TIME AND PLACE – Class will be held on Mondays, Tuesdays, Thursdays and Fridays from 9:00 – 11:00 am. Class will take place via zoom. Zoom Meeting ID: **975 6733 4366** Password: **CellsRock**

COURSE DIRECTOR

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COURSE GOALS AND OBJECTIVES

Biomed 508 is a graduate level course intended for students who plan a professional career in the biomedical sciences. As a pre-professional course, the expectations for students by the instructors is high. In general, for successful completion of the course, students should anticipate spending several hours outside of class for each class session to read the assignments and study lecture and discussion material.

A knowledge base of key concepts and experimental methods in modern cell biology is essential for the successful analysis of many complex biomedical research problems.   However, the successful scientist must also develop additional skills and experience in experimental design and analysis. These skills include:
1. The ability to read and understand the scientific literature in order to:
    a. identify the principal questions and hypotheses;
    b. interpret and critically analyze data from the literature as well as your own experiments;
    c. propose novel hypotheses that will address gaps in current knowledge;
    d. design effective experiments that will test hypotheses and answer important questions.
2. The ability to effectively manage and evaluate large amounts of scientific information.
3. The ability to effectively communicate ideas through writing and speaking.
4. The ability to work productively in groups.
5. The ability to apply the skills in 1-4 above in order to design and execute important research questions, and to evaluate, critically analyze, and interpret one's own research data in the context of the scientific literature.

CODE OF ETHICS & PROFESSIONALISM
Although students may choose to work on various parts of the course in groups, all students are expected to turn in written work that has been prepared individually. Ideas and information derived from group interactions must be acknowledged. Students must not copy from printed references, from the Internet or from other students.   All work must be properly referenced. *It is unethical to represent others' work as your own*. Students found plagiarizing works from any source will be given a failing grade in the course.

Your presence throughout the course and your on-time arrival to class are your professional responsibility to your colleagues. Attendance is mandatory. To obtain an excused absence, students are required to notify the course instructor by e-mail in advance. Evaluation of the validity of the excused absence is up to the course instructor, but in general, only illness will be considered a valid excuse. Failure to obtain an excused absence will result in the loss of credit for that day's assignment. Points will be deducted from late assignments.

Professional conduct includes respecting others in the class, students and instructors alike. The use of computers, iPads, etc., will be limited to classroom-specific tasks, and cell phones will be turned off. *Checking email, facebook, surfing the web for fun, will not be allowed. (If you have a personal situation that requires you to be available by phone or other electronic means, please notify the instructor).*

ASSESSMENTS AND GRADES
We will attempt to balance content and scientific process by using both lectures and question/answer/discussion formats. The grade will be determined based on the following formula:

1. **2 Exams = 50% of your final grade (25% each exam) (Total of 320 points)**
   The exam format will be determined by the block instructors. The exams will cover fundamental concepts, experimental design, and data interpretation. Exam 1 will be on November 6th, and Exam 2 will be on December 8th, during finals week.

2. **In Class Assignments = 50% of your final grade (approximately 40 points/week: 320 points total)**
   Each week, the course instructor will provide an outline for how they will be evaluating the 40 points of in class assignments. This weekly component of your grade will be comprised of points earned from the following activities:
   - **Quizzes**
   - **Learning Objective Assignments**
   - **Problem Based Learning Assignments**
   - **Paper Discussion and Future Directions Write Ups**

ASSIGNMENTS - Readings for the course will come primarily from reviews and the original research literature, supplemented where appropriate by textbook readings. Course instructors will identify textbook readings relevant to each block – the text readings should be primarily used for review purposes prior to class, so that students are prepared with the essential background knowledge. Primary literature is available from journals found in the UMM libraries. Students should become familiar with the Pub-Med search engine, and are also encouraged to use the internet to find relevant information.

TEXTBOOK – *Lewin's Cells*, 3rd edition (2015), edited by Plopper, Sharp, and Sikorski (Jones & Bartlett Learning, Publishers) will be used for suggested background reading from most instructors. Several copies of this text are on reserve in the Health Sciences Center Library and Informatics Center. In some cases, other texts may be used; in those cases the assigned readings will be provided in pdf format, and/or several copies will be made available on reserve in the library as Ebooks. Other excellent molecular and cell biology texts that students can refer to: 1); *Molecular Cell Biology*, 7th edition (2012) by Lodish et al., (Freeman, Publishers); 2) *Molecular Biology of the Cell*, 5th edition (2008) by Alberts et al., (Garland Publishers). If interested, any of these books may be purchased at various online booksellers (used copies may be available).

WEB PORTAL – UNM LEARN – We will be using UNM Learn to upload lectures and assignments for the class. To log on, use your UNM NetID. The link to the portal is https://learn.unm.edu/.

Week 1:	October 12th - 16th	Dr. Jennifer Gillette	Nuclear Structure & Protein Synthesis
Week 2:	October 19st - 23th	Dr. Jennifer Gillette Dr. Jing Pu	Protein Processing, Protein Transport, Endocytosis, Lysosomes & Degradation
Week 3:	October 26th – November 30st	Dr. Judy Cannon	Cytoskeleton, Motility & Cell Mechanics
Week 4:	November 2th – 5th	Dr. Jennifer Gillette	Autophagy & Mitochondrial Dynamics
Exam 1	November 6th		
Week 5:	November 9th – 13th	Dr. Aaron Neumann	Biological Membranes, Ion Transport and Cell Polarity
Week 6:	November 16th – 20nd	Dr. Diane Lidke	Signal Transduction
Week 7:	November 23th – 24th	Dr. Julie In	Cell Cycle Progression and Cell Death
Week 8:	November 30th - December 4th	Dr. Judy Cannon	Multicellular interactions, Tissues, Development & Differentiation
Exam 2	December 8th		

Week 1: Jennifer Gillette

Monday, October 12

       Course and Syllabus Overview

       Due prior to class: Read the Gupta paper

             Paper – Gupta et al….Nucleolin modulates compartmentalization and dynamics of histone 2B-ECFP in the nucleolus.

       Lecture – Nuclear Structure and Organization (Lewins: Chapter 9)

       Homework Assignment Due 10/13: Future Directions: Hypothesis and Experimental Design

Tuesday, October 13

       Discussion of Homework

       Lecture – Nucleocytoplasmic Trafficking (Lewins: Chapter 9)

       Homework Assignment Due 10/15: Exam Question on Nuclear Transport

Thursday, October 15

       Discussion of Homework

       Lecture – Endoplasmic Reticulum: Structure and Function (Lewins: Chapter 7)

       Homework Assignment Due 10/16:

             1) Virtual Cloning Assignment

             2) Design experiments to determine if the NLS is Necessary and/or Sufficient for nuclear trafficking.

Friday, October 16

       Lecture - Protein folding and Quality Control in the ER

       PBL Discussion: Protein folding and trafficking

Week 2: Jennifer Gillette and Jing Pu

Monday, October 19

       Due prior to class: Read the Bagashev et al. 2018 paper

          CD19 Alterations emerging after CD19-directed immunotherapy cause retention of the misfolded protein in the ER

       Lecture - Golgi dynamics, Protein Processing, and Mechanisms of Protein Transport

             (Lewins: Chapter 8.1 -8.12)

       Paper Discussion: Bagashev et al. 2018 – CD19 Alterations emerging after CD19-directed immunotherapy cause retention of the misfolded protein in the ER

       Homework Assignment Due 10/20: Future Directions: Hypothesis and Experimental Design

<u>Tuesday, October 20</u>
        Discussion of Homework
        Lecture - Vesicle Budding, Membrane Fusion and Coat Proteins (Lewins: Chapter 8.1 -8.12)
        Homework Assignment Due 10/22: 1) Protein Trafficking inherited disease discussion
                                          2) Mechanism of Botulinum toxin discussion

<u>Thursday, October 22</u>
        Discussion of PBL Assignment Questions 1 & 2
        Lecture – Endocytosis (Chapter 8.13-8.16)
        Paper Discussion or PBL….TBD☺
        Homework Assignment Due 10/23: Exosomes

<u>Friday, October 23:</u> Dr. Jing
        <u>Due prior to class:</u> Read the Bar-Peled et al. 2012 *Cell* paper
        Lecture – Multiple functions of lysosomes in cell growth and metabolism
        PBL Discussion – Ragulator is a GEF for the rag GTPases that signal amino acid levels to mTORC1

Week 3: Judy Cannon
<u>Monday Oct 26: Actin</u>
        Due before class: future directions for paper 1 (see citation below).
        Write 1 paragraph with rationale (what is the important question being asked), hypothesis, and 1 aim based on paper. Emphasize: rationale, hypothesis, aim all about FUTURE, not a paper summary. It should be based from the paper, meaning a natural extension, but do NOT state rationale of paper, but rationale of your future hypothesis and how you would test your future hypothesis.
        Pre quiz-score will not count
        Lecture - Actin (Lewin Chapter 12)

        Paper #1 discussion:
        Renkawitz J , Kopf A, Stopp J, de Vries I, Driscoll MK, Merrin J, Hauschild R, Welf ES, Danuser G, Fiolka R, Sixt M. Nature. 2019 Apr;568(7753):546-550. doi: 10.1038/s41586-019-1087-5
        Nuclear positioning facilitates amoeboid migration along the path of least resistance

<u>Tuesday Oct 27: Microtubules</u>
        Due before class: Disease PBL-please fill out boxes directly in PPT file.
        Lecture: Microtubules (Lewin Ch 11)
        Disease based problem based learning discussion

<u>Thursday Oct 29: Intermediate Filaments</u>
        Due before class: Read Lewin Ch 13
        Email Intermediate filaments problem set before class start
        Discussion and review of IF problem set
        Focus on technique: cell migration assays
        Lecture: Actin and MT motors

<u>Friday Oct. 30: Actin/MT motors</u>
        Due before class: Paper #2 future directions writeup (see explanation for day 1)
        Quiz-score will count
        Cytoskeleton-review
        Future directions discussion

        Paper #2 discussion: Qu X, Yuan FN, Corona C, Pasini S, Pero ME, Gundersen GG, Shelanski ML, Bartolini F. J Cell Biol. 2017 Oct 2;216(10):3161-3178. doi: 10.1083/jcb.201701045. Epub 2017 Sep 6. Stabilization of dynamic microtubules by mDia1 drives Tau-dependent Aβ1-42 synaptotoxicity.

Future directions discussion

Week 4: Jennifer Gillette
Monday, November 2
      Prior to class: Read Hirabayashi et al. 2017
      Lecture – Mitochondrial Dynamics and Function
      Paper Discussion: Hirabayashi et al. 2017….ER-mitochondria tethering by PDZD8 regulates Ca+2
           dynamics in mammalian neurons.
      Homework Assignment Due 11/5: Future Directions: Hypothesis and Experimental Design

Tuesday, November 3
      ELECTION DAY: NO CLASS
      Your voice counts! Please go vote!!!!

Thursday, November 5
      Lecture – Autophagy
      PBL Discussion - Pexophagy; and Discussion Session in Preparation for Exam 1

Friday, November 6
      Exam #1: 9-12pm

Week 5: Aaron Neumann
Monday, November 9
Lecture: Ion Transport across Biological Membranes (1h)
      Lewins Cells, 3d ed., Ch 6

Active Learning: Plasma Membrane Repair I (1h)
      Before class—study Andrews iBioseminars (refer to overview sheet)
      https://www.ibiology.org/ibioseminars/mechanisms-plasma-membrane-repair.html
      https://www.ibiology.org/ibioseminars/ca2-dependent-lysosomal-exocytosis-mediates-endocytosis-wound-healing-function.html
      Quiz on Andrews iBioseminars (20 min; 10 min quiz, 10 min discussion)
      Small Group Discussion Sessions & Preparation for Group Presentations in next class session
      (assigned topics, 40 min)

Tuesday, November 10
Lecture: Biological Membranes I (1h)
      Stillwell, Biological Membranes, chapters 4,5,6,7
      http://www.sciencedirect.com/science/book/9780444637727

Active Learning: Plasma Membrane Repair II (1h) (refer to overview sheet)
      Small Group Presentations (15 min each plus 5 min for questions)

Thursday, November 12
Lecture: Biological Membranes II (1h)
      Stillwell, Biological Membranes, chapters 8,10,11, and parts of 20,21,22

Active Learning: Methods for studying lipid membrane organization (1h)
      Before class—study Mayor iBioseminars (refer to activity overview sheet)
      https://www.ibiology.org/ibioseminars/cell-biology/satyajit-mayor-part-1.html
      https://www.ibiology.org/ibioseminars/cell-biology/satyajit-mayor-part-2.html
      https://www.ibiology.org/ibioseminars/cell-biology/satyajit-mayor-part-3.html
      Student group presentations on methodological approaches to studying membrane structure and
      dynamics (15 min prep, 3x15min presentations)

<u>Friday, November 13</u>
Lecture: Cell Polarity (1h)
        Lewins Cells, Ch 8 & 19

Active Learning: Lipid Rafts Debate (1h)
        Before class—TBA
        Debate on the resolution: "Biologically significant lipid domains, or "rafts", supported by lateral segregation of membrane lipids exist in living cells."

Week 6: Diane Lidke
<u>Monday, November 16</u>
Pre-Quiz
Lecture: Introduction to signaling (Lewin 18.1-11)

<u>Tuesday, November 17</u>
Paper Discussion
        Park et al, "SH2 Domains Serve as Lipid-Binding Modules for pTyr-Signaling Proteins" *Molecular Cell* (2016)
Homework I:
        a. Turn in the Discussion Sheet for Park et al (5 pts)
        b. Hypothesis and future directions (10 pts) – turn in by start of class on <u>Thursday</u>
        Write 1 paragraph with rationale (what is the important question being asked), hypothesis, and 1 aim based on paper. Emphasize: rationale, hypothesis, aim all about FUTURE, not a paper summary. It should be based from the paper, meaning a natural extension, including rationale of your future hypothesis and how you would test this hypothesis.
Lecture: Receptor Tyrosine Kinases (Lewin 18.30) & GPCRs (Lewin 18.20-23)

<u>Thursday, November 19</u>
Homework II hand-out: Targeting dysregulated signaling in cancer
Lecture: Adhesion-based signaling; immune receptors/immune synapse (Lewin 18.34)

<u>Friday, November 20</u>
Post-Quiz (10 pts; best of pre- and post-quiz)
Homework II Discussion/presentation (write-up 10 pts; presentation 5 pts)
Wrap-up

Week 7: Julie In
<u>Monday, November 23:</u>
        <u>Due prior to class:</u> Read paper #1, prepare to discuss in class
        Lecture- Cell Cycle
        Paper Discussion – Paper #1:
        Written Assignment (due Tues, Nov 24; submit in class): possible future direction and at least one method to test your hypothesis

<u>Paper #1:</u> Yue et al. Experimental Cell Research, 2020. Prostaglandin E2 accelerated recovery of chemotherapy-induced intestinal damage by increasing expression of cyclin D
(link: https://www.sciencedirect.com/science/article/pii/S0014482720300070?via%3Dihub)

<u>Tuesday, November 24:</u>
        <u>Due prior to class:</u> Read paper #2, prepare to discuss in class

Lecture- Cell Death
Paper Discussion – Paper #2
Written Assignment (due Wed, Nov 25; submit via email): possible future direction and at least one method to test your hypothesis

Paper #2: Brock et al. Nature Communications, 2019. Stem cell proliferation is induced by apoptotic bodies from dying cells during epithelial tissue maintenance
(link: https://www.nature.com/articles/s41467-019-09010-6)

Have a Safe and Enjoyable Thanksgiving Break

Week 8: Judy Cannon
Monday Nov. 30: Cell-cell communication
Due before class: future directions writeup of the following paper. Please email me 2 copies of your future directions, one with your name and one without your name.

Cell Host Microbe. 2017 Jun 14;21(6):671-681.e4. doi: 10.1016/j.chom.2017.05.009.
IL-22 Upregulates Epithelial Claudin-2 to Drive Diarrhea and Enteric Pathogen Clearance.
Tsai PY1, Zhang B2, He WQ3, Zha JM4, Odenwald MA1, Singh G5, Tamura A6, Shen L1, Sailer A1, Yeruva S5, Kuo WT7, Fu YX8, Tsukita S6, Turner JR9.

Reminder of my expectations for future directions writeup:

Write 1 paragraph with rationale of your future direction (what is the important question being asked), your new hypothesis, and 1 new aim that will test your hypothesis. The future direction should extend from results of the paper (rather than some completely unrelated direction).
Emphasize: rationale, hypothesis, aim all about FUTURE, not a paper summary. It should be based from the paper, meaning a natural extension, but do NOT state rationale of paper, but rationale of your future hypothesis and how you would test your future hypothesis.

Lecture: Cell-cell communication; junctions
Paper discussion

Tues Dec 1: Cell-cell communication
Due before class: I will post anonymous copies (numbered) of all the future directions written for the paper discussed Monday. Please select 3 at random and give comments about what you felt were 1-2 strengths and 1-2 weaknesses of the proposed future directions. Email me back with your comments.

Discuss future directions, what is a good choice for future directions
Lecture: Cell-cell communication Pt 2

Thurs Dec 3: ECM and integrins
Due before class: future directions write up of:
J Cell Biol. 2017 Nov 6;216(11):3509-3520. doi: 10.1083/jcb.201702033. Epub 2017 Sep 20.
Cancer-associated fibroblasts lead tumor invasion through integrin-β3-dependent fibronectin assembly.
Attieh Y, Clark AG, Grass C, Richon S, Pocard M, Mariani P, Elkhatib N, Betz T, Gurchenkov B, Vignjevic DM.

Paper discussion and future directions
Lecture: ECM and integrins.

Fri Dec 4: ECM
Due before class: Each of you will be assigned one extracellular matrix protein or component. Below is your assignment. Prepare a PPT presentation about your ECM component answering all the questions below. Please email me your PPT before class.

Prepare a "cheat sheet" of bullet points for key info about your ECM component. You and your classmates will use this for an in class-quiz.

For the class, I will load your PPT onto the computer in the classroom. Each of you will have then approximately 5 minutes to present your PPT to the class. 10 points of your 40 point total for the week will be a combination of the PPT and your presentation.

End of class: ECM quiz

Week 9: Final Exam Week
Monday, December 7
        Exam Review Discussion

Tuesday, December 8
        Exam #2: 9-12pm