



Muscle Physiology

HLTH 147-01

CRN: 81438

4 Credits

Professor: Courtney Jensen, Ph.D.
Graduate Assistants: Stacey Ugale, Addisen Azevedo
Class Location: WPC, room 224
Class Days: Monday, Wednesday, Friday
Class Times: 9:30am – 10:45am
Lab Location: Main Gym, room 103
Lab Days/Times: Tuesdays at 10:00am or 11:00am
Office Hours: *CJ:* Mon & Wed: 11:00 to 12:15pm
Location: DUC Fireside
SU: Mon: 2:00pm to 3:00pm
AA: Mon: 11:00am to noon
Location: GA Office



(209) 946-3133



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SU: s_ugale@u.pacific.edu
AA: a_azevedo3@u.pacific.edu

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1. Structure of the Course

The semester begins on Monday, August 26, 2024. We meet every Monday, Wednesday, and Friday (except for holidays, of course) in WPC, room 224.

In previous semesters, students have struggled with my exams. Mean scores were 65-75%. And the mean overall course grade (over 8 years) was under 78%. The lectures were heavy and there were no assignments to help students prepare for the exams. Last semester, I tried something new. And the mean score went up ~10%. So I'm repeating it.

Here's how it works:

I have lecture recordings, which are more direct and concise than my standard lectures. The entire semester is already posted at <https://musclephys.com>.

During class, we will do quizzes based on those lectures. Each day's quiz is worth 1 point... of extra credit. You cannot *lose* points in class. You can only gain extra credit. And the questions are designed to prepare you for the exams. If you know the answers to every quiz question, you'll know the answers to every exam question.

There are 42 total class sessions (counting the final exam and the 3 "midterms"). During the classes before exam days (September 18, October 16, and November 22), I will lecture. No quizzes on those days. During the 3 class sessions before the final (December 2, 4, and 6), I will lecture. No quizzes. That leaves 29 quiz days (I'll lecture for brief period on each, but the bulk of those days is the quizzes).

The maximum amount of extra credit you can get is 25 points. In other words: if you do every extra credit assignment, 4 classes won't count. That way, if you're sick or have scheduling conflicts, you're not penalized for missing a week and a half. Because nobody wants a sick person to show up. (Me most of all: I have a compromised immune system and if sick people come to class, that could end the semester for me.)

The exams are still going to be hard, but this structure should help everyone succeed.

As long as you do both (watch the recordings and do the quizzes), everyone should get a grade they're happy with. And (the most important part to me), you should learn everything I think is important.

Okay, that's all.

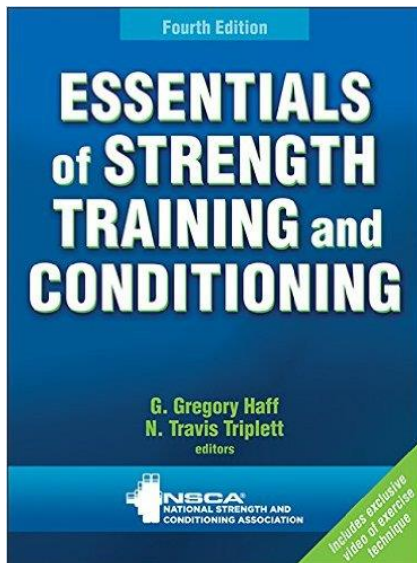
2. Purpose of the Course

Catalog description: HLTH 147. Muscle Physiology. 4 Units. This course is focused on skeletal muscle physiology. Topics include the structure and function of muscle tissue, protein synthesis, cell signaling cascades, the specificity of adaptation, enzymes and their roles in metabolism, endocrine function, anabolic steroids, muscle damage, inflammatory physiology, neuromuscular principles (e.g., size principle), and the mechanisms of muscle fatigue. Laboratory assignments focus on skeletal muscle testing and evaluation. Prerequisite: HESP 129 and upper-division class standing. Lab fee required.

HLTH 147 is designed for Health, Exercise, and Sport Science majors who have already taken its prerequisite (HLTH 129). Coming into this class, all students should have an understanding of the fundamentals of exercise physiology. Throughout this semester, we'll build on that foundation. What was presented in the previous semesters gave you a set of exposures; in this semester we'll cover those topics (and others) in more detail. You should enter this course with a grasp on these phenomena, and you should leave with something close to expertise.

There are labs and laboratory assignments. The purpose of the laboratory assignments is to give you more practical experience with the physiological principles, showing you how they can be applied in real world settings. At the end of the course, you should be able to design a custom health plan for anyone (and for any set of goals) that is physiologically sound. And you should be able to explain it.

3. Required Materials: No book, just a computer



Nothing is required, but if you plan on doing the CSCS Cert after graduation, then this is your book.

Haff GG & Triplett NT. (November, 2015). *Essentials of Strength Training and Conditioning*. Human Kinetics, Champaign, IL, USA.

Some portions are available on Google Books:

https://books.google.com/books/about/Essentials_of_Strength_Training_and_Cond.html?id=bfuXCgAAQBAI



Students are required to use Canvas (<https://pacific.instructure.com/>). The first three exams will be taken on Canvas (proctored, in class). Announcements will also be made on Canvas. And some course files will be posted there. Including this syllabus. So if you're not familiar with Canvas, it's a good idea to do some familiarizing.

5. Exams, Assignments, and Other Points

HESP 147 is divided into 4 blocks. At the end of each block is an exam (3 “midterms”; 1 final). All 4 exams are worth the same number of points. The first 3 cover only material taught during that block; the final is comprehensive. And then there are some laboratory reports.

The breakdown of all points is as follows:

Exams. 4 exams (3 + final exam) at 100 points each.	<i>400 points</i>
Laboratory Reports. 7 labs, 5 reports at 20 points each.	<i>100 points</i>
In-Class Quizzes. 25 possible points of extra credit.	<i>25 points</i>

The final exam (100 points) will require the assimilation of material you’ve learned during the entire semester. All questions will ask you to design an appropriate workout for an individual who has specific goals and specific mechanical or physiological requirements.

6. Grading Scale

Final grades are determined by calculating accumulated points from all tests, quizzes, reports, and assignments and dividing that number by the total points possible (500).

I'm not going to round your grade up when the semester is over no matter how close you are to the cutoff. Your exact points determine your grade (449 is a B+ just as 400 is a B-). Think how absurd it would be the other way around: "Well, technically you got a B-, but you were so close to the C+ cutoff that I'm just going to go ahead and round you down." During the semester, you should be able to collect enough extra credit to round your grade along the way. Additional rounding after the semester ends would just be academic welfare. You don't need it.

Letter Grade	Points	Percent
Yay!	465+	93%
A-	450–464	90%
B+	435–449	87%
B	415–434	83%
B-	400–414	80%
C+	385–399	77%
C	365–384	73%
C-	350–364	70%
D+	335–349	67%
D	300–334	60%
Sorry.	0–299	<60%

I grade the exams. Your graduate assistant grades your lab reports. "Courtney, I have a complaint about my lab grade!" or whatever. Okay. Take it up with your G.A. They're nice. And they want you to succeed.

7. Grade Indicator

- A, A- Quality of work indicates full mastery of the subject; a solid A (no minus) signifies extraordinary distinction (and is difficult to accomplish).
- B+, B, B- Work indicates good comprehension of the course material. You can explain things like mTOR, size principle, and the inflammatory cascade. And you spent the semester demonstrating that ability on assignments, labs, and exams.
- C+, C, C- Earned by work that demonstrates satisfactory comprehension of the course material; student has met the basic requirements for completing assigned work and participating in class activities.
- D+, D, D- Work is not fully satisfactory but the student participated enough in the class activities and has enough of a command of muscle physiology to be (minimally) worthy of course credit toward a degree.
- F Quality of work is not satisfactory and is unworthy of course credit.

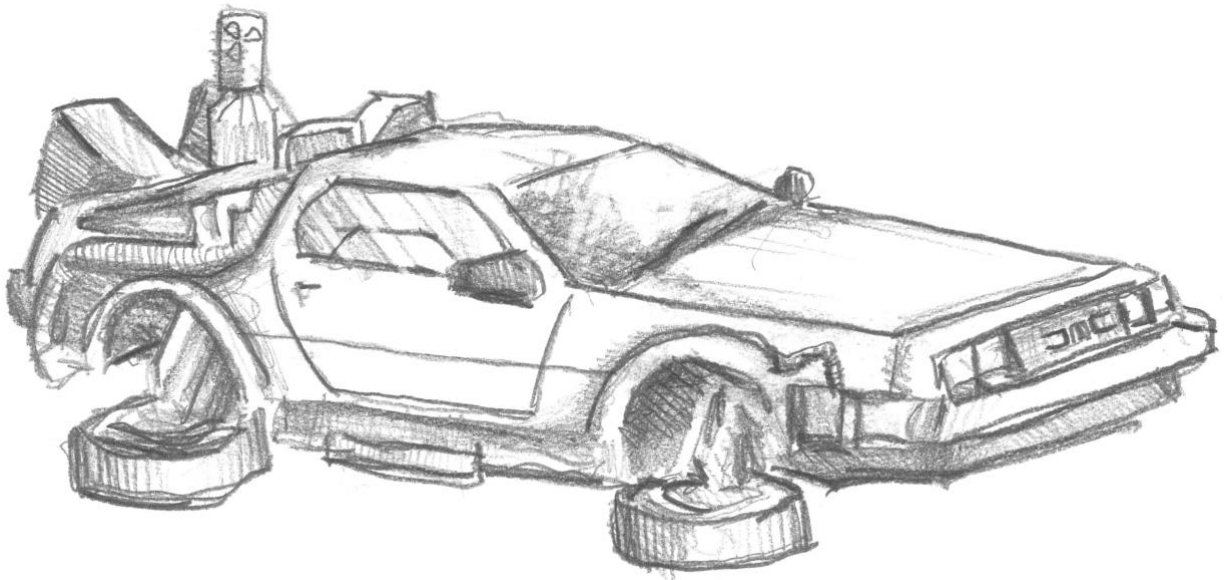
8. End of the Semester Inflation Requests

Student:

“We’ve reached the end of the semester and I seem to have finished in the B+ zone. Is there anything I can do to bump my grade up to an A- or an A?”

Professor:

“You could invent a time machine, go back a few months, study harder, and get better grades on the exams.”



9. Student Responsibilities

- Attendance is not mandatory. But it's really, *really* helpful. The assignments themselves are designed to prepare you for the exams. *And* you get extra credit for doing them. Your main responsibility, though, is to stay on top of the recorded lectures. Do not fall behind. If you fall behind, the in-class activities won't be as helpful. And it can be awfully hard to catch up. The content gets deeper and deeper, faster and faster. Stay on top of the lectures.
- Timeliness. If you do come to class, show up on time. Only because it annoys everyone when class is underway and a late-waker wanders in with a clunky gait, trying to find a chair. "Can I squeeze in behind you?", after identifying an open spot three seats in. Everyone I've ever met whose presence was a disruptive one didn't make it very far in life. Way better success rate among the punctual folks. So if you're going to show up, be timely about it.
- Due dates. They're not negotiable. This applies to exams, labs, and in-class assignments.
- If you become aware of a scheduling conflict (an *important* conflict) that precludes your presence at a lab or exam, it can be rescheduled if you notify me (or your G.A. if it's a lab) at least 24 hours prior. If I receive an email from you mid-exam ("Hey sorry something came up can I take the test tomorrow?"), you will receive a zero.
- Emergencies. I understand these, and experience them myself. In the case of an emergency, you don't need to contact me in advance. Just attend to your situation and notify me when you can. But be prepared to provide documentation. Evidence of some believable variety. We'll figure out a solution and your grade won't be affected; there's no reason to worry. However, if your definition of "emergency" is not compatible with my definition (e.g., "My pet looked *so* sad this morning; I couldn't leave him home all by his lonesome"), then you probably do have reason to worry.
- All students must abide by the University of the Pacific's policy regarding academic honesty (page 14 of Tiger Lore Student Handbook) and the University Honor Code:

The Honor Code at the University of the Pacific calls upon each student to exhibit a high degree of maturity, responsibility, and personal integrity. Students are expected to:

- 1) Act honestly in all matters
- 2) Actively encourage academic integrity
- 3) Discourage any form of cheating or dishonesty by others
- 4) Inform the instructor and appropriate university administrator if she or he has a reasonable and good faith belief and substantial evidence that a violation of the Academic Honesty Policy has occurred.

Violations will be referred to and investigated by the Office of Student Conduct and Community Standards. If a student is found responsible, it will be documented as part of his or her permanent academic record. A student may receive a range of penalties, including failure of an assignment, failure of the course, suspension, or dismissal from the University. The Academic Honesty Policy is available at: <http://www.pacific.edu/Campus-Life/Safety-and-Conduct/Student-Conduct/Tiger-Lore-Student-Handbook-.html>

10. Students with Disabilities

Students with learning disabilities who feel they may benefit from support services and/or accommodations during exams or lectures should contact *The Office of Services for Students with Disabilities*.

- Location: First floor of the McCaffrey Center, rooms 115 and 137
- Phone: (209) 946-3221
- Email: ssd@pacific.edu
- Online: www.pacific.edu/disabilities

The “SSD Office” offers a variety of services for students with disabilities. Accommodations cannot be made unless you have registered with them first. To begin registering, contact the SSD Director for information on how to obtain an Accommodations Request Letter.

3-Step Accommodation Process:

1. Meet with SSD Director, provide documentation, and complete registration forms
2. Request accommodation(s) by completing the Request for Accommodations Form
3. Arrange to meet with professors to discuss accommodation(s) and sign the Accommodation Request Letter

To ensure timeliness of services, initiate this process early. The wait time may be as long as 1–2 weeks or as short as 1–2 days. After the instructor receives the accommodation letter, please schedule a meeting with the instructor during office hours or some other mutually convenient time to arrange the accommodation(s).

11. Professor’s (i.e., My) Responsibilities

1. Online postings: I will maintain a presence on Canvas. There, you will find your syllabus, lab information and assignments, and all announcements by me as well as your GAs. The online lectures (and all corresponding materials) are available at <https://www.musclephys.com>

2. Office hours: I will be available for office hours during the times stated on the first page. If those hours do not work for you, you can also make appointments to Zoom with me. I’m not available 24 hours a day though. Because I’m a person. With a hectic schedule and medical needs.

3. Phone and email responses: I will be punctual with response times whenever possible. If you have a lot of questions or your questions would require a lot of typing, I may ask that you call or visit me during office hours.

4. Returning student work: The GAs and I will return materials in a timely manner to allow you to benefit from the feedback given, and hopefully improve your subsequent score.

5. Changes to class schedule: I reserve the right to change the class schedule as required. In the event that this happens, I will post all changes on Canvas. This will happen a few times as I will have medical appointments that conflict with our class. I’ll do my best to minimize its inconvenience while informing everyone as quickly as possible.

6. Preferred pronouns: I tend to call people by their names. Excepting words like “they” and “somebody” (and those that involve me, e.g., I and mine), I’m not very pronouny in my speech. But if you have a pronoun that would not be obvious to me (or feel like sharing your obvious pronouns), please, please do so. Let me know at any time and I will, of course, respect and honor it. I may not have time to discuss exam grades in detail or respond to administrative questions (or whatever), but being polite and fostering an inclusive learning environment that feels safe and dignified doesn’t take time. I’m not Dolores Umbridge. Every day, I receive about 15 hours of requests beyond what any human is capable of doing, but addressing people as they wish to be addressed takes 5 seconds.



12. Course Objectives and Outcomes

Lecture Objectives:

1. Learn about ATP hydrolysis (the generation/release of energy) and its relationship to muscle fatigue and the “burning” sensation. Learn the cellular mechanisms of fatigue. Review the structure and function of skeletal muscle, and how sliding filament theory works. Understand how ATP hydrolysis relates to cross-bridge activity; what impedes cross-bridge formation and what promotes it? This begins with the neural activation of the muscle and ends with calcium’s *return* to the sarcoplasmic reticulum. Understand each step along the way, and no matter what the biological stress is, be able to identify the likely culprits (both central and cellular).
2. Understand the neural laws governing muscle recruitment. Beyond the mere generation of an action potential, understand orderly recruitment of fiber types and the implications and applications of size principle.
3. Learn the stages of healing, from the initial injury to the remodeling of the tissue’s definitive matrix. Understand the role and the timeline of inflammation in the healing process.
4. Discover how protein synthesis works. What promotes it, what inhibits it, and what are the cellular mechanisms underlying its action? How does signal transduction promote the therapeutic repair and remodeling of tissues (e.g., muscles, tendons, bones)? Understand the similarities and differences between cell signaling for muscle hypertrophy and therapy of tendinopathy. Understand the relationship between healing and inflammation as it relates to cell signaling cascades.
5. Learn the differences between toleration, habituation, and adaptation. Be able to apply principles of specificity to any metabolic or mechanical stress, predicting the physiological responses.
6. Understand the fundamentals of human metabolism and how the balance between catabolism and anabolism is maintained. As a component of this, understand the activity and behavior of enzymes, and the myriad ways in which enzymes control and regulate your metabolic function.

Laboratory Objectives:































Most labs will be conducted on the Proteus device or the Cybex Humac Norm system. These measure muscle force production through isometric, isotonic (concentric, eccentric), and isokinetic (varying degrees per second) motions. Throughout the semester, we’ll evaluate different expressions of strength, making bilateral (dominant vs. non-dominant) comparisons over several body parts. We’ll write reports based on the effects of fatigue, flexor-extensor balances, and history of injury. In conducting the labs, you will come to understand the difference between concentric and eccentric muscle activation, and how muscle function can be disrupted (e.g., mechanical and chemical damage brought about by eccentric stress). You will experience (and explain) delayed onset muscle soreness. You will also understand how the mechanisms of fatigue affect exercise performance in a variety of settings.

Course Objectives:

At the conclusion of this course you should understand how the human body interacts with its environment. You should know the underlying physiology at play when the body merely tolerates a stress, habituates to it, or adapts to it. These should not be memorized lines; you should be able to visualize the phenomena and express them in your own language. And you should be able to *apply* this information to your own life, in your workouts, in discussions with your family about health and disease, and in your daily behaviors.

13. Course Content and Calendar In-Class Quiz

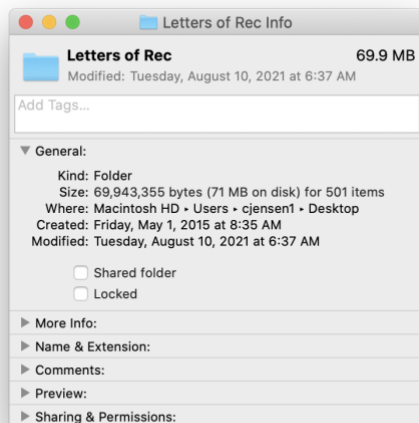
CLASS #	DATE	TOPIC	QUIZ VIDEOS
1	MON, Aug 26	Introduction: Syllabus, Structure, and Expectations	
2	 WED, Aug 28	Foundation, Principles, and Goals of an Exercise Prescription	1, 2
3	 FRI, Aug 30	Structure and Function of the Skeletal Muscle System	3, 4
4	 WED, Sept 4	Structure and Function of the Neuromuscular System	5
5	 FRI, Sept 6	Excitation-Contraction Coupling and Reflex Arcs	6, 7
6	 MON, Sept 9	Skeletal Muscle Types and Fiber Type Switching	8
7	 WED, Sept 11	History and Biology of Size Principle	9
8	 FRI, Sept 13	Practical Applications of Size Principle	10
9	 MON, Sept 16	Specificity of Adaptation: History, Biology, and Applications	11, 12
10	WED, Sept 18	Review for First Exam	
EXAM #1	FRI, Sept 20	EXAM # 1	
11	MON, Sept 23	Introduction to Biomechanics (Beginning at the Foot)	
12	 WED, Sept 25	Principles of Biomechanics	13, 14
13	 FRI, Sept 27	Levers	15
14	 MON, Sept 30	Determinants of Force Production	16
15	 WED, Oct 2	Joint Compression and Neural Rewiring	17
16	 MON, Oct 7	Molecular Mechanisms of Nociception	18
17	 WED, Oct 9	Injuries, Clotting, and Inflammation	19
18	 FRI, Oct 11	Inflammation and Tissue Healing	20
19	 MON, Oct 14	Active and Reactive Hyperemia	21
20	WED, Oct 16	Review for Second Exam	
EXAM #2	FRI, Oct 18	EXAM # 2	
21	MON, Oct 21	Mid-Semester Housekeeping	
22	 WED, Oct 23	Introduction to the Endocrine System	22
23	 FRI, Oct 25	Endocrine Function	23
24	 MON, Oct 28	Hormone Actions	24
25	 WED, Oct 30	Introduction to Anabolic Steroids in Sport	25
26	 FRI, Nov 1	Anabolic Steroids: Philosophy, Effects, and Side Effects	26
27	 MON, Nov 4	Enzymes: Modes of Regulation and Roles in Metabolism	27
28	 WED, Nov 6	Cell Signaling 1: The Context and Environment of mTOR	28
29	 FRI, Nov 8	Cell Signaling 2: mTOR Itself	29
30	 MON, Nov 11	Cell Signaling 3: Navigating the mTOR Map	30
31	 WED, Nov 13	Cell Signaling 4: How Food and Hormones Influence mTOR	31
32	 FRI, Nov 15	Cell Signaling 5: Metabolic Regulation by AMPK	32
33	 MON, Nov 18	Cell Signaling 6: Applications and Considerations of mTOR	33
34	 WED, Nov 20	Cell Signaling 7: Exercise and Supplements on mTOR	34
35	FRI, Nov 22	Tryptophan and Fatigue: Indictment and Acquittal of Turkey	
EXAM #3	MON, Nov 25	EXAM # 3	
36	MON, Dec 2	Exertional Muscle Burning: Lactic Acid vs. Hydrolysis	

37	WED, Dec 4	Cellular Mechanisms of Muscular Fatigue
38	FRI, Dec 6	Muscular Fatigue: Central vs. Peripheral
FINAL	EXAM WEEK	
EXAM	Dec 9 – Dec 13	WED, Dec 11, 8:00am – 11:00am

14. Course Evaluation

1. Copies of student work may be retained to assess how the learning objectives of the course are being met. And I might scan your work (just the good bits) for future slideshows.
2. If you have suggestions (“it’d be great if we could learn about...”), feel free to speak up. If possible, we will accommodate those suggestions. If not possible, don’t hesitate to visit me during office hours.
3. We’ll do the student evaluations at the very end of the semester. Probably on the last day of class. Probably immediately after the final. That feels like the best way for you to know what it is you’re evaluating. Filling out the forms three weeks before the end of class seems odd to me. It’s like reviewing a movie without watching the last 20 minutes.

15. Letters of Recommendation



I get a lot of requests. See that little picture to the left? That’s the folder that contains all of my letters of recommendation. I came to Pacific spring semester, 2015. On Friday, May 1st, I created that folder and wrote my first letter of recommendation for a Pacific student. Kiran. She got accepted to a couple of M.D. programs and a few D.O. programs. She chose a D.O. school in California. Then more students asked me for letters. And more. On Tuesday, August 10, 2021, I wrote my 501st letter. During my first year, I wrote a letter for every student who asked. During my second year, I came close. And then I never came close again. Today, the difference between the number of requests I receive and the number of letters a human being can write is funny. Why am I telling you this? To warn you of the possibility that you won’t receive a letter from me. Not because you don’t deserve one – you very likely will – but because I’m a person. And just like all other people, I’m not capable of infinity hours of work. I would like to be, but... again: I’m only a person.

So... if you want a letter from me at some point, you need at least a B in every class we’ve had together and I need at least a month’s notice (no exceptions here). At whatever moment you ask, my wait list is at least 10 students long. Now, if you want a *good* letter, you have to send me the content you want included (details about your life and details about those details). If I have to sit down and come up with the whole thing from scratch (and then look up awards, grades, dates that you took my classes, etc.), it’s going to take me all day. If I have a list of letter ingredients in front of me, I can cook up a good one in an hour. The more work *you* put in – sending me your résumé, transcript, and everything you want highlighted – the more compelling my letter will be. If all you want is a template, don’t give me much to work with. But if you want a page of sunshiny, glowing praise, then help me out.

16. Important Dates for University of the Pacific

Fall 2024

Description	Date(s)
Payment Deadline for Fall 2024	August 1
Classes Begin	August 26
Labor Day (Holiday - no classes)	September 2
# Last Day to Add Classes	September 6
# Last Day for Pass/No Credit or Letter Grade Option	September 6
# Last Day to Drop Classes (without record of enrollment)	September 6
# Last Day to Drop Classes with 100% Refund	September 6
Last Day for Pro-Rated Refund	September 20
Census Date	September 20
Deadline for faculty to submit week 5 Early Grades	September 27
Fall Student Break	October 4
Spring 2025 Schedule of Classes Available	October 7
* Advising for Spring 2025 for continuing students	October 14-25
Last Day to Withdraw	October 25
* Early Registration Appointments begin for continuing students-Spring 2025	October 28 - November 1
Thanksgiving Break	November 27-29
Classes Resume	December 2
Classes End	December 6
Final Examination Period	December 9-13
Deadline to Petition to Walk in May 2025 Commencement (Summer 2025 Graduates)	December 13
Deadline for Faculty to Submit Final Grades	December 17

Day/Time of Final	Monday	Tuesday	Wednesday	Thursday	Friday
	Dec. 9	Dec. 10	Dec. 11	Dec. 12	Dec. 13
DAY/TIME OF CLASS					
8-11 a.m.	MWF 8-9:30 a.m.	TR 10 a.m.-noon	MWF 9:30-11 a.m.	TR 8-10 a.m.	MWF 11 a.m.-12:30 p.m.
11 a.m.-noon	Break				
Noon-3 p.m.	MWF 12:30-2 p.m.	TR 1-3 p.m.	MWF 2-3:30 p.m.	X	X
3-6 p.m.	X	X	X	TR 3-5 p.m.	MWF 3:30-5 p.m.
6-7 p.m.	Break				
7-10 p.m.	MW 8-10 p.m.	TR 8-10 p.m.	MW 5-7 p.m. 6-8 p.m.	TR 5-7 p.m. 6-8 p.m.	X

Final exam Schedule

Our final exam:
Wednesday, December 11
8:00am to 11:00am