

# Anatomy and Physiology 12

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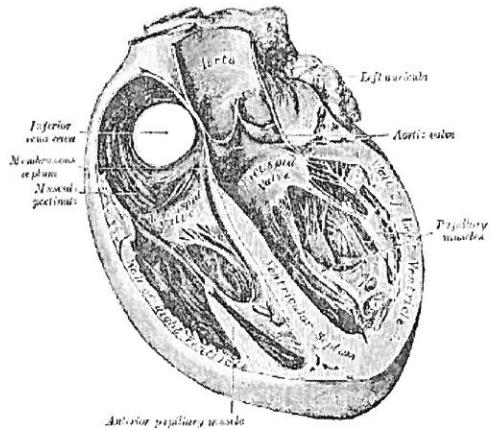
Structure of Insulin

What are the **Big Ideas** in Anatomy and Physiology 12?

- 💡 **Homeostasis** is maintained through physiological processes.
- 💡 **Gene expression**, through protein synthesis, is an interaction between genes and the environment.
- 💡 **Organ systems** have complex interrelationships to maintain homeostasis.

Hello, and welcome to Anatomy and Physiology 12. In the coming semester, we will be exploring these Big Ideas together, learning the habits of mind with “doing” science, and gaining the **Core Competencies** of:

- 💡 Have a curiosity to continually learn more about something of interest.
- 💡 Communicate scientific ideas and information, and a suggested course of action.
- 💡 Make an argument based on evidence.
- 💡 Contribute to care for self, others, community, and the world.



The human heart by Henry Gray.  
Anatomy of the Human Body. 1918.

## Classroom Expectation

- 👉 Regular attendance is mandatory. Please come to the class on time.
- 👉 If you are going to miss class, please talk to me ahead of time.  
For sudden illness or emergency, please email me at your earlier convenience.
- 👉 Assignments are due at the beginning of the class on the due date.  
Late assignments may result in penalties.
- 👉 You will be working with other students in different experiments and projects.  
You might start with the same data or observation, but you will still have to do individual work in your own words.  
Copying will result in no mark on the assignment.
- 👉 Respect your teacher and classmates by not using your cellphone in class.

## Assessment

The process of your learning will be evaluated in various ways.

### ***10% Classroom Participation***

- Self-assessment and reflections
- Providing and receiving peer feedbacks
- Homework checks

### ***45% Assignments***

- Experiments and laboratory reports
- Dissections
- Projects

### ***45% Tests and Exams***

- The midterm exam will cover contents in the first half of the course and the final exam will cover contents in the second half of the course.
- A better result in the midterm exam will also replace the overall test mark in the first half of the course. A better result in the final exam will also replace the overall test mark in the second half of the course.

Week	Unit	Big Ideas
1 – 3	1. Biological Molecules and Protein Synthesis	 <b>Gene expression</b> , through protein synthesis, is an interaction between genes and the environment.
4 – 5	2. Membrane Transport and Enzymes	 <b>Homeostasis</b> is maintained through physiological processes.
6 – 7	3. Digestive System	 <b>Homeostasis</b> is maintained through physiological processes.  <b>Organ systems</b> have complex interrelationships to maintain homeostasis.
8 – 10	4. Circulatory and Respiratory System	 <b>Homeostasis</b> is maintained through physiological processes.  <b>Organ systems</b> have complex interrelationships to maintain homeostasis.
10 – 12	5. Nervous and Urinary System	 <b>Homeostasis</b> is maintained through physiological processes.  <b>Organ systems</b> have complex interrelationships to maintain homeostasis.
13 – 14	6. Reproductive System	 <b>Homeostasis</b> is maintained through physiological processes.  <b>Organ systems</b> have complex interrelationships to maintain homeostasis.

**Anatomy and Physiology 12****Charles Huang****Unit 1: Biological Molecules and Protein Synthesis**

<b><u>Big Ideas:</u></b> <ul style="list-style-type: none"><li>Gene expression, through protein synthesis, is an interaction between genes and the environment.</li></ul>	<b><u>Core Competencies:</u></b> <p>Communication<ul style="list-style-type: none"><li>I listen and respond to others. I can consider my purpose when I am choosing a form and content. I can communicate clearly about topics I know and understand well.</li></ul></p> <p>Critical Thinking<ul style="list-style-type: none"><li>I can use what I know and observe to identify problems and ask questions.</li></ul></p> <p>Social Awareness and Responsibilities<ul style="list-style-type: none"><li>I can interact with others and my surroundings respectfully.</li></ul></p>	<b><u>Curricular Competencies:</u></b> <p>Planning and Conducting<ul style="list-style-type: none"><li>Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data</li></ul></p> <p>Processing and Analyzing Data and Information<ul style="list-style-type: none"><li>Construct, analyze, and interpret graphs, models, and/or diagrams</li></ul></p> <p>Evaluating<ul style="list-style-type: none"><li>Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled</li></ul></p> <p>Communicating<ul style="list-style-type: none"><li>Formulate physical or mental theoretical models to describe a phenomenon</li></ul></p>	<b><u>Content:</u></b> <p>Biological molecules:<ul style="list-style-type: none"><li>water, acids, bases, buffers</li><li>dehydration and synthesis reactions</li><li>organic molecules: carbohydrates, lipids, proteins, nucleic acids, ATP</li></ul></p> <p>Gene expression:<ul style="list-style-type: none"><li>protein synthesis – transcription and translation</li><li>genomics</li></ul></p> <p>Structure and function of all cells<ul style="list-style-type: none"><li>structural proteins, hormones, enzymes</li></ul></p> <p>Biotechnology:<ul style="list-style-type: none"><li>cloning, recombinant DNA, GMOs, transgenic organisms, genetic modification, gene therapy</li></ul></p>
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## Anatomy and Physiology 12

## Charles Huang

## Unit 1: Biological Molecules and Protein Synthesis

### First Peoples Principles of Learning:

- Learning involves patience and time.

### Learning Targets:

1. Describe the importance of pH to biological systems in the human body.
2. Demonstrate a knowledge of dehydration synthesis and hydrolysis as applied to organic monomers and polymers.
3. Differentiate among carbohydrates, lipids, proteins, and nucleic acids with respect to chemical structure and their functions.

4. Relate the general structure of the ATP molecule to its role as the “energy currency” of cells.

5. Describe how rough and smooth ER, vesicles, Golgi bodies and cell membrane function to compartmentalize the cell and move materials through it.

6. Describe the three steps in the semi-conservative replication of DNA.

7. Identify the roles of DNA, mRNA, tRNA and ribosomes in the processes of transcription and translation, including initiation, elongation, and termination.

8. Use examples to explain how mutations in DNA may lead to genetic disorders.

### Assessments:

#### Formative:

- Homework checks and review
- Teacher signature to provide oral feedback during data measurement for experiments and during model construction
- Group discussion and peer review prior to submission of projects

#### Summative:

- Microscope lab report
  - data collection, calculation and analysis assessment
- DNA replication model
  - includes self-assessment
- Protein synthesis model
  - includes self-reflection on improvements made between the two projects
- DNA code conversion from protein data bank
- Unit test

**Anatomy and Physiology 12****Charles Huang****Unit 2: Membrane Transport and Enzymes**

<b>Big Ideas:</b> <ul style="list-style-type: none"><li>Homeostasis is maintained through physiological processes.</li></ul>	<b>Core Competencies:</b> <p>Communication</p> <ul style="list-style-type: none"><li>I contribute during group activities, cooperate with others, and listen respectfully to their ideas. I can work with others for a specific purpose.</li></ul>
<b>Question to Support Inquiry:</b> <p>How can salmon live in both freshwater and saltwater environments during their lifecycle?</p> <p>How is lactose-free milk produced?</p> <p>How does different types of sugar affect our body through the different rate of membrane transport?</p>	<b>Critical Thinking</b> <ul style="list-style-type: none"><li>I use observation and data to draw conclusions, make judgments, and ask new questions.</li></ul> <b>Personal Awareness and Responsibilities</b> <ul style="list-style-type: none"><li>I can take action toward meeting my own wants and needs and finding joy and satisfaction, and work toward a goal or solving a problem.</li></ul>
<b>Curricular Competencies:</b> <p>Planning and Conducting</p> <ul style="list-style-type: none"><li>Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data</li></ul> <p>Processing and Analyzing Data and Information</p> <ul style="list-style-type: none"><li>Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies</li></ul> <p>Evaluating</p> <ul style="list-style-type: none"><li>Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions</li></ul>	<b>Content:</b> <p>Metabolism:</p> <ul style="list-style-type: none"><li>anabolism and catabolism</li><li>ATP production and utilization</li><li>models and regulation of enzymatic reactions (e.g., lock-and-key model)</li></ul> <p>Enzymes:</p> <ul style="list-style-type: none"><li>substrate, coenzyme, activation energy</li><li>regulation of enzyme activity (e.g., allosteric inhibition)</li></ul> <p>Transport across a cell membrane:</p> <ul style="list-style-type: none"><li>structure of the plasma membrane</li><li>selective permeability</li><li>diffusion, osmosis, facilitated transport, active transport, endocytosis, exocytosis</li></ul>

**Anatomy and Physiology 12****Charles Huang****Unit 2: Membrane Transport and Enzymes****First Peoples Principles of Learning:**

- Learning is holistic, reflexive, reflective, experimental, and relational (focused on connectedness, on reciprocal relationships, and a sense of place)
- Learning involves patience and time.

<u>Learning Targets:</u>	<u>Assessments:</u>
<ol style="list-style-type: none"><li>1. Explain why the cell membrane is described as “selectively permeable”.</li><li>2. Describe passive transport processes including diffusion, osmosis, and facilitated transport.</li><li>3. Describe active transport processes including active transport, endocytosis (phagocytosis and pinocytosis), and exocytosis.</li><li>4. Explain models of enzymatic action (e.g., induced fit).</li><li>5. Differentiate between the roles of enzymes and coenzymes in biochemical reactions.</li><li>6. Identify the role of vitamins as coenzymes.</li><li>7. Apply knowledge of proteins to explain the effects on enzyme activity of pH, temperature, substrate concentration, enzyme concentration, competitive inhibitors, and non-competitive inhibitors including heavy metals.</li></ol>	<p>Formative:</p> <ul style="list-style-type: none"><li>• Homework checks and review</li><li>• Teacher signature to provide oral feedback during data measurement for the experiment</li><li>• Group discussion following video of related topics</li></ul> <p>Summative:</p> <ul style="list-style-type: none"><li>• Unit Test</li><li>• Transport lab report<ul style="list-style-type: none"><li>- data collection, calculation and analysis assessment</li></ul></li></ul>

## Anatomy and Physiology 12

## Unit 3: Digestive System

Charles Huang

<p><b><u>Big Ideas:</u></b></p> <ul style="list-style-type: none"><li>Homeostasis is maintained through physiological processes.</li><li>Organ systems have complex interrelationships to maintain homeostasis.</li></ul>	<p><b><u>Core Competencies:</u></b></p> <p>Communication</p> <ul style="list-style-type: none"><li>I can communicate clearly about topics I know and understand well, using forms and strategies I have practiced. I gather the basic information I need and present it.</li></ul>
<p><b><u>Question to Support Inquiry:</u></b></p> <p>Why do some people have sensitivity to certain foods (e.g., lactose, gluten)?</p> <p>Why does difference types of cells look different under the microscope?</p> <p>Explain why a diet of foods with a high glycemic index causes insulin resistance and Type II diabetes</p>	<p>Creative Thinking</p> <ul style="list-style-type: none"><li>I can use my imagination to get new ideas of my own, or build on other's ideas, or combine other people's ideas in new ways.</li></ul> <p>Critical Thinking</p> <ul style="list-style-type: none"><li>I can assess my own efforts and experiences and identify new goals. I give, receive, and act on constructive feedback.</li></ul>
<p><b><u>Curricular Competencies:</u></b></p> <p>Questioning and Predicting</p> <ul style="list-style-type: none"><li>Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world</li></ul> <p>Processing and Analyzing Data and Information</p> <ul style="list-style-type: none"><li>Analyze cause-and-effect relationships</li></ul> <p>Evaluating</p> <ul style="list-style-type: none"><li>Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources</li></ul>	<p><b><u>Content:</u></b></p> <p>Organization:</p> <ul style="list-style-type: none"><li>molecules, organelles, cells, tissues, organs, organ systems</li></ul> <p>Organ systems:</p> <ul style="list-style-type: none"><li>endocrine, digestive</li></ul> <p>Feedback loops:</p> <ul style="list-style-type: none"><li>negative: normal glucose levels in blood</li></ul> <p>Lifestyle differences:</p> <ul style="list-style-type: none"><li>dietary plans, exercise, alcohol consumption</li></ul> <p>Disease:</p> <ul style="list-style-type: none"><li>may occur when body systems fail to maintain homeostasis</li></ul>

## Anatomy and Physiology 12

## Charles Huang

## Unit 3: Digestive System

### First Peoples Principles of Learning:

- Learning is holistic, reflexive, reflective, experimental, and relational (focused on connectedness, on reciprocal relationships, and a sense of place)
- Learning involves patience and time.

### Learning Targets:

1. Identify the pancreas as the source gland for insulin, and describe the function of insulin in maintaining blood sugar levels.
2. List at least six major functions of the liver.
3. Explain the role of bile in the emulsification of fats.
4. Describe how the small intestine is specialized for chemical and physical digestion and absorption
5. Describe the structure of the villus, including microvilli, and explain the functions of the capillaries and lacteals within it.
6. Describe the functions of anaerobic bacteria in the colon.

### Learning Targets:

- Assessments:
- Formative:
- Homework checks and review
  - Discussion during fetal pig dissection on the digestive system
- Summative:
- Unit test
  - Diagram of enzymes and process of digestion throughout the digestive tract

## Anatomy and Physiology 12

## Charles Huang

## Unit 4. Circulatory and Respiratory System

### Big Ideas:

- Homeostasis is maintained through physiological processes.
- Organ systems have complex interrelationships to maintain homeostasis.

### Core Competencies:

#### Communication

- I can identify and apply roles and strategies to facilitate groupwork. I am an active listener and speaker

#### Critical Thinking

- I consider more than one way to proceed and make choices based on my reasoning and what I am trying to do.

How does the body respond to infection by a pathogen such as Zika virus, avian flu or HIV?

Are high blood pressure changes during exercise the same as hypertension?

### Question to Support Inquiry:

### Curricular Competencies:

#### Questioning and Predicting

- Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world

#### Planning and conducting

- Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods

#### Processing and Analyzing Data and Information

- Experience and interpret the local environment

#### Evaluating

- Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled

### Core Competencies:

#### Critical Thinking

- I consider more than one way to proceed and make choices based on my reasoning and what I am trying to do.

#### Positive Personal & Cultural Identity

- I can identify my individual characteristics and explain what interests me.

#### Organ systems:

- cardiovascular, lymphatic/immune, respiratory

#### Feedback loops:

- negative: normal CO<sub>2</sub> levels in blood
- positive: acidosis, blood clotting

#### Lifestyle differences:

- smoking, salt intake, vaccinations

#### Disease:

- may occur when body systems fail to maintain homeostasis

Anatomy and Physiology 12	Charles Huang	Unit 4. Circulatory and Respiratory System
First Peoples Principles of Learning:		
<ul style="list-style-type: none"> <li>• Learning involves patience and time.</li> <li>• Learning involves recognizing the consequences of one's actions.</li> </ul>		
Learning Targets:	Assessments:	
<ol style="list-style-type: none"> <li>1. Recognize heart structures.</li> <li>2. Differentiate between systolic and diastolic pressures.</li> <li>3. Describe hypertension and hypotension and their causes.</li> <li>4. Demonstrate the measurement of blood pressure.</li> <li>5. Describe and differentiate among the five types of blood vessels.</li> <li>6. Demonstrate a knowledge of the path of a blood cell from the aorta through the body and back to the left ventricle.</li> <li>7. Explain the roles of antigens and antibodies.</li> <li>8. Describe the functions of the lymphatic system.</li> <li>9. Compare the processes of inhalation and exhalation.</li> <li>10. Describe the exchange of carbon dioxide and oxygen during internal and external respiration.</li> </ol>	<p><u>Formative:</u></p> <ul style="list-style-type: none"> <li>• Homework checks and review</li> <li>• Teacher signature to provide oral feedback during data measurement for both experiments</li> <li>• Inquiry video on the lack of lymphatic vessels in the brain</li> <li>• Blood pressure measurement with a double stethoscope</li> <li>• Discussion during fetal pig dissection</li> </ul> <p><u>Summative:</u></p> <ul style="list-style-type: none"> <li>• Blood typing experiment <ul style="list-style-type: none"> <li>- data collection and analysis assessment</li> </ul> </li> <li>• Unit test</li> <li>• Lung capacity experiment <ul style="list-style-type: none"> <li>- experimental design, data collection and analysis assessment</li> </ul> </li> </ul>	

**Anatomy and Physiology 12****Unit 5: Nervous and Urinary System****Charles Huang**

<b>Big Ideas:</b> <ul style="list-style-type: none"><li>Homeostasis is maintained through physiological processes.</li><li>Organ systems have complex interrelationships to maintain homeostasis.</li></ul>	<b>Core Competencies:</b> <p>Communication</p> <ul style="list-style-type: none"><li>I recognize how my contributions and those of others complement each other. I can plan with others and adjust our plan according to the group's purpose.</li></ul>
<b>Question to Support Inquiry:</b> <p>How does introducing novel activities such as games, physical activities, languages, and music promote healthy brain function?</p> <p>What is the impact of placebos on the effectiveness of a health product or service?</p> <p>How does caffeine affect the brain?</p>	Critical Thinking <ul style="list-style-type: none"><li>I consider alternative approaches and make strategic choices. I take risks and recognize that I may not be immediately successful.</li></ul> Creative Thinking <ul style="list-style-type: none"><li>I generate new ideas as I pursue my interests. I deliberately learn a lot about something by doing research, talking to others, or practicing, so that I can generate new ideas.</li></ul>
<b>Curricular Competencies:</b> <p>Questioning and Predicting</p> <ul style="list-style-type: none"><li>Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest</li></ul> <p>Evaluating</p> <ul style="list-style-type: none"><li>Connect scientific explorations to careers in science</li></ul>	<b>Content:</b> <p>Organ systems:</p> <ul style="list-style-type: none"><li>nervous, endocrine, urinary</li></ul> <p>Feedback loops:</p> <ul style="list-style-type: none"><li>negative: maintaining normal body temperature</li><li>positive: temperature regulation (heat stroke, hypothermia)</li></ul> <p>Lifestyle differences:</p> <ul style="list-style-type: none"><li>exercise, sleep, alcohol consumption, drugs</li></ul> <p>Disease:</p> <ul style="list-style-type: none"><li>may occur when body systems fail to maintain homeostasis</li></ul>
<b>Applying and Innovating</b>	

**Anatomy and Physiology 12****Charles Huang****Unit 5: Nervous and Urinary System****First Peoples Principles of Learning:**

- Learning involves patience and time.
- Learning involves recognizing the consequences of one's actions.

<b>Learning Targets:</b>	<b>Assessments:</b>
<ol style="list-style-type: none"><li>1. Differentiate among sensory, motor, and interneurons with respect to structure and function.</li><li>2. Explain the process by which impulses travel across a synapse.</li><li>3. Describe how neurotransmitters are broken down in the synaptic cleft.</li><li>4. Compare the locations and functions of the central and peripheral nervous systems.</li><li>5. Differentiate between the functions of the autonomic and somatic nervous systems.</li><li>6. Describe how the kidneys maintain blood pH.</li><li>7. Compare urea and glucose content of blood in the renal artery with that of the renal vein.</li><li>8. Describe how the hypothalamus, posterior pituitary, ADH, and the nephron achieve homeostasis of water levels in the blood.</li></ol>	<p>Formative: • Homework checks and review</p> <p>Teacher signature to provide oral feedback during data measurement for both dissections</p> <p>Inquiry video on neurogenesis and nerve impulses</p> <p>Sheep kidney dissection</p> <p>Discussion during fetal pig dissection</p> <p>Summative: • Unit test</p> <p>• Diagram and path of a red blood cell</p> <p>• Heart dissection - identifying structures of the heart</p>

## Anatomy and Physiology 12

## Charles Huang

## Unit 6: Reproductive System

<p><b><u>Big Ideas:</u></b></p> <ul style="list-style-type: none"><li>• Homeostasis is maintained through physiological processes.</li><li>• Organ systems have complex interrelationships to maintain homeostasis.</li></ul>	<p><b><u>Core Competencies:</u></b></p> <p>Creative Thinking</p> <ul style="list-style-type: none"><li>• I can get new ideas or reinterpret others' ideas in novel ways.</li></ul> <p>Critical Thinking</p> <ul style="list-style-type: none"><li>• I can ask questions and offer judgments, conclusions, and interpretations supported by evidence I or others have gathered.</li></ul>
<p><b><u>Question to Support Inquiry:</u></b></p> <p>How effective are the different contraception and fertility methods?</p> <p>How is pregnancy tested?</p>	<p><b><u>Content:</u></b></p> <p>Organ systems:</p> <ul style="list-style-type: none"><li>• endocrine, reproductive</li></ul> <p>Feedback loops:</p> <ul style="list-style-type: none"><li>• positive: oxytocin in childbirth</li></ul> <p>Lifestyle differences:</p> <ul style="list-style-type: none"><li>• drugs, vaccinations, contraception, fertility drugs</li></ul> <p>Disease:</p> <ul style="list-style-type: none"><li>• may occur when body systems fail to maintain homeostasis</li></ul>
<p><b><u>Curricular Competencies:</u></b></p> <p>Processing and analyzing data and information</p> <ul style="list-style-type: none"><li>• Use knowledge of scientific concepts to draw conclusions that are consistent with evidence</li></ul> <p>Communicating</p> <ul style="list-style-type: none"><li>• Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations</li></ul>	

First Peoples Principles of Learning	Anatomy and Physiology 12	Charles Huang	Unit 6: Reproductive System
<ul style="list-style-type: none"> <li>• Learning involves patience and time.</li> </ul>	<p><b>Learning Targets:</b></p> <ol style="list-style-type: none"> <li>1. Describe the path of sperm from the seminiferous tubules to the urethral opening.</li> <li>2. List the components seminal fluid (as contributed by the Cowper's glands, prostate gland, and seminal vesicles), and describe the functions of each component.</li> <li>3. Identify the tail (flagellum), midpiece, head, and acrosome of a mature sperm and state their functions.</li> <li>4. Describe the homeostatic regulation of testosterone levels by the hypothalamus, anterior pituitary, and testes</li> <li>5. Describe the sequence of events in the ovarian cycle, with reference the follicular phase, ovulation, and the luteal phase.</li> <li>6. Describe the sequence of events in the uterine cycle, with reference to menstruation, the proliferative phase, and the secretory phase.</li> <li>7. Describe the control of the ovarian and uterine cycles by hormones including gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estrogen, and progesterone.</li> </ol>	<p><b>Assessments:</b></p> <p>Formative:</p> <ul style="list-style-type: none"> <li>• Homework checks and review</li> </ul> <p>Summative:</p> <ul style="list-style-type: none"> <li>• Discussion during fetal pig dissection on the digestive system</li> <li>• Unit Test</li> <li>• Presentation of the different contraception and fertility methods</li> </ul>	