



# UNIVERSITÀ DEGLI STUDI DI PALERMO

<b>DEPARTMENT</b>	Fisica e Chimica - Emilio Segrè		
<b>ACADEMIC YEAR</b>	2022/2023		
<b>MASTER'S DEGREE (MSC)</b>	CHEMISTRY		
<b>INTEGRATED COURSE</b>	PRINCIPLES OF CHEMISTRY TEACHING METHODOLOGY		
<b>CODE</b>	19829		
<b>MODULES</b>	Yes		
<b>NUMBER OF MODULES</b>	2		
<b>SCIENTIFIC SECTOR(S)</b>	CHIM/06, CHIM/02		
<b>HEAD PROFESSOR(S)</b>	MAGGIO ANTONELLA MARIA	Professore Associato	Univ. di PALERMO
<b>OTHER PROFESSOR(S)</b>	MAGGIO ANTONELLA MARIA LOMBARDO RENATO	Professore Associato Ricercatore	Univ. di PALERMO Univ. di PALERMO
<b>CREDITS</b>	6		
<b>PROPAEDEUTICAL SUBJECTS</b>			
<b>MUTUALIZATION</b>			
<b>YEAR</b>	1		
<b>TERM (SEMESTER)</b>	1° semester		
<b>ATTENDANCE</b>	Mandatory		
<b>EVALUATION</b>	Out of 30		
<b>TEACHER OFFICE HOURS</b>	<b>LOMBARDO RENATO</b> Tuesday 10:00 12:00 Dipartimento STEBICEF Studio 1/B4, edificio 17, viale delle Scienze Thursday 10:00 12:00 Dipartimento STEBICEF Studio 1/B4, edificio 17, viale delle Scienze <b>MAGGIO ANTONELLA MARIA</b> Monday 12:00 13:00 Studio del docente Viale delle Scienze edificio 17 - piano 0 - Studio 0/D28		

**DOCENTE:** Prof.ssa ANTONELLA MARIA MAGGIO

<b>PREREQUISITES</b>	Students should have acquired a sound understanding of the basic concepts in general chemistry usually present in introductory chemistry courses belonging to any science and/or technology degree program as well as basic mathematical and computer skills.
<b>LEARNING OUTCOMES</b>	<p>Content and objectives of this course are coherent with the general guidelines by the Didactics Division of the Italian Chemical Society (DD-SCI). The course aims at making science graduates aware of the cultural value as well as social and economical role of chemistry. As a consequence, the course has an independent education function. However, credits gained with this course can be used within the 24 CFU required for admission to the teacher training program in high schools.</p> <p>At the end of the course the student will be able to:</p> <ul style="list-style-type: none"><li>- understand and communicate chemistry content identifying the conceptual dependencies and its different conceptual levels (macroscopic, microscopic and symbolic) also with the aid of concept maps;</li><li>- design and implement teaching/learning environments based on the student' active role for acquiring competences in the science and technology area;</li><li>- place in historical context the main chemistry discoveries and illustrate the evolution of selected chemistry ideas in connection with the historical-cultural context;</li><li>- use current multimedia tools for chemistry didactics.</li></ul>
<b>ASSESSMENT METHODS</b>	<p>The overall assessment is the result of a successful achievement of the specific objectives of the two activities which are individually assigned and handed in, as a written report, at the end of the course and of an oral exam. The oral exam has the objective of verifying that the student has acquired competences and content dealt with during the course. The student will be required to address two different questions on any topic of the course program.</p> <p>The final assessment aims at verifying the student knowledge and understanding of the course content, didactics and interpretation skills as well as autonomous thinking. The student will be required to present in a teaching context the historical and epistemological aspects, specific aspect of chemistry with respect to other sciences and to convey, in a clear and unambiguous fashion, the key concepts of the discipline even to a non specialized audience. The assessment is graded on a thirty-point scale. The passing level will be reached when the student demonstrates a basic content knowledge and understanding and is able to construct didactic approach to the resolution of a specific problem. In addition, the student has to demonstrate communication skills in order to transfer his/her own ideas to the examiner.</p>
<b>TEACHING METHODS</b>	The course, consisting of two modules, includes lectures as well as individual and group practical classroom and/or laboratory activities. The first module deals with key concepts of chemistry relevant to any school level; the second module is concerned with chemistry didactics topics more specific for high school and university teaching.

**MODULE**  
**METHODS FOR TEACHING AND LEARNING CHEMISTRY**

*Prof. RENATO LOMBARDO*

**SUGGESTED BIBLIOGRAPHY**

Testi di riferimento:

A Guidebook of Good Practice for the Pre-Service Training of Chemistry Teachers,  
scaricabile da <https://zdch.uj.edu.pl/documents/87419401/e347904e-c062-4275-b688-c222629d57a4>.  
G. Villani, La Chiave del mondo. Dalla filosofia alla scienza: l'onnipotenza delle molecole, CUEN, 2001,  
scaricabile da <http://www.culturachimica.it/wp-content/uploads/2017/04/La-chiave-del-mondo.pdf>.  
V. Domenici, Insegnare e apprendere la chimica, Mondadori, 2018, ISBN: 8861846009

Testi di approfondimento:

D. Antiseri, Epistemologia e didattica delle scienze, Armando Ed., 2000.  
L. Cerruti, Bella e potente: la chimica del Novecento fra scienza e società, (2a ed.) Ed.Riuniti, 2016.  
C. Fiorentini, E. Aquilini, D. Colombi, A. Testoni, Leggere il mondo oltre le apparenze, Armando Editore, 2007.  
J.G. García-Martínez (Ed.), E. Serrano-Torregrosa (Ed.), Chemistry Education: Best Practices, Opportunities and Trends, Wiley 2015.  
M.B. Ligorio, S. Cacciamani, Psicologia dell'educazione, Carocci Ed., 2013.  
L. Paoloni, Nuova didattica della chimica: un progetto culturale per la scuola secondaria, Società Chimica italiana, 1982.  
E. Roletto, La scuola dell'apprendimento Erickson, 2005.  
E. Scerri, The Periodic Table: Its Story and Its Significance, Oxford University Press, 2006.

<b>AMBIT</b>	20975-Attività formative affini o integrative
<b>INDIVIDUAL STUDY (Hrs)</b>	47
<b>COURSE ACTIVITY (Hrs)</b>	28

**EDUCATIONAL OBJECTIVES OF THE MODULE**

Present and discuss the main theoretical frameworks developed in chemistry didactics;  
Critically discuss the pedagogical connection among the fundamental chemistry concepts at the macroscopic, microscopic and symbolic levels;  
Present and discuss the methodological and didactic conversion techniques of the basic concepts of chemistry relevant to second-degree school level, taking into account the findings of learning psychology;  
Place in a historical context the basic concepts and underline the effectiveness of the historical and philosophical approach to chemistry teaching from school to university.

**SYLLABUS**

<b>Hrs</b>	<b>Frontal teaching</b>
3	Elements of main science teaching and learning paradigms (Empiricism, Behaviorism and Constructivism. Summary of Bruner, Piaget, Vygotsky theories.
2	Elements of Epistemology: Nature of Science (Popper, Kuhn, Lakatos, ecc.) and of Chemistry; Chemistry specific aspects and comparison with other sciences; Didactic value of chemistry epistemology;
3	The logical structure of chemistry and its key concepts at the macroscopic (simple and compound substances, physical state, etc.), microscopic (atom, molecule, etc.) and symbolic (chemical formula, structural formula, etc.) levels
6	Criteria and methodologies for the implementation of authentic teaching/learning contexts based on an active role by students;
2	Competences in learning environments, with special reference to the science and technology area
<b>Hrs</b>	<b>Practice</b>
12	Implementation of a learning sequence on one of the key concepts identified in the lecture section of the course with the objective of specifying the target, the necessary requisites; the expected learning outcomes; the necessary implicit conceptual framework; the detailed description of activities to be performed in the classroom or in the laboratory; the time requirements; acquired competences assessment techniques. Alternatively: small group activities aimed at developing students' familiarity with methodological aspects of chemistry teaching according to the cooperative learning technique.

## MODULE THE FOUNDING PRINCIPLES OF CHEMISTRY AND THEIR EDUCATIONAL IMPLEMENTATION

Prof.ssa ANTONELLA MARIA MAGGIO

### SUGGESTED BIBLIOGRAPHY

Testi di riferimento:

A Guidebook of Good Practice for the Pre-Service Training of Chemistry Teachers, scaricabile da <http://www.ec2e2n.net/publication/msct2>.

G. Villani, La Chiave del mondo. Dalla filosofia alla scienza: l'onnipotenza delle molecole, CUEN, 2001, scaricabile da <http://www.culturachimica.it/wp-content/uploads/2017/04/La-chiave-del-mondo.pdf>.

V. Domenici, Insegnare e apprendere la chimica, Mondadori, 2018, ISBN: 8861846009

Testi di approfondimento:

D. Antiseri, Epistemologia e didattica delle scienze, Armando Ed., 2000.

L. Cerruti, Bella e potente: la chimica del Novecento fra scienza e società, (2a ed.) Ed.Riuniti, 2016.

C. Fiorentini, E. Aquilini, D. Colombi, A. Testoni, Leggere il mondo oltre le apparenze, Armando Editore, 2007.

J.G. Garcia-Martinez (Ed.), E. Serrano-Torregrosa (Ed.), Chemistry Education: Best Practices, Opportunities and Trends, Wiley 2015.

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L. Paoloni, Nuova didattica della chimica: un progetto culturale per la scuola secondaria, Società Chimica italiana, 1982.

E. Roletto, La scuola dell'apprendimento Erickson, 2005.

E. Scerri, The Periodic Table: Its Story and Its Significance, Oxford University Press, 2006.

<b>AMBIT</b>	20975-Attività formative affini o integrative
<b>INDIVIDUAL STUDY (Hrs)</b>	47
<b>COURSE ACTIVITY (Hrs)</b>	28

### EDUCATIONAL OBJECTIVES OF THE MODULE

- Critically discuss the pedagogical relationship existing between the basic concepts of chemistry at the macroscopic and microscopic level, limited to the particle model of matter for the study of physical properties;
- Present and discuss the methodologies and techniques of educational transposition of the concepts of chemistry that can be proposed in the first cycle of education, taking into account the acquisitions of learning psychology;
- Provide criteria and tools for planning educational activities related to chemistry according to the training objectives and the degree of education in which it operates;
- Present and discuss examples of use of specific multimedia technological resources and tools for chemistry education;
- Discuss the relationship between chemistry and other disciplines, highlighting its specific features in terms of conceptual structure and cognitive approach to reality.

## SYLLABUS

Hrs	Frontal teaching
2	The teaching of Chemistry in Italian school: competition classes that enable the teaching of chemistry or other disciplines that include it, curricular aspects related to them and national guidelines for the curriculum;
4	The logical structure of chemistry and its founding concepts at the macroscopic level (simple substance, compound substance, physical state, etc.) and microscopic (particle model of matter)
4	the teaching implications of this structure in terms of conceptual propaedeutics and construction of vertical didactic paths between the different levels of education;
4	chemistry teaching and learning processes through tools and technologies, including new digital technologies for distance learning and preparation of concept maps
2	chemistry relationship with other sciences.
Hrs	Practice
12	Implementation of a learning sequence on one of the key concepts identified in the lecture section of the course with the objective of specifying the target, the necessary requisites; the expected learning outcomes; the necessary implicit conceptual framework; the detailed description of activities to be performed in the classroom or in the laboratory; the time requirements; acquired competences assessment techniques. Alternatively: small group activities aimed at developing students' familiarity with methodological aspects of chemistry teaching according to the cooperative learning technique.