410 (5) Medicinal Chemistry          PCOL 350 ADME: (3) How the Body Changes Drugs          PHYS 426 (3) Thermal Physics          PHYS 431 (3) Molecular Biophysics          PHYS 484 (3) Nuclear Magnetic Resonance Spectroscopy          PTYS 407 (3) Chemistry of the Solar System          PTYS 416 (3) Asteroids, Comets, and Kuiper Belt Objects</p> <p><b>Advanced Electives II:</b>          Choose an additional 3 units either from the list above, or from the following list, or from approved 500-level CHEM courses:</p> <p>CHEM 392 (1-6) Directed Research          CHEM 392H (1-6) Honors Directed Research          CHEM 399 (1-5) Independent Study          CHEM 399H (1-5) Honors Independent Study          CHEM 405A (1) Basic Laboratory Safety</p>
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Internship, practicum, applied course requirements. (Yes/No). If yes, provide description.	No	No
Senior thesis or senior project required (Yes/No). If yes, provide description.	No	No
Additional requirements (provide description)	Minimum 2.0 GPA in the major	Minimum 2.0 GPA in the major
Minor (optional or required)	optional	optional

\* These changes require Arizona Board of Regents (ABOR) approval.

VI. Faculty impact – will new faculty hires be required to deliver the new, proposed curriculum?

New faculty hires will not be needed to implement this program change. Several existing faculty members have already agreed to develop new foundational coursework. Some courses have or will be eliminated (e.g., CHEM 14X in-person classes) to offset the new classes added. Table 1 below summarizes the course additions to and deletions from the program. Although it appears that we are adding more units to our teaching load, this can be accounted for by considering the following:

- a. The new majors' colloquium courses (CHEM 195A and 295A) will be taught by existing CBC faculty on a rotating basis as part of their department service load. (-2 units)
- b. We are also deleting CHEM 404B (Advanced Inorganic Chemistry) and offering CHEM 410, which will be co-convened with our existing CHEM 510 graduate class. (-3 units)
- c. The foundational lab courses (CHEM 256L and CHEM 330L) are run by TAs and supervised by laboratory managers. Adding the extra spring section of CHEM 256L therefore does not increase faculty teaching load. (-2 units)

**Table 1.** Changes to CHEM course offerings needed to institute revised BS chemistry degree.

New course	Semester offered	Units added	First offered	Deleted course (s)	Units deleted
CHEM 181 Majors General Chemistry I	Fall	4	Fall 2023	CHEM 141 + CHEM 143 (in-person)	4
CHEM 182 Majors General Chemistry II	Spring	4	Spring 2024	CHEM 142 + CHEM 144 (in-person)	4
CHEM 246 Principles of Organic Chemistry	Fall and Spring	6	Fall 2025	CHEM 246A	3
CHEM 227 Principles of Analytical Chemistry	Fall	3	Spring 2026	CHEM 325	2
CHEM 310 Principles of Inorganic Chemistry	Spring	3	Fall 2025	CHEM 404A	3
CHEM 256L Syntheses (lab)	Fall and Spring	4	Fall 2025	CHEM 247A	2
CHEM 330L Chemical Measurements (lab)	Fall	2	Fall 2026	CHEM 326	2
CHEM 385 Principles of Physical Chemistry	Fall	3	Fall 2025	CHEM 480A (off sequence)	3
CHEM 346 Lectures in Organic Chemistry II	Spring	3	Spring 2026	CHEM 246B	3
CHEM 485 Physical Chemistry II	Spring	3	Spring 2027	CHEM 480B (offered fall and spring)	6
CHEM 195A First Year Colloquium	Fall	1	Fall 2023		
CHEM 295A Second Year Colloquium	Spring	1	Spring 2025		
CHEM 356L Synthesis Lab II	Spring	3	Spring 2027	CHEM 247B	2
<b>Total units added</b>		<b>40</b>		<b>Total units deleted</b>	<b>34</b>

\*We will continue to offer CHEM 480A once per year (rather than twice) for students in other departments such as Chemical Engineering.

Most content in the upper-level courses and labs will not change. Students will have more flexibility and options in selecting their advanced coursework, but we do not anticipate any additional teaching obligations because of this program change. We are currently making a concerted effort to expand the upper-level elective course availability by converting several of our graduate courses to combined 400/500-level options. For new elective courses that fall outside CBC, we have obtained support from those departments (IMB, PCOL, BME, ENVS, CHEE, and MSE) to include their courses in our program (see Appendix C).

- VII. Budgetary impact – indicate new resources needed and source of funding to implement proposed changes. If reallocating resources, indicate where resources will be taken from and the impact this will have on students/faculty/program/unit.

The overall department teaching load will not increase as explained above in part a. Some faculty effort will be required to develop new courses. In some cases (e.g., CHEM 256L, 330L, 356L laboratory courses) these efforts will involve a simple redistribution of existing topics and activities in our existing curriculum. The laboratory supervisors have already committed to implementing the new lab curriculum. Other foundational courses (e.g., CHEM 246, 310, 385) will require a more deliberate design of new pedagogy and content with sufficient subject coverage that is suitable for students at the sophomore level. The new in-depth courses, CHEM 346 and 485, will also require some development effort. Several faculty members have offered to develop the new curriculum and have already created syllabi for many of the new course offerings. We anticipate the only budgetary impact associated with the new program will be the cost to pay five replacement instructors for one semester (\$50,000 total) to teach courses so that these faculty can develop the aforementioned courses. Since these new classes will not be offered until the second year of the new program (AY 2025-2026), this cost can be spread over the span of two years.

- VIII. Transfer Student Consideration

Students transferring into the chemistry BS program usually have completed one or two years of chemistry. In most programs (including Arizona community colleges), students take general chemistry in year one and organic chemistry in year two. Table 2 shows the equivalencies for these courses in the new BS plan. General chemistry coursework completed at other institutions will be accepted as equivalent to the CHEM 181/182 sequence. Students who have completed organic chemistry I and II elsewhere will get credit for completing the foundational organic chemistry class (CHEM 246) and the foundational Syntheses lab course (CHEM 256L).

**Table 2.** Equivalencies for most common transfer coursework in the new chemistry BS degree.

Coursework completed	Equivalency
General chemistry I with lab	CHEM 181 General chemistry I
General chemistry II with lab	CHEM 182 General chemistry II
Organic chemistry I & II (with lab)	CHEM 246 (Foundational organic) + CHEM 256L (Syntheses lab)

Students transferring in their second year will easily transition to the new program, as they will have completed general chemistry and will start the second year taking the same courses as non-transfer students. They will be exempt from the CHEM 195a colloquium requirement and enroll in CHEM 295a in the spring semester.

Students transferring in their third year will be exempt from both CHEM 195a and 295a. Table 3 shows the generic study plan for a third-year transfer student. By offering the foundational Chemical Measurement lab course (CHEM 330L) in both fall and spring semesters, we will be able to accommodate the needs of transfer students such that they can complete their remaining degree requirements within two years.

**Table 3.** Generic example study plan for a student transferring into the CHEM BS program in the third year.

	Fall			Spring		
	Course	Units	Prereqs	Course	Units	Prereqs
Third year	CHEM 227 found analyt	3	CHEM 182	CHEM 330L meas lab	2	227 co or pre req
	BIOC 384 (or 462A)	3	CHEM 246	CHEM 310 found inorg	3	CHEM 246
	CHEM 385 found pchem	3	MATH 129, PHYS 241	Upper division class/lab	3	varies
	Gen Ed or other electives	6		Gen Ed or other electives	3	
				CHEM electives	3	varies
			CHEM 395A	1		
	<b>Total units</b>	<b>15</b>		<b>Total units</b>	<b>15</b>	
Fourth year	Upper division class/lab	3	varies	Upper division class/lab	3	varies
	Upper division class/lab	3	varies	Upper division class/lab	3	varies
	Gen Ed or other electives	6		Gen Ed or other electives	6	
	CHEM electives	3	varies	CHEM electives	3	varies
	<b>Total units</b>	<b>15</b>		<b>Total units</b>	<b>15</b>	

IX. Required signatures

Program Director/Main Proposer (print name and title): Dee Belle-Oudry

CBC Associate Dept Head, Education & Academic Affairs

Program Director/Main Proposer signature:

Date: 10/25/2023



Department Head (print name and title): Craig Aspinwall

CBC Department Head, Professor of Chemistry

Department Head's signature:

Date:

10/26/2023



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Associate/Assistant Dean (print name): Rebecca Gomez

Associate/Assistant Dean's signature:



Date: 11/2/23

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Dean (print name): Carmala Garzione



Dean's signature:

Date: 11/3/2023

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Graduate: For use by Curricular Affairs (for majors):

Committee	Approval date
GPERC	
Graduate Council	
College Academic Administrators Council	
Arizona Board of Regents (if applicable)	

For minors and certificates:

Committee	Approval date
GPERC	

UG: For use by Curricular Affairs (for majors):

Committee	Approval date
APC	
Undergraduate Council	
U-CAAC	

For minors and certificates:

Committee	Approval date
APS	
Undergraduate Council	

## Appendix A

Comparison of existing CHEM BS requirements with new proposed degree

### Requirements for existing CHEM BS

Course number	Units
MATH 122A/B or 125 Calc I	3-5
MATH 129 Calc II	3
PHYS 141	4
PHYS 241	4

Gen Chem I & II	8	<b>Core major requirements</b>
CHEM 246a + 246b	6	
CHEM 247a + 247b	2	
CHEM 325 & 326	4	
CHEM 380 (or MATH 223)	3	
CHEM 480A + 480B	8	
CHEM 401A	3	
CHEM 400A	3	
CHEM 400B	3	
CHEM 395A	1	
CHEM 404A	3	
CHEM 412	3	
BIOC 384 or 462A	3	
<b>Total units</b>	<b>50</b>	

Electives	5 units "restricted"electives; 3 units larger list
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### Requirements for new CHEM BS

Course number	Units
MATH 122A/B or 125 Calc I	3-5
MATH 129 Calc II	3
PHYS 141	4
PHYS 241	4

CHEM 181 & 182	8	<b>Core major requirements</b>
CHEM 195a	1	
CHEM 246 found org	3	
CHEM 310 found inorg	3	
CHEM 227 found analyt	3	
CHEM 385 found pchem	3	
CHEM 256L synth lab	2	
CHEM 330L meas lab	2	
CHEM 295a	1	
CHEM 395a	1	
BIOC 384 (or 462A)	3	
<b>Total units</b>	<b>30</b>	

<b>Two courses from the following:</b>	6	<b>In-depth coursework</b>
CHEM 401A		
CHEM 485 adv pchem		
CHEM 410/510		
CHEM 346 adv org		
CHEM 423A/523A		
CHEM 487/587		
CHEM 450/550		
<b>Three lab courses from the following:</b>	9	
CHEM 400A		
CHEM 400B		
CHEM 412		
CHEM 356L adv synth lab		
BIOC 463a		
Directed research (492 or 498)		
Electives-List A	6	
Electives-List A or B	3	
<b>Total units</b>	<b>24</b>	

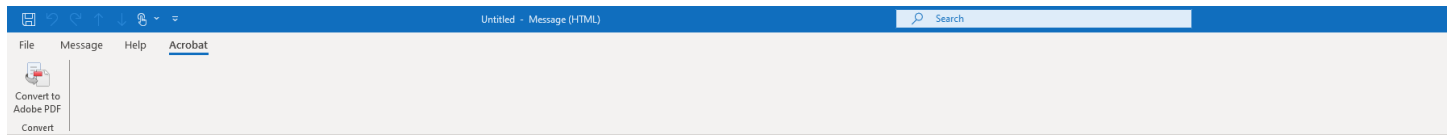
## Appendix B

### Electives lists for CHEM BS degree


Course	Course
CHEM 346 (3) Advanced Organic Chemistry	CHEM 392 (1-6) Directed Research
CHEM 356L (3) Advanced Synthesis Laboratory	CHEM 392H (1-6) Honors Directed Research
CHEM 410/510 (3) Advanced Inorganic Chemistry	CHEM 399 (1-5) Independent Study
CHEM 412 (3) Inorganic Preparations	CHEM 399H (1-5) Honors Independent Study
CHEM 442b/542b (3) Polymer Chemistry	CHEM 405A (1) Basic Laboratory Safety
CHEM 446 (3) Organic Preparations	CHEM 405B (1) Advanced Laboratory Safety
CHEM 447 (3) Organic Structural Analysis Laboratory	CHEM 405C (1) Chemical Hygiene and Regulations
CHEM 449A/549A Topics in Chemical Biology	CHEM 491 (1-3) Preceptorship
MSE 460 (3) Materials Science of Polymers	CHEM 491H (1-3) Honors Preceptorship
PCOL 410 (5) Medicinal Chemistry	CHEM 492 (1-6) Directed Research
CHEM 450/550 (3) Synthetic and Mechanistic Organic Chemistry	CHEM 492H (1-6) Honors Directed Research
PCOL 350 ADME: (3) How the Body Changes Drugs	CHEM 493 (1-5) Internship
CHEM 400A (3) Chemical Measurements Laboratory	CHEM 496D (1) Chemistry Discovery
CHEM 401a (3) Instrumental Analysis	CHEM 498 (3) Senior Capstone
CHEM 422/522 (3) Electroanalytical Chemistry	CHEM 498H (3) Honors Thesis
CHEM 423a/523a (3) Bioanalytical Chemistry	CHEM 499 (1-6) Independent Study
CHEM 426B/526B (3) Analytical Molecular Spectroscopy	CHEM 499H (1-6) Honors Independent Study
CHEM 425A/525A (3) Mass Spectrometry	
CHEM 427/527 (3) Separations	
CHEM 428B/528B (3) Advanced Analytical Chemistry Laboratory	
BME 420 (3) Biophotonics	
BME 447 (3) Sensors and Controls	
BME 485 (3) Nanoscience and Nanotechnology for Biomedical Engineers	
IMB 401 (4) Medical Microbiology & Immunobiology	
IMB 406 (3) Human Immunobiology	
ENVS 410 (3) Microbial Biogeochemistry and Global Change	<b>Color Key:</b>
ENVS 425 (3) Environmental Microbiology	green = appropriate for Building Molecules track
ASTR 488A (3) Astrochemistry	blue = appropriate for Bioanalytical track
CHEE/MSE 432 (3) Organic Electronic Materials & Devices	peach = appropriate for Quantum Molecular Universe track
CHEE/CHEM/MSE 437 (3) Surface Science	
CHEM 380 (3) Mathematical Physics for Chemistry	
CHEM 400B (3) Chemical Measurements Laboratory	
CHEM 485 (3) Advanced Physical Chemistry	
CHEM 487/587 (3) Introduction to Molecular Spectroscopy	
CHEM 418/518 (3) Computational Chemistry	
PHYS 426 (3) Thermal Physics	
PHYS 431 (3) Molecular Biophysics	
PHYS 484 (3) Nuclear Magnetic Resonance Spectroscopy	
PTYS 407 (3) Chemistry of the Solar System	
PTYS 416 (3) Asteroids, Comets, and Kuiper Belt Objects	
BIOC 385 (3) Metabolic Biochemistry	
BIOC/CHEM/ECOL/PLS/MCB 448A (3) Plant Biochemistry and Metabolic Engineering	
BIOC 462B (4) Biochemistry	
BIOC 463A (4) Biochemical Laboratory Techniques	
ENVS/GEOS/HWRS 340 (3) Environmental Chemistry	
ENVS 462 (3) Environmental Soil and Water Chemistry	
ENVS 464 (3) Environmental Organic Chemistry	
GEOS 400 (3) Introduction to Geochemistry	

# Appendix C

## Departmental letters of support for new electives added to the CHEM BS degree plan



(no subject)

 Schnellmann, Jennifer G - (schnelli)  
To: Belle-Oudry, Deirdre A - (dbelle)

You replied to this message on 10/24/2023 7:46 AM.


Hello!  
Dr. V sent me your note.

We host the PCOL courses and we are agreeable to PCOL 350 being added to the elective list for the CHEM BA and BS degrees and CHEM majors who have the appropriate prerequisites will be welcome to enroll.  
Let me know if I can do more.




**Jennifer G. Schnellmann, PhD**  
Associate Professor  
College of Medicine, Department of Medical Pharmacology  
College of Pharmacy, Department of Pharmacology and Toxicology  
Director, Undergraduate Education, Pharmaceutical Sciences



**Re: Chem electives discussion**

 Gutruf, Philipp - (pgutruf)  
To: Belle-Oudry, Deirdre A - (dbelle)  
Cc: Aspinwall, Craig A - (aspinwal); Pemberton, Jeanne E - (pembertn); Arrotta, Lisa Michelle - (lisaarotta)

You replied to this message on 10/23/2023 1:46 PM.  
If there are problems with how this message is displayed, click here to view it in a web browser.

 sensors fall 2023.pdf 193 KB  
 2023 BME 485 585 syllabus (1).pdf 173 KB  
 BME\_OPT1\_420\_-\_520\_syllabus\_2023.pdf 217 KB

Hi Dee,

Here are the syllabi that I collected from our faculty.

All of them indicated that they can potentially allow students from Chem to take the course.

Let me know what you think.

Regards,

**Dr. Philipp Gutruf**  
Craig M. Berge Faculty Fellow  
Assistant Professor  
Biomedical Engineering  
College of Engineering  
Electrical and Computer Engineering  
Bios  
Neuroscience GIDP  
The University of Arizona  
GutrufLab  
Bioscience Research Laboratories  
1230 N. Cherry Ave  
Tucson, AZ 85721  
Phone: +1 217 402 4385  
Web: <https://gutruf.lab.arizona.edu>



**From:** [Curry, Joan E - \(jecurry\)](#)  
**To:** [Landeem, Kathleen A - \(klandeem\)](#); [Belle-Oudry, Deirdre A - \(dbelle\)](#)  
**Subject:** Re: Adding ENVS classes to CBC elective list  
**Date:** Wednesday, November 8, 2023 7:47:07 PM  
**Attachments:** [image001.png](#)  
[Outlook-dnkq0o1a.png](#)

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Hi Deirdre,

Yes, please add the courses to your curriculum as options.

Apologies for the delay!

Thanks,  
Joan

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**From:** Landeem, Kathleen A - (klandeem) <klandeem@arizona.edu>  
**Sent:** Wednesday, November 8, 2023 4:05:24 PM  
**To:** Belle-Oudry, Deirdre A - (dbelle) <dbelle@arizona.edu>  
**Subject:** Re: Adding ENVS classes to CBC elective list

Hi Deirdre:

We are working on our APR so Dr. Curry may be a bit behind with emails. I will send out a call on this and try to respond to your ASAP. Thank you for your patience.

Kathleen Landeem  
Senior Academic Advisor II,  
Department of Environmental Science (ENVS)  
The University of Arizona  
Campus Office: Shantz 424  
POB 210038 | Tucson, AZ 85721-0038  
Office: 520-621-1606  
[Schedule an appointment](#)

My [zoom](#) link: <https://arizona.zoom.us/my/advisingenvironmentalscience>  
ENVS Website Information: <https://environmentalscience.cals.arizona.edu/>



---

**From:** Belle-Oudry, Deirdre A - (dbelle) <dbelle@arizona.edu>  
**Sent:** Wednesday, November 8, 2023 14:32  
**To:** Landeem, Kathleen A - (klandeem) <klandeem@arizona.edu>  
**Subject:** FW: Adding ENVS classes to CBC elective list

Hello Kathleen,

I reached out to Dr. Curry about this but had no response. Is there someone else in charge of undergraduate academics that I should reach out to for this?

I appreciate your advice on this.

Best

Dee Belle-Oudry

---

**From:** Belle-Oudry, Deirdre A - (dbelle)

**Sent:** Monday, October 23, 2023 1:31 PM

**To:** Curry, Joan E - (jecurry) <Curry@ag.arizona.edu>

**Subject:** Adding ENVS classes to CBC elective list

Dear Dr. Curry,

The CBC Department is embarking on a major revision in our undergraduate chemistry degree program. We are exploring the possibility of adding some new upper-level electives for our chemistry BA and BS degrees, including the following ENVS courses:

- [ENVS 410 Microbial Biogeochemistry and Global Change](#)
- [ENVS 425 Environmental Microbiology](#)

Note that ENVS 340, ENVS 462, and ENVS 464 are already listed as electives in the CBC undergraduate programs.

We typically graduate ~40 chemistry majors and ~80 biochemistry majors each year. However, we have a very long list of allowed electives so I do not anticipate large numbers of CBC students taking these courses.

If you approve of this change, can you please provide a brief letter of support (an email is fine) to assist us with implementing our new degree plan? If you would like more information or prefer to discuss this further, please let me know.

We greatly appreciate your assistance.

Best regards,

Dee Belle-Oudry

Dee Belle-Oudry

Associate Dept Head for Academic Affairs



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**From:** [Ogden, Kimberly L - \(ogden\)](#)  
**To:** [Belle-Oudry, Deirdre A - \(dbelle\)](#); [Tin, Sammy - \(tin\)](#)  
**Subject:** Re: Adding CHEE/MSE 432 to Chemistry elective list  
**Date:** Monday, October 23, 2023 2:27:39 PM  
**Attachments:** [image001.png](#)

---

We probably have some other courses that could also work let me ask the faculty

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**From:** Belle-Oudry, Deirdre A - (dbelle) <dbelle@arizona.edu>  
**Sent:** Monday, October 23, 2023 4:44:08 PM  
**To:** Ogden, Kimberly L - (ogden) <ogden@arizona.edu>; Tin, Sammy - (tin) <tin@arizona.edu>  
**Subject:** Adding CHEE/MSE 432 to Chemistry elective list

Dear Dr. Ogden and Dr. Tin,

The CBC Department is embarking on a major revision in our undergraduate chemistry degree program. We are exploring the possibility of adding some new upper-level electives for our chemistry BA and BS degrees, including the following course:

- CHEE/MSE 432 Organic Electronic Materials & Devices

We typically graduate ~40 chemistry majors each year. However, we have a very long list of allowed electives, so I do not anticipate large numbers of CBC students taking this course.

If you approve of this change, can you please provide a brief letter of support (an email is fine) to assist us with implementing our new degree plan? If you would like more information or prefer to discuss this further, please let me know.

We greatly appreciate your assistance.

Best regards,  
Dee Belle-Oudry

Dee Belle-Oudry  
Associate Dept Head for Academic Affairs



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