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Fundamentals of Biomedical Science (IBMS 5000)

Fall 2020

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Course Objective: The Integrated Biomedical Sciences (IBMS) program core course will expose a diverse group of students to a range of multidisciplinary topics. The focus of the core course is to promote the development of independent, critical and creative thinking skills, to teach you how to use information you learn, and to foster the development of skills in experimental design and data analysis. The course will accomplish these tasks by having you be active participants in your education. Active learning methods include, independent learning (assignments outside class), in-class participation, and small group discussions of concepts and the primary scientific literature. It is our hope that this course will result in graduate students who are well-prepared to begin the next phase of becoming a research scientist; students who can think independently, critically, and creatively, who know how to use information (not just regurgitate it), and who know how to learn new information on their own.

Time: Generally, Mondays (8:00 to 11:30 am), Tues-Fridays (8:30-11:00 am) – although there are some exceptions – see course schedule for specific dates/times/rooms. Attendance is required. *Please note: arriving to class late (even by a few minutes) is disruptive to the learning of the other students in class and to the professor. Life happens to everyone and this is understood; but being late habitually is not acceptable. Please set your alarms to provide enough time to get to class on time. Another note, occasionally classes may convene at different times, please see course schedule on Canvas for up to date information.*

Place: Lectures are usually in room MED 209L, but see the course schedule as there are some dates when lectures/discussions will be in other rooms. Small groups on Thurs/Fri meet in various rooms – see lecture schedule. – *This is a hold-over from an ancient time when students and faculty met in person for education. Of course now, in modern times, the course will be delivered online using Zoom. Instructions will be sent to you.*

Comments from the course director:

Even though this course is entitled "Fundamentals of Biomedical Science", it is impossible to cover everything there is to know about Biomedical Science in one semester. I can't stress this enough – you need to take authority over your education. We can simply provide a solid framework for you to build upon. As you are exposed to new ideas or concepts in this course, continue on your own to explore further, especially, but not exclusively, in your area of interest. The course is designed to teach you how to think about scientific concepts and how to think experimentally and creatively. Use the skills you will learn in this course to dig deeper into the subjects. If you come across a concept in this class, or in your own research, that you don't know about, spend some time to learn about it on your own. Wikipedia is your friend. Although it's not a true, solid scientific resource, it can give you a place to begin and help you move forward in your search for an answer. Hopefully, this course will provide you with the tools/skills such that you can learn about new things without waiting for a professor to tell you about them.

You are in training to become an experimentalist, a problem solver, a scientist. As a graduate student, your training involves thinking, reading, questioning, and discussing. Just as the more an athlete trains, the better he/she becomes, the same is true for you. The more effort you put into training the better you will become, making you more competitive for jobs after graduation. We can't <u>give</u> you an education (training), you must work for it. Of course, I strongly believe that everyone must have balance in their lives - spending all your time training isn't good for you (or your relationships). However, there are time periods when you do have to spend more of your time on training, just remember to maintain a balance that works for you.

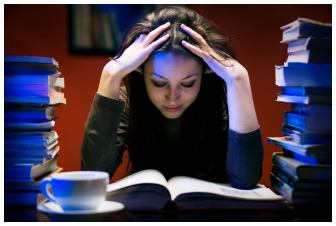
Course Overview:

The design of the IBMS core course centers around weekly "topics" that form a nucleus for discussion of "core concepts" of Biomedical Science. With the exception of the "Obesity" week, each topic will be covered in 1 week by interdisciplinary faculty teams, each lead by a faculty team leader.

A note about "topics": The material for each week has a "topic" heading, for example, 'Epilepsy' or 'HIV', or 'Aging'. Please keep in mind that these <u>topic titles are used simply to provide some context for the "core concepts" that are being presented each week</u>. You shouldn't think that you will learn all aspects of 'Epilepsy' in one week! Instead, you'll be presented with concepts, such as ion channels and regulation of membrane potential, synaptic function and plasticity, and neural circuits and reflexes, that all fit under an umbrella of 'Epilepsy'.

Each week of the course can be divided broadly into 3 parts; A) Independent Learning, B) Didactic Lectures and C) Primary Literature Discussion.

A) ***Independent Learning:*** One important skill needed for life after a Ph.D. is the ability to continue learning. This continual learning does not come in the form of learning from didactic lectures (where professors tell you what <u>they</u> think you need to know), but happens because <u>you</u> decide there's something you need to know. <u>You</u> find the material (books, papers, online material, etc.), and read it, think about it and learn it on your own. To begin to help you prepare for this process, this course contains a section each week for you to learn something on your own. Each week you will receive an assignment (typically a reading assignment, but it could be to watch a video, or investigate topic on the web, etc.) generally to be completed before class



begins on Monday morning. Along with the assignment, you will receive a set of discussion guide questions to help you focus your learning. These guide questions are designed to help you to assess your understanding of what you should have learned from the assignment. The guide questions also form the basis for a faculty-led group discussion with the class each Monday morning. For more details, see the Independent Learning section below.

B) **Didactic Lectures:** On Monday's and Tuesdays (and usually Wednesdays) of each week, there will be didactic lectures (2 - 1 hr lectures/day) that cover specific core concepts of Biomedical Sciences. Depending upon the week and at the discretion of the weekly faculty team, Wednesdays can be used for various laboratory demonstrations or for didactic lectures, or both. Please refer to the course schedule for details for each week. Lectures will be recorded (video/audio) and will be available on Canvas (see below) for you to review. However, please be aware that technology sometimes fails and recordings are not guaranteed. Slides (PowerPoint files) will also be available on Canvas.

Weeks 4, 8, 12 and 16 are Exam Weeks. On Exam Weeks, class is held only on Mon, Tues and Wed (the primary literature discussions (below)are not held on Exam weeks). The exam takes place on Thurs and Fri and covers the material of the preceding 4 weeks (see Grading below for more information).

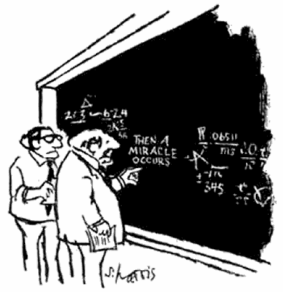
C) **Paper Discussions:** Each week (with the exception of Exam weeks), you will read a paper from the primary literature, chosen by the faculty team, that focuses on one or more concepts of the weekly topic (see below for some advice on how to read a scientific paper). You will receive discussion questions for each paper to help stimulate thinking and subsequent discussion. The paper must be read (and some thought given to it) before Thursday morning.

On Thursdays, you will meet in small groups of 8 students (or less) to discuss the paper, considering the discussion questions provided, and to discuss any aspect of the paper you didn't understand. Each week, you will be randomly assigned to a group (see Canvas for your weekly group assignments). The purpose of the Thursday meeting is for you to prepare for the discussion with a faculty member on the following dat (Friday).

On Fridays, you will meet in the same groups as the preceding Thursday, together with a faculty member as a discussion leader. Each student in the group will be chosen randomly, by the faculty discussion leader, to present different aspects of the paper (i.e. Introduction, Figure 1, 2, or 3, etc., or Discussion). Thus, each student should be prepared to present any aspect of the paper. The faculty leader will ask questions (not just limited to the paper discussion guide questions) of the chosen student and of students in the group to assess the level of understanding. All students in the group are encouraged to ask and answer questions (but first allow the chosen student to finish). You will be graded by the faculty discussion leader on your participation in this exercise (see the criteria for discussion grading below) and the faculty discussion leader will provide some written comments for each student to help them improve their performance in subsequent weeks.

Textbooks: Currently there are three recommended (not required) textbooks for the course: **Alberts' Molecular Biology of the Cell, 6th edition, Nov 2014 (**ISBN-10: 0815344325 | ISBN-13: 978-0815344322**), Boron's Medical Physiology, 3rd edition 2016 (**ISBN-10: 1455743771 | ISBN-13: 978-1455743773**), and Parham's The Immune System, 4th Edition 2014 (**ISBN-10: 081534466X | ISBN-13: 978-0815344667). Texts are on reserve in the library, available in the Bookstore and can be purchased in electronic form from Vitalsource (http://www.vitalsource.com/). The electronic versions can be downloaded to your computer and/or tablet/phone and notes made on one device are automatically available to the other devices. In addition, you can use any internet-connected computer/tablet to read your purchased books online (good if you forgot your laptop and are in the library.

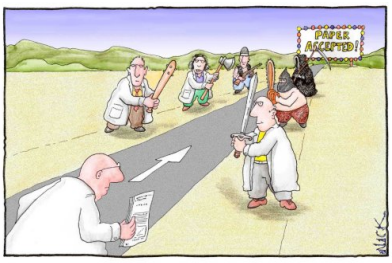
Canvas: This course uses Canvas as a repository for course-related information. Canvas is a web-based course management system. To access Canvas go to http://www.uthscsa.edu/university/canvas with an up-to-date browser. Also, Canvas can be accessed from the "Quicklinks" pull down menu (upper right side) of the UTHSCSA main page located at http://www.uthscsa.edu/. Click "Canvas Login" and submit your UTHSCSA domain username/password (same as your email username/password) for access. This course (IBMS 5000 – "FA20 IBMS 5000 Funds Of Biomedical Sciences") will be accessible through the Courses List. If you have a hold on your account you will not be able to access Canvas until your hold is cleared. For information and tutorials on how to use Canvas, see https://uthscsa.instructure.com/courses/1/pages/student-orientation.



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

Surveys: Each week you will be asked to complete an online survey (anonymously). Your opinion is very important to us as one of our goals is to improve the course and remove any obstacles to your learning. It is not uncommon for us to make a significant change to the course based upon comments provided by students. Your responses to the survey are anonymous, but linked to your email address (we only know if you took the survey). Of course, you are welcome, and are encouraged, to provide your comments to the course director at any time in person or by email.

"Of students surveyed, 64% prefer English and 32% prefer math. The fact that these numbers do not add up to 100 may help explain why."



Most scientists regarded the new streamlined peer-review process as 'quite an improvement.'

Peer Review: In addition to the course survey, each week (except exam weeks) you will complete an online, anonymous, peer review survey in which each of you will evaluate the performance of the other individual members of your weekly group. This survey is anonymous and we only know whether you completed the survey or not. Each week, each of you will receive the comments made by each of the other members of your team that week. Constructive criticism and complements by your peers can help you improve your performance.

Independent Learning Assignments

One of the important components of this course is to help students learn to learn new material on their own. We all have to do this continually to be successful researchers.

Each week you will receive an assignment from the faculty team along with a set of guide questions (5-10) to help you focus your learning and understanding. The assignment is to be completed over the weekend before the didactic lectures begin (however, there are some exceptions). Independent learning assignments can be derived from online videos, or from reading assignments from chapters in a text book or from the primary literature. Alternatively, questions can be provided and students required to search on their own for answers. Another assignment example would be to run a virtual experiment on a computer simulation, results/interpretations of which would be discussed in class.

On Monday morning of each week, a faculty member will orchestrate a discussion of the assignment between students in class. Students will be called upon randomly to address key issues in the learning assignment (initially based upon the discussion questions provided, but students should be prepared to go beyond the questions provided). Students not specifically called upon will also be encouraged to participate in the discussion.

Grading:

Grades are derived from the 4 exams and the 12 paper discussion grades. The exams contribute 85% and the paper discussions contribute 15% to the final grade. See below for the grading criteria for the paper discussions. If your grade is borderline (A/B, B/C, or C/D), at the discretion of the course director, consideration of your attendance record, timeliness to class, class participation and preparedness, completion of surveys can tip the balance in a positive or negative direction.

"I see you got an A+++ in science."

a. **Exams:** There are four exams in the course. All together, exams are worth 85% of the final grade in the course. Exams are held on Thursdays and Fridays of the 4 exam weeks and each exam will cover the previous 4 weeks of material.

   Open-book, take-home exams, These exams contain essay-type questions provided by each of the weekly faculty teams. Exam questions will emphasize use of information, critical thinking and analysis rather than fact recollection. It is very important to note that exam questions generally will not ask you to repeat what you were told in lecture and may not be solely based on the material presented in lecture. However, if you understand the independent learning, lecture and discussion paper material, you should be able to answer questions with an additional bit of research. The lecture material is necessary , but not sufficient, to answer the questions. These exams are not only assessments, but are also learning-mechanisms. Exams will be distributed electronically on Thursday afternoon (1:00 pm) of exam week and answers (Microsoft Word format or pdf) must be submitted electronically (on Canvas) by 12:00 am on Saturday (midnight on Friday) (there are no classes on Thursdays and Fridays of exam weeks). You are on the "honor system" not to discuss the exam with others. You are allowed to use the library and the internet to answer questions, however, answers submitted must be your own. Do not copy text or figures directly from another source without proper citation. Plagiarism will result in disciplinary action. Answers will be graded by the weekly faculty teams.

b. **Paper Discussion**: 15% of the final course grade is derived from the 12 weekly paper discussions. In the small group paper discussions on Fridays, you will receive a letter grade and written comments from the faculty leader of that group. See the "Friday Discussion Grade Guide" (attached here below and posted on Canvas) for some guidelines

for discussion participation grades. For purposes of averaging, an A is worth 100 points, B is 89 points, C is 79 points and F is 0.

c. **Class Participation:** Your participation in class activities, while not graded explicitly, can contribute in a positive or negative manner to your final grade. Attendance, being on time for class, completing the peer review surveys could be used to adjust your grade at the discretion of the course director. If your grade computed from exams and paper discussions is borderline between an A and B, B and C, or C and D, having a good record of attendance, being on time and completing the peer reviews and surveys could shift your grade to the higher level. Conversely…

Course Schedule: The course schedule, posted on Canvas, contains a list of the lectures, discussion periods, and exams, including the date and time. The schedule is updated periodically and posted to Canvas. Please check regularly the schedule for changes that can occur during the semester.

Email: Email is used to provide you with up-to-date information about the course. Please check your email (yourname@livemail.uthscsa.edu) regularly. You can also contact the course director via email at any time with questions (clarkew@uthscsa.edu).

Integrity/Professional Conduct

Our expectation is that you will exhibit the high standards of scholastic and scientific integrity as outlined in the current UTHSCSA catalog. Any evidence of dishonesty (including, but not limited to, cheating on exams, plagiarism (presenting text, figures, diagrams from other sources as your own), tampering with reference material or files or representing someone else's work as your own, will be taken very seriously. Failure to properly abide by these standards of professional conduct will result in a grade of 0 for an exam and may include dismissal from the program. If you have any questions regarding what constitutes proper professional conduct, please contact the course director, Dr. Bill Clarke (clarkew@uthscsa.edu).

If you suspect another student of professional misconduct, please bring your suspicions to the course director. Confidentiality will be maintained during any ongoing investigation of suspected academic or scientific misconduct.

If you need help: You have several sources of help available to you. Questions about material in a particular week (from reading, lectures, papers) can be answered by either the weekly team leader or the faculty member delivering the lecture or leading the paper discussion (please cc the course director on your correspondence). Administrative and Canvas questions can be directed to Donna Navarro in the Graduate Dean's Office (NavarroD3@uthscsa.edu). And of course you can contact the course director (clarkew@uthscsa.edu) at any time.

Note: the information on this handout is accurate at the time of printing. However, it is subject to change. Please check Canvas for the most up-to-date information.

Friday Discussion Grade Guide

Each student in the small group paper discussions on Fridays will receive a letter grade as well as written comments from the faculty leader. Grading guidelines are presented below.

Grade	Criteria
A	Demonstrates excellent preparation: not only knows the specifics of the paper but has thought through implications of them. Offers interpretations and analysis of paper (more than just recitation of facts). Contributes well to discussion in an ongoing way: responds to other students' points, thinks through own points, questions others in a constructive way, offers and supports suggestions that may be counter to the majority opinion. Offers analysis, synthesis, and critique of the paper, e.g., puts together pieces of the discussion to suggest new experimental approaches for future work.
B	Demonstrates adequate preparation: knows the specifics of the paper, but does not show evidence of trying to interpret or analyze them. Offers straightforward information (e.g., information straight from the paper), with marginal attempts to analyze and interpret the paper. Does not offer to contribute to discussion, but contributes to a moderate degree when called on.
C	Has read the paper, but has difficulty presenting the specifics when asked. Tries to respond when called on but does not offer much. Demonstrates infrequent involvement in discussion.
F	Is not able to present the specifics of the paper well. Does not add anything to the discussion. Not prepared.

Advice: How to read a scientific paper

One of the important components of this course is to expose you to critical and creative thinking, experimental design and analysis, and data interpretation using the primary literature. Obviously, this will require you to read and analyze papers from the literature. Some of you may not have much experience with this and so here is some pointers on how to read a scientific paper.

The information below was obtained from an article presented at Rice University:

How to Read a Scientific Article

Mary Purugganan, Ph.D. maryp@rice.edu Jan Hewitt, Ph.D. jhewitt@rice.edu

Reading a scientific article is a complex task. The *worst* way to approach this task is to treat it like the reading of a textbook—reading from title to literature cited, digesting every word along the way without any reflection or criticism. Rather, you should begin by skimming the article to identify its structure and features. As you read, look for the author's main points. Generate questions before, during, and after reading. Draw inferences based on your own experiences and knowledge. And to really improve understanding and recall, take notes as you read. This handout discusses each of these strategies in more detail.

1. Skim the article and identify its structure.

Most journals use a conventional IMRD structure: An abstract followed by Introduction, Methods, Results, and Discussion. Each of these sections normally contains easily recognized conventional features, and if you read with an anticipation of these features, you will read an article more quickly and comprehend more.

Features of Abstracts

Abstracts usually contain four kinds of information: ·

purpose or rationale of study (why they did it)

methodology (how they did it)

(what they found)

conclusion (what it means)

Most scientists read the abstract first. Others—especially experts in the field—skip right from the title to the visuals because the visuals, in many cases, tell the reader what kinds of experiments were done and what results were obtained. You should probably begin reading a paper by reading the abstract carefully and noting the four kinds of information outlined above. Then move first to the visuals and then to the rest of the paper.

Features of Introductions

Introductions serve two purposes: creating readers' interest in the subject and providing them with enough information to understand the article. Generally, introductions accomplish this by leading readers from broad information (what is *known* about the topic) to more specific information (what is *not known*) to a focal point (what *question* the authors asked and answered). Thus, authors describe previous work that led to current understanding of the topic (the broad) and then situate their work (the specific) within the field.

Features of Methods

The Methods section tells the reader what experiments were done to answer the question stated in the Introduction. Methods are often difficult to read, especially for graduate students, because of technical language and a level of detail sufficient for another trained scientist to repeat the experiments. However, you can more fully understand the design of the experiments and evaluate their validity by reading the Methods section carefully.

Features of Results and Discussion

The Results section contains results—statements of what was found, and reference to the data shown in visuals (figures and tables). Normally, authors do not include information that would need to be referenced, such as comparison to others' results. Instead, that material is placed in the Discussion—placing the work in context of the broader field. The Discussion also functions to provide a clear answer to the question posed in the Introduction and to explain how the results support that conclusion.

Atypical Structure

Some articles you read will deviate from the conventional content of IMRD sections. For instance, Letters to *Nature* appear to begin with an abstract, followed by the body of the article. Upon reading, however, you will see that the "abstract" is a summary of the work filled with extensive introduction (for the purpose of catching the attention of a wide audience), and the next paragraph begins a description of the experiments.

Therefore, when you begin to read an article for the first time, skim the article to analyze the document as a whole. Are the sections labeled with headings that identify the structure? If not, note what the structure is. Decide which sections contain the material most essential to your understanding of the article. Then decide the order in which you will read the sections.

2. Distinguish main points.

Because articles contain so much information, it may be difficult to distinguish the *main points* of an article from the *subordinate points*. Fortunately, there are many indicators of the author's main points:

Document level

	visuals (especially figure and table titles)
Title	
Abstract	first sentence or the last 1-2 sentences of the Introduction
Keywords	

Paragraph level: words or phrases to look for

surprising	*in contrast with previous work*
unexpected	*has seldom been addressed*
we hypothesize that	*we develop*
we propose	*the data suggest*
we introduce	

3. Generate questions and be aware of your understanding

Reading is an active task. Before and during your reading, ask yourself these questions:

Who are these authors? What journal is this? Might I question the credibility of the work?

Have I taken the time to understand all the terminology?
Have I gone back to read an article or review that would help me understand this work better?
Am I spending too much time reading the less important parts of this article?
Is there someone I can talk to about confusing parts of this article?

After reading, ask yourself these questions:

What specific problem does this research address? Why is it important?
Is the method used a good one? The best one?
What are the specific findings? Am I able to summarize them in one or two sentences?
Are the findings supported by persuasive evidence?
Is there an alternative interpretation of the data that the author did not address?
How are the findings unique/new/unusual or supportive of other work in the field?
How do these results relate to the work I'm interested in? To other work I've read about?
What are some of the specific applications of the ideas presented here? What are some further experiments that would answer remaining questions?

4. Draw inferences.

Not everything that you learn from an article is stated explicitly. As you read, rely on your prior knowledge and world experience, as well as the background provided in the article, to draw inferences from the material. Research has shown that readers who actively draw inferences are better able to understand and recall information.

As an example, in the box below is an excerpt from the Introduction of an article in the journal *Biochemistry (Ballestar et al., 2000)*. The comments in italics are questions and inferences that might be drawn by a student reader.

> Rett Syndrome is a childhood neurodevelopmental disorder and one of the most common causes of mental retardation in females *Comment: Hmmm...must be related to a gene on the X-chromosome*, with an incidence of 1 in 10000-15000. *Comment: How common is that? Not too likely to happen to me, but there must be several such children born in Houston every year*. Rett syndrome patients are characterized by a period of normal growth and development (6-18 months) followed by regression with loss of speech and purposeful hand use. *Comment: What happens? Something must be triggered or activated at late infancy*. Patients also develop seizures, autism, and ataxia. After initial regression, the condition stabilizes and patients survive into adulthood. Studies of familial cases provided evidence that Rett is caused by X-linked dominant mutations in a gene subject to X-chromosome inactivation. Recently, a number of mutations in the gene encoding the methyl-CpG binding transcriptional repressor MeCP2 have been associated with Rett Syndrome. *Comment: MeCP2 mutations probably cause Rett Syndrome. This must be an important master-regulator to affect so many processes in the brain. I wonder what they know about it...*

5. Take notes as you read.

Effective readers take notes—it improves recall and comprehension. You may think you'll remember everything you read in researching class assignments, professional papers, proposals, or your thesis, but details will slip away. Develop a template for recording notes on articles you read, or adapt the template below for use. As you accumulate a large collection of articles, this template will help you distinguish articles and quickly locate the correct reference for your own writing. The time spent filling out the form will save you hours of rereading when you write a Background, Related Work, or a Literature Review section.

Template for Taking Notes on Research Articles: Easy access for later use

Whenever you read an article, pertinent book chapter, or research on the web, use the following format (or something similar) to make an electronic record of your notes for later easy access. Put quotation marks around any exact wording you write down so that you can avoid accidental plagiarism when you later cite the article.

Complete citation. Author(s), Date of publication, Title (book or article), Journal, Volume #, Issue #, pages:

If web access: url; date accessed

Key Words:

General subject:

Specific subject:

Hypothesis:

Methodology:

Result(s):

Summary of key points:

Context (how this article relates to other work in the field; how it ties in with key issues and findings by others, including yourself):

Significance (to the field; in relation to your own work):

Important Figures and/or Tables (brief description; page number):

Cited References to follow up on (cite those obviously related to your topic AND any papers frequently cited by others because those works may well prove to be essential as you develop your own work):

Other Comments:

References

Ballestar, E., Yusufzai, T.M., and Wolffe, A.P. (2000) Effects of Rett Syndrome Mutations of the Methyl-CpG Binding Domain of the Transcriptional Repressor MeCP2 on Selectivity for Association with Methylated DNA. *Biochemistry* 31, 7100-7106.

Burnett, R. (2001) *Technical Communication*. 5th ed. San Antonio: Harcourt College Publishers.

Zeiger, M. (2000) *Essentials of Writing Biomedical Research Papers*. 2nd Ed. St. Louis: McGraw-Hill.

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