

2026 Akita University Faculty of Medicine Syllabus

Category	: 基礎医学 IV
Course Title	: Neuroscience and Organ Function II
Eligible Students	: grade 2 Related Course
Code	: 71563015
Schedule	: week 17 ~ week 17
Credits	: 1

1. Lead Instructor

Tomohiro Numata	(Professor, Department of Integrative Physiology, 6272, Office Hour: By appointment)
Takafumi Miki	(Professor, Department of Cell Physiology, 6069, Office Hour: By appointment)

2. Instructors

Tomohiro Numata	(Professor, Department of Integrative Physiology, 6272, Office Hour: By appointment)
Takafumi Miki	(Professor, Department of Cell Physiology, 6069, Office Hour: By appointment)
Yosuke Okamoto	(Lecturer, Department of Cell Physiology, 6070)

3. Course Description Outline(Course Objectives)

Acquiring comprehensive knowledge of human body functions is crucial to addressing unknown pathological conditions and formulating treatments in clinical settings. The acquisition process involves understanding the physiological functions across various layers of the human body, encompassing molecules, cells, tissues, and individuals. Applying the acquired knowledge to clinical practice involves utilizing ICT to investigate disease mechanisms and independently devising potential treatments.

Through a structured approach of independent learning, regular knowledge assessments, and targeted review of deficient areas, students will cultivate a cyclical learning habit conducive to lifelong learning. Additionally, students will foster scientific inquisitiveness by practicing international literature search methods and data interpretation to support Evidence-Based Medicine (EBM). Simultaneously, they will develop the ability to articulate discovered knowledge and skills understandably, honing communication skills in the process. This holistic approach equips students with a foundational research mindset alongside the commitment to lifelong learning.

The curriculum also emphasizes a comprehensive understanding of professionalism, including trust, honesty, consideration, reflection, and ethical conduct, as well as aspects of medical behavioral science, medical safety, medical law (system), and EBM. Students will build a well-rounded knowledge base through the judicious use of ICT.

Aim:

Provide an Overview of Renal/Urinary, Digestive, and Hematopoietic Systems:

Develop the ability to provide a comprehensive overview of the cell and organ functions within the renal/urinary, digestive, and hematopoietic systems, spanning from basics to pathology (1-1 ~ 1-2, 2-1 ~ 2-6, 2-8, 3-1 ~ 3-7, 4-1 ~ 4-7, 5-1 ~ 5-4, 6-1 ~ 6-2) .

Understand Mechanisms for Maintaining Homeostasis:

Gain a thorough understanding of the structure and function of mechanisms that maintain homeostasis, encompassing body temperature, fluid volume, and electrolytes. Develop the ability to comprehensively outline physiological functions to pathology at each level of the human body(1-1 ~ 1-2, 2-1 ~ 2-6, 2-8, 3-1 ~ 3-7, 4-1 ~ 4-7, 5-1 ~ 5-4, 6-1 ~ 6-2) .

Learn Related Professionalism and Comprehensive Judgment:

Acquire knowledge in related professionalism, including trust, honesty, consideration, reflection, and ethics, along with medical behavioral science, medical safety, medical law (system), comprehensive judgment using EBM, and the appropriate use of ICT (1-1 ~ 1-2, 3-3, 3-5, 3-7, 4-4).

臨床現場で未知の病態に対処して治療法を考案するためには、人体の機能に関する知識の習得が不可欠である。この知識の獲得は人体の機能について、分子・細胞・組織・個体に至る各階層の生理機能を包括的に理解することから始まる。講義で得た知識を診療に活かすためには、各疾患の根本的なメカニズムを ICT を駆使して検索し、治療の可能性について主体的に検討する。これらの計画に基づいた主体的な学びや知識の確認のための定期的な試験、不足した領域の再確認を通じて、生涯学習を実現する学びの循環の習慣を身につける。また、EBM を実現するために国際的な文献検索の方法の実践やデータを読み解く体験を通じ、科学的探究心を養う。同時に、自身の発見した知識や技術を理解し、他者に分りやすく説明するための表現力やその作成過程で生じるコミュニケーション能力を養う。これらの学習を通じて、生涯学習に加えてリサーチマインドの基礎を身につける。また、信頼、誠実、思いやり、省察、倫理のプロフェッショナリズムや医療行動科学、医療安全、医療法（制度）、EBM を活用した総合的に理解するための学習も含み、ICT の適切な活用を通じて包括的な知識を築き上げる。

ねらい

- (1) 腎・泌尿器系、消化器系、造血系について、基礎から病態まで細胞及び臓器機能を中心に概説することができる。(1-1 ~ 1-2, 2-1 ~ 2-6, 2-8, 3-1 ~ 3-7, 4-1 ~ 4-7, 5-1 ~ 5-4, 6-1 ~ 6-2)
- (2) 生体の恒常性、体温、体液量と体液電解質維持のための仕組みについて構造と機能を理解し、これを基盤にして人体の各階層における生理機能から病態まで含めて包括的に概説することができる。(1-1 ~ 1-2, 2-1 ~ 2-6, 2-8, 3-1 ~ 3-7, 4-1 ~ 4-7, 5-1 ~ 5-4, 6-1 ~ 6-2)
- (3) 関連するプロフェッショナリズム（信頼、誠実、思いやり、省察、倫理）医療行動科学、医療安全、医療法（制度）、ENM を活用した総合的な判断、ICT の適切な活用について学ぶ。(1-1 ~ 1-2, 3-3, 3-5, 3-7, 4-4)

4. Textbook/Reference Books

人体の正常構造と機能（日本医事新報社）
（参考図書）
標準生理学（医学書院）

5. Assessment

Attendance, reports and exams.

To be eligible for the common examination, students must attend at least two-thirds of the lectures in each course.

出席状況、レポート及び試験

ただし、統一試験の受験資格は、各講座の講義について出席率が 2/3 以上であることを要件とする。

6. Out of Class Study/Message

- Proceed with lectures according to designated textbooks and handouts.
- The designated textbook should be prepared by the first day of the lecture.
- Slight changes may occur depending on the schedule of the instructor.

- 指定教科書及び配布資料に沿って講義を進める。
- 指定教科書は事前に指示するので、講義初日までに用意し、予習して受講すること。
- 担当教員の予定により、若干変更する場合がある。

Topics and Contents of class, Course Objectives						
	Class Date	Period	Class Format	Topics and Contents of class, Course Objectives	Instructors	Class Room
1	8 / 24 (Mon)	1-2	Lecture	<p>Theme: Blood (1) - Introduction to hematopoietic organs (1) Explain the composition of blood and the type of blood cells. (2) Explain the structure and function of the spleen, thymus, lymph nodes, tonsils and Peyer 's patches.</p> <p>血液の組成と血球の種類を説明できる。 脾臓、胸腺、リンパ節、扁桃と Peyer 板の構造と機能を説明できる。</p>	Yosuke Okamoto	第 2 講義室
2	8 / 24 (Mon)	3-4	Lecture	<p>Theme: Blood (2) - Erythrocytes Explain the structure and function of red blood cells and hemoglobin.</p> <p>赤血球とヘモグロビンの構造と機能を説明できる。</p>	Yosuke Okamoto	第 2 講義室
3	8 / 24 (Mon)	5-6	Lecture	<p>Theme: Renal function (1) Overview of Kidney Function Content: Roles of the kidney (fluid/electrolyte, acid-base, blood pressure regulation, endocrine functions); renal anatomy (nephron, renal corpuscle, tubules); global view of renal function and the concept of clearance. Learning Objectives:</p> <ol style="list-style-type: none"> List and explain major renal functions in terms of body fluid/electrolytes, acid&#8211;base balance, blood pressure, and endocrine regulation. Diagram renal structure (cortex/medulla, nephron, renal corpuscle, tubular segments) and explain their organization. Explain urine formation using the concepts of filtration, reabsorption, and secretion. Define clearance in words and formulas and relate it to the concept of GFR assessment. 	Tomohiro Numata	第 2 講義室
4	8 / 24 (Mon)	7-8	Lecture	<p>Theme: Renal function (2) Regulation of renal electrolyte composition and water balance Content: Filtration pressure and regulation of GFR; fundamentals of reabsorption/secretion; Na⁺; balance and extracellular fluid volume; K⁺; balance and its clinical significance for membrane excitability. Learning Objectives:</p> <ol style="list-style-type: none"> Explain the components of filtration pressure (hydrostatic vs oncotic/colloid osmotic pressure). Outline GFR regulation (afferent/efferent arterioles; basic concept of autoregulation). Explain, using examples (edema/dehydration), how Na⁺; balance directly determines body fluid volume and blood pressure. Outline how abnormal K⁺; balance affects cardiac and neuromuscular excitability (directionality of hyperkalemia vs hypokalemia). 	Tomohiro Numata	第 2 講義室

Topics and Contents of class, Course Objectives						
	Class Date	Period	Class Format	Topics and Contents of class, Course Objectives	Instructors	Class Room
5	8 / 24 (Mon)	9-10	Lecture	<p>Theme: Kidney function (3) Kidney and hormones, reabsorption, and secretion</p> <p>Content: Overview of electrolytes beyond Na⁺; (e.g., Ca²⁺;/phosphate); water balance and osmolality; hormonal regulation (ADH/vasopressin, renin;angiotensin;aldosterone system); concepts of diuresis.</p> <p>Learning Objectives:</p> <ol style="list-style-type: none"> 1.Use the concept of osmolality to explain water movement and the basic interpretation of serum Na⁺; 2.Explain stimuli for ADH (vasopressin) secretion and its actions in the kidney. 3.Outline the purpose of the renin;angiotensin;aldosterone system (maintenance of volume and blood pressure) and its renal sites of action. 4.Distinguish osmotic diuresis from water diuresis in words. 	Tomohiro Numata	第 2 講義室
6	8 / 26 (Wed)	1-2	Lecture	<p>Theme: Renal function (4) Pathophysiology of the kidney, urination</p> <p>Content: Representative disorders of water/Na⁺; balance (dehydration, edema; introductory approach to hypo-/hypernatremia); neural control of storage and voiding (micturition reflex) and overview of voiding dysfunction.</p> <p>Learning Objectives:</p> <ol style="list-style-type: none"> 1.Explain dehydration and edema from the perspectives of body fluid compartments and Na⁺;/water balance. 2.Outline hypo-/hypernatremia using volume status (hypo-/eu-/hypervolemic) at an introductory level. 3.Explain neural control of storage and voiding by organizing sympathetic, parasympathetic, and somatic pathways. 4.Outline typical patterns of voiding dysfunction (e.g., urinary retention, frequency) in relation to reflex mechanisms. 	Tomohiro Numata	第 2 講義室
7	8 / 26 (Wed)	3-4	Exercise	<p>Theme: Renal function</p> <p>Content: Review of key renal concepts (nephron organization, GFR, Na⁺;/K⁺;/water handling, ADH/RAAS); mini-cases; fundamentals of calculations and data interpretation.</p> <p>Learning Objectives:</p> <ol style="list-style-type: none"> 1.Diagram renal structure;function relationships and explain them using accurate terminology. 2.Use given information (e.g., urine volume, Na⁺;, osmolality) to describe the likely direction of pathophysiology. 3.Reflect on the rationale for incorrect answers and verbalize the next learning plan (what to review). 	Tomohiro Numata	第 2 講義室

Topics and Contents of class, Course Objectives						
	Class Date	Period	Class Format	Topics and Contents of class, Course Objectives	Instructors	Class Room
8	8 / 26 (Wed)	5-6	Lecture	Theme: Blood (3) - White blood cells Explain the type and function of white blood cells. 白血球の種類と機能を説明できる。	Yosuke Okamoto	第 2 講義室
9	8 / 26 (Wed)	7-8	Lecture	Theme: Blood (4) - Platelets Explain the function of platelets and the mechanism of hemostasis and coagulation / fibrinolysis. 血小板の機能と止血や凝固・線溶の機序を説明できる。	Yosuke Okamoto	第 2 講義室
10	8 / 26 (Wed)	9-10	Lecture	Theme: Blood (5) - Blood and Plasma (1) Explain the plasma components. (2) Explain the types and functions of plasma proteins. (1) 血漿成分を説明できる。 (2) 血漿タンパク質の種類と機能を説明できる。	Yosuke Okamoto	第 2 講義室
11	8 / 27 (Thu)	1-2	Lecture	Theme: Homeostasis (1) - Introduction (1) Explain the maintenance of homeostasis and adaptation of the living body. (2) Explain the regulation mechanism (negative feedback regulation) for maintaining homeostasis. (1) 生体の恒常性維持と適応を説明できる。 (2) 恒常性維持のための調節機構 (ネガティブフィードバック調節) を説明できる。	Takafumi Miki	第 2 講義室
12	8 / 27 (Thu)	3-4	Lecture	Theme: Homeostasis (1) - Body fluid (1) Explain the body fluid composition and compartment. (2) Explain the regulation mechanism of body fluid. (3) Explain the ionic composition of body fluids and their regulatory mechanism. (1) 体液組成と区画について説明できる。 (2) 体液の調節機構について説明できる。 (3) 体液のイオン組成とその調節機構を説明できる。	Takafumi Miki	第 2 講義室
13	8 / 27 (Thu)	5-6	Lecture	Theme: Digestion / absorption (1) Digestion and absorption Content: Overall gastrointestinal structure; innervation (enteric nervous system and autonomic nervous system); framework of digestion and absorption; roles of gastrointestinal hormones. Learning Objectives: 1.Explain major segments and functions of the GI tract from oral cavity to colon. 2.Outline GI innervation, focusing on the enteric and autonomic nervous systems. 3.Explain the general flow of digestion (breakdown) absorption transport for nutrients. 4.Provide examples of how GI hormones regulate secretion and motility.	Tomohiro Numata	第 2 講義室

Topics and Contents of class, Course Objectives						
	Class Date	Period	Class Format	Topics and Contents of class, Course Objectives	Instructors	Class Room
14	8 / 27 (Thu)	7-8	Lecture	<p>Theme: Digestion / absorption (2) Food intake and transportation Content: Mechanisms of swallowing; motility of esophagus, stomach, and intestines (peristalsis, segmentation); introductory overview of digestion/absorption by nutrient class. Learning Objectives:</p> <ol style="list-style-type: none"> 1.Explain the sequence of the swallowing reflex and outline why aspiration can occur. 2.Explain the difference between peristalsis and segmentation. 3.Outline where and what happens during digestion and absorption of carbohydrates, lipids, and proteins. 	Tomohiro Numata	第 2 講義室
15	8 / 27 (Thu)	9-10	Lecture	<p>Theme: Digestion/absorption (3) Secretion of digestive juice Content: Stomach (secretion and motility); liver and bile; basics of jaundice; roles of exocrine pancreatic secretion. Learning Objectives:</p> <ol style="list-style-type: none"> 1.Outline gastric secretions (acid, enzymes, mucus) and the basic framework of their regulation. 2.List and explain major liver functions (metabolism, detoxification, bile production, etc.). 3.Explain jaundice using an introductory framework (hemolytic, hepatocellular, obstructive). 4.Explain roles of exocrine pancreatic secretion (digestive enzymes and bicarbonate). 	Tomohiro Numata	第 2 講義室
16	8 / 28 (Fri)	1-2	Lecture	<p>Theme: Digestion / absorption (4) Digestion and absorption of nutrients Content: Small intestinal absorption mechanisms (e.g., villi); water and electrolyte absorption in the colon and intestinal environment; introductory pathophysiology of diarrhea and constipation. Learning Objectives:</p> <ol style="list-style-type: none"> 1.Explain small intestinal structure and features that facilitate absorption. 2.Explain major colonic functions (water/electrolyte absorption and stool formation). 3.Classify diarrhea/constipation from the perspectives of secretion, absorption, and motility and outline typical directions. 	Tomohiro Numata	第 2 講義室

Topics and Contents of class, Course Objectives						
	Class Date	Period	Class Format	Topics and Contents of class, Course Objectives	Instructors	Class Room
17	8 / 28 (Fri)	3-4	Exercise	<p>Theme: Exercise/Practice Content: Consolidation of key concepts; mini-cases linked to clinical presentations (diarrhea, jaundice, mal-absorption, etc.) with evidence-based reasoning. Learning Objectives:</p> <ol style="list-style-type: none"> 1.Explain GI structure, innervation, motility, and secretion in an integrated manner. 2.Propose a pathophysiological framework from symptoms (e.g., diarrhea, constipation, jaundice). 3.Use ICT to confirm basic information and summarize key points concisely, including academic integrity. 	Tomohiro Numata	第 2 講義室
18	8 / 28 (Fri)	5-6	Lecture	<p>Theme: Homeostasis (3) - Acid-base balance 1 (1) Outline the mechanism for regulating pH of the body fluid. (2) Explain the physiological meaning of the Hendersen-Hasselbalch equation.</p> <p>(1) 体液 pH の調節機構を概説できる。 (2) Hendersen-Hasselbalch の式について、その生理的意味を説明できる。</p>	Takafumi Miki	第 2 講義室
19	8 / 28 (Fri)	7-8	Lecture	<p>Theme: Homeostasis (4) - Acid-base balance 2 Explain the role of respiration and kidneys in acid-base balance of the body fluid.</p> <p>体液 pH 調節における呼吸及び腎臓の役割について説明できる。</p>	Takafumi Miki	第 2 講義室
20	8 / 28 (Fri)	9-10	Lecture	<p>Theme: Homeostasis (5) - Rhythmic changes in the living body Explain rhythmic changes in biological functions and the internal environment.</p> <p>生体機能や体内環境のリズム性変化を説明できる。</p>	Takafumi Miki	第 2 講義室