

TOURO UNIVERSITY CALIFORNIA COLLEGE OF PHARMACY

Preparative Materials in Biological and Pharmaceutical Sciences

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Faculty from the Department of Biological and Pharmaceutical Sciences

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TABLE OF CONTENTS

- I. ANATOMY
- II. PHYSIOLOGY
- III. MEMBRANE PHYSIOLOGY & ION TRANSPORT
- IV. BIOCHEMISTRY
- V. CELL & MOLECULAR BIOLOGY
- VI. CELL SIGNALLING
- VII. IMMUNOLOGY & MICROBIOLOGY
- VIII. CALCULATIONS
- IX. PHARMACOLOGY
- X. PHARMACEUTICS
- XI. MEDICINAL CHEMISTRY

I. ANATOMY

During your first few classes in biological sciences, we will be reviewing cellular structure and function concepts. You are encouraged to review basic anatomy and physiology so that you are able to get up to speed quickly, and cruise through this material.

<http://www.nlm.nih.gov/medlineplus/healthtopics.html>

On the left you'll see "Body Locations/Systems." Click on any one for review,
OR,

Go to <http://www.nlm.nih.gov/medlineplus/anatomy.html>

Scroll down to "Start Here" and click on "Anatomy & Physiology"
which will bring you to the NCI SEER Training Modules.

<http://training.seer.cancer.gov/anatomy/>

Click on the Module Map to go to:

<http://training.seer.cancer.gov/anatomy/index.html?map>

- Review the "Cells, Tissues, and Membranes" section.
- Review all of the "Body Systems" sections you have time to read.
- Read the "Review" and take the "Quiz" at the end of each section.

When finished you can go back to the page <http://www.nlm.nih.gov/medlineplus/anatomy.html>

And go into depth on any listed topic.

II. PHYSIOLOGY

These are the systems you will be studying in Year 1:

- Gastrointestinal tract
- Renal/urinary system
- Ear, nose, throat
- Musculoskeletal
- Cardiovascular
- Skin/Integument

Here are some useful open-access, free resources that may help in reviewing the structure and function of these systems:

1. Khan Academy's Human Anatomy & Physiology:

<https://www.khanacademy.org/science/health-and-medicine/human-anatomy-and-physiology>

Well-organized, interesting and short videos on all of the systems listed above and more.

2. Duke University's Introductory Human Physiology at Coursera:

<https://www.coursera.org/learn/physiology>

This is an entire course in physiology, developed for health science majors. Concise and detailed, these lectures are packaged in short videos. Lecture notes and practice quiz questions can be downloaded from the site. Starts 7/31 and only one week's material open at a time. Highly recommended!

3. Wikibooks Human Physiology: https://en.wikibooks.org/wiki/Human_Physiology
This is a comprehensive, easy-to-read resource that provides a better review of anatomy than physiology. It is a useful resource for gaining a comprehensive overview.
4. Openstax (Rice University) Anatomy & Physiology: <http://cnx.org/contents/FPtK1z mh@8.25:zMTtFGyH@4/Introduction>
A searchable, digital resource available in multiple formats. Developed to support most undergraduate Anatomy & Physiology courses. Best for providing "the big picture." Lacks description of key cellular mechanisms.

Finally, not free but very reasonable...

5. For those who prefer a printed text, Barron's E-Z Anatomy and Physiology (3rd edition, 2010) is a high-yield, key-concept review of Anatomy & Physiology. Currently under \$12.00 at Amazon (also available for \$9.99 as an e-book):
https://www.amazon.com/Anatomy-Physiology-3rd-Barrons-E-Z-ebook/dp/B004NSVDVK/ref=sr_1_22?s=books&ie=UTF8&qid=1499976985&sr=1-22&keywords=physiology

III. MEMBRANE PHYSIOLOGY & ION TRANSPORT

We will review the membrane potential of excitable cells (neurons, muscle cells, and a few others) in an early lecture, but many folks will benefit from a preview:

<https://www.youtube.com/watch?v=PtKAeihnbv0>

From this basic situation we will build the mechanisms necessary for neuronal signaling (graded potential, action potentials, and neurotransmission). Then we will be able to discuss the many ways that drugs can affect the nervous system and the cardiovascular system.

IV. BIOCHEMISTRY

1. Basic building blocks

Because much of what you will be learning in the first year has to do with how drugs interact with binding pockets on protein, it is very worthwhile to review how DNA replicates, how RNA is transcribed, and how proteins are synthesized and folded in order to carry out functions. This is the "central dogma" of biology, and a review will be helpful if you need a refresher. The "chemical components" chapter is a basic review of the types of chemicals/bonds you will need to know to begin a more in-depth review of the structure/activity of drugs, and how they interact with host proteins.

- Molecular Biology of the Cell Hardcover, 6th Ed., 2014, Bruce Alberts et al. (Eds.). ISBN-13: 978-0815344322; ISBN-10: 0815344325.

Focus especially on (links to free 4th edition):

1. [From DNA to RNA.](#)
2. [Protein Function.](#)
3. [The Chemical Components of a Cell.](#)
4. [The Shape and Structure of Proteins.](#)
5. [From RNA to Protein.](#) and
6. [DNA Replication Mechanisms.](#)

2. Central dogma videos

If you have time, these videos can also be very helpful in "seeing" how these processes are carried out. These are a few really informative movies on how DNA replicates, how RNA is transcribed, and how protein gets synthesized.

- DNA-RNA-protein: https://www.youtube.com/watch?v=yqESR7E4b_8
- More details about transcription & translation: <https://www.youtube.com/watch?v=J3HVVi2k2No>
- Translation video: <https://www.youtube.com/watch?v=-zb6r1MMTkc>

V. CELL & MOLECULAR BIOLOGY

In order for the incoming students to generate strong foundations in Cell and Molecular Biology during the summer of 2017 and the 2017-2018 school years in Pharmacy, it is recommend that they regularly read the following textbook:

- Molecular Biology of the Cell Hardcover, 6th Ed., 2014, Bruce Alberts et al. (Eds.). ISBN-13: 978-0815344322; ISBN-10: 0815344325.
- This is a free link to the 4th Ed. of the same textbook through NCBI:
<http://www.ncbi.nlm.nih.gov/books/NBK21054/?term=molecular%20biology%20of%20the%20cell>

VI. CELL SIGNALLING

Physiological processes in cells occur via communication of the intracellular components with the extracellular environment. This mode of communication is facilitated by many endogenous chemicals such as neurotransmitters, hormones, autacoids, immunogenic molecules, etc., commonly referred to as "ligands". In order for these chemicals to elicit a particular response in a particular cell type, they need to bind to a receptor on the cell membrane/cytoplasm to create a "signaling cascade", which finally culminates in a physiological response. The signaling cascade consists of various cellular players such as transport proteins, ions, enzymes and pumps to just name a few.

During your introductory classes in pharmacology, you will learn more about the *receptor-ligand* interactions and the various types of signaling cascades. Moreover, this will be the foundation for the rest of your pharmacology classes when dealing with pertinent topics such as "mechanism of drug action" and "side-effects" of drugs.

In order to be better prepared for cell-signaling pathways, our recommendation is for you to review

contents from the following two links and get familiarized with the various terms and processes used related to this topic:

1. (This is an animation):
http://www.wiley.com/legacy/college/boyer/0470003790/animations/signal_transduction/signals_transduction.htm
2. <http://www.ncbi.nlm.nih.gov/books/NBK21521/> (this is Section 21.4; Neurotransmitters, Synapses, and Impulse Transmission from the book: Molecular Cell Biology, 4th edition; Harvey Lodish, Arnold Berk, Lawrence Zipursky, Paul Matsudaira, David Baltimore, and James Darnell.

VII. IMMUNOLOGY/MICROBIOLOGY

At TUC, Infectious Diseases (ID) is a perennial topic in that it is taught in the context of each organ system. In the Fall semester, we will review some basic concepts in microbiology and immunology before delving into a very large class of drugs – antibacterials.

Key topic areas to review from your Prerequisite Microbiology Course include:

- Bacterial structures: cell wall, capsules, appendages, and spores
- Classification strategies: Gram-positive and Gram-negative, aerobic vs anaerobic or facultative anaerobic, hemolysis
- Bacterial growth: logarithmic vs stationary phase, biofilms

A Free eBook (Medical Microbiology – Baylor ed) www.ncbi.nlm.nih.gov/books/NBK8477/#A289

Finally, here are some other useful resources to help set the stage:

1. ***Especially recommended:*** Animated Videos on Microbiology and the Immune System: <http://armandoh.org> Armando Hasudungan is a scientist communicator for **Garvan Institute of Medical Research in Sydney Australia**. He has created a library of 10-20min introductory videos on a variety of medical subjects, including microbiology and immunology. This is very similar to the Kahn Academy with the added benefit of summary graphics available on Facebook!
2. Useful article on principles of infectiveness
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4374184/>
3. Wikibook Immune System:
https://en.wikibooks.org/wiki/Human_Physiology/The_Immune_System
This is a great, straightforward introduction (or review) to the lymphatic system, key tissues and immune cells, and overview of immune responses. It even includes a little quiz at the end!!!
4. Not free – but affordable review guides available through Amazon:
 - Harvey and Cornelissen’s Lippincott Illustrated Review on Microbiology (Ed. 3) used \$30.00
 - Gladwin, Trattler, and Mahan’s Clinical Microbiology Made Ridiculously Simple (Ed. 6) used \$20.00

VIII. CALCULATIONS

There are two categories of calculations that you will study and master in pharmacy school.

First, there are pharmaceutical calculations, involving units, ratios, concentrations, dilutions, etc. There are many online resources available for you to study such calculations. One such guide is *Pharmaceutical Calculations: The Freedom of Open Source and the Beauty of Math*, an open source book that you can download as a pdf file. This is free (you can donate \$15 to them but this is not required to use the resource for yourself). We recommend that you review **Unit 1 Basic Arithmetic: Chapter 1 – 5**. Here is the link: <http://pharmaceuticalcalculations.org/downloads.php>

Second, there are calculations required for pharmacokinetics (PK). PK uses the same kind of math used for pharmacy calculations described above, but additionally uses concepts and equations involved in studying rates of exponential decay. Here is a link to a short resource on exponential decay (page 4 of the pdf file): <http://www.math.unt.edu/~baf0018/courses/handouts/exponentialnotes.pdf>

You will be required to algebraically manipulate fundamental pharmacokinetics equations involved in the exponential decay of drug concentration (C) with time (t). If you can solve the following equation for time (t) then you have the type of skills required for the class (note: you do not need to actually know what the symbols k and C₀ are to solve the equation for time t).

$$C = C_0 e^{-kt}$$

Hint: 1) divide both sides of the equation by C₀; 2) take natural logarithm *ln* of both sides of the equation; 3) divide both sides of equation by -k; 4) use $\ln(a/b) = -\ln(b/a)$ to get rid of minus sign. These steps will solve the equation for t. Answer: $t = (1/k) \ln(C_0/C)$.

Knowing the principles of algebraic (including exponential and logarithmic) relationships will get you through ~99% of the math you will encounter as a pharmacy student. In addition to the above resources online, other good summaries of these principles can be found at sites like:

<http://www.dummies.com/how-to/education-languages/math/algebra/>

IX. PHARMACOLOGY

Although you will be covering these topics in great detail during your first year, it is helpful to start out by understanding some of the basic ideas in pharmacology. The slide set (courtesy of a free link at UCSD) is a brief introduction to Pharmacology basic concepts, and the second link is a flash card set of terms. The process of assimilating a new body of information starts with a good vocabulary. You will find it helpful to have some idea how the vocabulary links to concepts before you start classes in August.

1. Pharmacology basics (UCSD):

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiKndyEtd3NAhUB5GMKHcM_DJ4QFggcMAA&url=http%3A%2F%2Fwww.cogsci.ucsd.edu%2F~pineda%2FCOGS174%2Foverheads%2Fppt%2FPharmacology_Basics.ppt&usg=AFQjCNF9-1HEBivBQFiohVQC1L6Owrqnkg&sig2=VPaRMK5v7IMCDytVzuYFfw

2. **Pharmacology terms:**

<https://quizlet.com/19776/pharmacology-basics-flash-cards/>

X. PHARMACEUTICS

Most of you will be studying the discipline of Pharmaceutics for the very first time. This discipline covers dosage forms and drug delivery systems such as tablets, injections, aerosols, emulsions, suspensions, etc. Pharmaceutics builds on a number of other scientific disciplines including physical chemistry. In the College of Pharmacy, you will first study physical pharmacy (application of physical chemistry to Pharmacy) before studying Pharmaceutics. In that regard, familiarity with concepts such as diffusion, osmosis, etc. will be valuable.

A good resource for Pharmaceutics is Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. Available at the TUC Library and at:

http://www.amazon.com/Ansels-Pharmaceutical-Dosage-Delivery-Systems/dp/1451188765/ref=sr_1_1?ie=UTF8&qid=1434746798&sr=8-1&keywords=Ansel%27s+dosage+forms

XI. MEDICINAL CHEMISTRY

This self-paced review covers organic functional groups, nomenclature, physical/chemical properties, acidity, basicity, metabolism, and provides good background material for medicinal chemistry.

Review of Organic Functional groups, 5e:

- <http://0-pharmacy.lwwhealthlibrary.com.library.touro.edu/book.aspx?bookid=824>

Additional review of acids, bases, and pH can be found at:

<http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch11/acidbase.php>

<http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch17/water.php>