BIOU3GE: Introduction

Biological Evolution: The change over time in the heritable characteristics of a population.

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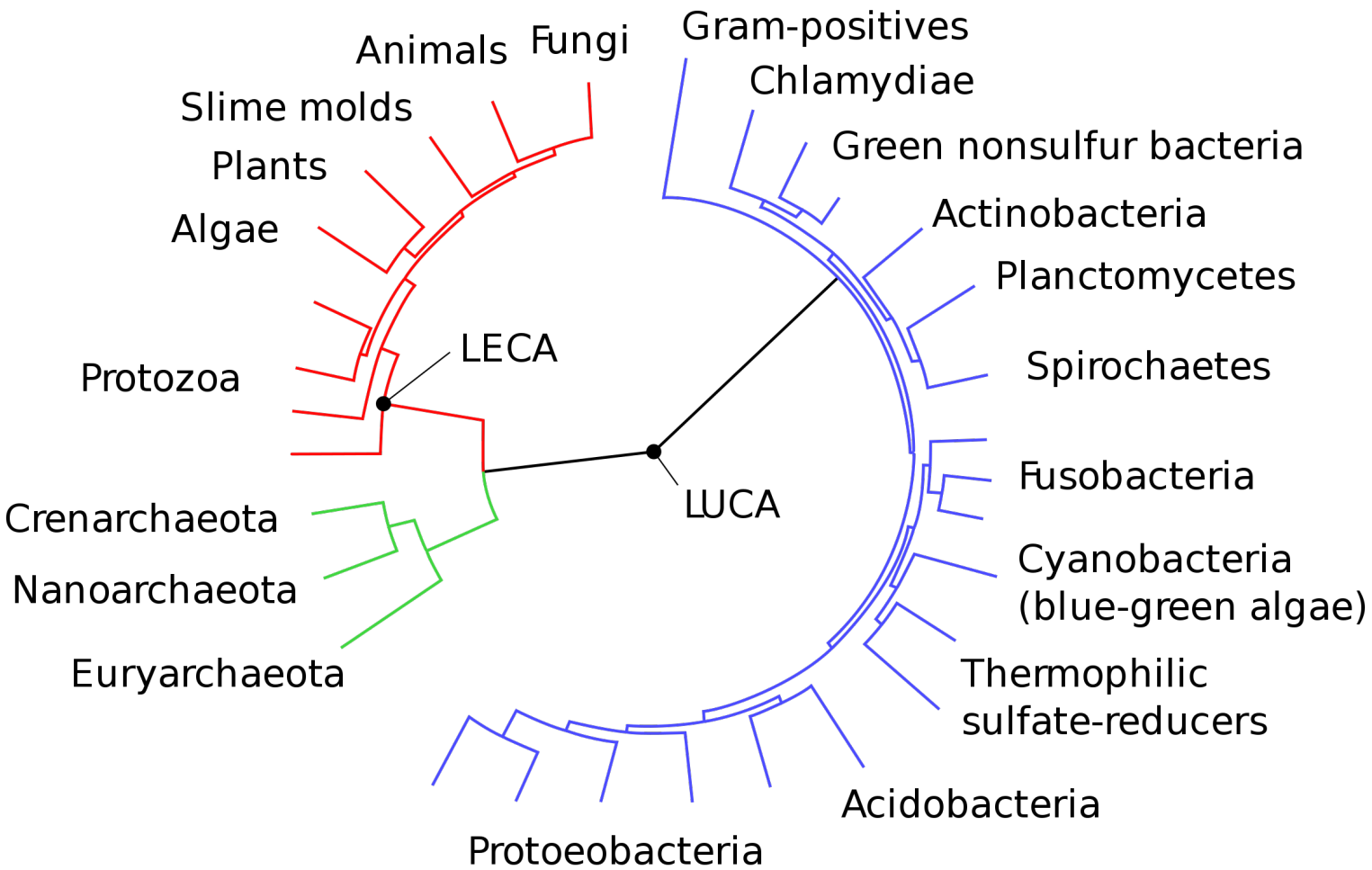
Genetics: The study of heredity and the variation of inherited characteristics.

Evolution and Genetics



[2]Image: Public Domain

Questions

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- How do offspring inherit characteristics from their parents?
- What processes cause traits to change in populations over time?
- How do populations adapt to their environments?

Intended Learning Outcomes

ILO1: Demonstrate knowledge and comprehension of the mechanisms of heredity and evolution, and their consequences for population genetic structure and biodiversity.

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ILO3: Analyse genetic data to draw genetic and evolutionary inferences.

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ILO1: Demonstrate knowledge and comprehension of the mechanisms of heredity and evolution, and their consequences for population genetic structure and biodiversity.

ILO2: Apply evolutionary and genetic principles, including principles of transmission and population genetics, to answer specific questions and solve specific problems.

ILO3: Analyse genetic data to draw genetic and evolutionary inferences.

ILO4: Explain core practical techniques used in molecular biology, genetics and evolution.

Lecturers

Armin Sturm

Brad Duthie

Alastair Skeffington

Dan Chapman

Structure of the module

- Lectures (Canvas)
- Practicals (Face-to-face)
- Assessments (Canvas)

Learning and Teaching Units

1. Genetic Mechanisms I
2. Evolution and Mechanisms of Inheritance
3. Evolutionary Ecology
4. Genetic Mechanisms II
5. Evolution of Species

Reading List

- *Evolution* (4th edition) by Futuyma and Kirkpatrick
- *Biology: A Global Approach* (12th edition) by Campbell et al.

Genetic Mechanisms I

Week 2: Introducing the molecular basis of evolution and genetics

- 2.1: DNA: The carrier of genetic information
- 2.2: One gene, one polypeptide
- 2.3: Information flow

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Week 3: The molecular basis of evolution and genetics continued

- 3.1: Chromosome structure
- 3.2: DNA Replication and mutation
- 3.3: Regulation of gene expression

Evolution and Mechanisms of Inheritance

Week 4: The Basics of Evolution and Inheritance

- 4.1 Origins of evolutionary thought
- 4.2 Influences on Darwin
- 4.3 Natural selection: Darwin's four postulates
- 4.4 Mendelian genetics
- 4.5 Incomplete dominance and codominance
- 4.6 Sex linkage

Evolution and Mechanisms of Inheritance

Week 5: The Basics of Evolution and Inheritance

- 5.1 Population genetics: Hardy-Weinberg Equilibrium
- 5.2 Mutation and Recombination
- 5.3 Gene flow
- 5.4 Genetic drift
- 5.5 Natural selection
- 5.6 Nonrandom mating

Week 6: Complex inheritance and evolution

- 6.1 Linkage disequilibrium
- 6.2 Epistasis
- 6.3 Quantitative genetics

Week 8: Specific topics to be determined.

Week 9: Genetic Mechanisms II

- 9.1 Evolution and Development
- 9.2 Gene and Genome Evolution
- 9.3 Endosymbiotic Theor

Week 10: Evolution of Species

- 10.1 Phylogeny: Reconstructing the tree of life
- 10.2 Species and speciation
- 10.3 Modes of speciation

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Week 11: Adaptive Radiation

- 11.1 Adaptive radiation

Practicals: Weeks 3 and 10

- Learn how to extract DNA from sample organisms for a gene of interest
- Understand how DNA is amplified and the gene sequence read
- Use DNA barcoding tools to identify and classify a plant species
- Analyse evolutionary relationships by comparing phylogenies

Week 3 Practical

- DNA extraction in Cottrell 2B147 lab
- Choose 1 of 3 timeslots (3 hours)
- **Must bring a white lab coat and goggles**
- Work in groups of 3 or 4
- Understand steps after extraction (amplification and sequencing)

Week 10 Practical

- Analyse results of DNA sequencing
- Use DNA sequence data to identify sample organism
- Construct phylogenetic trees and place sample

Workshops

- Essay planning
- Mendel's Mechanism
- Population Genetics
- Ecology and Evolution

Assessments

1. Short answer essay plan (0%)
2. Population genetics assignment (25%)
3. Phylogenetics Lab Report (25%)
4. Short Answer Essay Journal Portfolio (50%)

Short answer essay plan

- Read, "Killing the behavioral zombie: genes, evolution, and why behavior isn't special" (Zuk and Spencer 2020)
- Consider question, "What are some reasons that the nature versus nurture distinction is a misleading way to think about evolved behaviours?"
- Produce a **plan** for a short answer essay (bullet points)
- Receive feedback to help on the exam

[1] Zuk, M., & Spencer, H. G. (2020). Killing the behavioral zombie: genes, evolution, and why behavior isn't special. BioScience, 70(6), 515-520.

Population Genetics Assignment

- Apply skills from population genetics lab
- Case study of *Daphnia pulex* (freshwater crustacean)
- Numerical calculations to work out from dataset
- One short answer essay question based on case study data

Phylogenetics Lab Report

- Apply skills from Week 3 and 10 lab
- Answer 3 questions on DNA sequencing, identification, and phylogeny
- Roughly 400 words per question

Exam

- 4 short answer essay questions
- 450-550 words expected
- Questions released over semester
- Submitted at exam time
- Extensions cannot be given

Module representative

- Need volunteers to be module reps
- Provide confidential feedback
- Participate in Student Staff Feedback Committee (SSFC)