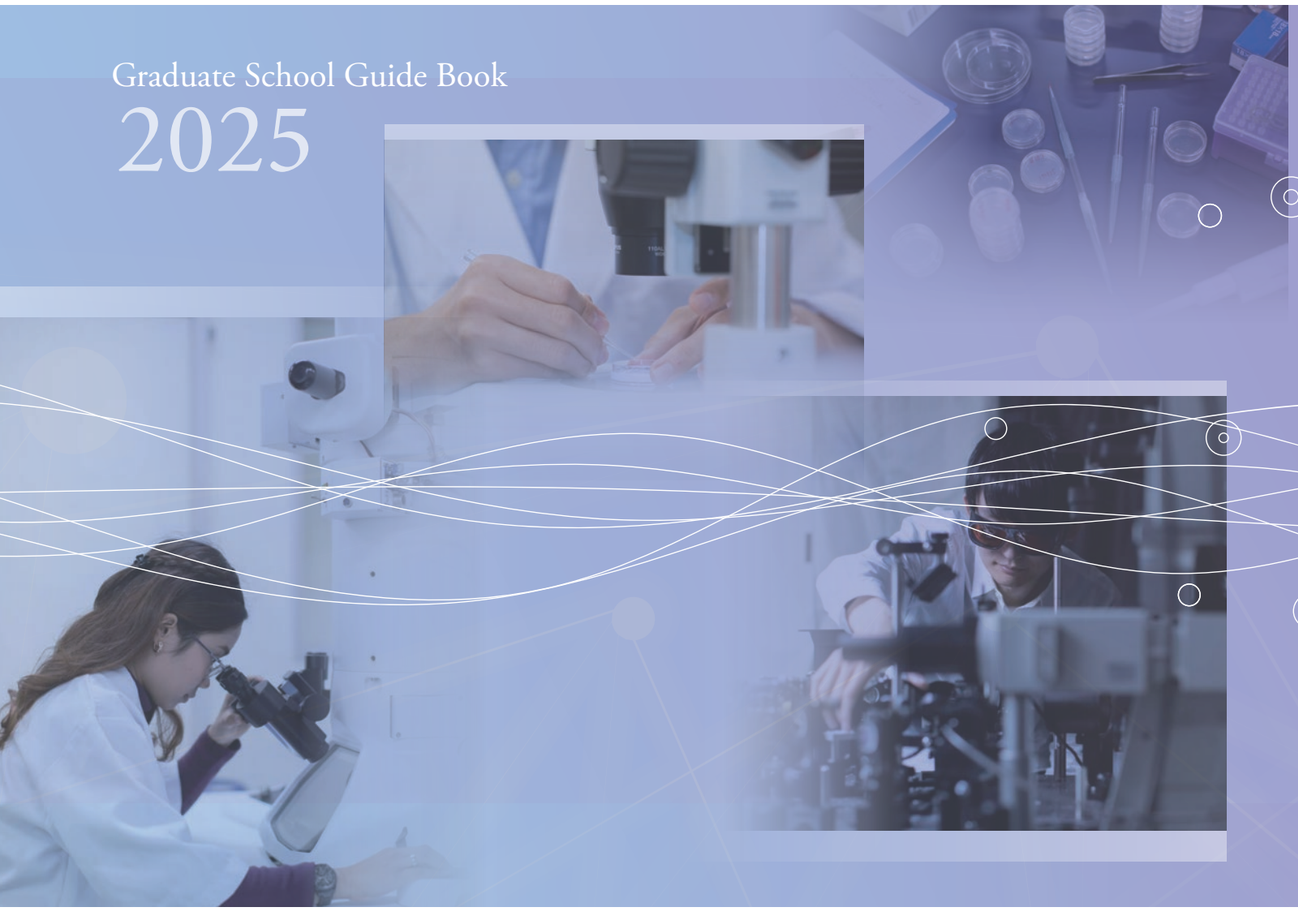
University of Tsukuba
筑波大学

Ph.D.Program in
Humanics

Ph.D. Program in Humanics

University of Tsukuba
WISE Program
(Doctoral Program for World-leading Innovative & Smart Education)

Graduate School Guide Book
2025



Unprecedented times call for
Unprecedented individuals.

Graduate School Guide Book 2025

Ph.D. Program in Humanics

University of Tsukuba
WISE Program
(Doctoral Program for World-leading Innovative & Smart Education)

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2025.4

Ph.D.Program in
Humanics

Unprecedented times call for Unprecedented individuals.

Our world has changed dramatically in a few short years.
In these unprecedented times, conventional wisdom and standard ways of thinking no longer apply. These times call for individuals who can offer solutions with completely new values unbound by precedent.

Humanics, an innovative field consisting of biomedical sciences combined with physical sciences, engineering, and informatics, guides students to master both disciplines for their own research while continuously breaking down and overcoming existing barriers.
This will lead to ideas like none ever seen along with science and technology breakthroughs that were thought to be impossible.
The more unknown the terrain, the greater its potential to move the world.

Don’t follow another person’s path. Create your own.

The Ph.D. Program in Humanics cultivates leaders equipped with doctoral-level knowledge and skills in the fields of both biomedical sciences and physical sciences/engineering/informatics, together with the scientific expertise to achieve integration of these fields and the capacity to apply them in wider society. The program aims thereby to address challenges to human life and health and enables the sustainable prosperity of all humankind. We will welcome students who have studied either biomedical sciences or physical sciences/engineering/informatics, and who are willing to study the other discipline and fuse them together. People who have worked as a physician or an engineer are also very welcome.

Takeshi Sakurai
Program Leader,
Ph.D. program in Humanics
Associate Director/Professor,
International Institute for Integrative Sleep Medicine (WPI-IIIS),
University of Tsukuba

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Biomedical sciences × Physical sciences・Engineering ・Informatics =

Social background and installation of the Ph. D. Program in Humanics

In order to overcome the life and health challenges of the present and future and for humanity to prosper sustainably, we must constantly incorporate knowledge and technology from different fields into those of biomedical sciences of the moment and keep challenging ourselves to create a new paradigm.

To create a new paradigm by integrating biomedical sciences and different disciplines, it is necessary to develop leaders who can talk with each other using the languages of both fields, understand both deeply, and integrate them in order to make it a reality.

For example, da Vinci, a surgical support robot, was developed from the idea of a surgeon entrepreneur with an engineering background, and the Wearable Cyborg HAL was inspired and implemented in the real world by an engineer who had studied human physiology. Optogenetics, a leading candidate for the Nobel Prize, that manipulates neuronal activity with light was founded by a psychiatrist who was well versed in optical technologies and genetic engineering. However, the educational system to develop such leaders capable of integrating biomedical sciences and different disciplines, did not exist in our country.

This program is a Ph.D. program that aims to overcome intractable challenges of life and health and to ensure the sustainable development of humanity, by developing outstanding talents who can create a qualitatively different paradigm that goes far beyond the common sense of biomedical sciences and physical sciences/engineering/informatics - that is, ZERO to ONE -.

The program is adopted by MEXT, the Ministry of Education, Culture, Sports, Science and Technology “ WISE Program (Doctoral Program for World-leading Innovative & Smart Education)”. The program received the highest score in the final evaluation in 2024.

The WISE Program

（Doctoral Program for World-leading innovative & Smart Education）

At its core, what propels the WISE Program is each university leveraging its unique strengths and capabilities. Building upon their heretofore accomplishments in campus reform, these universities carry out systematic collaborations with other universities, research institutions and corporations in and outside Japan. By establishing integrated master's-doctoral programs, which over a 5-year period endow their students with a melding of top world-class educational and research prowess, these universities cultivate the kind of outstanding Ph.D. professional who can pilot forward various sectors of society. Concurrently, the program propels the establishment of excellent academic hubs capable of sustainably advancing human resource development and exchange and of generating new joint research initiatives.

https://www.jsps.go.jp/j-takuetsu-pro/data/WISEbrochure_en.pdf

What is Humanics?

“Humanics” is an academic field that sheds light on the fundamental principles of physiology and pathology of the human and generates new science and technology to achieve a healthy and comfortable life of human beings in the society.

In order to nurture the Humanics talents, this program has a unique educational system to cultivate students' “bidisciplinary expertise” in the fields of both biomedical sciences and physical sciences/engineering/informatics.

In addition, the program is designed to have them acquire “Capability of Problem Discovery”, “Capability of Breakthrough”, and “Capability of Accomplishment” that are practically necessary to establish research topics and to apply research results to society.

Humanics Aims for Fusion Research

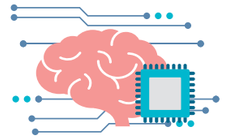
（CASE01, CASE02）

“Humanics” aims to promote integrated research that creates a qualitatively different paradigm that goes far beyond the common sense of biomedical sciences and physical sciences/engineering/informatics.

Future Image of Students

- **Researchers** creating a new interdisciplinary field
- **Entrepreneurs** who industrialize complementary technology of human function
- **Medical doctors** with knowledge of cybernics and informatics
- **Government administrators** who can create a novel plan of medical administration

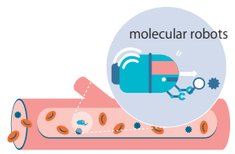
CASE 01



Improvement of cognitive function and mental health

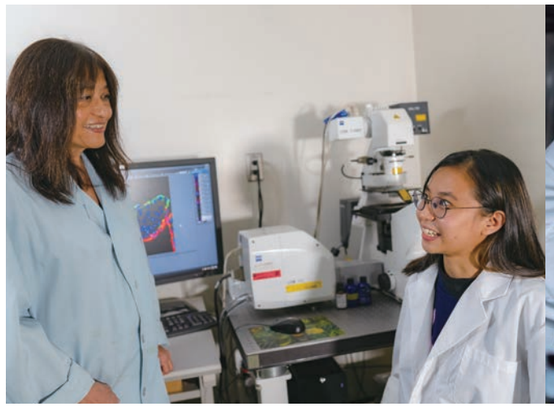
Development of artificial neural network devices that can be linked to the brain, and understanding of sensibility, motivation, and thoughts, etc.

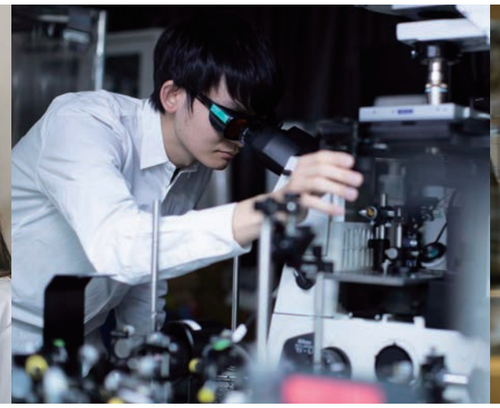
CASE 02



Overcoming intractable diseases by molecular robots

Development of molecular robots to intervene in cell functions based on the understanding of molecular pathogenesis and to control infectious diseases and cancer.





Why “Humanics” research now?

What kind of talent does the Ph. D. Program in Humanics seek to develop? Why is Humanics a necessary academic discipline in the future? Professor Masashi Yanagisawa, the program coordinator of this program and a world leader in sleep research, and Professor Yoshiyuki Sankai, a leading expert in robotics and Cybernics research in Japan, talked passionately about their own experiences.

Yanagisawa First, I'll ask Prof. Sankai: **the biggest selling point of the Ph.D. Program in Humanics is to cultivate leaders who can fluently use the “languages” of both biomedical sciences and physical sciences/engineering/informatics.**[1] That's exactly what Prof. Sankai is like. You are working on robots right now. What made you focus on exoskeleton-assisted robots?

Sankai I always liked robots and the sciences, but I think that my interest in “people” played an even larger role in shaping my area of focus. When looking at human life, there are some that reach an old age before succumbing to illness, while others die too early from illnesses they were born with. I wanted to create technology that improves, expands, and remedies the natural functions of humans across this spectrum of people, and going one step further, I wanted to create robots, cyborgs, and Cybernics technologies that support the evolution of medicine, welfare, and what we consider daily life, effectively evolving the human race. **When all is said and done, “people” are at the center of all of my outputs.**[2]

Yanagisawa When did you decide to make such a robot?

Sankai Probably by the time I reached junior high school. In fact, I had already been thinking about wanting to get Ph.D. in both engineering and medicine.

Yanagisawa That's exactly Humanics. You got a Ph.D. in Tsukuba?

Sankai At that time, the University of Tsukuba had a large number of faculty members because the medical science and engineering departments were newly established. Because of that, I luckily had two professors taking care of me. One was a professor of system control / blood purification treatment in a new engineering field, and the other was a professor of human machine / control. My research involved tactile feedback from a small robotic fingertip touching the stomach wall to find tumors using master-slave technology.

Yanagisawa So you got a degree in medical engineering, but both mentors were engineering professors. How did you study biology and medicine?

Sankai That is a good point, Professor Yanagisawa (laughs). At that time, there was a rule at the University of Tsukuba that required us to take lectures from other departments. In other words, **since I was an engineering student, I had to take classes outside of engineering, so I chose medicine.**[3] I enrolled in courses by Professor Hori, a Professor of Cardiac Surgery, and the Dean of Medical School, University of Tsukuba.

1. Educational Subjects in Humanics
In order to carry out, for example, medical-engineering collaboration, we need leaders who can have conversations in the languages of biomedical sciences and of engineering, deeply understand both fields, and create a new paradigm by fusing them together.

2. What is Humanics? (Fig.1)
A discipline that clarifies the principles of homeostasis of life, the physiology and pathology of the "human" as an individual, and creates new science and technology that can realize a healthy and comfortable life as a "human" in society.

Yanagisawa Professor Motokazu Hori also taught me when I was a medical student.

Sankai I was the only engineering student enrolled in his class. When I was told to come to the hospital at 7:30 in the morning, there would be a conference taking place already. Patient slides came out one after another, and terms I had never heard before were being tossed around. When that finished, we would go to each patient. This is the so-called “Daimyo Procession”.

Yanagisawa The Professor's round!

Sankai When we made our way to the patients, the professor who found out that I was an engineering student would always asked me a lot of difficult questions. He would ask things like “what is the pore size of the artificial kidney membrane now?” so, I always felt a lot of pressure (laughs). But when we were allowed to observe surgical operations, Professor Hori kept me at the front and explained everything to me one by one. In a sense, he was doing what Humanics mentors would be doing nowadays.

Yanagisawa Great.

Sankai It was very nice to experience these moments every week in my youth. In retrospect, it was wonderful to have a culture that accepted different worlds with different approaches simultaneously. I think the same could be said for the academic discipline of Humanics.

Yanagisawa The improvised way you learned both fields is made commonplace in Humanics. In the case of Professor Sankai, you may have happened to take medical classes, but it is not usually possible for an engineering student to get into a surgical site and see a clinical “daimyo procession” and an operating theater. This is something that even students studying medical engineering cannot easily experience. There is a strong impact if it can be done as a matter of course. You also touched the language spoken on the spot.

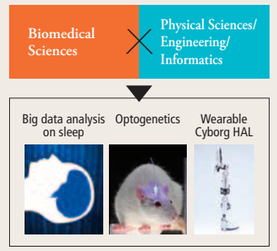
Sankai What surprised me was that nobody would explain any of these terms. The lecture just proceeds with the assumption that everyone is following, so I had to study them on my own. The great thing about Humanics is that it grants the opportunity to jump into the frontier of the real world where you are compelled to keep up.

Yanagisawa Now let's talk about me. In high school, I was a typical STEM student studying only physics and chemistry. I then enrolled in the school of medicine at the University of Tsukuba. When I was the first year student, I took the class taught by Professor Kaichiro Yanagisawa (unrelated) of genetics, and I realized that modern biology is very exciting. In the meantime, I had the opportunity to meet with physical science and engineering professors, joined a group of young researchers of mathematical engineering, and was exposed to fields such as medical informatics and quantitative analysis. In 1985, when I was a sixth-year medical student, I also wrote an original paper on the subject of cell cycle.

Sankai That's quite early.

3. Pre-admission program in Humanics
In collaboration with bachelor's and master's programs, applicants in the medical sciences (6 years system) who wish to enroll will be given an opportunity to study physical sciences, engineering and informatics, and applicants in the physical sciences/ engineering/ informatics (4 years) will be provided basic knowledge in medicine, as well as practical training and exercises.

【Fig.1】
Big data analysis of sleep, optogenetics, Wearable Cyborg HAL, etc. are created by the fusion of biomedical sciences and physical sciences/engineering/informatics.



Yanagisawa Masashi × Sankai Yoshiyuki

Masashi Yanagisawa

Program coordinator,
Ph. D. Program in Humanics
Director/Professor,
International Institute for Integrative Sleep Medicine(WPI-IIIS),
University of Tsukuba

Research field：Neuroscience

Yoshiyuki Sankai

Co-Coordinator,
Ph. D. Program in Humanics
Director,
Executive Research Director,
Professor, Faculty of Engineering, Information and Systems,
R&D Center for Frontiers of MIRAI in Policy and Technology,
Center for Cybernics Research,
University of Tsukuba

Research field：Cybernics

Yanagisawa Masashi × *Sankai Yoshiyuki*

Becoming a talent who can handle the languages of both medical sciences and physical sciences/engineering/informatics.

Yanagisawa I came up with a quantitative model by myself and performed mathematical simulation of the cell cycle. The experiment was conducted at the Lawrence Livermore Laboratory in the United States for three months each in the winter and summer of 1984. The cell cycle was experimentally measured by flow cytometry, which was state-of-the-art at that time, and simulated with the Cray-1.

Sankai Cray-1, it was a supercomputer of the era wasn't it? It must have been pretty special to be able to have access to an environment with Cray-1 in your days.

Yanagisawa I didn't even study for entrance exam in high school, but there was an award in my high school that commended me for excellent research in science. I decided to take it with a friend who was strong in software and we made a personal computer from scratch. Created a simple interpreter programming language using assembler language.

Sankai That's amazing.

Yanagisawa After I entered graduate school, I became so involved in experimental biology research that I was far away from actually using quantitative methods. But I've always had a sense of crisis. This is because, even though we were doing joint research with the mathematical sciences, we sometimes did not understand each other. I thought this was very bad. **That's why when I applied for this program to the MEXT Graduate School of Excellence, I argued that "we should have a double mentor system." Students were always assigned to two supervisors to force them to learn medical biology on the one hand and physical sciences/engineering/informatics on the other.[4]** For example, students from engineering will have direct access to clinical medicine from the first year, just like Prof. Sankai. They are still young and can absorb a lot if exposed. I think that such an environment will cultivate outstanding talents.

Sankai It is nice that we agree that the target is "people." There are a lot of things in the natural sciences that exist without the presence of humans, but "people" cannot be the target without the existence of humans. In that sense, Humanics is a place where this image of people provides a certain directionality while medicine and engineering can march forward as one.

Yanagisawa It's just right for the times. When I entered graduate school, it was difficult for biology to generate data anyway, but in the age of omics, it became relatively easy to get large amounts of biological data. Biology students in Humanics are now trying to use mathematics and informatics as tools. Eventually, I think we will go one step further from here, which will lead to biological theory and concepts from the mathematical side.

Sankai What is important and at the core of this interaction is "evolving together". Before I got my doctorate in graduate school, I was actually considering reentering the university to learn medicine from the basics. Instead, a professor advised me, "why don't you try to coordinate with medicine." Now that I think about it, I'm very grateful for his advice as this accelerated my growth beyond my imagination.I really believe that you, Professor Yanagisawa, also see Humanics as a curriculum that develops people, and medicine and engineering are really compatible.

Yanagisawa For example, medicine literally uses engineering as a tool, but in fact, you will not be able to produce sharp results in bioinformatics, for example, unless you have a truly deep understanding. And there are extremely few good bioinformaticians in Japan. If you don't understand mathematical principles, you can't be an expert, and the language is quite different in the first place. It is essential to be able to handle both worlds of biomedical sciences and physical sciences/engineering/informatics.

Sankai However I think it's very important that you are able to clearly depict the concept behind the language in your head, and not just have a superficial understanding of the language. A high-level understanding of the language should allow you to jump to the next stage of thought and discussion instantly. Isn't this Humanics a program born with that in mind?

Time is limited, so while we can never be sure if we can reach the goals we place ourselves, Humanics can act as a trigger for some people who may go all the way. It is important for Humanics to become a field that allows for constant growth in a person so that they can navigate life in this society.

Yanagisawa Ph.D. Program in Humanics has conducted an entrance examination twice a year so far, and there were 12 applicants for the winter exam in 2019. In the 2020 class, 14 students have passed. Enrolled students are outstanding, and there are many international students. This time, we also did an overseas entrance exam. Finally, would you like to give a message to students who are planning to take Humanics?

Sankai I have only one message. Whatever your goal may be, become a pioneer who enjoys every moment of their journey. You may encounter many obstacles, but our time in life is limited. **I want you to never forget the wonder and excitement of exploring new areas in your field.[5]**

Yanagisawa What I often say to young people is to study what they think is really interesting. If you don't find it genuinely interesting yourself, there's no way you can explain the excitement to others. That's why in choosing Humanics, I want you to pursue questions and perspectives that you feel are truly really interesting. I want you to do something that you can boast about, "this is interesting" not just because someone said, "it would be interesting if you did this." You don't have to force others to understand it. It's more important to keep believing in yourself that this is really interesting.

4. Double mentor system in Humanics (Fig.2)

Students earn a Ph.D. degree through the "double mentor system", in which faculty members from both biomedical sciences and physical sciences/engineering/informatics initiate a research collaboration to provide guidance to students. "Reverse mentor system" means that students impart knowledge from one field to another and act as a bridge between different research fields. Students will learn bi-disciplinary expertise as well as communication skills.

5. Career path of Humanics students

- Researchers creating a new interdisciplinary field
- Entrepreneurs who industrialize complementary technology of human function
- Medical doctors with knowledge of cybernics and informatics
- Government administrators who can make a novel plan of medical administration

【Fig.2】 Example of Humanics research

Biomedical sciences × physical sciences/engineering/informatics enables doctoral research based on joint research that fuses two fields.

Biomedical sciences	Physical sciences/Engineering/Informatics	Humanics research
 **Vascular matrix biology** Director of Life Science Center for Survival Dynamics, Tsukuba Advanced Research Alliance (TARA) Professor **Hiromi Yanagisawa**	 **Smart polymers** Faculty of Pure and Applied Sciences Professor **Mitsuhiro Ebara**	Investigation of the role of macrophages in FBN1 mutant mice and development of therapeutic strategy for aortic dissection
 **Spine and Spinal Surgery & Regenerative Medicine** Orthopedic Surgery Faculty of Medicine Visiting Professor **Masashi Yamazaki**	 **Cybernics** Dean of the Institute of Systems and Information Engineering Professor **Kenji Suzuki**	Application of Wearable Cyborg HAL to CNS disease and its gait analysis for each disease
 **Immunology** Faculty of Medicine Professor **Kazuko Shibuya**	 **Glycan engineering** National Institute of Advanced Industrial Science and Technology(AIST) Office Manager **Hiroaki Tateno**	A discovery of the glycan-based drug candidate for atopic dermatitis
 **Neurophysiology** Center for the Evolutionary Origins of Human Behavior, Kyoto University (EHUB) Professor **Masayuki Matsumot**	 **Computational Neuroscience** Faculty of Engineering, Information and Systems Professor **Jun Izawa**	Identify the cerebral neural circuits that make decisions, aiming to realize artificial intelligence that makes decisions using the same mechanism as the brain
 **Neuroscience of sleep** International Institute for Integrative Sleep Medicine (WPI-IIIS) Assistant Professor **Sakiko Honjoh**	 **MRI Medical Physics** Faculty of Engineering, Information and Systems Associate Professor **Tomokazu Tsurugizawa**	Elucidation of functional networks in the whole brain during sleep using the newly developed functional MRI.

Four features of our Program

Pre-admission program
Double mentor system
Reverse mentor system
Collaboration with outstanding research institutions

Feature 1

Pre-admission program

Seamless transition to an integrated education system

Physical Sciences /Engineering /Informatics

Biomedical Sciences

Pre-admission Program

Admission

Physical Sciences /Engineering/Informatics

Medical Cybernics
Artificial intelligence
Computational biology
Numerical and statistical analysis
Biological signal processing
Material organic chemistry
Nano material engineering, etc.

Basic Medicine

Anatomy,physiology,pathology, pharmacology,immunology, etc.

Clinical Medicine

Basic knowledge of treatment and clinical condition of each organ,social medicine, epidemiology, bedside, etc.

This program offers prospective students an opportunity to have an interdisciplinary background of the program before enrollment as a pre-admission program in their undergraduate years, which creates a seamlessly integrated system for transition to graduate education.

Feature 3

Learning with friends from all over the world

We have curriculums in English so that you can earn Ph.D. degree with English taught classes. Also we have multilingual staff to support your student life. You will be able to meet students from all over the world with different backgrounds, so you can exchange ideas with each other and cultivate internationality. We have travel grants to support your domestic/ international researches.

Feature 4

Combination of biomedical sciences and physical sciences/engineering/informatics

The program is supported by a variety of research centers and companies from biomedical sciences and physical sciences/engineering/informatics

Private companies

- CYBERDYNE Inc.
- Toyota Motor Corporation (R&D Center for Strategic Frontiers in Social Planning)
- Hitachi, Ltd.
- S' UIMIN Inc.

Research centers

- International Institute for Integrative Sleep Medicine (WPI-IIIS)
- Center for Cybernics Research
- R&D Center for Precision Medicine (PMC)
- National Institute of Advanced Industrial Science and Technology (AIST)
- National Institute for Materials Science (NIMS,WPI-MANA)

Overseas Universities

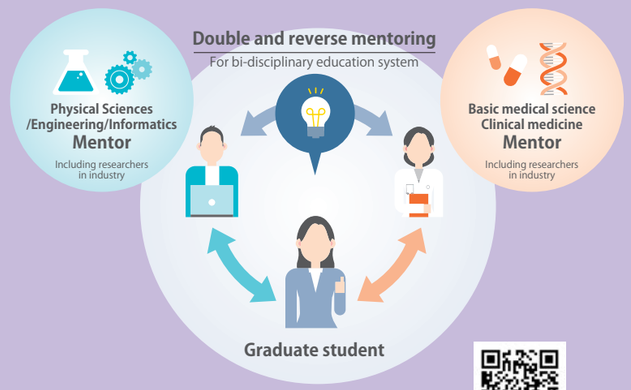
- University of California, Irvine
- University of Bordeaux
- National Taiwan University

Qualifying Examination

Feature 2

Double mentor and reverse mentor systems

Students earn Ph.D. degree through the "double mentor system", in which faculty members from both biomedical sciences and physical sciences/engineering/informatics initiate a research collaboration to provide guidance to students. "Reverse mentor system" means that students impart knowledge from one field to another and act as a bridge between different research fields. Students will learn bi-disciplinary expertise as well as communication skills.



Matching from about 100 mentors
https://www.phd-humanics.tsukuba.ac.jp/en/mentor/

Diploma policy※

For outstanding human talents

Ph.D. in Medical Sciences
Ph.D. in Science
Ph.D. in Engineering

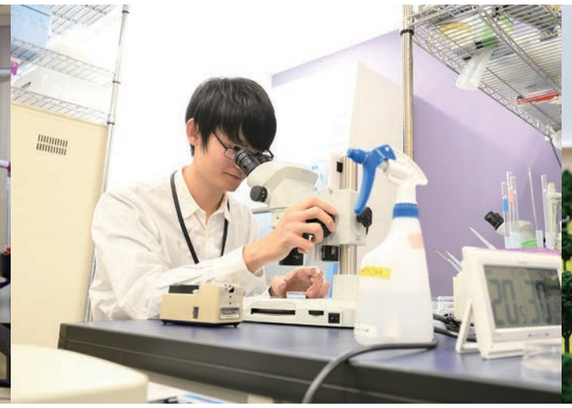
※What is the Diploma Policy?
In addition to the biomedical sciences, based on unique and excellent research topics that fuse the fields of physical sciences / engineering / informatics, high-quality results suitable for the doctor's degree are obtained and put together for a thesis. Ph.D. in Medical Sciences, Ph.D. in Science, or Ph.D. in Engineering will be given to a doctoral dissertation that has been compiled and meets the required criteria in the final examination.

1~2nd year

Double mentor and reverse mentor systems

Bachelor Graduate

Graduate



Extensive curriculum to develop human talents in the field of Humanics

In Ph. D. Program in Humanics, students study basic/clinical medicine or physical sciences/engineering/ informatics through lectures and exercises. With e-learning and PBL, students are specialized in bi-disciplinary research under a double mentor system. In addition, through taking entrepreneurship education, internships, overseas lab rotation, etc., we will help students cultivate motivation and negotiation skills to play an active part in the world.

Students having graduated from a 6th year course of a university or one with a master's degree may be eligible to apply for a QE even in the first year if they have sufficient academic achievements.

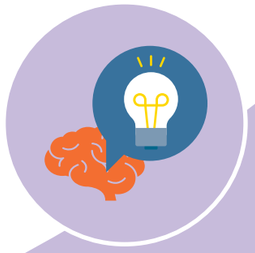
Interdisciplinary learning through practices and exercises

- ○ International Research Rotation (1 month)
- ○ Internship (1 month)
- ○Appropriate Technology

QE by the end of the 2nd year

Evaluated for the ability to propose a research plan in the area of Humanics

QE：Qualifying Examination, a test to evaluate the ability of proposing a research plan in the area of Humanics. The test period depends on the degree of achievement (the second year in the standard)



Integrated research of biomedical sciences and physical sciences/ engineering/ informatics

Cultivating capability to generate the ZERO to ONE task based on interdisciplinary learnings

Dissertation Defense
5th-year-end in the standard

Degree completion requirements

- ○ Having passed QE
- ○ Obtaining 45 credits or more
- ○ Research results equivalent to original papers published in peer-reviewed international journals
- ○ Achieving the required score of the portfolio type achievement evaluation

Quality assurance by portfolio-based achievement evaluation

- **Bi-disciplinary Expertise** — The capability to integrate two or more research fields based on doctoral-level knowledge and skills in biomedical sciences and one of physical sciences/engineering/informatics.
- **Capability of understanding in bi-disciplinary research from a macro-perspective** — The capability to understand and explain the global trends in biomedical sciences and physical sciences/engineering/informatics.
- **Capability to design a bi-disciplinary research** — The capability to formulate a new paradigm and overcome difficulties by conducting integrated research through bi-disciplinary expertise.
- **Capability to produce outcomes from a bi-disciplinary research** — The capability to execute a bi-disciplinary research to implement the academic and social impacts of the integrated researches toward society.

Ph.D. in Medical Sciences
Ph.D. in Science
Ph.D. in Engineering

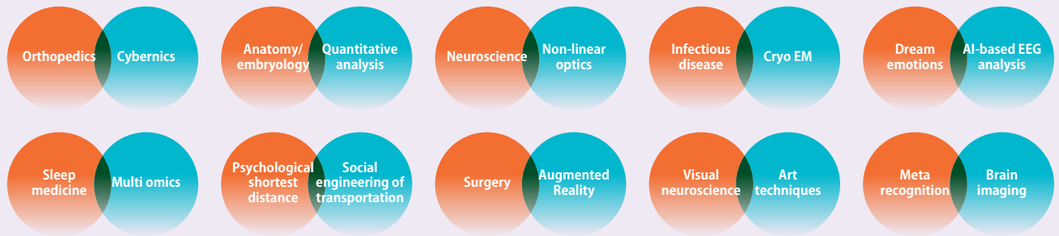
Becoming an outstanding Ph.D. talent creating new industries and interdisciplinary fields based on Humanics research!

- **Researchers** creating a new interdisciplinary field
- **Entrepreneurs** who industrialize complementary technology of human functions
- **Medical doctors** with knowledge of cybernics and informatics
- **Government administrators** who can make a novel plan of medical administration etc. ……

Integrated Research Humanics is pursing

In Humanics - that brings together knowledge from various fields to create new science and technology, research born from your ideas may change the future of society and each of us.

Humanics research example



Maria Thea Rane Dela Cruz Clarin

Fields of study
Vascular Matrix Biology / Smart Polymers

Mentors
Dr. Hiromi Yanagisawa / Dr. Mitsuhiro Ebara

Quenching Curiosity through Scientific Work

Since I first heard about the Ph.D. Program in Humanics cultivating bi-disciplinary research, I have been fascinated with the countless potential opportunities. I graduated with a biological engineering degree, where I previously worked on the design of biomaterials. As I am interested in doing deeper biology, particularly in elucidating molecular mechanisms underlying diseases, I decided that this program is the most suitable for me. This led me to my current research theme revolving around the development of a therapeutic strategy using smart polymers for aortic dissection (AD). In my main mentor's lab at the TARA center, we investigate the pathophysiology of AD, while the synthesis of polymers and the development of nanoparticles are done at my sub-mentor's lab at NIMS. To manage my progress, I switch back and forth between two laboratories. My mentors have provided me with a nurturing environment where I can freely pursue my interests while ensuring that I make progress on my work through consistent communication.

It has been helpful to plan the experiments ahead, but it is also important to be adaptive whenever there are unexpected obstacles along the way and to learn from each experience. Moreover, my colleagues from both laboratories have been very supportive, which makes me further appreciate the value of collaboration. Through this program, I am able to quench my curiosity by doing scientific work, while aiming to contribute to society. Indeed, I always learn something new, not only in my own research, but through the access and exposure to different research fields, I get to immerse myself in different perspectives as well.

Learn Widely and Expand Your Options

I started my research in neuroscience in the laboratory of my current main mentor, Dr. Hayashi, since my senior year of the College of Biological Sciences, University of Tsukuba. In my research, I felt the need for efficient image processing techniques to extract and count the number of signals in images of mouse brain slices. This motivated me to enroll in the Ph.D. Program in Humanics that seemed most suitable for these kind of research topics fusing biomedical sciences and physical sciences/ engineering. I decided to engage in developing an image processing program for whole brain of mice under the supervision of Dr. Takizawa, my sub-mentor, who specializes in image processing engineering.

At present, I have been conducting experiments and immunohistochemical staining on mice under the direction of Dr. Hayashi. Furthermore, using the microscopic images obtained from there, I have been developing a new program for image processing with the guidance of Dr. Takizawa and his lab members. Thanks to the Program's interdisciplinary nature, I managed to publish a paper as early as April of my second year that showed my achievements in both fields. The image processing component in my research attract additional interests of other researchers and deepen discussion with them when I attend academic conferences in life sciences.

For the Program's curriculum, I initially experienced some difficulties with some courses that were not in the field of my specialization. However, those courses taught by faculty members with a high level of expertise were valuable and have helped me a lot. It may have taken much longer time if I had to learn them on my own. The Program has an advantage over other programs in that students can comfortably focus on their research. For example, I took most compulsory classes in the first year, which has enabled me to focus more on my research after the second year.

The diversity of the faculty members and students is one of the outstanding features of the Program and has facilitated me to absorb the knowledge across different fields. Through interacting with them, I have been able to expand my capacities both in my research and myself.

Hibiki Okamura

Fields of study
Sleep science / Image processing technique

Mentors
Dr. Yu Hayashi / Dr. Hotaka Takizawa

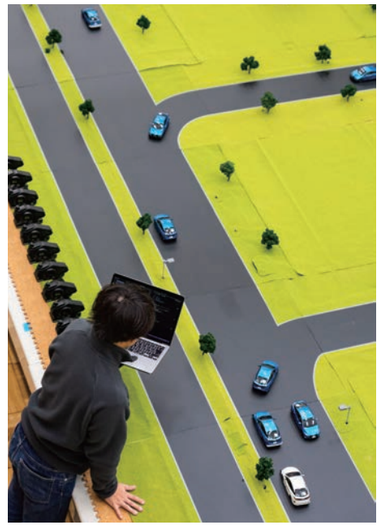
Takahiro Noguchi

Fields of study
Mathematical informatics / Human sleep science

Mentors
Dr. Ando Hiroyasu / Dr. Abe Takashi

New Challenges in Different Fields

When I enrolled in the Humanics degree program to pursue a PhD degree, I was working as a researcher at the University of Tsukuba. During my master's degree, I majored in urban planning. I remember that when I graduated from the program and started working there, I was often agonizing over the possibility of connecting measurement data obtained from people to my research. That was when I encountered the Humanics degree program. This program allowed me to challenge myself in a new field and, furthermore, as a fusion of different fields, I could work hard on my research under two mentor professors. Under Professor Ando, I am studying the effects of human decision making on self-driving cars using miniature traffic models. By using physical models, we can capture phenomena unique to real space that cannot be supplemented by model-based simulations. In addition, under Dr. Abe, I am developing and researching a method for estimating human arousal levels using a non-contact device. Although the two areas of research seem to be independent, I often use the knowledge I have gained from one to advance the other, and I spend my days encountering new discoveries. In this program, we have professors from different fields as mentors, which allows us to develop multidisciplinary and multifaceted ways of thinking across fields. In addition, my fellow students have a wide range of backgrounds in their fields, which I believe provides the opportunity to conduct research activities in a very stimulating environment.



Asking the Right Questions

Before entering the Humanics program, I was pursuing a master's degree in biomedical engineering in my home country, Colombia. In the final year of the program, I was offered to come to the University of Tsukuba as an exchange research student through the transpacific program. That's how I arrived at the artificial intelligence laboratory and met my current advisor. I was introduced to the Humanics program by another professor working in the AI lab and, as a person who couldn't choose between pure engineering and pure biomedical sciences (which is why my bachelor's and master's degrees are in biomedical engineering), I considered the Humanics program to be the perfect fit for my aspirations to pursue high-level research in both areas.

My research topic is prosthetics, specifically the development of new passive lower limb prosthesis and the influence of this designs in amputees' biomechanics, including gait and muscular variables. I strongly believe that the research and development of medical devices is inevitably (and finally) heading towards bi-disciplinarity, such that significant impact inpatients' outcomes and quality of life can only be achieved by the acquisition and development of bi-disciplinary knowledge and expertise. Humanics, as it pertains to my research, is not only about new devices working properly but also about asking relatively new but powerful questions as to how the device influences the user's physiology, how the patient is also affecting the device, and even how the devices make the users feel. Simultaneously acquiring knowledge from two different fields can be challenging and time consuming. Having a strong financial support from the program really helps to focus only on the important things, for which I am really thankful . Finally, another thing which I believe makes this program unique is the immense diversity of research fields, cultures , and nationalities, which allows for endless combinations and the development of truly innovative and distinctive multidisciplinary projects.

Sergio Alberto Galindo Leon

Fields of study
Prosthetics / Orthopedics

Mentors
Dr. Kenji Suzuki / Dr. Masashi Yamazaki

Ph.D. Program in Humanics

CROSS TALK

Ryota Ishikawa

Research Area : Informatics/Computational neuroscience
Mentors : Faculty of Engineering, Information and Systems
Dr. Jun Izawa
Faculty of Medicine　Dr. Masayuki Matsumoto

Felix Adolfo Ipanaque Arevalo

Research Area：Cognitive Neuroscience/AI
Mentors：International Institute for Integrative Sleep Medicine
Dr. Takashi Abe
Center for Computational Sciences　Dr. Kazumasa Horie

Minori Masaki

Research Area : Sleep medicine/Nonlinear optics
Mentors : International Institute for Integrative Sleep Medicine
Dr. Masashi Yanagisawa
Kyushu University　Dr. Hideaki Kano

Nicholas Ryan Schwier

Research Area : Computer vision and image media/Neuroscience
Mentors : Center for Computational Sciences
Dr. Yoshinari Kameda
Faculty of Medicine　Dr. Masayuki Masu

Learning from different fields opens up new possibilities.

Felix: How did you find the Humanics program (HX)?

Minori: I was originally interested in sleep research, so I visited the Yanagisawa/Funato laboratory, and I heard about HX from Masashi.

Nick: I used to work at the office of international affairs, and I found HX there.

Ryota: I heard about HX from Izawa sensei, when I was in the second year of the master's program and looking for a PhD program. I found that HX offers excellent student support, so I decided to take the HX exam.

Nick: Can you speak more about your background, how you thought your profile would fit into HX, and how you became interested in HX?

Minori: My background is in medicine. While I was working as a resident, I felt that medical treatment was not based on medical science alone, as CT and MRI were born out of knowledge in physics. I thought we would need to have even more knowledge of other fields in the future. So, I felt HX was suitable for me.

Nick: I was a photographer for 10 years, I mainly worked on commercials and advertising, but I decided to restart my career in science. I came to University of Tsukuba to learn biology. Since my artistic knowledge wouldn't help me in a traditional biology program, I let that part of myself go and focused on my new path. HX has allowed me to combine my previous art skills with my new biology knowledge to create a new way of researching how our minds work.

Ryota: My background is in psychology. I graduated from the School of Psychology at the University of Tsukuba. But I felt psychology has limited means for studying humans, their brain activity and computational principles. So, I got interested in informatics. Fortunately, during my master's program, I met Izawa sensei and started collaborating with his informatics and engineering laboratory. Because I was also interested in neuroscience, I decided to learn much more about experimental methods forexamining the human brain. My research topic and interest are interdisciplinary approaches between informatics and neuroscience, so HX represents the best way to achieve my goal.

Nick: Okay. Let's talk about advantages and disadvantages within HX.

Ryota: Yeah, one advantage is the financial support program, which allows me to focus on the research. I can concentrate on my research activities without other worries. So, the environment is my biggest advantage. The disadvantage is that interdisciplinary research requires a lot of time and funding. In my case, I research VR system engineering and, at the same time, the neuro-mechanisms of the brain. So, I need time to study both areas. Recently, I struggled to summarize my research and ideas in a paper, because the subject matter of informatics and neuroscience is so broad. It is challenging for me to present results and write papers.

Nick: I have the same exact problem. I'm writing a paper right now and I have no idea what journal to send it in, because it's a cognitive behavioral neuroscience experiment and uses Artistic theory, but it's also a VR engineering experiment. So, it's always challenging to decide which journal to submit to.

Minori: Learning about other fields is very difficult. My fields are medicine and nonlinear optical physics. Last year, I began studying quantum mechanics, which is very hard to learn. Because I am from medicine, it is also very difficult to learn important papers in other fields. In contrast, I can study optical physics with Dr. Kano, my mentor. He is a professor of optical physics, which makes it very easy to learn, not just by myself but also as he teaches me. I think learning about optical physics makes me realize how well commercial microscopes are made.

(Prof. Yanagisawa joins in the middle here.)

Nick: We're just discussing the advantages and disadvantages of the program right now.

Yanagisawa: Yes, I knew from the beginning that there are lots of difficul-ties and hurdles for each student to be an expert in both fields—that is, of course, not an easy thing. Still, I think that the program forcing you to do that, to at least try to do both, is actually very valuable thing. To be completely honest, I wish there had been such programs when I was in graduate school. No such program existed then, and I really wanted to immerse myself in two different fields. So, I think you may feel very stressed at this time, but 10 years later looking back, I hope most of you will feel that HX was a fun and valuable time, becoming an important asset to your career.

Nick: I think I would agree with you. I believe this program works best when someone has a vision and takes what tools or building blocks to help them pursue that vision.

Felix: One of the advantages I found in this program is that you have five years to get deep into what really interests you. Most of the PhD programs out there are three years long. So, five years was a good amount of time for me to engage in a completely new field.

(Professor Yanagisawa leaves the room at this point.)

Nick: What type of person is best suited for HX?

Minori: I think curiosity is very important. Because we must get to know other fields, talk to all kinds of people, and study this field, the people who can have fun learning other fields are the best suited for HX program, I think.

Nick: That's good answer, thank you. And Felix?

Felix: I feel the best fit for this program are people who have different and diverse interests—someone who wants to pick up one specific subject of one field and wants to try to combine it with a completely different field. In my case, I work at the intersection of cognitive neuroscience, AI, and psychology. Someone that has maybe worked in heterogenous spaces, with the willingness to explore new ideas, and who is also able to communicate their motivation in a compelling way.

Nick: Okay, thank you. I think this program is hard in more ways than just the obvious ones. I think, in order for someone to make it through, they need to have some sort of inner fire or inner drive that shoves them forward to a path that they want, because no one in this program is ever going to tell you what to do. And even if they do, it isn't the point of the program. So, I think that someone really needs to be able to push themselves forward, even if it's just them supporting themselves.

Minori: I think there are two goals in this program: One is a goal you will achieve by the end of HX; and the second is the goal of your life, so please answer it, starting from Felix.

Felix: I entered the HX program looking for a new idea that could later become a business opportunity. The idea of taking control of sleep and improving it was fascinating. I think that, for every flaw in human nature, there is an industry to exploit it—and sleep, like any other human need, has the potential to improve people's lives dramatically. I want to turn my work into a valuable outcome to make a spin-off company. In recent years, more people are becoming aware of the benefits of good sleep, and I want to support this trend. I already have a business background, an entrepreneurial background, and now I am gaining a scientific background that will give me the skills to make a good product in the future.

Minori: OK thank you. How about Nick?

Nick: Yes, so I guess, my immediate goal is to get either at least a postdoc position coming out of this program or, ideally, just get a position as a professor in a university in Europe—but anywhere, in any University that'll hire me. Then, eventually, what I want to be is a principal investigator with my own lab and teaching my own classes.

Minori: How about Ryota?

Ryota: Okay, my short-term goal is of course getting a PhD in this program. To achieve that, I need to solidify logic of my idea and my research. As for the final long-term goal, I have not yet decided whether to remain in academia or not, but I at least want to work in science and research. In academia, there are a lot of difficulties here, but I want to keep my interest in science and research topics. So, that is my final goal in life.

Minori: Thank you. For my goal, I'm studying sleep, which is so important for so many people. Still, the fundamental principles are not well known at this time. So, I want to reveal sleep mechanisms as much as possible using the non-linear optical microscope. I want to study this in the HX program. In the future, I plan to go further in academia and keep studying sleep or some other medical programs, and I want to someday become a professor.

Admission Information

Ideal candidate

We will welcome students who have studied either **biomedical sciences** or **physical sciences/engineering/informatics**, and who are willing to study the other discipline and fuse them together. People who have worked as a physician or an engineer are also very welcome.

Information for applicants

○ **Number of Students to be Admitted**
A few students

○ **Degree**
One of the following degrees.
Ph.D. in Medical Sciences, Ph.D. in Science, Ph.D. in Engineering

○ **Language used in the Program**
English or Japanese (Students can complete all requirements only in English.)

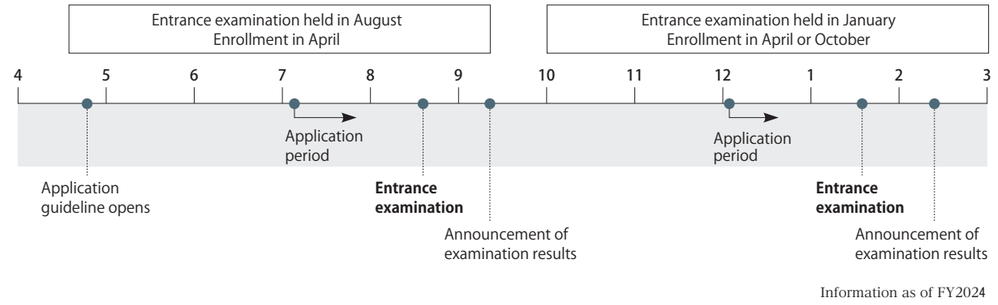
○ **Entrance exam information**
For the latest information, please see the website below.
https://www.phd-humanics.tsukuba.ac.jp/en/admission/

○ **Financial supports**
For the latest information, please see the website below.
https://www.phd-humanics.tsukuba.ac.jp/en/support/

○ **Student dormitory**
Student dormitory has been established to offer students excellent study environment along with the opportunity to experience autonomous civic life.
For further information regarding rooms, facilities and monthly rent, please refer to the website below.
https://www.tsukuba.ac.jp/en/campuslife/support-healthlife/accommodation/

Annual schedule of entrance examination

We have the entrance examination twice a year,
one in late August and the other in late January or early February.



Information as of FY2024

Application steps

Ph.D.Program in Humanics
Mentors list
https://www.phd-humanics.tsukuba.ac.jp/en/mentor/

STEP 1

● Contact two desired mentors

After confirming the research field of each faculty mentors, contact two desired mentors by e-mail and ask for a permission. Choose one mentor from biomedical sciences, and also choose another mentor from physical sciences/engineering/informatics. Decide which mentor is your main mentor.

STEP 2

● Application (web entry)

The applicant is required to submit the following items.
・Applicant information
・Research plan (about 1000 words in English)
・It is necessary to submit a TOEIC official certificate or a TOEFL test taker score report.
・Desired mentors; one from biomedical sciences, another from physical sciences/engineering/informatics.
・Recommendation letter from the dean of your department or your supervisor
・Academic transcript and graduation certificate
・Examination fee

For details, please refer to the application guidelines.

STEP 3

● Admission

Oral examination I concerns knowledge in biomedical sciences, physical sciences, engineering and informatics.

Oral examination II concerns your research proposal and career plan.

Information as of FY2024