GENERAL BIOLOGY – ECOLOGY – ZOOLOGY (48 hours)

Syllabus General Biology

Foundations of life: the chemistry of the cell.

Cytology: cell characteristics and organization.

From cells to individuals: tissues- organs- organism- holobiont.

Foundations of genetics: Mendel's laws and characters transmission.

Transcription, translation and their control.

Concepts of epigenetics.

Concepts of EvoDevo: developmental biology focusing on adaptation to environment.

Syllabus Ecology

- Ecology: definition and scopes.

- The physical environment.

- The biosphere: Terrestrial and aquatic biomes.

- Populations: definition; Population dynamics and regulation; Intraspecific competition; Exponential and logistic growth.

- Competition: Inter-specific interactions.

- Communities: Biodiversity concepts and theories; Biodiversity indices; Ecological succession.

- Ecosystems: Biogeochemical cycles. Primary and secondary productivity; Principles of hydrobiology.

Syllabus Zoology

- What is biodiversity? The multiple levels of biodiversity. Taxonomy and classification

- Main taxonomic groups of animals: Cnidarians, Annelids, Arthropods, Molluscs, Echinoderms. The main taxa of vertebrates.

- Foundations of genetics. The DNA, The Basic Principles of Heredity, population genetics. The importance of genetic diversity

- Foundations of evolutionary biology. Evolution by natural selection. Speciation. Macroevolution.

References General Biology

Russell, Hertz, McMillan- Biology: The Dynamic Science (Units 1, 2). Brooks/Cole Pub Co 2013.

Raven, Johnson, Mason, Losos, Singer- Biology. McGraw-Hill Education, 2016.

References Ecology

One of the following textbooks can be helpful for both self-learning and for attending the crash course:

Bowman WD & Hacker SD (2020): Ecology (Fifth edition). Oxford University Press.

Singer FD (2016): Ecology in action. Cambridge University Press.

Smith TM & Smith RM (2014): Elements of ecology (Ninth edition). Pearson.

References Zoology

Eldra P. Solomon, Charles E. Martin, Diana W. Martin, Linda R. Berg. Biology, 10th Edition.

The whole textbook is extremely useful for students without a biological background. The most important chapters are:

Part 1: THE ORGANIZATION OF LIFE.

1. A View of Life.

2. Atoms and Molecules: The Chemical Basis of Life.

3. The Chemistry of Life: Organic Compounds.

4. Organization of the Cell.

5. Biological Membranes.

6. Cell Communication.

Part 2: ENERGY TRANSFER THROUGH LIVING SYSTEMS.

7. Energy and Metabolism.

Part 3: THE CONTINUITY OF LIFE: GENETICS.

10. Chromosomes, Mitosis, and Meiosis.

11. The Basic Principles of Heredity.

12. DNA: The Carrier of Genetic Information.

Part 4: THE CONTINUITY OF LIFE: EVOLUTION.

18. Introduction to Darwinian Evolution.

19. Evolutionary Change in Populations.

20. Speciation and Macroevolution.

21. The Origin and Evolutionary History of Life.

Part 5: THE DIVERSITY OF LIFE.

23. Understanding Diversity: Systematics.

30. An Introduction to Animal Diversity.

31. Sponges, Cnidarians, Ctenophores, and Protostomes.

32. The Deuterostomes.

Part 7: STRUCTURE AND LIFE PROCESSES IN ANIMALS.

39. Animal Structure and Function: An Introduction.

40. Protection, Support, and Movement.

41. Neural Signaling.

43. Sensory Systems.

44. Internal Transport.

46. Gas Exchange.

47. Processing Food and Nutrition.

48. Osmoregulation and Disposal of Metabolic Wastes.

50. Reproduction.

CHEMISTRY (15 hours)

A Self-Assessment Test will be delivered before the Crash Course to determine the student's present level of general inorganic and organic chemistry knowledge. Students will be encouraged to attend the Chemistry Crash Course in case of an unsatisfactory score (lower than 40/60) on the assessment Test. This test consists of 44 multiple-choice questions and 16 true-false questions and students will have 60 minutes to complete the overall test.

Syllabus

i) Stoichiometry, Reactions in Aqueous Solutions and Energy Relationships in Chemical Reactions.

ii) Gases.

iii) Chemical Applications: Solution chemistry, Acid-base equilibria, pH, Titrations, Buffers, Solubility.

iv) Chemical bonds in organic chemistry.

v) Main physical, structural properties and mechanisms of reaction of:

Hydrocarbons (alkanes, alkenes, alkynes);

Halogenated hydrocarbons, alcohols, amines;

Carbonyl compounds: aldehydes and ketones;

Carboxylic acids and their main derivatives;

Aromatics.

References

Timberlake, Karen C. (2015): General, Organic, and Biological Chemistry: Structures of Life, Global Edition. ISBN 10: 1292096195 / ISBN 13: 9781292096193. Editor: Pearson.

EARTH SCIENCES (16 hours)

Syllabus

Earth Sciences: definition and scopes.

Minerals and rocks: composition, genesis and classification.

Earthquakes and volcanos.

Slope dynamics and landslides.

Landscape: definition, features and evolution.

Atmosphere: composition and evolution.

The world water cycle.

Climate and its recent changes.

Introduction and application of Earth Observation (EO) through satellite remote sensing

References

https://open.umn.edu/opentextbooks/textbooks/physical-geography

https://drive.google.com/drive/folders/1prHnOB77NSpjZwYkOqx-oYWF2NpqS0HG

MATHEMATICS (32 hours)

Syllabus

Introductory topics: algebra, equations, miscellaneous.

Functions of one variables and their properties.

Continuity and differentiability.

Single-variable optimization.

References

Stewart J. (2010): Calculus. Cengage Learning, Inc; 7th Revised ed. Edition.

Strang G. (2009): Introduction to Linear Algebra. 4th ed. Wellesley-Cambridge Press.

MICROECONOMICS (30 hours)

Syllabus

The market.

The budget constraint.

Preferences.

Utility.

Choice.

Demand.

Slutsky's equation.

Market demand.

Equilibrium.

Technology.

Profit maximization.

Minimization of costs.

Cost curves.

Firm supply.

Industry supply.

Monopoly. Monopoly behaviour.

References

H. R. Varian, Intermediate Microeconomics: A Modern Approach, W.W. Norton Pub. (any edition). Chapters: 1-6, 8, 15-16, 19-26.

STATISTICS (24 hours)

Syllabus

Probability measures and events.

Random variables.

Distributions, mean and variance.

Conditional probability.

The Law of Large Numbers.

The Central Limit Theory.

Sampling distributions.

Parameter estimation.

Confidence Intervals.

Hypothesis testing:

Z-test on one mean;

t-test to compare two means;

F-test to compare two variances;

One way and two ways ANOVA tests;

Chi-square tests of independence.

References

Trosset M.W. (2009): An introduction to statistical inference and its applications with R, CRC Press. Chapters: 3, 4, 5, 8, 9, 10, 11, 14.

Robert V. Hogg, Elliot Tanis, Dale Zimmerman (2015): Probability and statistical inference -Pearson.