Montana State University
Department of Food Systems, Nutrition, and Kinesiology
KIN 325R: Biomechanics, Spring 2025

Meeting Times and Location:

Lecture:

- Time: Tuesday and Thursday 9:25 – 10:40 AM
- Location: Reid 104.

Lab:

- All labs take place in: Harrison 101A
- Times: Tuesdays 11:00 AM – 12:50 PM
  Tuesdays 1:10 – 3:00 PM
  Tuesdays 3:10 – 5:00 PM
  Wednesdays 12:10 – 2:00 PM
  Wednesdays 2:10 – 4:00 PM
  Thursdays 3:10 – 5:00 PM

Teaching Team:

Lecture Instructor

- **Dr. Jim Becker**
  - E-mail: james.becker4@montana.edu
  - Office: Student Wellness Center 0223
  - Open lab/office hours: Mondays 3:00 – 5:00 pm

Graduate Teaching Assistants:

- **Isaac Burgess**
  - Labs: Tuesdays 11:00 – 12:50 & 1:10 – 3:00 PM
  - E-mail: isaacburgess@montana.edu
  - Open lab/office hours: Fridays 12:00 – 2:00 PM
- **Ethan Livingood**
  - Lab Sections: Tuesdays & Thursdays 3:10 – 5:00 pm
  - E-mail: ethanlivingood@montana.edu
  - Open lab/office hours: TBA
- **Allie Lynch**
  - Lab Sections: Wednesdays 12:10 – 2:00 PM & 2:10 – 4:00 PM
  - E-mail: alexandralynch@montana.edu
  - Open lab/office hours: Mondays 10:00 am – 12:00 pm

University R Core Course

This course meets University R requirements for the core curriculum. To do so effectively, the course emphasizes the following points:

Core Qualities:

1. Effective Communication: This course requires effective communication in both written and oral forms. Through weekly lab reports you will practice concise scientific writing where you present the problem and your hypotheses, summarizes your methods used to collect and analyze data, present results in a variety of formats (text, tabular, graphical), and synthesize your results with previous studies to

develop more comprehensive understanding of the topic. You will apply these skills in a cumulative research project where you write a scientific paper and develop and give an oral presentation as if you were presenting your work at a scientific conference. Along the way you will practice providing feedback and peer review to your fellow students to assist in improving the quality of written and verbal communication.

2. Thinking and problem solving: The course requires that you develop a research question in the field of biomechanics, design a study protocol to answer that question, and conduct the study including processing and analysis of all data. During your oral presentation you will also answer questions from the audience regarding your project which will include critiquing the pros and cons of your chosen research design.

Core Perspectives: This research (R) course will build on research skills you have developed in prerequisite courses including research methods and statistics. You will have the opportunity to develop a research question and design a study to address this question. Along the way you will learn how to use state of the art technology for research in the field of human movement analysis. You will integrate your findings with previous studies on the topic to explain your results, to discuss limitations to your experiment, and to suggest areas for future research.

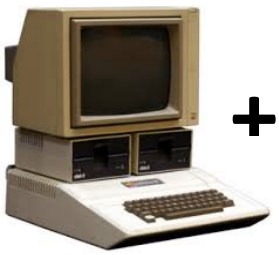
Course Description:

This course is designed to introduce students to the field of biomechanics. We will specifically focus on the application of Newtonian physics to describe and analyze human movement, and the course will incorporate both lecture and laboratory components. In the lecture component students will be introduced to basic mechanical principles and gain experience applying these principles to the analysis of human movement. Most days students will have the opportunity to challenge their understanding of biomechanics through sample exam questions, discuss and solve problems with their peers, and analyze clinical case scenarios relating to injury and/or performance. The laboratory component will serve as a venue for students to gain hands on experience with laboratory methods currently used within the field, and further solidify their ability to both qualitatively and quantitatively analyze human movement. The laboratory section is designed to complement the lecture component and students must be enrolled in both lecture and a laboratory section.

Prerequisites: Mathematics: M151 (Precalculus) or M161 (Survey of Calculus); Anatomy: BIOH 201 (Human Anatomy & Physiology I); Physics: PHSX 205 (College Physics); Kinesiology: KIN 322 (Kinesiology); Research Methods: HDFS 371 (Research Methods); Statistics: STAT 216Q (either a pre or co-requisite).

Required Resources:

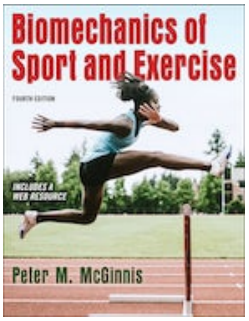
A calculator which, at a minimum, can perform trigonometric functions. Graphing calculators are acceptable as well. Students should **NOT** plan to use their phone as their calculator



You will need regular access to a computer in this course. Many of the labs will involve collecting and analyzing data. For most of them you can use your own laptop if desired. Since the lecture portion of this course will be conducted online you will also require a web-browser (i.e. Firefox, Internet Explorer, Chrome), working webcam, WebEx, and Adobe reader (or other suitable software for reading and saving pdf files).

For lab, you will also need a word processing program (i.e. Microsoft Word), a spreadsheet program (i.e. Microsoft Excel), statistical analysis software (i.e. SPSS or R), and presentation generation software (i.e. Microsoft Powerpoint). Information for downloading additional software which will be used in the laboratory sections will be provided during the lab sections.

Optional Resources:



Title: Biomechanics of Sport and Exercise.
Author: Peter McGinnis
ISBN: 978-0736079662
This text can serve as both a general resource and source for problems and exercises over the course of the semester. Older versions of the textbook are acceptable as well.

Scanning App
Many assignments, as well as the problem portions of exams, will be turned in online. For ease of organization, some assignments will need to be turned in as a single PDF file. There are numerous free apps available which accomplish this goal. If you have a question about one please see a member of the teaching team.

Course Philosophy:
It is the teaching team's intent to provide an environment which facilitates active learning. As such, during lecture periods students will be encouraged to discuss information while interacting with their peers and the instructors. Weekly assignments will provide students with opportunities to apply the information and problem solve beyond the examples discussed in lecture.

Respect for Diversity: It is the teaching team's intent that students from all diverse backgrounds and perspectives be well-served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is the teaching team's intent to present materials and activities that are respectful of diversity: gender identity, sexual orientation, disability, age, socioeconomic status, ethnicity, race, religion, culture, perspective, and other background characteristics. Your suggestions about how to improve the value of diversity in this course are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course for you personally or for other students or student groups.

In addition, in scheduling exams, I have attempted to avoid conflicts with major religious holidays. If, however, I have inadvertently scheduled an exam or major deadline that creates a conflict with your religious observances, please let me know as soon as possible so that we can make other arrangements.
(Adapted from University of Iowa)

Inclusivity Statement: The teaching team supports an inclusive learning environment where diversity and individual differences are understood, respected, appreciated, and recognized as a source of strength. We expect that students, faculty, administrators and staff at MSU will respect differences and demonstrate

diligence in understanding how other peoples' perspectives, behaviors, and worldviews may be different from their own.
(Adapted from the University of Northern Colorado)

Student Learning Objectives:

Upon completion of this course students will be able to:

1. Describe fundamental mechanical principles underlying kinematic and kinetic analysis of human movement (including the nature of scalar and vector quantities; how to resolve and combining force vectors; the various types of motion experienced by the human body; basic kinematic parameters of distance, displacement, speed, velocity, and acceleration as they relate to both linear and angular motion; the relationship between linear and angular kinematics; the behavior of projectiles; basic kinetic parameters of force, torque, inertia, mass, momentum, and weight as they relate to both linear and angular kinetics).
2. Explain the linear and angular forms of Newton's laws of motion and apply these laws to analyze human movement in healthy and pathologic populations.
3. Describe how to determine the whole-body center of mass, the relationship between center of mass motion and stability, and explain how controlling center of mass motion influences sports performance or may be altered in clinical populations.
4. Explain the biological and mechanical mechanisms by which muscles produce movement.
5. Apply biomechanical principles to analyze "real-world" questions regarding clinical rehabilitation or sport performance.
6. Design, conduct, analyze, and interpret biomechanics research while communicating results in written and oral formats.

Grading Policy and Distribution Across Assignments

The following grading scale will be used for determining final letter grades in this course:

Numeric Score	Letter Grade	Numeric Score	Letter Grade
> 93:	A	77 – 79.9	C+
90 – 92.9	A-	73 – 76.9	C
87 – 89.9	B+	70 – 72.9	C-
83 – 86.9	B	67 – 69.9	D+
80 – 82.9	B-	63 – 66.9	D
		60 – 62.9	D-
		Below 60	F

Please note that grades will **NOT** be assigned on a curve in this course, so you are **NOT** in competition with any of your fellow students.

Grades will be distributed across the various activities in the course as follows:

Lecture (65% of course)	Homework	15%
	Exams (2 Midterms exams at 15% each and Final Exam - 20%)	50%
Lab (35% of course)	Pre-Lab Quizzes	5%
	Lab reports (5 reports)	10%
	Final lab project and presentation	20%

Description of Course Activities:

Homework:

- Overview:
  - These assignments will serve to prepare students for class so they can better participate in class activities, provide students with an opportunity to organize required content and information in a manner which best suits their learning preference, and provide students with opportunities to practice problems similar to those they will be asked to solve on exams.
  - Assignments are due on the day indicated and should be turned at the end of class that day unless otherwise specified by the instructor.
  - Students will be allowed to use their completed assignments on the exams.
  - Students will have one "freebie" missed assignment for which they will not be penalized.
- Where are they located and how are they turned in:
  - Assignments can be found in the External Brains folder on D2L. The list of assignments and due dates will be updated as the semester progresses based on where we are in the class.
  - Hard copies of assignments will be turned into the appropriate folders in class. Electronic copies of the assignments may be submitted to the appropriate D2L assignment folder. **In order to receive a grade all parts of the assignment must be included in a single PDF file.**
- How they are graded:
  - Assignments are graded based on the guidelines and rubric which can be found in the External Brain folder on D2L.
  - No late assignments or revisions of original will be accepted without prior approval from the course instructor or documented illness, injury, or hardship.

Exams:

- Overview:
  - Each exam will have two parts. Part 1 will be closed book and will consist of a combination of short true/false, multiple choice, and math-based problems, and will be completed by each student on their own. This part counts for 80% of the final exam score. For part 2 of the exam students will work in small groups to re-take the entire exam as a group. They may research answers, use their class assignments or other resources, and discuss with their group members. One final set of answers will be submitted for each group. The part 2 will be worth 20% of the final exam score. The part 2 is intended to make each exam a learning experience as well as an assessment. However, it is optional and if a student chooses not to complete a part 2 then their entire exam score will be based on their individual part 1 answers.
  - All exams are cumulative.
- When are exams and how are they completed:
  - The dates of exams are shown in the course schedule at the end of this document.
- Final Exam:
  - The final exam will be given during date indicated in the Registrar's calendar for final exams. This is also shown in the schedule at the end of this document.
  - The format will be similar to exams 1 and 2 and consist of closed and open notes sections.

- Variable Grading Options for exams:
    - In line with the course philosophy, the exam weightings are structured to allow students to demonstrate their learning over the duration of the semester. This approach also allows flexibility for unexpected scenarios which occur over the semester. The different exam weights are shown below. Final course grades will be calculated using the option which produced the highest possible result for students:

Exam	Option A	Option B	Option C	Option D	Option E
Midterm 1	15%	0%	25%	10%	5%
Midterm 2	15%	25%	0%	15%	5%
Final Exam	20%	25%	25%	25%	40%
Total Contribution to final course grade	50%	50%	50%	50%	50%

Pre-lab Quizzes:

- Overview:
    - The pre-lab quizzes are designed to help students prepare for the laboratory activity each week. After reading the lab packet students should be able to provide background information about the lab, as well as descriptions of procedures and equipment being used in the lab.
- Where are they located and how are they turned in:
    - Pre-lab quizzes can be found in the quizzes folder on D2L. They must be completed before lab. Since the quizzes are designed to help students prepare for lab, late quizzes will **NOT** be accepted. If you know you will miss a lab please make arrangements to complete the quiz with your lab instructor **before** the lab section.

Lab Reports:

- Overview:
    - Lab reports will provide an opportunity to practice written scientific communication. Each lab report will have an introduction, methods, results, and discussion section, and they are designed to build towards the final project. More specific details for each report will be provided in lab.
- When are they due and how are they turned in?
    - Lab reports are due 1 week following the completion of the lab. They are turned in to the appropriate assignments folder on D2L.

Final Lab Projects and Presentation:

- Overview
    - One of the most important aspects of a laboratory component is that it provides students with an opportunity to become a practitioner in the field they are studying…in this case examining problems like a biomechanist. The final project will take place either during lab time or other times students chose to work during the last half of the semester. In the project students will apply the tools and techniques they have learned over the course of the semester to perform both qualitative and quantitative analyses of an activity of their choice. Specific details of the project will be discussed in lab.
- When are they due?
    - Final papers will be due the last week of lab. Presentations will occur in lab during this week. If you know ahead of time that you are not going to be in lab this week please make sure to include that when groups are formed for the projects in the middle of the semester.

Montana State University and Instructor Policies:

Health Related Class Absences: Please evaluate your own health status regularly and refrain from attending class and other on-campus events if you are ill. Students who miss class due to illness will be given opportunities to access course materials online and make up assignments. You are encouraged to seek appropriate medical attention for treatment of illness. In the event of contagious illness, please do not come to class or to campus to turn in work. Instead notify me by email about your absence as soon as practical, so that accommodations can be made. Documentation (a Doctor's note) for medical excuses is not required. MSU University Health Partners - as part their commitment to maintain patient confidentiality, to encourage more appropriate use of healthcare resources, and to support meaningful dialogue between instructors and students - does not provide such documentation.

Student Conduct and Plagiarism: All assignments should be completed by the student submitting them. Students are not allowed to collaborate on any assignments, lab reports, or part 1 of exams for this course. All assignments should be original works with proper citations. If it is found that a student has plagiarized on the assignment, a first offence that is deemed small will result in loss of credit for that assignment. If the first offence is serious and willful, the student will loss credit for that assignment, their overall grade will be dropped by 1 letter, and they will be reported to the Board of Conduct at Montana State University. A second small offence will result in losing credit for the assignment, loss of one letter grade, and being reported to the Board of Conduct at Montana State University. A second serious and willful act of plagiarism will result in the failure of the course and more serious sanctions from the Conduct Board at Montana State University. For questions on plagiarism, please see the Montana State University student code of conduct: http://www.montana.edu/policy/student_conduct/

Adding, Dropping, and Withdrawal from the course: Student wishing to enroll in the course may do so using MyInfo until **January 23rd**. The last day to add classes with an Add/Drop form is **January 30th**. It is also the last day to drop a course online using MyInfo. The final day to drop classes without a 'W' grade is **February 6th** and students who have not paid their fees will be automatically dropped by 4:30pm that same day. During the final three weeks of the semester (**after April 17th**) withdrawals are generally not permitted except for exceptional circumstances outside the student's control (serious illness, accident, death in family, etc…). If such a situation arises, students should discuss with the instructor the feasibility of receiving an "I" and making up required work to finish the course.

Behavioral Expectations: Montana State University expects all students to conduct themselves as honest, responsible and law-abiding members of the academic community and to respect the rights of other students, members of the faculty and staff and the public to use, enjoy and participate in the University programs and facilities. For additional information reference see: http://www2.montana.edu/policy/student_conduct/cg600.htm.

Students with Disabilities: If you are a student with a disability and wish to use your approved accommodations for this course, please contact me during my office hours to discuss. Please have your Accommodation Notification or Blue Card available for verification of accommodations. Accommodations are approved through the Office of Disability Services located in SUB 174. Please see Disability Services for more information by clicking here.

Missed Lecture and Lab Policy: As the course schedule with exact exam, lab, and assignment due dates are published on the first day of class, students are expected to adhere to these deadlines. No extensions, late work, or revisions will be allowed for assignments and exams will not be re-scheduled. However, if a student has an illness, injury, or hardship the instructor will try to make appropriate accommodations for the student.

Students should make every effort to alert the instructor about an illness, injury, or hardship that will interfere with them attending class or turning in assignments as quickly as possible.

The Final Word: It is the intent of the teaching team to be as flexible and collaborative as possible. However, this requires communication. This is a two way process, we will communicate our expectations to you and we expect that should any circumstance arise which requires accommodation that you communicate with us, preferable well in advance, though we recognize this may not always be possible. If we don't know what is going on we cannot accommodate to help. Please help us help you be successful in this course.

Tentative Course Schedule:

Week	Date	Lecture Topic	External Brain Assignments*	Lab
1	Tues 1/14	Intro to course		
	Thurs 1/16	Intro lab reports / Field of Biomechanics	Chap 1, Sec 1-3	
2	Tues 1/21	Forces	Chap 2, Sec 1-3	Lab 1 – Math and Excel review Online Lab – See D2L
	Thurs 1/23			
3	Tues 1/28	Forces	Chap 2, Sec 4-5	Open lab work time
	Thurs 1/30	Torque		
4	Tues 2/4	Torque	Chap 2, Problems & Chap 3, Sec 1-3	Lab 2 – Torque and moment arms
	Thurs 2/6			
5	Tues 2/11	Static Equilibrium		Lab 3 – Quantitative video analysis
	Thurs 2/13		Chap 3, Problems	
6	Tues 2/18	**Midterm 1 - Individual**		Lab 4 – Vertical jump
	Thurs 2/20	**Midterm 1 – Group Portion**		
7	Tues 2/25	Center of Mass	Chap 4, Sec 1-3	Lab 5 – EMG
	Thurs 2/27			
8	Tues 3/4	Linear Velocity and Projectile Motion	Chap 4, Problems & Chap 5, Sec 1-3	Intro to projects
	Thurs 3/6		Chap 5, Sec 4	
9	Tues 3/11	Linear Kinetics	Chap 5, Problems & Chap 6, Sec 1-2	Data collection time and work time (for those not collecting data)
	Thurs 3/13			
Spring Break No Class 3/17 – 3/21				
10	Tues 3/25	Angular Kinematics		Data collection time and work time (for those not collecting data)
	Thurs 3/27			
11	Tues 4/1	**Midterm 2 - Individual**		Draft – intro/methods Practice presentations work time
	Thurs 4/3	**Midterm 2 – Group Portion**		
12	Tues 4/8	Angular Kinetics		Project work time
	Thurs 4/10			
13	Tues 4/15	Work, Energy, and Power		Draft – results/discussion Practice presentations
	Thurs 4/17	Mechanics of Biologic tissues		
14	Tues 4/22	Muscle mechanics		Project work time
	Thurs 4/24			
15	Tues 4/29	Wrap up and review		Presentations and final papers due
	Thurs 5/1			
Final Exam – Tuesday, May 6th 8:00 – 9:50 AM in Reid 104				

* The rest of the External Brain due dates will be updated as the semester progresses based on the pace at which we are moving through the material.