Course Topics and Goals
Coordination of metabolism by hormonal signals. An exploration of simple cells (red blood cells) to more complex tissues (muscle and liver) will be used as a framework to discuss the progression in metabolic complexity. Techniques used to study biochemical pathways will be presented in the context of these major biological mechanisms. Learners will also develop problem solving and analytical skills that are more generally applicable to the life sciences.
Learning Objectives
1. Relate covalent and non-covalent interactions to their importance in biological interactions and structures.
2. Identify the amino acids and their chemical properties. Analyze how their presence in a protein changes its overall characteristics.
3. Identify the levels of structure in proteins and describe the stabilization of these structures.
4. Describe the structure and mechanism of representative enzymes in biochemical pathways.
5. Interpret plots of enzyme kinetic data both with and without inhibitors.
6. Describe the primary catabolic and anabolic pathways pertaining to the following molecular classes (Glycolysis, Citric Acid Cycle, Electron Transport, Oxidative Phosphorylation, Pentose Phosphate Pathway, Light and Dark Photosynthetic Reactions, Calvin Cycle, Gluconeogenesis, Glycogenesis, Glycogenolysis and Beta-Oxidation):
   a. Carbohydrates
   b. Lipids
7. For each pathway in 6, identify the key regulatory points, the energetics of the reactions, the enzymes and the chemical transformations involved. Analyze how energetic changes and hormonal signals modify the reactions and change the active pathways.
8. Identify important characteristics of lipid membrane structure and compare mechanisms of molecular transport across membranes.
9. Evaluate how organismal energy state and hormonal signals modify activation and inhibition of different biochemical pathways.
10. Interpret biochemical data tables

Prerequisite: CHEM 322A or CHEM 325A (Organic Chemistry)

Course Notes
Lectures: The lecture slides posted on the course Blackboard internet site [https://blackboard.usc.edu](https://blackboard.usc.edu). Lectures 12-38 will have an audio and written transcript section that should be read or listened to at home before coming to lecture that day. It is also recommended to read the corresponding section of the textbook in preparation for in-class problem sets. There will be at-home quiz questions associated with the at-home portion of the lecture on the Blackboard course website under “Assignments”. The remainder of the lecture slides will be presented in class.

It is important to attend all of the lectures during the course and to take good notes for study. Prior to attending each lecture, it is also recommended to read the appropriate portions of the textbook. Examinations will be based on application of material from lecture slides, verbal information conveyed during lecture, at-home quiz material, and in-class problem sets. Material from the textbook that is not presented in lecture slides or in the lecture presentation will not be included in examination material. All course material, information, announcements and grades will be posted on Blackboard until the end of the semester.

Email Communication:
To ensure privacy, only student’s USC email accounts may be used for email communications. Students are responsible for understanding the content of email messages that the instructor sends to their USC accounts. Therefore, each student must check their USC email regularly and make sure their account is not over quota, so new messages can be received.

Recommended Readings and Supplementary Materials

Primary research articles for Discussions will be posted as .pdfs on Bb for students to read before coming to the lecture discussion period.

MCAT Practice Materials (in-class problem sets):


Description and Assessment of Assignments
Midterms will include multiple choice, short answer and mathematical problems that can be done without a calculator.
Midterm 1 will cover material for Learning Objectives 1, 2, 3, and 10
Midterm 2 will cover material for Learning Objectives 4, 5, 6, 7, 8, 9 and 10
Midterm 3 will cover material for Learning Objectives 6, 7, 9, and 10
Quizzes will be on material from the at-home portion of the lecture material and should be answered individually prior to coming to class. Points will be given both for participation and correctness.
Problem sets will be on material from the entirety of the lecture. Problems will be completed in pairs or small groups on the Blackboard website. Groups might be asked at to present their thought process and solution to the class. Individuals within a group should all contribute equally to the workload. Points will be given for both participation and correctness. Additionally, students will be asked to submit practice problems from lecture material that appropriately cover learning objectives. Students will submit problems to a Blackboard share page and post correct answers. The instructor will use these questions for up to 10% of the midterm exam content. Each student will be assigned to prepare 2 questions for their assigned lecture and will receive up to 5 points of extra credit, if the questions and answers are well-researched and at an appropriate level of difficulty for the course.

Grading Breakdown
The course grade will be based upon 1189 possible points:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm 1</td>
<td>250</td>
<td>22.34</td>
</tr>
<tr>
<td>Midterm 2</td>
<td>250</td>
<td>22.34</td>
</tr>
<tr>
<td>Final Exam</td>
<td>250</td>
<td>22.34</td>
</tr>
<tr>
<td>At-home quizzes</td>
<td>34</td>
<td>3.03</td>
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<tr>
<td>In-class problem sets</td>
<td>85</td>
<td>7.6</td>
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<tr>
<td>Laboratory</td>
<td>250</td>
<td>22.34</td>
</tr>
<tr>
<td>Total</td>
<td>1119</td>
<td>100</td>
</tr>
</tbody>
</table>

Course letter grades:
The following is an average of previous years' grade distributions. It is not meant to be definitive, but rather to set a general expectation. The final grade distribution for the 2023 spring semester will reflect both overall class performance, and the academic standards of the instructors.
A-range: 90.9 ±1.5%
B-range: 74.1 ±1.4%
C-range: 57.1 ±1.4%

Assignment Submission Policy
Answers to quiz questions should be submitted prior to the start of class at 12:00 pm. Quizzes for subsequent lectures are typically open 48 hours in advance of the next flipped lecture. Answers to group work assignments should be submitted before 11:59 p.m. on days with a lecture section.
If you do not have access to a smart phone, tablet or laptop computer, please see Dr. Bancroft to make accommodations to submit your assignments.

Grading Timeline
Grades for Midterm Exams will be posted within one calendar week following the exam date.

Additional Policies
COVID-19 health policy:
Students are expected to comply with all aspects of USC’s COVID-19 policy. Failure to do so may result in removal from the class and referral to SJACs.

Missing Midterm Exam:
In case a midterm exam must be missed for legitimate reasons, discuss the situation with the course instructor prior to the exam, if possible. If an exam is missed for an emergency or for a valid health reason (with written documentation), the scores of the other two exams will be prorated to comprise your total point score. Rules governing exams are given in more detail in your Student Contract, which is also posted on the class website: https://blackboard.usc.edu.

Regrades:
In the event an error is made in the grading of your exam, written submittal of a description of the error with the exam should be returned to Dr. Bancroft within a week after receiving your graded exam. After this time period, exams will not be regraded.

Lecture Absences:
Attendance at all lecture sections is expected. If you must miss class due to illness, valid USC travel or other emergency, please present Dr. Bancroft with evidence of the reason for absence and you will be allowed to make-up in-class work assignments within 1 week of the missed lecture period.
Course Schedule:

<table>
<thead>
<tr>
<th>Wk.</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>Reading</th>
<th>Due (in class)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug. 26 (CB)</td>
<td>Intro to Biochemistry and the Language of Chemistry</td>
<td>Ch. 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aug. 28</td>
<td>Chemical Foundations of Life</td>
<td>Ch. 2</td>
<td>Lec 2 quiz &amp; prob. set</td>
</tr>
<tr>
<td></td>
<td>Aug. 30</td>
<td>Energy in Biochemistry</td>
<td>Ch. 3</td>
<td>Lec 3 quiz &amp; prob. set</td>
</tr>
<tr>
<td>2</td>
<td>Sept. 2</td>
<td>No lecture, Labor Day</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sept. 4</td>
<td>Nucleic Acids</td>
<td>Ch. 4</td>
<td>Lec 4 quiz &amp; prob. set</td>
</tr>
<tr>
<td></td>
<td>Sept. 6</td>
<td>Nucleic Acids</td>
<td>Ch. 4</td>
<td>Lec 5 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 9</td>
<td>Amino Acids and Primary Structure</td>
<td>Ch. 5</td>
<td>Lec 6 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 11</td>
<td>Protein Structure</td>
<td>Ch. 6</td>
<td>Lec 7 quiz &amp; prob. set</td>
</tr>
<tr>
<td></td>
<td>Sept. 13</td>
<td>Protein Structure and Biochemical Methods</td>
<td>Ch. 6</td>
<td>Lec 8 quiz &amp; prob. set</td>
</tr>
<tr>
<td>3</td>
<td>Sept. 16</td>
<td>Protein Sequencing</td>
<td>Ch. 6</td>
<td>Lec 9 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 18</td>
<td>Predicting and determining protein structure</td>
<td>Ch. 6</td>
<td>Lec 10 quiz &amp; prob. set</td>
</tr>
<tr>
<td></td>
<td>Sept. 20</td>
<td>Enzymes</td>
<td>Ch. 8</td>
<td>Lec 11 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 23</td>
<td>Enzymes</td>
<td>Ch. 8</td>
<td>Lec 12 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 25</td>
<td>Enzymes</td>
<td>Ch. 8</td>
<td>Lec 13 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Sept. 27</td>
<td>Midterm 1 (Lectures 1-12) (CB)</td>
<td></td>
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<tr>
<td>4</td>
<td>Sept. 30</td>
<td>Enzymes</td>
<td>Ch. 8</td>
<td>Lec 14 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Oct. 2</td>
<td>Current Science in Biochemistry (Discussion)</td>
<td>TBD</td>
<td>Lec 15 quiz &amp; prob. set</td>
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<td>Oct. 4</td>
<td>Carbohydrates</td>
<td>Ch. 9</td>
<td>Lec 16 quiz &amp; prob. set</td>
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<tr>
<td>5</td>
<td>Oct. 7</td>
<td>Lipids, Membranes and Cellular Transport</td>
<td>Ch. 10</td>
<td>Lec 17 quiz &amp; prob. set</td>
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<td></td>
<td>Oct. 9</td>
<td>Lipids, Membranes and Cellular Transport</td>
<td>Ch. 10</td>
<td>Lec 18 quiz &amp; prob. set</td>
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<tr>
<td></td>
<td>Oct. 11</td>
<td>No Lecture, Fall Break</td>
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<tr>
<td></td>
<td>Oct. 14</td>
<td>Cell Signaling</td>
<td>Ch. 20</td>
<td>Lec 19 quiz &amp; prob. set</td>
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<td>6</td>
<td>Oct. 16 (GJ)</td>
<td>Intro to Metabolism</td>
<td>Ch. 11</td>
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<td></td>
<td>Oct. 18</td>
<td>Intro to Metabolism</td>
<td>Ch. 11</td>
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<tr>
<td></td>
<td>Oct. 21</td>
<td>Glycolysis</td>
<td>Ch. 12</td>
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<tr>
<td></td>
<td>Oct. 23</td>
<td>Glycolysis</td>
<td>Ch. 12</td>
<td></td>
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<tr>
<td></td>
<td>Oct. 25</td>
<td>Gluconeogenesis and Glycolysis Review</td>
<td>Ch. 12</td>
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<tr>
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<td>Oct. 28</td>
<td>The Citric Acid Cycle</td>
<td>Ch. 13</td>
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<tr>
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<td>Oct. 30</td>
<td>The Citric Acid Cycle</td>
<td>Ch. 13</td>
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<td>Nov. 1</td>
<td>Midterm 2 (Lectures 13-25)</td>
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<tr>
<td>7</td>
<td>Nov. 4</td>
<td>Oxidative Phosphorylation</td>
<td>Ch. 14</td>
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<tr>
<td></td>
<td>Nov. 6</td>
<td>Oxidative Phosphorylation</td>
<td>Ch. 14</td>
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<td>Nov. 8</td>
<td>Oxidative Phosphorylation</td>
<td>Ch. 14</td>
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<td></td>
<td>Nov. 11</td>
<td>No Lecture, Veteran's Day</td>
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<tr>
<td>8</td>
<td>Nov. 13</td>
<td>Oxidative Phosphorylation</td>
<td>Ch. 14</td>
<td></td>
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<tr>
<td></td>
<td>Nov. 15</td>
<td>Photosynthesis</td>
<td>Ch. 15</td>
<td></td>
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<tr>
<td>9</td>
<td>Nov. 18</td>
<td>Photosynthesis</td>
<td>Ch. 15</td>
<td></td>
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<tr>
<td></td>
<td>Nov. 20</td>
<td>Photosynthesis</td>
<td>Ch. 15</td>
<td></td>
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<tr>
<td></td>
<td>Nov. 22</td>
<td>The Calvin Cycle</td>
<td>Ch. 15</td>
<td></td>
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<tr>
<td>10</td>
<td>Nov. 25</td>
<td>The Calvin Cycle</td>
<td>Ch. 15</td>
<td></td>
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<tr>
<td></td>
<td>Nov. 27</td>
<td>No lecture, Thanksgiving</td>
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<tr>
<td></td>
<td>Nov. 29</td>
<td>No lecture, Thanksgiving</td>
<td></td>
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<tr>
<td>11</td>
<td>Dec. 2</td>
<td>The Pentose Phosphate Pathway</td>
<td>Ch. 12</td>
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<tr>
<td></td>
<td>Dec. 4</td>
<td>Glycogen</td>
<td>Ch. 12</td>
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<td></td>
<td>Dec. 6</td>
<td>Fatty Acid Metabolism</td>
<td>Ch. 16</td>
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<td></td>
<td>Dec. 13</td>
<td>Final Exam: 11 am-12 pm (Lectures 28-38)</td>
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</tbody>
</table>
Statement on Academic Conduct and Support Systems

Academic Integrity:
The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, compromises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university’s mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or “recycle” work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity’s website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for
the determination of appropriate accommodations for students who encounter
disability-related barriers. Once a student has completed the OSAS process
(registration, initial appointment, and submitted documentation) and
accommodations are determined to be reasonable and appropriate, a Letter of
Accommodation (LOA) will be available to generate for each course. The LOA
must be given to each course instructor by the student and followed up with a
discussion. This should be done as early in the semester as possible as
accommodations are not retroactive. More information can be found at
osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at
osasfrontdesk@usc.edu.
-
Support Systems:

**Counseling and Mental Health** - (213) 740-9355 – 24/7 on call
Free and confidential mental health treatment for students, including short-term
psychotherapy, group counseling, stress fitness workshops, and crisis
intervention.

**988 Suicide and Crisis Lifeline** - 988 for both calls and text messages – 24/7 on
call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide
Prevention Lifeline) provides free and confidential emotional support to people
in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the
United States. The Lifeline is comprised of a national network of over 200 local
crisis centers, combining custom local care and resources with national standards
and best practices. The new, shorter phone number makes it easier for people to
remember and access mental health crisis services (though the previous 1 (800)
273-8255 number will continue to function indefinitely) and represents a
continued commitment to those in crisis.

**Relationship and Sexual Violence Prevention Services (RSVP)** - (213)
740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations
related to gender- and power-based harm (including sexual assault, intimate
partner violence, and stalking).

**Office for Equity, Equal Opportunity, and Title IX (EEO-TIX)** - (213) 740-5086
Information about how to get help or help someone affected by harassment or
discrimination, rights of protected classes, reporting options, and additional
resources for students, faculty, staff, visitors, and applicants.

**Reporting Incidents of Bias or Harassment** - (213) 740-5086 or (213) 821-8298
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

**The Office of Student Accessibility Services (OSAS) - (213) 740-0776**
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

**USC Campus Support and Intervention - (213) 740-0411**
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

**Diversity, Equity and Inclusion - (213) 740-2101**
Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

**USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call**
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

**USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call**
Non-emergency assistance or information.

**Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)**
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

**Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu**
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.