CELL AND REGENERATIVE BIOLOGY (CRB)

CRB/MED HIST 615 – REGENERATIVE MEDICINE ETHICS AND SOCIETY
3 credits.

Study of regenerative medicine and stem cell research within social, ethical and political contexts.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Understand current and past legal, political and social issues related to regenerative medicine. This includes laws and regulations, but also an understanding of clinical ethics issues, translational research and commercialization, and emerging, novel techniques requiring careful ethical consideration.
Audience: Both Grad & Undergrad

2. Understand more about relations of science, the state, and public, particularly around controversial or novel innovations and will learn how best to address emerging controversies and public concerns ethically in their professional careers.
Audience: Both Grad & Undergrad

3. Learn the guidelines for the responsible conduct of research for stem cell science, where to access regulatory and oversight documents, and how to apply for research protocols with ethics oversight.
Audience: Both Grad & Undergrad

4. Gain analytical skills for addressing policy, legal and social issues through research and writing exercises. Analytical and professional presentation skills will also be learned through classroom interactions and discussion.
Audience: Graduate

CRB 625 – STEM CELL SEMINAR
1 credit.

Examines various special topics in stem cell and regenerative medicine research.
Requisites: Junior standing
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Appreciate the broad range of stem cell and regenerative medicine research and potential clinical applications
Audience: Both Grad & Undergrad

2. Critically consider the current state of specific regenerative medicine applications
Audience: Both Grad & Undergrad

3. Evaluate the ethical and public policy questions that stem cell research raises
Audience: Both Grad & Undergrad

4. Identify and describe potential clinical applications of current stem cell and regenerative medicine research
Audience: Undergraduate

5. Apply the knowledge gained on current themes in stem cell and regenerative medicine to research in the field
Audience: Graduate

CRB 630 – PROTEOMICS APPROACHES FOR BIOLOGISTS
2 credits.

Proteomics and metabolomics are playing an increasingly important role in biology and medicine. Many biology labs are now starting to use proteomics and metabolomics in their research projects. Includes the essential fundamentals and applications in mass spectrometry-based proteomics and metabolomics to address biological/medical problems. Design of proteomics/metabolomics experiments, troubleshooting, and proper interpretation of the results.
Requisites: BIOCHEM 501, 507, or graduate/professional standing
Repeatable for Credit: No
Last Taught: Spring 2026

CRB 640 – FUNDAMENTALS OF STEM CELL AND REGENERATIVE BIOLOGY
3 credits.

Provides a foundation to understand fundamental biological, mechanistic, and experimental concepts in the field of stem cell and regenerative biology.
Requisites: BIOCORE 383, BIOCHEM 501, BIOCHEM 507, GENETICS 466, GENETICS 467, ZOOLOGY 570, or graduate/professional standing
Course Designation: Breadth - Biological Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Identify the characteristics of embryonic stem cells, induced pluripotent stem cells, and adult stem cells from cardiac, blood, neural, endodermal, and vascular tissues
Audience: Both Grad & Undergrad

2. Identify experimental technologies used to investigate stem cells
Audience: Both Grad & Undergrad

3. Present scientific articles assigned by the instructor
Audience: Both Grad & Undergrad

4. Moderate a scientific discussion among their peers
Audience: Both Grad & Undergrad

5. Critique and discuss scientific articles
Audience: Both Grad & Undergrad

6. Formulate hypotheses and propose experiments as future directions that could follow from the discussed articles
Audience: Graduate

CRB 650 – MOLECULAR AND CELLULAR ORGANOGENESIS
3 credits.

Covers the most current knowledge of the principles of organogenesis. Focuses on the molecular and cellular pathways leading to normal tissue and organ development and regeneration, including in depth discussions of specification and differentiation processes.
Requisites: (ZOOLOGY/BIOLOGY/BOTANY 151 or BIOCORE 383) and junior standing, or graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2025
Learning Outcomes: 1. Describe common biological principles of organogenesis and unique pathways for different organs
Audience: Both Grad & Undergrad

2. Describe current experimental technologies used to investigate organogenesis
Audience: Both Grad & Undergrad

3. Critically read, discuss, and summarize scientific articles
Audience: Both Grad & Undergrad

4. Recognize and restate the hypothesis underlying a research article
Audience: Both Grad & Undergrad

5. Give a formal scientific presentation
Audience: Both Grad & Undergrad

6. Identify strengths and weaknesses of different experimental approaches
Audience: Graduate

7. Propose future experimental directions based on data presented
Audience: Graduate

CRB/B M E 670 – BIOLOGY OF HEART DISEASE AND REGENERATION
3 credits.

Presents diverse topics in contemporary heart biology to facilitate understanding of biological, mechanistic, and experimental concepts of cardiac physiology, disease, and regeneration. Learn cellular and molecular mechanisms underlying heart physiology, function, disease and regenerative ability in various model systems. Includes thinking critically about methodology, experimental design and interpretation, and how conclusions are reached in heart biology through cutting-edge literature.
Requisites: (ZOOLOGY/BIOLOGY/BOTANY 151 and BIOCHEM 501) or graduate/professional standing.
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Gain knowledge of cardiovascular physiology and biology, use of genetic model organisms, stem cell biology and regenerative medicine (didactic portion of course; attendance, and exams).
Audience: Both Grad & Undergrad

2. Understand the main themes of heart biology by reading and discussing state-of-the-art literature (journal reviews; evaluated by lecturer for each journal review session).
Audience: Both Grad & Undergrad

3. Develop ability to critically evaluate published scientific research in the cardiovascular field by discussing with peers and instructors.
Audience: Both Grad & Undergrad

4. Analyze scientific data and methodology employed in the field of heart biology.
Audience: Graduate

5. Develop ability to create an experimental design for different types of heart biology research (such as hypothesis, methodology or phenomenon driven studies).
Audience: Graduate

6. Understand the current challenges for developing therapeutic strategies for heart disease and regeneration and propose feasible approaches to resolve these challenges.
Audience: Graduate

7. Understand the concepts of techniques and methods that are currently used for cardiac biology research.
Audience: Undergraduate

8. Describe the challenges for developing therapeutic strategies for heart disease and regeneration.
Audience: Undergraduate

CRB 675 – TOPICS IN CELL AND REGENERATIVE BIOLOGY
1-3 credits.

Examines various special topics in Cell and Regenerative Biology.
Requisites: (ZOOLOGY/BIOLOGY 101 and 102) or BOTANY/BIOLOGY 130 or (ZOOLOGY/BIOLOGY/BOTANY 151 and 152) or BIOCORE 383; or graduate/professional standing
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Apply, analyze, or evaluate advanced theories, concepts, or methods in cell and regenerative biology
Audience: Both Grad & Undergrad

2. Identify and describe key theories, concepts, and methods in cell and regenerative biology
Audience: Both Grad & Undergrad

3. Explore a new phenomenon or modality in cell and regenerative biology and apply the knowledge gained to research in the field
Audience: Graduate

CRB 699 – INDEPENDENT STUDY
1-4 credits.

One-on-one learning experience allowing undergraduates to work with a faculty adviser to develop research projects and skills.
Requisites: Consent of instructor
Course Designation: Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Apply concepts learned in coursework to real life situations and settings
Audience: Undergraduate

2. Read, understand, and effectively search scientific literature
Audience: Undergraduate

3. Develop critical, analytical, and independent thinking skills
Audience: Undergraduate

CRB/MEDICINE 701 – CELL SIGNALING AND HUMAN DISEASE
1 credit.

Landmark discoveries, as well as current knowledge and controversies in human health, with an emphasis on cancer biology.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Critically evaluate the primary literature underlying medical knowledge.
Audience: Graduate

2. Practice presentation and leading discussion of primary literature.
Audience: Graduate

3. Read the basic evidence underlying landmark discoveries and controversies in cancer biology.
Audience: Graduate

4. Understand how grant proposals are written and evaluated.
Audience: Graduate

CRB/GENETICS 710 – DEVELOPMENTAL GENETICS
3 credits.

Covers a broad range of topics in animal development, with an emphasis on molecular mechanisms. Focuses on common themes, with the goal of understanding and analyzing current research in developmental biology and genetics.
Requisites: Graduate/professional standing
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Fall 2025
Learning Outcomes: 1. Ability to critically evaluate published scientific work (journal reviews).
Audience: Graduate

2. Ability to communicate critical evaluations professionally and articulately (lecturer and TA feedback at each session).
Audience: Graduate

3. Develop deep knowledge of developmental biology, use of genetic model organisms, stem cell biology and regenerative medicine (didactic portion of course).
Audience: Graduate

4. Improved presentation skills (each student has a scheduled presentation four times during the semester in addition to ad hoc participation).
Audience: Graduate

5. Skills in providing feedback to peers (through student evaluations peer presentations each class period).
Audience: Graduate

CRB 720 – EXPERIMENTAL APPROACHES TO DEVELOPMENT AND ORGANOGENESIS: METHODS, TECHNIQUES, AND INSIGHTS
3 credits.

Covers the most current knowledge of the principles of development and organogenesis with a particular focus on novel experimental and analytical approaches (microscopy, single cell multi-omics, bioinformatics). Focuses on the molecular and cellular pathways leading to normal tissue and organ development and regeneration, including in depth discussions of specification and differentiation processes.
Requisites: GENETICS/CRB 710, not open to students with credit for CRB 650
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Describe common biological principles of organogenesis and unique pathways for different organs
Audience: Graduate

2. Describe current experimental technologies used to investigate organogenesis
Audience: Graduate

3. Critically read, discuss, and summarize scientific articles
Audience: Graduate

4. Recognize and restate the hypothesis underlying a research article
Audience: Graduate

5. Give a formal scientific presentation
Audience: Graduate

6. Identify strengths and weaknesses of different experimental approaches
Audience: Graduate

7. Propose future experimental directions based on data presented
Audience: Graduate

CRB 810 – MOUSE GENETICS AND EMBRYONIC STEM CELLS: LAB IMMERSION AND UNDERSTANDING CURRENT LITERATURE
2 credits.

Clinically relevant methods of scientific thought, inquiry and analysis via the presentation of specific research topics. Emerging concepts in developmental genetics and embryonic stem (ES) cell biology are used as a means of introducing the participants to the critical importance of identifying the "right" question, selecting the "best" tools to answer the question, using the appropriate logic to interpret experimental results and finally, constructing appropriate conclusions. Application of the literature of mouse genetics and laboratory research to biomedical health decisions. Strong emphasis on the tools used in the research literature and to 'get your hands dirty' learning the basics of the laboratory techniques involved.
Requisites: MED SC-M 810, 811, 812, and 813
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Learning Outcomes: 1. Demonstrate competencies in design and interpretation of mouse genetic experiments from literature.
Audience: Graduate

2. Demonstrate competencies in techniques in early embryonic stem cell fate decisions.
Audience: Graduate

3. Successful performance of basic wet lab techniques related to mouse genetic experiments
Audience: Graduate

4. Successful performance of embryonic stem cell culture derivation and differentiation.
Audience: Graduate

CRB 842 – BUSINESS OF BIOTECHNOLOGY: SUSTAINING GROWTH
3 credits.

Examine how companies gain and sustain competitive advantages.
Requisites: Declared in the Biotechnology graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Analyze industry forces and environmental trends to assess industry potential.
Audience: Graduate

2. Assess company's resources for potential to generate a competitive advantage.
Audience: Graduate

3. Identify opportunities and strategies to add or supplement capabilities.
Audience: Graduate

4. Understand the challenges and opportunities of creating value through a global strategy.
Audience: Graduate

5. Explain how companies might add value across diverse lines of business through knowledge of R&D strategic management.
Audience: Graduate

6. Understand how to apply negotiation and management skills to guide strategic change efforts.
Audience: Graduate

7. Apply tools learned across curriculum, including quantitative and qualitative analysis.
Audience: Graduate

CRB 844 – ADVANCED BIOTECHNOLOGY: GLOBAL PERSPECTIVES
3 credits.

Focuses on state-of-the-art topics of global importance in biotechnology. Skills and knowledge from previous courses are integrated and applied to achieve a new level of synthesis and depth of understanding about important programs in biotechnology today. Deepen technical understanding of novel technologies and broaden awareness of ethical and regulatory issues in biotechnology globally. Increase awareness of opportunities for intellectual collaboration and entrepreneurship.
Requisites: Declared in the Biotechnology graduate program
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Identify, research, and devise a final research topic with both faculty and peer input, from numerous perspectives (science, business, law, regulatory, ethical, and political)
Audience: Graduate

2. Summarize and communicate an assigned special topic in global biotechnology, including stem cell applications, healthcare innovations, biomanufacturing issues, or metagenomic and microbiome analysis.
Audience: Graduate

3. Demonstrate effective written and oral communication through a variety of formats and to a variety of audiences.
Audience: Graduate

4. Develop effective strategies for researching different biotechnologies in depth and critical analysis, using a variety of sources.
Audience: Graduate

CRB 845 – PROFESSIONAL DEVELOPMENT AND EFFECTIVE MANAGEMENT
1 credit.

Focus on effective management and career development. Learn and practice the applied skills needed for effective managers that lead to synergistic team success within a biotechnology company. Different communication styles will be explored that are used to engage and assess employees. Professional development will be explored to expand career pathways through networking and by generating professional resumes and interviewing skills.
Requisites: Declared in Biotechnology MS
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Analyze skills required to influence, prioritize, and set goals in a biotechnology company.
Audience: Graduate

2. Evaluate team culture in terms of what really matters to enable results and provide psychological safety.
Audience: Graduate

3. Create situational, behavioral, and impact driven feedback strategies so that both the employee and manager are successful.
Audience: Graduate

4. Explore the differences between managing and coaching the team through case studies and scenarios.
Audience: Graduate

5. Generate a career development plan that includes effective resumes, cover letters, networking, and employment research skills.
Audience: Graduate

CRB 846 – BIOTECHNOLOGY CAPSTONE
1 credit.

Goal is to identify a global biotechnology problem, find a technical solution, and analyze all aspects from a business, regulatory, and scientific perspective.
Requisites: Declared in Biotechnology MS
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Last Taught: Spring 2026
Learning Outcomes: 1. Identify an important global biotechnology-based problem and define a novel biotechnology-based solution to address it.
Audience: Graduate

2. Analyze the economic logic of the global biotechnology problem and solution. Consider customers, market, pricing, and competitors.
Audience: Graduate

3. Provide insightful business and technical questions to research including finding effective resources and subject matter experts.
Audience: Graduate

4. Discuss the global/international technical and business considerations using information and tools covered in previous courses in the MS in Biotechnology Program.
Audience: Graduate

5. Identify a company to implement your proposed solution to augment the company's current portfolio.
Audience: Graduate

6. Identify key regulatory, intellectual property, manufacturing, social, or political issues that could impact the success of the solution.
Audience: Graduate

7. Critique both technical and business considerations in a clear, concise, and logical manner to make credible technical and business solutions and recommendations.
Audience: Graduate

CRB 850 – FUNDAMENTALS OF STEM CELL AND REGENERATIVE BIOLOGY
1 credit.

Gain in-depth knowledge of the fundamentals of stem cell and regenerative biology. This knowledge forms the basis for novel translational research and both diagnostic and therapeutic options. Topics to be covered include the origins of embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs) and how they are being used for both research and for clinical applications. Read, discuss, and present cutting-edge literature on how iPSCs are being used to model a variety of human diseases and how stem cell therapies are being used to treat autoimmune disorders such as Lupus Erythematosus, Multiple Sclerosis, and Crohn's disease. Participate in the Stem Cell and Regenerative Medicine Center weekly seminar, and hear from top UW researchers about how they are using stem cells to develop therapies for bone and vascular repair.
Requisites: MED SC-M 810, 811, 812, and 813
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Learning Outcomes: 1. Describe the fundamentals of stem cell biology, including the derivation of embryonic and induced pluripotent stem cells
Audience: Graduate

2. Describe the ethical considerations for using stem cells in research
Audience: Graduate

3. Describe the ethical considerations for using stem cells in the clinic
Audience: Graduate

4. Discuss how induced pluripotent stem cells can be used to model human diseases
Audience: Graduate

5. Discuss translational approaches to use of stem cells for bone and vascular regeneration
Audience: Graduate

6. Discuss the current status of stem cell transplantation for treatment of autoimmune disorders
Audience: Graduate

CRB 860 – THE BEAT GOES ON: GENERATION AND REGENERATION OF THE HEART
2 credits.

The molecular and cellular development of the heart and of its regenerative potential. This knowledge forms the basis for novel translational research and both diagnostic and therapeutic options. Topics to be covered include the genetics underlying normal heart development as well as cardiac tissue specification and differentiation with a focus on molecular signals, associated signal transduction pathways, and transcriptional regulation. Read, discuss, and present cutting-edge literature on the genetic contributions to congenital heart defects and adult heart disease and on cardiac stem cells and the regenerative capacity of the heart. Participate in Adult and Pediatric Cardiology Grand Rounds, the Madison Perinatology Conference, learn about cutting-edge molecular diagnostics for fetal, pediatric and adult cardiac disease, and learn when and how to perform an adult echocardiogram.
Requisites: MED SC-M 810, 811, 812, and 813
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: No
Learning Outcomes: 1. Describe the fundamentals of cardiac development, including the transcription factors and signaling pathways that regulate normal cardiac morphogenesis
Audience: Graduate

2. Describe the genetic factors underlying normal and pathological cardiac development
Audience: Graduate

3. Provide examples of fetal, neonatal and adult cardiac defects that have genetic etiologies
Audience: Graduate

4. Discuss animal models and tissue-engineering systems used to investigate cardiac developmen
Audience: Graduate

5. Discuss the current status of cardiac regeneration using stem cells and resident cardiac cells
Audience: Graduate

6. Describe state of the art molecular and imaging tools used to diagnose cardiac defects
Audience: Graduate

7. Explain when each of these tools should be applied
Audience: Graduate

CRB 990 – RESEARCH AND THESIS
1-9 credits.

Research and Thesis.
Requisites: Consent of instructor
Course Designation: Grad 50% - Counts toward 50% graduate coursework requirement
Repeatable for Credit: Yes, unlimited number of completions
Last Taught: Spring 2026
Learning Outcomes: 1. Exhibit a broad understanding of general cell and regenerative biology principles.
Audience: Graduate

2. Conduct independent research using a variety of approaches.
Audience: Graduate

3. Think critically to address research challenges.
Audience: Graduate

4. Exhibit and foster professional and ethical conduct in their research.
Audience: Graduate

5. Collaborate with other investigators within or outside the thesis lab.
Audience: Graduate