<table>
<thead>
<tr>
<th>DATE</th>
<th>Topics</th>
<th>Topic Leader(s)/Instructors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Introduction to Conserved Biological Principles</td>
<td>Topic Leader: David Loose Instructors: Terry Walters Mike Lorenz David Loose John Byrne Ghislain Breton Jeff Chang</td>
</tr>
<tr>
<td>August 29-September 2</td>
<td>• Evolutionary Foundations of Biomedical Science • Value and Limitations of Model Systems • Growth and Reproduction: Normal Growth, Regeneration, Wound Healing, Regulatory Pathways • Homeostasis at the Cellular Level • Evolution of Nervous Systems and Homeostasis • Homeostasis at the Organismal Level; Vascular Systems and Homeostasis • Circadian Rhythms, Thermoregulation • System Level Integration, Polygenic Diseases</td>
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<tr>
<td>Week 2</td>
<td>Principles of Genetics and Modern Genomics</td>
<td>Topic Leaders: Craig Hanis Instructors: Bill Mattox Craig Hanis Mike Lorenz Myriam Fornage Nick Navin Richard Behringer</td>
</tr>
<tr>
<td>September 6-9</td>
<td>• Mutations and Gene Function • Human Genetics/Disease Inferences • Screens, Gene Interactions and Pathways • Introduction to Genomics • Genomics and Chronic Disease • Fundamentals of Mouse Genetics • Gene Targeting and Conditional Genetics in the Mouse</td>
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<tr>
<td>No Class on Labor Day, Sept 5</td>
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<tr>
<td>Week 3</td>
<td>Transcription, Epigenetics and RNA</td>
<td>Topic Leaders: Mark Bedford Xiaobing Shi Ambro van Hoof Instructors: Xiaobing Shi Xuetong (Snow) Shen Mark Bedford Taiping Chen Ambro van Hoof Bill Mattox Leng Han</td>
</tr>
<tr>
<td>September 12-16</td>
<td>• Basal Transcription • What is Chromatin &amp; How Does it Regulate Transcription? • The Histone Code: Epigenetic Readers, Writers, and Erasers • DNA Methylation and Epigenetic Inheritance • Big Questions: How are Steps in Gene Expression Executed and Regulated? • Splicing and Alternative Splicing • mRNA 3' End Formation and Alternative Polyadenylation • Transcriptome Analysis Methods • Measuring Steps in Gene Expression</td>
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<tr>
<td>Week 4</td>
<td>RNA and the Transcriptome</td>
<td>Topic Leader: Ambro van Hoof Instructors: John Hagan Nick Delay Ambro van Hoof Ann-Bin Shyu Jiqiang (Lanny) Ling</td>
</tr>
<tr>
<td>September 19-23</td>
<td>• miRNAs • sRNAs in Prokaryotes • mRNA Degradation • Riboswitches • mRNP Granules: Assembly and Function of P-bodies and Stress Granules • Cutting Edge: mRNA Modifications Obesity and Cancer (m6A, and oligo U,C, and A tails) • From CRISPR RNA Biology to Editing Any Genome Anywhere Anyway</td>
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<tr>
<td>Week 5</td>
<td>The Birth and Destruction of Proteins</td>
<td>Topic Leader: Catherine Denicourt</td>
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| September 26-30 | • Ribosome Biogenesis and Basic Translation  
• Translational Control Mechanisms  
• Mechanism and Regulation of Protein Folding  
• Pathologies Associated with Protein Misfolding (Neurodegenerative Disorders, Prions)  
• Protein Degradation Mechanisms: Ubiquitin-proteasome  
• Protein Degradation Mechanisms: Lysosomal and Autophagy  
• Pathologies Associated with Defective Protein Degradation Mechanisms |  |
|  | • Ribosome Biogenesis and Basic Translation  
• Translational Control Mechanisms  
• Mechanism and Regulation of Protein Folding  
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• Protein Degradation Mechanisms: Lysosomal and Autophagy  
• Pathologies Associated with Defective Protein Degradation Mechanisms |  |
|  | Topic Leaders:  
Catherine Denicourt  
Guangwei Du  
Kevin Morano  
Sheng Zhang  
Shane Cunha  
Ching On Wong |  |
|  | Instructors:  
Catherine Denicourt  
Guangwei Du  
Kevin Morano  
Sheng Zhang  
Shane Cunha  
Ching On Wong |  |

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<tr>
<th>Week 6</th>
<th>Protein Structure and Function/Metabolism</th>
<th>Topic Leader: Vasanthi Jayaraman Phillip Carpenter</th>
</tr>
</thead>
</table>
| October 3-7 | • Metabolic Pathway- Energy and Glucose  
• Metabolic Pathway: Fatty Acid and Ketone Bodies  
• Flipped Classroom: Metabolic Pathways in Diet and Exercise  
• Structure Based Control of Protein Function - The Case of Hexokinase and Glucokinase  
• Protein Structure Tools- Unnatural Amino Acids  
• Skeletal Muscle Metabolism In Health & Disease  
• Metabolic Cycles in Health and Disease |  |
|  | • Metabolic Pathway- Energy and Glucose  
• Metabolic Pathway: Fatty Acid and Ketone Bodies  
• Flipped Classroom: Metabolic Pathways in Diet and Exercise  
• Structure Based Control of Protein Function - The Case of Hexokinase and Glucokinase  
• Protein Structure Tools- Unnatural Amino Acids  
• Skeletal Muscle Metabolism In Health & Disease  
• Metabolic Cycles in Health and Disease |  |
|  | Topic Leaders:  
Vasanthi Jayaraman  
Phillip Carpenter  
Phillip Carpenter  
Vasanthi Jayaraman  
Darren Boehning  
Irina Serysheva  
Alemayehu (Alex) Gorfe  
Vihang Narkar  
Heinrich Taegtmeyer  
Lei Zheng |  |
|  | Instructors:  
Vasanthi Jayaraman  
Phillip Carpenter  
Darren Boehning  
Irina Serysheva  
Alemayehu (Alex) Gorfe  
Vihang Narkar  
Heinrich Taegtmeyer  
Lei Zheng |  |

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<tr>
<th>Week 7</th>
<th>Cell Biology – From the Membrane to the Nucleus and Back Again</th>
<th>Topic Leader: Ilya Levental</th>
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</thead>
</table>
| October 10-14 | • Overview of Cell Membrane Biology, Cellular Compartment and Organelle  
• Cell Membrane Potential and Regulation of Ions and Water Transport Across the Cell Membrane  
• Intracellular Vesicle Trafficking  
• Protein Sorting: ER to Golgi, Lysosomes, Endocytosis/Exocytosis  
• The Mitochondria  
• Antigen Presentation Part 1. MHC Class I and II: Protein Trafficking Influences the Outcome of the Immune Response  
• Antigen Presentation Part 2. MHC Class I and II: Protein Trafficking Influences the Outcome of the Immune Response  
• Nuclear Membrane and Nuclear Pores, Nuclear Membrane Protein Import/Export  
• Antibodies Structure, Production and Use in Cell Biology |  |
|  | • Overview of Cell Membrane Biology, Cellular Compartment and Organelle  
• Cell Membrane Potential and Regulation of Ions and Water Transport Across the Cell Membrane  
• Intracellular Vesicle Trafficking  
• Protein Sorting: ER to Golgi, Lysosomes, Endocytosis/Exocytosis  
• The Mitochondria  
• Antigen Presentation Part 1. MHC Class I and II: Protein Trafficking Influences the Outcome of the Immune Response  
• Antigen Presentation Part 2. MHC Class I and II: Protein Trafficking Influences the Outcome of the Immune Response  
• Nuclear Membrane and Nuclear Pores, Nuclear Membrane Protein Import/Export  
• Antibodies Structure, Production and Use in Cell Biology |  |
|  | Topic Leaders:  
Ilya Levental  
Florian Muller  
Greg Lizee  
Oleh Pochynyuk  
Jeffrey Molldrem  
Jiha Kim  
Andy Bean |  |
|  | Instructors:  
Ilya Levental  
Florian Muller  
Greg Lizee  
Oleh Pochynyuk  
Jeffrey Molldrem  
Jiha Kim  
Andy Bean |  |
# Foundations of Biomedical Research Syllabus – Fall 2016

<table>
<thead>
<tr>
<th>Week 8</th>
<th>Cytoskeletal Dynamics and Cell Motility</th>
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<tbody>
<tr>
<td>October 17-21</td>
<td>• Cytoskeletal Networks, the Cell Scaffold</td>
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<tr>
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<td>• Imaging Adhesion and Motility</td>
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<td>• ECM and Integrins</td>
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<td>• Cell: Cell Contacts</td>
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<td>• Small GTPases and Motility</td>
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<td>• Cell Polarity</td>
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<td>• Mechanical Forces in Cellular Adhesion</td>
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<td>• Adhesion, Immune Response &amp; Leukocytes Trafficking</td>
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</tbody>
</table>

**Topic Leader:** Andrew Gladden  
**Instructors:** Pierre McCrea  
Li Ma  
Tomasz Zal  
Adriana Paulucci  
Joseph McCarty  
Pierre McCrea  
Jeff Frost  
Andrew Gladden  
George Eisenhoffer  
Randy Johnson

<table>
<thead>
<tr>
<th>Week 9</th>
<th>Cell Cycle and DNA Repair Machinery</th>
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<tbody>
<tr>
<td>October 24-28</td>
<td>• History of Cell Cycle Research</td>
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<tr>
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<td>• The RB-E2F Pathway</td>
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<td>• DNA Replication and Mitosis</td>
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<td>• Checkpoints &amp; DNA Damage Responses</td>
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<td>• DNA Repair I</td>
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<td>• DNA repair II</td>
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<td>• Mutagenesis and Genome Stability</td>
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<td>• DNA Repair III</td>
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<td>• Intrastrand Crosslink Repair</td>
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</table>

**Topic Leader:** David Johnson  
**Instructors:**  
David Johnson  
Helen Piwnica-Worms  
Kevin McBride  
Margarida Santos  
Philip Carpenter  
Francesca Cole  
Katharina Schlacher

<table>
<thead>
<tr>
<th>Week 10</th>
<th>Guarding the Genome</th>
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<tbody>
<tr>
<td>October 31 - November 4</td>
<td>• Lectures 1 &amp; 2 TBA</td>
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<tr>
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<td>• The Story of p53 in Cancer</td>
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<td>• All in the Family: Genetic Predisposition to Cancer</td>
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<tr>
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<td>• Clinical Implications of Defective DNA Repair</td>
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<td>• Antigen receptor diversification in adaptive immunity</td>
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<td>• Killing cells softly</td>
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</table>

**Topic Leader:** Michelle Barton  
**Instructors:**  
Michelle Barton  
Joya Chandra  
Sean Post  
Xiongbin Lu  
Vicki Huff  
Joya Chandra  
Eric Davis  
Russell Broaddus  
Nancy Gordon

<table>
<thead>
<tr>
<th>Week 11</th>
<th>Extracellular and Intracellular Communication</th>
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<tbody>
<tr>
<td>November 7-11</td>
<td>• Diversity and Conservation in Signaling</td>
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<tr>
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<td>• Genetic Analysis of Signaling: Yeast Pheromone Response</td>
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<td>• GPCRs and Second Messengers</td>
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<td>• Temporal and Spatial Control of Signaling</td>
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<td>• Receptor Tyrosine Kinases and Ras</td>
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<td>• Developmental Signaling Pathways</td>
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<td>• Bacterial Quorum Sensing and Two-Component Signaling</td>
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<td>• Genomic Models of Signaling Networks</td>
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</tbody>
</table>

**Topic Leader:** Mike Lorenz  
**Instructors:**  
Mike Lorenz  
Carmen Dessauer  
Michael Galko  
Danielle Garsin  
Jeff Chang
### Week 12
**November 14-18**

**Developmental Biology**
- **Fundamental Concepts**: Developmental Biology
- **Gene Regulatory Networks**: Germ Cell Development
- **Germ Layers**: Progenitor Tissues & Differentiation
- **Induction**: Molecular Conversations Between Cells and Tissues
- **Pattern Formation**: Development of Regional Identities in Embryos & Tissues
- **Morphogenesis**: Cell Behaviors to Generate Tissues & Organs
- **Stem Cells**: From Tumors to Pluripotent Stem Cells
- **Homeostasis and regeneration**: Restoring old or damaged tissues
- **Evolution and development**: Mechanisms leading to species-specific traits

**Topic Leader:** Richard Behringer

**Instructors:**
- Richard Behringer
- Swathi Arur
- Rachel Miller
- Yoshi Komatsu
- Eric Swindell
- Jichao Chen
- George Eisenhoffer

---

### Week 13
**November 28 - December 2**

**Signaling Systems and Stress**
- Intro to Signaling Systems and Stress
- Endocrine Signaling During Stress
- Immune Signaling Principles
- Neural Signaling During Stress
- Immune Signaling During Stress
- Pain-Related Signaling
- Endocrine Signaling Principles
- Signaling and Growth

**Topic Leader:** Terry Walters

**Instructors:**
- Nick Justice
- Annemieke Kavelaars
- Dorothy Lewis
- Agi Schonbrunn
- Terry Walters

---

### Week 14
**December 5-9**

**TMC All Stars - Biological Revolution**
- Genetic Architecture of Common Chronic Diseases
- Leveraging Epigenetics Toward Therapeutic Development
- Telomeres in Cancer and Aging
- Anthrax: of Mice, Men and Tomato Seedlings

**Topic Leader:** Eric Swindell

**Instructors:**
- Eric Boerwinkle
- Michelle Barton
- Ronald DePinho
- Theresa Koehler

---

*The overall goal is to integrate different disciplines (Genetics, Microbiology, Immunology, Neurobiology, Cancer Biology, Therapeutics, Developmental Biology, Physiology, etc.).*

*Each week will also have Biostats, Critical thinking (e.g., classic papers), Group exercises, and a take home assessment (e.g., design an experiment...pitfalls, controls, paper critique, etc.)*