Environmental Change and Global Sustainability - How to address any gap in the personnel preparation

Students admitted to the Master program even without completely comply with the admission prerequisites have to attend on-line crash courses in order to fill the gaps in their personnel preparation.

Crash courses will start August 31st and will end September 25th. All lectures will also be recorded and they will be available to students at the link https://ariel.unimi.it/.

The list of crash courses that will be provided is reported in the following, together with crash courses syllabi and suggested references. Students are recommended to start filling the gaps in their preparation before the beginning of the crash courses and they are invited to read the suggested references.

GENERAL BIOLOGY – ECOLOGY – ZOOLOGY (48 hours)

Syllabus General Biology
Fundations of life: the chemistry of the cell.
Citology: cell characteristics and organization.
From cells to individuals: tissues- organs- organism- holobiont.
Fundations 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.
Levels of ecological organization: organisms, populations, communities, ecosystems, biosphere.
Populations: Population dynamics and regulation. Intraspecific competition. Exponential and logistic growth.
Community. Biodiversity concepts and theories. Positive and negative interspecific association. Biodiversity indices. Ecological succession.
Ecosystems. Terrestrial and aquatic biomes. Biogeochemical cycles. Primary and secondary productivity.
Principles of hydrobiology.
Biological indicators.
Basics of environmental contamination.

Syllabus Zoology
- The biological levels of organization: the cell, the tissues, the main organs
- 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.
- Fundations of genetics. The DNA, The Basic Principles of Heredity, population genetics. The importance of genetic diversity
- Fundations 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 forty four multiple-choice questions and sixteen 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.

MATHEMATICS (32 hours)

Syllabus

Introductory topics: algebra, equations, miscellaneous.
Functions of one variables and their properties.
Continuity and differentiability.
Single-variable optimization.
Integration.
Matrix and vector algebra. Determinants and inverse matrices.
Linear Transformation. Eigenvectors and eigenvalues

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 behavior.

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.
Sample distributions.
Parameters 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.