

<p>Amino Acids</p> <ul style="list-style-type: none"> <li>• Description                     <ul style="list-style-type: none"> <li>○ Absolute configuration at the <math>\alpha</math> position</li> <li>○ Amino acids as dipolar ions</li> <li>○ Classifications                             <ul style="list-style-type: none"> <li>▪ Acidic or basic</li> <li>▪ Hydrophobic or hydrophilic</li> </ul> </li> </ul> </li> <li>• Reactions                     <ul style="list-style-type: none"> <li>○ Sulfur linkage for cysteine and cysteine</li> <li>○ Peptide linkage: polypeptides and proteins</li> <li>○ Hydrolysis</li> </ul> </li> </ul>	CHM 314, 420, 451 & BIO 151, 151L, 312, 312L, 403, 403L, 411, 411L, 440	1
<p>Protein Structure</p> <ul style="list-style-type: none"> <li>• Structure                     <ul style="list-style-type: none"> <li>○ 1° structure of proteins</li> <li>○ 2° structure of proteins</li> <li>○ 3° structure of proteins; role of proline, cysteine, hydrophobic bonding</li> <li>○ 4° structure of proteins (BIO, BC)</li> </ul> </li> <li>• Conformational stability                     <ul style="list-style-type: none"> <li>○ Denaturing and folding</li> <li>○ Hydrophobic interactions</li> <li>○ Solvation layer (entropy) (BC)</li> </ul> </li> <li>• Separation techniques                     <ul style="list-style-type: none"> <li>○ Isoelectric point</li> <li>○ Electrophoresis</li> </ul> </li> </ul>	CHM 420, 451, 462L & BIO 151, 151L, 312, 312L, 403, 403L, 411, 411L, 440, 462	
<p>Non-Enzymatic Protein Function</p> <ul style="list-style-type: none"> <li>• Binding</li> <li>• Immune system</li> <li>• Motors</li> </ul>	BIO 151, 151L, 312, 312L, 403, 403L, 411, 411L, 427 & CHM 420, 451, 452	
<p>Enzyme Structure and Function</p> <ul style="list-style-type: none"> <li>• Function of enzymes in catalyzing biological reactions</li> <li>• Enzyme classification by reaction type</li> <li>• Reduction of activation energy</li> <li>• Substrates and enzyme specificity</li> <li>• Active Site Model</li> <li>• Induced-fit Model</li> <li>• Mechanism of catalysis                     <ul style="list-style-type: none"> <li>○ Cofactors</li> <li>○ Coenzymes</li> <li>○ Water-soluble vitamins</li> </ul> </li> <li>• Effects of local conditions on enzyme activity</li> </ul>	BIO 151, 151L, 411, 411L, 462 & CHM 420, 451, 452	
<p>Control of Enzyme Activity</p> <ul style="list-style-type: none"> <li>• Kinetics                     <ul style="list-style-type: none"> <li>○ General (catalysis)</li> <li>○ Michaelis-Menten</li> <li>○ Cooperativity</li> </ul> </li> <li>• Feedback regulation</li> </ul>	BIO 151, 151L, 411, 411L 462 & CHM 420, 451, 452	

<ul style="list-style-type: none"> <li>• Inhibition – types             <ul style="list-style-type: none"> <li>○ Competitive</li> <li>○ Non-competitive</li> <li>○ Mixed (BC)</li> <li>○ Uncompetitive (BC)</li> </ul> </li> <li>• Regulatory enzymes             <ul style="list-style-type: none"> <li>○ Allosteric enzymes</li> <li>○ Covalently-modified enzymes</li> <li>○ Zymogen</li> </ul> </li> </ul>		2
<p>Nucleic Acid Structure and Function</p> <ul style="list-style-type: none"> <li>• Description</li> <li>• Nucleotides and nucleosides             <ul style="list-style-type: none"> <li>○ Sugar phosphate backbone</li> <li>○ Pyrimidine, purine residues</li> </ul> </li> <li>• Deoxyribonucleic acid (DNA): double helix, Watson–Crick model of DNA structure</li> <li>• Base pairing specificity: A with T, G with C</li> <li>• Function in transmission of genetic information (BIO)</li> <li>• DNA denaturation, reannealing, hybridization</li> </ul>	<p>CHM 314, 420, 451, 452 &amp; BIO 151, 151L, 312, 312L, 462</p>	
<p>DNA Replication</p> <ul style="list-style-type: none"> <li>• Mechanism of replication: separation of strands, specific coupling of free nucleic acids</li> <li>• Semi-conservative nature of replication</li> <li>• Specific enzymes involved in replication</li> <li>• Origins of replication, multiple origins in eukaryotes</li> <li>• Replicating the ends of DNA molecules</li> </ul>	<p>BIO 151, 151L, 312, 312L, 440, 462, 470 &amp; CHM 452</p>	
<p>Repair of DNA</p> <ul style="list-style-type: none"> <li>• Repair during replication</li> <li>• Repair of mutations</li> </ul>	<p>BIO 151, 151L, 312, 312L, 411, 411L, 440, 462 &amp; CHM 452</p>	
<p>Genetic Code</p> <ul style="list-style-type: none"> <li>• Central Dogma: DNA → RNA → protein</li> <li>• The triplet code</li> <li>• Codon-anticodon relationship</li> <li>• Degenerate code, wobble pairing</li> <li>• Missense, nonsense codons</li> <li>• Initiation, termination codons</li> <li>• Messenger RNA (mRNA)</li> </ul>	<p>BIO 151, 151L, 312, 312L, 411, 411L, 462 &amp; CHM 452, 462L</p>	
<p>Transcription</p> <ul style="list-style-type: none"> <li>• Transfer RNA (tRNA); ribosomal RNA (rRNA)</li> <li>• Mechanism of transcription</li> <li>• mRNA processing in eukaryotes, introns, exons</li> <li>• Ribozymes, spliceosomes, small nuclear ribonucleoproteins (snRNPs), small nuclear RNA (snRNAs)</li> <li>• Functional and evolutionary importance of introns</li> </ul>	<p>BIO 151, 151L, 312, 312L, 462 &amp; CHM 452</p>	

<p>Translation</p> <ul style="list-style-type: none"> <li>• Roles of mRNA, tRNA, rRNA</li> <li>• Role and structure of ribosomes</li> <li>• Initiation, termination co-factors</li> <li>• Post-translational modification of proteins</li> </ul>	<p>BIO 151, 151L, 312, 312L, 462 &amp; CHM 452</p>	<p>3</p>
<p>Eukaryotic Chromosome Organization</p> <ul style="list-style-type: none"> <li>• Chromosomal proteins</li> <li>• Single copy vs. repetitive DNA</li> <li>• Supercoiling</li> <li>• Heterochromatin vs. euchromatin</li> <li>• Telomeres, centromeres</li> </ul>	<p>BIO 151, 151L, 312, 312L, 442, 462 &amp; CHM 452</p>	
<p>Control of Gene Expression in Prokaryotes</p> <ul style="list-style-type: none"> <li>• Operon Concept, Jacob-Monod Model</li> <li>• Gene repression in bacteria</li> <li>• Positive control in bacteria</li> </ul>	<p>BIO 151, 151L, 312, 312L, 411, 411L, 462</p>	
<p>Control of Gene Expression in Eukaryotes</p> <ul style="list-style-type: none"> <li>• Transcriptional regulation</li> <li>• DNA binding proteins, transcription factors</li> <li>• Gene amplification and duplication</li> <li>• Post-transcriptional control, basic concept of splicing (introns, exons)</li> <li>• Cancer as a failure of normal cellular controls, oncogenes, tumor suppressor genes</li> <li>• Regulation of chromatin structure</li> <li>• DNA methylation</li> <li>• Role of non-coding RNAs</li> </ul>	<p>BIO 151, 151L, 312, 312L, 411, 411L, 462</p>	
<p>Recombinant DNA and Biotechnology</p> <ul style="list-style-type: none"> <li>• Gene cloning</li> <li>• Restriction enzymes</li> <li>• DNA libraries</li> <li>• Generation of cDNA</li> <li>• Hybridization</li> <li>• Expressing cloned genes</li> <li>• Polymerase Chain Reaction</li> <li>• Gel Electrophoresis and Southern Blotting</li> <li>• DNA sequencing</li> <li>• Analyzing gene expression</li> <li>• Determining gene function</li> <li>• Stem cells</li> <li>• Practical applications of DNA technology: medical applications, human gene therapy, pharmaceuticals, forensic evidence, environmental cleanup, agriculture</li> <li>• Safety and ethics of DNA technology</li> </ul>	<p>BIO 151, 151L, 312, 312L, 411, 411L &amp; CHM 462L</p>	
<p>Evidence that DNA is Genetic Material</p>	<p>BIO 151, 151L, 312, 312L, &amp; CHM 420, 451, 452</p>	

<p>Mendelian Concepts</p> <ul style="list-style-type: none"> <li>• Phenotype and genotype</li> <li>• Gene</li> <li>• Locus</li> <li>• Allele: single and multiple</li> <li>• Homozygosity and heterozygosity</li> <li>• Wild-type</li> <li>• Recessiveness</li> <li>• Complete dominance</li> <li>• Co-dominance</li> <li>• Incomplete dominance, leakage, penetrance, expressivity</li> <li>• Hybridization: viability</li> <li>• Gene pool</li> </ul>	<p>BIO 151, 151L, 152, 152L, 301, 312, 312L</p>	<p>4</p>
<p>Meiosis and Other Factors Affecting Genetic Variability</p> <ul style="list-style-type: none"> <li>• Significance of meiosis</li> <li>• Important differences between meiosis and mitosis</li> <li>• Segregation of genes             <ul style="list-style-type: none"> <li>○ Independent assortment</li> <li>○ Linkage</li> <li>○ Recombination                 <ul style="list-style-type: none"> <li>▪ Single crossovers</li> <li>▪ Double crossovers</li> <li>▪ Synaptonemal complex</li> <li>▪ Tetrad</li> </ul> </li> <li>○ Sex-linked characteristics</li> <li>○ Very few genes on Y chromosome</li> <li>○ Sex determination</li> <li>○ Cytoplasmic/extranuclear inheritance</li> </ul> </li> <li>• Mutation             <ul style="list-style-type: none"> <li>○ General concept of mutation — error in DNA sequence</li> <li>○ Types of mutations: random, translation error, transcription error, base substitution, inversion, addition, deletion, translocation, mispairing</li> <li>○ Advantageous vs. deleterious mutation</li> <li>○ Inborn errors of metabolism</li> <li>○ Relationship of mutagens to carcinogens</li> </ul> </li> <li>• Genetic drift</li> <li>• Synapsis or crossing-over mechanism for increasing genetic diversity</li> </ul>	<p>BIO 151, 151L, 152, 152L, 312, 312L</p>	
<p>Analytic Methods</p> <ul style="list-style-type: none"> <li>• Hardy–Weinberg Principle</li> <li>• Test cross</li> <li>• Gene mapping: crossover frequencies</li> <li>• Biometry: statistical methods</li> </ul>	<p>BIO 151, 151L, 152, 152L, 312, 312L, 403L, 411L, 475L</p>	
<p>Evolution</p> <ul style="list-style-type: none"> <li>• Natural selection             <ul style="list-style-type: none"> <li>○ Fitness concept</li> </ul> </li> </ul>	<p>BIO 151, 151L, 152, 152L, 312, 312L</p>	

<ul style="list-style-type: none"> <li>○ Selection by differential reproduction</li> <li>○ Concepts of natural and group selection</li> <li>○ Evolutionary success as increase in percent representation in the gene pool of the next generation</li> <li>○ generation</li> <li>● Speciation             <ul style="list-style-type: none"> <li>○ Polymorphism</li> <li>○ Adaptation and specialization</li> <li>○ Inbreeding</li> <li>○ Outbreeding</li> <li>○ Bottlenecks</li> </ul> </li> <li>● Evolutionary time as measured by gradual random changes in genome</li> </ul>		5
<p>Principles of Bioenergetics</p> <ul style="list-style-type: none"> <li>● Bioenergetics/thermodynamics             <ul style="list-style-type: none"> <li>○ Free energy/Keq                 <ul style="list-style-type: none"> <li>▪ Equilibrium constant</li> <li>▪ Relationship of the equilibrium constant and <math>\Delta G^\circ</math></li> </ul> </li> <li>○ Concentration                 <ul style="list-style-type: none"> <li>▪ Le Châtelier's Principle</li> </ul> </li> <li>○ Endothermic/exothermic reactions</li> <li>○ Free energy: G</li> <li>○ Spontaneous reactions and <math>\Delta G^\circ</math></li> </ul> </li> <li>● Phosphoryl group transfers and ATP             <ul style="list-style-type: none"> <li>○ ATP hydrolysis <math>\Delta G \ll 0</math></li> <li>○ ATP group transfers</li> </ul> </li> <li>● Biological oxidation-reduction             <ul style="list-style-type: none"> <li>○ Half-reactions</li> <li>○ Soluble electron carriers</li> <li>○ Flavoproteins</li> </ul> </li> </ul>	<p>BIO 151, 151L, 411, 411L &amp; CHM 420, 451</p>	
<p>Carbohydrates</p> <ul style="list-style-type: none"> <li>● Description             <ul style="list-style-type: none"> <li>○ Nomenclature and classification, common names</li> <li>○ Absolute configuration</li> <li>○ Cyclic structure and conformations of hexoses</li> <li>○ Epimers and anomers</li> </ul> </li> <li>● Hydrolysis of the glycoside linkage</li> <li>● Monosaccharides</li> <li>● Disaccharides</li> <li>● Polysaccharides</li> </ul>	<p>BIO 151, 151L &amp; CHM 314, 420, 451</p>	
<p>Glycolysis, Gluconeogenesis, and the Pentose Phosphate Pathway</p> <ul style="list-style-type: none"> <li>● Glycolysis (aerobic), substrates and products             <ul style="list-style-type: none"> <li>○ Feeder pathways: glycogen, starch metabolism</li> </ul> </li> <li>● Fermentation (anaerobic glycolysis)</li> <li>● Gluconeogenesis (BC)</li> <li>● Pentose phosphate pathway (BC)</li> <li>● Net molecular and energetic results of respiration processes</li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L &amp; CHM 420, 451</p>	

<p>Principles of Metabolic Regulation</p> <ul style="list-style-type: none"> <li>• Regulation of metabolic pathways (BIO, BC) <ul style="list-style-type: none"> <li>○ Maintenance of a dynamic steady state</li> </ul> </li> <li>• Regulation of glycolysis and gluconeogenesis</li> <li>• Metabolism of glycogen</li> <li>• Regulation of glycogen synthesis and breakdown <ul style="list-style-type: none"> <li>○ Allosteric and hormonal control</li> </ul> </li> <li>• Analysis of metabolic control</li> </ul>	<p>BIO 151, 151L, 411, 411L &amp; CHM 420, 451, 452</p>	<p>6</p>
<p>Citric Acid Cycle</p> <ul style="list-style-type: none"> <li>• Acetyl-CoA production (BC)</li> <li>• Reactions of the cycle, substrates and products</li> <li>• Regulation of the cycle</li> <li>• Net molecular and energetic results of respiration processes</li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L &amp; CHM 420, 452</p>	
<p>Metabolism of Fatty Acids and Proteins</p> <ul style="list-style-type: none"> <li>• Description of fatty acids (BC)</li> <li>• Digestion, mobilization, and transport of fats</li> <li>• Oxidation of fatty acids <ul style="list-style-type: none"> <li>○ Saturated fats</li> <li>○ Unsaturated fats</li> </ul> </li> <li>• Ketone bodies (BC)</li> <li>• Anabolism of fats (BIO)</li> <li>• Non-template synthesis: biosynthesis of lipids and polysaccharides (BIO)</li> <li>• Metabolism of proteins (BIO)</li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L &amp; CHM 420, 452</p>	
<p>Oxidative Phosphorylation</p> <ul style="list-style-type: none"> <li>• Electron transport chain and oxidative phosphorylation, substrates and products, general features of the pathway</li> <li>• Electron transfer in mitochondria <ul style="list-style-type: none"> <li>○ NADH, NADPH</li> <li>○ Flavoproteins</li> <li>○ Cytochromes</li> </ul> </li> <li>• ATP synthase, chemiosmotic coupling <ul style="list-style-type: none"> <li>○ Proton motive force</li> </ul> </li> <li>• Net molecular and energetic results of respiration processes</li> <li>• Regulation of oxidative phosphorylation</li> <li>• Mitochondria, apoptosis, oxidative stress (BC)</li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L &amp; CHM 420, 452</p>	
<p>Hormonal Regulation and Integration of Metabolism</p> <ul style="list-style-type: none"> <li>• Higher level integration of hormone structure and function</li> <li>• Tissue specific metabolism</li> <li>• Hormonal regulation of fuel metabolism</li> <li>• Obesity and regulation of body mass</li> </ul>	<p>BIO 151, 151L, 403, 403L, &amp; CHM 420, 452</p>	
<p>Plasma Membrane</p> <ul style="list-style-type: none"> <li>• General function in cell containment</li> <li>• Composition of membranes <ul style="list-style-type: none"> <li>○ Lipid components (BIO, BC, OC) <ul style="list-style-type: none"> <li>▪ Phospholipids (and phosphatids)</li> </ul> </li> </ul> </li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L, 440 &amp; CHM 124, 420, 451</p>	

<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>▪ Steroids</li> <li>▪ Waxes</li> </ul> </li> <li>○ Protein components</li> <li>○ Fluid mosaic model</li> <li>● Membrane dynamics</li> <li>● Solute transport across membranes           <ul style="list-style-type: none"> <li>○ Thermodynamic considerations</li> <li>○ Osmosis               <ul style="list-style-type: none"> <li>▪ Colligative properties, osmotic pressure (GC)</li> </ul> </li> <li>○ Passive transport</li> <li>○ Active transport               <ul style="list-style-type: none"> <li>▪ Sodium/potassium pump</li> </ul> </li> </ul> </li> <li>● Membrane channels</li> <li>● Membrane potential</li> <li>● Membrane receptors</li> <li>● Exocytosis and endocytosis</li> <li>● Intercellular junctions (BIO)           <ul style="list-style-type: none"> <li>○ Gap junctions</li> <li>○ Tight junctions</li> <li>○ Desmosomes</li> </ul> </li> </ul>	<p>7</p>
<p>Membrane-Bound Organelles and Defining Characteristics of Eukaryotic Cells</p> <ul style="list-style-type: none"> <li>● Defining characteristics of eukaryotic cells: membrane bound nucleus, presence of organelles,</li> <li>● mitotic division</li> <li>● Nucleus           <ul style="list-style-type: none"> <li>○ Compartmentalization, storage of genetic information</li> <li>○ Nucleolus: location and function</li> <li>○ Nuclear envelope, nuclear pores</li> </ul> </li> <li>● Mitochondria           <ul style="list-style-type: none"> <li>○ Site of ATP production</li> <li>○ Inner and outer membrane structure (BIO, BC)</li> <li>○ Self-replication</li> </ul> </li> <li>● Lysosomes: membrane-bound vesicles containing hydrolytic enzymes</li> <li>● Endoplasmic reticulum           <ul style="list-style-type: none"> <li>○ Rough and smooth components</li> <li>○ Rough endoplasmic reticulum site of ribosomes</li> <li>○ Double membrane structure</li> <li>○ Role in membrane biosynthesis</li> <li>○ Role in biosynthesis of secreted proteins</li> </ul> </li> <li>● Golgi apparatus: general structure and role in packaging and secretion</li> </ul> <p>Peroxisomes: organelles that collect peroxides</p>	<p>BIO 151, 151L, 403, 403L, 440 &amp; CHM 420, 451</p>
<p>Cytoskeleton</p> <ul style="list-style-type: none"> <li>● General function in cell support and movement</li> </ul>	<p>BIO 151, 151L, 440</p>

<ul style="list-style-type: none"> <li>• Microfilaments: composition and role in cleavage and contractility</li> <li>• Microtubules: composition and role in support and transport</li> <li>• Intermediate filaments, role in support</li> <li>• Composition and function of cilia and flagella</li> <li>• Centrioles, microtubule organizing centers</li> </ul>		8
Tissues Formed From Eukaryotic Cells <ul style="list-style-type: none"> <li>• Epithelial cells</li> <li>• Connective tissue cells</li> </ul>	BIO 151, 151L, 440, 442	
Cell Theory <ul style="list-style-type: none"> <li>• History and development</li> <li>• Impact on biology</li> </ul>	BIO 151, 151L, 411, 411L, 440	
Classification and Structure of Prokaryotic Cells <ul style="list-style-type: none"> <li>• Prokaryotic domains                         <ul style="list-style-type: none"> <li>○ Archaea</li> <li>○ Bacteria</li> </ul> </li> <li>• Major classifications of bacteria by shape                         <ul style="list-style-type: none"> <li>○ Bacilli (rod-shaped)</li> <li>○ Spirilli (spiral shaped)</li> <li>○ Cocci (spherical)</li> </ul> </li> <li>• Lack of nuclear membrane and mitotic apparatus</li> <li>• Lack of typical eukaryotic organelles</li> <li>• Presence of cell wall in bacteria</li> <li>• Flagellar propulsion, mechanism</li> </ul>	BIO 151, 151L, 411, 411L	
Growth and Physiology of Prokaryotic Cells <ul style="list-style-type: none"> <li>• Reproduction by fission</li> <li>• High degree of genetic adaptability, acquisition of antibiotic resistance</li> <li>• Exponential growth</li> <li>• Existence of anaerobic and aerobic variants</li> <li>• Parasitic and symbiotic</li> <li>• Chemotaxis</li> </ul>	BIO 151, 151L, 411, 411L	
Genetics of Prokaryotic Cells <ul style="list-style-type: none"> <li>• Existence of plasmids, extragenomic DNA</li> <li>• Transformation: incorporation into bacterial genome of DNA fragments from external medium</li> <li>• Conjugation</li> <li>• Transposons (also present in eukaryotic cells)</li> </ul>	BIO 151, 151L, 312L, 403, 411, 411L	
Virus Structure <ul style="list-style-type: none"> <li>• General structural characteristics (nucleic acid and protein, enveloped and nonenveloped)</li> <li>• Lack organelles and nucleus</li> <li>• Structural aspects of typical bacteriophage</li> <li>• Genomic content--RNA or DNA</li> <li>• Size relative to bacteria and eukaryotic cells</li> </ul>	BIO 151, 151L, 411, 411L	
Viral Life Cycle	BIO 151, 151L, 411, 411L	



<ul style="list-style-type: none"> <li>• Self-replicating biological units that must reproduce within specific host cell</li> <li>• Generalized phage and animal virus life cycles             <ul style="list-style-type: none"> <li>○ Attachment to host, penetration of cell membrane or cell wall, and entry of viral genetic material</li> <li>○ Use of host synthetic mechanism to replicate viral components</li> <li>○ Self-assembly and release of new viral particles</li> </ul> </li> <li>• Transduction: transfer of genetic material by viruses</li> <li>• Retrovirus life cycle: integration into host DNA, reverse transcriptase, HIV</li> <li>• Prions and viroids: subviral particles</li> </ul>		9
<p>Mitosis</p> <ul style="list-style-type: none"> <li>• Mitotic process: prophase, metaphase, anaphase, telophase, interphase</li> <li>• Mitotic structures             <ul style="list-style-type: none"> <li>○ Centrioles, asters, spindles</li> <li>○ Chromatids, centromeres, kinetochores</li> <li>○ Nuclear membrane breakdown and reorganization</li> <li>○ Mechanisms of chromosome movement</li> </ul> </li> <li>• Phases of cell cycle: G<sub>0</sub>, G<sub>1</sub>, S, G<sub>2</sub>, M</li> <li>• Growth arrest</li> <li>• Control of cell cycle</li> <li>• Loss of cell cycle controls in cancer cells</li> </ul>	<p>BIO 151, 151L, 312, 312L, 440, 442</p>	
<p>Biosignalling</p> <ul style="list-style-type: none"> <li>• Oncogenes, apoptosis</li> </ul>	<p>BIO 151, 151L, 403, 403L, 411, 411L, 440</p>	
<p>Reproductive System</p> <ul style="list-style-type: none"> <li>• Gametogenesis by meiosis</li> <li>• Ovum and sperm             <ul style="list-style-type: none"> <li>○ Differences in formation</li> <li>○ Differences in morphology</li> <li>○ Relative contribution to next generation</li> </ul> </li> <li>• Reproductive sequence: fertilization, implantation, development, birth</li> </ul>	<p>BIO 152, 152L, 403, 403L, 475, 475L</p>	
<p>Embryogenesis</p> <ul style="list-style-type: none"> <li>• Stages of early development (order and general features of each)             <ul style="list-style-type: none"> <li>○ Fertilization</li> <li>○ Cleavage</li> <li>○ Blastula formation</li> <li>○ Gastrulation                 <ul style="list-style-type: none"> <li>▪ First cell movements</li> <li>▪ Formation of primary germ layers (endoderm, mesoderm, ectoderm)</li> </ul> </li> <li>○ Neurulation</li> </ul> </li> <li>• Major structures arising out of primary germ layers</li> <li>• Neural crest</li> </ul>	<p>BIO 152, 152L, 442</p>	

<ul style="list-style-type: none"> <li>• Environment–gene interaction in development</li> </ul>		
<p>Mechanisms of Development</p> <ul style="list-style-type: none"> <li>• Cell specialization <ul style="list-style-type: none"> <li>○ Determination</li> <li>○ Differentiation</li> <li>○ Tissue types</li> </ul> </li> <li>• Cell–cell communication in development</li> <li>• Cell migration</li> <li>• Pluripotency: stem cells</li> <li>• Gene regulation in development</li> <li>• Programmed cell death</li> <li>• Existence of regenerative capacity in various species</li> <li>• Senescence and aging</li> </ul>	BIO 152, 152L, 442	10
<p>Nervous System: Structure and Function</p> <ul style="list-style-type: none"> <li>• Major Functions <ul style="list-style-type: none"> <li>○ High level control and integration of body systems</li> <li>○ Adaptive capability to external influences</li> </ul> </li> <li>• Organization of vertebrate nervous system</li> <li>• Sensor and effector neurons</li> <li>• Sympathetic and parasympathetic nervous systems: antagonistic control</li> <li>• Reflexes <ul style="list-style-type: none"> <li>○ Feedback loop, reflex arc</li> <li>○ Role of spinal cord and supraspinal circuits</li> </ul> </li> <li>• Integration with endocrine system: feedback control</li> </ul>	BIO 152	
<p>Nerve Cell</p> <ul style="list-style-type: none"> <li>• Cell body: site of nucleus, organelles</li> <li>• Dendrites: branched extensions of cell body</li> <li>• Axon: structure and function</li> <li>• Myelin sheath, Schwann cells, insulation of axon</li> <li>• Nodes of Ranvier: propagation of nerve impulse along axon</li> <li>• Synapse: site of impulse propagation between cells</li> <li>• Synaptic activity: transmitter molecules</li> <li>• Resting potential: electrochemical gradient</li> <li>• Action potential <ul style="list-style-type: none"> <li>○ Threshold, all-or-none</li> <li>○ Sodium/potassium pump</li> </ul> </li> <li>• Excitatory and inhibitory nerve fibers: summation, frequency of firing</li> <li>• Glial cells, neuroglia</li> </ul>	BIO 151, 151L, 403, 403L, 415	
<p>Electrochemistry</p> <ul style="list-style-type: none"> <li>• Concentration cell: direction of electron flow, Nernst equation</li> </ul>	BIO 403, 403L & CHM 124, 420, 451	
<p>Biosignalling</p> <ul style="list-style-type: none"> <li>• Gated ion channels <ul style="list-style-type: none"> <li>○ Voltage gated</li> <li>○ Ligand gated</li> </ul> </li> </ul>	BIO 151, 151L, 312, 312L, 440 & CHM 420, 451	

<ul style="list-style-type: none"> <li>• Receptor enzymes</li> <li>• G protein-coupled receptors</li> </ul>		11
<p>Lipids</p> <ul style="list-style-type: none"> <li>• Description; structure <ul style="list-style-type: none"> <li>○ Steroids</li> <li>○ Terpenes and terpenoids</li> </ul> </li> </ul>	BIO 151, 151L, 403, 403L, 411, 411L & CHM 420, 451, 452	
<p>Endocrine System: Hormones and Their Sources</p> <ul style="list-style-type: none"> <li>• Function of endocrine system: specific chemical control at cell, tissue, and organ level</li> <li>• Definitions of endocrine gland, hormone</li> <li>• Major endocrine glands: names, locations, products</li> <li>• Major types of hormones</li> <li>• Neuroendocrinology — relation between neurons and hormonal systems</li> </ul>	BIO 152, 152L, 403, 403L, 475, 475L	
<p>Endocrine System: Mechanisms of Hormone Action</p> <ul style="list-style-type: none"> <li>• Cellular mechanisms of hormone action</li> <li>• Transport of hormones: blood supply</li> <li>• Specificity of hormones: target tissue</li> <li>• Integration with nervous system: feedback control regulation by second messengers</li> </ul>	BIO 152, 152L, 403, 403L, 475, 475L	
<p>Respiratory System</p> <ul style="list-style-type: none"> <li>• General function <ul style="list-style-type: none"> <li>○ Gas exchange, thermoregulation</li> <li>○ Protection against disease: particulate matter</li> </ul> </li> <li>• Structure of lungs and alveoli</li> <li>• Breathing mechanisms <ul style="list-style-type: none"> <li>○ Diaphragm, rib cage, differential pressure</li> <li>○ Resiliency and surface tension effects</li> </ul> </li> <li>• Thermoregulation: nasal and tracheal capillary beds; evaporation, panting</li> <li>• Particulate filtration: nasal hairs, mucus/cilia system in lungs</li> <li>• Alveolar gas exchange <ul style="list-style-type: none"> <li>○ Diffusion, differential partial pressure</li> <li>○ Henry's Law (GC)</li> </ul> </li> <li>• pH control</li> <li>• Regulation by nervous control <ul style="list-style-type: none"> <li>○ CO<sub>2</sub> sensitivity</li> </ul> </li> </ul>	BIO 152, 152L, 403, 403L, 475, 475L	
<p>Circulatory System</p> <ul style="list-style-type: none"> <li>• Functions: circulation of oxygen, nutrients, hormones, ions and fluids, removal of metabolic waste</li> <li>• Role in thermoregulation</li> <li>• Four-chambered heart: structure and function</li> <li>• Endothelial cells</li> <li>• Systolic and diastolic pressure</li> <li>• Pulmonary and systemic circulation</li> </ul>	BIO 152, 152L, 403, 403L, 475, 475L	

<ul style="list-style-type: none"> <li>• Arterial and venous systems (arteries, arterioles, venules, veins)             <ul style="list-style-type: none"> <li>○ Structural and functional differences</li> <li>○ Pressure and flow characteristics</li> </ul> </li> <li>• Capillary beds             <ul style="list-style-type: none"> <li>○ Mechanisms of gas and solute exchange</li> <li>○ Mechanism of heat exchange</li> <li>○ Source of peripheral resistance</li> </ul> </li> <li>• Composition of blood             <ul style="list-style-type: none"> <li>○ Plasma, chemicals, blood cells</li> <li>○ Erythrocyte production and destruction; spleen, bone marrow</li> <li>○ Regulation of plasma volume</li> </ul> </li> <li>• Coagulation, clotting mechanisms</li> <li>• Oxygen transport by blood             <ul style="list-style-type: none"> <li>○ Hemoglobin, hematocrit</li> <li>○ Oxygen content</li> <li>○ Oxygen affinity</li> <li>○ Oxygen transport by blood; modification of oxygen affinity</li> </ul> </li> <li>• Carbon dioxide transport and level in blood</li> <li>• Nervous and endocrine control</li> </ul>	<p>12</p>
<p>Lymphatic System</p> <ul style="list-style-type: none"> <li>• Structure of lymphatic system</li> <li>• Major functions             <ul style="list-style-type: none"> <li>○ Equalization of fluid distribution</li> <li>○ Transport of proteins and large glycerides</li> <li>○ Production of lymphocytes involved in immune reactions</li> <li>○ Return of materials to the blood</li> </ul> </li> </ul>	<p>BIO 152, 152L 403, 403L</p>
<p>Immune System</p> <ul style="list-style-type: none"> <li>• Innate (non-specific) vs. adaptive (specific) immunity</li> <li>• Adaptive immune system cells             <ul style="list-style-type: none"> <li>○ T-lymphocytes</li> <li>○ B-lymphocytes</li> </ul> </li> <li>• Innate immune system cells             <ul style="list-style-type: none"> <li>○ Macrophages</li> <li>○ Phagocytes</li> </ul> </li> <li>• Concept of antigen and antibody</li> <li>• Antigen presentation</li> <li>• Clonal selection</li> <li>• Antigen-antibody recognition</li> <li>• Structure of antibody molecule</li> <li>• Recognition of self vs. non-self, autoimmune diseases</li> <li>• Major histocompatibility complex</li> </ul>	<p>BIO 411, 411L, 427</p>
<p>Digestive System</p> <ul style="list-style-type: none"> <li>• Ingestion             <ul style="list-style-type: none"> <li>○ Saliva as lubrication and source of enzymes</li> <li>○ Ingestion, esophagus, transport function</li> </ul> </li> </ul>	<p>BIO 403, 403L, 475, 475L</p>

<ul style="list-style-type: none"> <li>• Stomach <ul style="list-style-type: none"> <li>○ Storage and churning of food</li> <li>○ Low pH, gastric juice, mucal protection against self-destruction</li> <li>○ Production of digestive enzymes, site of digestion</li> <li>○ Structure (gross)</li> </ul> </li> <li>• Liver <ul style="list-style-type: none"> <li>○ Structural relationship of liver within gastrointestinal system</li> <li>○ Production of bile</li> <li>○ Role in blood glucose regulation, detoxification</li> </ul> </li> <li>• Bile <ul style="list-style-type: none"> <li>○ Storage in gall bladder</li> <li>○ Function</li> </ul> </li> <li>• Pancreas <ul style="list-style-type: none"> <li>○ Production of enzymes</li> <li>○ Transport of enzymes to small intestine</li> </ul> </li> <li>• Small Intestine <ul style="list-style-type: none"> <li>○ Absorption of food molecules and water</li> <li>○ Function and structure of villi</li> <li>○ Production of enzymes, site of digestion</li> <li>○ Neutralization of stomach acid</li> <li>○ Structure (anatomic subdivisions)</li> </ul> </li> <li>• Large Intestine <ul style="list-style-type: none"> <li>○ Absorption of water</li> <li>○ Bacterial flora</li> <li>○ Structure (gross)</li> </ul> </li> <li>• Rectum: storage and elimination of waste, feces</li> <li>• Muscular control <ul style="list-style-type: none"> <li>○ Peristalsis</li> </ul> </li> <li>• Endocrine control <ul style="list-style-type: none"> <li>○ Hormones</li> <li>○ Target tissues</li> </ul> </li> <li>• Nervous control: the enteric nervous system</li> </ul>	
<p>Excretory System</p> <ul style="list-style-type: none"> <li>• Roles in homeostasis <ul style="list-style-type: none"> <li>○ Blood pressure</li> <li>○ Osmoregulation</li> <li>○ Acid-base balance</li> <li>○ Removal of soluble nitrogenous waste</li> </ul> </li> <li>• Kidney structure <ul style="list-style-type: none"> <li>○ Cortex</li> <li>○ Medulla</li> </ul> </li> <li>• Nephron structure <ul style="list-style-type: none"> <li>○ Glomerulus</li> <li>○ Bowman's capsule</li> <li>○ Proximal tubule</li> </ul> </li> </ul>	BIO 403, 403L, 475, 475L

<ul style="list-style-type: none"> <li>○ Loop of Henle</li> <li>○ Distal tubule</li> <li>○ Collecting duct</li> <li>● Formation of urine             <ul style="list-style-type: none"> <li>○ Glomerular filtration</li> <li>○ Secretion and reabsorption of solutes</li> <li>○ Concentration of urine</li> <li>○ Counter-current multiplier mechanism</li> </ul> </li> <li>● Storage and elimination: ureter, bladder, urethra</li> <li>● Osmoregulation: capillary reabsorption of H<sub>2</sub>O, amino acids, glucose, ions</li> <li>● Muscular control: sphincter muscle</li> </ul>		14
<p>Reproductive System</p> <ul style="list-style-type: none"> <li>● Male and female reproductive structures and their functions             <ul style="list-style-type: none"> <li>○ Gonads</li> <li>○ Genitalia</li> <li>○ Differences between male and female structures</li> </ul> </li> <li>● Hormonal control of reproduction             <ul style="list-style-type: none"> <li>○ Male and female sexual development</li> <li>○ Female reproductive cycle</li> <li>○ Pregnancy, parturition, lactation</li> <li>○ Integration with nervous control</li> </ul> </li> </ul>	<p>BIO 403, 403L, 475, 475L</p>	
<p>Muscle System</p> <ul style="list-style-type: none"> <li>● Important functions             <ul style="list-style-type: none"> <li>○ Support: mobility</li> <li>○ Peripheral circulatory assistance</li> <li>○ Thermoregulation (shivering reflex)</li> </ul> </li> <li>● Structure of three basic muscle types: striated, smooth, cardiac</li> <li>● Muscle structure and control of contraction             <ul style="list-style-type: none"> <li>○ T-tubule system</li> <li>○ Contractile apparatus</li> <li>○ Sarcoplasmic reticulum</li> <li>○ Fiber type</li> <li>○ Contractile velocity of different muscle types</li> </ul> </li> <li>● Regulation of cardiac muscle contraction</li> <li>● Oxygen debt: fatigue</li> <li>● Nervous control             <ul style="list-style-type: none"> <li>○ Motor neurons</li> <li>○ Neuromuscular junction, motor end plates</li> <li>○ Sympathetic and parasympathetic innervation</li> <li>○ Voluntary and involuntary muscles</li> </ul> </li> </ul>	<p>BIO 403, 403L, 475, 475L</p>	
<p>Specialized Cell-Muscle Cell</p> <ul style="list-style-type: none"> <li>● Structural characteristics of striated, smooth, and cardiac muscle</li> <li>● Abundant mitochondria in red muscle cells: ATP source</li> <li>● Organization of contractile elements: actin and myosin filaments, crossbridges, sliding filament model</li> <li>● Sarcomeres: "I" and "A" bands, "M" and "Z" lines, "H" zone</li> </ul>	<p>BIO 403, 403L, 440, 475, 475L</p>	

<ul style="list-style-type: none"> <li>• Presence of troponin and tropomyosin</li> <li>• Calcium regulation of contraction</li> </ul>		15
<p>Skeletal System</p> <ul style="list-style-type: none"> <li>• Functions                             <ul style="list-style-type: none"> <li>○ Structural rigidity and support</li> <li>○ Calcium storage</li> <li>○ Physical protection</li> </ul> </li> <li>• Skeletal structure                             <ul style="list-style-type: none"> <li>○ Specialization of bone types, structures</li> <li>○ Joint structures</li> <li>○ Endoskeleton vs. exoskeleton</li> </ul> </li> <li>• Bone structure                             <ul style="list-style-type: none"> <li>○ Calcium/protein matrix</li> <li>○ Cellular composition of bone</li> </ul> </li> <li>• Cartilage: structure and function</li> <li>• Ligaments, tendons</li> <li>• Endocrine control</li> </ul>	BIO 475, 475L	
<p>Skin System</p> <ul style="list-style-type: none"> <li>• Structure                             <ul style="list-style-type: none"> <li>○ Layer differentiation, cell types</li> <li>○ Relative impermeability to water</li> </ul> </li> <li>• Functions in homeostasis and osmoregulation</li> <li>• Functions in thermoregulation                             <ul style="list-style-type: none"> <li>○ Hair, erectile musculature</li> <li>○ Fat layer for insulation</li> <li>○ Sweat glands, location in dermis</li> <li>○ Vasoconstriction and vasodilation in surface capillaries</li> </ul> </li> <li>• Physical protection                             <ul style="list-style-type: none"> <li>○ Nails, calluses, hair</li> <li>○ Protection against abrasion, disease organisms</li> </ul> </li> <li>• Hormonal control: sweating, vasodilation, and vasoconstriction</li> </ul>	BIO 403, 403L, 475, 475L	
<p>Circulatory System</p> <ul style="list-style-type: none"> <li>• Arterial and venous systems; pressure and flow characteristics</li> </ul>	BIO 403, 403L	
<p>Gas Phase</p> <ul style="list-style-type: none"> <li>• Absolute temperature, (K) Kelvin Scale</li> <li>• Pressure, simple mercury barometer</li> <li>• Molar volume at 0°C and 1 atm = 22.4 L/mol</li> <li>• Ideal gas                             <ul style="list-style-type: none"> <li>○ Definition</li> <li>○ Ideal Gas Law: <math>PV = nRT</math></li> <li>○ Boyle's Law: <math>PV = \text{constant}</math></li> <li>○ Charles' Law: <math>V/T = \text{constant}</math></li> <li>○ Avogadro's Law: <math>V/n = \text{constant}</math></li> </ul> </li> <li>• Kinetic Molecular Theory of Gases                             <ul style="list-style-type: none"> <li>○ Heat capacity at constant volume and at constant pressure (PHY)</li> <li>○ Boltzmann's Constant (PHY)</li> </ul> </li> </ul>	BIO 411, 411L & CHM 123	

<ul style="list-style-type: none"> <li>• Deviation of real gas behavior from Ideal Gas Law <ul style="list-style-type: none"> <li>○ Qualitative</li> <li>○ Quantitative (Van der Waals' Equation)</li> </ul> </li> <li>• Partial pressure, mole fraction</li> <li>• Dalton's Law relating partial pressure to composition</li> </ul>		16
<p>Specialized Cell - Nerve Cell</p> <ul style="list-style-type: none"> <li>• Myelin sheath, Schwann cells, insulation of axon</li> <li>• Nodes of Ranvier: propagation of nerve impulse along axon</li> </ul>	BIO 403, 415	
<p>Nucleotides and Nucleic Acids</p> <ul style="list-style-type: none"> <li>• Nucleotides and nucleosides: composition <ul style="list-style-type: none"> <li>○ Sugar phosphate backbone</li> <li>○ Pyrimidine, purine residues</li> </ul> </li> <li>• Deoxyribonucleic acid: DNA, double helix</li> <li>• Chemistry (OC, BC)</li> <li>• Other functions (OC, BC)</li> </ul>	BIO 151, 151L, 312, 312L & CHM 314, 420, 451, 452	
<p>Enzymes</p> <ul style="list-style-type: none"> <li>• Classification by reaction type</li> <li>• Mechanism <ul style="list-style-type: none"> <li>○ Substrates and enzyme specificity</li> <li>○ Active site model</li> <li>○ Induced-fit model</li> <li>○ Cofactors, coenzymes and vitamins</li> </ul> </li> <li>• Kinetics <ul style="list-style-type: none"> <li>○ General (catalysis)</li> <li>○ Michaelis-Menten</li> <li>○ Cooperativity</li> <li>○ Effects of local conditions on enzyme activity</li> </ul> </li> <li>• Inhibition</li> <li>• Regulatory enzymes <ul style="list-style-type: none"> <li>○ Allosteric</li> <li>○ Covalently modified</li> </ul> </li> </ul>	BIO 151, 151L, 312, 312L, 403, 403L, 411, 411L & CHM 420, 451, 452, 462L	
<p>Rate Processes in Chemical Reactions - Kinetics and Equilibrium</p> <ul style="list-style-type: none"> <li>• Reaction rate</li> <li>• Dependence of reaction rate upon concentration of reactants <ul style="list-style-type: none"> <li>○ Rate law, rate constant</li> <li>○ Reaction order</li> </ul> </li> <li>• Rate-determining step</li> <li>• Dependence of reaction rate upon temperature <ul style="list-style-type: none"> <li>○ Activation energy <ul style="list-style-type: none"> <li>▪ Activated complex or transition state</li> <li>▪ Interpretation of energy profiles showing energies of reactants, products, activation energy, and <math>\Delta H</math> for the reaction</li> </ul> </li> <li>○ Use of the Arrhenius Equation</li> </ul> </li> <li>• Kinetic control versus thermodynamic control of a reaction</li> <li>• Catalysts</li> <li>• Equilibrium in reversible chemical reactions</li> </ul>	BIO 411, 411L & CHM 124	



<ul style="list-style-type: none"> <li>○ Law of Mass Action</li> <li>○ Equilibrium Constant</li> <li>○ Application of Le Châtelier's Principle</li> <li>● Relationship of the equilibrium constant and <math>\Delta G^\circ</math></li> </ul>		17
<p>Sensory Processing</p> <ul style="list-style-type: none"> <li>● Sensation <ul style="list-style-type: none"> <li>○ Thresholds</li> <li>○ Weber's Law (PSY)</li> <li>○ Signal detection theory (PSY)</li> <li>○ Sensory adaptation</li> </ul> </li> <li>● Sensory receptors <ul style="list-style-type: none"> <li>○ Sensory pathways</li> <li>○ Types of sensory receptors</li> </ul> </li> </ul>	PSY101, 323 & BIO 403, 403L, 415	
<p>Vision</p> <ul style="list-style-type: none"> <li>● Structure and function of the eye</li> <li>● Visual processing <ul style="list-style-type: none"> <li>○ Visual pathways in the brain</li> <li>○ Parallel processing (PSY)</li> <li>○ Feature detection (PSY)</li> </ul> </li> </ul>	PSY 101, 323, 422 & BIO 403, 403L, 415	
<p>Hearing</p> <ul style="list-style-type: none"> <li>● Auditory processing <ul style="list-style-type: none"> <li>○ Auditory pathways in the brain</li> </ul> </li> <li>● Sensory reception by hair cells (PSY)</li> </ul>	PSY 101, 323, 422 & BIO 403, 403L, 415	
<p>Other Senses</p> <ul style="list-style-type: none"> <li>● Somatosensation <ul style="list-style-type: none"> <li>○ Pain perception (PSY)</li> </ul> </li> <li>● Taste <ul style="list-style-type: none"> <li>○ Taste buds/chemoreceptors that detect specific chemicals</li> </ul> </li> <li>● Smell <ul style="list-style-type: none"> <li>○ Olfactory cells/chemoreceptors that detect specific chemicals</li> <li>○ Pheromones (BIO)</li> <li>○ Olfactory pathways in the brain (BIO)</li> </ul> </li> <li>● Kinesthetic sense (PSY)</li> <li>● Vestibular sense</li> </ul>	PSY 101, 323, 422 & BIO 403, 403L, 415	
<p>Cognition</p> <ul style="list-style-type: none"> <li>● Information-processing model</li> <li>● Cognitive development <ul style="list-style-type: none"> <li>○ Piaget's stages of cognitive development</li> <li>○ Cognitive changes in late adulthood</li> <li>○ Role of culture in cognitive development</li> <li>○ Influence of heredity and environment on cognitive development</li> </ul> </li> <li>● Biological factors that affect cognition (PSY, BIO)</li> <li>● Problem solving and decision making (PSY, BIO) <ul style="list-style-type: none"> <li>○ Types of problem solving</li> </ul> </li> </ul>	PSY 101, 321, 351 & BIO 403, 403L, 415	

<ul style="list-style-type: none"> <li>○ Barriers to effective problem solving</li> <li>○ Approaches to problem solving</li> <li>○ Heuristics, biases, intuition, and emotion             <ul style="list-style-type: none"> <li>▪ Overconfidence and belief perseverance</li> </ul> </li> <li>● Intellectual functioning             <ul style="list-style-type: none"> <li>○ Multiple definitions of intelligence</li> <li>○ Influence of heredity and environment on intelligence</li> <li>○ Variations in intellectual ability</li> </ul> </li> </ul>	<p>18</p>
<p>Consciousness</p> <ul style="list-style-type: none"> <li>● States of consciousness             <ul style="list-style-type: none"> <li>○ Alertness (PSY, BIO)</li> <li>○ Sleep                 <ul style="list-style-type: none"> <li>▪ Stages of sleep</li> <li>▪ Sleep cycles and changes to sleep cycles</li> <li>▪ Sleep and circadian rhythms (PSY, BIO)</li> <li>▪ Dreaming</li> <li>▪ Sleep disorders</li> </ul> </li> <li>○ Hypnosis and meditation</li> </ul> </li> <li>● Consciousness altering drugs             <ul style="list-style-type: none"> <li>○ Types of consciousness altering drugs and their effects on the nervous system and behavior</li> <li>○ Drug addiction and the reward pathway in the brain</li> </ul> </li> </ul>	<p>PSY 101, 321, 422 &amp; BIO 403, 403L, 415</p>
<p>Memory</p> <ul style="list-style-type: none"> <li>● Encoding             <ul style="list-style-type: none"> <li>○ Process of encoding information</li> <li>○ Processes that aid in encoding memories</li> </ul> </li> <li>● Storage             <ul style="list-style-type: none"> <li>○ Types of memory storage (e.g., sensory, working, long-term)</li> <li>○ Semantic networks and spreading activation</li> </ul> </li> <li>● Retrieval             <ul style="list-style-type: none"> <li>○ Recall, recognition, and relearning</li> <li>○ Retrieval cues</li> <li>○ The role of emotion in retrieving memories</li> </ul> </li> <li>● Forgetting             <ul style="list-style-type: none"> <li>○ Aging and memory</li> <li>○ Memory dysfunctions (e.g., Alzheimer’s disease, Korsakoff’s syndrome)</li> <li>○ Decay</li> <li>○ Interference</li> <li>○ Memory construction and source monitoring</li> </ul> </li> <li>● Changes in synaptic connections underlie memory and learning (PSY, BIO)             <ul style="list-style-type: none"> <li>○ Neural plasticity</li> <li>○ Memory and learning</li> <li>○ Long-term potentiation</li> </ul> </li> </ul>	<p>PSY 101, 321 &amp; BIO 403, 403L, 415</p>

<p>Language</p> <ul style="list-style-type: none"> <li>• Theories of language development (e.g., learning, Nativist, Interactionist)</li> <li>• Influence of language on cognition</li> <li>• Different brain areas control language and speech (PSY, BIO)</li> </ul>	<p>PSY 101, 321, 351 &amp; BIO 403, 403L, 415</p>	<p>19</p>
<p>Emotion</p> <ul style="list-style-type: none"> <li>• Three components of emotion (i.e., cognitive, physiological, behavioral)</li> <li>• Universal emotions (e.g., fear, anger, happiness, surprise, joy, disgust, sadness)</li> <li>• Adaptive role of emotion</li> <li>• Theories of emotion             <ul style="list-style-type: none"> <li>○ James-Lange theory</li> <li>○ Cannon-Bard theory</li> <li>○ Schachter-Singer theory</li> </ul> </li> <li>• The role of biological processes in perceiving emotion (PSY, BIO)             <ul style="list-style-type: none"> <li>○ Generation and experience of emotions involve many brain regions</li> <li>○ The role of the limbic system in emotion</li> <li>○ Emotional experiences can be stored as memories that can be recalled by similar circumstances</li> <li>○ Prefrontal cortex is critical for emotional experience, and is also important in temperament and decision making</li> <li>○ Emotion and the autonomic nervous system</li> <li>○ Physiological markers of emotion (signatures of emotion)</li> </ul> </li> </ul>	<p>PSY 101, 366 &amp; BIO 403, 403L, 415</p>	
<p>Stress</p> <ul style="list-style-type: none"> <li>• The nature of stress             <ul style="list-style-type: none"> <li>○ Appraisal</li> <li>○ Different types of stressors (e.g., cataclysmic events, personal, etc.)</li> <li>○ Effects of stress on psychological functions</li> </ul> </li> <li>• Stress outcomes/response to stressors             <ul style="list-style-type: none"> <li>○ Physiological (PSY, BIO)</li> <li>○ Emotional</li> <li>○ Behavioral</li> </ul> </li> <li>• Managing stress (e.g., exercise, relaxation techniques, spirituality, etc.)</li> </ul>	<p>PSY 101, 351, 366, 422 &amp; BIO 403, 403L, 415</p>	
<p>Biological Bases of Behavior</p> <ul style="list-style-type: none"> <li>• The nervous system             <ul style="list-style-type: none"> <li>○ Neurons                 <ul style="list-style-type: none"> <li>▪ The reflex arc</li> </ul> </li> <li>○ Neurotransmitters</li> <li>○ Peripheral nervous system</li> <li>○ Central nervous system                 <ul style="list-style-type: none"> <li>▪ The brain</li> </ul> </li> </ul> </li> </ul>	<p>PSY 101, 321, 322, 323, 351, 366, 422</p> <p>BIO 403, 475, 415, 312</p>	

<ul style="list-style-type: none"> <li>○ The brainstem</li> <li>○ The cerebellum</li> <li>○ The diencephalon (BIO)</li> <li>○ The cerebrum</li> <li>○ Control of voluntary movement in the cerebral cortex</li> <li>○ Information processing in the cerebral cortex</li> <li>○ Lateralization of cortical functions</li> <li>○ Methods of studying the brain</li> <li>● Neurons communicate and influence behavior (PSY)</li> <li>● Influence of neurotransmitters on behavior (PSY)</li> <li>● The endocrine system             <ul style="list-style-type: none"> <li>○ Components of the endocrine system</li> <li>○ Effects of the endocrine system on behavior</li> </ul> </li> <li>● Behavioral genetics             <ul style="list-style-type: none"> <li>○ Genes, temperament, and heredity</li> <li>○ Adaptive value of traits and behaviors</li> <li>○ Interaction between heredity and environmental influences</li> </ul> </li> <li>● Genetic and environmental factors contribute to the development of behaviors             <ul style="list-style-type: none"> <li>○ Experience and behavior (PSY)</li> <li>○ Regulatory genes and behavior (BIO)</li> <li>○ Genetically based behavioral variation in natural populations</li> </ul> </li> <li>● Human physiological development (PSY)             <ul style="list-style-type: none"> <li>○ Prenatal development</li> <li>○ Motor development</li> <li>○ Developmental changes in adolescence</li> </ul> </li> </ul>		<p>20</p>
<p>Associative Learning</p> <ul style="list-style-type: none"> <li>● Classical conditioning (PSY, BIO)             <ul style="list-style-type: none"> <li>○ Neutral, conditioned, and unconditioned stimuli</li> <li>○ Conditioned and unconditioned response</li> <li>○ Processes: acquisition, extinction, spontaneous recovery, generalization, discrimination</li> </ul> </li> <li>● Operant conditioning (PSY, BIO)             <ul style="list-style-type: none"> <li>○ Processes of shaping and extinction</li> <li>○ Types of reinforcement: positive, negative, primary, conditional</li> <li>○ Reinforcement schedules: fixed-ratio, variable-ratio, fixed-interval, variable-interval</li> <li>○ Punishment</li> <li>○ Escape and avoidance learning</li> </ul> </li> <li>● Biological factors that affect associative learning             <ul style="list-style-type: none"> <li>○ Development of learned behaviors (PSY, BIO)</li> </ul> </li> </ul>	<p>BIO 415</p> <p>PSY 101, 322, 351</p>	