

Schedule

2018 EON-ELSI Winter School in Earth-Life Sciences
January 22nd – February 2nd, 2017
Earth-Life Science Institute, Tokyo Institute of Technology
Tokyo, Japan

Students can arrive at ELSI after 8AM. There will be a lounge where you can relax and chat with other students or researchers. Coffee will be available after 830AM. All events to take place in ELSI Hall, unless otherwise noted.

Sunday January 21st

Arrival in Tokyo

Monday January 22nd

8:15 AM

9:00 – 9:30 AM

9:30 – 10:00 AM

Depart for ELSI (ELSI researchers will lead you from your hotel to ELSI)

Welcoming, Registration, and Coffee

Introduction to School and Goals

10:00 – 10:30 AM

Lecture

Yuichiro Ueno (ELSI)

Tectonic Description of Japan

The basics of plate tectonics and "differentiation of the Earth" will be covered in the context of the geology of the island of Japan and its evolution: A window to understand early Earth.

10:30 – 11:30 AM

Lecture

Takeshi Ohba (Tokai University)

Volcanology of Japan

Beneath the Japanese islands, the Pacific plate and the Philippine Sea plate are subducting. Sea water carried by the plates act as a reagent to melt hot mantle, which why Japan has about 100 volcanoes. These volcanoes have a variety of eruptive styles. In 1991, Mt Unzen produced a small pyroclastic flow, killing 43; in 2014, Mt Ontake suddenly ejected rock debris on climbers, killing 63. Volcanology is working towards a goal where variable eruptions can be predicted properly; active volcanoes should be observed comprehensively. The observation of earthquakes and ground deformation are established physical methods, while recently, chemical observation has drawn attention. In 2015, Mt Hakone weakly erupted. Before, during and after the eruption, significant changes were detected in the chemical and isotopic composition of fumarolic gases. In addition, rare volcanic disasters at Lakes Nyos and Monoun in Cameroon will be discussed.

11:30AM – 12:00 PM

Student Project Introduction

12:00 PM – 1:00 PM

Lunch

1:00 – 3:00 PM

Scientific Speed Dating

3:00 – 3:30 PM

Coffee Break

3:30 – 6:00 PM

Tutorial

Katie Petrie (ELSI/Univ. California-San Diego), *Marine Lasbleis* (ELSI)

Virtual Machine Setup

Set up your laptop to run software for tutorials; introduction to command-line computing with UNIX and python. (BRING YOUR LAPTOP)

6:00 – 9:00 PM

Dinner and Poster Session

Tuesday January 23rd

8:15AM

Field Excursion

Depart on Field Excursion (YOU MUST BE AT ELSI BY 8:15AM; DON'T BE LATE, WE WILL LEAVE WITHOUT YOU!)

Wednesday January 24th

Field Excursion

Thursday January 25th

Field Excursion

7:00 – 8:00 PM

Lecture

Tomohiro Mochizuki, Shawn McGlynn (ELSI)

Microbial and Viral Diversity

Microbial and Viral Diversity will be covered, focusing on specific examples from Japan.

8:00 – 9:00 PM

Lecture

Katie Petrie (ELSI/Univ. California-San Diego)

Diversity of Evolutionary Mechanisms

Going deeper than 'survival of the fittest' to understand how and why things change over time.

Friday January 26th

Daytime

Field Excursion

Late Afternoon

Return to Tokyo

Saturday January 27th – Sunday January 28th Free Time in Tokyo

Monday January 29th

9:00 – 10:30 AM

Lecture

Shigeru Ida, Hidenori Genda (ELSI)

Planetary Formation

We will overview the current understanding of the planetary formation model for the Solar system and exoplanetary systems and discuss open questions in planet formation, including the classical model and its problems, pebble accretion, gas giant formation, orbital migration, formation of rocky planets, rocky planet magma oceans, moon formation, tails of planetesimal accretion (late veneer, late heavy bombardment), water and organic molecule delivery during planet formation

10:30 – 10:45 AM

Coffee Break

10:45 AM – 12:00 PM

Lecture/Tutorial

Katie Petrie (ELSI/Univ. California-San Diego), Jennifer Hoyal Cuthill (ELSI/Cambridge)

Phylogenetic Trees

Methods to model ancestral relationships to understand evolution in the past. (BRING LAPTOP)

12:00 – 1:00 PM

Lunch

1:00 – 2:30 PM

Lecture

Shigehiko Tateno, Christine Houser (ELSI)

Earth Interior

The Earth's interior holds clues of the Earth's early surface environment and informs target selection for exoplanet studies. We will provide an introduction into how we study the structure and composition of the Earth's deep interior by combining seismology and mineral physics.

2:30 – 3:30 PM

Student Project Preparation

3:30 – 3:45 PM

Coffee Break

3:45 – 5:30 PM

Lecture/Tutorial

Ramses Ramirez, Hiroyuki Kurokawa (ELSI)

Planetary Atmospheres

How can we calculate our solar system's habitable zone? Climatic and geologic factors that have maintained habitable conditions on Earth over long timescales will be considered, and students will compute the habitable zone through simple programs. The driving forces of long-term change, including atmospheric escape and replenishment processes, and geochemical signatures of atmospheric evolution history will also be covered. (BRING LAPTOP)

5:30 – 6:30 PM

Telescope Night (or Student Project Preparation)

6:30 – 9:00 PM

Dinner and Student Project Preparation

Tuesday January 30th

9:00 AM – 12:00 PM

Tutorial

Juliane Dannberg, Rene Gassmoeller (Colorado State Univ.)

ASPECT – Mantle Convection

Introduction to numerical geodynamic modeling, in particular of the dynamics of the Earth's deep interior. This will include a general introduction and a hands-on tutorial explaining how to create such models with the open source software ASPECT. (BRING LAPTOP)

12:00 – 1:00 PM

Lunch

1:00 – 2:30 PM

Student Project Preparation

2:30 – 3:30 PM

Lecture

Shawn McGlynn (ELSI)

Approaches to Prebiotic Chemistry, Why Things Happen in Chemistry

What is chemical energy? How does it flow between molecules, and how can we quantify it? Here we will discuss some basics of statistical thermodynamics to be able to approach energy flow in prebiotic and biotic systems.

3:30 – 3:45 PM

Coffee Break

3:45 – 4:30 PM Lecture	<i>Henderson J. Cleaves (ELSI)</i> The Structural Basis of Biochemistry <i>Living systems are composed of a relatively few types of small molecules that are recombined to give rise to an almost infinite array of larger ones. What is the material basis of life? How are cells and their components constructed? The ways molecular structure determines and contributes to molecular function in biochemistry are discussed.</i>
4:30 – 5:30 PM Lecture	<i>Shawn McGlynn (ELSI)</i> Chemical Themes in Biology, Biological Energy, Material Organization <i>Contemporary biology uses an array of protein “machines” which act as energy converters – here we will survey these machines and find common themes in their conversion properties. Going from this we can try and ask which types may yet exist unknown in the contemporary biosphere, as which types may have been lost in the course of biological evolution through extinction, and which types life on other planets might employ.</i>
5:30 – 6:30 PM	Student Project Time
6:30 – 9:00 PM	Dinner and Student Project Time

Wednesday January 31st

9:00 AM – 12:00 PM Lecture	<i>Elizabeth Tasker (JAXA), Yuka Fujii (ELSI), Steven Desch (Arizona State University), Cayman Unterborn (Arizona State University)</i> Exoplanets <i>The principal of main detection techniques and our current picture of how planets form, from dust grains to terrestrial planets and gas giants and a brief discussion of migration, will be covered. Methods and the results of observations of exoplanet atmospheres, as well as the future prospects for characterizing Earth-like planets will also be discussed.</i>
12:00 – 1:00 PM	Lunch
1:00 – 2:00 PM	Student Project Time
2:00 – 2:45 PM Lecture	<i>Nathaniel Virgo (ELSI)</i> Introduction to Artificial Life and Self-Organisation <i>Artificial life is an interdisciplinary field that aims to understand life by simulating it. A key theme is that complex systems can behave very differently from the sum of their parts. This lecture will introduce key concepts and examples in the study of self-organisation, collective dynamics and open-ended evolution, with a particular focus on the origins of life.</i>
2:45 – 3:00 PM	Coffee Break
3:00 – 5:00 PM Tutorial	<i>Nicholas Guttenberg (Araya Brain Imaging)</i> Machine learning techniques for Artificial Life <i>This session will go through the basics of how neural networks are trained, and will show how to use those ideas to train multiple agents to communicate and coordinate to accomplish tasks. We will go through an example code training agents to tell each-other where a target resource is and to navigate to that resource. (BRING LAPTOP)</i>
5:00 – 6:30 PM	Student Project Time
6:30 – 9:00 PM	Dinner and Student Project Time

Thursday February 1st

9:00 – 11:30 AM Tutorial	<i>Katie Petrie (ELSI/Univ. California-San Diego)</i> Next Generation Sequencing, Evolution of Population, Omics, and the Continued Discovery of Biological Diversity <i>Hands-on introduction to next generation sequencing as an analytic and experimental tool using computational analysis of a public data set. (BRING LAPTOP)</i>
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11:30 AM – 12:00 PM

Lecture

Shigenori Maruyama (ELSI/Tokyo Institute of Technology)

Geology of Japan

The geology of Japan from 600Ma-present will be presented based on 1) the new concept of accretionary complex including numbers of fragments of oceanic lithosphere from the paleo-Pacific Ocean, and 2) extensive intermittent occurrence of tectonic erosion destroying the leading edge of continental crust. Present day Japan is regarded as the world standard of Pacific-type orogeny, leading to deformation of the earth's crust due to tectonic plate interactions. Through these interactions, the Japanese orogenic belt developed downward through time; this orogenic belt was carried far below the earth via plate tectonics, and the carried materials act as a deep-Earth heat generator, which we call the second continent. This second continent drives the amalgamation and dispersion of continents on Earth's surface.

12:00 – 1:00 PM

Lunch

1:00 – 2:00 PM

Visit to Archean Rock Museum (Depart from ELSI Hall)

2:00 – 2:45 PM

Tour of Rocks in and Around ELSI (Depart from ELSI Hall)

2:45 – 3:00 PM

Coffee Break

3:00 – 6:30 PM

Student Project Time

6:30 – 9:00 PM

Dinner and Elizabeth Tasker's talk and discussion

Friday February 2nd

9:00 – 10:00 AM

Lecture

Hilairy Hartnett (Arizona St. Univ.)

Biogeochemical Cycles in the Archean and Today

Today's ocean and the Archean ocean were both thriving ecosystems; but, modern organisms would not thrive in the Archean ocean and Archean organisms would find the modern ocean extreme. Both types of oceans have relevance for Astrobiology and exoplanet study. This lecture will outline the chemistry, biology, and habitability of modern and Archean oceans, and provide a framework for considering biosignatures and habitability in these contrasting environments.

10:00 – 11:00 AM

Lecture

Shigenori Maruyama (ELSI/Tokyo Institute of Technology)

History of life: from the birth to human beings

This interdisciplinary topic covers most scientific fields from galaxies to genomes. Earth's origin dates to 4.567Ga, and the present is the most fruitful time to solve this topic, long considered one of three mysteries in natural science: 1) origin of the Universe, 2) origin and evolution of life, and 3) origin of the brain. Critical time to drive significant evolution is synchronous from galaxy to genome and the Snowball earth (resulting in intense oscillations in temperature from -40 to +40 °C within 200 million years and triggered by starbursts due to a collision between the Milky Way Galaxy and a dwarf galaxy) seems to be a precursor of such evolution. As a result of such correlated events between Earth and the galaxy, life evolved to human through four steps: 1) emergence of life on earth, 2) evolution from prokaryote to eukaryote, 3) birth of metazoans and plants at 600Ma, and 4) finally the birth of human beings and rapid evolution to produce civilization. All such events have been recorded mainly on the Earth as geological record and the earliest sign of life is also given from such geological record.

11:00 – 11:15 AM

Coffee Break

11:15 AM – 12:15 PM

Lecture

Eric Smith (ELSI/Georgia Institute of Technology/Santa Fe institute)

Why are macro-worlds possible? What kind of macro-world is life?

The concept of entropy maximization applies much more widely than the domain of equilibrium thermodynamics where it was discovered, but when it is used in other domains, the relevant entropy function can change. This lecture will be about how to apply the idea of entropy maximization to dynamics and error correction, domains that are relevant to understanding the nature of the living state.

12:15 – 1:15 PM

Lunch

1:15 – 2:15 PM

Lab Tours in Small Groups (Depart from ELSI Hall)

2:15 – 4:15 PM

Student Presentations and Findings from Activities

4:15 – 5:00 PM

Discussion

ELSI Researchers

Open Questions in Astrobiology

Current open questions in astrobiology will be discussed, led by various ELSI researchers. This will also be a forum for open discussion about other issues in other related fields.

5:00 – 6:30 PM

Wrap-up

6:30PM -

Farewell Dinner