AUBIO/AUCHE 381 - Biochemistry: intermediary metabolism **UNIVERSITY OF ALBERTA**
Fall 2006 **AUGUSTANA FACULTY**

Prerequisites: AUCHE 252 - Organic Chemistry II
AUBIO/AUCHE 280 - Biochemistry: proteins, enzymes & energy

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Lectures: MWF 10:30-11:20 Rm M010

Office hours: These will posted outside my office on a weekly basis. Please sign up for a 15 minute block or make an appointment with me. Generally I am available for consultations on MWF.

Required texts:

Horton, H.R., L.A. Moran, K.G. Scrimgeour, M.D. Perry & J.D. Rawn. 2006. Principles of Biochemistry, 4th ed., Pearson Education, Inc., Upper Saddle River, NJ. 852 pp.

Pechenik, J. 2004. A Short Guide to Writing about Biology, 5th edition. Pearson Education, Inc. Montreal, QC. 302 pp.

Recommended text:

Scism, A.J. 2006. The Biochemistry Student Companion, 3rd ed. Pearson Education, Inc., Upper Saddle River, NJ. 194 pp.

Course Objectives:

This course is a continuation of AUBIO/AUCHE 280. Hence, we are again investigating the biochemical basis of life. This term we focus on intermediary metabolism. These are the metabolic reactions which feed off of or into glycolysis and the citric acid cycle. AUBIO/AUCHE 381 starts off by completing the metabolism of carbohydrates begun in AUBIO/AUCHE 280 (i.e. catabolism of hexoses other than glucose, glycogen metabolism, gluconeogenesis, and the pentose-phosphate pathway). The remainder of the course continues with an investigation of lipids, amino acids, and nucleotides, concluding with an examination of how all the metabolic pathways are coordinately controlled and how some organs of the mammalian body are specially designed to carry out particular metabolic functions. Hence, this course assumes knowledge of glycolysis, the citric acid cycle, amino acid structure and some appreciation of metabolic regulation, all of which were covered in the prerequisite to this course, AUBIO/AUCHE 280.

At the end of this course you will be expected to:

1. trace the catabolism and anabolism of carbohydrates, lipids, amino acids and nucleotides,
2. understand integration of cell metabolism, including energy production/consumption,
3. explain the control mechanisms which enable the cell/organ/body to shunt precursors and products to where they are needed,
4. explain the metabolic inter-relationships between the major organs of the mammalian body (eg. brain, liver, gut, muscle and adipose), and
5. have some appreciation of the metabolic basis of inherited and/or nutritional disease.

Evaluation and Mark Distribution:

Formal evaluation of your progress in the course will be through three exams (two midterm and one final exam) and a term paper. Students may receive a failing grade (i.e. F) in the course if:

a) unsatisfactory marks (< 50%) are earned on overall term work (e.g. term paper);
b) unsatisfactory marks are earned on instructor supervised material (exams);
c) an unsatisfactory mark is achieved on the final exam.

ASSIGNMENT		% FINAL GRADE	
	weighting	Your score	Final score
Quizzes	10	_____%	_____
Midterm exam I	15	_____%	_____
Midterm exam II	15	_____%	_____
Final exam	40	_____%	_____
Term paper	20	_____%	_____
Total	100		_____

Late assignments (e.g. term papers) will be penalized 10% of the earned mark per day late. Computer or printer problems are NOT acceptable reasons for an extension. Medical emergencies require a note signed by the attending physician in order for an extension to be considered. Extenuating family situations may also be considered as grounds for an extension.

Grades will be assigned according to natural breaks in the %mark distribution using the following table as a ***guide***:

F	D	D+	C-	C	C+	B-	B	B+	A-	A	A+
0-49	50-52	53-56	57-60	61-64	65-67	68-71	72-75	76-79	80-86	87-93	94-100

Please note that because grades indicate qualitative differences between students the mark/grade conversion may fluctuate +/- a few % for any given class of students.

Academic Integrity Statement:

"The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at www.ualberta.ca/secretariat/appeals.htm) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University." (GFC 29 SEP 2003) Further material on academic integrity may be found at the Truth*In*Education website: www.ualberta.ca/TIE.

Course Outline:

DATE	TOPIC	ASSIGNED READING	QUESTIONS *	
			Horton *et al*	Scism
Sept 8-11	Glucose alternatives	350-352	11:1	A14, B9,13, C5
Sept 13-15	Gluconeogenesis	357-366	12:2,5-6,9-10	A6-8, B5,8-11, C1-3,6,9-10, D1-2
Sept 18	Pentose-phosphate pathway & sucrose synthesis	367-370 464- 473	12:12&13 15:	A1-2,9-10, B1-2,C11-12,14, D3,6 A11 & C15
Sept 20-22	Glycogen metabolism	371-379	12:1,3-4,7-8,11	A3-5,11-13, B3-4,6-7, C4-5,7-8, D4-5
Sept 25-27	Lipid structure & nomenclature	253-274	9:1-7&9	A1-10,12,14, B1-11, C1-6,12-13, D1-2,4
Sept 29-Oct 2	FA absorption, transport & mobilization	509-513	9:6 16:4	A5&8 A10
Oct 4-6	β-oxidation & ketone bodies	498-506	16:2-3,5-6	A1-5,7,12, B1-6, C3-6,10, D1-2, 5
Oct 9	THANKSGIVING			
Oct 11	MIDTERM EXAM I			
Oct 13-20	Fatty acid synthesis & regulation of FA metabolism	479-485, 507- 508	16:7-13	A1,6,8, B7-9, C1-2,7-8,11-12, D1,4
Oct 23	Eicosanoids	488-490	16:14	B10,11, C14, D6
Oct 25 & 30	TG & PL synthesis	485-488, 490- 494	16:15	B14
Oct 26-29	FALL BREAK			
Nov 1-3	Cholesterol metabolism	494-498	16:1,16	A9-10, B12-13, C9,13, D3
Nov 6	MIDTERM EXAM II			
Nov 8-10	N metabolism - intro	520-525	17:1-3	A1,4,6,7, B1,5, C4
Nov 13	REMEMBRANCE DAY HOLIDAY			
Nov 15-17	Amino acid anabolism	526-538	17: 8,15-17	A2,8, B2,13, C3,7- 8,11,13
Nov 20	Amino acid catabolism	538-548	17: 9-11	A9, B3-4,10, C1,9-10,14
Nov 22	Urea cycle	549-554	17: 12	A10-11, B6-9,11-12, C2,5-6,11, D1-5
Nov 24	Nucleotide structure & purine synthesis	583- 589 557-563	19:	A1-3, B1-3, C1
Nov 27-29	Pyrimidine synthesis	563-573	18:1-7,13,15	A1-8,10-12, B1-6,9, C1- 11, D1-2,6-7
Dec 1	Nucleotide catabolism	573-580	18: 8-12,14	A9,13, B7-8,10-13, C12, D3-5
Dec 4-8	Integration of metabolism	344-346 379-381 516	11: 6,13 12: 1-6,10 13: 11-13 16: 2,6,10	 C4,7,10 C7 D2

* Additional practice problems are available with the objectives for each lecture section posted on WebCT.

Term Papers:

Papers *must* discuss biochemistry in a metabolic context. It needs to focus on the biochemistry (protein, energetics, enzymology, metabolism, regulation) NOT on genetics or physiology (though these may be mentioned in the paper). Hence, concentrate on how biochemical differences influence the metabolism of different species or how a metabolic pathway or protein may have evolved. How are the differences related to lifestyle of the organism or environment of the protein or pathway? How is regulation or energetics of the pathway achieved? Note that you may not choose a topic specifically covered in class. Papers are intended to go beyond what is in the course syllabus

Papers must be typed, double spaced, and 10 - 15 pages of text in length using 12 pt or 10 cpi courier font with one inch margins and full justification. Primary research articles ***must*** be used in addition to reviews and book articles. Any internet resources used MUST be peer-reviewed (check with me if you are unsure). References must be cited using the style explained in Pechenik. The purpose of the term paper is to give students experience in reading and analysing scientific literature. Pechenik (2004) has some good comments on how to read the literature (pp 21-28), take notes without plagiarizing (pp 29-37), search the literature (pp 37-48), cite the sources used (66-74), and writing (pp 2-20, 75-120, 130-142). Older editions of Pechenik have similar material (pages 1-52, 70-131 & 144-155 in the 4th edition or pages 1-51, 152-163 & 209-250 in the 3rd edition). Please note that I will assume that you have read these pages when I mark your papers. **These pages are an assigned reading**. *Medline,* BIOSIS*,* the *Biological & Agricultural Index*, and the *General Sciences Index* are good databases available online via the library webpage that will enormously aid your literature search. Please see one of our reference librarians in the Augustana Library if you are unsure how to use these resources.

It is expected that the content of the paper will go beyond what is covered in the course or in the textbook. Papers that rely heavily on textbooks as a source of information or on only a few sources will be correspondingly penalized. Fifteen to twenty references is typical.

Hence, papers will require current review and 1° research articles as their primary source. Note that the *experiments* and conclusions in the 1° articles must be discussed in the paper. The 1° articles are ***NOT*** to be used as review articles. They should be read for the relevant findings that the article is reporting for the first time based on the results of the experiments.

Cite all non-original information. This means that probably every second or third sentence will be followed by a citation note. Always go back to the original source of information. Do NOT cite ”(Joe Blow 1989 as cited by Jane Doe 1999)”. Literature used must be listed and cited using the style indicated in Pechenik. The Biological Sciences ***do not*** use footnotes or endnotes. Sources of information are noted by a superscript number at the end of the relevant sentence corresponding to the appropriately numbered reference listed at the back of the paper. Alternatively (and my personal preference), sources of information may be cited by placing the last name of the author(s) and year of publication within brackets at the end of the sentence. This citation should correspond to the name of the first author for the relevant article listed *alphabetically* at the end of the paper. Make sure information sources are properly documented in the literature cited list. If unsure, examine the relevant pages in Pechenik.

Ensure that the material is synthesized and analysed. Do NOT treat each reference in its own

paragraph. Synthesis and analysis often requires that references are compared and contrasted developing your own conclusions about the material. This is difficult to do if each reference is treated separately in its own paragraph.

Generally, papers will be graded with regard to their organization, breadth and depth of knowledge researched, critical evaluation of the literature cited and the level of writing style (i.e., clarity and succinctness). It is assumed that students are capable of proper writing structure. Term papers are ***NOT*** to be written as if they were going to be entries in an encyclopedia or junior textbook. They must be an investigation of a problem in the relevant discipline. Hence they require a ***THESIS STATEMENT***. This is crucial to the relative success of your paper. This thesis (or question) should be clearly stated without bias and express the complexity of the issue being investigated. The thesis statement should be specific. Avoid vague statements. The title of the paper should precisely convey the thesis.

Any concepts key to understanding the argument must be clarified when necessary. Any assumptions need to be noted when reasonable. The line of reasoning which leads to the conclusions should be well developed and explained. This reasoning must be well-supported with relevant citations from the literature. The paper has to consider and deal with objections, alternative points of view or lines of reasoning. Finally, the paper must consider the implications and consequences of the conclusions resulting from the reasoning. Always ask yourself how a particular sentence or paragraph relates to your thesis. If you cannot determine this then delete the material: it is not relevant to your paper. Your writing should clearly indicate to the reader the significance to the thesis of the point being presented and discussed. Edit your paper for clarity, accuracy, brevity and succinctness.

Use a sufficient number of references to accurately convey the breadth of opinion and research in the field. Hence, limiting the scope of your thesis (i.e. avoiding vague statements in your thesis) will aid your ability to cut down the number of references required to do this. I expect at least 15 references with the vast majority being 1° research papers.

In organizing your paper, think of it as having an hourglass type format. Your introduction should be broad, stating how your thesis is relevant to the broader aspects of the biological discipline. Then the body of your paper gets progressively narrow and focussed so that it can specifically address your thesis statement. Finally, finish the paper by broadening the focus again (as in the introduction) and write about how the conclusions from the thesis investigation reveal new insights into the broader aspects of biology.

So . . . papers entitled “Fibrinogen” or “Phosphofructokinase” will likely receive a failing grade. Titles such as these indicate the lack of a thesis statement and hence a lack of any critical evaluation/investigation into the biological literature.

WebCT Vista:

Objectives, keywords, practice questions and the lecture slideshows (without figures) are posted at the U/A WebCT Vista website for Augustana (www.ualberta.ca/WEBCT/augustana/index.html) under AUBIO/AUCHE 381 - Biochemistry: intermediary metabolism. There are also links to the Horton text website which also includes additional practice questions.

Exams:

The midterm exams are 50 minutes in length and will cover material from the beginning of the term (MT I) and from material covered since the first midterm (MT II). The midterm exams are NOT comprehensive. The final exam, in contrast, is three hours in duration and will cover material form the entire term (i.e. the final exam IS comprehensive). Types of questions to be expected are very similar to the end-of-chapter questions in Horton *et al*. Supplemental exams are not available in AUBIO/AUCHE 381. Missed exams (i.e. midterms) will be marked zero (0). If an acceptable excuse (e.g. medical or family emergency) is documented, then the weighting of the missed exam will be added to the % weighting of the final exam.

Important dates:

Sept 19	last day to ADD/DROP Fall courses
Oct 9	Thanksgiving
Oct 11	**Midterm Exam I**
Oct 26-29	Fall Break
Oct 30	Term paper outline due
Nov 6	**Midterm Exam II**
Nov 10	last day to WITHDRAW from a Fall course
Nov 13	Remembrance day holiday
Nov 24, 10:30 am	**Term paper due**
Dec 8	last day of classes
TBA	Final Exam in the gym

Policy about course outlines can be found in 23.4(2) of the University of Alberta Calendar