School of Systems Biology

**Creativity and Innovation - Spring 2025**

**BIOL-691-001, BIMR-510-001**

**BIOL-691-DL3, BIMR-510-DL1**

**Instructors**

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**Textbook: There is no textbook required for this class**

**Credit hours:** 3.000 Credits

**Meeting days and times:** Wednesday 4:30 PM – 7:10 PM

**Building and room:** Katherine Johnson Hall room 257

**DL Class links** will be available on Blackboard.

**Course description**

Creativity and innovative thinking is the most important requirement for success in any field. Creative thinking drives all progress in the arts, the sciences, and the commercial sector. Under this philosophy, graduate students should be immersed in a culture of creativity surrounded by mentors and advisors who explain and demonstrate the creative process. Graduate students should be shown that every team member in a modern academic lab – ranging from summer scientists to tenured professors – can be the originator (and inventor) of a seminal idea that opens a whole new field.

To succeed in the current highly competitive funding climate, a scientist must submit a grant proposal that is highly daring and risky, or they will fail to gain the attention of the study section. Moreover, if the idea isn’t totally new then it cannot be patented, and it will not have a significant impact in the commercial sector. Consequently, maximizing creativity is of primary importance to maintain a competitive edge in biomedical science. We strive to ensure that our students fundamentally understand that they gain future job security in science by taking a risk in the lab. Instead of following the current scientific vogue, we want our trainees to launch the next viral idea. We aspire to graduate scientists that create new technology, propose radical hypotheses, or select radical experimental systems, not just because it is cool, and may increase the probability of winning a grant application, but because it can be used to ask, and answer, questions in biology and medicine that have never been possible before.

In the beginning of this course, students will explore the origin and value of creativity and will be presented with examples of successful disruptive ideas and ideas that failed. In week seven, the students will receive a complete tutorial on patents and intellectual property for scientists. Throughout the course, students will exercise their creative abilities to solve real world timely scientific problems posed in class.

The course will be divided into three parts.

**Part 1 Introduction to Creativity**

What is Creativity? What is the difference between creativity and innovation? How does the creative process work? Does art versus science require a separate type of creativity? How can creativity be encouraged? How is creativity suppressed or discouraged? Examples of disruptive technologies. Examples of creativity based on addressing a need. Brainstorming. Creativity by trying to predict the future. How to know when to give up on one approach and move to another. Why is creativity and risk taking the most important skill for success in science? Marketing your idea. Creativity applied to medical diagnosis and treatment. Examples of the hottest trends is science today, and the impact of “fads” in science.

**Part 2 Inventions and Patents: A practical tutorial for scientists**

Introduction: origin and value of patents. Common misconceptions about patents. Types of Patents. Meaning of Novel, Non Obvious and Useful in Patent Terms. Utility versus composition of matter. Design Patents. Plant Patents. What is not patentable based on recent Supreme Court Decisions? Co-Inventors: Who is an inventor? Provisional Patent Application. Preparing a patent application. Design and language of Claims. Examiner office actions. Patent fees and issuance. Types of Licenses. Non Disclosure Agreements. Notebook records. Prior Art Searches. What constitutes a prior art disclosure? Examples of successful and flawed patents.

**Part 3 Practicing Creativity**

Students will participate in group brainstorming sessions that is coached by the Professors who pose a specific challenge. The students will compare different approaches to generating unexpected creative lead ideas. Every week, students will be posed different practical health related scientific challenges that are within their realm of expertise. Each challenge is a problem that could lead to a patentable invention, a grant application, or a high impact publication if a creative approach can be found. The students will be divided into groups of three and each group will work on their own to develop an approach to the challenge. Each group will then present their solutions to the whole class orally, or by powerpoint or even prototype mock up. Each group will choose one challenge to be developed further as their final presentation.

**Course Grading**

Grades will be based on 1) mid-term take home exam, 2) final project (Power Point presentation and a scientific poster) and 3) class participation (35%, 35%, 30%, respectively).

***Mid-term take home exam***: Open book essay on topics covered in class related to patents and inventions. The instructors will provide a set of open questions and students will have a week to answer to all the questions.

The mid term will be graded according to the following rubric





***Final:* the final exam will have two components: a presentation and a poster.**

***Final presentation***: students will propose a solution to a given challenge using the principles of the class. Students will choose the challenge, prepare a power point presentation, and deliver it to the class during the final four classes of the semester. This is

The presentation should include:

1. Description of the problem.
2. Explanation of why past solutions have failed.
3. Description of different radical ways of solving the problem. Choice of one solution and explanation of why it is the best idea.
4. Description of how to implement your idea.
5. Description of commercial potential and societal potential.

***Poster:*** Each student shall prepare a poster; the poster should contain the following information:

1. The challenge you are addressing.

2. Your idea.

3. The way your idea addresses the challenge.

4. The way your idea compares to other approaches that already exist.

5. Methods.

  a. If the proposed idea entails an experiment or a series of experiments, outline the

  experiments, and measures of success

  b. If the proposed idea includes a clinical trial, discuss the ethical issues of your study.

  c. If the proposed idea is a device, describe how to create a prototype, and potential commercialization.

6. Brief list of references

All 6 items should be addressed in the poster for completeness. A poster template will be posted on Blackboard.

The Final project will be graded using the following rubric

<https://stearnscenter.gmu.edu/wp-content/uploads/12-CT-rubric-landscape-8-10.pdf>

**Expectations for participation:**

* Students prepare for and actively engage in class discussion (e.g., demonstrate active listening, not distracted by electronics or peers)
* Students thoughtfully engage in in-class assignments and activities
* Students constructively participate in group activities
* Students participate in class discussion by
	+ raising informed discussion points;
	+ connecting discussion to reading material, news, and relevant experiences;
	+ asking questions;
	+ listening to other perspectives;
	+ sharing the floor with others; and
	+ posting thoughtfully to course discussion boards.

Class participation rubric

|  |  |  |  |
| --- | --- | --- | --- |
|  | Strong work | Needs development | Unsatisfactory |
| Listening | Actively and respectfully listens to peers and instructor | Sometimes displays lack of interest in comments of others | Projects lack of interest or disrespect for others |
| Preparation | Arrives fully prepared with all assignments completed, and notes on reading, observations, questions | Sometimes arrives unprepared or with only superficial preparation | Exhibits little evidence of having read or thought about assigned material |
| Quality of contributions | Comments are relevant and reflect understanding of: assigned text(s); previous remarks of other students; and insights about assigned material | Comments sometimes irrelevant, betray lack of preparation, or indicate lack of attention to previous remarks of other students | Comments reflect little understanding of either the assignment or previous remarks in seminar |
| Frequency of participation | Actively participates at appropriate times | Sometimes participates but at other times is “tuned out” | Seldom participates and is generally not engaged |

**Course Learning Outcomes:**

 Demonstrate applications of acquired knowledge of the mental process of creativity. Understand the difference between creativity and innovation.

 Become acquainted with concepts in innovation and patent submission structure.

 Understand the process of going from an idea to prototype to finish product.

 Recognize pitfalls and roadblocks to successful implementation of a creative idea.

 Formulate an original research topic

 Demonstrate proficiency and excellence in the core concepts

**Definition of Grades for Graduate Courses**

|  |  |  |
| --- | --- | --- |
| Grade | Quality Points | Graduate Courses |
| A+ | 4.00 | Satisfactory/Passing |
| A  | 4.00 | Satisfactory/Passing |
| A- | 3.67 | Satisfactory/Passing |
| B+ | 3.33 | Satisfactory/Passing |
| B  | 3.00 | Satisfactory/Passing |
| B- | 2.67 | Satisfactory\*/Passing |
| C  | 2.00 | Unsatisfactory/Passing |
| F  | 0.00 | Unsatisfactory/Failing |

\* Although a B- is a satisfactory grade for a course, students must maintain a 3.00 average in their degree program and present a 3.00 GPA for the courses listed on the graduation application.

Information about additional grade notations that apply to graduate students including “IN” Incomplete and “IP” In Progress as well as grading for undergraduate students may be found in the Academic Policies section of the catalog under [Grading System](http://catalog.gmu.edu/content.php?catoid=19&navoid=4065#grading). Graduate students are not required to take midterm exams.

**Weekly schedule**

|  |  |
| --- | --- |
| **Date** | **Topic** |
| Jan 22 | Creativity / Will artificial intelligence take over the world? |
| Jan 29 | Mental process of creativity and brainstorming: where do ideas come from? / Ethics in Creativity and Innovation   |
| Feb 5 | The Future of Medicine: Critical Medical Challenges Facing Biomedical Scientists of the Future  |
| Feb 7 | Where is the new CRISPR/Cas9 technology going to come from? Plant immune response  |
| Feb 12 | Why do we dream? / Intellectual Property and Patents  |
| Feb 19 | Cracking the carbohydrate structure code |
| Feb 26 | The class will not meet to allow students to work on the midterm. The questions will be posted on Blackboard on Feb 23rd and the essay is due on March 1st. |
| Mar 5 | Debate |
| Mar 19 | Next generation wearable devices / Bioinformatics to model somatic evolution in cancer and immunity |
| Mar 26 | Cancer Immunotherapy and the mind of cancer |
| Apr 2 | How do you take your idea to a commercial product in the biotechnology sector  |
| Apr 9 | Problem roulette and shark tank |
| Apr 16 | Practicing Creativity: students’ presentations |
| Apr 23 | Practicing Creativity: students’ presentations |
| Apr 30 | Final poster presentation |
| May 7 | Final is due |

**Campus Closure or Emergency Class Cancelation/Adjustment Policy**

*If the campus closes, or if a class meeting needs to be canceled or adjusted due to weather or other concern, students should check Blackboard for updates on how to continue learning and for information about any changes to events or assignments.*

**Late-work policies.**

“Standard Deduction” Policy: any late assignment will earn a flat 10% grade deduction as long as they are completed within 7 days of the deadline.

“One Extension” Policy: for assignments that are delayed more than 7 days, any student will have the option to propose a reasonable deadline extension, subject to instructor’s approval, once during the semester (as long as they provide a plan for how they will complete the work). Ad-hoc discussion with the instructors will take place to establish the grade deduction.

**Make-up or revision work.**

The following make-up or revision work policy addresses a case when student access to or performance in the course is negatively affected by outside circumstances:

* “Discussion Forum Make-Up”: students who must miss a class meeting when their participation was expected can provide a summary, analysis, and/or additional contribution based on the day’s questions/materials, and post asynchronously by one week to earn equivalent credit

**Course Materials and Student Privacy**

*All course materials posted to Blackboard or other course site are private to this class; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.*

* *Videorecordings -- whether made by instructors or students -- of class meetings that include audio, visual, or textual information from other students are private and must not be shared outside the class*
* *Live video conference meetings (e.g. Zoom) that include audio, textual, or visual information from other students must be viewed privately and not shared with others in your household or recorded and shared outside the class*
* *Some/All of our synchronous meetings in this class will be recorded to provide necessary information for students in this class. Recordings will be stored on Blackboard [or other secure site] and will only be accessible to students taking this course during this semester.*
* *Students must use their Mason email account to receive important University information, including communications related to this class. I will not respond to messages sent from or send messages to a non-Mason email address.*

**Plagiarism:**

Plagiarism is the presentation of someone else’s ideas or work as one’s own. Students must give credit for any information that is not either the result of original research or common knowledge. If a student borrows ideas or information from another author, he/she must acknowledge the author in the body of the text and on the reference page. Students found plagiarizing are subject to the penalties outlined in the Policies and Procedures section of the University Catalog, which include a hearing by the Honor Code Committee and may include a failing grade for the work in question or for the entire course. The following website provides helpful information concerning plagiarism for both students and faculty: <http://oai.gmu.edu/the-mason-honor-code-2/plagiarism/>

**Honor Code:**

* The integrity of the University community is affected by the individual choices made by each of us. As a Mason student, you should follow these fundamental principles at all times, as noted by the Honor Code: (1) All work submitted should be your own, without the use inappropriate assistance or resources, as defined by the assignment or faculty member; (2) When you use the work, the words, the images, or the ideas of others–including fellow students, online sites or tools, or your own prior creations–you must give full credit through accurate citations; (3) In creating your work, you should not take materials you are not authorized to use, or falsely represent ideas or processes regarding your work. If you are uncertain about the ground rules or ethical expectations regarding the integrity of your work on a particular assignment or exam, you should ask your instructor for clarification. Support for you to complete your work is available; no grade is important enough to justify academic misconduct.
* As in many classes, a number of projects in this class are designed to be completed within your study group. With collaborative work, names of all the participants should appear on the work. Collaborative projects may be divided up so that individual group members complete portions of the whole, provided that group members take sufficient steps to ensure that the pieces conceptually fit together in the end product. Other projects are designed to be undertaken independently. In the latter case, you may discuss your ideas with others and conference with peers on drafts of the work; however, it is not appropriate to give your paper to someone else to revise. You are responsible for making certain that there is no question that the work you hand in is your own, and that you follow the expectations of the Honor Code. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently.
* Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else’s work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.
* Any student use of Generative-AI tools should follow the fundamental principles of the Honor Code.

**Enrollment:**

* Students are responsible for verifying their enrollment in this class.
* Schedule adjustments should be made by the deadline published on the Registrar’s website.
* Note the add/drop dates in the Academic Calendar published on the Registrar’s website.
* After the last day to drop a class, withdrawing from this class requires the approval of the dean and is only allowed for nonacademic reasons.
* Undergraduate students may choose to exercise a selective withdrawal.
* See <http://registrar.gmu.edu> for selective withdrawal procedures.

**Ethics:**
Ethical behavior in the classroom is required of every student. The course will identify ethical policies and practices relevant to course topics.

**Technology:**

Students are expected to be competent in using current technology appropriate for this discipline. Such technology may include presentation software. Students are required to become familiar with Mason’s Responsible Use of Computing Policy #1301 <http://copyright.gmu.edu/?page_id=301>

**Disability:**

* Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474
* Disability Services at George Mason University is committed to providing equitable access to learning opportunities for all students by upholding the laws that ensure equal treatment of people with disabilities. If you are seeking accommodations for this class, please first visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Then please discuss your approved accommodations with me. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474

**Diversity:**

* Women and Gender Studies seeks to create a learning environment that fosters respect for people across identities. We welcome and value individuals and their differences, including gender expression and identity, race, economic status, sex, sexuality, ethnicity, national origin, first language, religion, age and ability. We encourage all members of the learning environment to engage with the material personally, but to also be open to exploring and learning from experiences different than their own.
* The School of Integrative Studies, an intentionally inclusive community, promotes and maintains an equitable and just work and learning environment. We welcome and value individuals and their differences including race, economic status, gender expression and identity, sex, sexual orientation, ethnicity, national origin, first language, religion, age, and disability.

**Civility:**

As a diverse community of learners, students must strive to work together in a setting of civility, tolerance, and respect for each other and for the instructor. Rules of classroom behavior (which apply to online as well as onsite courses) include but are not limited to the following:

* Conflicting opinions among members of a class are to be respected and responded to in a professional manner.
* Side conversations or other distracting behaviors including cell phone use or non-class online access are not to be engaged in during lectures, class discussions or presentations
* There are to be no offensive comments, language or gestures

Students not complying will be asked to cease immediately or leave the class session.

**Sexual Harassment, Sexual Misconduct, and Interpersonal Violence**

George Mason University is committed to providing a learning, living and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and student success. GMU encourages students and employees who believe that they have been sexually harassed, sexually assaulted or subjected to sexual or interpersonal misconduct to seek assistance and support. [University Policy 1202: Sexual Harassment and Misconduct](https://universitypolicy.gmu.edu/policies/sexual-harassment-policy/) speaks to the specifics of Mason’s process, the ***Notice of mandatory reporting of sexual or interpersonal misconduct:*** *As faculty member, Drs. Liotta and Luchini designated as a “Non-Confidential Employee,” and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, stalking, sexual exploitation, complicity, and retaliation to Mason’s Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason’s confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason’s Title IX Coordinator by calling 703-993-8730, or emailing* *titleix@gmu.edu**.*