COURSE SYLLABUS

Course: SYSTEMS PHYSIOLOGY II
Code: SCPS 681 **Credit:** 3 (3-0-6)
Prerequisite: –
Academic year: 2024 **Semester:** 1st

Course Organizer: Tai Chaiamarit, Ph.D., D.Phil.
Room: B. 522/1, Department of Physiology, Faculty of Science, Mahidol University
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Course Description

Mechanisms underlying the functions of the respiratory, renal, digestive, endocrine, and reproductive systems as well as the coordination of these systems to others in maintaining the homeostasis of body internal environment in response to disturbances from the external environment

Objectives:

After completion of this course, students should be able to:

1. Explain the fundamental concepts of respiratory, renal, gastrointestinal, endocrine and reproductive physiology
2. Explain the interactions among the various organs of respiratory, renal, gastrointestinal, endocrine and reproductive systems in response to stimuli or disturbances
3. Discuss the coordination of these systems and others in maintenance of the body homeostasis

Course Organization:

The course is composed of four units covering the systems of respiration (L1-5, 2 Discussions), gastrointestinal (L6-11, 2 Discussions), urinary (L12-18, 1 Discussion), and endocrine & reproductive (L19-25, 1 Discussion) with the total hours of lecture/activity of each system as follows:

		Lecture Hrs	Activity Hrs
Unit I	Respiratory System (L1-5, D1-2)	8	3.5
Unit II	Gastrointestinal System (L6-11, D3-4)	7	3.5
Unit III	Urinary System (L12-18, D5)	9	2
Unit IV	Endocrine and Reproductive Systems (L19-25, D6)	10	3
	TOTAL	34 (~74)	12 (~26)

The lesson plan of each lecture/small group discussion gathering the background & synopsis, learning objectives, lecture outline, learning organization, learning materials, suggested readings and student assessment are included in the syllabus. For the discussion class, the responsible instructor

will evaluate the student performance based on an appropriate rubric form attached herein as well as a post-quiz session.

Teaching & Learning Methods

1. On-site lecture with online WebEx or Zoom
2. Small group discussion
3. Self-study
4. Video record
5. Examination, participation & quiz

Teaching media

1. Textbooks: various physiology textbooks and reading materials essential for each study unit are individually suggested by the responsible instructor of each topic.
2. Digital media (CDs) are available in the library of the Department of Physiology.

Classroom

Room Pr. 401

Course Assessment

There are four written examinations taken after the completion of each unit as scheduled. The examination mainly covers the contents from lectures and assigned materials with the weight score of 10 points for each lecture hour. The weight score for each activity hour is also 10 points with 50% contribution from participation/discussion and another 50% from post-quiz right after the end of each class as summarized:

	EXAMINATION			ACTIVITY (points)	
	Date	Duration (hrs)	Score (points)	Participation	Quiz
UNIT I (Resp)	Friday Oct 4, 24	3	80	17.5	17.5
UNIT II (GI)	Friday Oct 25, 24	2.5	70	17.5	17.5
UNIT III (Urinary)	Friday Nov 8, 24	3	90	10	10
UNIT IV (Repro+Endo)	Friday Nov 22, 24	3.5	100	15	15
			340 ~ 74%	120 ~ 26%	

The score range for grading will be:

Grade	Score
A	≥ 80
B+	≥ 70
B	≥ 60

The minimum passing grade for the course completion is "B" for the graduate student from both the MS and PhD Programs in Physiology.

Grade	Score
C+	≥ 55
C	≥ 50
F	< 50

Tentative Date for Re-examination: December 2, 2024

List of Instructors

Instructors	E-mail	Room	Tel.
Prof. Jittima Weerachayaphorn, PhD (JW2)	jittima.wee@mahidol.ac.th	Pr.424	0-2201-5620
Assoc. Prof. Arthit Chairoungdua, PhD (AC)	arthit.chi@mahidol.ac.th	Pr.414	0-2201-5615
Assoc. Prof. Sunhapas Soodvilai, PhD (SS)	sunhapas.soo@mahidol.ac.th	Pr.418	0-2201-5617
Asst. Prof. Kanit Bhukhai, PhD (KB)	kanit.bhu@mahidol.ac.th	Pr.412	0-2201-5614
Asst. Prof. Nattapon Panupinthu, MD, PhD (NP)	nattapon.pan@mahidol.ac.th	Pr.420	0-2201-5620
Asst. Prof. Nittaya Boonmuen, PhD (NB)	nittaya.bom@mahidol.ac.th	B.518	0-2201-5513
Lecturer Panan Suntornsaratoon, PhD (PS)	panan.sun@mahidol.ac.th	B. 504	0-2201-5503
Lecturer Ratchaneevan Aeimlapa, PhD (RA)	ratchaneevan.aei@mahidol.ac.th	B. 522/2	0–2201–5500
Lecturer Suwimol Tangtrongsup, PhD (ST)	suwimol.tan@mahidol.ac.th	B.520	0-2201-5514
Lecturer Tai Chaiamarit, PhD, DPhil (TC)	tai.chm@mahidol.ac.th	B. 522/1	0-2201-5515

Course Attainment Evaluation

Program Learning Outcomes (PLOs) for MS in Physiology

1. Demonstrate moral and professional ethics
2. Evaluate physiological concepts for knowledge transfer/innovation and problem solving
3. Apply knowledge and research skills in physiology or related fields to produce publications/innovation
4. Demonstrate responsibility, leadership, and ability to work with others
5. Transfer/disseminate knowledge by using various means of communications

Program Learning Outcomes (PLOs) for PhD in Physiology

1. Demonstrate moral and professional ethics
2. Integrate knowledge in physiology and related fields for knowledge transfer/innovation and problem solving
3. Create research in physiology and related fields to produce international publications, patents or innovations
4. Demonstrate responsibility, leadership, and the ability to work with the others
5. Deliver specific and generalizable knowledge effectively by using various means of communication

Course Learning Outcomes (CLOs) for SCPS 681

1. Explain the fundamental concepts of respiratory, renal, gastrointestinal, endocrine and reproductive physiology
2. Explain the interactions among the various organs of respiratory, renal, gastrointestinal, endocrine and reproductive systems in response to stimuli or disturbances
3. Discuss the coordination of these systems and others in maintenance of the body homeostasis

Measurement of ELO Achievement for SCPS 681 by Students

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5
CLO 1					
CLO 2					
CLO 3					
Attainment Score					

SCPS 681: Systems Physiology II - 3(3-0-6)
Academic Year 2024
Department of Physiology, Faculty of Science, Mahidol University

Date	Act. #	Time	Topics	h	Instructor
Fri Sep 20, 24		09:00-09.30	Course orientation	0.5	TC
Unit I: Respiratory System **Total 11.5 h: Lecture = 8, Discussion = 3.5**					
Fri Sep 20, 24	L1	10.00-12.00	L: Overview of respiratory system & Mechanics of breathing	2.0	NP
Mon Sep 23, 24	L2	09.00-10.30	L: Lung ventilation	1.5	NP
	L3	10.30-12.00	L: Pulmonary circulation and ventilation-perfusion relationship	1.5	NP
Tues Sep 24, 24	L4	9.00-10.30	L: Pulmonary gas exchange and blood gas transport	1.5	NP
	L5	10.30-12.00	L: Control of breathing	1.5	NP
Fri Sep 27, 24	**D1**	09.00-10.30	Discussion: Lung function test	1.5	NP
Mon Sep 30, 24	**D2**	09.00-11.00	Discussion: Pathophysiology of respiratory diseases	2	NP
Fri Oct 4, 24		***09.00-12.00***	***EXAM Unit I (80 points)***	***3***	***JW & TC***
Unit II: Gastrointestinal System **Total 10.5 h: Lecture = 7, Discussion = 3.5**					
Tues Oct 15, 24	L6	09.00-10.00	L: Organization of GI system	1	JW2
	L7	10.00-11.00	L: Gastric function	1	RA
	L8	11.00-12.00	L: Gastrointestinal motility	1	RA
Thurs Oct 17, 24	L9	09.00-10.00	L: Nutrient digestion and absorption	1	PS
	L10	10.30-11.30	L: Electrolyte, water and vitamin absorption	1	PS
Fri Oct 18, 24	L11	09.00-11.00	L: Hepatobiliary function	2	JW2
Mon Oct 21, 24	**D3**	09.00-11.00	Discussion: Gastrointestinal function in health and disease	2	NP
Tues Oct 22, 24	**D4**	09.00-10.30	Discussion: Hepatopancreatobiliary	1.5	JW2
Fri Oct 25, 24		***09.00-11.30***	***EXAM Unit II (70 points)***	***2.5***	***JW & TC***
System Unit III: Urinary System **Total 11 h: Lecture = 9, Discussion = 2**					
Mon Oct 28, 24	L12	09.00-10.00	L: Nephron & how it works	1	KB
	L13	10.30-11.30	L: Renal hemodynamics	1	KB
Tues Oct 29, 24	L14	09.00-10.00	L: Renal tubular transport	1	KB
	L15	10.30-11.30	L: Concentration and dilution of urine	1	SS
Thurs Oct 31, 24	L16	09.00-11.00	L: Control of body fluid and osmolarity	2	SS
Fri Nov 1, 24	L17	09.00-10.00	L: Potassium, calcium, and phosphate homeostasis	1	SS
	L18	10.00-12.00	L: Renal regulation of acid-base balance	2	SS

Date	Act. #	Time	Topics	h	Instructor
Mon Nov 4, 24	**D5**	09.00-11.00	Discussion: Kidney function in health and disease & Renal function test	2	SS
Fri Nov 8, 24		*09.00-12.00*	*EXAM Unit III (90 points)*	*3*	*JW & TC*
Unit IV: Endocrine and Reproductive System **Total 13 h: Lecture = 10, Discussion = 3**					
Mon Nov 11, 24	L19	09.00-10.30	L: Principle of endocrinology & Hypothalamus-pituitary axis hormones	1.5	ST
	L20	10.30-12.00	L: Thyroid hormones & Hormone regulation of calcium and phosphate metabolism	1.5	ST
Tues Nov 12, 24	L21	09.00-10.30	L: Adrenal hormones	1.5	AC
	L22	10.30-12.00	L: Hormone regulation of fuel metabolism	1.5	AC
Thurs Nov 14, 24	L23	09.00-11.00	L: Female reproductive system	2	NB
Fri Nov 15, 24	L24	09.00-10.00	L: Male reproductive system	1	NB
	L25	10.30-11.30	L: Temperature regulation	1	TC
Mon Nov 18, 24	**D6**	09.00-12.00	Discussion: Diseases of hormonal control of fuel metabolism	3	AC
Fri Nov 22, 24		*09.00-12.30*	*EXAM Unit IV (100 points)*	*3.5*	*JW & TC*
Tentative Date for Re-examination: December 2, 2024					

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Assessment Rubric
SCPS 680 & 681: Systems Physiology I & II
Academic Year 2024

Student Name .....

Instructor: ..... **Date** ..... **Time** .....

Evaluation Rubric for Class Participation						
Criteria of Performance Assessment	**Inadequate (0 point)**	**Developing (below expectations) (1 point)**	**Accomplished (meets expectations) (2 point)**	**Exemplary (shows leaderships) (3 point)**	**SCORE**	**FINAL POINT**
Preparation (20%)	- Lack of preparation in advance	- Insufficient preparation for the assigned materials before class	- Sufficient preparation for the assigned materials before class	- Well preparation for class - Having questions or comments on materials beyond the assignment		
Active Participation (60%)	- No class contribution & discussion - No response to direct questions	- Less class contributions & discussion - Seldom volunteers in response to direct questions	- Proactive class contributions & discussion - Asking questions & response to direct questions	- Proactive with regular class contribution & discussion - Initiate discussion on topic related issues		
Listening Skills (20%)	- No listening attention to others - Non-responsive comment to discussion	- Less listening attention - Less comments to discussion	- Appropriate listener - Appropriate response to others	- Good listener without inappropriate interruption - Incorporate & expand response to others		
TOTAL SCORE OF CLASS PARTICIPATION & DISCUSSION						

ACTIVITIES	ASSIGNED SCORE	EARNED SCORE (point)
PERFORMANCE	50% = pt	..... /3 x ..... (assigned score) =
QUIZ	50% = pt	
TOTAL		

INSTRUCTOR SIGNATURE.....

DATE SUBMISSION .....

SCPS 681: Systems Physiology II

Exam I: Respiratory System

Date: Friday Oct 4, 2024

Time: 09:00 – 12:00

Instructors/ Activities	Lectures (hrs)	Exam Score (points)	Exam Time (mins)	Due Date for Exam Question Submission
NP	**8**	**80**	**180**	**Friday Sep 27, 2024**
NP / SGD I	2	20	In class Dis/Quiz = 50% / 50%	
NP / SGD II	1.5	15		

Exam II: GI System

Date: Friday Oct 25, 2024

Time: 09:00 – 11:30

Instructors/ Activities	Lectures (hrs)	Exam Score (points)	Exam Time (mins)	Due Date for Exam Question Submission
RA	2	20	45	Friday Oct 18, 2024
PS	2	20	45	
JW2	3	30	60	
Total	**7**	**70**	**150**	
NP / SGD I	2	20	In class Dis/Quiz = 50% / 50%	
JW2 / SGD	1.5	15		

Exam III: Urinary System

Date: Friday Nov 8, 2024

Time: 09:00 – 12:00

Instructors/ Activities	Lectures (hrs)	Exam Score (points)	Exam Time (mins)	Due Date for Exam Question Submission
SS	6	60	120	Friday Nov 1, 2024
KB	3	30	60	
Total	**9**	**90**	**180**	
SS / SGD	2	20	In class Dis/Quiz = 50% / 50%	

Exam IV: Endocrine & Reproductive Systems

Date: Friday Nov 22, 2024

Time: 09:00 – 12:30

Instructors/ Activities	Lectures (hrs)	Exam Score (points)	Exam Time (mins)	Due Date for Exam Question Submission
ST	3	30	63	Friday Nov 15, 2024
AC	3	30	63	
NB	3	30	63	
TC	1	10	21	
Total	**10**	**100**	**210**	
AC / SGD	3	30	In class Dis/Quiz = 50% / 50%	

Exam : Activities = 340 : 120 → ~ 74 : 26

SCPS 681: Systems Physiology II
Lesson Plan 2024

Topic **Lecture 1: Overview of respiratory system & Mechanics of breathing**
Date Wednesday Sep 20, 2024 **Time** 10.00 – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The respiratory system is essential for delivering oxygen from the ambient air to the circulation and removing carbon dioxide from the blood back to the ambient air. Exchange of these two gases facilitates the energy metabolism in every cells. Airways and the respiratory muscles are working synchronously and continuously to generate airflow in and out of the lungs. The mechanism of airflow along the various size of airways will be discussed.

Objectives

Students should be able to:

1. Give an overview of the functions of respiratory system
2. Explain the organization of the conductive airways and respiratory unit
3. Describe the changes in airway and pleural pressure associated with airflow
4. Describe the importance of compliance and elasticity on lung mechanics

Lecture Outline

1. Structure and function of respiratory system
2. Conductive airways and respiratory unit
3. Static properties of the lungs
4. Dynamic properties of the lungs

Learning Organization

1. Read learning materials before the lecture
2. 100-min lecture presentation
3. 20-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 26: Organization of the Respiratory System, Elsevier Saunders.
2. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 27: Mechanics of Ventilation, Elsevier Saunders.
3. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 20: Introduction to the Respiratory System, Mosby Elsevier.
4. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 21: Static Lung and Chest Wall Mechanics, Mosby Elsevier.

5. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 22: Dynamic Lung and Chest Wall Mechanics, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 20 points

Topic **Lecture 2: Lung ventilation**
Date Monday Sep 23, 2024 **Time** 09.00 – 10.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Ventilation is the process that air moves in and out of the lungs. Inhalation causes the air to fill conductive airways and respiratory unit. Amounts of air that enter alveoli then paticipate in gas exchange. Understanding of pulmonary ventilation is important for clinical application related to airway diseases, i.e., asthma and chronic obstructive pulmonary disease (COPD).

Objectives

Students should be able to:

1. Describe the significance of anatomical and physiological dead spaces
2. Explain the equations that are used to calculate minute and alveolar ventilations
3. Describe factors that can affect partial pressure of oxygen in alveolar gas equation
4. Describe changes in the ventilations upon the alteration of airway resistance

Lecture Outline

1. Definition of pulmonary ventilation
2. Anatomical and physiological dead spaces
3. Minute and alveolar ventilations
4. Alveolar gas equation
5. Airway resistance and pulmonary ventilation

Learning Organization

1. Read learning materials before the lecture
2. 75-min lecture presentation
3. 15-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 31: Ventilation and Perfusion of the Lungs, Elsevier Saunders.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 23: Ventilation, Perfusion and Ventilation/Perfusion Relationships, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Lecture 3: Pulmonary circulation and ventilation-perfusion relationship**
Date Monday Sep 23, 2024 **Time** 10.30 – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Optimal ratio of ventilation and perfusion at pulmonary capillary beds helps gas exchange between alveolar air and blood that flows through the lungs. There is an unique mechanism that helps maitaining this balance. The matching of ventilation and perfusion at rest and during special situations allows us to adjust properly the arterial blood gases and acid-base balance.

Objectives

Students should be able to:

1. Explain organization and basic properties of pulmonary circulation
2. Describe factors that regulate pulmonary blood flow and pulmonary hemodynamics
3. Explain the impotance of ventilation and perfusion matching
4. Describe the consequences of ventilation and perfusion imbalance

Lecture Outline

1. Pulmonary circulation
2. Pulmonary blood flow and hemodynamics
3. Regulation of ventilation and perfusion matching
4. Disruption of ventilation and perfusion matching and development of shunt

Learning Organization

1. Read learning materials before the lecture
2. 75-min lecture presentation
3. 15-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 31: Ventilation and Perfusion of the Lungs, Elsevier Saunders.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 23: Ventilation, Perfusion and Ventilation/Perfusion Relationships, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Lecture 4: Pulmonary gas exchange and blood gas transport**
Date Tuesday Sep 24, 2024 **Time** 09.00 – 10.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Oxygen transport is essential for tisssue fuctions. Pulmonary and circulatory systems work in concert to ensure that adequate oxygen contents are distributed according to tissue requirement. In return, carbon dioxide is produced as a byproduct of cellular metabolism. Kinetics of oxygen and carbon dioxide transport are the primary focuses on this lecture.

Objectives

Students should be able to:

1. Explain the properties of gas transport across membranes
2. Discuss benefits and limitations of diffusion and perfusion-limited gas transport
3. Describe factors that affect oxygen carrying capacity of hemoglobin
4. Describe the transport of carbon dioxide in the blood

Lecture Outline

1. Gas diffusion
2. Diffusion and perfusion-limited gas transport
3. Oxygen carrying capacity of hemoglobin and plasma
4. Carbon dioxide transport in the blood

Learning Organization

1. Read learning materials before the lecture
2. 75-min lecture presentation
3. 15-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 30: Gas Exchange in the Lungs, Elsevier Saunders.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 24: Oxygen and Carbon Dioxide Transport, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Lecture 5: Control of breathing**
Date Tuesday Sep 24, 2024 **Time** 10.30 – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Breathing action is mostly effortless and unnoticed. Under normal circumstance, the depth and rhythm of breathing is quietly adjusted by the circuit of neuronal activities. However, efforts are needed when there are changes in body metabolism as well as pulmonary diseases. Shortness of breath is a potent warning sign of tissue hypoxia. It must be effectively corrected via compensatory mechanisms to re-establish homeostasis.

Objectives

Students should be able to:

1. Describe the organization of autonomic respiratory centers in the brainstem
2. Describe neural and chemical controls of ventilation
3. Discuss the importance of central and peripheral chemoreceptors
4. Discuss the patterns of normal and abnormal respiration

Lecture Outline

1. Respiratory centers
2. Control of ventilation
3. Central and peripheral chemoreceptors
4. Normal and abnormal respiratory patterns

Learning Organization

1. Read learning materials before the lecture
2. 75-min lecture presentation
3. 15-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 32: Control of Ventilation, Elsevier Saunders.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 25: Control of Respiration, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Discussion 1: Lung function test**
Date Friday September 27, 2024 **Time** 09.00 – 10.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & synopsis

Assessment of lung function mostly relies on the volume measurement at different phases of respiration. Determination of lung volumes can predict the conditions of airways and parenchyma. The static lung volumes that obtain in patients help clinician to assess the disease progression and therapeutic outcome.

Objectives

Students should be able to:

1. Define volumes and capacities in lung function test
2. Describe factors that affect lung volumes and capacities
3. Disscuss changes in lung volume and capacities in the diseases of airway and parenchyma

Lecture Outline

1. Static lung function test
2. Dynamic lung function test
3. Lung function test in patient with asthma
4. Lung function test in patient with COPD

Learning Organization

1. Each student receives a topic related to respiratory physiology before class
2. Students give a concise presentation on the assigned topics during class
3. Students in the class discuss about the topics and related issues

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout for basic concepts of respiratory pathophysiology

Suggested Readings

1. Boron and Boulpaep **(**2017**)** Medical Physiology, 3rd Edition**.**
2. Koeppen and Stanton **(**2018**)** Berne & Levy Physiology**.** 7th Edition**.**

Student Assessment

1. Student performance 50% (7.5 points)
   - Basic and applied knowledge in the contents of presentation
   - Student participation
2. Post-Quiz 50% (7.5 points)

Topic **Discussion 2: Pathophysiology of respiratory diseases**
Date Monday September 30, 2024 **Time** 09.00 – 11.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & synopsis

Respiratory diseases arise from several etiologies, which essentially cause impairment of tissue oxygenation and accumulation of CO_2. These result in cell death, tissue dysfunction and death if untreated. Tissue hypoxia caused by respiratory diseases starting with inadequate O_2 intake, in which fresh air is unable to reach alveoli. Respiratory muscles and competent airways must work together to ensure adequate air entry. Once reaching the alveoli, the functional unit of gas exchange must have optimal surface area, thickness and O_2 gradient to allow proper O_2 diffusion. Lastly, amount of blood supply to the alveoli should match with O_2 availability. It is important to recognize these steps in respiration during normal and in diseases to understand the consequences and give proper management in patients.

Objectives

Students should be able to:

1. Define common terms used in respiratory pathophysiology, i.e., hypoxia, hypoxemia, hypercapnia, hyperoxia, SaO_2, FiO_2, FEV_1/FVC, PEEP, diffusion defect, V/Q mismatch, shunt
2. Apply basic knowledge of respiratory physiology to explain the underlying mechanisms of common respiratory disorders, i.e., asthma, COPD, restrictive lung diseases
3. Discuss possible outcomes in patients with respiratory disorders

Lecture Outline

1. Definition and development of hypoxia, hypoxemia and hypercapnia, hyperoxia
2. Breathing in high altitude
3. Respiratory disorders with diffusion defect
4. Respiratory disorders with V/Q mismatch
5. Respiratory disorders with shunt

Learning Organization

1. Each student receives a topic related to respiratory physiology before class
2. Students give a concise presentation on the assigned topics during class
3. Students in the class discuss about the topics and related issues

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout for basic concepts of respiratory pathophysiology

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition.

Student assessment

1. Student performance 50% (10 points)
    - Basic and applied knowledge in the contents of presentation
    - Student participation
2. Post-Quiz 50% (10 points)

Topic **Lecture 6: Organization of GI system**
Date Tuesday Oct 15, 2024 **Time** 09.00 – 10.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Jittima Weerachayaphorn, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: jittima.wee@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The gastrointestinal (GI) system, also known as the digestive system, is a complex network of organs that is essential for processing food, absorbing nutrients, and eliminating waste. It plays a crucial role in maintaining overall health and supporting the body's metabolic functions. The GI system is divided into the upper and lower GI tracts, each comprising specific organs with distinct function that work together to ensure the efficient breakdown and utilization of nutrients. Understanding the organization and function of the gastrointestinal system is fundamental for comprehending how our body efficiently transforms food into energy and essential nutrients, and for identifying and treating digestive disorders.

Objectives

Students should be able to:

1. Identify the anatomical structure of the gastrointestinal system
2. Explain the regulatory mechanism of the gastrointestinal system
3. Describe the specific functions of each segments of the gastrointestinal tract
4. Explain mechanical and chemical processes in the gastrointestinal tract
5. Integrate knowledge of the gastrointestinal system's structure and function to understand how disruptions can leads to disease

Lecture Outline

1. Structure and function of gastrointestinal system
2. Regulatory mechanism of the gastrointestinal system
3. Control mechanism in the gastrointestinal tract
4. Major physiological processes occurring in the gastrointestinal tract

Learning Organization

1. Read learning materials before the lecture
2. 50-min lecture
3. 10-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 41**:** Organization of the Gastrointestinal System, Elsevier Inc.
2. Bruce Koeppen (2024), Berne & Levy Physiology. 8th Edition, Chapter 27: Functional Anatomy and General Principles of Regulation in the Gastrointestinal Tract, Elsevier Inc.

3. Mulroney and Myers (2025), Netter's Essential Physiology, 3rd Edition, Chapter 22: Overview of the Gastrointestinal Tract, Elsevier Inc.

Student Assessment

1. Student participation in class
2. Written examination

Topic **Lecture 7: Gastric function**
Date Tuesday Oct 15, 2024 **Time** 10.00 AM – 11.00 AM
Room PR401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Ratchaneevan Aeimlapa. Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: Ratchaneevan.aei@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The stomach serves several important functions for the gastrointestinal system. It secretes acid and enzyme necessary for protein digestion as well as assimilates food contents readily to be absorbed in the latter segments. Several factors are involved in the process of acid secretion to ensure that the digestion is proper, but not harmful to gastric mucosa.

Objectives

Students should be able to:

1. Describe functional anatomy of the stomach
2. Explain the process of acid, enzyme, other component secretion by the stomach
3. Explain the stimulatory and inhibitory mechanisms of acid secretion
4. Describe the protective mechanisms of gastric and duodenal epithelia to gastric acid
5. Explain the process of gastric filling and emptying

Lecture Outline

1. Functional anatomy of the stomach
2. Acid and pepsinogen secretion
3. Regulation of acid secretion
4. Protective mechanisms for acid secretion
5. Gastric filling and emptying

Learning Organization

1. Read learning materials before the lecture
2. 50-min lecture presentation
3. 10-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Elsevier Saunders.
2. Linda S. Costanzo (2018) Physiology, 6th Edition, Elsevier Saunders.

Student Assessment

1. Written examination
2. Student participation in class

Topic **Lecture 8: Gastrointestinal motility**
Date Tuesday Oct 15, 2024 **Time** 11.00 AM – 12.00 AM
Room PR401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Ratchaneevan Aeimlapa. Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: Ratchaneevan.aei@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Gastrointestinal motility functions to grind, mix, and fragment ingested food to prepare it for digestion and absorption, and then it propels the food along the gastrointestinal tract. Contraction and relaxation of smooth muscle are key to these actions.

Objectives

Students should be able to:

1. Describe the organization and function of smooth muscle cells of gastrointestinal tract
2. Distinguish tonic and rhythmic contraction
3. List the functions of the sphincters in various locations along gastrointestinal tract
4. Describe motility of the small and large intestines

Lecture Outline

1. Smooth muscles of the gastrointestinal tract
2. Tonic and rhythmic contractions
3. Function of the sphincters
4. Motility of the small and large intestines

Learning Organization

4. Read learning materials before the lecture
5. 50-min lecture presentation
6. 10-min questions and answers

Learning Materials

3. Lesson plan including the objectives and lecture outline
4. Handout of the lecture presentation

Suggested Readings

3. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Elsevier Saunders.
4. Linda S. Costanzo (2018) Physiology, 6th Edition, Elsevier Saunders.

Student Assessment

3. Written examination
4. Student participation in class

Topic **Lecture 9: Nutrient digestion and absorption**
Date Thursday Oct 17, 2024 **Time** 09.00 – 10.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Dr. Panan Suntornsaratoon, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: panan.sun@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Utilization of the nutrients from the digested foods needs many activities of two essential processes, digestion and absorption. Digestion includes both mechanical and chemical activities to break down the ingested foods into small molecules that can be absorbed by the epithelial lining cells of the gastrointestinal tract. The absorbed nutrients then pass into blood or lymph and circulate throughout the body. Nutrient absorptions of the dietary carbohydrate, proteins and lipids are taken care by differential mechanisms in which the defect or failure at any point of the process may lead to certain pathological conditions.

Objectives

Students should be able to:

1. Describe an overview of carbohydrate, protein and lipid digestion
2. Explain the roles of SGLT1 and other transporters for carbohydrate absorption
3. Describe the processes involving protein, peptide and amino acid absorption
4. Describe essential steps for lipid absorption

Lecture Outline

1. Overview of nutrient digestion and absorption
2. Carbohydrate digestion and absorption
3. Peptide and amino acid digestion and absorption
4. Fat assimilation and lipid absorption

Learning Organization

1. Read learning materials before the lecture
2. 50-min lecture presentation
3. 10-min question and answer

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 45: Nutrient Digestion and Absorption, Elsevier Saunders.
2. Gail W. Jenkins, Christopher P. Kemnitz, Gerard J. Tortora (2012) Anatomy and Physiology from science to life, 3rd Edition, Chapter 23: The digestive system (sections 23.2, 23.4, 23.6, 23.7 and 23.8). Wiley.

Student Assessment

1. Student participation in class
2. Written examination 10 points

Topic **Lecture 10: Electrolyte, water and vitamin absorption**
Date Thursday Oct 17, 2024 **Time** 10.30 – 11.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Dr. Panan Suntornsaratoon, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: panan.sun@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The major electrolytes/minerals in our body are sodium, chloride, potassium, bicarbonate, calcium and phosphate constantly transported in and out of the intestinal lumen under the control of neural and hormonal systems. There are two main groups of vitamins, including fat-soluble and water-soluble ones. Fat-soluble vitamin A, D, E and K, are absorbed in the small intestine along with dietary lipids. Water-soluble vitamins (e.g., B and C), on the other hand, are transported via carrier-mediated mechanisms. Despite the essential need of small amount of vitamins and minerals for normal cell functions, growth and development, deficiency of some vitamins leads to a variety of clinical abnormalities.

Objectives

Students should be able to:

1. Describe the overall mechanisms of fluid and electrolyte absorption
2. Explain the process involving sodium transport across intestinal epithelium
3. Describe the mechanism regulating chloride absorption and secretion in the intestine
4. Describe the mechanism regulating potassium absorption and secretion in the intestine
5. Describe the regulation of vitamin and mineral absorption across intestinal segments

Lecture Outline

1. Overview of fluid and electrolyte absorption
2. Regulation of sodium transport across intestinal epithelium
3. Regulation of chloride absorption and secretion in the intestine
4. Regulation of potassium absorption and secretion in the intestine
5. Regulation of vitamin and mineral absorption across intestinal segments

Learning Organization

1. Read learning materials before the lecture
2. 50-min lecture presentation
3. 10-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 45: Intestinal Fluid and Electrolyte Movement, Elsevier Saunders.

Student Assessment

1. Student participation in class
2. Written examination 10 points

Topic **Lecture 11: Hepatobiliary function**
Date Friday Oct 18, 2024 **Time** 09:00 – 11:00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Dr. Jittima Weerachayaphorn, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: jittima.wee@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The liver is a distinct organ and performs many unique interconnected functions. This lecture provides a comprehensive overview of the critical roles played by the liver, bile ducts, and pancreas in maintaining overall health and supporting the digestive system. Key topics include the liver's metabolic functions, such as the synthesis and secretion of bile, the detoxification of drugs and other substances, and excretion of bilirubin. This lecture will also delve into the composition and functions of bile, particularly the role of bile salts in digestive and nutrient absorption within the intestinal tract. In addition to liver functions, the lecture will encompass pancreatic physiology, focusing on the production and regulation of pancreatic secretion and its regulation. By understanding these interconnected systems, students will gain a deeper appreciation of the complexities of hepatobiliary and pancreatic functions and their significance in maintaining digestive health and overall homeostasis.

Objectives

Students should be able to:

1. Describe the metabolic functions of the liver
2. Explain the process of bile formation and secretion by the liver
3. Describe the enterohepatic circulation of bile acids
4. Explain the liver's mechanisms for detoxify and excreting endogenous and exogenous xenobiotics, with a specific focus on bilirubin metabolism
5. Explain the physiological processes involved in pancreatic secretion
6. Explain the regulatory mechanisms controlling pancreatic secretion
7. Integrate knowledge of hepatobiliary and pancreatic functions to understand their interdependence on digestive homeostasis

Lecture Outline

1. Organization of hepatobiliary and pancreatic systems
2. Liver functions
3. Bile formation and secretion
4. Role of bile salts and enterohepatic circulation
5. Role of the gallbladder
6. Bilirubin metabolism and excretion
7. Pancreatic functions
8. Regulatory mechanism of pancreatic secretion

Learning Organization

1. Read learning materials before the lecture
2. 70-minute lecture with a 10-minute-intermission
3. 10-minute questions and answers

Learning Materials

3. Lesson plan including the objectives and lecture outline

4. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapter 46**:** Hepatobiliary Function, Elsevier Inc.
2. Bruce Koeppen (2024), Berne & Levy Physiology. 8th Edition, Chapter 32: Transport and Metabolic Functions of the Liver, Elsevier Inc.
3. Mulroney and Myers (2025), Netter's Essential Physiology, 3rd Edition, Chapter 25**:** Hepatobiliary Function, Elsevier Inc.

Student Assessment

1. Student participation in class
2. Written Examination

Topic **Discussion 3: Gastrointestinal function in health and disease**
Date Monday Oct 21, 2024 **Time** 09.00 – 11.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nattapon Panupinthu, M.D., Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nattapon.pan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Functions of the gastrointestinal tract require precise signals from several inputs. These signals can be initiated from distant origins such as neuronal firing from the brain. Moreover, neuronal activities from the enteric nervous systems play significant roles in these processes. Disturbance of the hormonal controls represents another aspect for gastrointestinal dysfunction. These functional abnormalities involve motility disorders, indigestion, malabsorption and inappropriate secretion. Common disorders related to these four issues will be discussed.

Objectives

Students should be able to:

1. Apply basic knowledge of gastrointestinal functions to explain the underlying mechanisms of common disorders
2. Discuss possible outcomes in patients with gastrointestinal disorders
3. Give possible therapeutic interventions that related to the pathophysiology of the diseases

Lecture Outline

1. Motility disorders
2. Indigestion
3. Malabsorption
4. Inappropriate secretion

Learning Organization

1. Each student receives a topic related to these four aspects of GI disorders before class
2. Students give a concise presentation on the assigned topics during class
3. Students in the class discuss about the topics and related issues

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition.

Student Assessment

1. Student performance 50% (10 points)
    - Basic and applied knowledge in the contents of presentation
    - Student participation
2. Post-discussion Quiz 50% (10 points)

Topic **Discussion 4: Hepatopancreatobiliary disorders**
Date Tuesday Oct 22, 2024 **Time** 09:00 – 10:30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Jittima Weerachayaphorn, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: jittima.wee@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & synopsis

The hepatopancreatobiliary disease is generally referred to as any disorder of the hepatobiliary and pancreatic system that impairs its normal function. This particular disorder may result from various causes including viral, bacterial infection, toxic chemicals, alcohol consumption, and metabolic disorders. This discussion session will enhance students to integrate new knowledge in pathophysiology with prior knowledge in liver physiology and learn further why a person has pancreatic and hepatobiliary disease along with clinical manifestation/symptoms of these diseases/disorders through case scenarios and case presentations.

Learning Objectives

Students should be able to:

1. Define pathophysiology of hepatobiliary and pancreatic disorders/diseases
2. Explain how the hepatopancreatobiliary system functions under physiological and pathophysiological conditions
3. Interpret and correlate the biochemical markers for the hepatobiliary and pancreatic functions
4. Relate basic sciences in hepatobiliary and pancreatic system with the clinical scenarios

Discussion Outline

1. Bilirubin excretion
2. Bile formation and secretion
3. Pancreatic secretion
4. Clinical manifestations of hepatobiliary and pancreatic disorders/diseases
5. Biochemical markers in differentiating cholestatic disorders and biliary pancreatitis
6. Pathophysiology of common hepatobiliary and pancreatic disorders/diseases

Learning Organization

1. Study the assigned case study questions before class provided in advance
2. Review gastrointestinal lectures and references before participating in discussion
3. Prepare and answer the leading questions for the group discussion

Learning Materials

1. Case study assignment
2. Quiz
3. Cisco WebEx program
4. Video record for review

Suggested Readings

1. Boron WF and Boulpaep EL. (2017). 'Hepatobiliary Function' in Medical Physiology (3rd ed). Chapter 46, (pp. 944-973). Elsevier
2. Theise NS. (2015). 'Liver and Gallbladder' in Robbins and Cotran Pathologic Basis of Disease (9th ed). Chapter 18, (pp. 821-882). Elsevier
3. Hruban RH and Lacobuzio-Donahue CA (2015). 'The pancreas' in Robbins and Cotran Pathologic Basis of Disease (9th ed). Chapter 19, (pp. 883-896). Elsevier

Student Assessment

1. Pre-quiz and post-quiz discussion 50% (7.5 points)
2. Individual student performance 50% (7.5 points)
   (along with contribution and accuracy in content)

Topic **Lecture 12: Nephron & How it works**
Date Monday Oct 28, 2024 **Time** 09.00 – 10.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Kanit Bhukhai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The kidneys function as an excretory organ to regulate (1) body fluid osmolality and volumes, (2) electrolyte balance, (3) acid-base balance, (4) excretion of metabolic products and foreign substances, and (5) production and secretion of hormones. It works in conjunction with the other systems to regulate the volume and the composition of the body fluids within a very narrow range despite wide variations in the intake of food and water.

Objectives

Students should be able to:

1. Describe the role of kidney in maintaining homeostasis
2. Describe the functional relationships between the urinary system and other systems
3. Describe how the urine is formed

Lecture Outline

1. The major functions of kidney and the function of each nephron segment
2. Integration with other systems

Learning Organization

1. Lecture 30 min.
2. Discussion with leading questions 30 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 10 points

Topic **Lecture 13: Renal hemodynamics**
Date Monday Oct 28, 2024 **Time** 10.30 – 11.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Kanit Bhukhai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: kanit.bhu@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Urine formation is a process that starts with glomerular filtration and is influenced by changes in renal hemodynamics. Many factors interact to maintain a consistent blood flow allowing filtration and urine formation to continue even blood pressure systemic changes. This lecture will be explained contributing factors that impact on renal hemodynamics include the current theory of autoregulatory mechanisms, forced involved glomerular filtration, renal blood flow and glomerular filtration rate, and the clearance concept and its applications. Knowledge of the effects of these factors will allow students to understand the clinical conditions that can alter renal hemodynamics and glomerular filtration.

Objectives

Students should be able to:

1. Understand the clearance concept and its applications
2. Identify the important factors which are responsible for the determination of glomerular filtration rate (GFR) and renal blood flow (RBF)
3. Describe the current theory of autoregulation of GFR and RBF
4. Explain how certain circumstances could influence RBF despite autoregulation

Lecture Outline

1. Renal clearance and clearance ratios
2. Processes of ultrafiltration and forces involved
3. The concept of autoregulation of GFR and RBF
4. Measurement of GFR and RBF

Learning Organization

1. Lecture 30 min.
2. Discussion with leading questions 30 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 10 points

Topic **Lecture 14: Renal tubular transport**
Date Tuesday Oct 29, 2024 **Time** 09.00 – 10.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Kanit Bhukhai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: kanit.bhu@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

By the three processes of urine formation: (1) ultrafiltration of plasma by the glomerulus, (2) reabsorption of water and solutes from the ultrafiltrate, and (3) secretion of selected solutes into tubular fluid. The renal reabsorption and secretion determine volume and composition of the urine. This topic will be discussed on NaCl and water reabsorption, transport of organic anions and cations, the transport proteins involved in solute and water transport, and some of the factors and hormones that regulate NaCl transport. Moreover, the transport mechanisms along the nephron, physiological relevance of these transport processes, and glomerulotubular balance and its physiological importance will be explained.

Objectives

Students should be able to:

1. The transport mechanisms of water and solute (reabsorption and secretion) via the transporters along the nephron
2. Measurement of reabsorption and secretion
3. Examples of substances that are reabsorbed and secreted
4. Factors and hormones that regulate solutes and water transport
5. Glomerulotubular balance

Lecture Outline

1. Mechanisms of water and solute transport along the nephron
2. Concepts of reabsorption and secretion measurement
3. The major hormones that regulate NaCl and water reabsorption by the kidneys
4. Glomerulotubular balance, and what is its physiological importance

Learning Organization

1. Lecture 30 min.
2. Discussion with leading questions 30 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 10 points

Topic **Lecture 15: Concentration and dilution of urine**
Date Tuesday Oct 29, 2024 **Time** 10.30 – 11.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Sunhapas Soodvilai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The kidneys maintain the osmolality and volume of the body fluids within a narrow range by regulating excretion of water and solutes, respectively. The regulation of renal water/solute excretion is via urine concentration and dilution.

Objectives

Students should be able to:

1. Describe how various concentration and volume of urine are produced.
2. Describe the factors that determine the concentration of urine.
3. Explain how solute-free water could be used to evaluate renal water handling.

Lecture Outline

1. Factors involve in renal concentration and dilution mechanism
2. The generation of corticopapillary osmotic gradient
3. The solutes that contribute to the osmotic gradient and the mechanisms involved (countercurrent multiplication and urea recycling)
4. How the fluid changes when moving along the tubular segments
5. The maintenance of the osmotic gradient (countercurrent exchange: the role of vasa recta)
6. Assessment of renal water handling by measuring solute-free water clearance

Learning Organization

1. Lecture 30 min.
2. Discussion with leading questions 30 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 10 points

Topic **Lecture 16: Control of body fluid and osmolarity**
Date Thursday Oct 31, 2024 **Time** 09.00 – 11.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Sunhapas Soodvilai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The kidneys play an important role in maintaining the body fluid osmolality and volume by regulating excretion of water and NaCl, respectively. The regulation of renal water excretion and NaCl excretion requires conjunction with the cardiovascular, endocrine, and nervous systems.

Objectives

Students should be able to:

1. Explain how the volume and osmolarity of the body fluid are maintained within a narrow range.
2. Identify the hormones that play important roles in regulating fluid and electrolytes balance, and describe their effects.
3. Describe how sodium excretion is important in determination of ECF volume and discuss the mechanisms by which sodium is regulated.

Lecture Outline

1. Basic concepts pertaining to body fluid balance
2. The disturbance that cause a shift of water between body fluid compartments
3. Responses to water deprivation and excess
4. Regulation of Na^+ balance: The renal mechanisms that regulate Na^+ excretion
5. Responses to increased and decreased Na^+ intake
6. The involvement of the kidney in edema formation

Learning Organization

1. Lecture 110 min
2. Questions & Answers 10 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 20 points

Topic **Lecture 17: Potassium, calcium, and phosphate homeostasis**
Date Friday Nov 1, 2024 **Time** 09.00 – 10.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Sunhapas Soodvilai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The kidneys play an important role in maintaining plasma concentration of potassium, calcium, and phosphate. The ions homeostasis is maintained by regulation of renal excretion and distribution of potassium between the ICF and ECF compartments. These processes are involved by hormones.

Objectives

Students should be able to:

1. Explain how K+ is crucial for many cellular functions.
2. Describe how K+ homeostasis is maintained by hormones and the kidneys.
3. Describe the regulation of K+ excretion by kidneys.
4. Describe how pathophysiological factors alter K+ homeostasis.
5. Describe how the kidneys regulate plasma levels of Ca+ and PO-4.
6. Describe the hormones involve in the regulating plasma levels of Ca+ and PO-4.
7. Describe how the kidneys regulate the excretion of Ca+ and PO-4.

Lecture Outline

1. How K+ homeostasis is maintained by the body (i.e. internal, external).
2. Cellular K+ transport mechanisms
3. Factors that affect K+ balance
4. Renal potassium homeostasis
5. Consequences of hyperkalemia and hypokalemia
6. General features how the kidneys regulate calcium and phosphate homeostasis.
7. The kidney, in conjunctions with gastrointestinal tract and bone, play a vital role in regulating plasma calcium and phosphate.
8. Hormones regulate plasma calcium and phosphate and their actions.

Learning Organization

1. Lecture 30 min.
2. Discussion with leading questions 30 min

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 10 points

Topic **Lecture 18: Renal regulation of acid-base balance**
Date Friday Nov 1, 2024 **Time** 10.00 AM – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Sunhapas Soodvilai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

pH of body fluid is a crucial factor for cellular functions. Kidneys work in concert with lungs to regulate the pH in narrow limits of buffers within body fluids. The kidneys help maintain the acid–base balance by excreting acid/base ions into the urine in order to maintain a constant of plasma pH.

Objectives

Students should be able to:

1. Explain the major mechanisms by which the body defends itself against changes in acid-base balance.
2. Describe the important role of kidney in the regulation of acid-base balance.
3. Distinguish the difference between simple metabolic and respiratory acid-base disorder, and how they are differentiated by blood gas measurements.

Lecture Outline

1. The system involved in acid-base homeostasis
2. The defense mechanisms the body used to minimize the impact of acid and alkali on the pH of body fluid
3. Renal regulation of acid-base balance
4. HCO_3 reabsorption and acid excretion
5. Metabolic and respiratory acid-base disorders
6. Blood gas analysis

Learning Organization

1. Lecture 110 min.
2. Question & Answer 10 min.

Learning Materials

1. Handout of lectures
2. Video record for review

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

Written examination 20 points

Topic **Discussion 5: Kidney function in health and disease & Renal function test**
Date Monday Nov 4, 2024 **Time** 09.00 – 11.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Sunhapas Soodvilai, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: sunhapas.soo@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Objectives

Students should be able to:

1. Discuss the roles of kidney in the regulation of body function under normal and disease conditions.

Discussion Outline

1. Assessment of Renal Function (case study no.1)
2. Role of kidney in body fluid regulation (case study no. 2)
3. Role of kidney in regulation of acid-base balance in normal and disease condition (case study no. 3)

Learning Organization

1. Discussion with leading questions 120 min

Learning Materials

1. Three case studies with leading questions are provided one week before class.

Suggested Readings

Berne, R.M. and Levy, M.N., Koeppen, B.M. and Stanton, B.A. (2018) Physiology, 7th edition Mosby Elsevier Science.

Student Assessment

1. Performance 50% (15 points)
   - Participation 10 points
   - Assignment (report) 5 points
2. Post-test 50% (15 points)

Topic **Lecture 19: Principles of endocrinology & Hypothalamus-pituitary axis hormones**
Date Monday Nov 11, 2024 **Time** 9.00 – 10.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Dr. Suwimol Tangtrongsup, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: suwimol.tan@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The endocrine system is one of major regulatory systems secreting hormones into the blood that distributes hormones throughout the body. Levels of hormones in the blood must be regulated at appropriate levels to ensure proper regulations and functions of the target organs

Growth and development are essential for life especially during those first few years until adolescence. Several factors can influence growth and development of a child including genetic factors, nutrition, parental care and hormones. Pituitary hormones, such as growth hormone and prolactin play critical roles to ensure proper physical growth.

Objectives

Students should be able to:

1. Classify hormones based on their chemical structure and mechanisms of action
2. Describe major types of intracellular signaling pathways
3. Discuss the concept of feedback regulation in the context of homeostasis
4. Identify trophic hormone and describe their functions in relation to their targets
5. Describe the factors that regulate body growth
6. Describe feedback regulation of secretion and actions of growth hormone
7. Describe the physiological effects of growth hormone

Lecture Outline

1. Classification of hormones, their structure and mechanisms of action
2. Signal transduction pathways and hormone interaction
3. Concept of negative and positive feedback regulation and its significance
4. Biosynthesis, processing and release of peptide, steroid and amino-acid-derived hormones
5. Hypothalamo-pituitary-control of growth hormone secretion
6. Actions of growth hormone
7. Etiology and pathophysiology of diabetes insipidus, gigantism, acromegaly and dwarfism

Learning Organization

1. Read learning materials before the lecture
2. 75-min lecture presentation
3. 15-min questions and answers

Learning Materials

1. Lesson plan including the objectives and lecture outline
2. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep (2017) Medical Physiology, 3rd Edition, Chapters 47 and 48: Organization of endocrine control and Endocrine regulation of growth and body mass, Elsevier Saunders.
2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapters 41: The Hypothalamus and Pituitary Gland, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Lecture 20: Thyroid hormones & Hormone regulation of calcium and phosphate metabolism**

Date Monday Nov 11, 2024 **Time** 10.30 – 12.00 PM

Room PR.401, Department of Physiology, Faculty of Science, Mahidol University

Lecturer Dr. Suwimol Tangtrongsup, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: suwimol.tan@mahidol.ac.th

Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Thyroid hormones are one of the essential hormones playing a critical role in normal physical and mental growth, development, and metabolism. They are the only hormones require an essential trace of element, iodine, for active hormone production. Iodine deficiency leads to hypothyroidism, which has a severe effect on CNS development in infancy.

Bone is a living tissue, constantly remodeled even after completion of growth. Bone remodeling serves to keep the skeleton strong and functional. Under regulation of hormones, bone provides calcium and phosphate in order to maintain the plasma calcium and phosphate levels.

Objectives

Students should be able to:

1. Describe the synthesis of thyroid hormones
2. Describe the physiological roles of thyroid hormones
3. Describe the structural organization of bone
4. Relate the functional activities of bone cells to bone remodeling
5. Describe the actions of parathyroid hormone, vitamin D and calcitonin

Lecture Outline

1. Synthesis and its regulation of thyroid hormones
2. Actions of thyroid hormones
3. Physiological effects of thyroid hormone
4. Hypothyroidism and hyperthyroidism
5. Physiology of bone
6. Bone remodeling process
7. Actions of parathyroid hormone, vitamin D and calcitonin on calcium and phosphate homeostasis
8. Abnormalities of hormonal control calcium level

Learning Organization

4. Read learning materials before the lecture
5. 75-min lecture presentation
6. 15-min questions and answers

Learning Materials

3. Lesson plan including the objectives and lecture outline
4. Handout of the lecture presentation

Suggested Readings

1. Boron and Boulpaep **(**2017**)** Medical Physiology, 3rd Edition, Chapter 49 and 52**:** The Thyroid Gland, The Parathyroid Gland and Vitamin D, Elsevier Saunders**.**

2. Koeppen and Stanton (2018) Berne & Levy Physiology. 7th Edition, Chapter 40 and 42: Hormonal Regulation of Calcium and Phosphate Metabolism, The Thyroid Gland, Mosby Elsevier.

Student Assessment

1. Student participation in class
2. Written examination 15 points

Topic **Lecture 21: Adrenal hormones**
Date Tuesday Nov 12, 2024 **Time** 09.00 – 10.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Arthit Chairoungdua, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: arthit.chi@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Adrenal glands have complex endocrine structures that produce two structurally distinct classes of hormones. Catecholamine is critical by acting as a rapid responder to stress such as hypoglycemia and exercise to regulate multiple parameters of physiology. Steroid hormones secreted from this gland also play critical roles in our body such as glucose utilization, inflammatory and salt and volume homeostasis. Malfunction of adrenal gland causes several diseases. Study the regulation of secretion and metabolism, function, and feedback mechanism is necessary to understanding adrenal gland related diseases.

Objectives

Students should be able to:

1. List important hormones secreted by the adrenal cortex and medulla.
2. Briefly explain the common molecular mechanism of steroid hormones.
3. Describe the process of steroidogenesis.
4. Describe physiological functions of aldosterone.
5. Describe physiological functions of glucocorticoids.
6. Describe physiological functions of adrenal androgens related to adrenarche.
7. Discuss the pathogenesis of congenital adrenal hyperplasia (CAH).
8. Describe physiological functions of hormones from adrenal medulla.

Lecture Outline

1. Steroidogenesis in adrenal glands
2. Physiological functions of mineralocorticoids - synthesis and actions.
3. Physiological functions of glucocorticoid - synthesis and actions.
4. Conn’s syndrome - aldosterone excess.
5. Adrenal insufficiency, Addison’s disease, and Cushing’s syndrome.
6. Adrenal androgens
7. Congenital adrenal hyperplasia (CAH)
8. Catecholamines from adrenal medulla
9. Pheochromocytoma

Learning Organization

1. Read learning materials before the lecture.
2. 80 min for lecture
3. 10 min for questions and answers

Learning Materials

1. Lecture outlines
2. Handout of the lecture presentation
3. Video record for review

Suggested Readings

1. Boron WF, Boulpaep EL. Medical Physiology, 2nd ed., Elsevier 2009. p1057–1073.
2. Berne, Levy, Koeppen, Stanton. Physiology 5th ed., Mosby 2004, p 883-919.

Student Assessment

Written examination 15 points

Topic **Lecture 22: Hormone regulation of fuel metabolism**
Date Tuesday Nov 12, 2024 **Time** 10.30 – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Arthit Chairoungdua, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: arthit.chi@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

Nutrient especially Glucose is fuel used for energy production. Fuel metabolism is regulated by several hormones in our body. Pancreas secret two important hormones that are crucial for normal regulation of glucose, lipid and protein metabolism. Malfunction of these hormones courses diabetes mellitus, the most common endocrine dysfunction. Study the regulation of secretion and metabolism, function, signaling pathway and feedback mechanism is necessary to understanding the disease.

Objectives

Students should be able to:

1. Discuss the major determinants of glucose homeostasis.
2. Describe factors that regulate the release of insulin and glucagon.
3. Discuss the effects of insulin and glucagon as relate to the regulation of glucose metabolism.
4. Explain how additional humoral factors play roles in fuel metabolism.
5. Discuss the pathogenesis of diabetes mellitus.

Lecture Outline

1. General concepts of energy balance
2. Fuel metabolism & the endocrine pancreas
    - Cell types and hormones production
    - Actions of major pancreatic hormones
3. Other regulators of fuel metabolism
4. Diabetes mellitus: the most common endocrine disorder

Learning Organization

1. Study the learning materials provided in advance
2. 80 min for lecture
3. 10 min for questions and answers

Learning Materials

1. Transcripts of lecture outlines
2. Printed copies of PowerPoint printout
3. Video record for review

Suggested Readings

1. Berne RM and Levy MN. Physiology. 5th ed. St. Louis: Mosby, 2004. Chapter 40: Whole body metabolism; and, Chapter 41: Hormones of the pancreatic islets.
2. Boron WF and Boulpaep EL. Medical Physiology. Updated ed. Philadelphia: Elsevier, 2005. Chapter 50: The endocrine pancreas.
3. Cryer PE. Glucose Homeostasis and Hypoglycemia. In: Williams Textbook of Endocrinology. Editor, Larsen PR. Saunders 10th ed., 2003, p. 1585-1611.

4. Koeppen BM, Stanton BA. Berne & Levy Physiology. 6th ed. Philadelphia: Mosby, 2008. Chapter 38: Hormonal Regulation of Energy Metabolism.

Student Assessment

Written examination 15 points

Topic **Lecture 23: Female reproductive system**
Date Thursday Nov 14, 2024 **Time** 09:00 – 11.00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nittaya Boonmuen, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: nittaya.bom@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & synopsis

The two basic components of the female reproductive system are the gonads and the reproductive tract. The ovaries are the gonad in the female reproductive system. The ovaries perform an endocrine function, which is regulated within a hypothalamic-pituitary-gonadal axis. The gonads are distinct from other endocrine glands in that they also perform an exocrine function. The reproductive tract is involved in several aspects of gamete development, function, and transport and, in women, allows fertilization, implantation, and gestation. Normal gametogenesis in the gonads and the development and physiology of the reproductive tract are absolutely dependent on the endocrine function of the gonads.

Objectives

Students should be able to:

1. Describe the process of sex determination
2. Describe the structures and functions of the female reproductive system
3. Explain the concept of menstrual cycle
4. Describe the endocrine regulation of reproduction
5. Describe hormonal and mechanical factors involved in pregnancy and parturition
6. Describe the stages and hormonal control of lactation
7. Explain the cause and effect of menopause

Lecture Outline

1. Sex determination
2. Structures and functions of the female reproductive system
3. Menstrual cycle
4. Endocrine regulation of reproduction
5. Pregnancy and parturition
6. Lactation
7. Menopause

Learning Organization

1. Study the learning materials before the lecture
2. 80-minute lecture with 10-minute intermission (35-10-35)
3. 10-minute questions and answers

Learning materials

1. Transcripts of lecture outline
2. Handout of PowerPoint lecture presentation

Suggested readings

1. Boron, W.F. and Boulpaep. The reproductive system, Medical Physiology (3rd Ed.), Elsevier Saunders, 2017
2. Costanzo, L.S. Reproductive Physiology, Physiology (6th Ed.). Elsevier Saunders, 2018
3. Koeppen, B. M., & Stanton. B. A. The Endocrine and Reproductive Systems, Berne & Levy physiology (7th Ed). Elsevier, 2018

Student Assessment

Written examination 20 points

Topic **Lecture 24: Male reproductive system**
Date Friday Nov 15, 2024 **Time** 09:00 – 10:00 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Asst. Prof. Nittaya Boonmuen, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: jittima.wee@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & synopsis

Male reproductive functions include three major parts: (1) Sperm formation — spermatogenesis; (2) performance of the male sexual act; and (3) regulation of male reproductive functions by the male hormones. Related to reproductive functions are the effects of the male sex hormones on the accessory sexual organs, cellular metabolism, growth, and other functions of the body.

Objectives

Students should be able to:

1. Explain the process of sex determination
2. Describe the structures and functions of the male reproductive systems
3. Explain the endocrine regulation of male reproduction
4. Describe the male puberty
5. Explain the process of the sexual act
6. Describe the abnormalities of male reproduction

Lecture Outline

1. Sex determination
2. Structures and functions of the male reproductive systems
3. Endocrine regulation of male reproduction
4. Male puberty
5. Sexual act
6. Abnormalities of the male reproduction

Learning Organization

1. Study the learning materials before the lecture
2. 50-minute lecture
3. 10-minute questions and answers

Learning materials

1. Transcripts of the lecture
2. Handout of PowerPoint lecture presentation

Suggested readings

1. Boron, W.F. and Boulpaep. The reproductive system, Medical Physiology (3nd ed.), Elsevier Saunders, 2017
2. Costanzo, L.S. Reproductive Physiology, Physiology (6th ed.). Elsevier Saunders, 2018
3. Koeppen, B. M., & Stanton. B. A. The Endocrine and Reproductive Systems, Berne & Levy physiology (7th ed). Elsevier, 2018

Student assessment

1. Pre-quiz
2. Written examination 10 points

Topic **Lecture 25: Temperature regulation**
Date Friday Nov 15, 2024 **Time** 10:30 – 11.30 AM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Tai Chaiamarit, PhD, DPhil
Department of Physiology, Faculty of Science, Mahidol University
E-mail: tai.chm@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Background & Synopsis

The purpose of this section is to learn how the thermoregulatory system works to maintain body temperature within a relatively narrow range under such a very wide range of ambient temperature, prolonged heat and cold exposure, and under normal and abnormal physiological conditions, for example: fever. It will be approached by studying the heat balance between heat production and heat loss, analyzing important factors influencing normal body temperature, and the functions of each individual component of the thermoregulatory system. In addition, the heat-increasing and heat-decreasing neural and humoral mechanisms employed to maintain the body temperatures constant will be discussed. The knowledge you gain become beneficial for understanding some of the causes and manifestations of thermoregulatory disturbances and malfunction.

Objectives

Students should be able to:

1. Describe the thermal balance for the body
2. Describe the regulation of body temperature
3. Explain the mechanisms for maintaining thermal balance in heat and cold environments
4. Describe physiological changes that occur as a result of acclimatization to heat
5. Explain physiological consequences of deviations in body core temperature

Lecture Outline

1. Core temperature concept and thermal balance
2. Regulation of body temperature
3. Mechanisms for maintaining thermal balance in heat and cold
4. Pathophysiology of temperature regulation: Fever, Heat Stroke
5. Abnormalities of body temperature regulation

Learning Organization

1. Assigned reading of the chapters from Guyton's Medical Physiology
2. The 55-minute lecture along with students' discussion
3. The 5-minute questions and answers

Learning Materials

PowerPoint media

Suggested Readings

John E. Hall. (2016). 'Body temperature regulation and fever' in Guyton and Hall Textbook of Medical Physiology (13th Ed), Chapter 74, (pp.911-919). Elsevier.

Student Assessment

Written Examination 10 points

Topic **Discussion 6: Diseases of hormonal control of fuel metabolism**
Date Monday Nov 18, 2024 **Time** 09.00 – 12.00 PM
Room PR.401, Department of Physiology, Faculty of Science, Mahidol University
Lecturer Assoc. Prof. Arthit Chairoungdua, Ph.D.
Department of Physiology, Faculty of Science, Mahidol University
E-mail: arthit.chi@mahidol.ac.th
Students Graduate students in the Program of Physiology and related Programs

Objectives

Students should be able to:

1. Describe physiological roles of hormones controlling blood glucose
2. Describe consequences of the insulin resistance to the body's metabolism of nutrients
3. Describe synthetic pathways and physiological actions of hormones produced by adrenal cortex
4. Describe consequences of adrenal cortex hormone excess
5. Describe pathophysiology of Cushing's syndrome

Discussion Outline

1. Hormonal regulation of blood glucose
2. Insulin actions in various tissues
3. Type II diabetes mellitus
4. Insulin resistance and body metabolism
5. Adrenal cortex hormones: synthesis and actions
6. Cushing syndrome: pathophysiology and diagnosis

Learning Organization

1. Students will study the assigned cases and consult to available learning materials in order to answer the leading questions
2. Student have to complete pre-test before class
3. Students will discuss their questions regarding the provide question led by the tutor

Learning Materials

1. Handout of lecture
2. Textbook
3. Cases and questions

Suggested Readings

1. Berne RM, Levy MN, Koeppen BM and Stanton BA (2004) Physiology 5th Ed., Mosby, Inc.

Student Assessment

1. Conference performance 50% (15 points)
2. Post-discussion quiz 50% (15 points)