INSTRUCTORS

Allan MacKenzie-Graham, PhD
Jeff Alger, PhD

Neuroscience Research Building 225Z
635 Charles Young Drive

Email: amg@ucla.edu
   jralger@ucla.edu

Office hours: Make an appointment by email
BIOGRAPHY

• BS in Neuroscience, UCLA 1996
• PhD in Neuroscience, UCLA 2006
• Postdoc in Neurology, UCLA 2006-2010
• Associate Professor in Neurology, UCLA 2010-present
• Associate Professor in Physics and Biology in Medicine, UCLA 2015-present
• Associate Professor in Neuroscience, UCLA 2015-present
COURSE OBJECTIVES

• Introduction to human anatomy

• How normal and abnormal human anatomy is viewed using radiological imaging equipment
A strong understanding of anatomy and physiology (and associated terminology) is essential for a medical physicist to collaborate with his/her colleagues in medicine. After completing this material, the student should be able to interpret common medical terminology from knowledge of Greek and Latin root words. The student should be able to identify gross anatomical structures (especially on CT images used in treatment planning), define the major organ systems, and describe the physiological mechanisms for repair, maintenance, and growth. Anatomical structures and physiological function should be correlated with the imaging modalities used to view them. A basic introduction of cell physiology and function should be integrated to help the student understand basic concepts such as hypoxia, apoptosis, angiogenesis, hyperplasia, carcinogenesis, etc.
1. Anatomical Nomenclature
   (a) Origin of anatomical names
   (b) Prefixes and suffixes
   (c) Anatomical position and body plane terminology

2. Bones and Bone Marrow
   (a) Classification (including spine)
   (b) Structure
   (c) Development
   (d) Function and relevance of marrow (red vs. yellow)
   (e) Radiographic appearance (x-ray, CT, MRI, nuclear medicine)

3. Brain and CNS
   (a) Anatomy
   (b) Brain structure and function
   (c) Nerve propagation and organization—diseases of the CNS
   (d) Radiography and pathology

4. Thorax
   (a) Bones of the thorax
   (b) Organs in the thorax
   (c) Physiology
   (d) Radiography and pathology

5. Abdomen
   (a) Divisions and regions
   (b) Organs in the abdomen
   (c) Abdominal systems
   (d) Physiology
   (e) Radiography and pathology

6. Respiratory System
   (a) Organs
   (b) Physiology
   (c) Radiography and pathology

7. Digestive System
   (a) Divisions
   (b) Location, extension
   (c) Physiology
   (d) Radiography and pathology

8. Urinary System
   (a) Organs
   (b) Location
   (c) Physiology
   (d) Radiography and pathology

9. Reproductive System
   (a) Organs
   (b) Location
   (c) Physiology
   (d) Radiography and pathology

10. Circulatory System
    (a) Major components
    (b) Physiology
    (c) Radiography and pathology
The Complete Human Body: The Definitive Visual Guide (Roberts)

2nd Edition

• Provided by the program
• Available on Amazon

Suggested Texts & Other Resources

• Dorland’s Illustrated Medical Dictionary (Saunders)
• Atlas of Human Anatomy (Netter)
• Gray’s Anatomy (Gray)
## SYLLABUS

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/03</td>
<td>1</td>
<td>Course intro &amp; basic biology</td>
</tr>
<tr>
<td>10/10</td>
<td>2</td>
<td>Imaging techniques</td>
</tr>
<tr>
<td>10/17</td>
<td>3</td>
<td>Musculoskeletal 1</td>
</tr>
<tr>
<td>10/24</td>
<td>4</td>
<td>Musculoskeletal 2</td>
</tr>
<tr>
<td>10/31</td>
<td>5</td>
<td>Neuroanatomy 1</td>
</tr>
<tr>
<td>11/07</td>
<td>6</td>
<td>Neuroanatomy 2</td>
</tr>
<tr>
<td>11/14</td>
<td>7</td>
<td>Cardiovascular 1</td>
</tr>
<tr>
<td>11/21</td>
<td>8</td>
<td>Cardiovascular 2</td>
</tr>
<tr>
<td>11/21</td>
<td>8a</td>
<td>Student presentations (5:00 - 6:00 pm)</td>
</tr>
<tr>
<td>11/27</td>
<td>9</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>11/27</td>
<td>9a</td>
<td>Student presentations (5:00 - 6:00 pm)</td>
</tr>
<tr>
<td>12/05</td>
<td>10</td>
<td>Genitourinary</td>
</tr>
<tr>
<td>12/05</td>
<td>10a</td>
<td>Student presentations (5:00 - 6:00 pm)</td>
</tr>
</tbody>
</table>
STUDENT PRESENTATIONS

- Goals
  - Greater student interaction
  - Practice on reading literature
  - Learning the language of biology
  - Practice on oral presentations
  - Practice making slides

- Each student will be randomly assigned a recent publication related to anatomic imaging or molecular biology
  - Available on October 17, 2016

- Each student will make a 10 minute presentation on the publication
  - List of learning points
  - Slide presentation
GRADING

- 2/3 Final exam
- 1/3 Student presentation
BIOLOGY REFRESHER
EUKARYOTIC CELL

• Cell membrane
• Nucleus
• Mitochondria
• Ribosomes
• Smooth endoplasmic reticulum
• Rough endoplasmic reticulum
• Golgi body
• Lysosome
• Centriole
• Cytoskeleton
• Found in the nucleus

• 23 pairs of chromosomes
  • 22 autosomes
  • XX (female) or XY (male)

• DNA wraps around histones that condense into chromosomes
DEOXYRIBONUCLEIC ACID

- Double helix structure
- Sugar-phosphate chain
- Nitrogenous bases
  - Adenine
  - Thymine
  - Cytosine
  - Guanine
DNA REPLICATION
• Building blocks of protein
• 20 amino acids used in protein synthesis
• Conserved from bacteria to man
PROTEIN STRUCTURE

• Primary structure
  • Amino acid sequence

• Secondary structure
  • Alpha helix
  • Beta pleated sheet

• Tertiary structure
  • Overall 3D structure

• Quaternary structure
  • Multiple polypeptide chains
DEVELOPMENTAL BIOLOGY
EMBRYOGENESIS

Day 1: Fertilisation
Day 2: Cleavage
Day 3: Compaction
Day 4: Differentiation
Day 5: Cavitation
Day 6: Zona hatching
Day 7: Implantation
Day 8: Bilaminar disc formation
Day 9: Cell mass differentiation
Day 10: Amniotic cavity formation
Day 11: Amniotic cavity expansion
Day 12: Mesoderm formation
Day 13: Pre-chordal plate formation
Day 14: Neural plate formation
Day 15: Neural tube formation
Day 16: Limbs and heart formation
Day 17: Digestive tract formation
Day 18: Amniotic sac enlargement
Day 19: Placenta formation
Day 20: Fetal circulation development
Day 21: Liver rudiment development
Day 22: Lung bud formation
Day 23: Kidney rudiment formation
Day 24: Ear and eye development
Day 25: Nervous system development
Day 26: Musculoskeletal system development
Day 27: Skin development
Day 28: Hair and nail development
GASTRULATION

- Ectoderm
  - Skin
  - Nervous system
- Endoderm
  - Digestive track
  - Respiratory track
- Mesoderm
  - Muscle
  - Bone
CELLULAR DIFFERENTIATION

- Embryonic stem cell
- Pluripotent stem cell
- Multipotent stem cell
EVOLUTIONARY BIOLOGY
PRIMATE EVOLUTION

- Ardipithecus
- Australopithecus
- Homo
EVOLUTION OF CRANIAL CAPACITY

- Australopithecus africanus
  - 457 cm³
- Homo habilis
  - 552 cm³
- Homo erectus
  - 1016 cm³
- Homo neanderthalensis
  - 1512 cm³
- Homo sapiens
  - 1355 cm³
ANATOMIC ORIENTATION
ANATOMIC POSITION

- anterior
- posterior
- ventral
- dorsal
- left
- right
- lateral
- medial
- superior
- inferior
- cranial
- caudal
PLANES OF SECTION

- sagittal
- coronal
- axial
  - horizontal
  - transverse
  - transaxial
  - cross-sectional
- oblique