**Fall 2016**

**IBMS 5000: Fundamentals of Biomedical Sciences**

**Course Director: Bill Clarke, Ph.D.**

**(Updated: 12/1/16)**

| | | | | | **Week 1: Genetic Basis of Human Disease Team Leader: Robin Leach** |
|---|---|---|---|---|---|
| Date | Day | Time | Room | Lecturer | Topic |
| 8/22/16 | Mon | 8:00 - 9:00 | MED 209L | Robin Leach | Independent Learning Discussion |
| 8/22/16 | Mon | 9:15 - 10:15 | MED 209L | Ben Eaton | Genes, gene function and heredity |
| 8/22/16 | Mon | 10:30 - 11:30 | MED 209L | Renee Yew | Replication of the Genome |
| 8/23/16 | Tue | 8:30 - 9:30 | MED 209L | Denise O'Keefe | Epigentics |
| 8/23/16 | Tue | 9:45 - 10:45 | MED 209L | Robin Leach | Human Genetics & Precision Medicine |
| 8/24/16 | Wed | 8:30 - 10:45 | MED 209L | David Kolodrubetz<br>Ellen Kraig<br>Robin Leach | DNA double helix (in class activity) |
| 8/25/16 | Thu | 8:30 - 10:45 | LEC2.030<br>LIB2.041<br>LIB2.043<br>LIB 2.044 | Robin Leach | Small Groups |
| 8/26/16 | Fri | 8:30 - 10:45 | LEC2.030<br>LEC 2.041<br>LIB2.043<br>LIB 2.044 | Ben Eaton<br>Denise O'Keefe<br>Robin Leach<br>Dean Bacich | Small Groups |
| | | | | | **Week 2: To Grow or Not to Grow Team Leader: Alex** |
| Date | Day | Time | | Lecturer | Topic |
| 8/29/16 | Mon | 8:00 - 9:00 | MED 209L | Alex Bishop | Independent Learning Discussion |
| 8/29/16 | Mon | 9:15 - 10:15 | MED 209L | Rong Li | Transcriptional Regulation |
| 8/29/16 | Mon | 10:30 - 11:30 | MED 209L | Yanfen Hu | Signal Transduction |
| 8/30/16 | Tue | 8:30 - 9:30 | MED 209L | Alex Pertsemlidis | Genes - coding and non coding |
| 8/30/16 | Tue | 9:45 - 10:45 | MED 209L | Alex Bishop | Damage Response and DNA Repair |
| 8/31/16 | Wed | 8:30 - 9:30 | MED 209L | Dr. Renee Yew | Vectorology I / Vectorology II |
| 8/31/16 | Wed | 9:45 - 10:45 | MED 209L | | |
| 9/1/16 | Thu | 8:30 - 10:45 | LEC2.030<br>LIB2.041<br>LIB2.043<br>LIB 2.044 | Alex Bishop | Small Groups |
| **9/2/16** | **Fri** | **8:30 – 10:45** | LEC2.030<br>LEC2.041<br>LIB2.043<br>LIB 2.044 | Dmitri Ivanov<br>Jason Liu<br>Renee Yew<br>Ratna Vadlamudi | Small Groups |
| | | | | | **Week 3: Manipulation of the mouse genome: Animal models of human disease** |
| Date | Day | Time | | Lecturer | Topic |
| **9/5/16** | Mon | | Holiday | | **No Class - Labor Day** |
| 9/6/16 | Tue | 8:00 - 8:45 | 209L | Qitao Ran, Paul Hasty | Independent Learning Discussion |
| 9/6/16 | Tue | 8:55 - 9:55 | 209L | Qitao Ran | Transgenic Mouse Models |
| 9/6/16 | Tue | 10:00 - 11:00 | 209L | Paul Hasty | Gene Targeting & Embryonic Stem Cells |
| 9/7/16 | Wed | 8:30 - 9:30 | 209L | Xin-Yun Lu | RNA Interference |
| 9/7/16 | Wed | 9:45 - 10:45 | 209L | Ben Eaton | Genetic Manipulations in Flies |
| 9/8/16 | Thu | 8:30 – 10:45 | LEC2.030<br>LEC2.041<br>LIB2.043<br>LIB 2.044 | Qitao Ran | Small groups |
| 9/9/16 | Fri | 8:30 - 10:45 | LEC2.030<br>LEC2.041<br>LIB2.043<br>LIB 2.044 | Paul Hasty<br>Qitao Ran<br>Ramaswamy Sharma<br>Arunabh Bhattacharya | Small groups |
| | | | | | **Week 4: Imaging Team** |
| Date | Day | Time | | Lecturer | Topic |
| 9/12/16 | Mon | 8:00 - 9:00 | MED 209L | James Lechleiter,<br>Geoffrey Clarke | Independent Learning Discussion |
| 9/12/16 | Mon | 9:15 - 10:15 | MED 209L | James Lechleiter | Visualizing Cells with Optical Microscope (Contrast, Fluorescence and 3D-Imaging) |
| 9/12/16 | Mon | 10:30 - 11:30 | MED 209L | James Lechleiter | Specialized Techniques in Optical Microscopy (Calcium, FRET and Super Revolution) |
| 9/13/16 | Tue | 8:30 - 9:30 | MED 209L | Geoffrey Clarke | Molecular Imagining I (CT, SPECT and PET) |
| 9/13/16 | Tue | 9:45 - 10:45 | MED 209L | Geoffery Clarke | Molecular Imagining II ( MRI and Ultrasound) |
| 9/14/16 | Wed | 8:30 - 10:45 | MED 209L | Lechleiter/Clarke/Beth Goins | Imaging Core Tours and Demonstrations |
| 9/15/16 | Thu | 9:00 – 11:00 | MED 209L | | **EXAM 1** |
| 9/16/16 | Fri | | | | **EXAM 1** |

| | | | | | **Week 5: Lost (and Found) in Translation**<br>**Team Leader: Rui Sousa** |
|---|---|---|---|---|---|
| Date | Day | Time | | Lecturer | Topic |
| 9/19/16 | Mon | 8:00 - 9:00 | MED 209L | Rui Sousa | Independent Learning Discussion |
| 9/19/16 | Mon | 9:15 - 10:15 | MED 209L | Rui Sousa | Proteins: Ligand Binding, Induced Fit and Allostery |
| 9/19/16 | Mon | 10:30 - 11:30 | MED 209L | Maria Gaczynska | Atomic Forces and Electron Microscopy in Protein Structure and Mechanism: Methods and Concepts |
| 9/20/16 | Tue | 8:30 - 9:30 | MED 209L | Dmitri Ivanov | 1. Protein Purification/Analysis Methods, 2. Protein Structure Determination |
| 9/20/16 | Tue | 9:45 - 10:45 | MED 209L | Dmitri Ivanov | Mechanisms of Protein Translation |
| 9/21/16 | Wed | 8:30 - 9:30 | MED 209L | Yuzuru Shiio | Post-Translational Modification |
| 9/21/16 | Wed | 9:45 - 10:45 | MED 209L | | |
| 9/22/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Rui Sousa | Small Groups |
| 9/23/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LEC 2.038<br>LEC 2.040<br>LIB 2.041 | Yuzuru Shiio<br>Rui Sousa<br>Dmitri Ivanov<br>Maria Gaczynska | Small Groups |
| | | | | | **Week 6: Losing proteostasis: Alzheimer's and other diseases**<br>**Team Leader: Veronica Galvan** |
| Date | Day | Time | | Lecturer | Topic |
| 9/26/16 | Mon | 8:00 - 9:00 | MED 209L | Rui Sousa | Protein folding and stability: The chaperone system |
| 9/26/16 | Mon | 9:15 - 10:15 | MED 209L | Rui Sousa / Veronica Galvan | Student/classroom assignment review |
| 9/26/16 | Mon | 10:30 - 11:30 | MED 209L | Hai Rao | Protein degradation: Autophagy |
| 9/27/16 | Tue | 8:30 - 9:30 | MED 209L | Hai Rao | Protein degradation: The ubiquitin/proteasome system |
| 9/27/16 | Tue | 9:45 - 10:45 | MED 209L | Qitao Ran | Protein folding |
| 9/28/16 | Wed | 8:30 - 9:30 | MED 209L | Veronica Galvan | Functional assessment of phenotypes in animal models of proteinopathies |
| 9/28/16 | Wed | 9:45 - 10:45 | MED 209L | Ben Eaton | Practical demonstrations. Students will be dived in groups and go with Dr. Galvan |
| 9/29/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Veronica Galvan | Small Groups |
| 9/30/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Veronica Galvan<br>Rui Sousa<br>Hai Rao<br>Nat Clark | Small Groups |
| | | | | | **Week 7: Obesity I**<br>**Team Leader: Lily Dong** |
| Date | Day | Time | | Lecturer | Topic |
| 10/3/16 | Mon | 8:00 - 9:00 | MED 209L | Lily Dong/James Nelson | Independent Learning Discussion |
| 10/3/16 | Mon | 9:15 - 10:15 | MED 209L | Lily Dong | Energy balance and problems with obesity |
| 10/3/16 | Mon | 10:30 - 11:30 | MED 209L | James Nelson | Insulin Signaling and Insulin Resistance |
| 10/4/16 | Tue | 8:30 - 9:30 | MED 209L | James Lechleiter | ER, ER Stress and Obesity |
| 10/4/16 | Tue | 9:45 - 10:45 | MED 209L | Mengwei Zang | Obese-induced fatty liver diseases |
| 10/5/16 | Wed | 8:30 - 9:30 | MED 209L | Feng Liu | Adipose tissue: Regulation and function |
| 10/5/16 | Wed | 9:45 - 10:45 | MED 209L | Nicholas Musi | Skeletal muscle tissue: Glucose Homeostasis and exercise |
| 10/6/16 | Thu | 8:30 - 9:30 | MED 209L | Reto Asmis | Obesity-induced inflammation |
| 10/6/16 | Thu | 9:45 - 10:45 | MED 209L | Yidong Bai | Obesity-associated mitochondrial dysfunction |
| 10/7/16 | Fri | 8:30 – 9:30 | MED 209L | Xin-Yun Lu | Central Nervous System Control of Food Intake and Body Weight |
| 10/7/16 | Fri | 9:45 – 10:45 | MED 209L | Lily Dong | Gut microbiota and organ communication |
| | | | | | **Week 8: Obesity II**<br>**Team Leader: Lily Dong** |
| Date | Day | Time | | Lecturer | Topic |
| 10/10/16 | Mon | 8:30 – 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Lily Dong | Small Groups |
| 10/11/16 | Tue | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Reto Asmis<br>Mengwel Zang<br>Jim Lechleiter<br>Jim Nelson | Small Groups |
| 10/12/16 | Wed | | | | **NO CLASS** |
| 10/12/16 | Wed | | | | **NO CLASS** |
| 10/13/16 | Thu | | | | **EXAM 2** |
| 10/14/16 | Fri | | | | **EXAM 2** |

| | | | | | **Week 9: Aging Team**<br>**Leader: James Nelson** |
|---|---|---|---|---|---|
| Date | Day | Time | | Lecturer | Topic |
| 10/17/16 | Mon | 8:00 - 9:00 | MED 209L | James Nelson<br>Alfred Fisher | Independent Learning Discussion |
| 10/17/16 | Mon | 9:15 - 10:15 | MED 209L | Alfred Fisher | Overview of Aging and Frailty |
| 10/17/16 | Mon | 10:30 - 11:30 | MED 209L | James Nelson | CR and other interventions to probe mechanisms in aging |
| 10/18/16 | Tue | 8:30 - 9:30 | MED 209L | Peter Hornsby | Aging and Cancer |
| 10/18/16 | Tue | 9:45 - 10:45 | MED 209L | David Sharp | mTOR, Age Regulation and Opportunities for Intervention |
| 10/19/16 | Wed | 8:30 - 9:30 | STRF 102 | Qitao Ran | Oxidative stress and aging |
| 10/19/16 | Wed | 9:45 - 10:45 | STRF | Alfred Fisher | Aging research in a nematode lab (lab demonstrations) |
| 10/20/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LEC 2.041<br>LIB 2.043<br>LIB 2.044 | James Nelson | Small Groups |
| 10/21/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | James Nelson<br>Peter Hornsby<br>Qitao Ran<br>David Sharp | Small Groups |
| | | | | | **Week 10:Vaccine Biology**<br>**Team Leader: Guangming Zhong** |
| Date | Day | Time | | Lecturer | Topic |
| 10/24/16 | Mon | 10:30 – 11:30 | MED 209L | Guangming Zhong | Independent Learning Discussion |
| 10/24/16 | Mon | 12:45 – 1:45 | MED 209L | Keith Krolick | Vaccine Biology Intro |
| 10/24/16 | Mon | 1:50 – 2:50 | MED 209L | Mike Berton | Innate immunity |
| 10/25/16 | Tue | 1:30 – 2:30 | MED 309L | Keith Krolick | Antigen presentation & T cell immunity |
| 10/25/16 | Tue | 2:45 – 3:45 | MED 309L | Mike Berton | Humoral immunity |
| 10/26/16<br>10/26/16 | Wed | 8:30am - 10:45 | MED 209L | Ellen Kraig<br>Tony Infante | Antibody Power |
| 10/27/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Guangming Zhong | Small Groups |
| 10/28/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | | Small Groups |
| | | | | | **Week 11: HIV Team**<br>**Leader: Yan Xiang** |
| Date | Day | Time | | | Topic |
| 10/31/16 | Mon | 8:00 - 9:00 | MED 209L | Yan Xiang | Independent Learning Discussion |
| 10/31/16 | Mon | 9:15 - 10:15 | MED 209L | Yan Xiang | Introduction to viruses |
| 10/31/16 | Mon | 10:30 - 11:30 | MED 209L | Barbara Taylor | HIV Biology |
| 11/1/16 | Tue | 8:30 - 9:30 | MED 209L | Keith Krolick | Immunodeficiency |
| 11/1/16 | Tue | 9:45 - 10:45 | MED 209L | Guangming Zhong | HIV Vaccine |
| 11/2/16 | Wed | 8:30 - 9:30 | MED 209L | Ricardo Carrion | Emerging viral infection |
| 11/2/16 | Wed | 9:45 - 10:45 | MED 209L | Sunil Ahuja | HIV and clinical disease – assemble at 209L then led to VA |
| 11/3/16 | Thu | 8:30-11:50 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Yan Xiang | Small Groups |
| 11/4/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Yan Xiang<br>William Kaiser<br>Zhenming Xu<br>Peter Dube | Small Groups |
| | | | | | **Week 12:Bioinformatics and Next Generation Sequencing**<br>**Team Leader: Alexander Pertsemlidis** |
| Date | Day | Time | | Lecturer | Topic |
| 11/7/16 | Mon | 8:30 - 9:30 | MED 209L | Alexander Pertsemlidis | Introduction: Big Data Technologies |
| 11/7/16 | Mon | 9:45 - 10:45 | MED 209L | Yidong Chen | Big Data Resources |
| 11/8/16 | Tue | 8:30 - 9:30 | MED 209L | Alexander Pertsemlidis | Pairwise Sequence Comparison |
| 11/8/16 | Tue | 9:45 – 10:45 | MED 209L | Alexander Pertsemlidis | Multiple Sequence Comparison |
| 11/9/16 | Wed | 8:00 – 9:00 | MED 209L | Alexander Pertsemlidis | Independent Learning Discussion |
| 11/9/16 | Wed | 9:15 – 10:15 | MED 209L | Yidong Chen | NGS and Precision Medicine |
| 11/9/16 | Wed | 10:30 – 11:30 | MED 209L | Yidong Chen | Examples and Discussion |
| 11/10/16 | Thu | 9:00-11:00 | MED 209L | | **EXAM 3** |
| 11/11/16 | Fri | | | | **EXAM 3** |

| | | | | | **Week 13: Asthma**<br>**Team Leader: Peter Dube** |
|---|---|---|---|---|---|
| Date | Day | Time | | Lecturer | Topic |
| 11/14/16 | Mon | 8:00 - 9:00 | MED 209L | Peter Dube | Independent Learning Discussion |
| 11/14/16 | Mon | 9:15 - 10:15 | MED 209L | Edward Brooks | Overview of asthma |
| 11/14/16 | Mon | 10:30 - 11:30 | MED 209L | Jesus Guajardo | Overview of the respiratory system |
| 11/15/16 | Tue | 8:30 - 9:30 | MED 209L | Peter Dube | T-cells and asthma, experimental modeling of asthma |
| 11/15/16 | Tue | 9:45 - 10:45 | MED 209L | Robert Brenner | Airway smooth muscle signaling |
| 11/16/16 | Wed | 8:30 - 9:30 | MED 209L | Peter Dube | Airway remodeling |
| 11/16/16 | Wed | 9:45 - 10:45 | MED 209L | Peter Dube | Open discussion (mandatory) |
| 11/17/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Peter Dube | Small Groups |
| 11/18/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Peter Dube<br>Edward Brooks<br>Keith Krolick<br>Michael Berton | Small Groups |
| | | | | | **No Lectures (Thanksgiving Week - 11/21/16 through 11/25/16)** |
| | | | | | **Week 14: Mood Disorders**<br>**Team Leader: Dan Lodge** |
| Date | Day | Time | | Lecturer | Topic |
| 11/28/16 | Mon | 8:00 - 9:00 | MED 209L | Dan Lodge | Independent Learning Discussion- Intro to mood disorders |
| 11/28/16 | Mon | 9:15 - 10:15 | MED 209L | David Morilak | Neural Basis of Emotion |
| 11/28/16 | Mon | 10:30 - 11:30 | MED 209L | Lyn Daws | Biogenic Amine transporters |
| 11/29/16 | Tue | 8:30 - 9:30 | MED 209L | Alan Frazer | Pharmacological treatment – Active Learning |
| 11/29/16 | Tue | 9:45 - 10:45 | MED 209L | Jason O'Connor | Pathophysiology |
| 11/30/16 | Wed | 8:30 - 9:30 | MED 209L | Gek Sia | Neurogenesis |
| 11/30/16 | Wed | 9:45 - 10:45 | MED 209L | Flavia Carreno | Animal Models |
| 12/1/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Dan Lodge | Small Groups |
| 12/2/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Dan Lodge<br>David Morilak<br>Jason O'Connor<br>Gek Sia | Small Groups |
| | | | | | **Week 15:Epilepsy**<br>**Team Leader: Ben Eaton** |
| Date | Day | Time | | Lecturer | Topic |
| 12/5/16 | Mon | 8:30 - 9:30 | MED 209L | Ben Eaton | Independent Learning Discussion |
| 12/5/16 | Mon | 9:45 - 10:45 | MED 209L | Martin Paukert | Introductory Concepts of Brain Function |
| 12/6/16 | Tue | 8:30 – 9:30 | MED 209L | Mark Shapiro | Intrinsic excitability |
| 12/6/16 | Tue | 9:45 – 10:45 | MED 209L | Jason Pugh | Synaptic transmission |
| 12/7/16 | Wed | 8:30 - 9:30 | MED 209L | Martin Paukert | Concepts of Neural Circuitry |
| 12/7/16 | Wed | 9:45- 10:45 | MED 209L | Jose Cavazos | Translational concepts in Epilepsy |
| 12/8/16 | Thu | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Robert Brenner/<br>Ben Eaton | Small Groups |
| 12/9/16 | Fri | 8:30 - 10:45 | LEC 2.030<br>LIB 2.041<br>LIB 2.043<br>LIB 2.044 | Jason Pugh<br>Mike Beckstead<br>Chase Carver<br>Jun Hee Kim | Small Groups |
| | | | | | **Week 16: Regenerative Medicine**<br>**Team Leader: Peter Hornsby** |
| Date | Day | Time | | Lecturer | Topic |
| 12/12/16 | Mon | 8:00 - 9:00 | MED 209L | Peter Hornsby | Independent Learning Discussion |
| 12/12/16 | Mon | 9:15 - 10:15 | MED 209L | Pei Wang | From Development to Regeneration |
| 12/12/16 | Mon | 10:30 - 11:30 | MED 209L | Erzsi Kokovay | Basic Principles of Adult Stem Cell Homeostasis |
| 12/13/16 | Tue | 8:30 - 9:30 | MED 209L | Donna Lehman | Human Disease Modeling |
| 12/13/16 | Tue | 9:45 - 10:15 | MED 209L | Peter Hornsby | Organoid models in regenerative medicine |
| 12/14/16 | Wed | | | | **No Class** |
| 12/14/16 | Wed | | | | **No Class** |
| 12/15/16 | Thu | | | | **EXAM 4** |
| 12/16/16 | Fri | | | | **EXAM 4** |

*Updated 8/5/16*


# Fundamentals of Biomedical Science (IBMS 5000)

Fall 2016

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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.

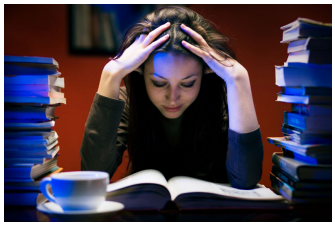
**Time:** Generally, Mondays (8:00 to 11:30 am), Tues-Fridays (8:30-11:00 am) – although there are some exceptions – see course schedule for specific dates/times/rooms. Attendance is required. *Please note: arriving to class late (even by a few minutes) is disruptive to the learning of the other students 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. Note, occasionally classes may convene at different times due to teaching conflicts, 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 lectures will be in MED 444B or MED 409L). Small groups on Thurs/Fri meet in various rooms – see syllabus.

**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 (a list of these topics and concepts is presented at the end of this document). 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. 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 they think you need to know), but happens because you decide there's something you need to know. You 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 sometimes 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. Slides will also be available on Canvas. If you want to take notes on them during class, please print out a copy and bring it with you.

Weeks 4, 8, 12 and 16 are Exam Weeks. On Exam Weeks, class is held only on Mon, Tues and Wed (there is no paper discussion 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) P**aper 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.

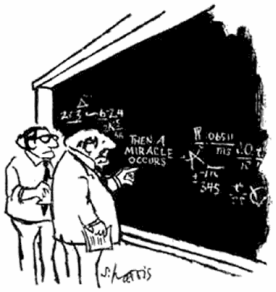
On Thursdays, you will meet in small groups of 8 students (or less) to discuss the paper, considering the discussion questions provided, and to discuss any aspect of the paper you didn't understand. Each week, you will be randomly assigned to a group (see Canvas for your weekly group and room assignments). It's helpful to bring your laptop to the discussion to be able to look up information and to go beyond the specifics of the assigned paper and thereby develop a

strong understanding of the paper. The purpose of the Thursday meeting is for you to prepare for the discussion with a faculty member on Friday.

On Fridays, you will meet in the same groups as the preceding Thursday, together with a faculty member. Each student in the group will be chosen randomly 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 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 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). Some of the independent learning assignments will come from these texts. 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.

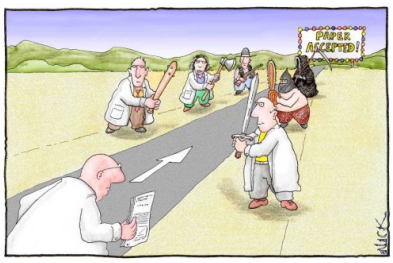
**Canvas**: This course uses Canvas as a repository for course-related information. Canvas is a web-based course management system. To access Canvas go to http://www.uthscsa.edu/canvas/ with an up-to-date browser. Also, Canvas can be accessed from the "Quicklinks" pull down menu (upper right side) of 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 – "FA16 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 two online surveys (anonymously). One survey that comes from the UTHSCSA Academic Assessment and Compliance office requests your comments about the week's content and performance of individual lecturers (and on exam weeks, there are questions about the exam). 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. 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:** The second weekly survey is a 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.

**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 could 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 be encouraged to participate in the discussion.

**Grading:** Grades are derived from the 4 exams, the 12 online quizzes and the 12 paper discussion grades. The exams contribute 70%, the quizzes contribute 15% and the paper discussions also 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), consideration of your attendance record, timeliness to class, class participation and preparedness, completion of peer reviews 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 and each exam consists of two parts, an in-class, closed book exam and an open-book, take-home exam. All together, exams are worth 70% of the final grade in the course. Exams are held on Thursdays and Fridays of the 4 exam weeks and each exam will cover 4 weeks of lectures.

i. Closed-book, in-class exams: A 2 hour, in-class, closed book exam will be given to test learning of key facts/concepts for each week. Each week's faculty team will provide short-answer, and/or multiple choice questions. This portion of the exam will be given on Thursday morning of exam weeks from 9:00 to 11:00 am.

ii. 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 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. These exams are also learning-mechanisms. Exams will be distributed electronically on Thursday afternoon (1:00 pm) of exam week and answers (typed) must be returned electronically (on Canvas) by 5:00 pm 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. Answers submitted must be your own. Do not copy text or figures directly from another source. Plagiarism will result in disciplinary action. Answers will be graded by the weekly faculty teams.

b. **Quizzes:** Each week a quiz that covers factual material will be given (with the exception of the "short weeks" that occur during exam weeks). The quiz will be made available online, using Canvas, on Fridays (12:00 noon – midnight). Depending upon the number of questions, students will have a finite time (30-60 min) to answer the questions. All 12 quizzes together are worth 15% of the final grade.

c. **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.

d. **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 will affect your grade in a positive manner. If your grade computed from exams, quizzes 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 will shift your grade to the higher level. Conversely…

**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.

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. Administrative and Canvas questions can be directed to Kay Eskew in the Graduate Dean's Office (Eskew@uthscsa.edu). And of course the course director can be contacted with the information in the header of this document.


*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.<br><br>Offers interpretations and analysis of paper (more than just recitation of facts).<br><br>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.<br><br>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.<br><br>Offers straightforward information (e.g., information straight from the paper), with marginal attempts to analyze and interpret the paper.<br><br>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.<br><br>Tries to respond when called on but does not offer much.<br><br>Demonstrates infrequent involvement in discussion. |
| F | Is not able to present the specifics of the paper well.<br><br>Does not add anything to the discussion.<br><br>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.

Supported by the Cain Project for Engineering and Professional Communication Rice University, 2004

## Fundamentals of Biomedical Science (IBMS 5000) Weekly Topics/Concepts

The list below shows the core concepts arranged in groups associated with weekly topics as assembled by the core course committee. Concepts and topics were derived from faculty from the various programs. Topics are meant to serve as "umbrellas" to cluster the core concepts in a relatively meaningful way. The focus of the course is to present the concepts, not cover the topics. The order of this list is based upon the order arranged for the 2011 course. The order may change for different years.

**Week 1: Genetic Basis of Human Disease –** The major focus of this topic is DNA and the genome and how human diseases can originate from mutations. Relatively simple examples of genotypic changes that alter individual proteins and pathways will be discussed in order to demonstrate how state-of-the-art mapping techniques can lead us to the causes of some human diseases and/or phenotypes.

- Genetics, genomics, epigenetics
- meiosis
- chromosomes / DNA structure / chromatin / nuclear matrix
- DNA replication
- genome methods – GWAS, comparative genome hybridization, arrays, Southerns, etc.
- DNA sequencing/next generation sequencing

**Week 2 To Grow or Not to Grow –** Uses the cancer cell as the model for understanding many basic aspects of cell biology, signal transduction and gene regulation. Papers for discussion should be on the topic of basic cancer biology or cell growth control, emphasizing how the study of cancer biology can help us understand normal cell biology.

- Apoptosis/cell death
- Mitosis, cycle regulation and checkpoints
- Transcription & RNA processing mechanisms
- RNA expression analysis
- mIRNA
- Oncogenes and tumor suppressor genes
- DNA damage, repair and recombination
- Genomic instability, Non coding RNA
- Binding Determination, allosterism, receptor ligand
- Signal transduction

**Week 3 Manipulation of the mouse genome: Animal models of human disease – *(Labor Day week)*** The major focus of this topic should be on technologies that will be used throughout the rest of the course; these will include transgenics, knockouts, conditional knockouts and others. Examples could be selected to demonstrate the limitations (i.e. embryonic lethals) and potentials of each approach and will focus on the value of having such models for testing potential therapeutics and understanding disease mechanisms.

- model selection and justification - in vitro and in vivo
- experimental design and data analysis (statistical tools)
- tissue culture / transfection
- gene knock down with RNAi
- gene knockout, transgenics, conditional ko
- site directed mutagenesis

**Week 4: Imaging (Mini Topic)/Exam Week 1 –** This week does double duty as exam week and methods week. Accordingly, the topic emphasis is lessened slightly to allow time for examination. 3 of the 4 mini-weeks are devoted either to methods used broadly throughout biomedical science or to topics with highly integrative concepts. This first mini-topic on imaging should provide a light introduction to the theory and practice of modern-day microscopic imaging**.**

imaging - microscopic - both cellular and and whole animal, fluorescence methods

**Week 5: Lost (and Found) in Translation – T**he focus of this topic is to understand the basic mechanisms that regulate proteins in a cell including translation, localization, and all aspects of post-translational modification (phosphorylation, ubiquitination, sumolation, acetylation, methylation, etc). The topic discussion should also include protein structure, proteomics, and methods for protein analysis.

Translation mechanisms
Protein trafficking
subcellular localization
Structure-Function (allosterism, ligand binding, isomerism, cellular specialization, heteromerization)
Protein structure determination
Mass spectrometry & "omics"
Protein separation/analysis (SDS-PAGE, chromatography, immunoprecipitation, Mass Spec)
Western Blots
Post translational Modification

**Week 6: Alzheimer's Disease: Protein Folding Diseases –** The major focus of this topic is protein folding diseases using Alzheimer's Disease as a nucleus for discussion. Included would be discussions of ALS, Huntington's disease, Parkinson's disease, Creutzfeldt-Jakob disease, or other proteopathy diseases. Other multi-disciplinary aspects of Alzheimer's disease could be included such as APP-dependent nuclear signaling, learning and memory, and animal models for Alzheimer's.

Aging
Protein stability, degradation
Animal model systems
Behavioral approaches
Autophagy
Proteasome

**Week 7 Aging –** The major focus of the topic is lifespan regulation in rodent and invertebrate models. Emphasizes the relationships between molecular and cellular processes, such as growth control signaling mechanisms mTOR and insulin/IGF, with regulation at the whole-body level, introducing the important physiological concept of homeostasis. Covers organ size regulation in the adult via stem cell biology. Brings in relationships between molecular and cellular processes and physiopathological consequences (DNA damage, inflammation).

Systems biology
DNA damage, repair
Homeostasis
stem cells
bioinformatics tools
cellular senescence
Inflammation
Animal models
Signaling mechanisms of lifespan (mTOR insulin, etc)_

**Week 8: Bioinformatics and Next Generation Sequencing (Mini Topic) /Exam Week 2 –** Focuses on the application of computer-based methods (use of databases, data mining, pattern recognition, etc) to solve formal and practical problems associated with the management and analysis of biological data, especially with respect to molecular biology. Typical applications involve mapping and analyzing DNA and protein sequences, aligning different DNA and protein sequences to compare them and creating and viewing 3-D models of protein structures. New high-throughput sequencing methods can also be incorporated here**.**

**Week 9: Vaccine Biology -** The major focus of this topic will be immune responses and regulation; this could expand upon the previous week's topic (aging) by initially demonstrating the features of both adaptive and innate immunity that are negatively impacted in the elderly. Importantly, antibody specificity will be addressed as many techniques in use today require these reagents (i.e. polyclonal vs. monoclonal).

- Immunological memory/clonal selection
- Innate immunity and Adaptive immunity
- Signal transduction and immune signaling
- Cytokines and chemokines
- Immune receptor specificity and diversity
- Vaccines
- Cell sorting
- monoclonal vs polyclonal Abs and techniques

**Week 10: HIV -** This topic seeks to explore the host-pathogen relationship, using HIV (or another viral, fungal, or bacterial pathogen) as a model. Areas to hit include how pathogens manipulate host function (systemically or at the cellular level) and how pathogens evolve with their hosts and evade recognition. The latter could be connected to the prior week's topic by discussing why vaccines have failed against pathogens like HIV. Another integrative aspect of this topic is to introduce how drugs have been used as pharmacological tools to explore pathogen virulence strategies.

- Manipulation of host cell function
- Virus evolution/emerging infections/co-evolution
- Immune evasion mechanisms
- Host-pathogen interaction
- prokaryotic / eukaryotic - overall cell and organelle structure
- Virulence determinants
- Pathogen recognition
- Vaccines
- Drugs as pharmacological tools

**Week 11: Asthma –** The focus of the topic is on bringing together aspects of physiology (lung, gas control, airway smooth muscle, autonomic nervous system) with aspects of the immune system that come together to produce allergy and asthma (inflammation, autoimmunity). Emphasizes how real topics in the biomedical research are always integrated from several disciplines. Introduces basic aspects of electrically excitable cells.

- Innate immunity and Adaptive immunity
- Cytokines and chemokines
- Toxins
- Immune tolerance
- Inflammation
- Ion channels and regulation of membrane potential
- Muscle function
- Central control of peripheral organs via the autonomic nervous system
- Transport of blood gases and microcirculatory exchange
- Biomechanics (breathing, movement, etc.)
- Acid/base balance and bicarbonate/nonbicarbonate buffering

**Week 12: Energy Metabolism (Mini-Topic)/ Exam Week 3**

- Metabolic regulation
- Molecular endocrinology: Actions of peptide and nonpeptide hormones
- Regulation of energy balance at the whole organism level (includes thermogenesis)
- Negative feedback regulation of hormones
- Endocrine regulation of nutrient usage by different organs of the body
- Energy metabolism

**Week 13 Obesity –** The focus of the topic is on bringing together aspects of physiology (energy balance, glucose/insulin regulation, fat storage and utilization, and physical exercise) with aspects of the microbiology (the gut flora, its control, and how it interacts with the body) that come together to produce normal weight control and the pathological consequences of its failure, obesity and type II diabetes.

- Commensalism/symbiosis, gut flora
- Biofilms
- Diabetes/Insulin Resistance
- Genetics
- Exercise

**Week 14 No Lectures – *Thanksgiving Week*)**

**Week 15: The Heart – T**he focus of the topic is on bringing together aspects of physiology (cardiac function, cardiovascular biology, homeostasis of plasma lipids) with the physiopathological consequences of failure of normal heart function (myocardial infarction) which brings in potential cell therapies via stimulated remodeling and healing of damage, and drug therapy to prevent and cure heart disease.

Tissue damage and remodeling
Inflammation
Cell-cell communication
Extracellular matrix
Membrane structure and transport
Lipid metabolism
Ion channels and regulation of membrane potential
Muscle function
Central control of peripheral organs via the autonomic nervous system
Transport of blood gases and microcirculatory exchange
stem cells
Drugs as pharmacological tools

**Week 16: Epilepsy -** The focus of the topic will be to illustrate how the basic cellular functions of the neuron, including excitability, synaptic transmission, and circuit formation, contribute to the pathology of epilepsy. This topic is also ideal for introducing concepts surrounding the pharmacological treatment of neurological disorders. Electrophysiological and fluorescent approaches to quantifying neural function should be stressed**.**

Membrane structure and transport
Ion channels and regulation of membrane potential
Synaptic function and plasticity
Neural circuits and reflexes
Plasticity
Drugs as pharmacological tools
Optigenetic manipulation of protein function
Electrophysiology
RNA expression analysis

**Week 17: Regenerative Medicine (Mini Topic) /Exam Week 4 -** The focus of the topic is on how molecular and cellular processes (interactions of cells within tissues, control by local communication, control by cell growth and cell death) interact with the larger scale processes of wound healing and tissue regeneration and the role of stem cells in these processes. Discussion of papers can bring in modern aspects of uses of stem cells and of stimulated regeneration in therapy for trauma, neurodegeneration, etc.

Apoptosis/cell death
Cytokines and chemokines
Cell development and differentiation
Tissue damage and remodeling
Cell migration/cytoskeleton Function
Cell-cell communication
Transcriptional regulation
Extracellular matrices
Maintenance of extracellular environment
Homeostasis
stem cells