Welcome to the Chemistry Department!

This guide is intended to provide you with some of the basic information about the Chemistry major and introduce you to undergraduate life within the department. In addition to this resource, the undergraduate web page, http://www.chem.psu.edu/undergrad should be consulted for more frequently updated information.

Beyond providing a challenging curriculum, the Chemistry major affords numerous opportunities outside of the classroom, such as participation in student-run groups that sponsor outreach and social events, the chance to conduct graduate-level research in many forefront areas of chemistry, and opportunities to study abroad or to undertake internships in an industrial setting. We hope that you take full advantage of the many opportunities open to Chemistry majors at Penn State.

Table of Contents

Chemistry B.S. Degree Check Sheet
Program Year 2019-2020

FIRST YEAR SEMINAR (1 cr)

PSU 016: First-Year Seminar Science	**1**		

MATHEMATICS/STATISTICS (13 cr)

MATH 140(B): Calculus 1[2]	**4**		
MATH 141(B): Calculus 2[2]	**4**		
MATH 231: Multivariable Calculus	**2**		
MATH 250: Ordinary Diff. Equations or STAT 401 Experimental Methods	**3**		

PHYSICS (12 cr)

PHYS 211: Mechanics	**4**		
PHYS 212: Electricity and Magnetism	**4**		
PHYS 213 + 214: Thermal & Quantum	**4**		

CHEMISTRY (36 cr)

CHEM 110(H): Chemical Principles 1	**3**		
CHEM 111: Experimental Chemistry 1	**1**		
CHEM 112(H): Chemical Principles 2	**3**		
CHEM 113: Experimental Chemistry 2	**1**		
CHEM 210(H): Organic Chemistry 1	**3**		
CHEM 212(H): Organic Chemistry 2	**3**		
CHEM 213W(M): Organic Chemistry Lab	**2**		
CHEM 227 (or 221): Analytical Chemistry	**4**		
CHEM 310: Intro. Inorganic Chemistry	**3**		
CHEM 316: The Professional Chemist	**1**		
CHEM 450: Phys. Chem. - Thermodynamics	**3**		
CHEM 452: Physical Chemistry - Quantum	**3**		
CHEM 457: Experimental Phys. Chem	**2**		
CHEM 423W, 425W, 431W or 459W	**4**		

a) A grade of C or better is required in all courses in this category.

400- LEVEL CHEMISTRY ELECTIVES (16 cr)

b) Up to 6 co-op credits (2 each of SC 295, 395, 495) may be used in this category. CHEM 494 may be used, but the total of CHEM 494 credits plus co-op credits must not exceed 8. A grade of C or better is required in all courses in this category.

WRITING/SPEAKING (GWS; 9 cr)

ENGL 015 or 030: Rhetoric & Comp.[8]	**3**		
ENGL 202C: Technical Writing[9]	**3**		
CAS 100A: Effective Speech[9]	**3**		

c) A grade of C or better is required in all GWS courses.

HEALTH and WELLNESS (GHW; 3 cr)

(GHW)			
(GHW)			
(GHW)			

ARTS (GA; 6 cr)

(GA)	**3**		
(GA)	**3**		
(GA)	**3**		

HUMANITIES (GH; 6 cr)

(GH)	**3**		
(GH)	**3**		
(GH)	**3**		

SOCIAL AND BEHAVIORAL SCIENCES (GS; 6 cr)

(GS)	**3**		
(GS)	**3**		
(GS)	**3**		

d) Students may substitute 3 credits from one of the knowledge domains GHW, GA, GH, or GS for 3 credits in another domain. Students may also substitute 3 credits in foreign/second language at the third or higher level for 3 credits in any one of these three categories. However, such substitutions cannot not lead to the complete elimination of any category. Contact your advisor to adjust your audit if either of these substitutions is used.

GENERAL ELECTIVES (17 cr)

e) Up to 3 co-op credits (1 each of SC 295, 395, and 495) may be used in this category. CHEM 294 (Chemical Research)[5] may be used in this category, but CHEM 494 or 496 may not..

UNITED STATES (US), INTERNATIONAL CULTURES (IL) and INTEGRATIVE STUDIES REQUIREMENTS[6]: Students must complete 3 credits in US and 3 credits in IL. A course carrying both designations only satisfies 3 credits of this requirement. Students entering after Spring 2019 must complete 6 credits of integrative studies using courses either designated as inter-domain or linked. All of these requirements may be made within the 45 general education courses listed above.

AREAS OF CONCENTRATION: Although there are no formal options within the Chemistry major, students may select courses according to areas of greatest interest. Recommended academic plans for specializations in analytical, physical, synthetic, and biological chemistry, as well as recommendations for transfer students are provided in this handbook.

Notes on the Degree Requirements

If you consider yourself a Chemistry major, make sure that the chemistry department knows about it and that you have a chemistry faculty member as an advisor. This recommendation applies to students at all levels and is especially important for transfer students and double majors.

1. ***First-Year Seminar***: All first-year students are required to take a first-year seminar sometime during their first year. Although this requirement is satisfied no matter what seminar you take, we strongly encourage students majoring in Chemistry to take the seminar offered by the chemistry department. This one-credit course is offered in two sections (Sections 200 and 201 of PSU 016) and only in the fall. The goal of the seminar is to inform you about the opportunities available to undergraduates at Penn State and in the chemistry department and to provide you with an opportunity to get to know your fellow Chemistry majors. First-year seminar is not required of transfer students, but the credit missing because of its absence must be made up by an additional general elective credit.

2. ***Entry to Major (ETM) & Grade Requirements***: Formal admission to the Chemistry major usually occurs after the fourth semester and requires the following:

   (a) A GPA of 2.50 and a C or better in the courses CHEM 110, 111, 112, 113, 210 and MATH 140 and 141.

   (b) An overall cumulative GPA of 2.0 or higher in all courses at the time of ETM.

   To graduate with a degree in chemistry requires the following:

   (a) A grade of C or better in all chemistry courses, including 400-level electives.

   (b) An overall GPA of 2.0 or higher.

   Once you have met requirements, <u>you must request entry into the major</u> using the Update Academics function in LionPATH. It is advantageous to officially achieve major status as soon as possible, because Chemistry major status is often required to qualify for endowed scholarships within the chemistry department. Students may request ETM once they have passed or are enrolled for all of the ETM courses.

3. ***ACS Certification***: The American Chemical Society (ACS) gives its stamp of approval to undergraduate degrees if certain course and lab criteria are met. An ACS-approved degree enables you to become a member of the ACS immediately upon graduation instead of becoming an associate member during your first three years of professional experience. If you desire ACS approval, you should include in your 16 credits of chemistry electives: (i) CHEM 476 Biological Chemistry or BMB 401 General Biochemistry; (ii) CHEM 400; and (iii) either a 400-level laboratory course beyond the minimum requirements or 2 credits of CHEM 494 or 1 credit each of SC 295, 395, and 495.

4. ***Alternative Choices for Chemistry Electives***: For 400-level chemistry elective credits, it is possible to substitute some 400-level courses in biochemistry, materials science, or other chemistry-related disciplines. 500-level courses may also be used. See pp. 13–14 for a list of courses and details.

   Most advanced courses are offered in either the fall or spring semesters, and a few are only offered in alternating years. See the schedule on p. 11 and plan accordingly.

5. ***Research for Credit***: CHEM 494, Chemical Research, is highly recommended for all Chemistry majors. It involves participation in a research project, usually under the supervision of a member of the chemistry faculty. Faculty members from other departments may also supervise CHEM 494 with the approval of the Associate Head for Undergraduate Education. Students interested in CHEM 494 should discuss this option with their advisor and begin interviewing faculty no later than their fifth semester in residence. See pp. 23-27 for more details.

   Up to eight credits of CHEM 494 can be used in the category of 400-level chemistry electives (fewer if co-op credits are being used). CHEM 494 (and CHEM 496) cannot be used in the general electives category.

   CHEM 294 is meant for research performed in a student's first two years of study, during a time when he/she would not typically be enrolled in 400-level courses. For this reason, CHEM 294 cannot be used for 400-level chemistry elective credit, but it can be used for general elective credit.

6. ***General Education Requirements***: Penn State requires a total of 45 credits to cover its general education (GE) requirements. 15 credits are in foundational subjects consisting of 9 credits in writing and speech (GWS), and 6 credits in mathematics or related quantification topics (GQ). 30 additional credits are required in five different knowledge domains: health and wellness (GHW, 3 credits) natural sciences (GN, 9 credits), and 6 credits each in arts (GA), humanities (GH), and social and behavioral sciences (GS). Students may substitute for three credits in any of these knowledge domains either 3 credits from another knowledge domain or 3 credits of a foreign/second language at the third or higher level, provided that this substitution will not lead to the complete elimination of any category. Such substitutions are not automatically coded into your LionPATH degree audit so if you use one of them, contact your advisor to have the substitution properly included in your audit.

   Students entering after spring 2019 must complete 6 credits of integrative studies as part of their GE requirements. These courses may be among those already used to satisfy other GE requirements. Integrative studies courses can either be courses designated as inter-domain or linked courses. Only one of these two course types, not a combination of the two, may be used to satisfy this requirement.

   Students must also have at least 3 credits of US and 3 credits of IL course work to satisfy the United States (US) and International (IL) Cultures requirements. Note that a course carrying both US and IL designations only satisfies one of these requirements; however, IL and US courses can be paired with courses in one of the knowledge domains and count for both general education requirements.

7. ***Health and Wellness*** (GHW, formerly GHA) courses are often hard to schedule. Have alternative choices selected and be flexible. Try to satisfy this requirement before your senior year. Note that you cannot repeat a given GHA course.

8. ***ENGL 015*** may be taken during either the fall or spring semester. Advanced students may take ENGL 030 instead of ENGL 015, and may also schedule ENGL 030 in either fall or spring. If you have taken ENGL 015/030 in the fall, then schedule a GA/GH/GS course in the spring, or *vice versa*.

   CAS 100A may be scheduled at any time. Fourth-semester standing is required to register for ***ENGL 202C***. It is best to schedule ENGL 202C prior to the writing-intensive laboratory courses (CHEM 457, 423W, and 431W).

   Schreyer's Honors College students must take a combined ENGL and CAS course that runs a full year in lieu of ENGL 015 and CAS 100A. In the fall, students register for ***137H***, and in the subsequent spring semester take the corresponding ***138T*** course. For example, if an honors student registers for ENGL 137H in the fall, he or she would then register CAS 138T in the spring. Alternatively, he or she could register for CAS 137H in the fall and ENGL 138T in the spring.

9. **ENGL 015**, **CAS 100A** (or **137H** and **137T**), and **ENGL 202C** must all be passed with a grade of C or better in order to satisfy the GWS requirements.

10. **Excluded Courses:** Some courses are considered to be inappropriate for general elective credit and therefore cannot be counted toward the total number of credits required for the degree. These courses are:

    - CHEM 001, 003, 020, 101, 108, 202, 203, and no more than 3 credits of CHEM 106 or 110
    - MATH 001, 002, 003, 004, 017, 018, 021, 022, 026, 030, 034, 035, 036, 037, 040, 041, 081-083, 110, 111, 200, AND only 4 credits of MATH 140A
    - BI SC 001, 002, 003, 004
    - CAS 126
    - ENGL 004, 005
    - PH SC 007
    - STAT 100
    - BMB 001
    - CMPSC 001, 100
    - LL ED 005, 010
    - PHYS 001, 150, 151, 250, 251

11. ***CHEM 227*** and ***CHEM 310*** are sophomore or junior-level courses offered in both the fall and spring semesters. University Park students should enroll in both CHEM 227 and CHEM 310 during their sophomore year. Students transferring to UP from other campuses where these courses are not offered should enroll as soon as possible after transferring.

12. ***CHEM 316*** is offered only in the fall semester and should be scheduled at the beginning of your junior year. If your schedule is off-sequence, such that your junior year does not start in the fall, then you should schedule CHEM 316 at the end of your sophomore year. ***If you are transferring to UP from another campus, it is especially important that you take CHEM 316 immediately*** because it will help to orient you to the program and introduce you to your fellow Chemistry majors.

13. ***CHEM 423W, CHEM 425W, CHEM 431W, and CHEM 459W*** are writing-intensive, capstone laboratory courses in the areas of analytical (423W, 425W), synthetic (431W), and physical chemistry (459W). Only one of these courses is required, but students may take as many as desired and use the additional credits to satisfy the 400-level CHEM elective requirement. These courses are only offered once a year: (425W and 431W in the fall, and 423W and 459W in the spring).

    These labs are highly time intensive and ***no more than one 400-level chemistry lab course should ever be scheduled in the same semester***.

14. ***A total of 125 credits is required for graduation***.

Recommended Academic Plan - Analytical Concentration

Semester 1	Credits	Semester 2	Credits
PSU 16 First-Year Seminar in Chemistry	*1*	***CHEM 112(H) Chemical Principles II (GN)***	***3***
CHEM 110(H) Chemical Principles I (GN)	***3***	***CHEM 113 Experimental Chemistry II (GN)***	***1***
CHEM 111 Experimental Chemistry I (GN)	***1***	***MATH 141(B) Calculus w. Analytical Geometry II (GQ)***	***4***
MATH 140(B) Calculus w. Analytical Geometry I (GQ)	***4***	*GA/GH/GS or ENGL 015 if not in 1st sem. (GX)*	*3*
ENGL 15(30) Rhetoric and Composition (GWS)	*3*	*PHYS 211 General Physics, Mechanics (GN)*	*4*
GA/GH/GS General Education Course (GX)	*3*	*Health & Wellness (GHW)*	*1.5*
Total Credits:	15	Total Credits:	16.5
Semester 3	**Credits**	**Semester 4**	**Credits**
CHEM 210(H) Organic Chemistry I	**3**	**CHEM 212(H) Organic Chemistry II**	**3**
CHEM 227 Analytical Chemistry	**4**	**CHEM 213W(M) Organic Chemistry Lab**	**2**
MATH 231 Calculus of Several Variables	2	**CHEM 310 Introductory Inorganic Chemistry**	**3**
PHYS 212 General Physics, E&M (GN)	*4*	*PHYS 213& 214 Fluids, Thermal, Waves, Quantum (GN)*	4
GA/GH/GS General Education Course (GX)	*3*	***CHEM 400 Chemical Literature***	**1**
		CHEM 430 Structural Analysis of Organic Compounds	***3***
Total Credits:	16	Total Credits:	16
Semester 5	**Credits**	**Semester 6**	**Credits**
CHEM 316 The Professional Chemist	**1**	**CHEM 452 Physical Chemistry II-Quantum Chem.**	**3**
CHEM 450 Physical Chemistry I - Thermodynamics	**3**	**CHEM 457 Experimental Physical Chemistry**	**2**
CHEM 4xx 400-Level Chemistry Elective	**3**	General Elective Course	3
ENGL 202C Technical Writing (GWS)	3	*CAS 100A Effective Speech (GWS)*	*3*
GA/GH/GS General Education Course (GX)	*3*	STAT 401 Experimental Methods	3
General Elective Course	3	*Health & Wellness (GHW)*	*1.5*
Total Credits:	16	Total Credits:	15.5
Semester 7	**Credits**	**Semester 8**	**Credits**
CHEM 425W Chrom. & Electrochem.[(a)] or CHEM 4xx	**3 or 4**	**CHEM 423W Chemical Spectroscopy[(a)] or CHEM 4xx**	**4**
CHEM 4xx 400-Level Chemistry Elective	**4**	**CHEM 4xx 400-Level Chemistry Elective**	**3**
GA/GH/GS General Education Course (GX)	*3*	*GA/GH/GS General Education Course (GX)*	*3*
General Elective Course	3	General Elective Course	3
General Elective Course	3	General Elective Course	3
Total Credits:	16 or 17	Total Credits:	16

Bold type indicates courses requiring a quality grade of C or better. *Italic* type indicates courses that satisfy both major and general education requirements. (a) Only one of CHEM 423W, CHEM 425W, CHEM 431W and CHEM 459W is required. If a student is going directly into a Bachelor of Science level, it is advantageous to take both 423W and 425W.

Recommended Academic Plan - Physical Concentration

Semester 1	Credits	Semester 2	Credits
PSU 16 First-Year Seminar in Chemistry	*1*	***CHEM 112(H) Chemical Principles II (GN)***	***3***
CHEM 110(H) Chemical Principles I (GN)	***3***	***CHEM 113 Experimental Chemistry II (GN)***	***1***
CHEM 111 Experimental Chemistry I (GN)	***1***	***MATH 141(B) Calculus w. Analytical Geometry II (GQ)***	***4***
MATH 140(B) Calculus w. Analytical Geometry I (GQ)	***4***	*GA/GH/GS or ENGL 015 if not in 1st sem. (GX)*	*3*
ENGL 15(30) Rhetoric and Composition (GWS)	*3*	*PHYS 211 General Physics, Mechanics (GN)*	*4*
GA/GH/GS General Education Course (GX)	*3*		
Total Credits:	15	Total Credits:	15

Semester 3	Credits	Semester 4	Credits
CHEM 210(H) Organic Chemistry I	**3**	**CHEM 212(H) Organic Chemistry II**	**3**
CHEM 227 Analytical Chemistry	**4**	**CHEM 213W(M) Organic Chemistry Lab**	**2**
MATH 231 Calculus of Several Variables	2	**CHEM 310 Introductory Inorganic Chemistry**	**3**
PHYS 212 General Physics-E&M (GN)	*4*	*PHYS 213 Fluids & Thermal Physics (GN)*	2
GHW Health and Wellness (GHW)	*1.5*	*PHYS 214 Wave Motion and Quantum (GN)*	2
CHEM 400 Chemical Literature	**1**	*GA/GH/GS General Education Course (GX)*	*3*
Total Credits:	15.5	Total Credits:	15

Semester 5	Credits	Semester 6	Credits
CHEM 316 The Professional Chemist	**1**	**CHEM 457 Experimental Physical Chemistry**	**2**
CHEM 450 Physical Chemistry I - Thermodynamics	**3**	**CHEM 464 Chemical Kinetics**	**3**
CHEM 452 Physical Chemistry II - Quantum Chemistry	**3**	STAT 401 Exp. Methods	3
MATH 250 Differential Equations	4	*ENGL 202C Technical Writing (GWS)*	*3*
CAS 100A Effective Speech (GWS)	*3*	*GA/GH/GS General Education Course (GX)*	3
GA/GH/GS General Education Course (GX)	*3*	*GHW Health and Wellness (GHW)*	*1.5*
Total Credits:	17	Total Credits:	15.5

Semester 7	Credits	Semester 8	Credits
CHEM 4xx 400-Level Chemistry Elective	**3**	**CHEM 459W Advanced Experimental Physical Chem.**	**4**
CHEM 4xx 400-Level Chemistry Elective	**3**	**CHEM 4xx 400-Level Chemistry Elective**	**3**
CHEM 4xx 400-Level Chemistry Elective	**3**	General Elective Course	3
GA/GH/GS General Education Course (GX)	*3*	General Elective Course	3
General Elective Course	3	General Elective Course	3
GHW Health and Wellness (GHW)	1.5		
Total Credits:	17.5	Total Credits:	16

Bold type indicates courses requiring a quality grade of C or better. *Italic* type indicates courses that satisfy both major and general education requirements.

Recommended Academic Plan – Synthetic/Biological Concentration

Semester 1	Credits	Semester 2	Credits
PSU 16 First-Year Seminar in Chemistry	*1*	***CHEM 112(H) Chemical Principles II (GN)***	***3***
CHEM 110(H) Chemical Principles I (GN)	***3***	***CHEM 113 Experimental Chemistry II (GN)***	***1***
CHEM 111 Experimental Chemistry I (GN)	***1***	***MATH 141(B) Calculus w. Analytical Geometry II (GQ)***	***4***
MATH 140(B) Calculus w. Analytical Geometry I (GQ)	***4***	*GA/GH/GS or ENGL 015 if not in 1st sem. (GX)*	*3*
ENGL 15(30) Rhetoric and Composition (GWS)	*3*	*PHYS 211 General Physics, Mechanics (GN)*	*4*
GA/GH/GS General Education Course (GX)	*3*		
Total Credits:	15	Total Credits:	15
Semester 3	**Credits**	**Semester 4**	**Credits**
CHEM 210(H) Organic Chemistry I	**3**	**CHEM 212(H) Organic Chemistry II**	**3**
CHEM 227 Analytical Chemistry	4	**CHEM 213W(M) Organic Chemistry Lab**	**2**
MATH 231 Calculus Several Variables	2	**CHEM 310 Introductory Inorganic Chemistry**	3
PHYS 212 General Physics-E&M (GN)	*4*	**CHEM 400 Chemical Literature**	**1**
GA/GH/GS General Education Course (GX)	*3*	**CHEM 430 Structural Analysis of Organic Compounds**	***3***
		GA/GH/GS General Education Course (GX)	*3*
Total Credits:	16	Total Credits:	15
Semester 5	**Credits**	**Semester 6**	**Credits**
CHEM 316 The Professional Chemist	**1**	**CHEM 452 Physical Chemistry II- Quantum Chemistry**	**3**
CHEM 431W Organic and Inorganic Preparations	**4**	**CHEM 457 Experimental Physical Chemistry**	**2**
CHEM 450 Physical Chemistry I - Thermodynamics	**3**	*PHYS 213 Fluids & Thermal Physics (GN)*	2
ENGL 202C Technical Writing (GWS)	*3*	*PHYS 214 Wave Motion and Quantum (GN)*	2
General Elective Course	*3*	*CAS 100A Effective Speech (GWS)*	*3*
GHW Health and Wellness (GHW)	*1.5*	*GA/GH/GS General Education Course (GX)*	*3*
Total Credits:	16.5	Total Credits:	15
Semester 7	**Credits**	**Semester 8**	**Credits**
CHEM 425W Chromatog. & Electrochem.	**4**	**CHEM 432 Organic Reaction Mechanisms**	**3**
CHEM 476 Biological Chemistry	**3**	**CHEM 4xx 400-Level Chemistry Elective**	**3**
MATH 250 Diff. Equations or STAT 401 Exp. Methods	3	**CHEM 4xx 400-Level Chemistry Elective**	**3**
GA/GH/GS General Education Course (GX)	*3*	*GA/GH/GS General Education Course (GX)*	4
GHW Health and Wellness (GHW)	*1.5*	General Elective Course	3
General Elective Course	3		
Total Credits:	17.5	Total Credits:	16

Bold type indicates courses requiring a quality grade of C or better. *Italic* type indicates courses that satisfy both major and general education requirements.

Recommended Academic Plan for Transfer Students[a]

Semester 1	Credits	Semester 2	Credits
PSU 16 First-Year Seminar in Chemistry	*1*	***CHEM 112(H) Chemical Principles II (GN)***	***3***
CHEM 110(H) Chemical Principles I (GN)	***3***	***CHEM 113 Experimental Chemistry II (GN)***	***1***
CHEM 111 Experimental Chemistry I (GN)	***1***	***MATH 141(B) Calculus w. Analytical Geometry II (GQ)***	***4***
MATH 140(B) Calculus w. Analytical Geometry I (GQ)	***4***	*GA/GH/GS or ENGL 015 if not in 1st sem. (GX)*	*3*
ENGL 15(30) Rhetoric and Composition (GWS)	*3*	*PHYS 211 General Physics, Mechanics (GN)*	*4*
GA/GH/GS General Education Course (GX)	*3*	*GHW Health and Wellness (GHW)*	*1.5*
Total Credits:	15	Total Credits:	16.5
Semester 3	**Credits**	**Semester 4**	**Credits**
CHEM 210(H) Organic Chemistry I	**3**	**CHEM 212(H) Organic Chemistry II**	**3**
MATH 231 Calculus of Several Variables	2	**CHEM 213W(M) Organic Chemistry Lab**	**2**
PHYS 212 General Physics-E&M (GN)	*4*	*ENGL 202C Technical Writing (GWS)*	*3*
CAS 100A Effective Speech (GWS)	*3*	*PHYS 213 Fluids & Thermal Physics (GN)*	2
GA/GH/GS General Education Course (GX)	*3*	*PHYS 214 Wave Motion and Quantum (GN)*	2
General Elective Course	3	*GA/GH/GS General Education Course (GX)*	*3*
Total Credits:	18	Total Credits:	15
Semester 5	**Credits**	**Semester 6**	**Credits**
CHEM 227 Analytical Chemistry	**4**	**CHEM 310 Introductory Inorganic Chemistry**	**3**
CHEM 316 The Professional Chemist	**1**	**CHEM 400 Chemical Literature**	**1**
CHEM 450 Physical Chemistry I - Thermodynamics	**3**	**CHEM 430 Structural Analysis or CHEM 4xx**	**3**
MATH 250: Diff. Equations or STAT 401 Exp. Methods	*3*	**CHEM 452 Physical Chemistry II – Quantum Chem.**	**3**
GA/GH/GS General Education Course (GX)	*3*	**CHEM 457 Experimental Physical Chemistry**	**2**
GHW Health and Wellness (GHW)	*1.5*	*GA/GH/GS General Education Course (GX)*	3
		General Elective Course	3
Total Credits:	15.5	Total Credits:	18
Semester 7	**Credits**	**Semester 8**	**Credits**
CHEM 431W Organic & Inorganic Prep.[b] or CHEM 425W Chromatography and Electrochemistry[b]	**4**	**CHEM 423W Chemical Spectroscopy[b] or CHEM 459W Advanced Experimental Physical Chemistry [b]**	**4**
CHEM 4xx 400-Level Chem. Elective	**3**	**CHEM 4xx 400-Level Chem. Elective**	**3**
General Elective Course	3	**CHEM 4xx 400-Level Chem. Elective**	**3**
General Elective Course	3	General Elective Course	3
		General Elective Course	3
Total Credits:	17	Total Credits:	16

Bold type indicates courses requiring a quality grade of C or better. *Italic* type indicates courses that satisfy both major and general education requirements. (a) Course selection will vary with interest area and preparation. Consult with an advisor about course selection prior to beginning at UP. (b) Only one of 423W, 425W, 431W, and 459W is required.

Prerequisites & Scheduling of Core Courses

As an aid to help you plan out your course schedule, below is a listing of the common required courses for the Chemistry major, their prerequisite and concurrent requirements, and the semesters in which they are offered at University Park. Also listed are some courses of relevance for students seeking advanced degrees in medicine and pharmacy.

Core Courses

Course	Prerequisites with Concurrents, if applicable	Offered at UP
CHEM 110; 110H	Satisfactory on the Math placement test or MATH 022 or 041	Fa, Sp, Su; Fa
CHEM 111	Prerequisite or Concurrent CHEM 110	Fa, Sp
CHEM 112; 112H	CHEM 110	Fa, Sp, Su; Sp
CHEM 113	CHEM 111; Prerequisite or Concurrent CHEM 112	Fa, Sp
CHEM 210; 210H	CHEM 112	Fa, Sp, Su; Fa
CHEM 227	CHEM 112, 113, MATH 140	Fa, Sp
CHEM 212; 212H	CHEM 210	Fa, Sp, Su; Sp
CHEM 213W; 213M	CHEM 210; Prerequisite or Concurrent CHEM 212	Fa, Sp, Su; Sp
CHEM 310	CHEM 112; (CHEM 210 recommended)	Fa, Sp
CHEM 316	4th semester standing in chemistry	Fa
CHEM 450	CHEM 112, MATH 141; PHYS 211 or PHYS 212	Fa, Sp
CHEM 452	CHEM 112, MATH 141; PHYS 211 or PHYS 212	Fa, Sp
CHEM 457	Prerequisite or Concurrent CHEM 450	Fa, Sp
CHEM 423W	CHEM 227 (221) & 452	Sp
CHEM 425W	CHEM 227 (221) &450	Fa
CHEM 431W	CHEM 213W	Fa
CHEM 459W	CHEM 450 & 457; Prerequisite or Concurrent CHEM 452	Sp
MATH 140	Satisfactory the Math placement test or MATH 022+026 or MATH 040 or 041	Fa, Sp, Su
MATH 141	MATH 140	Fa, Sp, Su
MATH 231	MATH 141	Fa, Sp, Su
MATH 250	MATH 141	Fa, Sp, Su
STAT 401	MATH 141	Fa, Sp, Su
PHYS 211R&L	MATH 140	Fa, Sp, Su
PHYS 212R&L	MATH 140 & PHYS 211; Concurrent MATH 141	Fa, Sp, Su
PHYS 213	MATH 140 & PHYS 211; Concurrent MATH 141	Fa, Sp, Su
PHYS 214	MATH 141, PHYS 211, PHYS 212	Fa, Sp, Su

Courses for Medical, Pharmacy School

Course; M (Med), P (Pharm)	Prerequisites	Offered at UP
BIOL 110; M, P	N/A	Fa, Sp, Su
BIOL 230W; M, P	BIOL 110, CHEM 110	Fa
BIOL 240W; M, P	BIOL 110, CHEM 110	Sp
BIOL 472; M, P	BIOL 240W, CHEM 203 (212/213W)	Fa, Sp, Su
BMB 401	CHEM 212; BMB 251 or BIOL 230W	Fa, Sp, Su
BMB 402	BMB 401 or CHEM 476	Fa, Sp
BMB 211	CHEM 110 & 210	Fa, Sp, Su
MICRB 201; M, P	CHEM 110	Fa, Sp

Schedule of Course Chemistry Courses 2019-2020

Below is a listing of all chemistry courses offered at University Park during the 2019-2020 academic year. Note that most courses at the 400–500 level are offered in only one semester per year. This pattern of offerings changes occasionally, but you can use the listing below as a guide to when courses are likely to be offered in future years.

100 - 400 Level Courses	SU19	FA19	SP20
PSU 016 (Sections 200, 201)		X	
CHEM 001			X
CHEM 101	X	X	X
CHEM 108		X	X
CHEM 110	X	X	X
CHEM 110H		X	
CHEM 111		X	X
CHEM 112	X	X	X
CHEM 112H			X
CHEM 113	X	X	X
CHEM 130		X	X
CHEM 202	X	X	X
CHEM 203		X	X
CHEM 210	X	X	X
CHEM 210H		X	
CHEM 212	X	X	X
CHEM 212H			X
CHEM 213W	X	X	X
CHEM 213M			X
CHEM 227		X	X
CHEM 233			X
CHEM 310			X
CHEM 316		X	
CHEM 400		X	X
CHEM 402			X
CHEM 408		X	
CHEM 412		X	
CHEM 423W			X
CHEM 425W		X	
CHEM 430			X
CHEM 431W		X	
CHEM 432			X
CHEM 448			X
CHEM 450		X	X
CHEM 452	X	X	X
CHEM 457	X	X	X
CHEM 459W			X
CHEM 464			X
CHEM 466			X
CHEM 476		X	
CHEM 497 (Special Topics)		X	X

500 Level Courses	SU19	FA19	SP20
CHEM 500		X	X
CHEM 511			X
CHEM 516		X	
CHEM 517			
CHEM 518			X
CHEM 519			X
CHEM 524*			
CHEM 525*		X	
CHEM 526*		X	
CHEM 535		X	
CHEM 536			X
CHEM 537			X
CHEM 538		X	
CHEM 539		X	
CHEM 540		X	
CHEM 543			X
CHEM 545		X	
CHEM 565		X	
CHEM 566			X
CHEM 567			X
CHEM 572			
CHEM 573			
CHEM 597B			X

Honors Courses in Chemistry

Honors sections of some chemistry courses are offered on a regular basis. Students who are not enrolled in the Schreyer Honors College may take these courses. Chemistry majors who have strong qualifications and are willing to accept the challenges involved are encouraged to enroll in these honors sections. Honors lecture classes are smaller than regular classes, which allows for greater interaction with the instructor. Honors laboratory courses involve projects that make extensive use of modern chemical instrumentation and expose students to contemporary research methodologies early in their careers. Both aspects of honors courses are valuable preparation for joining one of the many research groups in the department at an early date. Talk with your advisor about enrollment in honors classes.

Students with exceptional academic records (CGPA>3.7) who are not in the honors program may apply for admission as rising sophomores and juniors. Application materials are available in early March. For more information https://www.shc.psu.edu/admissions/apply/gateway.cfm.

Below is a listing of honors sections regularly offered.

Course Number	*Course Title*	*Credits*	*Semester*
CHEM 110H	Chemical Principles I—Honors	3	Fall
CHEM 112H	Chemical Principles II—Honors	3	Spring
CHEM 210H	Organic Chemistry I—Honors	4	Fall
CHEM 212H	Organic Chemistry II—Honors	3	Spring
CHEM 213M	Laboratory in Organic Chemistry—Honors	2	Spring
CHEM 431M*	Organic and Inorganic Preparations—Honors	4	Fall
CHEM 452H	Physical Chemistry II—Quantum Chemistry	3	Yearly

* CHEM 431M is not a regular course offering, but it can be scheduled as an honors option.

400-Level Chemistry Electives

In addition to the required courses, Chemistry majors must select sixteen credits of advanced chemistry electives. Of these credits, at least six must come from regular 400- or 500-level course work in chemistry (i.e., not CHEM 494 or 495 or courses from other departments). Students seeking a minor in chemistry must also complete at least five credits of regular chemistry course work as part of their 400-level electives.

Up to eight credits of chemical research (CHEM 494) can be used in this category, and up to six credits of co-op experience (two credits each of SC 295, 395, and 495) can be used, but the total number of CHEM 494 and SC X95 credits cannot exceed eight.

Some 400-level courses in other departments can also be used in this category, as described below.

400-Level Chemistry Courses:

CHEM 400 [1]	Chemical Literature[(b)]
CHEM 402	Chemistry in the Environment
CHEM 408	Computational Chemistry
CHEM 412	Transition Metal Chemistry[(c)]
CHEM 423W [4]	Chemical Spectroscopy[(a)]
CHEM 425W [4]	Chromatography and Electrochemistry[(a)]
CHEM 430	Structural Analysis of Organic Compounds
CHEM 431W [4]	Organic and Inorganic Preparations[(a)]
CHEM 432	Organic Reaction Mechanisms
CHEM 448	Surface Chemistry
CHEM 459W [4]	Advanced Experimental Physical Chemistry[(a)]
CHEM 464	Chemical Kinetics and Dynamics
CHEM 466	Molecular Thermodynamics
CHEM 476	Biological Chemistry[(d)]
CHEM 497	Special Topics

All courses are three credits unless noted otherwise by [#].

500-Level Chemistry Courses:

CHEM 511	Chemical Nanoscience
CHEM 516	Inorganic Chemistry
CHEM 517	Organometallic Chemistry
CHEM 518	Symmetry and Spectroscopy in Inorganic Chemistry
CHEM 519	Materials Chemistry
CHEM 524	Electroanalytical Chemistry
CHEM 525	Analytical Separations
CHEM 526	Spectroscopic Analysis
CHEM 535	Physical Organic Chemistry

CHEM 536	Medicinal Chemistry and Chemical Biology
CHEM 537	Organic Synthesis
CHEM 538	Spectroscopic Methods in Bio
CHEM 539	Biochemical Reaction Mechanisms
CHEM 540	Biophysical Chemistry
CHEM 545	Statistical Thermodynamics
CHEM 565, 566	Quantum Chemistry I and II
CHEM 567	Molecular Spectroscopy
CHEM 572	Nucleic Acid Chemistry
CHEM 573	NMR Spectroscopy for Synthetic and Biological Chemistry

Any senior with a 3.50 or higher cumulative grade point average may be admitted to 500-level courses with the consent of the instructor. Complete the form "Request for Undergraduate Student to take 500-Level Courses," which is available in 219 Whitmore or on the undergraduate web page. Schreyer Scholars need not complete this form.

Courses from Other Departments:

BMB 401	General Biochemistry I[(d)]
BMB 402	General Biochemistry II
BMB 433	Molecular and Cellular Toxicology
BMB 474	Analytical Biochemistry
FD SC 400	Food Chemistry
MATSE 441	Polymeric Materials I
MATSE 443	Introduction to the Materials Science of Polymers

For Chemistry majors, any of the courses listed above can be used for 400-level chemistry elective credit, without permission, as long as students fulfill the six-credit requirement of regular chemistry courses. They will not, however, be automatically entered into your degree audit. Please contact your academic advisor and ask them to submit a request to have your degree audit appropriately adjusted. These courses cannot be used to satisfy the 400-level elective requirements for the minor.

Use of any courses other than those above requires prior approval. To request approval, submit a copy of the course syllabus to the Associate Head for Undergraduate Education *before* you register for the course.

Notes:

(a) One of the advanced lab courses (CHEM 423W, 425W, 431W, or 459W) is required. The others may be used for 400-level elective credit.

(b) CHEM 400 is not required, but it is useful for all areas of chemistry. It is recommended that CHEM 400 be taken prior to any of the advanced laboratory classes (CHEM 423W, 425W, 431W, or 459W).

(c) Although the major does not require inorganic chemistry courses beyond CHEM 310, students are strongly encouraged to take CHEM 412.

(d) Accreditation by the ACS requires three credits of course work in biological chemistry, which can be satisfied by either BMB 401 or CHEM 476. Only one of these courses can be taken for credit.

Advanced Courses for Various Concentrations

There are no formal options offered with the chemistry degree. You should choose your elective courses to best suit your chemical interests. Below are some courses recommended for different interest areas. Note that courses from other departments may or may not satisfy the requirements for 400-level chemistry elective credit.

Analytical Chemistry

CHEM 402	Chemistry in the Environment
CHEM 423W	Chemical Spectroscopy
CHEM 425W	Chromatography and Electrochemistry
CHEM 524	Electroanalytical Chemistry
CHEM 525	Analytical Separations
CHEM 526	Spectroscopic Analysis

Biological Chemistry

CHEM 476	Biological Chemistry[(a)]
CHEM 540	Biophysical Chemistry
BMB 401	General Biochemistry[(a)]
BMB 402	General Biochemistry
BMB 433	Molecular and Cellular Toxicology
BMB 474	Analytical Biochemistry
FD SC 400	Food Chemistry

(a) Credit is given for only one of CHEM 476 and BMB 401.

Chemical Education

PSYCH 100	Introductory Psychology (GS)
EDPSY 014	Learning and Instruction
EDTHP 115	Education in American Society (US)
EDTHP 440	Introduction to Philosophy of Education
SCIED 411	Teaching Secondary Science I

Inorganic Chemistry & Materials

CHEM 412	Transition Metal Chemistry
CHEM 516	Inorganic Chemistry
CHEM 518	Symmetry & Spectroscopy in Inorganic Chemistry
CHEM 519	Materials Chemistry
MATSE 441	Polymeric Materials I
MATSE 443	Introduction to the Materials Science of Polymers

Organic & Synthetic Chemistry

CHEM 430	Structural Analysis of Organic Compounds
CHEM 432	Organic Reaction Mechanisms
CHEM 535	Physical Organic Chemistry
CHEM 537	Organic Synthesis

Physical & Theoretical Chemistry

CHEM 408	Computational Chemistry
CHEM 448	Surface Chemistry
CHEM 464	Chemical Kinetics & Dynamics
CHEM 466	Molecular Thermodynamics
PHYS 412	Solid State Physics I
PHYS 419	Theoretical Mechanics
CHEM 545	Statistical Thermodynamics
CHEM 565	Quantum Chemistry I
CHEM 566	Quantum Chemistry II

Additional Information for…

(1) Transfer Students:

If you have transferred to University Park, from another Penn State campus or elsewhere, it is imperative that you contact a chemistry advisor immediately upon your arrival (if not before) in order to discuss your course selection. We welcome visits before you start at University Park, and would be happy to give you a tour of the labs and discuss a proposed academic plan when you visit. If you have not been assigned an advisor, contact the chemistry department's Undergraduate Program Office at 814-865-9391.

(2) Schreyer Honors Scholars:

To earn an honors degree in Chemistry, a student must prepare a thesis in chemistry or a related area and do so under the supervision of a thesis advisor (or co-advisor) who is a faculty member within the Department of Chemistry.
More information can be found on p. 12 of this guide and on the Schreyer Honors College web site: https://www.shc.psu.edu/academic/thesis/.

(3) Students Intending to Minor in Chemistry:

Obtaining a minor in Chemistry requires a minimum of 26 credits including the following:

Prescribed Courses (16 Credits): General Chemistry Lecture and Laboratory; Organic Chemistry Lecture and Organic Laboratory

Prescribed Courses (4–6 Credits): 4 Credits of CHEM 221 or CHEM 227, OR 6 Credits of CHEM 452 (3 credits) and either CHEM 450 or CHEM 466 (3 Credits)

The remaining 4–6 credits can be chosen from any of the regular 400-level chemistry courses, with the exception of CHEM 400. CHEM 494–CHEM 499 cannot be used for this purpose, nor can courses from other departments. A grade of C or better is required for all courses in the minor.

Please refer to p. 20 for the Chemistry Minor Requirement Check Sheet.

(4) Students Applying to Medical School:

The following are some recommendations for students interested in applying to medical school. They were written in consultation with Dr. Ron Markle, director of the Premedicine and Science majors. If you are interested in applying to medical school, it is essential that you schedule an appointment to speak to one of the Premedicine program advisors early in your college career so that they can apprise you of the application process in more detail. Be sure to opt in to the premedicine and health professions weekly newsletter via the LISTSERV l-premedicine-prehealth-subscribe-request@lists.psu.edu. During your first or second year, make an appointment to speak to a Premedicine program advisor by calling 865-7620. There is an excellent summary of this process on the Premedicine program website: www.science.psu.edu/premed/. This summary should be reviewed before meeting with a premed advisor.

In addition to the courses required for the Chemistry major, be aware that medical school admissions are now moving toward "competency areas" for students preparing to enter medical studies. For now, most schools still expect to see particular courses on the academic record. Presently, the following courses are strongly recommended for successful application to medical school*:

> BIOL 110, BIOL 230: These classes with labs cover general biological principles, genetics, and cellular and molecular biology. All are key topics to expect on the MCAT. A free download of the entire MCAT topic set (120+ pages) can be found on the AAMC.org website.

CHEM 476 or BMB 401 and, if possible, BMB 402 are recommended; BMB 211 is an option. Biochemistry will be tested on the MCAT^{2015}.

The following courses are considered desirable:

A physiology course such as BIOL 472 is preferred (but BIOL 240 or 141 can help)

STAT 200 or 250: Statistics will be woven throughout the MCAT^{2015}

MICRB 201

With the MCAT^{2015}, it is now essential to include introductory psychology and sociology in your course selections, recognizing that foundational information of these disciplines can also be acquired via courses in religious studies or human development and family studies, to cite a pair of alternatives. The MCAT now includes topics in these areas! It is desirable to select courses from the disciplines of health policy administration and foreign languages (especially Spanish).

Note that some medical schools have additional requirements. For example, the Ohio State University College of Medicine requires anatomy; contact them for details. More schools are requiring some biochemistry just to apply, and a few schools also require a biochemistry lab. It is important to check out each medical school of interest in order to ensure that you meet all course requirements.

Other factors important for admission to medical school are first-hand experiences (essential) in healthcare settings (hospital volunteering and physician shadowing are two examples), and demonstrated leadership in extracurricular activities. Note that one activity as a leader is better than several activities in which you are just a member. Experiences in the health care industry could be either as a volunteer or for pay. The Medical College Admission Test (MCAT)* (i.e., well within the upper half of those taking test) is also important. Ranking in the 75th percentile or higher is a good goal. Interpretations of scores on the new MCAT^{2015} are just beginning to be worked out; there is little more to share at this time.

One need not major in Premedicine, or even in Science, to be successful in gaining admission to medical school. However, it is critical to maintain a high GPA ($\geq$3.60) in the necessary (and desirable) science courses and to learn about the admissions process. Familiarize yourself with the MCAT website, the American Medical College Application Service (MD programs) and American Association of Colleges of Osteopathic Medicine Application Service (DO programs) organizations, and plan on applying early when the application cycle commences in June of your application year. With both the D.O. and M.D. national organizations, there is excellent information summarized for each participating school's entering class grades, MCAT scores, etc. AAMC charges a small fee for web access; at this time, AACOM does not charge.

(5) Students Seeking Advanced Degrees in Pharmacy:

If you are interested in seeking an advanced degree in pharmacy (a doctor of pharmacy or "Pharm.D." degree), the American Association of Colleges of Pharmacy (AACP) maintains a helpful website that contains useful career information and answers to frequently asked questions: https://www.aacp.org/resources/student-center.

The following are several things to keep in mind:

i) It is not necessary to complete a four-year degree before applying to pharmacy programs, but the majority of Pharm.D. candidates do so.

ii) In addition to the courses required for the Chemistry major, Pharm.D. programs typically require courses in general biology, microbiology, and anatomy and physiology. Requirements vary among schools, and you are

advised to check the particular schools of interest to you. Some Penn State courses of relevance are the following:

BIOL 110, BIOL 230, BIOL 240, BIOL 472, and MICRB 201

Introductory courses in microeconomics and statistics might also be useful.

iii) Most pharmacy programs require applicants to take the Pharmacy College Admissions Test (PCAT). The test covers both general aptitude and content knowledge in fields relevant to pharmacy and is similar to the MCAT test for medical school applicants. You should prepare to take this exam in the spring of your junior year.

iv) A summary for "Applying to Pharmacy School," which also pertains to other health professions, can be found on the college's website for the Premedicine program: http://science.psu.edu/premed/docs/Pharmacy

Requirements for the Chemistry Minor—FA18/SP19

Prescribed Courses (16 Credits)	Credits	Letter Grade
CHEM 110 (GN)—Chemical Principles I	3	
CHEM 111 (GN)—Experimental Chemistry I	1	
CHEM 112 (GN)—Chemical Principles II	3	
CHEM 113 (GN)—Experimental Chemistry II	1	
CHEM 210—Organic Chemistry I	3	
CHEM 212—Organic Chemistry II	3	
CHEM 213W—Laboratory in Organic Chemistry	2	

Prescribed Courses (4–6 Credits) **4 Credits: CHEM 221 or CHEM 227** **OR** **6 Credits of: CHEM 452 (3 Credits) and either CHEM 450 or 466 (3 Credits)**	Credits	Letter Grade
CHEM 227—Analytical Chemistry (formerly labeled CHEM 221 at some locations)	4	
CHEM 450 or 466—Physical Chemistry—Thermodynamics or Molecular Thermodynamics	3	
CHEM 452—Physical Chemistry—Quantum Chemistry	3	

400-Level Chemistry Electives (6 Credits)	Credits	Letter Grade
CHEM 402—Chemistry in the Environment	3	
CHEM 408—Computational Chemistry	3	
CHEM 410—Inorganic Chemistry	3	
CHEM 412—Transition Metal Chemistry	3	
CHEM 423W—Chemical Spectroscopy	4	
CHEM 425W—Chromatography and Electrochemistry	3	
CHEM 427W—Forensic Chemistry	4	
CHEM 430—Structural Analysis of Organic Compounds	3	
CHEM 431W—Organic and Inorganic Preparations	4	
CHEM 432—Organic Reaction Mechanisms	3	
CHEM 448—Surface Chemistry	3	
CHEM 457—Experimental Physical Chemistry	2	
CHEM 459W—Advanced Experimental Physical Chemistry	4	
CHEM 464—Chemical Kinetics and Dynamics	3	
CHEM 466—Molecular Thermodynamics (if not used in above category)	3	
CHEM 476—Biological Chemistry	3	
CHEM 497—Special Topics (by permission)	3	

A grade of C or better is required for all courses in the minor. Courses from other majors cannot be substituted for these electives.

For students with sufficient background, chemistry courses at the 500 level may also be used.

Science Education Opportunities

Students with an interest in science education can participate in many academic and service learning activities that may begin as early as their first year. It is important to engage in some of these activities to gain experience in communicating your knowledge of science to others.

Specialized Advising: Dr. Jackie Bortiatynski (jxb46@psu.edu), the director of the Center for Excellence in Science Education and an associate teaching professor in chemistry, will assist students in building the academic plans needed to prepare for a career in science education.

Student Service Scholarship Opportunities

1. Learning Assistant (LA) Program: This program provides science students with the opportunity to participate as peer learning facilitators in courses in which they have previously excelled. This is a great opportunity to begin to discover and understand how you learn and how to share this valuable information with your peers. In essence, you are training to be a learning coach. Students who are selected for this opportunity will participate in a 1-credit science pedagogy course that presents research-based methods on teaching and learning and also introduces you to the research literature on these topics. While taking this course, you begin serving as an LA working closely with a faculty member to help guide students in active learning activities both in and outside formal class meetings. Weekly content meetings with your faculty mentor for the course you are facilitating will help you understand common misconceptions students struggle with throughout the course, and you will be providing the faculty mentor with feedback on student participation, motivation, and mastery of the material. This experience is a great opportunity for students considering a career in education and will also certainly strengthen your communication skills. Students earn credit for their participation in the pedagogy course and one credit for their work as a learning facilitator. Currently, CHEM 101, CHEM 108, CHEM 110, CHEM 110H, CHEM 112, CHEM 202, CHEM 203, CHEM 210, CHEM 212, CHEM 227, and CHEM 310 are using learning assistants, so there are plenty of opportunities to facilitate learning activities in a variety of chemical subjects. The chemistry department recruits LAs each semester, so you can enter the program in either the fall or spring semester. Please contact Dr. Lori Stepan at lsv10@psu.edu for more information or to apply.

2. Tutoring Experiences: Tutoring assignments are available both in the chemistry department and through Penn State Learning, (https://pennstatelearning.psu.edu/gsg-employment-opportunities) a center that hosts peer-led help sessions for students. Both of these tutoring opportunities provide financial compensation. For more information on becoming a chemistry tutor, come to the chemistry undergraduate office in 219 Whitmore Lab or call 814-865-9391.

3. Teaching Assistants: Positions are available for undergraduates to work in the instrument room and in select chemistry lab courses after completing appropriate course work. Prior to serving as a teaching assistant, you need to complete the required training. These positions provide financial compensation on an hourly basis. Please contact the instructor with whom you wish to work for more information.

4. Outreach: Multiple venues are available for students to participate in activities designed to interest children in science. Opportunities include the following: Summer Experience in the Eberly College of Science (SEECoS), Science-U, and the Nittany Chemical Society Student Club. The Outreach Office in the Eberly College of Science administers these and more activities, and you can see the full list of programming on their website: http://science.psu.edu/outreach.

Career-Related Experience and Study Abroad Opportunities

The Eberly College of Science is pleased to offer career counseling and programming to assist students. The college's Office of Science Engagement (https://scienceengagement.psu.edu) supports students in their efforts to secure internships and co-op positions. Services include the following:

- Individualized résumé and cover letter reviews
- A database of internship and co-op postings
- General and specialized career counseling
- Professional development seminar series (with speakers from companies such as Geisinger Healthcare, GlaxoSmithKline, and Merck)

In addition to these services, the college's externship program (reserved for our first- and second-year students) provides a means for students to experience a "day in the life" of their alumni host. The Office of Science Engagement also manages a co-op program which allows students to participate in co-curricular training while gaining professional experience in industry or governmental research and still receiving credit for these experiences.

Many students have indicated that these programs have given them the opportunity to explore careers and job categories so that they may better prepare for their career goals; participating in an internship or co-op enables students to graduate with relevant job experience in addition to their degree. These same experiences also serve as great talking points for graduate, medical, or professional school interviews.

International Opportunities

You have a lot of chances to get international experience during your time at Penn State. If you want to take chemistry courses abroad, you should consult with your advisor to find out what courses might transfer. If you're interested in studying a language, taking general education courses, or visiting a particular country or culture, Penn State's Education Abroad Office offers almost 200 different study abroad options for Penn State students. If you'd like to get research experience abroad, there are sometimes International Research Experience for Undergraduates (IREU) programs specifically for Chemistry majors. If you're not sure about studying abroad for a full semester, then you may want to look at the summer program options or check out the embedded courses offered on campus during the regular semester and which include an international travel component. A complete list of all study abroad programs and embedded courses can be found at http://gpglobalea.gp.psu.edu, and more science-specific information about international opportunities can be found at https://scienceengagement.psu.edu/education-abroad. You can visit either office at any point to get more information and to explore your options, but plan early, because most programs require early applications. Be sure to talk with your advisor about how you want to fit an international experience into your Chemistry major.

Resources

Don't have a resume or cover letter? Visit the Office of Science Engagement website at https://scienceengagement.psu.edu/employer-resources/ for samples. For more information about gaining career-related or international experience, please contact the Office of Science Engagement at 814-865-5000.

Research in the Chemistry Department

Although it is not a requirement for the degree, research is an important component of undergraduate education, whether or not you are bound for graduate work in chemistry. There are many reasons to round out your education with some research. They include testing and enriching your understanding of chemical concepts, gaining an understanding of how science is actually done, and fostering closer interactions with other chemistry students and faculty members. Interactions with the faculty are very helpful for obtaining quality recommendations for whichever career path you follow after graduation. Such recommendations are indispensable for students intending to pursue advanced degrees in chemistry. For these reasons, the majority of Chemistry majors graduate with several semesters of research experience. In most cases, this experience is gained through working with a research group within the chemistry department, although a few students elect to do research in allied departments.

There is no particular time frame for undergraduate research. Some undergraduates get involved during their junior year, but others start while they are still a first- or second-year student. The appropriate course designation for research undertaken "early" in a student's career (prior to taking 400-level chemistry electives) is CHEM 294. Research performed later is designated CHEM 494. Many of our majors also elect to spend a summer doing research at University Park. The department has limited funds with which to support a few top students in summer research, and some faculty members may have grant support for undergraduates. These funding decisions are usually made early in the spring semester, so inquire with a faculty member early if you are interested in summer research.

CHEM 494, Chemical Research: Up to eight credits of research (CHEM 494) may be applied to fulfill the 400-level elective requirement of the major. Fewer CHEM credits may be applied if co-op credits are also used for this purpose. Students are expected to work in the lab for a minimum of six hours per week per credit of CHEM 494. The same commitment is expected for CHEM 294. To register for CHEM 494, students should have the faculty member overseeing the research send a request to the Undergraduate Program Office, specifying the number of credits prior to the end of the drop/add period for the semester in which credit is requested.

Each semester in which you are enrolled in CHEM 494, you must submit a brief written report. The report should summarize the work performed during the semester, the conclusions reached as a result, and your recommendations regarding next steps for the project. As a guide, you can think of the report as being comparable to a formal lab report you've written in courses such as CHEM 213W, CHEM 457, or one of the advanced labs. But the specific content, format, and length of the report is up to your research advisor; you should consult with him or her before writing the report. You and your research advisor will also decide when a first draft of the report is due. In order for you to receive a grade for CHEM 494 (or CHEM 494H), an electronic copy of a final version of the report, approved by your advisor, must be sent to the Associate Head for Undergraduate Education (Dr. Dan Sykes; dgs12@psu.edu), preferably in PDF format, on or before the last day of classes. Students writing an undergraduate thesis (see below) may submit a copy of their thesis as the CHEM 494 report during their final semester. In the case of CHEM 294, your research advisor will decide whether a report is required; CHEM 294 reports need not be submitted to the chemistry department.

Research Theses: You may decide to culminate several semesters of research work by documenting your results in the form of an undergraduate thesis. If you are a member of the Schreyer Honors College (SHC), a thesis is required to graduate with distinction (see https://www.shc.psu.edu/academic/thesis). If not, the Eberly College of Science offers a certificate via the Science Research Distinction (SCIRES) program (see http://science.psu.edu/current-students/academic-programs/certificate-programs). Completing a research thesis indicates a high level of achievement, and the resulting distinction is an important addition to your CV. Details of the specific requirements and deadlines for these two approaches can be found at the SHC and SCIRES websites listed above.

From the perspective of the chemistry department, the requirements for an undergraduate research thesis in chemistry are the same for honors and non-honors students. Research in chemistry or a related area must be undertaken under the supervision of a thesis advisor (or co-advisor) who is a faculty member in the Department of Chemistry.

The thesis will be evaluated by a three-person committee consisting of the research advisor and at least two other faculty members. In the case of SHC theses, one of the committee members should be your honors advisor. At least two members of the committee must be from the tenure-track faculty; the third participant may be a non-tenure-track faculty member. When appropriate, participating faculty members may be from departments other than chemistry. Note that the chemistry requirements for thesis evaluation are more comprehensive than those of the SHC or the SCIRES programs. Students fulfilling the chemistry requirements will automatically fulfill the requirements of either of these two programs.

After the thesis is approved by the research advisor, and at least one week prior to the submission deadline, students should provide a complete copy of the thesis to all committee members and schedule a meeting with the committee. During this meeting, the candidate first presents a 20–30-minute talk to their committee members and, if desired, to other interested persons. The committee members will then discuss the research with the student, decide whether it satisfies requirements for research distinction, and suggest any required changes to the thesis. Students are responsible for scheduling a meeting of their committee early enough to meet the program-specific deadlines for final submission. Contact the chemistry department's Undergraduate Program Office to reserve an appropriate room for this meeting. Be sure to bring the required signature page to the meeting. Theses must be signed by all committee members and, in the case of SCIRES theses, the Associate Head for Undergraduate Education must also sign. In the case of SHC theses, the final audit for conferring an honors degree must be completed by the Schreyer Honors College.

Finding a Research Group: Below is a list of chemistry faculty members with research groups that often include undergraduates. There are brief statements of research areas provided here; much more detail is available on individual research web sites, which can be found at http://chem.psu.edu/directory/faculty. Look over these pages and see what looks most interesting. Once you have identified research groups of potential interest, be proactive in making yourself known to the faculty member involved. Whether a given group can accommodate you upon first contact will depend on many factors and will vary with time. Even if you cannot get into the group of your choice initially, persistence usually pays off. Keep in mind that a strong performance in course work, especially in lab courses, can benefit you in finding a research group; laboratory directors are often consulted for information on undergraduates seeking to join a research group. Finally, it is important that you seek out opportunities and make yourself known to potential research directors well in advance, especially if you are seeking a summer position.

Chemistry Faculty Members Who Often Supervise Undergraduate Research:

Dr. Harry Allcock: Polymer chemistry and materials synthesis; biomedical uses of synthetic polymers, hybrid organic-inorganic ring systems and macromolecules; organometallic chemistry; synthesis, reaction mechanisms, and x-ray structure studies; solid state and surface chemistry; electroactive, optical, and electronic materials; use of polymers in solid ionic conductors, energy storage, and fuel cell devices; molecular recognition by porous solids. Students should have an interest in organic or inorganic synthesis.

Dr. John Asbury: Physical and materials chemistry; ultrafast laser spectroscopy of emerging photovoltaic materials based on conjugated polymers and colloidal quantum dots. Research opportunities include working with lasers, time-resolved vibrational spectroscopy, fabrication of solar cells, and synthesis of small molecules and semiconductor nanocrystals.

Dr. John Badding: Materials chemistry. Optical materials, semiconductor materials, carbon materials. Optical fiber lasers, modulators, detectors, and chemical sensors. High pressure science. Nanostructured semiconductor metalattice materials with electronic and photonic applications. Carbon nanomaterials such as sp^3 carbon nanothreads.

Dr. Philip Bevilacqua: Biological and biophysical chemistry; characterization of RNA folding and dynamics *in vivo*; catalytic RNA; prediction of RNA structure from sequence under *in vivo*-like conditions. Prerequisites: first-year or sophomore student; willing to work at least 10 hours per week and over the summer; an honors student or willing to write a thesis; independent and highly motivated.

Dr. David Boehr: Biological and biophysical chemistry; structure and dynamics of proteins in solution. The emphasis is on understanding the role of protein dynamics in enzyme function and regulation. This information can be used for optimizing protein engineering and structure-based drug design. Our lab combines nuclear magnetic resonance spectroscopy with other molecular biology and biochemical/biophysical techniques to study enzymes important for bacterial and viral pathogenesis.

Dr. Squire Booker: Understanding the unique chemistry of S-adenosylmethionine and its use in donating methyl groups in cellular reactions. The chemistry and biochemistry of iron-sulfur clusters. Elucidation of natural product biosynthetic pathways with a particular focus on steps that involve radical-mediated catalysis.

Dr. Paul Cremer: Studies of biomaterials, water structure, ions, and interfaces. Our laboratory uses a combination of fluorescence microscopy, vibrational spectroscopy, and microfluidic methods to understand the interactions of ions at lipid bilayer, polymer, and protein surfaces. We also design new biosensors for these applications.

Dr. Joseph Cotruvo: Chemical biology and biochemistry to probe how cells acquire, traffic, and utilize metal ions and organic cofactors. Design of protein- and RNA-based fluorescent sensors to study metals in biology. Applications to host-pathogen interactions, neurodegenerative disease, and cancer biology. Mechanistic enzymology.

Dr. Sheryl Dykstra: Chemical education, development of lab experiments and related activities for organic chemistry.

Dr. Elizabeth Elacqua: Application of directional and responsive assembly to synthetic polymer and materials science. Organic polymer nanoparticles; directional supramolecular assembly; dynamic covalent and noncovalent chemistry; organic synthesis and polymer chemistry; fabrication of well-defined polymeric and colloidal materials.

Dr. Miriam Freedman: Atmospheric chemistry. Spectroscopy of laboratory-generated aerosol particles; microscopy of particle morphology; surface science of laboratory proxies for atmospheric particulate matter; computational studies of particle optical properties and water uptake. Instrument design and development. The goal of our research is to understand the interactions between aerosol particles, solar radiation, and clouds. Interested students should have completed a year of general chemistry.

Dr. Lasse Jensen: Our research lies in the field of theoretical chemistry and involves developing new methods for simulations of metal-molecule interactions. We seek to use computer simulations to gain a fundamental understanding of the underlying physics and chemistry. We are particularly interested in understanding the optical properties of molecules at the interface of plasmonic nanomaterials.

Dr. Christine Keating: Application of colloid and surface chemistry to problems in materials science and biology. Artificial cells; experimental models for intracellular liquid-liquid phase separation, biomimetic mineralization; directed self-assembly of particles, integration of nontraditional materials with top-down lithographic fabrication.

Dr. Joseph Keiser: Chemical education, development of lab experiments and related activities for general chemistry.

Dr. Kenneth L. Knappenberger, Jr.: Physical, analytical, and materials chemistry. Research objectives include determining the influence of material structure on the optical properties of plasmonic particles, nanoclusters, and semiconductor heterostructures. These materials have applications as catalysts, sensors, medical diagnostics and therapeutics, and quantum information. Student researchers learn experimental methods needed for drawing these structure-function correlations, such as laser spectroscopy and super-resolution microscopy.

Dr. Gerald Knizia: Theoretical chemistry; our group develops and applies computational methods for (a) investigating the electronic structure of molecules and (b) for finding the mechanisms of chemical reactions. Prerequisites: interest in quantum mechanics, algorithms, and software development. Previous experience with programming or scripting (e.g., in Python, C++, C#, Java) or with quantum chemistry software highly welcome, but not strictly required.

Dr. Ben Lear: Synthesis of inorganic molecules and materials for use in studies of electron transfer and molecular dynamics. Spectroscopic measurements of these molecules and materials. We focus on problems that are of fundamental importance to molecular electronics and alternative energy. Prerequisites: one semester of organic chemistry and at least two semesters of a laboratory course.

Dr. Tae-Hee Lee: Single molecule biophysics. Single molecule spectroscopic/microscopic method development and application with an emphasis on the roles of dynamics in the functions of biological macromolecules and complexes. Methods of interest include single molecule fluorescence resonance energy transfer, precise localization of macromolecules by fluorescence and light scattering, single photon correlation spectroscopy, and optical trapping. Molecules and complexes of interest include the nucleosome, chromatin modification enzymes and remodelers, RNA polymerase, and DNA replisome.

Dr. Mark Maroncelli: Solvation and solvent effects on chemical processes, especially ultrafast electron and proton transfer reactions; unusual solvent environments such as supercritical fluids, gas-expanded liquids, and ionic liquids; ultrafast spectroscopy, NMR relaxation, and computational chemistry. Prerequisites: CHEM 450 or CHEM 452.

Dr. Katherine Masters: Curriculum development; design and implementation of experiments for organic laboratory courses, specifically CHEM 213M and CHEM 431W. In CHEM 213M, the current focus is the implementation of theme-based modules, which focus on teaching basic organic lab techniques in a specific context. In CHEM 431W,

recent interests include collaborating with faculty in other departments to design synthetically focused experiments with direct relevance/applications to other fields. Prerequisites: CHEM 213W, preferably CHEM 213M.

Dr. Bratoljub Milosavljevic: Kinetics and mechanism of reactions in various fields of physical chemistry such as photochemistry, radiation chemistry, sonochemistry, materials chemistry, colloidal chemistry, and free-radical chemistry of biologically important molecules.

Dr. Will Noid: Application of theories and methods from statistical mechanics to questions in structural biology and materials science; development, application, and theory for multiscale modeling for complex systems; interactions of unfolded and intrinsically disordered proteins; aggregation phenomena in energy-related nanomaterials; biomolecular simulations. Knowledge of vector calculus, classical mechanics, computer simulation, and thermodynamics are useful, but not necessary for undergraduate research.

Dr. Ed O'Brien: Theoretical and computational chemistry and biophysics; development and application of coarse-grained simulation models to biomolecules and the cellular environment; mathematical modeling of molecular and cellular processes using tools such as chemical kinetics and statistical mechanics; bioinformatic and systems approaches to integrating large experimental data sets into predictive models. This group is ideally suited for undergraduate students interested in multi-disciplinary research at the interface of chemistry and physics with biology.

Dr. Ray Schaak: Chemical synthesis of inorganic solids and nanostructures with applications in catalysis, magnetism, optics, and solar energy conversion.

Dr. Ayusman Sen: Catalysis; energy; nanotechnology; nano/microrobots; complex systems.

Dr. Scott Showalter: Biophysical chemistry; solution NMR spectroscopy of intrinsically disordered proteins and microRNA; computational and theoretical studies of disordered protein and RNA conformational dynamics; biophysical studies of macromolecular interactions involving intrinsically disordered proteins and/or RNA. Emphasis is placed on understanding the functional implications of biomolecular dynamics and disorder for cellular signaling and the regulation of gene expression. Freshmen and sophomores are required to provide the name of a faculty member who can be contacted for a reference. Appropriate choices would be a chemistry instructor from a course they took or an honors adviser. Juniors and seniors are welcome to provide a reference, but are not required to do so.

Dr. Xin Zhang: Biological chemistry and chemical biology; folding and misfolding of proteins in cells. Our lab develops small molecule tools to image folding, misfolding, and aggregation of proteins in live cells. Emphases are to understand (a) how the cellular proteome can be properly maintained under cellular stresses and (b) the biochemical nature of soluble protein aggregates in diseases. A combination of synthetic chemistry, biochemistry, and cell biology is employed in our research to achieve these goals. Knowledge from our research will be used to direct our efforts to develop drugs that counteract the human diseases that are rooted in defective proteostasis.

Student Service Scholarship Opportunities

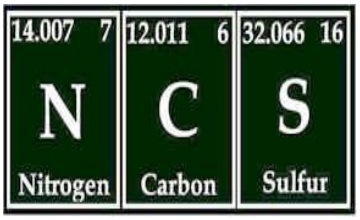
Students are encouraged to engage in service scholarship as members of the Department of Chemistry educational community. The department and the Eberly College of Science have a host of opportunities for students to engage in projects promoting science literacy and networking within the science community. Two of the more popular organizations that our majors participate in are the Nittany Chemical Society and the Science-U Summer Camps program.

The Chemistry Department Learning Assistant (LA) Program:

Learning assistants are undergraduate peer mentors who facilitate collaborative, active learning both during class and during problem-solving study sessions outside of class. They are an important connection between the instructor and the students. LAs work intimately with a faculty member, who can write letters of recommendation and introduce new opportunities. They also learn the course material very deeply, which can further goals of teaching and graduate school or medical school entrance. LAs earn one credit for their work with students, and first-time LAs earn one credit taking a specially designed pedagogy course on best practices in teaching and learning. Chemistry classes that currently benefit from the talents of LAs include PSU 016, CHEM 101, CHEM 108, CHEM 110, CHEM 110H, CHEM 112, CHEM 202, CHEM 203, CHEM 210, CHEM 212, CHEM 213M, CHEM 227, and CHEM 310. LAs meet weekly with the instructor as part of the educational team, and they work with the instructor on special projects to enhance learning. For more information about the LA program and becoming an LA, please contact Dr. Lori Stepan (lsv10@psu.edu) or the chemistry instructor with whom you wish to work.

The Nittany Chemical Society (NCS):

The Nittany Chemical Society is a student-affiliate chapter of the American Chemical Society (ACS), providing students with the opportunity to participate in leadership, outreach, and professional development activities that are decided upon each year by the chapter membership. This professional club often participates in events at Penn State, the Eberly College of Science, and in the local community, such as Exploration-U at area schools, THON Science Wish, Haunted-U, and Children's Day at the Central Pennsylvania Festival of the Arts. In addition, the club holds events such as the annual Halloween Demo Show and participates in chemistry department events such as "So You Think You Can Demo" and the annual ice cream social. Active members of ACS can receive travel funds for attending national ACS meetings to present their undergraduate research projects and promote the student chapter.



If you are interested in joining NCS, please feel free to contact Dr. Lori Stepan (lsv10@psu.edu) or Dr. Joseph Houck (jdh68@pdu.edu)

For more information, and current events—check out Nittany Chemical Society on Facebook or their website: http://sites.psu.edu/nittanychemicalsociety/

Science-U Opportunities:

Established in 1999, Science-U offers hands-on, exciting, age-appropriate science camps for both residential and day campers in grades K–12. Camps are held in the summer, and day camps are held throughout the school year. In addition, community science nights and after-school programs are held in collaboration with local schools. Penn State graduate and undergraduate students can work as mentors in collaboration with faculty members and Science-U staff to execute each camp's curriculum. The camps provide youth with a thrilling chance to experience the wonders of science!

To get involved, or to find more information, visit their website: http://www.sciencecamps.psu.edu

Scholarships and Awards

Awards and Scholarships Based on GPA:

The chemistry department is endowed with a number of scholarships specific to Chemistry majors. Students are selected for these awards based on academic performance and financial need. These scholarships typically range between $1,000 and $3,000 per year, with the amount increasing according to semester standing and GPA. Awards typically begin for GPAs above 3.5 once students have formally entered the major. There is no application necessary to be considered for these scholarships. At the end of each spring semester, a committee of faculty members reviews the academic record of all chemistry students and selects recipients on this basis. Recipients are notified by the Eberly College of Science during the summer.

Teas Scholarship:

The Teas Scholarship is a full-tuition scholarship awarded each year to three undergraduate Chemistry majors (one rising sophomore, one rising junior, and one rising senior). There is an opportunity for renewal of the sophomore and junior scholarships by existing Teas Scholars. The selection of recipients for the Teas Scholarship is based mainly on academic achievement. If funds allow, one tuition and room/board scholarship is given to an additional rising senior undergraduate Chemistry major.

L. Peter Gold Scholarship:

This scholarship was established in the memory of the late Dr. L. Peter Gold, a beloved long-time member of the chemistry faculty. This scholarship recognizes the achievements, both in academics and in service to the department, of an undergraduate Chemistry major who has transferred to University Park from another Penn State campus.

Hach Scientific Foundation Scholarship:

Each year, Hach Foundation Scholarships are awarded to as many as two Chemistry majors who intend to pursue careers in K-12 teaching. The Hach Foundation mission is “to foster and support chemistry education, and to make evident the interdependence between chemistry education and the public.” Applicants must have a minimum GPA of 3.0. The annual award amount is $6,000.

The Peter Craig Breen Memorial Award for Excellence in Undergraduate Chemistry Research: This award was created in memory of Peter Breen to recognize a Penn State undergraduate Chemistry major who has achieved excellence in academics and research. Peter was an undergraduate Chemistry major and a Schreyer Honors College student. He exemplified excellence both academics and in research. Peter passed away in 2014. The Breen family has generously established this award in his memory. It is given out yearly to a junior or senior Chemistry major based on course work and research accomplishments.

Travel Support:

Attending scientific meetings is an important way to broaden one’s perspectives on chemistry and the chemical profession and to begin establishing a professional network. There are several sources of funding to help cover the costs associated with meeting attendance. Some funds may be available from external grants associated with the research. Ask your preceptor about this possibility. The local section of the ACS also provides travel awards for active members of the Nittany Chemical Society. Speak to the NCS faculty advisor for more information. Finally, Penn State has a university-wide program for funding undergraduate conference travel. Details on how to apply can be found at https://undergradresearch.psu.edu/travel/index.cfm. Conference travel request forms should be submitted to the chemistry department's Undergraduate Program Office.

Other Scholarship Resources:

In addition to the above chemistry-specific scholarships and awards, Chemistry majors often compete effectively for university-wide as well as nationally prestigious awards such as the Goldwater, Gates Cambridge, Marshall, and Fulbright Scholarships. For more information, visit the University Fellowships Office website at www.ufo.psu.edu or speak to the staff in the University Fellowships Office (321 Boucke Building), who are happy to assist you in the preparation and submission of scholarship applications.

Need Help or Advice?

There are many resources available if you need help or advice. The staff of the undergraduate office answer questions regarding degree requirements, and provide help with scheduling as well as information about tutoring, work-study opportunities, and other resources and opportunities for chemistry students.

Chemistry Undergraduate Office

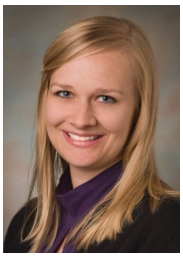
219 Whitmore Lab
University Park, PA
Phone: 814-865-9391
Hours: Monday–Friday; 8:00 a.m.–5:00 p.m

Academic Advising: Faculty advisors are able to assist you with strategies for a successful college career, course selection and curriculum options, future career pathways, and related issues.

Dr. John Asbury
112 Chemistry Building
814-863-6309
jba11@psu.edu

Dr. David Boehr
240 Chemistry Building
814-863-8605
ddb12@psu.edu

Dr. Jackie Bortiatynski
123 Ritenour
814-865-2772
jxb46@psu.edu



Dr. Sheryl Dykstra
211 Whitmore Lab
814-867-2568
sad270@psu.edu

Dr. Ray Funk
431 Chemistry Building
814-865-2057
rlf@chem.psu.edu
(HONORS)

Dr. Aaron Garner
220A Whitmore Lab
814-863-5853
rag57@psu.edu

Dr. Joseph Houck
220B Whitmore Lab
814-865-0106
jdh68@psu.edu

Dr. Linlin Jensen
220C Whitmore Lab
814-867-2227
luz11@psu.edu

Dr. Joe Keiser
213 Whitmore Lab
814-863-3209
jtk1@psu.edu

Dr. Ken Knappenberger
315 Chemistry Building
814-865-1228
klk260@psu.edu

Dr. Tae-Hee Lee
230 Chemistry Building
814-867-2232
thlee@psu.edu

Dr. Mark Maroncelli
408 Chemistry Building
814-865-0898
maroncelli@psu.edu

Dr. Pshemak Maslak
228 Chemistry Building
814-865-2991
pm@chem.psu.edu

Dr. Kate Masters
214 Whitmore Lab
814-863-3209
kmasters@psu.edu

Dr. Bratoljub Milosavljevic
331C Whitmore Lab
814-865-7481
bhm11@psu.edu

Dr. Kyle Schmid
212 Whitmore Lab
814-865-5690
kms565@psu.edu

Dr. Lori Stepan
220D Whitmore Lab
814-867-2292
lsv10@psu.edu
(MINORS)

Dr. Dan Sykes
330 Whitmore Lab
814-863-0796
dgs12@psu.edu

Help with Coursework: We highly recommend that you attend faculty and teaching assistant office hours and attend guided study sessions led by learning assistants and guided study group leaders. Your classmates and your senior colleagues are also some of the best resources available, and forming study groups is highly recommended. The teaching assistants and tutors are available to help answer questions during most regular class hours from Monday to Thursday, 9:00 a.m.–10:30 p.m., and Fridays 9:00 a.m.–5:00 p.m. in the Chemistry Resource Center (CRC), 205 Whitmore Lab. Schedules for guided study sessions held by learning assistants are posted on the individual course websites. The guided study sessions led by guided study group leaders, as well additional resources for effective learning in all your courses, are posted on the Penn State Learning website: http://pennstatelearning.psu.edu. A detailed schedule of subject coverage is posted in 205 Whitmore Lab (the CRC).

Private tutors are also available for many courses and can be hired for additional one-on-one help. See the undergraduate staff for availability and contact information.

"Climate" Issues: A central goal of the chemistry department is to establish a welcoming environment in which all students, researchers, faculty, and staff can contribute fully to the shared missions of education, research, and service. Doing so requires a climate in which the diversity of the department's membership—in terms of racial and cultural heritage, gender, physical ability, sexual orientation, and educational background—is both recognized and appreciated, in which individuals are intrinsically valued and respected irrespective of such differences, and where everyone is encouraged to achieve his or her maximum potential.

To help achieve this goal, the department has designated several faculty members as ombudspersons: Dr. Lasse Jensen (lxj18), Dr. Kenneth Knappenbeger (klk260), Dr. Pshemak Maslak (nly), and Dr. Katherine Masters (kmm14). These ombudspersons are available to discuss any concerns you might have about working relationships within the department or any discriminatory behavior or sexual harassment you have experienced or witnessed. All such discussions will be kept in strict confidence.

University-Wide Resources: Penn State has a vast array of programs and services to assist students with numerous aspects of college life. Some of the more important services are as following:

Center for Adult Learner Services
http://www.outreach.psu.edu/lifelong-learning
405 Old Main
1-800-252-3592, Option 1

Center for Counseling and Psychological Services
http://studentaffairs.psu.edu/counseling
501 Student Health Center
814-863-0395

Center for Spiritual and Ethical Development
http://studentaffairs.psu.edu/spiritual/
111 Pasquerilla Spiritual Center/Eisenhower Chapel;
814-865-6548

Student Activities
http://studentaffairs.psu.edu/hub/
103 HUB-Robeson Center
814-863-9755

Gender Equity Center
https://studentaffairs.psu.edu/genderequity
204 Boucke Building
814-863-2027

Student Disability Resources
https://equity.psu.edu/student-disability-resources
116 Boucke Building
814-863-1807

Division of Undergraduate Studies (DUS)
https://dus.psu.edu
101 Grange Building
814-865-7576

Penn State Learning (PSL)
http://pennstatelearning.psu.edu
220 Boucke Building
7 Sparks Building
814-865-1841

Office of Global Programs
https://global.psu.edu/internationals-penn-state
410 Boucke Building
814-865-7681

Lesbian, Gay, Bisexual, Transgender, Queer and Ally (LGBTQA) Student Resource Center
https://studentaffairs.psu.edu/lgbtqa/
101 Boucke Building
814-863-1248

Multicultural Resource Center (MRC)
http://www.equity.psu.edu/mrc/
314 Old Main
814-865-5906

Residence Life
http://studentaffairs.psu.edu/reslife/
201 Johnston Commons
814-863-1710

Student Care and Advocacy
https://studentaffairs.psu.edu/studentcare/
129 Boucke Building
814-863-2020

Office of Student Aid
http://www.psu.edu/studentaid/
314 Shields Building
814-865-6301

University Health Services
http://studentaffairs.psu.edu/health/
Student Health Center
814-863-0774

What Happens After Penn State?

In a typical year, approximately 40–50 students graduate with bachelor's degrees in chemistry from our department. Of these graduates, roughly half attend graduate school in chemistry or a closely related field, or attend a professional school in medicine, dentistry, or law; the other half typically pursue industrial positions, usually with chemical or pharmaceutical firms. What direction is right for you? As you progress through your undergraduate career at Penn State, you should be thinking about the answer to this question. Some course work, especially CHEM 316 (The Professional Chemist), is intended to help you make this decision. Faculty and student colleagues can also provide advice, but the onus is on you to think about and explore the possibilities. Research and co-op experiences are some of the best ways to learn more about your next step if it entails graduate school or industry. There are many other choices available to those holding a bachelor's degree in chemistry.

Some resources that can help you envision the possibilities are posted on the ACS careers website, which can be accessed at http://www.acs.org/content/acs/en/careers.html.

A similar site at the Royal Society of Chemistry is http://www.rsc.org/Education/HEstudents/careers.asp.

A Wikipedia article, "Careers in Chemistry: A Wealth of Opportunities," is also useful: http://en.wikibooks.org/wiki/Chemical_Information_Sources/Careers_in_Chemistry.

The Eberly College of Science offers a course—SC 402 Science-Related Employment: Corporate Organization, Opportunities, and Expectations—focusing on industrial and related careers.

A slightly dated but still valuable book containing mini-biographies of real people taking a variety of career paths from a bachelor's degree in chemistry is F. Owens, R. Uhler, and C. Marasco's *Careers for Chemists, A World Outside the Lab* (ACS, Washington, 1997). Copies of this book are available in the Chemistry Resource Center.

The chemistry department also maintains a database of recent graduates who are willing to share career experiences with current undergraduates. Speak to someone in the Undergraduate Program Office if you would like to obtain contact information.

Please Keep in Touch! Once you graduate, we hope that you will keep in touch and periodically let us know how you are doing in your career after Penn State. We have created a LinkedIn group, "Penn State Chemistry Alumni," that will help you keep in touch with your classmates; please join us at www.linkedin.com/groups/4675545/profile.

At any time, we welcome reflections you might have on the training you received here and how it relates to your current career. If you are in the area, please stop by to see how things have changed (or not) since your days with us.