Biochem 6600 Regulation of Metabolism

2022 Fall B 1.5 credits
Tu/Th 9:30-11:00 AM
10/18/22 – 12/08/22
EHSEB 2600

Course Directors:
Keren Hilgendorf, PhD, Assistant Professor of Biochemistry
Contact information: keren.hilgendorf@biochem.utah.edu (recommended for M-F, 8-5)
Cell phone: 512-426-6735 (texting recommended for evenings and weekend)

Janet Lindsley, PhD, Professor of Biochemistry, Adjunct Professor of Nutrition and Integrative
Physiology
Contact information: janet@biochem.utah.edu (recommended for M-F, 8-5) Cell phone:
801-558-3893 (texting recommended for evenings and weekend)

Teaching Assistants:
Magnus Creed, graduate student in Biochemistry Department
Magnus.Creed@utah.edu
Rachel Skabelund, graduate student in Biochemistry Department
rachel.skabelund@utah.edu

Course Objectives
1. To review and integrate the basic metabolic pathways involving primarily
   carbohydrates and fats.
2. To provide the foundation for students to be able to understand the literature in the
   broad fields of type 2 diabetes and metabolic regulation.
3. To understand the integration of signaling events that are initiated outside of a cell
   (such as insulin binding to the insulin receptor) with those initiated within a cell (such
   as increased AMP levels activating AMP-activated protein kinase).
4. To outline the goals and methods of specific cutting-edge topics in metabolic
   regulation from UHealth experts in the field.
5. To demonstrate curiosity about the metabolic research occurring on campus.
6. To develop knowledge and skills in interpreting and communicating metabolism
   research findings.

Course description
This course will be taught by a mixture of discussion, didactic (lecture), readings, on-line
quizzes and student presentation modalities. The focus is on the regulation of sugar and
fat metabolism in eukaryotes, with an emphasis on mammals. The course will begin with
a review of carbohydrate and lipid metabolic pathways, particularly pathway
integration and regulation. The middle portion of the course is an exposure to the
breadth of metabolism research questions being asked here at University of Utah Health
Sciences by a variety of faculty. The course ends with students choosing one of the
faculty members’ metabolism research papers, or related paper and presenting the
main question being asked with an example of the methods, data, and interpretation
from one figure.
Course resources

**Required textbook:** *Human Metabolism: A Regulatory Perspective*, 4th Edition, by Keith Frayn and Rhys Evans (2019). This is a very readable textbook that covers the basic physiology of how human metabolism is regulated. It is not focused on metabolic pathways, but instead clearly explains the concepts of how we can either feast for days or fast for weeks and still function. It is an accessible introduction to basic endocrine physiology, with a focus on insulin, glucagon and cortisol. The 3rd edition is available free on-line from the Marriot Library (see: [http://site.ebrary.com/lib/utah/docDetail.action?docID=10358863](http://site.ebrary.com/lib/utah/docDetail.action?docID=10358863)). The newer 4th edition has two new chapters, and a few other updates. However, the majority of what you will need for this course is available in the free 3rd edition. Note: if you envision a future career related to human metabolism, you may want to invest in this book.

**Basic Metabolism Overview (BMO):** This 66-page pdf divided into 4 chapters reviews the metabolic pathways central to human metabolism. You will be expected to know and use this information, as well as being able to integrate it with the physiology described in the Frayn textbook.

**Pathways of human metabolism map (metmap)**
[https://metabolicpathways.stanford.edu/](https://metabolicpathways.stanford.edu/): We will be referring regularly to this searchable metabolic map. Additionally, it will be provided for your mid-course exam. Therefore, this class is NOT about memorizing metabolic pathways, but you will be expected to be able to read and interpret the metmap.

For the first part of the course, access to an undergraduate or medical biochemistry textbook may also be useful. For example: Stryer (Berg et al) or Lehninger Biochemistry might be useful.

The Medical Biochemistry website may also be helpful: [http://themedicalbiochemistrypage.org/](http://themedicalbiochemistrypage.org/)

For the middle section of the course, the breadth of metabolism research occurring at the U will be explored. Two research articles chosen by the upcoming presenters will be posted on Canvas and you will be expected to choose one of them to read for each class session. After reading one of the articles, you will submit a thoughtful question to contribute to the following day’s discussion. To earn participation points during this section of the course, you are expected to verbally ask at least 2 questions over these 5 sessions.

For the final section of the course, in which each student will present one of the key findings from a research paper by one of our faculty, or related metabolism paper, you will want to look up relevant literature: [https://pubmed.ncbi.nlm.nih.gov/](https://pubmed.ncbi.nlm.nih.gov/)

**Canvas:** A Canvas site will be used during this course to post: 1. The course syllabus and Learning objectives, 2. Pre-class homework and Post-research-talk curiosities (set up as quizzes), 3. Mid-course, take-home exam, and 4. Readings and discussion materials.
Student assessment

Grades will be based on the following criteria:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>7%</td>
</tr>
<tr>
<td>Participation</td>
<td>15%</td>
</tr>
<tr>
<td>Pre-class homework (10/19-11/21)</td>
<td>25%</td>
</tr>
<tr>
<td>Take-home exam (due 11/02, 1 PM)</td>
<td>30%</td>
</tr>
<tr>
<td>Post-research-talk curiosities (11/04-11/23)</td>
<td>8%</td>
</tr>
<tr>
<td>Student research presentations (11/29-12/08)</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

This course is based on active discussion and participation within the classroom. **Therefore, attendance and participation are required and graded.** You will receive 0.5 pt for each class session that you attend. Your classroom participation grade will be based on the following criteria: 1) contributed fully to the class discussion of metabolism problems and research questions, 2) behaved in a professional and respectful manner towards classmates and faculty, 3) completed all in-class submitted activities, including feedback for classmate presentation sessions, and 4) asked at least 2 questions during the research talk section of the course. If you are not in class you will not be able to earn classroom participation or attendance points. However, if you notify Drs. Lindsley and Hilgendorf in advance of your need to miss a class, it may be possible to make up some missed points by completing an alternative assignment.

**On-line homework assignments will be posted on Canvas prior to classes 2-10. These homework assignments will be due at 6 PM the night before class.** They are designed to help prepare you to fully participate in the learning activities occurring during class time.

For classes 2-5 there will be two parts to each assignment (each part posted as a quiz). The single-best-answer, multiple-choice question part will be set up to allow you two chances to choose the correct response. The second part will be a few short answer/essay questions, including a place for you to submit a question you have relating to the upcoming class discussion.

For classes 6-10, you will read at least one of two research papers provided by the faculty giving short research talks, and submit one thoughtful question based on the paper. These questions will help inform the class discussion.

**Take-home exam:** Immediately after class session 5 has ended, this exam will become available on Canvas. You will have one hour to complete the exam once you start taking it. The completed exam is due on the following day, **Wednesday, November 2 at 1:00 PM.** You may use a clean copy (without any notes) of the Pathways of Human metabolism map (metmap) during the exam, but no other reference materials; other than the metmap it is a closed-book, closed-notes, closed website, no consultation, individual exam. If you envision challenges completing the exam by 1:00 PM on November 2 contact Drs. Lindsley and Hilgendorf as soon as possible. If your score on the take-home exam does not reflect your goals for this course, then you may submit a written reflection describing your original misunderstanding of the relevant question(s) and an explanation of the correct answer by email to Drs. Lindsley and Hilgendorf (janet@biochem.utah.edu;
keren.hilgendorf@biochem.utah.edu) within one week of exam scores being released to earn up to half the missed points back.

Post-research talk curiosities: During the middle section of the course, 10 of our metabolism faculty researchers will each give a ~20-min talk and lead a discussion about where they think this research story could/should go in the future. After each of these 5 class sessions, students will submit a short description of what they found most curious about one of the two discussions and what they would do next on the project. Each submitted curiosity will count for 2% of the course grade. The grading rubric is shown in Appendix A.

Students presenting metabolism research: Students will sign-up to present the research question, methods and data from one figure from a research paper from one of the metabolism faculty at the University of Utah; for students who have already joined a metabolism research lab they must choose a different faculty member’s research to present. Students who choose the same faculty member’s research will be asked to coordinate their presentations so that each presents a separate part of the question and data. Students will each have 10 minutes to present during one of the final class sessions. This research presentation will contribute 15% of the final course grade; see Appendix B for the grading rubric. Students who are not teaching on a given day will provide written feedback to one of the presenting students; providing this feedback will also count as part of the participation grade. See appendix C for the student feedback form.

EVALUATION SCHEME:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percentage</th>
<th>Letter Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94-100</td>
<td>C-</td>
<td>70-72</td>
</tr>
<tr>
<td>A-</td>
<td>90-93</td>
<td>D+</td>
<td>67-69</td>
</tr>
<tr>
<td>B+</td>
<td>86-89</td>
<td>D</td>
<td>64-66</td>
</tr>
<tr>
<td>B</td>
<td>82-85</td>
<td>D-</td>
<td>60-63</td>
</tr>
<tr>
<td>B-</td>
<td>79-81</td>
<td>E</td>
<td>Below 60</td>
</tr>
<tr>
<td>C+</td>
<td>76-78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>73-75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scores will be rounded: Example 94.4=94, 94.5=95
**Class schedule:** All classes will be from 9:30-11:00 AM on Tuesdays and Thursdays.

2022 BioC 6600  
Regulation of Metabolism  
9:30 – 11:00 AM  
EHSEB 2600

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Class Title</th>
<th>Reading Assignment</th>
<th>Instructor</th>
<th>Reading Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/18</td>
<td>Tu</td>
<td>Introduction to metabolism and its regulation</td>
<td>Course syllabus; BMO Ch 1</td>
<td>Hilgendorf &amp; Lindsley</td>
<td>1</td>
</tr>
<tr>
<td>10/20</td>
<td>Th</td>
<td>Respiration, TCA cycle, carbohydrate catabolism</td>
<td>BMO Ch 1 &amp; 2; Frayn 3rd ed Ch 2 (p. 27-30) or 4th ed Ch 2 (p. 48-49, 60-63, 66-68)</td>
<td>Lindsley</td>
<td>2</td>
</tr>
<tr>
<td>10/25</td>
<td>Tu</td>
<td>Glycogen, Gluconeogenesis and blood glucose regulation</td>
<td>BMO Ch 3; Frayn 3rd ed Ch 11 (p. 306-324) or 4th ed Ch 12 (p. 346-355)</td>
<td>Lindsley</td>
<td>3</td>
</tr>
<tr>
<td>10/27</td>
<td>Th</td>
<td>Lipid metabolism</td>
<td>BMO Ch 4; Frayn 3rd ed Ch 10 (p. 275-295) or 4th ed Ch 10 (p. 302-322)</td>
<td>Hilgendorf</td>
<td>4</td>
</tr>
<tr>
<td>11/01</td>
<td>Tu</td>
<td>Integration of Carbohydrate &amp; Fat Metabolism</td>
<td>BMO review all chapters; Frayn 3rd ed Ch. 7 (p. 169-187) or 4th ed Ch. 7 (p. 204-222)</td>
<td>Hilgendorf</td>
<td>5</td>
</tr>
<tr>
<td>11/02</td>
<td>Wed</td>
<td>1-hour Take-home exam due by 1 PM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/03</td>
<td>Th</td>
<td>Metabolism research talks &amp; discussion</td>
<td>Provided on Canvas</td>
<td>Funai, Bettini</td>
<td>6</td>
</tr>
<tr>
<td>11/08</td>
<td>Tu</td>
<td>Metabolism research talks &amp; discussion</td>
<td>Provided on Canvas</td>
<td>Boudina, Hilgendorf</td>
<td>7</td>
</tr>
<tr>
<td>11/10</td>
<td>Th</td>
<td>Metabolism research talks &amp; discussion</td>
<td>Provided on Canvas</td>
<td>Ayer, Chaudhuir</td>
<td>8</td>
</tr>
<tr>
<td>11/15</td>
<td>Tu</td>
<td>Metabolism research talks &amp; discussion</td>
<td>Provided on Canvas</td>
<td>Chaix, Ducker</td>
<td>9</td>
</tr>
<tr>
<td>11/17</td>
<td>Th</td>
<td>Metabolism research talks &amp; discussion</td>
<td>Provided on Canvas</td>
<td>Summers, Holland</td>
<td>10</td>
</tr>
<tr>
<td>11/22</td>
<td>Tu</td>
<td>Metabolism research talk &amp; discussion; Discussion of expectations for student research presentations</td>
<td>TA video posted</td>
<td>Playdon; Hilgendorf &amp; Lindsley</td>
<td>11</td>
</tr>
<tr>
<td>11/24</td>
<td></td>
<td>Happy Thanksgiving!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/29</td>
<td>Th</td>
<td>Student research presentations</td>
<td>Students</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>12/01</td>
<td>Tu</td>
<td>Student research presentations</td>
<td>Students</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>12/06</td>
<td>Th</td>
<td>Student research presentations</td>
<td>Students</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>12/08</td>
<td>Tu</td>
<td>Student research presentations</td>
<td>Students</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>
**The Americans with Disabilities Act**
The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

Given the nature of this course, attendance is required and adjustments cannot be granted to allow non-attendance. However, if you need to seek an ADA accommodation to request an exception to this attendance policy due to a disability, please contact the Center for Disability and Access (CDA). CDA will work with us to determine what, if any, ADA accommodations are reasonable and appropriate.

**University Safety Statement**
The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

**Addressing Sexual Misconduct**
Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

**Appropriate Use of Technology**
Technology is an important part of everyday life and can contribute greatly to the learning environment. Students are expected to use technology in a professional and appropriate way that does not distract other learners. Appropriate uses include, but are not limited to: note taking, searching online for relevant information, answering in-class formative assessment questions, and viewing course materials on Canvas. Inappropriate uses include, but are not limited to: texting, personal email, shopping, social media, and browsing any websites not relevant to the course. Course-specific technology guidelines will be indicated by the Course Directors. Please use your judgment when using technology and be considerate of your faculty and fellow students.

**Spring 2022 COVID-19 statement**
This class meets in a building on the Health Sciences campus that currently requires that everyone wear high quality masks (N95, KN95 or level 3 greater surgical masks) over both their nose and mouth at all times.
The COVID-19 guidelines for the University of Utah are adapted often due to the ever-changing status of the pandemic. For the most up-to-date information regarding the campus guidelines, visit https://coronavirus.utah.edu.

Please let your Course Directors know as soon as possible if you must miss an in-person class due to COVID isolation/quarantine so that we can work to accommodate your remote participation.

**Drop/Withdrawal Policies.** Students may drop a course within the first two weeks of a given semester without any penalties. Students may officially withdraw (W) from a class or all classes after the drop deadline through the midpoint of a course. A “W” grade is recorded on the transcript and appropriate tuition/fees are assessed. The grade “W” is not used in calculating the student’s GPA. For deadlines to withdraw from full-term, first, and second session classes, see the U’s Academic Calendar.

Other important information to consider including:

a. Student Code: http://regulations.utah.edu/academics/6-400.php
b. Accommodation Policy (see Section Q): http://regulations.utah.edu/academics/6-100.php

**Student Mental Health Resources**

- Rates of burnout, anxiety, depression, isolation, and loneliness have noticeably increased during the pandemic. If you need help, reach out for campus mental health resources, including counseling, trainings and other support.
- Consider participating in a Mental Health First Aid or other wellness-themed training provided by our Center for Student Wellness and sharing these opportunities with your peers, teaching assistants and department colleagues

**Undocumented Student Support Statement.** Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

**SACNAS at the U of U** is an award-winning community that supports the success and advancement of Chicanos/Hispanics & Native Americans in Science: https://uofuhealth.utah.edu/sacnas/

**Diverse Student Support.** Your success at the University of Utah is important to all of us here! If you feel like you need extra support in academics, overcoming personal difficulties, or finding community, the U is here for you.

**Student Support Services (TRIO)**

TRIO federal programs are targeted to serve and assist low-income individuals, first-generation college students, and individuals with disabilities.

Student Support Services (SSS) is a TRIO program for current or incoming undergraduate university students who are seeking their first bachelor’s degree and need academic assistance and other services to be successful at the University of Utah.
For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

**Student Support Services (TRIO)**
801-581-7188
trio.utah.edu
Room 2075
1901 E. S. Campus Dr.
Salt Lake City, UT 84112

**American Indian Students**

The A IRC works to increase American Indian student visibility and success on campus by advocating for and providing student centered programs and tools to enhance academic success, cultural events to promote personal well-being, and a supportive “home-away-from-home” space for students to grow and develop leadership skills.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

**American Indian Resource Center**
801-581-7019
diversity.utah.edu/centers/airc
Fort Douglas Building 622
1925 De Trobriand St.
Salt Lake City, UT 84113

**Black Students**

Using a pan-African lens, the Black Cultural Center seeks to counteract persistent campus-wide and global anti-blackness. The Black Cultural Center works to holistically enrich, educate, and advocate for students, faculty, and staff through Black centered programming, culturally affirming educational initiatives, and retention strategies.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

**Black Cultural Center**
801-213-1441
diversity.utah.edu/centers/bcc
Fort Douglas Building 603
95 Fort Douglas Blvd.
Salt Lake City, UT 84113

**Students with Children**

Our mission is to support and coordinate information, program development and services that enhance family resources as well as the availability, affordability and quality of child care for University students, faculty and staff.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:
**Center for Childcare & Family Resources**
801-585-5897  
[childcare.utah.edu](http://childcare.utah.edu)  
408 Union Building  
200 S. Central Campus Dr.  
Salt Lake City, UT 84112

**Students with Disabilities**

The Center for Disability Services is dedicated to serving students with disabilities by providing the opportunity for success and equal access at the University of Utah. They also strive to create an inclusive, safe, and respectful environment.

For more information about what support they provide and links to other resources, view their website or contact:

**Center for Disability Services**
801-581-5020  
[disability.utah.edu](http://disability.utah.edu)  
162 Union Building  
200 S. Central Campus Dr.  
Salt Lake City, UT 84112

**Students across Intersectional Identities and Experiences**

The Center for Equity and Student Belonging (CESB) creates community and advocates for academic success and belonging for students across inter-sectional identities and experiences among our African, African American, Black, Native, Indigenous, American Indian, Asian, Asian American, Latinx, Chicanx, Pacific Islander, Multiracial, LGBTQ+, Neurodiverse and Disabled students of color.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

**Center for Equity and Student Belonging (CESB)**
801-581-8151  
[diversity.utah.edu/centers/CESB/](http://diversity.utah.edu/centers/CESB/)  
235 Union Building  
200 S. Central Campus Dr.  
Salt Lake City, UT 84112

**English as a Second/Additional Language (ESL) Students**

If you are an English language learner, there are several resources on campus available to help you develop your English writing and language skills. Feel free to contact:

**Writing Center**
801-587-9122  
[writingcenter.utah.edu](http://writingcenter.utah.edu)  
2701 Marriott Library  
295 S 1500 E  
Salt Lake City, UT 84112
Undocumented Students

Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles that prevent you from engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center.

Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families.

For more information about what support they provide and links to other resources, view their website or contact:

Dream Center
801-213-3697
dream.utah.edu
1120 Annex (Wing B)
1901 E. S. Campus Dr.
Salt Lake City, UT 84112

LGBTQ+ Students

The LGBTQ+ Resource Center acts in accountability with the campus community by identifying the needs of people with a queer range of [a]gender and [a]sexual experiences and responding with university-wide services.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

LGBTQ+ Resource Center
801-587-7973
lgbt.utah.edu (Links to an external site.)
409 Union Building
200 S. Central Campus Dr.
Salt Lake City, UT 84112

Veterans & Military Students

The mission of the Veterans Support Center is to improve and enhance the individual and academic success of veterans, service members, and their family members who attend the university; to help them receive the benefits they earned; and to serve as a liaison between the student veteran community and the university.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:
Women

The Women’s Resource Center (WRC) at the University of Utah serves as the central resource for educational and support services for women. Honoring the complexities of women’s identities, the WRC facilitates choices and changes through programs, counseling, and training grounded in a commitment to advance social justice and equality.

For more information about what support they provide, a list of ongoing events, and links to other resources, view their website or contact:

**Women’s Resource Center**
801-581-8030
[womenscenter.utah.edu](http://womenscenter.utah.edu)
411 Union Building
200 S. Central Campus Dr.
Salt Lake City, UT 84112

Inclusivity at the U

The Office for Inclusive Excellence is here to engage, support, and advance an environment fostering the values of respect, diversity, equity, inclusivity, and academic excellence for students in our increasingly global campus community. They also handle reports of bias in the classroom as outlined below:

*Bias or hate incidents consist of speech, conduct, or some other form of expression or action that is motivated wholly or in part by prejudice or bias whose impact discriminates, demeans, embarrasses, assigns stereotypes, harasses, or excludes individuals because of their race, color, ethnicity, national origin, language, sex, size, gender identity or expression, sexual orientation, disability, age, or religion.*

For more information about what support they provide and links to other resources, or to report a bias incident, view their website or contact:

**Office for Inclusive Excellence**
801-581-4600
[inclusive-excellence.utah.edu](http://inclusive-excellence.utah.edu)
170 Annex (Wing D)
1901 E. S. Campus Dr.
Salt Lake City, UT 84112

Other Student Groups at the U

To learn more about some of the other resource groups available at the U, check out:

[getinvolved.utah.edu](http://getinvolved.utah.edu/)
studentsuccess.utah.edu/resources/student-support
Learning Objectives and readings for class sessions:

Class 1: Introduction to metabolism and its regulation
Readings: Course syllabus; Basic Metabolic Overview (BMO) Ch. 1
1. Describe the overall course structure, expectations and modes for assessment/grading.
2. Identify current level of metabolism knowledge and personal goals for this course.
3. Identify the process of carbon oxidation as the basis of our catabolic metabolism.
4. Sketch an overview of the central metabolic pathways, including connections between them.

Class 2: Respiration, TCA cycle, carbohydrate catabolism
Readings: BMO Ch. 1 and 2, Frayn 3rd Ed (free, online) Ch. 2 p. 27-30 OR Frayn 4th Ed p. 48-49, 60-63, 66-68:
1. List the general types of metabolic regulatory mechanisms used by human tissues and cells, and identify which operate on short time scales and which operate on longer time scales.
2. Describe the roles played by the B vitamins niacin, riboflavin, pantothenic acid and thiamine (examples of micronutrients) in the process of carbon oxidation.
3. Explain how the majority of oxygen is used in our bodies.
4. Explain the function of dehydrogenase enzymes in metabolism.
5. Identify amino acids as essential sources of TCA cycle intermediates.
6. Utilize understanding of respiratory control to predict the effects of inhibitors of the electron transport chain.
7. Explain why deleterious mutations of the mitochondrial genome invariably affect cellular respiration.
8. Diagram the process by which brown adipose tissue functions to produce heat.
9. Explain the overall purpose of glycolysis in the context of human physiology.
10. Describe the regulation of the committed step of glycolysis.
11. Predict which situations are likely to result in elevated blood lactate levels.
12. Analyze why 2-deoxyglucose is so effective in labeling tumors.
13. Describe when and why glucose-6-phosphate enters the pentose phosphate pathway.
14. Explain, in a general sense, how and where fructose and galactose are catabolized.

Class 3: Glycogen, Gluconeogenesis and blood glucose regulation
Readings: Basic Metabolic Overview (BMO) Ch. 3; Frayn 3rd Ed Ch. 11, p. 306-324 OR Frayn 4th Ed Ch 12 p. 346-355.
1. Summarize the metabolic effects of insulin and glucagon on carbohydrate, lipid and protein metabolism.
2. Describe the processes of glycogen synthesis and breakdown.
3. Explain the differing roles of glycogen in the liver and non-liver tissues.
4. Identify the key substrates and enzymes for gluconeogenesis.
5. Describe how insulin and glucagon regulate glycogen synthesis, glycogenolysis and gluconeogenesis.
6. Recognize that a lack of suppression of gluconeogenesis is one of the major causes of hyperglycemia in untreated diabetics.

Class 4: Lipid metabolism
Readings: Frayn 3rd Ed Ch. 10 p. 275-295 OR Frayn 4th Ed Ch 10 p. 302-322; Basic Metabolic Overview (BMO) Ch. 4
1. Describe the shared property of all lipids that makes their digestion, absorption and metabolism very different from those of carbohydrates and proteins.
2. Explain when blood levels of chylomicrons are expected to be elevated.
3. Describe the fates of dietary lipids, including conditions that should favor lipid storage or fatty acid oxidation.
4. Describe when, where and how fatty acid oxidation occurs in the body.
5. Explain why ketone bodies are and how their levels are primarily regulated.
6. Identify conditions that promote fatty acid synthesis and outline the process.
7. Explain the transport of lipids through the body.
8. Describe the general features of cholesterol biosynthesis and regulation.
9. Explain the formation, role and fate of chylomicrons, VLDLs, LDL-cholesterol and HDL-cholesterol.
10. Predict how HMG-CoA reductase inhibitors (statins, such as Lipitor), functioning primarily in the liver, lower serum LDL-cholesterol.
11. Hypothesize why people with insulin resistance often have elevated serum triglycerides.

Class 5: Integration of Carbohydrate & Fat Metabolism/ In-class Quiz on material from classes 1-5
Readings: Frayn 3rd Ed Ch. 7 p. 169-187 OR Frayn 4th Ed p. 204-222; Basic Metabolic Overview (BMO) review all chapters
1. Diagram the major metabolic processes occurring in liver, adipose, muscle, brain during the feed-fasting cycle and exercise.
2. Explain the major forms of regulation for these metabolic processes.
3. Draw curves showing blood levels of glucose, non-esterified fatty acids, triglycerides, insulin, and glucagon with time following a meal.
4. Describe the differences in the regulation and metabolism that occurs during untreated diabetes.

Classes 6-10:
1. To practice reading metabolism research literature and asking relevant questions.
2. To outline the goals and methods of specific cutting-edge topics in metabolic regulation from UHealth experts in the field.
3. To demonstrate curiosity about the metabolic research occurring on campus.

Classes 11-15:
1. To develop knowledge and skills in interpreting and communicating primary literature metabolism research findings.
2. To practice giving effective feedback to peers.
Appendix A: Post-research talk curiosity submission grading rubric:

<table>
<thead>
<tr>
<th>Curiosity characteristics</th>
<th>Grade (pts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not submitted or irrelevant to discussed topics or identical to that of other students.</td>
<td>0</td>
</tr>
<tr>
<td>Submitted a relevant description of something curious, but does not specifically connect with the classroom discussion or show understanding of the topic discussed.</td>
<td>1</td>
</tr>
<tr>
<td>Submitted a curiosity description that shows understanding of the classroom discussion, and is distinct from other student submissions.</td>
<td>2</td>
</tr>
<tr>
<td>Submitted a curiosity description that shows understanding of the classroom discussion, thoughtfully goes beyond the discussion (adds new point(s) not mentioned during the class discussion) and is distinct from other student submissions.</td>
<td>3</td>
</tr>
</tbody>
</table>

Examples of past curiosity submissions that have received full credit:

1. Dr. X’s talk correlated the progression of intestinal tumors to lowered levels of Mitochondrial Pyruvate Carriers (MPC). I was intrigued by his “punch lines” on how metabolites are not just a response but serve as a cue for cellular homeostasis. Further, his presentation highlighted the role of MPC in determining the “stemness/differentiation” state of the cell. Since Wnt signaling is said to stimulate mitochondrial biogenesis (1), a potential direction I could think of is Wnt signaling and MPC in the above context.

2. I found it interesting that via nutritional metabolites, you can find how the food was prepared. When I worked in bone marrow transplant as a dietitian, it was stressed that not many foods were off-the-table in terms of restriction, other than lunch meat. It was a hot topic at the time because people really struggle with telling a cancer patient going through treatment that they should not consume something because they already struggle so much with getting enough nutrition as the treatment progresses. Therefore, the main type of counseling that I’d give my patients is to provide and go over handouts for food preparation and safe food handling practices. I am wondering how processed foods show metabolites that are different than fresh or whole foods. I understand that you can tell if the food was fried, etc, but is there a way to tell if the meat source is from whole meat vs lunch meat from a package? Is there a bacterial component that can be detected through metabolites (maybe via the effects on gut microbiome) that can positively or negatively affect a patient’s outcome? Additionally, I wanted to ask X’s view on vitamin D supplementation for different cancer types. This was also an area of controversy and interest. Since foods that contain dairy fat (such as milk) are also foods that are fortified with vitamin D, how could this be navigated in terms of dietary recommendations? There are different forms of vitamin D (activated vs non-activated) that you can get in supplemental or dietary form. Looking at these metabolites in the body as they relate to cancer risk would clear up a lot of confusion in the field. Thank you for taking the time to talk with our class and consider my questions/comments!
# Appendix B: Student 10-min research presentation grading rubric

Student presenter: *student name*  
Faculty Evaluator:  

<table>
<thead>
<tr>
<th>15 total points</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible points</td>
<td>Grading component</td>
</tr>
<tr>
<td>3</td>
<td>Clear and concise description and presentation of the research question being asked.</td>
</tr>
<tr>
<td>3</td>
<td>Clear and concise description and presentation of the background research methods used for the figure being presented.</td>
</tr>
<tr>
<td>3</td>
<td>Clear and concise description and presentation of the data shown in the figure (one panel of a multi-panel figure may be all that time allows)</td>
</tr>
<tr>
<td>3</td>
<td>Clear and concise explanation of what was learned by the experimental data, and how this fits in with the body of metabolism knowledge. (demonstrate an understanding of everything you present; answer questions appropriately, critically evaluate what's being presented, synthesize well with other material presented during the course)</td>
</tr>
<tr>
<td>3</td>
<td>Presentation organization (including keeping to 10-min limit, referencing primary sources used, appropriate use of technology, correct spelling on slides, etc) and engagement with audience (making the session interesting, making connections with other parts of the course, encouraging questions and answering them appropriately)</td>
</tr>
</tbody>
</table>

Comments:  

Final grade (out of 15 points):
### Appendix C: Student peer feedback form for student presentation sessions

**Presenter’s Name:** __________________________  
**Evaluator’s Name:** __________________________

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Somewhat agree</th>
<th>Neutral</th>
<th>Somewhat disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearly stated the research question</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearly explained the research methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearly explained one figure (or panel of a complex figure)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearly summarized what was learned by the experiment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials (PowerPoint, etc) helpful and professional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No distracting mannerisms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pertinent &amp; accurate information; intellectually prepared</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Well organized; appropriate amount of info; summarized</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What worked well in this presentation? List at least one specific item.

How could the presenter improve? List at least one specific way.