Check the University Catalogs website at [www.catalogs.umn.edu](http://www.catalogs.umn.edu) for the most current course information. The courses in this catalog are not offered every semester. To find out whether a course is offered during a particular semester, consult the online [Class Schedule](http://onestop.umn.edu/registrar/registration/courses.html).

### Course Designators

In conjunction with course numbers, departments and programs are identified by a 2-, 3-, or 4-letter designator prefix (e.g., CE for Civil Engineering, POL for Political Science, ECON for Economics). When no designator precedes the number of a course listed as a prerequisite, that prerequisite course is in the same department as the course being described.

### Course Numbers

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0xxx</td>
<td>Courses that do not carry credit toward any University degree.</td>
</tr>
<tr>
<td>1xxx</td>
<td>Courses primarily for undergraduate students in their first year of study.</td>
</tr>
<tr>
<td>2xxx</td>
<td>Courses primarily for undergraduate students in their second year of study.</td>
</tr>
<tr>
<td>3xxx</td>
<td>Courses primarily for undergraduate students in their third year of study.</td>
</tr>
<tr>
<td>4xxx</td>
<td>Courses primarily for undergraduate students in their fourth year of study; graduate students may enroll in such courses for degree credit. 4xxx courses can be counted for a Graduate School degree if the course is taught by a member of the graduate faculty or an individual appointed to Limited Teaching Status (LTS).</td>
</tr>
<tr>
<td>5xxx</td>
<td>Courses primarily for graduate students; undergraduate students in their third or fourth year may enroll in such courses.</td>
</tr>
</tbody>
</table>

### Course Symbols

The following symbols are used throughout the course prerequisites of most University catalogs to denote common and recurring items of information.

- `=` Credit will not be granted if credit has been received for the course listed after this symbol.
- `&` Concurrent registration is required (or allowed) in the course listed after this symbol.
- `#` Approval of the instructor is required for registration.
- `%` Approval of the department offering the course is required for registration.
- `@` Approval of the college offering the course is required for registration.

- `1-4 cr [max 6]` The course can be taken for 1 to 4 credits and may be repeated for up to 6 credits.

### Abbreviations

The following abbreviations are used throughout the course prerequisites of most University catalogs to denote common and recurring items of information.

- **Prereq**...........Course prerequisites.
- **cr**...............Credit.
- **div**..............Division.
- **DUS**..............Director of undergraduate studies.
- **equiv**............Equivalent.
- **fr, soph, jr, sr**..Freshman, sophomore, junior, senior.
- **H**................Honors. Courses with an H following the course number satisfy honors requirements.
- **V**................Honors and Writing Intensive. Courses with a V following the course number satisfy both honors and liberal education writing intensive requirements.
- **W**................Writing Intensive. Courses with a W following the course number satisfy the writing intensive requirement for liberal education.
- **A-F only**........A-F grade basis only; course may not be audited or pass/fail.
- **A-F or Aud**.......A-F grade basis, or course may be audited for no grade.
- **S-N only**........S-N grade basis only (pass/fail), course may not be audited or taken A-F.
- **S-N or Aud**.......S-N grade basis (pass/fail), or course may be audited for no grade.
- **No Grade**........No grade will be given for the course; typically used for laboratory components of courses.
- **OPT No Aud**.....Student selects the grading option; course may not be audited.
- **Stdnt Opt**.......Student selects the grading option; course may be audited.

### Course Listing Sample

**Xology (Xolo)**

**College of Liberal Education**

**Xolo 5101. Methods in Xology. (3-4 cr [max 8 cr]; A-F only. =3101. Prereq–3578 or #)**

Historical, numerical, sociological, and Freudian methods of research in xology with applications to contemporary problems.
Biology (BIOL)

BIOL 2311. Integrative Biology. (5.0 cr.; A-F or Audit; prerequisite Grade of at least C- in BIOL 2311, CHEM 1231 or CHEM 2321; fall, every year) Introduction to core biological concepts, from molecules to complex systems. How principles from chemistry, cellular biology, genetics, and evolution contribute to understanding of complex systems. Problem solving, applications to health sciences. Lab.

BIOL 2331. Anatomy and Physiology I. (4.0 cr.; A-F or Audit; prerequisite Grade of at least C- in BIOL 2331 or placement test; fall, every year) Shape, structure, and function of human body and its parts. Basic anatomy, structure, and function of body systems and special senses. Concepts/principles of body organization, histology, and hematology. Case studies. Lab.

BIOL 2332. Anatomy and Physiology II. (4.0 cr.; A-F or Audit; prerequisite Grade of at least C- in BIOL 2331 or placement test; spring, every year) Shape, structure, and function of human body and its parts. Basic anatomy, structure, and function of body systems and special senses. Concepts/principles of body organization, histology, and hematology. Case studies. Lab.

BIOL 3311. Molecular Genetics. (3.0 cr.; A-F or Audit; prerequisite BIOL 2311, CHEM 1231, CHEM 2331; fall, every year) Advanced introduction to genetic information, molecular aspects of inheritance and disease; gene expression and regulation in cells/organisms; population genetics, mutation, and molecular evolution; genome analysis; and pedigree construction. Emphasizes human genetics. Incorporates ethical, social, and legal perspectives relevant to advances in genetic technology and increasing availability of human genetic information.


BIOL 3342. Microbiology and Environmental Issues. (1.0 cr.; A-F or Audit; prerequisite [3341, 3342, 3343]) Addresses environmental aspects of microbial issues. Topics vary and include microbial epidemiology, population interactions, and microbial interactions with ecosystems.

BIOL 3345. Microbiology Lab. (1.0 cr.; A-F or Audit; prerequisite BIOL 3341; fall, spring, every year) Techniques, experimental methods in microbial biology. Cultivation, isolation of microbial cultures. Physiological experiments.

BIOL 4312. Advanced Topics in Molecular and Cellular Biology and Genetics. (4.0 cr.; A-F or Audit; prerequisite BIOL 3311 and 3332; fall, every year) Advanced topics in molecular biology and genetics; previously required at least one of BIOL 3311 and 3332.

BIOC 2331. Introductory Biochemistry. (3.0 cr.; A-F or Audit; prerequisite BIOL 2331 or BIOL 3341; or BIOL 3332 or BIOL 3341; or BIOL 3331 or BIOL 3341; or BIOL 3321 or BIOL 3341; or BIOL 3311 and BIOL 3332; fall, every year) Biochemistry. Carbohydrates, lipids, amino acids, proteins, and nucleic acids. Introduction to biochemical processes and mechanisms. Mechanisms of transformation of energy, synthesis, and degradation of biomolecules. Regulation of cellular function by hormones and other signaling molecules.

BIOC 3332. Biochemistry II. (3.0 cr.; A-F or Audit; prerequisite BIOL 2332 or BIOL 3311 or BIOL 3321 or BIOL 3341 or BIOL 3342; or BIOL 3311 and BIOL 3332; fall, spring, every year) Advanced biochemistry. Carbohydrates, lipids, amino acids, proteins, and nucleic acids. Introduction to biochemical processes and mechanisms. Mechanisms of transformation of energy, synthesis, and degradation of biomolecules. Regulation of cellular function by hormones and other signaling molecules.

BIOC 4331. Molecular Biology of Viruses. (3.0 cr.; A-F or Audit; prerequisite BIOL 3311; spring, every year) Molecular biology of viruses. Genetics, cell biology, and replication of viruses. Introduction to virology. Laboratory experiments.

BIOC 4332. Molecular Biology of Bacteria. (3.0 cr.; A-F or Audit; prerequisite BIOL 3311; spring, every year) Molecular biology of bacteria. Genetics, cell biology, and replication of bacteria. Introduction to bacterial genetics. Laboratory experiments.

BIOC 4334. Molecular Biology of Fungi. (3.0 cr.; A-F or Audit; prerequisite BIOL 3311; spring, every year) Molecular biology of fungi. Genetics, cell biology, and replication of fungi. Introduction to fungal genetics. Laboratory experiments.


BIOC 4336. Immunology. (3.0 cr.; A-F or Audit; prerequisite BIOL 3332; [3341 and 3345] or BIOL 3321 or BIOL 3341; or BIOL 3321; fall, spring, every year) Immunology. Principles of immunology. Overview of the immune system. Development and function of immune cells. Mechanisms of immune response. Applications of immunology in medicine.

BIOC 4342. Neuroscience. (3.0 cr.; A-F or Audit; prerequisite BIOL 2331; [3323 or 3311 or BIOL 3321]; or BIOL 3321; fall, spring, every year) Neuroscience. Introduction to neuroscience. Principles of brain function from neurons to behaviors. Current research in neuroscience. Applications of neuroscience to health and disease.

BIOC 4364. Immunology. (3.0 cr.; A-F or Audit; prerequisite BIOL 3332; [3341 and 3345] or BIOL 3321; or BIOL 3321; fall, spring, every year) Immunology. Principles of immunology. Overview of the immune system. Development and function of immune cells. Mechanisms of immune response. Applications of immunology in medicine.

BIOC 4721. Special Topics in the Life Sciences. (1.0-4.0 cr.; maximum 4.0 cr.) Special topics in biology, genetics, and biotechnology. Emphasis on topics in, for instance, molecular biology and genetics; mathematics, statistics and biostatistics; programming in FORTRAN and C/C++; programming in Perl; data management; data mining.

BIOC 8444. FTE: Doctoral. (1.0 cr.; No Grade Associated; prerequisite Master's student; dissertation consent, DGS consent; fall, spring, summer, every year) Course taught in modular form. Overview of topics in, for instance, molecular biology and genetics; mathematics, statistics and biostatistics. Programming in FORTRAN and C/C++. Programming in Perl; data management; data mining.

BIOC 8510. Computation and Biology. (2.0 cr. [max 4.0 cr.]; prerequisite BIOC grad student or seniors; fall, spring, every year) Course taught in modular form. Overview of topics in, for instance, molecular biology and genetics; mathematics, statistics and biostatistics. Programming in FORTRAN and C/C++. Programming in Perl; data management; data mining.

BIOC 8600. Topics in Biomedical Informatics and Computational Biology. (0.5-4.0 cr. [max 24.0 cr.]; prerequisite BIOC grad student; permission of DGS; fall, spring, summer, every year) Each section corresponds to a Mayo 8XXX course.

BIOC 8666. Doctoral Pre-Thesis Credits. (1.0-6.0 cr.; max 12.0 cr.; No Grade Associated; prerequisite Doctoral student who has not passed prelim oral; no required consent for first two registrations, up to 12 combined cr.; 12 for 3rd/4th registrations, up to 24 combined cr.; doctoral student admitted before summer 2007 may register up to four times; up to 60 combined cr.; fall, spring, summer, every year) Doctoral Pre-Thesis Credits.

BIOC 8670. Topics in Management of Technology. (0.5-4.0 cr. [max 24.0 cr.]; prerequisite BIOC grad student; permission of DGS; fall, spring, summer, every year) Each section of this course corresponds to one of the MOT courses.

BIOC 8777. Thesis Credits: Master's. (1.0-18.0 cr.; max 50.0 cr.; No Grade Associated; fall, spring, summer, every year) TBD

BIOC 8888. Thesis Credit: Doctoral. (1.0-24.0 cr.; max 100.0 cr.; No Grade Associated; fall, spring, summer, every year) TBD

BIOC 8920. BIOC Colloquium. (1.0 cr.; max 2.0 cr.; S-N only; prerequisite BIOC grad student; fall, spring, every year) Weekly colloquium. Features research talks.

BIOC 8930. BIOC Journal Club. (1.0 cr.; max 4.0 cr.; S-N only; prerequisite BIOC grad student or seniors; fall, spring, every year) Weekly seminar. Journal articles presented by participants.

BIOC 8932. Proposal Writing Seminar. (1.0 cr.; S-N only; prerequisite BIOC PhD student or seniors; fall, spring, every year) Process of developing/writing research proposal that serves as basis for preliminary written exam in BIOC graduate program.

BIOC 8940. Education and Pedagogy Seminar. (1.0 cr.; max 4.0 cr.; S-N only; TBD)
The academic goal of this course is to extend the student learning experience into the local community. Responding to needs identified by local public, private, and nonprofit organizations, students will confront the challenges present in complex human systems and contribute to projects aimed at improving the quality of life in Southeastern Minnesota. In doing so, students participate in sustainable and meaningful partnerships between the University of Minnesota Rochester and the surrounding community. Students will also have the opportunity to build relationships with people of different backgrounds and life experiences, to broaden their worldview, to critically and creatively examine community concerns, and to discover their own capacity to affect change in the world around them.

CLI 2711. Career Exploration I. (1.0 cr.; S-N or Audit; prereq 1712 or #; fall, every year) Active exploration of diverse career fields. Effective resumes, cover letters, and interviewing. Orientation to research and service opportunities. Orientation to postbaccalaureate programs. Capstone planning.

CLI 2712. Career Exploration II. (1.0 cr.; S-N or Audit; prereq 2711 or #; fall, spring, every year) Active exploration of diverse career fields. Effective resumes, cover letters, and interviewing. Orientation to research and service opportunities. Orientation to postbaccalaureate programs. Capstone planning.

CLI 3390. Undergraduate Seminar. (1.0 cr.; S-N or Audit; #, %; fall, spring, every year) Individual research on specialized topics.

CLI 3394. Directed Research. (1.0-3.0 cr.; S-N or Audit; #, %; fall, spring, summer, every year) Individual study on selected topics or problems. Emphasizes selected readings, use of scientific literature.

CLI 4393. Capstone Directed Study. (1.0-3.0 cr.; S-N or Audit; #, %, acceptance of capstone proposal; fall, spring, summer, every year) Individual study on selected topics or problems.

CLI 4396. Internship: Professional Experience. (1.0-6.0 cr.; S-N or Audit; #, %, acceptance of internship proposal; fall, spring, summer, every year) Matches student’s academic/career goals with opportunities in industry, nonprofit organizations, and government agencies.


CLI 4712. Capstone Proposal Writing. (1.0 cr.; S-N or Audit; prereq 3711 or #; fall, spring, every year) This seminar focuses on all aspects of writing the proposal for the BSHS capstone.

The Center for Learning Innovation (CLI) represents the eighth part in a series of professional development courses that intentionally integrates student life, the curriculum, and career exploration to facilitate student growth and professional development. The purpose of this course is to participate in, observe, analyze and interpret your capstone experience. To illustrate your growth, you will record your observations and analysis throughout the semester. This course represents the eighth part in a series of professional development courses that intentionally integrates student life, the curriculum, and career exploration to facilitate student growth and professional development. The purpose of this course is to participate in, observe, analyze and interpret your capstone experience. To illustrate your growth, you will record your observations and analysis throughout the semester and present your capstone portfolio in a research paper or public presentation.
prereq \&4711 or \&4712, acceptance of capstone proposal, full-time enrollment in certificate program; fall, spring, summer, every year)
Enrollment in certificate program courses in a health profession.

CLI 4950. Special Topics. (1.0-3.0 cr. [max 6.0 cr.]; A-F or Audit; prereq #; %; fall, spring, summer, every year)
In-depth study of special topic related to BSHS program.

Chemistry (CHEM)

CHEM 1231. Organic Chemistry I. (4.0 cr.; A-F or Audit; prereq \&MATH 1161; [high school chemistry or equiv preferred and three years high school math required]; fall, every year)

CHEM 2231. Organic Chemistry II. (4.0 cr.; A-F or Audit; prereq Grade of at least C- in 1231, \&BIOL 2311; spring, every year)
Study of organic reactions (addition/elimination reactions, chemistry of carboxylic compounds, aromatic electrophilic substitution, rearrangements, oxidations and reductions); Biological examples. Introduction to the use of spectroscopic tools in structure elucidation (nuclear magnetic resonance, mass spectroscopy, Infrared and electronic absorption spectroscopy); Organic polymers and biologically important classes of organic compounds such as lipids, carbohydrates, amino acids, peptides, proteins, and nucleic acids; Lab.

CHEM 2331. General Chemistry I. (4.0 cr.; A-F or Audit; prereq Precalculus or equivalent; grade of at least C- in MATH 1161; BIOL 2311; 1231; fall, every year)

CHEM 2332. General Chemistry II. (4.0 cr.; A-F or Audit; prereq 2321; 2331; MATH 1171; spring, every year)

CHEM 3321. Chemical Biology/Bioorganic Chemistry. (3.0 cr.; A-F or Audit; prereq C- or better in 2231; Recommended \&OC 3321; spring, every year)
Topics include: Chemical control of signal transduction; Polypeptide biosynthesis; Non-natural amino acid insertion into proteins (in vivo nonsense suppression); Non-ribosomal peptides; Organic chemistry of polymerase chain reaction; Protein backbone modification - secondary structure stabilization; Chemical biology of fluorescent proteins. DNA binding antibiotics; DNA backbone modification; RNAi; Cell surface engineering through oligosaccharide biosynthesis.

CHEM 4721. Special Topics in Chemistry. (1.0-4.0 cr. [max 8.0 cr.]; A-F or Audit; prereq #; repeated enrollment allowed only if topics are different; fall, spring, offered periodically)
In-depth study of special topics in chemistry.

Echocardiography (ECHO)

ECHO 3011. Foundations of Echocardiography. (8.0 cr.; A-F only; fall, every year)
The intent of this course is to provide the student with a basic knowledge of performing an echocardiographic exam including two-dimensional imaging, Doppler, Color Flow imaging, patient care, transducer placement, imaging skills, assessment of systolic and diastolic function by echocardiography, basic instrumention of ultrasound physics and echocardiographic terminology. Students will participate in scanning labs in preparation for their clinical experience. Two-dimensional (2-D) and Doppler skills and competency testing will be completed during scanning labs. Students will apply 2-D and Doppler echocardiography skills learned in the classroom to echocardiographic exams performed in scanning lab demonstrating an understanding of the clinical application of echocardiography.

ECHO 3101. Cardiovascular Anatomy & Physiology. (2.0 cr.; A-F only; fall, every year)
The course is designed to provide the student with an in-depth understanding of gross and cross-sectional cardiac anatomy and an understanding of normal cardiac physiology. The concepts of cardiovascular physiology will include circulation blood flow, the cardiac cycle, electrical and mechanical properties of the heart, and blood flow hemodynamics of the arterial and venous system. This course will provide the foundation for advanced physiologic concepts and Doppler hemodynamic assessment in subsequent courses.

ECHO 3201. Adult Echocardiography I. (2.0 cr.; A-F only; spring, every year)
The intent of this course is to provide the student with the necessary knowledge of cardiomyopathies coronary artery disease. The course will focus on the echocardiographic assessment of dilated, hypertrophic and restrictive cardiomyopathies by 2-D, M-mode, Doppler and Color Flow imaging. This course will also provide the student with a basic understanding of coronary anatomy and distribution, pathophysiology of coronary heart disease, and the echocardiographic assessment of coronary heart disease and left ventricular assist devices. The course will also allow for students to get a basic understanding of Nuclear, CT, MRI, Cath Lab procedures and the information they can provide about the heart.

ECHO 3212. Adult Echocardiography II. (2.0 cr.; A-F only; spring, every year)
The intent of this course is to provide the student with the necessary knowledge for the echocardiographic assessment of valvar heart disease (stenosis, regurgitation, and prosthetic valves). Course content will include echocardiographic appearance of normal valve function and evaluation of valve area, mean gradient, regurgitant volume, and effective regurgitant orifice. This course will also include anatomy and clinical indications of TEE and provide students with the knowledge required to use the continuity equation and PISA formula and proper techniques for evaluating prosthetic valves.

ECHO 3222. Adult Echocardiography III. (2.0 cr.; A-F only; spring, every year)
The intent of this course is to provide the student with basic knowledge of major cardiac pathophysiology by covering the following: cardiac diseases due to systemic illness; pericardial disease; systemic and pulmonary hypertension; cardiac tumors and masses; and diseases of the great vessels. The course will include complete 2-D, M-mode, and Doppler assessment of the listed cardiovascular disorder and provide basic knowledge of and the sonographer's role during pericardiocentesis.

ECHO 3301. Clinical Practicum I. (3.0 cr.; S-N only; fall, every year)
The intent of this course is to provide the student with an opportunity to perform portions of an echo exam, review position, transducer placement, and terminology in the clinical setting. Two-dimensional (2-D) and Doppler skills learned in Foundations of Echocardiography will be applied in the clinical setting. Clinical Practicum I will provide the student with the opportunity to observe the clinical environment, understand the clinical application of echocardiography, and interact with clinical staff.

ECHO 3302. Clinical Practicum II. (7.0 cr.; A-F only; spring, every year)
The intent of this course is to continue to provide the student with the necessary skills and knowledge to integrate academic and clinical learning. Course content will include review of how to perform a routine two-dimensional, Color Flow, and Doppler echocardiography examination and the development of skills necessary to do a complete hemodynamic and Doppler assessment. Course will use hands-on experience to help develop the skills required to do a hemodynamic assessment.

ECHO 3403. Echocardiographic Application. (3.0 cr.; A-F only; summer, every year)
The intent of this course is to integrate knowledge from previous courses. This course will focus on case reviews and the integration of all 2-D and Doppler data. Students will be able to demonstrate application of echocardiographic data and recognize discrepancies in data, ability to identify key findings, ability to create a preliminary report, and effectively communicate the echo findings to the reviewer.

**ECHO 3503. Stress Echocardiography.** (2.0 cr.; A-F only; summer, every year)
This course will provide the student with the necessary knowledge regarding common lab values, ECG, and basis cardiac pharmacology along with a thorough understanding of the different types of stress tests performed in an echocardiographic laboratory and the technical aspects of the digitizing equipment. The role of the sonographer for each procedure will be identified. Students will develop an in-depth understanding of exercise echocardiography and the use of Dobutamine and contrast during a stress echo. The lab sessions for stress echocardiography will allow students the opportunity to demonstrate the required skills.

**ECHO 4111. Ultrasound Physics I.** (2.0 cr.; A-F only; fall, every year)
This course is designed to introduce the student to basic physics principles and instrumentation used in diagnostic ultrasound. The course will describe basic ultrasound physics principles, formulae and calculations as well as describe ultrasound itself. Key areas to be covered include: the properties of sound waves, principles of reflection, transmission, scattering and refraction; principles of attenuation and components of sound energy loss; transducer construction and function; sound beam anatomy; spatial resolution; transducer array technology; sound beam steering, and focusing. The course goal is to help the student understand the process by which an image is created, and ultimately identify ways to produce an optimal echo image.

**ECHO 4112. Ultrasound Physics II.** (2.0 cr.; A-F only; spring, every year)
The course is designed to expand the information learned in Ultrasound Physics I and provide new information regarding theory and operation of advanced diagnostic ultrasound equipment. The course will describe 2-dimensional imaging principles and instrumentation, image storage and display, the Doppler effect, pulsed and continuous wave Doppler generation, spectral analysis and display, color flow imaging, image features and artifacts, quality assurance, bioeffects and safety, and will introduce students to newer technologies including contrast and tissue harmonics, Doppler tissue imaging, and power Doppler. The course goal is to help the student understand the process by which an image is created. Doppler information is generated and displayed, and identify ways to produce high quality, diagnostic echocardiographic information.

**ECHO 4211. Congenital Heart Disease.** (3.0 cr.; A-F only; fall, every year)
The intent of this course is to provide the student with advanced knowledge of anatomy of congenital cardiac abnormalities, adult congenital heart disease (CHD), and follow-up of these patients. Surgical repair and interventional catheterization or methods will be discussed as well as postoperative complications. The student will also be provided necessary information on performing a systematic 2-D, spectral, and Color Flow Doppler examination on a patient with CHD.

**ECHO 4303. Clinical Practicum III.** (8.0 cr.; A-F only; summer, every year)
Clinical Practicum III will primarily focus on development of students clinical skills for 2-Dimensional and Doppler echocardiography. Clinical Practicum III is devoted to clinical training, allowing students an opportunity to apply didactic classroom instruction and develop their clinical skills. Students will begin to integrate the clinical and echo findings and identify final impressions related to the echo exam. Observational rotations will include intraoperative TEE, Outreach echocardiography, Stress Echocardiography, TEE and contrast echocardiography. 3D and strain rate echocardiography and the role of the sonographer for each procedure will also be included in this course. Lab sessions will allow students the opportunity to demonstrate the required skills for 3D and strain rate imaging.

**ECHO 4401. Clinical Practicum IV.** (8.0 cr.; A-F only; fall, every year)
Clinical Practicum IV will continue to develop the student’s clinical skills to complete an optimal echocardiographic hemodynamic assessment. The focus of the term will be the ability to integrate 2-D and echo data in an accurate patient report. Clinical Practicum IV will introduce students to congenital echocardiography, to the field of stress echocardiography, and to echocardiographic research.

**ECHO 4402. Clinical Practicum V.** (10.0 cr.; A-F only; spring, every year)
During Clinical Practicum V, the students will apply previous didactic and clinical training to complete a quality echocardiographic examination. Students will be responsible for integrating echo data, preparing preliminary echo findings and delivering the report.

**ECHO 4501. Research Project and Publication I.** (1.0 cr.; A-F only; spring, every year)
Students will be responsible for designing, developing and undertaking a research project which would be suitable for submission either to a scientific meeting or for publication. This will include developing a research question, designing and submitting a research protocol, reviewing related literature, and reporting the findings in abstract, paper, and/or a short oral presentation. Research mentors will be assigned to help guide independent study.

**ECHO 4502. Research Project and Publication II.** (1.0 cr.; A-F only; spring, every year)
This multidisciplinary course uses a blended format to introduce students to the fundamental practice, attitudes, and competencies needed by all health care providers. Professionalism, communication skills, infection control, vital signs, ergonomics, patient safety, medical emergencies, medication, and managing turbulence are reviewed. Students will practice general patient care procedures and delivery system, payment system, and supply/demand system is followed by a wider macroeconomic review to explore factors of change within the healthcare system. National health spending and the role of government and regulators in public and private health will be applied by case study and contemporary readings. The health of individuals and the health of groups will be studied in terms of cost, economic, ethical and socioeconomic disparities, and in non-Western countries. The course aims to make the language of healthcare finance and economics understandable and relevant for students in healthcare professions.

**HP 4802. Health Economics and Finance.** (3.0 cr. [max 6.0 cr.]; A-F only; spring, every year)
Students will learn micro- and macroeconomic theory applied within the healthcare sector. A flow of funds approach explores finances in healthcare transactions and incentives. Historical development of third party reimbursement, healthcare financial structures and mechanisms, individual health and public health factors affecting the delivery system, payment system, and supply/demand system is followed by a wider macroeconomic review to explore factors of change within the healthcare system. National health spending and the role of government and regulators in public and private health will be applied by case study and contemporary readings. The health of individuals and the health of groups will be studied in terms of cost, economic, ethical and socioeconomic disparities, and in non-Western countries. The course aims to make the language of healthcare finance and economics understandable and relevant for students in healthcare professions.

**HP 4902. Management and Leadership in Healthcare.** (2.0 cr. [max 4.0 cr.]; A-F only; spring, every year)
Students acquire background and skills of business/administrative aspects of healthcare. Applications of business theory are applied to medical settings. Functions of management organization models, budget and other planning, information systems, human resource functions including staff scheduling, employee evaluation, productivity management, personal accountability, group leadership, external factors including accreditation and non-Western views will be explored. Alternative theories including Systems Thinking will be explored and contrasted with traditional management.

**Humanities (HUM)**

**HUM 1431. Introduction to Philosophy.** (3.0 cr. [max 6.0 cr.]; A-F or Audit; fall, every year)
Introduction to methods of philosophical analysis. Examines a range of problems relevant to the sciences and to diverse global, cultural, scientific and religious traditions in historical and cultural contexts. Emphasis on critical thinking, communication and relevance to health sciences.

**HUM 1433. Introduction to Literature.** (3.0 cr. [max 6.0 cr.]; A-F or Audit; fall, every year)
Introduces literary genre and critical thinking. Focuses on the relationship between language and meaning in social and historical contexts. Emphasizes integration with sciences and relationship to health sciences.

**HUM 1435. Introduction to History.** (3.0 cr.; A-F or Audit; fall, spring, every year)
How historical knowledge is produced from artifacts (primary sources). Value/limitations of such sources. Approaches to the past. Thinking critically about assumptions/assertions.

**HUM 1441. Introduction to Ethics.** (3.0 cr.; A-F or Audit; prereq 1431 or 1433 or 1435 or 1441 or #: spring, every year)

Introduction to the philosophical analysis of ethical problems. Introduces ethical cases and explores methods of analysis and application of these methods to issues affecting people in everyday life. Ethical problems may be drawn from biomedicine, environment, globalization, business and sport. Emphasis on critical thinking and relevance to health sciences.

**HUM 3437. History and Philosophy of Science.** (3.0 cr.; A-F or Audit; prereq 1431 or 1433 or 1435 or 1441 or #: spring, every year)

This course will examine several historical and contemporary philosophical problems that arise within the context of scientific practice. Students will gain an understanding of the nature and historical origin of these problems and learn to critically evaluate possible solutions to these problems. Some of the problems that we will consider include: the nature of scientific explanation, the problem of induction, the problem of theory underdetermination, the social responsibilities of scientists, and scientific realism.

**HUM 3441. Ethics of Medicine and the Sciences.** (3.0 cr.; A-F or Audit; prereq 1441 or #: fall, every year)

This course enables students to engage in far more detailed and rigorous analysis of ethical problems relevant to the health sciences than is possible in introductory level courses. We will analyze problems drawn from law, medicine, healthcare, emerging technologies, and the sciences, using relevant ethical theory and the tools of philosophical argument.

**HUM 3471. Literatures of Diversity.** (3.0 cr.; A-F only; prereq [1431 or 1433 or 1435] or #: spring, every year)

Historical/contemporary analysis of the development of selfhood and identity in and across literatures of diverse populations and cultures. The course could address concerns that may include, but are not limited to race, gender, sexuality, ethnicity, religion, and issues of power/privilege.

**HUM 3481. Technology and Society.** (3.0 cr.; A-F only; prereq [1431 or 1433 or 1435] or #: fall, even years)

Historical/contemporary analysis of technology. The course explores ways in which technology influences, and is influenced by, cultures and their values and how technology figures in modes of truth production. The course could explore perspectives that may include, but are not limited to, the cultural, the philosophical, the historical and the literary.

**HUM 4721. Special Topics in Humanities.** (1.0-4.0 cr. [max 8.0 cr.]; A-F or Audit; prereq #: repeated enrollment allowed only if topics are different; fall, spring, offered periodically)

In-depth study of special topics in the humanities.

**Mathematics (MATH)**

**MATH 1090. College Algebra Short Course.** (1.0 cr.; A-F or Audit; fall, every year)

Review of fundamental concepts of algebra; set notations; introduction to function notation and graphs.

**MATH 1111. College Algebra, Trigonometry, and Precalculus.** (3.0 cr.; A-F or Audit; prereq Three yrs high school math or placement exam; fall, spring, every year)


**MATH 1161. Statistics and Discrete Mathematics.** (3.0 cr.; A-F or Audit; prereq Three yrs high school math or placement exam; fall, every year)


**MATH 1171. Calculus, Modeling, and Data I.** (3.0 cr.; A-F or Audit; prereq Grade of at least C- in [1161 or placement exam or #: fall, spring, every year])


**MATH 2161. Bioinformatics and Biostatistics.** (3.0 cr.; A-F or Audit; prereq Grade of at least C- in [1161, BIOL 2311]; fall, every year)

Retrieval of gene and protein sequence information from media (online databases, published articles, and other media); Gene and protein structure and function; Sequence recognition; Genome analysis; Sequence alignment; Phylogenetic analysis; Clinical trial and/or experiment design; Nonparametric analysis of clinical trial data; Analysis of variance (ANOVA); Logistic regression of clinical trial data; Survival analysis of clinical trial data.

**MATH 2171. Calculus, Modeling, and Data II.** (3.0 cr.; A-F or Audit; prereq Grade of at least C- in 1171 or placement exam; spring, every year)


**MATH 4721. Special Topics in the Mathematical Sciences.** (1.0-4.0 cr. [max 8.0 cr.]; A-F or Audit; prereq #: repeated enrollment allowed only if topics are different; fall, spring, offered periodically)

In-depth study of special topics in the mathematical sciences.

**Physics (PHYS)**

**PHYS 1251. Physics I.** (4.0 cr.; A-F or Audit; prereq Grade of at least C- in [1251 or equiv], Grade of at least C- in [MATH 1111 or equiv] or [MATH 1171 or equivalent] or MATH 2161; fall, spring, every year)

Fundamental principles of physics. Description of motion, forces, conservation principles, Applications to fluids, oscillations and waves. Ray optics and the eye. Information coding, including sound detection and visual perception. Focuses on biological and medical applications. Lab.

**PHYS 2251. Physics II.** (4.0 cr.; A-F or Audit; prereq Grade of at least C- in [1251 or equiv], Grade of at least C- in [MATH 1111 or equiv]; fall, spring, every year)

Fundamental principles of physics. Motion, forces and conservation principles. Applications to thermodynamics/kinetics, mass and heat transport, including osmosis, and diffusion. Electricity/magnetism. Application of electromagnetic radiation to biological systems, including photosynthesis, phototransduction, and x-ray imaging. Quantum mechanics, its application to biological systems. Feedback systems. Focuses on biological and medical applications. Lab.

**Psychology (PSY)**

**PSY 1511. Psychology.** (3.0 cr.; A-F or Audit; fall, spring, every year)

Scientific study of behavior and mental processes. Analysis of historical and contemporary paradigms in psychology, research methods, sequence and processes of human development, and the joint contribution of biological and environmental influences on behavior.

**PSY 3511. Human Development across the Lifespan.** (3.0 cr.; A-F or Audit; prereq PSY 1511; fall, every year)

This course will emphasize the diverse cultural, social, socioeconomic, and historical contexts of human development throughout the lifespan and explore how these contexts directly influence biosocial, cognitive and psychosocial aspects human development. The course will cover the basic principles of human development including: major paradigms, research methods, the sequences and processes of development, and the joint contributions of biological and environmental influences.

**PSY 3512. Principles of Abnormal Psychology.** (3.0 cr.; A-F or Audit; prereq PSY 1511 or equiv; or #: spring, every year)

Abnormal psychology is the study of the classification, explanation and treatment of abnormal phenomena and mental disorder. In this course we will focus on the major concepts and controversies in the field. We will consider how abnormality is defined and classified, and how the biological, psychological, and sociocultural paradigms contribute to understanding and treating individuals with mental disorder. The multicausality of mental disorder will be understood using a diathesis-stress model. Common types of mental disorders will be covered with an emphasis on the phenomenology of the disorder (i.e., what it is like to have the disorder), the
biopsychosocial causes of the disorder, and the major treatment approaches. Attention will be given to appreciating the impact of abnormal mental phenomena on the sufferer and their loved ones, and examining the values and ethics that apply to working with people with mental disorder.

Public Health (PUBH)

PUBH 2561. Public Health: A Global Perspective. (3.0 cr.; A-F or Audit; fall, spring, every year) Introductory overview of public health; history and contemporary principles, core disciplines, systems, problems/challenges, applications, career opportunities, etc. Discussion of the complementary roles of public health and healthcare systems in developed and developing countries. Application of public health principles to case studies from around the globe.

PUBH 3561. Environmental Health and Environmental Justice. (3.0 cr.; A-F or Audit; prereq 2561 or #; spring, every year) This course explores how environments affect both natural and built environments can negatively impact human health outcomes. We will examine major environmental health issues; exposures and diseases as well as potential prevention approaches or interventions for reducing associated disease burdens in developing and developed countries. The course also provides an introduction to the concept of environmental justice or notion that all communities, regardless of socioeconomic status, should bear an equal burden of environmental hazards.

PUBH 4561. Introduction to Epidemiology: Research and Data Exploration. (3.0 cr.; A-F or Audit; prereq 2561, MATH 1161 or #; fall, every year) Introductory overview of epidemiology and the basic science of public health. Topics covered to include history of the discipline, common epidemiologic measures, epidemiologic research designs, and basic statistics. The course also covers sources of public health data, public health surveillance, and outbreak investigation. Case studies and examples will explore epidemiologic topics/investigations in both developing and developed countries.

Radiography (RADI)

RADI 3011. Foundations of Radiography. (3.0 cr.; A-F only; fall, every year) This course introduces students to the profession and provides a foundation for understanding the radiographer’s role in a radiology department. The course also introduces the ethical responsibility to their profession, institution, and the diverse patient population is clarified through the introduction of the Radiographer’s Code of Ethics and the Patient’s Bill of Rights. The course will introduce radiographic positioning terminology as it relates to patient anatomy, exposure factors and corresponding technique chart use, interaction with patients, and methods to ensure radiation protection for patients and healthcare workers.

RADI 3101. Radiographic Procedures I. (3.0 cr.; A-F only; fall, every year) This course provides a review of the anatomy of the skeletal systems of the upper and lower limbs, the respiratory system and abdomen. Routine radiographic anatomy as well as pathology and traumatic changes demonstrated on radiographic images will be included. Methods to modify standard positioning for trauma, pathology and pediatric patients are presented. Positioning considerations and evaluating radiographs will be emphasized.

RADI 3102. Radiographic Procedures II. (7.0 cr.; A-F only; spring, every year) This course provides a review of the anatomy of the axial skeletal system and skull, the gastrointestinal system and the urinary system. Radiographic positioning instruction utilized to demonstrate the anatomy of the systems listed above is proved in this course. Routine radiographic anatomy as well as pathology and traumatic changes demonstrated on radiographic images will be included. Methods to modify standard positioning for trauma, pathology and pediatric patients are presented. Positioning considerations and evaluating radiographs will be emphasized.

RADI 3111. Radiation Physics. (2.0 cr.; A-F only; fall, every year) This course provides the student with an analysis of physics concepts in velocity, acceleration, force, weight, momentum, work, power, heat, magnetism, energy and anatomical structure, and their application for problem solving as they relate to x-ray production. The course provides an explanation of the function that electricity, magnification, transformers, and rectification play as components of x-ray circuitry. The components of the x-ray tube, their function, relations to one another and contribution to the production of x-rays are discussed and explained.

RADI 3201. Principles of Radiographic Exposure. (2.0 cr.; A-F only; spring, every year) This course begins with x-ray production. The emission spectrum from tungsten and molybdenum targets is described. Interactions of radiation with matter, dose, and the radiologic image are presented. The effect of scattered and secondary radiation on image quality and methods of control are included. Image receptors (film/screen) are discussed in terms of structure, function, types, and uses. The role of the primary variables (kVp, time mA, and SIRD) in radiography is presented. Their effects on density, contrast, and visibility of detail are defined. Methods of exposure calculation for changes in the primary variables are reviewed. Systems for building workable technique charts are presented.

RADI 3301. Clinical Practicum I. (5.0 cr.; A-F only; fall, every year) The course consists of two components; a lab practicum and a 16-week clinical rotation in the following clinical areas on the Mayo Clinic campus: Gonda 14 Orthopedics, Gonda 15 Cast room/hand clinic, Mayo EXU, Mayo GI, Mayo GI Nursing, Mayo Pediatrics, Computerized Tomography, Magnetic Resonance Imaging, Neuro-cardiovascular Imaging, SMH General, SMH Surgery, SMH Non-regular hours, SMH GI, RMH General, RMH Surgery, and Baldwin General. Lab practicum focuses on routine positioning and techniques of the spine and skull.

RADI 3302. Clinical Practicum II. (5.0 cr.; A-F only; spring, every year) The course consists of two components; a lab practicum and an 18-week clinical rotation in the following clinical areas on the Mayo Clinic campus: Gonda 14 Orthopedics, Gonda 15 Cast room/hand clinic, Mayo EXU, Mayo GI, Mayo GI Nursing, Mayo Pediatrics, Computerized Tomography, Magnetic Resonance Imaging, Neuro-cardiovascular Imaging, SMH General, SMH Surgery, SMH Non-regular hours, SMH GI, RMH General, RMH Surgery, and Baldwin General. Lab practicum focuses on routine positioning and techniques of the spine and skull.

RADI 3503. Radiographic Factor Analysis. (1.0 cr.; A-F only; summer, every year) Theoretical concepts and mathematical formulas needed to adjust exposure techniques in radiography practice will be presented in this course. Students will solve algebraic equations to determine how to make adjustments to exposure factors when changes to mA, time, kVp, screens, grids or distance are necessary. The concepts discussed are used by practicing radiographers every day in order to determine and adjust technical factors while producing images.

RADI 3603. Applied Radiography Topics. (1.0 cr.; A-F only; summer, every year) The Applied Radiography Course requires the student to perform a literature review of a radiologic topic of their choice and write a paper exploring the topic. The student must present a topic to the class and the title must include at least 50 words. The paper will include the purpose, method and scope of the literature search. The student will draw on the information and opinions of others who have written on the topic and offer their own significant opinions on the issues discussed. The paper requirements dictate that it must include 4-6 pages of text in the body of the paper and at least 6 references, 2 of which must be peer-reviewed journal articles, are required.

RADI 4101. Radiographic Procedures III. (3.0 cr.; A-F only; fall, every year) This course provides an introduction to MRI, CT, Mammography and Neuro-cardiovascular imaging. The history, theory and required equipment for the imaging modality is presented, along with an discussion on of the complementary roles of public health and healthcare systems in developed and developing countries. Application of public health principles to case studies from around the globe.
Radiation protection are included. Quality management concepts, measurements, interpretation, and correcting actions, and governmental regulations insuring compliance are presented. The theoretical concepts and practical application of fluoroscopy, tomography, automatic exposure control, and duplication of radiographs are discussed.

**RADI 4303. Clinical Practicum III.** (6.0 cr.; A-F only; summer, every year)
The course consists of two components; a lab practicum and a 16-week clinical rotation in the following clinical areas on the Mayo Clinical campus: Gonda 14 Orthopedics, Gonda 15 Cast room/hand clinic, Mayo EXU, Mayo GI, Mayo Pediatrics, SMH General, SMH Surgery, SMH trauma/portables, SMH Nonregular hours, SMH GI, RMH General, RMH Surgery, and Baldwin General. Lab practicum focuses on the anatomy, positioning and film critique of the projections covered in the Radiographic Procedures I and II courses and exposure factors learned in the Principles of Radiographic Exposure course.

**RADI 4401. Clinical Practicum IV.** (7.0 cr.; A-F only; fall, every year)
The course consists of two components; a lab practicum and a 16-week clinical rotation in the following clinical areas on the Mayo Clinical campus: Gonda 14 Orthopedics, Gonda 15 Cast room/hand clinic, Mayo EXU, Mayo GI, Mayo Pediatrics, SMH General, SMH Surgery, SMH trauma/portables, SMH Nonregular hours, SMH GI, RMH General, RMH Surgery, and Baldwin General. Lab practicum focuses on the anatomy, positioning and film critique of the projections covered in the Radiographic Procedures I and II courses and exposure factors learned in the Principles of Radiographic Exposure course.

**RADI 4402. Clinical Practicum V.** (8.0 cr.; A-F only; spring, every year)
The course consists of two components; a lab practicum and a 16-week clinical rotation in the following clinical areas on the Mayo Clinical campus: Gonda 14 Orthopedics, Gonda 15 Cast room/hand clinic, Mayo Pediatrics, Computerized Tomography, Magnetic Resonance Imaging, Neuro-cardiovascular Imaging, SMH General, SMH Surgery, SMH Nonregular hours, SMH GI/QA, RMH General, RMH Surgery, Baldwin General and optional rotations to Mammmography and Lake City Medical Center.

**Respiratory Care (Rochester) (RESP)***

**RESP 3011. Foundations of Respiratory Care.** (2.0 cr.; A-F only; fall, every year)
This course reviews the clinical roles/responsibilities and career options within the fields of respiratory care. In addition, this course provides students with a solid foundation in professional attributes, cardiopulmonary science, chemical and physics relationships, and mathematical skills to promote success as they begin the clinical-based curriculum. Students explore respiratory care subspecialties and role differences in various clinical settings. Class includes laboratory sessions, discussion, simulation and role-playing.

**RESP 3101. Respiratory Care Modalities and Equipment I.** (4.0 cr.; A-F only; fall, every year)
Students will become proficient in performing non-invasive monitoring and therapeutic procedures, including medical gas therapy, humidity and aerosol therapy, bronchial drainage and volume expansion therapy. Commonly prescribed aerosol medications will also be reviewed. Learners will practice skills using simulation-based education and in a laboratory setting. Procedures will be discussed in the context of national practice guidelines as to the scientific rationale, limitations, hazards and complications, issues of asepsis and modification to adapt to patient needs.

**RESP 3102. Respiratory Care Modalities and Equipment II.** (4.0 cr.; A-F only; spring, every year)
Students will become competent in the implementation and operation of a range of invasive monitoring devices and life support technology used in care of the critically ill patient. Learners will practice skills using simulation-based medical education and in a laboratory setting. This will include airway management, electrocardiogram hemodynamic and respiratory monitoring, and mechanical ventilation for perinatal, pediatric and adult patients.

**RESP 3201. Cardiopulmonary Patient Assessment.** (4.0 cr.; A-F only; fall, every year)
Patient assessment skills are developed to allow students to both gather and interpret a wide range of patient data. This would include the medical record, patient interview, physical examination, medical laboratory tests, pulmonary function reports (including blood gas analysis), hemodynamic record and radiographic imaging. Cardiopulmonary diseases are introduced with emphasis on pathophysiological manifestations that can be assessed. The laboratory provides a setting for role playing, mock exams and practice of assessment skills. A weekly bedside teaching case review is designed to integrate coursework, examination skills as well as the human aspect of patient care. The Mayo Multidisciplinary Simulation Center allows practice and debriefing of assessment skills in a safe environment.

**RESP 3202. Advanced Cardiopulmonary Physiology and Pathophysiology.** (3.0 cr.; A-F only; spring, every year)
The first half of the course will provide students with a detailed review of the physiology of cardiovascular and pulmonary systems. The second section involves a review of adult, pediatric and perinatal cardiopulmonary disorders. Emphasis will be placed on integrating assessment, laboratory evaluation, major pathology, pathophysiological manifestations and treatment options with focus on respiratory care. A bi-weekly bedside patient care review allows interaction with patients and application of coursework on cardiopulmonary disorders. The Mayo Multidisciplinary Simulation Center allows. Students to apply skills, knowledge and develop as reflective practitioners using simulated patients in a safe environment.

**RESP 3301. Clinical Practicum I.** (4.0 cr.; S-N only; fall, every year)
Students begin a series of rotations including 18 different clinical areas at the Mayo Medical Center. Each rotation requires completion of specific competencies. Those areas include 9 intensive care units, the operating room, emergency room, general floor care areas, pulmonary function labs, sleep disorders center, smoking cessation clinic, pulmonary rehabilitation program, home care and outpatient clinic. Learners will practice and master skills using simulation-based medical education. Students will perform respiratory care procedures and diagnostic testing with the supervision of a clinical instructor.

**RESP 3302. Clinical Practicum II.** (4.0 cr.; S-N only; spring, every year)
Students continue a series of rotations including 18 different clinical areas at the Mayo Medical Center. Those areas include 9 intensive care units, the operating room, emergency room, general floor care areas, pulmonary function labs, sleep disorders center, smoking cessation clinic, pulmonary rehabilitation program, home care and an outpatient clinic. Learners will practice and master skills using simulation-based medical education. Students will expand their competencies in adult as well as perinatal & pediatric critical respiratory care.

**RESP 3401. Seminar in Respiratory Care I.** (1.0 cr.; A-F only; fall, every year)
Students will attend weekly conferences and seminars in which issues and cases of clinical importance in respiratory care will be discussed. Students will, with faculty guidance, prepare a presentation on a topic and lead class discussion on the topic presented. The emphasis will be on a critical review of the medical literature. Effective presentation skills will be covered, (1 hour-either Pulmonary & Critical Care Medicine Case Conference or Combined Critical Care Conference) and 1 hour seminar weekly).

**RESP 3402. Seminar in Respiratory Care II.** (1.0 cr.; A-F only; spring, every year)
Students will attend weekly conferences and seminars in which cases and issues of clinical importance in respiratory care will be discussed. Students will prepare and present a case presentation and lead discussion on the case and issues raised by the case. The relevant medical literature will be critically reviewed. In the second part of the course students will gain familiarity with the common forms of medical literature and be introduced to the critical appraisal of published articles in a seminar format.

**RESP 3502. Clinical Research: Literature, Methodology, and Application.** (3.0 cr.; A-F only; prerequisite Statistics course; spring, every year)
Students will become readers and writers of research literature, especially that literature which pertains to health care. Students
will learn the methodologies of scientific investigation. Students will learn to become constructive critics of scientific investigation. The course provides study content in scientific writing, statistics, research study design, including problem statement development and protocol development, research questions or hypothesis development, feasibility analysis, sampling methods and instruments, data management, data analysis and interpretation, and dissemination of research.

RESP 4311. Advanced Perinatal and Pediatric Respiratory Care. (3.0 cr.; A-F only; fall, every year)

The didactic course combined with its clinical counterpart will allow students to assume the role of the perinatal/pediatrics specialist as defined by the National Board for Respiratory Care (NBRC). A thorough review of the literature on mechanical ventilation, monitoring applied with emphasis on an evidence-based care will be provided. Current strategies for extended mechanical ventilation or other forms of long-term support will be reviewed using case study examples.

RESP 4321. Advanced Cardiopulmonary Diagnostics. (2.0 cr.; A-F only; fall, every year)

Students will review the rationale and methods used in cardiopulmonary diagnostics. This course along with its clinical counterpart will allow students to assume the role of the advanced pulmonary function technologist and complete the NBRC's CPFT specialty board exams. Procedures in which participants would become competent include inert gas and body plethysmographic measurement of lung capacity, diffusion studies, bronchial provocation, and heart & lung function during maximal exercise. Interpretation of results and quality control in the laboratory will be facilitated by case reviews and laboratory experiences.

RESP 4331. Cardiopulmonary Rehabilitation, Disease Prevention and Case Management. (1.0 cr.; A-F only; fall, every year)

Students will review the delivery of care to chronically ill patients with lung and heart disorders with emphasis on respiratory care. The rehabilitation process will be applied to hospital-based program, extended care facilities and in the home. Topics include clinical testing, exercise prescriptions, and practice guidelines for management. Patient care reviews as part of the laboratory will underscore the multidisciplinary approach to case management and responsibilities unique to the respiratory therapist. This course along with its clinical counterpart will allow students to perform the responsibilities attributed to this subspecialty in respiratory care. Students will become certified asthma educators.

RESP 4341. Clinical Practicum III: Advanced Respiratory Care. (3.0 cr.; S-N only; fall, every year)

Students will complete competencies focused in the areas of advanced-level respiratory care including clinical subspecialties and related areas important to the respiratory care practitioner desiring greater scope of practice. Learners will practice and master skills using simulation-based medical education. Advanced Perinatal and Pediatric Respiratory Care:


RESP 4342. Clinical Practicum V: Advanced Respiratory Care. (3.0 cr.; S-N only; spring, every year)

Students will complete competencies focused in the areas of advanced-level respiratory care including clinical subspecialties and related areas important to the respiratory care practitioner desiring greater scope of practice. Learners will practice and master skills using simulation-based medical education. Advanced Perinatal and Pediatric Respiratory Care:

Clinical experiences in high-risk delivery, perinatal & pediatric intensive, inter-hospital transport and chronic care. Advanced Cardiopulmonary Diagnostics: Clinical experiences in pulmonary function testing including lung volume measurement, diffusion studies, exercise testing, sleep diagnostics, ventilation control, indirect calorimetry, provocation testing, oxygen titration and laboratory quality control. Cardiopulmonary Rehabilitation, disease prevention and case management: Clinical experiences in cardiopulmonary rehabilitation including cardiopulmonary disease assessment, disease prevention, patient family education, evaluation of impairment/disability, exercise training and social and psychological considerations.

RESP 4400. Advanced Adult Respiratory Critical Care Techniques. (3.0 cr.; A-F only; fall, every year)

Students will focus on topics relevant to providing respiratory care to critically ill adults. There will be an emphasis on reviewing case examples of cardiopulmonary problems and therapeutic procedures. However, a multi-organ system-wide patient approach will be maintained. Advanced competencies in ventilator management and critical care monitoring procedures including hemodynamic monitoring will be assured by laboratory experiences.

RESP 4401. Clinical Practicum IV: Advanced Adult Respiratory Critical Care. (1.3 cr.; A-F only; fall, every year)

Clinical experiences in intensive care of patients including post-operative general-surgical, neurology/neurologic surgery ICU, trauma care, medical ICU, thoracic surgical ICU, inter-hospital transport and hemodynamic monitoring.

RESP 4402. Clinical Practicum VI: Advanced Adult Respiratory Critical Care. (1.0 cr.; A-F only; spring, every year)

Clinical experiences in intensive care of patients including post-operative general-surgical, neurology/neurologic surgery ICU, trauma care, medical ICU, thoracic surgical ICU, inter-hospital transport and hemodynamic monitoring.

RESP 4501. Research Project I. (1.0 cr.; A-F only; fall, every year)

Students in small groups will be responsible for devising, developing and undertaking a research project which would be suitable for submission either to a scientific meeting or for publication. This will include developing a research question, devising and submitting a research protocol, carrying out the research and reporting the findings in abstract and a short oral presentation. Research mentors will be assigned to allow guided independent study.

RESP 4502. Research Project II. (1.0 cr.; A-F only; spring, every year)

Students in small groups will continue work on their chosen research project from RESP 4501. This project will be suitable for submission to either a scientific meeting or for publication. This will include developing a research question, devising and submitting a research protocol, carrying out the research and reporting the findings in abstract and a short oral presentation. Research mentors will be assigned to allow guided independent study.

RESP 4602. Grand Rounds. (2.0 cr.; A-F only; spring, every year)

This capstone course reviews allied health clinical and professional issues over a broad spectrum and also allows reflection on caregiver roles. Presentations cover a wide range of topics that impact allied health practitioners and include global views of national health policy, economics, multiculturalism/diversity, ethical and legal problems, and challenging clinical cases. Group discussion sessions provide a forum for multidisciplinary review of cases in order to bring larger issues down to individual patient and family experiences. A key element of the course will be the opportunity to both experience and apply course topics through service learning activities.

RESP 4802. Health Care Delivery Systems and Finance. (3.0 cr.; A-F only; spring, every year)

Students explore health care delivery systems including a review of health economics, third party and public reimbursement, and contemporary trends in health care organization, management and administration. Regulations, standards, quality assurance, accreditation and ethical issues are considered in the context of contemporary medical practice. Future implications for health care providers and professionals, patients and families, communities, and international health are included. This course will also provide an understanding of finance in the health care industry through a discussion of how the health care industry's financial information is interpreted and used. The course aims to make the language of health care finance understandable.
This course will explore the complicated class conflict; drug policy, legislation, and include drug use across cultures; social factors for drug use, including environmental and social stratification. Students will exercise decision-making in the context of ethical dilemmas regarding inequality, stratification, research ethics, and biomedical ethics.

SOC 3531. Health Policy in a Global Context. (3.0 cr.; A-F or Audit; spring, every year) Introduction to foundational ideas and research techniques in sociology. Includes a critical engagement with core concepts, including the sociological imagination, socialization, culture, the interplay between individuals and institutions, and social stratification.

SOC 3571. Health Policy in a Global Context. (3.0 cr.; A-F or Audit; prereq: &MATH 1161; fall, every year) This course will provide the skills and knowledge necessary to begin a clinical rotation in an ultrasound department. Students will receive lectures and participate in lab exercises to help them understand basic anatomy, physics, instrumentation, ultrasound terminology, scanning techniques, image orientation, film labeling, and scanner controls.

SONO 3111. Abdomen I Sonography. (3.0 cr.; A-F only; spring, every year) This course will present the anatomy, physiology, laboratory values, pathology, and sonographic appearances of the prevertebral vessels, kidneys, and spleen. There will be a review of scanning protocols and scanning practice in a controlled environment which will integrate course material with clinical applications.

SONO 3122. Abdomen II Sonography. (3.0 cr.; A-F only; spring, every year) This course will use lectures and scanning labs to help students learn the anatomy, physiology, laboratory values, pathology, and sonographic appearances and scanning techniques for the liver, biliary tree and pancreas.

SONO 3133. Abdomen III Sonography. (2.0 cr.; A-F only; summer, every year) This course will predominantly Blackboard course will present the anatomy, pathophysiology, laboratory values, and sonographic appearances of the GI tract, retroperitoneum, peritoneum, chest cavity, abdominal wall, as well as emergency sonography, transplant sonography and interventional applications. Emphasis and practical application will be placed on topics most commonly encountered in a typical sonography department such as appendix, FAST Scan, hypertrophic pyloric stenosis, renal-pancreas, and liver transplant and ultrasound guided sterile procedures.

SONO 3121. Cross-Sectional Abdominal Anotomy. (1.0 cr.; A-F only; fall, every year) This course will provide the student with the basic knowledge and skills necessary to perform duplex imaging of the abdominal arteries, lower extremity arteries and veins, and nonimaging testing of the peripheral vessels. Lectures and scanning labs include anatomy, pathophysiology, treatment, and testing techniques (including nonimaging vascular testing) for upper and lower extremity veins and arteries.

SONO 3313. Vascular Technology III. (1.0 cr.; A-F only; summer, every year) This course will cover anatomy, pathology, treatment, indications, and scanning techniques necessary to perform duplex imaging exams of upper extremity arteries and veins, dialysis grafts and mapping, lower extremity venous insufficiency and perforator veins, and upper and lower extremity venous mapping. Test validation and QA statistics will also be explored.

SONO 3401. OB Sonography. (2.0 cr.; A-F only; spring, every year) This course will provide the student with the necessary information to perform and
aid in interpreting normal and abnormal obstetrical sonograms. The following topics will be presented: embryology, first trimester sonography, normal fetal anatomy, amniotic fluid, invasive procedures, assessment of fetal age and growth restriction, placenta, cord, membranes, high-risk pregnancy, indications and safety.

SONO 4303. Concepts Review and Case Studies. (2.0 cr.; S-N only; summer, every year) This course provides the student opportunities to review concepts taught throughout the curriculum by completing computerized review exams and case studies.

SONO 3503. Superficial Sonography. (2.0 cr.; A-F only; summer, every year) This course will present anatomy, physiology, laboratory values, pathology and sonographic appearance of the breast, neck, prostate and scrotum. Musculoskeletal ultrasound will also be introduced. Review of scanning protocols and scanning practice will be conducted in scanning labs.

SONO 4111. Ultrasound Physics I. (2.0 cr.; A-F only; fall, every year) This course provides the student with a general overview of diagnostic pulse-echo ultrasound imaging devices, basic mathematical concepts, and knowledge of the basic physics of ultrasound and its interaction with tissue.

SONO 4112. Ultrasound Physics II. (2.0 cr.; A-F only; spring, every year) This course provides the student with a detailed description of the physics and technology of diagnostic pulse-echo B-mode ultrasound imaging devices.

SONO 4201. Pediatric Sonography. (1.0 cr.; A-F only; fall, every year) This course provides the student with necessary information about the anatomy of the neonatal brain and pathologies of intracranial hemorrhage. Other pediatric pathophysiologies are also presented including: pediatric renal/urinary tract disease, pediatric abdominal masses and neonatal hips and spines.

SONO 4301. Fetal Anomalies. (2.0 cr.; A-F only; fall, every year) The Fetal Anomalies course prepares students to define fetal pathologies and identify classic sonographic findings associated with cranial, thoracic, neck, GI, GU, skeletal, cardiac, and chromosomal fetal anomalies.

SONO 4303. Clinical Practicum III. (6.0 cr.; A-F only; summer, every year) This course is a 14-week clinical rotation in the following ultrasound areas: General, Vascular, Obstetrics, Vascular Testing Lab, and affiliate rotations. Students will learn through observation, scanning, and application of knowledge obtained during didactic coursework and scanning labs. Students will be indirectly supervised at the discretion of the Clinical Instructor.

SONO 4401. Clinical Practicum IV. (7.0 cr.; A-F only; fall, every year) This course is a 16-week clinical rotation in the following clinical areas: General, Vascular, Obstetrics, Vascular Testing Lab, Neurovascular Lab, and Breast Imaging. Students will learn through observation, scanning, and application of knowledge obtained during didactic coursework and scanning labs. Students will be indirectly supervised at the discretion of the Clinical Instructor.

SONO 4402. Clinical Practicum V. (8.0 cr.; A-F only; spring, every year) This course is a 17-week clinical rotation in the following clinical sites: General, Vascular, Obstetrics, Vascular Testing Lab, and selected specialty areas. Students will learn through observation scanning, and application of knowledge obtained during didactic coursework and scanning labs. Students will be indirectly supervised at the discretion of the Clinical Instructor.

SONO 4501. Research Project & Publication. (1.0 cr.; A-F only; fall, every year) This course provides the student with the opportunity to explore emerging technologies and advanced concepts in sonography through the completion of a research paper.

SONO 4502. Research Project and Publication II. (1.0 cr.; A-F only; spring, every year) This course provides the student with the opportunity to explore emerging technologies and advanced concepts in sonography through the completion of a poster to be submitted for competition at the Minnesota Society of Diagnostic Ultrasound (MSDU) Annual Spring Seminar, or the national SDMS meeting.

SONO 4602. Professional Growth and Development. (1.0 cr.; A-F only; spring, every year) This course provides the student with the opportunity to explore the many aspects of professionalism including: professional interactions, professional responsibilities, sonographer scope of practice, clinical practice standards, ARDMS credentialing requirements, legal issues, sonography lab expenses, interviewing and resume skills, and current sonographer issues.

SONO 4802. Mock Exams. (1.0 cr.; S-N only; spring, every year) Through a series of course reviews, mock registry examinations and information sessions, students are able to prepare for ARDMS examinations. Information on credentialing examinations, effective test-taking strategies, and ARDMS examination content are also provided. Students will be required to apply for and take the ARDMS Physics and Instrumentation board examination during the last part of Semester 5.

Spanish (SPAN)

SPAN 1520. Review of Foundations in Spanish. (1.0 cr.; A-F or Audit; prereq Previous high school or college-level Spanish coursework or equiv; Students must score above the threshold at the Entrance Placement Test; fall, every year) Catalog Description: (1.0 cr; Prereq- Previous high school or college-level Spanish coursework or equiv], %; A-F, fall, every year). Students who score above the threshold at the Entrance Placement Test have the option to enroll in a short course to review the materials covered in SPAN 1521. The course is taught utilizing many online and electronic resources, including digital video projects, online workbooks, Spanish-language news media, online radio, and social media use in Spanish.

SPAN 1521. Spanish I. (3.0 cr.; A-F or Audit; fall, every year) A communicative approach to grammar and vocabulary within the context of the health sciences. Development of listening, speaking, reading and writing skills.

SPAN 1522. Spanish II. (3.0 cr.; A-F or Audit; prereq 1521 or equiv or placement exam; spring, every year) A communicative approach to grammar and vocabulary within the context of the health sciences. Development of listening, speaking, reading and writing skills.

SPAN 2521. Spanish III. (3.0 cr.; A-F or Audit; prereq 2522 or equiv or placement exam; fall, every year) Intensive review of grammar and vocabulary within the context of the health sciences. Practice in oral and written communication.

SPAN 2524. Spanish IV. (3.0 cr.; A-F or Audit; prereq 2521 or equiv or placement exam; spring, every year) Intensive review of grammar and vocabulary within the context of the health sciences. Practice in oral and written communication.

SPAN 4721. Special Topics in Spanish. (1.0-4.0 cr. [max 8.0 cr.]; A-F or Audit; prereq #; repeated enrollment allowed only if topics are different; fall, spring, offered periodically) In-depth study of special topics in Spanish.

Writing Studies (WRIT)

WRIT 1511. Writing Studio I. (1.0 cr.; A-F or Audit; prereq Only Rochester-admitted students will be able to enroll in this course; fall, every year) Introduction to and practice of writing. Integrated into freshman academic coursework. Formal/informal writing assignments. Critical reading skills. Principles of audience, purpose, and argumentative strategies.

WRIT 1512. Writing Studio II. (1.0 cr.; A-F or Audit; prereq WRIT 1511 or #; spring, every year) Drafting, revising, editing. Integrated into freshman academic coursework. Formal/informal writing assignments. Critical reading skills. Principles of audience, purpose, and argumentative strategies. Library. Annotated bibliography.

WRIT 3511. Communication Methods. (3.0 cr.; A-F only; prereq WRIT 1512 or #, fall, every year) Theories/practices of interpersonal, small group, organizational, scientific, and technical communication. Theory and analysis of public presentation of information. Oral presentation skills. Visual communication. Small group work.