EVOLUTIONARY BIOLOGY CRASH COURSE

FIRST EDITION JULY 2022

Introduction to genetics and population genetics

Course by Stefany Moreno-Gámez

Understanding the forces that shape genetic variation is one of the main goals of evolutionary biology. This section will introduce basic concepts in population genetics and will explore classical models in the field that are used to study how allele and genotype frequencies change over time in response to processes like mutation, genetic drift and natural selection.

Mechanisms of molecular evolution

Course by Augustin Chen

Despite being the building blocks of life, genomes are extremely dynamic. This dynamic provides the raw material for evolution and selection to act upon, with consequences cascading to all levels of evolution, from the molecular world to species evolution. Thus, understanding the many forces acting on genomes and how they change over time is crucial to understand current models of evolution. This course will cover:

1. *DNA mutation and repair: building blocks*
2. *Functional consequences: by altering functions, some mutations provide material for selection to act upon*
3. *Peculiar mutations: exceptions to the rules*

Behavioural ecology

Course by Tanmay Dixit, Jan Kreider and Jana Riederer

The course aims to explore the way behaviour is shaped by evolution and how it feeds back into it. Evolutionary ecology shapes the way organisms behave and adapt and we will discover these aspects in the following subsections:

1. *(Inclusive) fitness and kin selection*
2. *Sexual selection*
3. *Coevolution and species interactions*
4. *Life history theory*

Evo-devo, plasticity and evolvability

Course by Jana Riederer

In this section we will discuss the role of evo-devo (evolutionary and developmental biology), phenotypic plasticity and evolvability in evolutionary biology. Specifically, we will discover the answer to following questions:

1. *What can genotype-ahenoty maps tell us about evolution?*
2. *How can development shape evolutionary trajectories?*
3. *What is the role of plasticity in evolutionary biology?*
4. *What factors affect a population's capacity for evolution?*

Apart from exploring the answer to these questions (and more), we will discuss recent work in these areas and link them to current debates and controversies in evolutionary biology.

Evolutionary Theory

Course by Giorgio Boccarella

With this course, we aim to provide you with an overview of evolutionary theory presented with a historical timeline. The story of this course will start at the beginning of evolution with the Darwinian thought on heritability and take you on a trip through time ending with modern concepts that we can learn from for example evolutionary computation. Three main points will be tackled:

1. *Darwinian thought to adaptive landscape*
2. *Kin selection, sexual selection and game theory*
3. *Introduction to evo-devo, macroevolution and evolutionary computation*

Tree thinking and speciation

Course by Henry North (part I) and Saudat Alishayeva (part II)

The course aims at giving students a background in what species are and how they come to exist. Furthermore, basic principles of species studies will be explained, with the focus on the use and understanding of evolutionary trees.

Part One consists of two subsections:

In 1.1, Speciation, we will consider:

1. *What species are*
2. *Modes of reproductive isolation across taxa*
3. *The relative roles of drift, gene flow and selection during speciation*
4. *How researchers go about studying speciation*
5. *Case studies of the genetic and behavioural basis of speciation*
6. *Secondary contact and reinforcement*
7. *The field of speciation genomics today*

In 1.2, Biogeography and tree thinking, we will consider:

1. *How evolutionary patterns are represented as trees*
2. *How to make evolutionary inferences based on tree topologies*
3. *Ancestral state reconstruction*
4. *Biogeography and landscape genetics*

Part Two considers the following sections:

1. *Data analysis tutorial, which includes R and bash syntax, data visualization in R and omics data analysis*
2. *Reproducibility and organising tips in coding*
3. *Introduction to multi-omics and integrative biology*
4. *Interviews and professional communication in bioinformatics*
5. *Resources for learning to code*

Application process guidelines

For this section, we will have a discussion forum together with lecturers.