

ROB 599 003 WN 2020

[Jump to Today](#)



Instructor:

Talia Y. Moore

Office Hours Thursday 2:30-4:30pm in 3312 GGBrown

Teaching Assistant: Xun Fu

Prerequisites:

None. Just bring your open mind, fun questions, and creative ideas.

Textbook:

None. A few different books regarding biomechanics and bioinspiration are available to borrow from Dr. Moore's office or available as ebooks online.

Meeting time and place:

Lecture: Tuesday, Thursday 1:30-2:30pm 422 Space Research Building

Lab: Tuesday 2:30-4:30pm 422 Space Research Building

Rationale:

Nature is full of biological organisms that are specialized for specific tasks. By examining the process by which natural selection shapes biological forms, we can learn from nature to inspire technological design. This course will explore biological strategies for swimming, flying, terrestrial locomotion, adhesion, sensing, and construction. This will be an interdisciplinary endeavor with team-based robotic design projects.

Communication:

- Announcements will be through Canvas.
- Course Logistics can be discussed on Piazza.
 - Sign up link: piazza.com/umich/winter2020/rob599003
- Teaming surveys will be administered in Canvas
- Collaborative workspaces and storage will be through Box.

Subreddit:

Links to relevant BioInspiration articles should be posted to [reddit.com/r/bioinspiration](https://www.reddit.com/r/bioinspiration) (<http://www.reddit.com/r/bioinspiration>)

Submit your username to the professor for credit (use a throwaway if you wish)

Every week do at least one of (not all):

- Post a link about Biology that could become technology
- Post a link about Technology that was inspired by Biology
- Post a link about a group of people working on BioInspiration
- Comment on 3 other links with meaningful discussion

Bioinspired Design Projects:

Three bioinspired design opportunities will be offered.

1. Print a Prosthetic Hand for Children. This will get you familiar with some of the equipment available to you in lab and introduce you to our team-based labs.
2. Create a Gecko-inspired adhesive. In the first session, teams will manufacture a gecko inspired adhesive and analyze the adhesive. In the second design session, teams will use their gecko-inspired adhesive as a design tool to propose a new product.
3. Test a Legged Robot. In the first session, teams will design an experiment to test the performance of the robot under different modifications. In the second design session, teams will use their robot as a design tool to propose a new product.
4. Novel Bioinspired Design. The final exam will be a 5 min video of a bioinspired design of your team's choice. Teams will select a journal publication with a biological discovery and extract the principle. Teams will then create a mock-up, prototype, and/or computer simulation/animation in combination with the setting in which your design is to be used. Designs should include possible societal impacts (health, fitness, environment, safety, security, education, connections to others or community, assisting underserved, disabled populations or underdeveloped countries, sports and entertainment). Resources from Lab will be available. The video must be posted to the assignment page in Canvas by midnight on April 20th. (You will NOT have a written exam.)

Grading:

- 5% SubReddit Participation
- 5% Class Participation (3 unexcused absences ok)
- 5% Prosthetic Hand
- 20% Midterm (in-class multiple choice)
- 5% Individual Design Assignments (decompose 2 papers)
- 15% Team Gecko Project
- 15% Team Kamigami Project
- 30% Team Final Design Project (5 min team video)
- Extra points for surveys! (1 point per survey)

Final grades are based both on an absolute scale, as well as a curve, along with potential positive effort adjustments. Our absolute scale is 100-90 A; 90-80 B; 80-70 C; 70-60 D; <60 F. Curve – In the unlikely event that assignments or grading show that the absolute scale is too high, we will lower the curve (e.g. 100-85 A; 85-75 B; etc; We will not raise it to make it more difficult to get a grade). At the end of the semester, we will all meet to discuss any student who is in the gray zone between grades. If you have shown effort, engagement, and improvement, you will receive the next higher grade. We will not pull down a student to a lower grade.

Academic accommodations:

Please make certain that you contact the Office of Services for Students with Disabilities at least 2 weeks before the midterm so that we can make accommodations.

Policies:

Honor code:

We expect students to act in accordance with the University of Michigan Engineering Honor code, available in the sidebar.

Exam:

We will not administer a make-up midterm exam. If you have to miss an exam for a valid, unforeseeable and urgent reason, your grade will be pro-rated. If you do find yourself facing an unforeseen emergency, please contact us as soon as possible to let us know. Documentation will be required. Please note: this policy is for valid emergencies. Students are otherwise expected to complete all assignments. While we will remind you about exam logistics, you are responsible for making sure that you complete every question and turn in the exam before you leave the room in which it is administered. We will not accept your exam after you have left the classroom.

Design assignments:

Only a documented illness or some other unforeseeable emergency will allow us to grant you a due date for a design assignment that is later than what is posted on this syllabus or in a Canvas Announcement. Anticipated events do not count as acceptable reasons for turning in your assignment late as you can and should plan ahead and turn your assignment in early. If your assignment is late, please still submit as soon as possible. You will lose a point for each day late.

Attendance in lecture:

We do not enforce attendance. That said, be advised that the midterm exam content will primarily derive from lectures. It is *strongly* recommended that you do not skip lecture. We grant 3 unexcused absences from lecture before points are lost.

Attendance in lab section:

Again, we do not enforce attendance, but will periodically take attendance. Design project attendance is mandatory and is part of your grade. It is *strongly* recommended that you do not skip your discussion section.

Recording lectures:

Lectures may NOT be recorded using audio or photographic equipment without the prior written permission of Dr. Moore or by formal recommendation of the Office of Services for Students with Disabilities. Lectures are comprised of copyrighted intellectual material, and the recording and sharing of that material without express permission is a violation of copyright and personal privacy. Additionally, the discussion of sensitive issues in this class requires that students feel safe to express their opinions without fear of future reprisal or exposure. Students caught recording course lectures using cameras, audio, or video equipment without prior notification and permission will be asked to leave the class. In addition, it is a violation of copyright to sell notes, assignments or exams to on-line companies.

Surveys and self-reports:

You will be asked to take part in a series of surveys and self-reports to help improve the course. These are anonymous and you are not required to answer all questions.

Schedule:















Date	Lecture	Lab/Discussion	Notes
Jan 9	Introduction		
Jan 14	BioDiscovery - How to discover nature's principles?	Lit search, Assign Gecko Paper 1	
Jan 16	BioDesign - How do I design from nature?		Gecko Paper 1 Due
Jan 21	BioConstraints - How are Nature's designs compromised?	Form teams, prosthetic hand activity (Guest speaker Michael Gonzalez), understanding scientific publications, Assign gecko paper #2	Teaming Survey Due
Jan 23	BioSelection - How do I select the best inspiration?		
Jan 28	BioScaling - How do I consider size?	Review Assignment 2. Discovery Decomposition and analogy check. Assignment #3 Select your own publication, do decomposition and check	Gecko Paper 2 Due
Jan 30	BioComplexity - How to simply and extract principles?		Recorded Lecture (last covered in midterm)
Feb 4	BioAdhesion	Assembly, Assist with Assignment 3,	Finger Selfie Due

		Teaming Tools	
Feb 6	BioAdhesion		
Feb 11	BioMotion - Walking	Review assignment 3, Gecko adhesive design project part 1	Assignment 3 Due
Feb 13	BioMotion - Running		
Feb 18	BioControl	Gecko Adhesive design project part 2	
Feb 20	BioSensing		
Feb 25	Q and A for midterm	Extra time for Gecko project	no lecture
Feb 27	Midterm		no lecture
Mar 3	Spring Break		no lecture
Mar 5	Spring Break		no lecture
March 10	BioPower - Nature	Dash Robot Design Project Part 1	
March 12	BioPower - Technology		
March 17	BioMaterials	Dash Robot Design Project Part 2	
March 19	BioMotion - Swimming		
March 24	BioMotion - Flying	Work on final project, teaming exercises	
March 26	BioProsthetics		
March 31	BioAnimation	Work on final project, teaming exercises	Research Publication Selection and Collaborative Plan due
April 2	Virtual Q and A with Bob Full		
April 7	Guest Lecture Paul Webb	Work on final project	
April 9	Jerboa Lecture with Mammalogy		BSB 1010 on Central Campus 1-2:30pm
April 14	Guest Lecture Kaushik Jayaram	Work on final project	
April 16	Team Project Preparation		
April 21	Summary	Present Final Design Projects	

Course Summary:

Date

Details

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Tue Jan 14, 2020	 r/BioInspiration username (https://umich.instructure.com/courses/345747/assignments/917459)	due by 1:29pm
Tue Jan 21, 2020	 Gecko Paper 1 (https://umich.instructure.com/courses/345747/assignments/914683)	due by 1:30pm
	 Teaming Survey (https://umich.instructure.com/courses/345747/assignments/958067)	due by 11:59pm
Tue Jan 28, 2020	 Gecko Paper 2 (https://umich.instructure.com/courses/345747/assignments/914684)	due by 1:30pm
Tue Feb 4, 2020	 Prosthetic Fingers (https://umich.instructure.com/courses/345747/assignments/914686)	due by 1:30pm
Tue Feb 11, 2020	 Prosthetic Hands (https://umich.instructure.com/courses/345747/assignments/914687)	due by 1:29pm
	 Self-guided Decomposition (https://umich.instructure.com/courses/345747/assignments/914685)	due by 1:30pm
Thu Feb 27, 2020	 Midterm Exam (https://umich.instructure.com/courses/345747/assignments/914688)	due by 1:30pm
Fri Feb 28, 2020	 Gecko-Inspired Adhesive Design Project (https://umich.instructure.com/courses/345747/assignments/917425)	due by 8:59pm
Tue Mar 24, 2020	 Kamigami Robot Design Project (https://umich.instructure.com/courses/345747/assignments/917427)	due by 1:29pm
Tue Mar 31, 2020	 Final Project Selection and Plan (https://umich.instructure.com/courses/345747/assignments/917457)	due by 1:29pm
Mon Apr 20, 2020	 Final Video Project (https://umich.instructure.com/courses/345747/assignments/917430)	due by 11:59pm
	 Class Participation (https://umich.instructure.com/courses/345747/assignments/917461)	
	 r/BioInspiration participation (https://umich.instructure.com/courses/345747/assignments/949069)	