Conventional metabolic pathways of \textit{D.\textit{radiodurans}} and systems that generate and defend against free radicals

\textbf{Fall 2010}

\textbf{Tuesdays & Thursdays 8:00 - 9:30AM}

\textbf{Elvey Auditorium}

Introduction to intermediary metabolism. Topics include structure and function of proteins, biological regulation and major pathways of carbon and nitrogen metabolism.
1. Course Information:
Principles of Metabolism and Biochemistry, BIOL 303 (4)
Meeting Times: Tuesday & Thursday 8:00 – 9:30 am, Elvey Auditorium
Monday 2:15 pm– (74449) Wednesday 2:15 pm– (74450) Irving I 201
Prerequisites: BIOL 115X; 116X; CHEM 105X; 106X.

2. Instructing Staff:
Barbara E Taylor, Ph.D., Assistant Professor of Biology (Neurophysiology)
Office: Arctic Health Research Building Room 202
Research Lab: Arctic Health Research Building Rooms 253
Phone: 474-2487 (office)
E-mail: betaylor@alaska.edu*
Office hours: Monday 12:30 - 2:00PM
Tuesday 2:30 - 4:30PM
Wednesday 12:30 - 2:00PM
* email is the LEAST DESIREABLE means of contact; the sheer volume of email I receive makes it impossible for me to respond to each in a timely manner

Velva Combs, MS graduate student in biochemistry and molecular biology
Office: Room 107 Irving I
Phone: 474-5404
E-mail: vmcombs@alaska.edu
Office hours: TBA

3. Course Readings/Materials:
A reserve copy is available in the BioSciences Library.

Blackboard Page: Students are expected to check the course webpage on Blackboard on a regular basis.
Login at http://classes.uaf.edu/webapps/login
Click “Principles of Metabolism and Biochemistry”
Contact us by email if you are unable to access this site.

Email Notifications: On occasion, students will be contacted via email. We will assume that each student will check their university-assigned email address (username@alaska.edu) on a regular basis.

4. Course Description:
Welcome to Principles of Metabolism and Biochemistry. The UAF Catalogue describes the topic of this course as follows: Introduction to metabolism at the molecular level. Topics include structure and function of proteins, enzyme function, biological regulation, and major pathways of carbon and nitrogen metabolism. The topics are presented in an evolutionary and ecological context.

The goal of this course is to provide a basic understanding of metabolism by studying its major pathways, regulation, and molecular components. **This course is designed as the first encounter with biochemistry for students that have taken introductory biology and chemistry courses. It will cover the fundamental facts and principles of metabolism and biochemistry.**
Biochemistry is the chemistry of living things. All living things have in common that they are adapted to survive, grow and reproduce. To do this they must produce a variety of biomolecules using resources they acquire from their environment. In this course we will strive for an understanding of how living organisms convert resources they acquire from their environment into more of themselves.

**Course Organization:** The course will lead the student in a consideration of the foundations of biochemistry, which integrate with the distinguishing features of living organisms. Living organisms have in common six distinguishing features:

1. their chemical complexity and microscopic organization;
2. their systems for extracting and transforming energy;
3. the defined functions of their components and the regulated interactions among their components;
4. their mechanisms for sensing and responding to the environment;
5. their capacity for self-replication and self-assembly;
6. their capacity to change over time.

These common features will be explored through the cellular, physical, chemical, genetic and evolutionary foundations of biochemistry. There are 3 central concepts each divided into topics (textbook chapters). We will spend 1 - 3 class periods on each topic. Questions and discussion throughout the course are encouraged and this syllabus should be considered flexible. We will begin with a general introduction to the chemistry of biological molecules and then consider the central concepts in more detail. The central concepts associated with this course are:

1. structure and catalysis;
2. bioenergetics and metabolism;
3. information pathways.

5. **Course Goals:**
The overall goal of this course is for the student to gain a fundamental working knowledge of biochemistry and to appreciate the impact of this field on other areas of biology. Specific areas of student development include achieving an understanding of:

1. the relationship between the structure and function of biological molecules;
2. the chemistry of intramolecular interactions in macromolecules;
3. the intermolecular interactions between macromolecules and their ligands;
4. free energy changes in biochemical processes;
5. the dynamics and regulation of metabolic pathways;
6. enzyme kinetics

**Expectations:** During the course of the semester certain information will need to be understood in order to reach the goals set above. A list of this information includes:

1. functional groups associated with biological molecules;
2. basic elements of protein structure;
3. general structure of macromolecules;
4. basic equations of enzyme kinetics;
5. sequence of reactions in glycolysis, glycogen metabolism, citric acid cycle, and the electron transport chain;
6. methods of metabolic regulation.

6. **Instructional Methods:**

1. **Lecture and Discussion.** Lectures and discussions will focus on the basic concepts of biochemistry. An important source for this information is written material. *Lehninger Principles of Biochemistry, Fifth Edition* (David L. Nelson, Michael M. Cox, W. H. Freeman, NY) is available at Amazon.com for $80 - $200, used and new.
You are expected to read the assigned textbook chapters, to attend the lectures, and take part in class exercises. The textbook and the lectures together define the material covered in the exams.

2. Recitation. As a student in BIOL303 you have registered in one of two recitation sessions:
   1. Mon 2:15 – 5:15 Irving I 201 (CRN 74449)
   2. Wed 2:15 – 5:15 Irving I 201 (CRN 74450)
   Recitations begin the week of September 13 and continue throughout the semester. There will be 13 recitations in total.

In the recitation students will actively engage with the core concepts of biochemistry and metabolism. Each recitation is organized in three parts: preparatory assignment, activity, and skill exercise. Each recitation will count toward 4% of the final grade; recitations in total will count toward 52% of the final grade. The assignment is intended to be completed before coming to recitation and will help set the stage for the recitation activity. Completion of each preparatory assignment prior to recitation will count 1% of the final grade. The activity is completed during the recitation period as part of a team. Your TA will guide you and answer questions as needed. Each recitation activity will count toward 3% of the final grade. These activities work best when all team members start with the same level of exposure to the material. Therefore, it is important to complete the assignment, but not start the activity before coming to class. The skill exercises are optional, challenging problems designed to help you practice and apply concepts introduced in the activity. Skill exercises are generally completed after recitation.

3. Blackboard Page. Several learning resources will be available on the course Blackboard Page:
   a. A copy of the lecture slides will be posted just prior to class.
   b. The recitation preparatory assignments, activity instructions, and skill exercises will be posted.
   c. Answers to the exam questions will be posted on Blackboard after the exams have been completed and graded.
   d. The course Blackboard Page will contain links to other instructional and informative pages on biochemistry. Some of these will include practice quizzes and short movie clips, which are especially good learning aids.
   e. A copy of this syllabus and the course calendar will be posted separately on Blackboard.

4. Exams. There will be three exams during the semester. They will test your knowledge of the lecture subjects to the depth covered in the text. You need access to text material to be fully prepared for all exams. Each exam will consist of multiple choice questions and (perhaps) short answer questions. Each exam will count toward 10% of the final grade. For each exam you are permitted to bring in a “cheat sheet”; this is a DOUBLE-SIDED, standard 8.5X11” page filled with any information you choose. Do not miss the scheduled exam times! If you miss an exam, your ONL opportunity for a make-up exam will be the first Tuesday lecture period following the exam.

5. Final Exam. The final exam will be held Saturday, December 18 from 10:15AM - 12:15PM. The final exam will be a cumulative test of your knowledge in biochemistry. The exam will consist of multiple choice questions and (perhaps) short answer questions. It will count toward 18% of the final grade. For the final exam you are permitted to bring in a “cheat sheet”; this is a DOUBLE-SIDED, standard 8.5X11” page filled with any information you choose.

7. Course Policies
   As a UAF student, you are subject to the Student Code of Conduct. In accordance with Board of Regents' Policy 09.02.01, UAF will maintain an academic environment in which the freedom to teach, conduct research,
learn, and administer the university is protected. Students will enjoy maximum benefit from this environment by accepting responsibilities commensurate with their role in the academic community. The principles of the Code are designed to facilitate communication, foster academic integrity, and defend freedoms of inquiry, discussion, and expression among members of the university community. You should become familiar with campus policies and regulations as published in the student handbook.

UAF requires students to conduct themselves honestly and responsibly, and to respect the rights of others. Conduct that unreasonably interferes with the learning environment or that violates the rights of others is prohibited. Students and student organizations will be responsible for ensuring that they and their guests comply with the Code while on property owned or controlled by the university or at activities authorized by the university.

Disciplinary action may be initiated by the university and disciplinary sanctions imposed against any student or student organization found responsible for committing, attempting to commit, or intentionally assisting in the commission of any of the following prohibited forms of conduct:

A. cheating, plagiarism, or other forms of academic dishonesty;
B. forgery, falsification, alteration, or misuse of documents, funds, or property;
C. damage or destruction of property;
D. theft of property or services;
E. harassment;
F. endangerment, assault, or infliction of physical harm;
G. disruptive or obstructive actions;
H. misuse of firearms, explosives, weapons, dangerous devices, or dangerous chemicals;
I. failure to comply with university directives;
J. misuse of alcohol or other intoxicants or drugs;
K. violation of published university policies, regulations, rules, or procedures; or
L. any other actions that result in unreasonable interference with the learning environment or the rights of others.

This list is not intended to define prohibited conduct in exhaustive terms, but rather to set forth examples to serve as guidelines for acceptable and unacceptable behavior.

Honesty is a primary responsibility of you and every other UAF student. The following are common guidelines regarding academic integrity:

1. Students will not collaborate on any quizzes or exams that will contribute to their grade in a course, unless permission is granted by the instructor of the course. Only those materials permitted by the instructor may be used to assist in quizzes and exams.
2. Students will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself (direct quotes or paraphrases) in compositions, theses and other reports.
3. No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors.

Alleged violations of the Code of Conduct will be reviewed in accordance with procedures specified in regent's policy, university regulations and UAF rules and procedures. For additional information and details about the Student Code of Conduct, contact the Dean of Student Services or web www.alaska.edu/bor/ or refer to the student handbook that is printed in the back of the class schedule for each semester. Students are encouraged to review the entire code.
A Few Words on Plagiarism: In general, DO NOT present someone else’s ideas or data as your own: you are expected and required to give credit where credit is due. Plagiarism is a violation of the law and may lead to serious repercussions! Please follow the following guidelines: for any written assignments, if you use someone else’s ideas, data, or other information, write it in your own words and include the reference in parentheses directly following that information. Avoid copying someone else’s text. If, however, you feel you have to include an exact copy of that text, put it in quotation marks followed by the reference in parentheses. Of course, include all cited references in the Literature Cited section. During oral presentations, please acknowledge the sources by mentioning their name(s) and year of publication or by printing them on overheads, slides, or handouts. Also be aware that you need to cite earlier work by yourself. Any substantial use of any written or other materials that was used for another course or that was generated in any other circumstances will not be accepted for credit in this course. Only minor contributions from earlier work with appropriate citation(s) will be accepted.

8. Evaluation
The final grade will be based on the average of all assignment marks according to the following fixed scale:

<table>
<thead>
<tr>
<th>Required Component</th>
<th>% value of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lecture Exams (3)</td>
<td>30% (10% each)</td>
</tr>
<tr>
<td>2. Recitation (weekly assignments and activities)</td>
<td>52% (4% each recitation; 1% each assignment, 3% each activity)</td>
</tr>
<tr>
<td>3. Final Exam</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

The class will be graded on a straight percentage basis: 90-100% is an A, 80-89.9% is a B, 70-79.9% is a C, 60-69.9% is a D, and < 60% is an F. We will not grade on a curve. This means that, in principle, it will be possible for everyone to get an A in this course.

Missed exams and recitations:
Times for exams and recitations are designated well in advance. Completion of these tasks at the designated time will be the responsibility of the student. Accommodations will only be made for legitimate and documented contingencies.

9. Disabilities Services
At UAF, the Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. We will work with the Office of Disabilities Services (fydso@uaf.edu, 474-5655) to provide reasonable accommodation to students with disabilities.
10. Course Calendar (subject to change)

Principles of Metabolism

Section I. Fundamentals of Biological Chemistry
1. Sept. 2  Class introduction
2. Sept. 7  Chapter 1  Foundations of Biochemistry
3. Sept. 9  Chapter 2  Water
4. Sept. 14  Chapter 3-5 (excerpts)  Amino Acids, Protein structure
5. Sept. 16  Chapter 6  Enzymes

Section II. Molecular properties of Biomolecules
6. Sept. 21  Chapter 6  More on Enzymes and their regulation
7. Sept. 23  **Exam I**  Exam includes all chapters previously covered
8. Sept. 28  Chapter 7  Carbohydrates
9. Sept. 30  Chapter 10  Lipids
10. Oct. 5  Chapter 11  Biological membranes & Transport

Section III. Intermediary Metabolism
11. Oct. 7  Chapter 12-13  Biosignaling & Bioenergetics
12. Oct. 12  Chapter 14  Glycolysis
14. Oct. 19  **Exam II**  Exam includes all chapters previously covered
15. Oct. 21  Chapter 14-16  Citric Acid Cycle
16. Oct. 26  Chapter 17  Fatty Acid Oxidation
17. Oct. 28  Chapter 17  Fatty Acid Oxidation
18. Nov. 2  Chapter 17  Fatty Acid Oxidation
19. Nov. 4  Chapter 18  Amino Acid Oxidation
20. Nov. 9  Chapter 19  Oxidative Phosphorylation and Photosynthesis
21. Nov. 11  Chapter 20  Carbohydrate Biosynthesis
22. Nov. 16  **Exam III**  Exam includes all chapters previously covered
23. Nov. 18  Chapter 21  Lipid Biosynthesis
24. Nov. 23  Chapter 22  Nitrogen Metabolism
25. Nov. 30  Chapter 23 & Suppl. Text  Integration of Metabolism & Review
26. Dec. 2  Chapter 23 & Suppl. Text  Integration of Metabolism & Review
27. Dec. 7  Chapter 23 & Suppl. Text  Integration of Metabolism & Review
28. Dec. 9  Chapter 23 & Suppl. Text  Integration of Metabolism & Review

**Dec. 18  10:15AM - 12:15PM**  COMPREHENSIVE FINAL EXAM