

Life in the Universe and the Space Environments  
2023 Spring Semester

※This course is permanent online course. It is always online.

※Entire course will be delivered in English.

Online course:

Lecture recordings will be distributed via Moodle once per week on Wednesday.  
(This course is asynchronous online course.)

Instructor: Yas Hashimoto

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Office Hours: 12:10-13:10, 15:10-16:10 Wed,  
16:00~18:00 Thu,  
or by appointment.

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Textbook: None Required

Suggested Reading:

"Life in the Universe"  
J. O. Bennett and S. Shostak  
Addison-Wesley 2012

"The Search for Life in the Universe"  
D. Goldsmith and Tobias Owen  
University Science Books 2001

"Cosmos"  
Carl Sagan  
Random House, New York 1980

Approximate Grading Policy:

.Home Works x 2 30 %  
.Midterm Exam 35 %  
.Final Exam 35 %

Rough Class Schedule:

2023 Feb 22 Introduction  
2023 Mar 01  
2023 Mar 08  
2023 Mar 15  
2023 Mar 22 HW1 out  
2023 Mar 29 HW1 due  
2023 Apr 05  
2023 Apr 12 Midterm Exam  
2023 Apr 19  
2023 Apr 26  
2023 May 03  
2023 May 10  
2023 May 17 HW2 out  
2023 May 24 HW2 due  
2023 May 31  
2023 Jun 07 Final Exam

Lecture topics:

\*Introduction

.What is human? What is the life?  
.What defines the life on Earth?  
.Bias: Must they be similar to life on Earth?  
.History of non-Earth life search  
.Extreme Biology on Earth: Life in hostile environments  
.Asteroids in Antarctic: Life from Mars?

\*Life in the Solar System: Life in the Neighborhood

.Moon  
.Venus and global warming: Was Venus habitable before?  
.Mars: Are Martians there?  
.Titan: Giant moon around Saturn  
.Galileo moons around Jupiter -- Salt water ocean?  
.Jovian atmosphere  
.Comets and Asteroids: DNA in comets?  
.Interplanetary space

\*Astrobiology by Space Missions and Probes: Sending Robot Astronomers

.Viking 1 and 2: First little Martian search  
.Path Finder: First moving robot scientists

- .Spirit and Opportunity:
- .Phoenix: Landing on the Martian ice
- .Curiosity Rover: Modern robot biologist
- .Stardust/Hayabusa: Bringing dusts back to Earth
- .Voyager I and II: Voyage to outer planets
- .Galileo: Monitoring Galileo moons
- .Cassini and Huygens lander: Landing on methane ocean
- .Future Europa mission: Submarine in the ocean
- \*Human Mission to Mars: Can we send people to Mars?
  - .Oxygen, Water, Food supply
  - .Current shortest duration plan
  - .Current park-orbit plan
- \*Search for Ingredients of Life:
  - .Water, Methane, Oxygen, CO<sub>2</sub>, and Amino Acids
  - .Sample return mission
  - .Spectroscopic analysis of organic molecules
- \*Exoplanets: Planets around other Suns
  - .Binary stars and brown dwarfs: Too small Sun.
  - .Hot Jupiters: Easy-to-find planets
  - .Habitable Zones: Not too hot, not too cold
  - .Direct method and corona graph: How to see planets, directly?
  - .Eclipsing, transit, and micro lensing: Blinking Sun
  - .Pulsar decay
  - .Radial velocity methods: Watch Sun to move
  - .Gliese system (Gliese 581d): First good candidate
  - .Future experiments: Find small planets around small stars
- \*Technology of Space Travel
  - .Early rocket and liquid fuel rocket: Modern rockets
  - .Solid motors: Old technology with new idea
  - .Gravitational assist: How to accelerate without gasoline
  - .Atmospheric brake: How to slow down
  - .Ion engine: Weak but long push
  - .Solar sailer: Catching 'solar wind'
  - .Nuclear engine
  - .Special relativity and time delay: Time machine
  - .General relativity, singularity in space-time: Warm hole ?
- \*Long Term Influence from Space Environments: Can human survive in the space?
  - .Solar wind and Galactic cosmic rays: Risk for Cancer?
  - .Calcium depletion and loss of the muscle
  - .Oxygen, Water, and Food supplies: Need to bring little Earth ?
  - .Mental effects: Home sick in space
  - .Evolution.. : Can life adapt to the space environments
- \*Probability of Extraterrestrial Life in the Universe: Someone there?
  - .Minkowski space and light cone: The space is too big to communicate?
  - .Drake's equation: Calculate the percentage of life
- \*Probing the edge of the solar system and sending message beyond
  - .Pioneer 10 and 11: First messengers
  - .Voyager I and II: Golden records
  - .New Horizons: Mission beyond Kuiper Belt
- \*SETI: Search for Extraterrestrial Intelligence
  - .SETI/Communicating via Radio
  - . "Message from Earth" and "Hello from Earth"