

## **Syllabus**

## Descrizione corso

Titolo insegnamento	Principi di chimica generale, organica e biochimica per le scienze alimentari
Codice insegnamento	40452
Titolo aggiuntivo	
Settore Scientifico- Disciplinare	
Lingua	Inglese
Corso di Studio	Corso di Laurea in Scienze alimentari ed enogastronomiche
Altri Corsi di Studio (mutuati)	
Docenti	prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food- sciences/academic-staff/person/30124
Assistente	
Semestre	Primo semestre
Anno/i di corso	1st
CFU	9
Ore didattica frontale	54
Ore di laboratorio	36
Ore di studio individuale	135
Ore di ricevimento previste	18
Sintesi contenuti	The course provides foundational knowledge of chemistry and biochemistry as applied to food sciences. Students will explore key topics, including atomic theory, chemical bonding, chemical reactions, and the chemistry of macronutrients such as carbohydrates, lipids, and proteins. Aerobic and anaerobic metabolism will also be examined, highlighting their roles in energy production and food systems.
Argomenti	Part 1 – General Chemistry



#### dell'insegnamento

Introductory concepts

Measurement units and conversions

Basic chemical calculations

Relationships between matter and energy

Matter and transformations

Properties of matter

Physical vs. chemical changes

Conservation of energy in natural and industrial processes

Atomic structure

Evolution of atomic theories ¿ modern atomic model

Subatomic particles: protons, neutrons, electrons

Orbitals and electronic configuration

Chemical bonds

Ionic, covalent, metallic

Influence on physical and chemical properties of substances

Elements, ions, and compounds

Chemical nomenclature and classification rules

Chemical reactions

Reaction mechanisms and balancing

Applied aspects

Heavy metal accumulation in food

Health risks, monitoring, and control methods

Part 2 – Organic Chemistry

Introduction to organic compounds

Bonding in carbon (catenation, hybridization)

Functional groups and classification of organic molecules

Main classes of organic compounds

Hydrocarbons: alkanes, alkenes, alkynes, aromatics

Alcohols, phenols, ethers

Aldehydes and ketones

Carboxylic acids and derivatives (esters, amides)

**Amines** 

Stereochemistry

Isomerism: structural and stereoisomers

Chirality and optical activity

Organic reactions

Addition, substitution, elimination, oxidation/reduction

Part 3 – Biochemistry



	Biological catalysis
	Enzymes: function, specificity, regulation
	Biomolecules and nutrition
	Carbohydrates
	Lipids
	Proteins and amino acids (overview)
	Vitamins and minerals
	Role in metabolism and nutritional quality of food
	Cellular biology foundations
	Structure and function of cells
	Key biochemical pathways
	Cellular respiration
	Aerobic respiration
	Glycolysis
	Krebs cycle (citric acid cycle)
	Electron transport chain ¿ ATP production
	Anaerobic respiration
	Implications in food and wine production
Parole chiave	Atom
	Chemical bond
	Reactions
	Carbon
	Functional groups
	Stereochemistry
	Enzymes
	Biomolecules
	Metabolism
Prerequisiti	
Insegnamenti propedeutici	None
Modalità di insegnamento	Teaching encompasses lectures that convey the theoretical
	concepts of chemistry and biochemistry as applied to the food and
	wine sector. These are complemented by practical laboratory
	activities, designed to develop technical skills and to consolidate
	the knowledge acquired through experimental work. Additionally,
	educational visits to companies in the sector are planned to
	promote the practical application of course content and provide
	students with direct contact with the business environment.
Obbligo di frequenza	No
	1



# Obiettivi formativi specifici orisultati di apprendimento attesi

**Obiettivi formativi specifici e** Knowledge and understanding:

Upon completion of their studies, graduates with a bachelor's degree in Food and Enogastronomy Sciences will have acquired a solid foundation of scientific knowledge in disciplines such as chemistry, physics, biology, mathematics, computer science, and law, specifically applied to the food and gastronomic sector. They will gain technological skills for managing production and transformation processes, along with an integrated view of the quality, safety, and sustainability of food supply chains and systems.

In addition, graduates will understand the principles related to waste reduction, resource optimization, and the reconciliation of economics and ethics, which are central elements for addressing the modern challenges of the agri-food system.

The knowledge and understanding skills mentioned above are acquired through participation in lectures, practical exercises, seminars, and through guided personal study and individual study as provided by the activated educational activities.

The verification of the achievement of learning outcomes is mainly carried out through exams and any interim tests. The tests may be written and/or oral, and may also consist of reports and oral presentations of projects or seminars.

Ability to apply knowledge and understanding:

Students will be able to practically apply the knowledge they have acquired, developing the ability to solve complex problems in the food and gastronomic sector. Thanks to a wide range of practical activities, such as laboratories, internships, workshops, and seminars, they will be able to use chemical, physical, sensory, and microbiological analysis methods to evaluate the quality and safety of food and production processes.

Graduates of the first profile will be able to manage food processing and preservation processes, design new technological solutions, and apply knowledge of plant genetics and process planning to ensure the quality of the final product. Graduates of the second profile will have advanced skills in managing restaurant businesses, promoting gastronomic heritage, and applying fermentation techniques and food design. In both paths, the ability to enhance by-products and reduce waste will be central, contributing to the sustainable innovation of the sector.

The educational activities are designed to strengthen the autonomy of judgment and the ability to make decisions in complex contexts, as well as to develop communication skills and the ability to work in multidisciplinary and international teams. At the end of the program, graduates will be able to independently apply their knowledge in professional contexts, promoting innovative and sustainable solutions for the challenges of the agri-food and gastronomic system.

The achievement of the ability to apply knowledge is accomplished through critical reflection on the texts proposed for individual study, stimulated by classroom activities, the study of research and application cases presented by the professors, the performance of practical laboratory exercises, fieldwork, bibliographic research, the completion of individual and/or group projects included in the core and elective courses of the curriculum, as well as during internships and the preparation of the final exam. The assessments, carried out through written and/or oral exams, reports, and exercises, involve the completion of specific tasks in which the student demonstrates mastery of tools, methodologies, and critical autonomy. During internships, the assessment is conducted through the presentation of a report by the student to the supervising professor.

#### Making judgements:

Evaluate and critically analyze the quality, safety, and sustainability of production processes and food products, considering scientific, technological, economic, and cultural aspects. Students will be able to make informed decisions based on scientific data and the analysis of production contexts to ensure the excellence of the final product.

Apply ethical and sustainable approaches, reconciling economic

needs with environmental and social requirements. Graduates will be able to identify solutions to reduce waste, enhance by-products, and optimize resource use, proposing food production models in line with the principles of the circular economy.

Express independent judgments regarding innovative techniques for the transformation and enhancement of food and gastronomic productions, evaluating the risks and opportunities associated with the introduction of new technologies or business models, both locally and internationally.

Interpret and manage complex data collected through chemical, physical, microbiological, and sensory analyses, in order to improve the quality of food products and effectively respond to food safety needs and regulatory requirements of the sector.

#### Communication skills:

Communicate effectively and appropriately with both technical and non-technical interlocutors, including professionals in the food and gastronomic sector, public and private institutions, and the general public. This includes the ability to adapt the communication style based on the audience, using the specific technical language of the food and gastronomic sector when necessary.

Present and discuss the results of their analyses and research in both written and oral form, using technological and multimedia tools. Graduates will be able to draft technical reports, research papers, and scientific documents, as well as present their results clearly and structured, for example during conferences, seminars, or business meetings.

Actively participate in discussions and group work in multidisciplinary and international contexts, demonstrating active listening, negotiation, and collaboration skills. Practical experiences and internships will provide students with the abilities to work effectively in teams and contribute to solving complex problems in the sector.

Use the three languages of instruction of the course (Italian, German, and English) fluently and confidently, both for written and oral communication. Thanks to the trilingual approach of the Free University of Bozen-Bolzano, graduates will be able to face

	international work contexts, participate in global networks, and
	contribute to the development of international cooperation projects
	to address the challenges of the food and gastronomic sector.
	Learning skills:
	At the end of the degree program, graduates will have developed
	strong learning skills, essential for successfully continuing academic
	studies and entering the workforce. In particular, they will be able
	to:
	Learn autonomously and continuously, keeping up to date with
	scientific and technological advancements in the food and
	gastronomic sector. Graduates will have acquired study methods
	and research tools that will allow them to independently update
	their skills, critically interpreting new knowledge.
	Effectively manage the learning of complex concepts by integrating
	the various scientific and technical disciplines covered in the
	degree program, such as chemistry, biology, food technologies,
	economics, and law. They will be able to identify the most relevant
	sources, understand and apply new methodologies, and adapt to
	sector developments.
	Develop collaborative learning strategies, thanks to the experience
	gained through group work, internships, and laboratory activities.
	Graduates will be able to share their knowledge and learn from
	others, demonstrating adaptability and teamwork skills.
	Continue their studies independently in Master's degree programs
	(such as the LM-70 class, Food Science and Technology, currently
	offered at the same university) or in other related fields, using the
	skills and methods acquired during the bachelor's degree to tackle
	new learning challenges, even in high-level academic and
	professional contexts.
Obiettivi formativi specifici e	
risultati di apprendimento	
attesi (ulteriori info.)	
Modalità di esame	The final assessment will consist of an oral exam, and there will
	also be written midterm tests.
Criteri di valutazione	- Knowledge of Key Concepts (40%)
	- Application and Critical Thinking (30%)
	- Integration of Topics (15%)
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	- Communication Skills (10%) - Engagement and Argumentation (5%)
Bibliografia obbligatoria	<ul> <li>Lecture Slides and Teaching Materials for General Chemistry and Biochemistry. Provided by the Professor.</li> <li>Robert B. Jordan. Principles of Inorganic Chemistry: Basics and Applications. Cham: Springer, 2024.</li> <li>David L. Nelson, Michael M. Cox, and Aaron Hoskins. Lehninger Principles of Biochemistry. 8th ed. New York: W. H. Freeman, 2021.</li> </ul>
Bibliografia facoltativa	
Altre informazioni	
Obiettivi di Sviluppo Sostenibile (SDGs)	Sconfiggere la fame, Buona salute, Istruzione di qualità, Partnership per gli obiettivi, Utilizzo responsabile delle risorse,
	Utilizzo sostenibile della terra, Innovazione e infrastrutture

## Modulo del corso

Titolo della parte	Chimica Generale e Biochimica
costituente del corso	
Codice insegnamento	40452A
Settore Scientifico- Disciplinare	AGR/13
Lingua	Inglese
Docenti	prof. Luigimaria Vittorio Borruso, luigimaria.borruso@unibz.it https://www.unibz.it/en/faculties/agricultural-environmental-food- sciences/academic-staff/person/30124
Assistente	
Semestre	Primo semestre
CFU	6
Docente responsabile	
Ore didattica frontale	36
Ore di laboratorio	24
Ore di studio individuale	90



Ore di ricevimento previste	18
Sintesi contenuti	This course introduces fundamental concepts of chemistry and biochemistry as they relate to food and wine sciences. Topics include measurements and calculations, matter and energy, atomic theory and the atom, chemical bonding, elements and ions, and nomenclature. It also covers chemical reactions, chemical composition, gases, and heavy metals residuals in food. The biochemistry section focuses on enzymes, carbohydrates and lipids, vitamins and minerals and introduces cellular biology and biochemistry. Topics related to cellular respiration include aerobic harvesting of energy, the stages of cellular respiration (glycolysis, the Krebs cycle, and the electron transport chain), and anaerobic respiration.
Argomenti	
dell'insegnamento	
Modalità di insegnamento	Teaching encompasses lectures that convey the theoretical concepts of chemistry and biochemistry as applied to the food and wine sector. These are complemented by practical laboratory activities, designed to develop technical skills and to consolidate the knowledge acquired through experimental work. Additionally, educational visits to companies in the sector are planned to promote the practical application of course content and provide students with direct contact with the business environment.
Bibliografia obbligatoria	<ul> <li>Lecture Slides and Teaching Materials for General Chemistry and Biochemistry. Provided by the Professor.</li> <li>David L. Nelson, Michael M. Cox, and Aaron Hoskins. Lehninger Principles of Biochemistry. 8th ed. New York: W. H. Freeman, 2021.</li> <li>Robert B. Jordan. Principles of Inorganic Chemistry: Basics and Applications. Cham: Springer, 2024.</li> </ul>
Bibliografia facoltativa	Vassilis Kontogiorgos. Introduction to Food Chemistry. 2nd ed. Cham: Springer, 2024.

## Modulo del corso

Titolo della parte	Chimica Organica
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costituente del corso	
Codice insegnamento	40452B
Settore Scientifico-	CHIM/06
Disciplinare	
Lingua	Inglese
Docenti	dr. Stefano Benini,
	Stefano.Benini@unibz.it
	https://www.unibz.it/en/faculties/agricultural-environmental-food-
	sciences/academic-staff/person/27433
Assistente	
Semestre	Primo semestre
CFU	3
Docente responsabile	
Ore didattica frontale	18
Ore di laboratorio	12
Ore di studio individuale	45
Ore di ricevimento previste	9
Sintesi contenuti	Properties and nomenclature of organic compounds
	- Alkanes, alkenes, alkynes.
	- Stereochemistry and chirality.
	- Alcohols, phenol, ether, thiols.
	- Aldehydes and ketones.
	- Carboxylic acids and derivatives
	- Amines.
	- Benzene and aromatic compounds.
	- Structure and function of bioorganic molecules (e.g., proteins,
	DNA)
Argomenti	
dell'insegnamento	
Modalità di insegnamento	Lectures with the use of power point presentations and laboratory
	practice. The material will be available in the Open Learning
	Environment (OLE) website.
Bibliografia obbligatoria	Prouga William H. Moyak Prusa M. "Ourania ahamaiatus"
	Brown, William H.; Novak, Bruce M. "Organic chemistry"
	ISBN: 978-1-305-58035-0 present in the library



Bibliografia facoltativa	Organic chemistry books present in the library
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