UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Chemistry

2627-1-F7503Q014-F7503Q01402

Aims

General objectives

General objectives of the teaching are:

1. provide information on the founding nuclei and conceptual nodes of Chemistry, also according to the level of education of the students;
2. provide the teaching tools of scientific knowledge and language appropriate for teaching;
3. connect the disciplines through a common didactic project;
4. stimulate logical connections and relationships between disciplines and within the discipline itself.**Specific objectives**
5. Identify key chemistry topics, recognize their foundational principles and core concepts, and master the interdisciplinary connections across the three scientific domains.
6. Ability to establish logical connections between chemistry topics, identify essential knowledge and methods for scientific content transfer, and develop educational materials and science communication pathways.
7. Ability to communicate environmental information, ideas, problems, and solutions to both specialist and non-specialist audiences, using appropriate technical and scientific language.
8. Strong public speaking and oral presentation skills (including through seminars, flipped classrooms, and group activities) and the capacity to contribute constructively to group discussions.

Contents

- The chemical structure of matter

- Principles and theories to describe chemical transformations

Detailed program

The module focuses on the illustration of an educational path based on particle description, which allows to understand at the roots the very nature of a chemical process, in particular based on a comparison with physical processes/phenomena. Didactic paths will be analyzed to introduce the concept of substance (at a macroscopic and microscopic level), to then move on to the concept of transformation of the substance through a comparison between physical and chemical phenomena. The topics will be discussed at different levels, with a view to the vertical chemistry curriculum, according to the level of education of the students: lower secondary school; upper secondary school (first two years and three years).

The ultimate goal of this approach is to provide a tool that allows students to understand the concepts of the chemical nature of compounds and their chemical transformations through pathways that take into account their cognitive development, and to have the ability to find them in the phenomena that surround us.

At lower secondary school level, didactic paths will be presented regarding: the physical states of matter; changes in status; the solutions; acids, bases and salts; introduction to a particle model of matter. At the level of secondary school (first two years) didactic paths will be presented regarding: the law of conservation of matter; the compositional hierarchy; the Dalton atomic model.

At the level of upper secondary school (three years), educational paths will be presented which, starting from the fundamental concepts, will allow understanding and interpreting the following chemical phenomena/concepts:

States of aggregation of matter. Gas laws. Notes on the solid state. Systems with multiple components. Solutions. Concentration. Solubility. Colligative properties.

Factors affecting the chemical kinetics. Speed ??of reaction. 1st and 2nd order reactions. Catalysis. I and II Principle of thermodynamics. Concept of chemical equilibrium. Relationship between kinetic spontaneity of a reaction. Dissociation of water. Acids and Bases. pH measurement. Titrations. Buffer Solutions.

Finally, experiments with household chemicals will be proposed, which will allow the chemical phenomenon to be observed directly.

Prerequisites

Basic knowledge of Chemistry will be considered acquired, and the references to texts and/or resources will be provided for integration or recap of the contents.

Teaching form

The course includes 2 CFU (16 hours) of lectures and 2 CFU (20 hours) of exercises, organized as follows:

-) 8 two-hour lectures, in person, Delivered Didactics;
-) 10 two-hour practical classes, in person, Interactive Teaching

Textbook and teaching resource

Lesson slides and supplementary material discussed during the course. All additional material discussed during the lessons will be loaded on the platform before the exam.

Bibliography

- Insegnare e apprendere Chimica; V. Domenici, Mondadori

- Leggere il mondo oltre le apparenze: per una didattica dei concetti fondamentali della chimica, di Carlo Fiorentini, Eleonora Aquilini, Domenica Colombi, Antonio Testoni, Armando Editore, 2007

- Rinnovare l'insegnamento delle scienze: aspetti storici, epistemologici, psicologici, pedagogici e didattici, Carlo Fiorentini, Aracne Editrice, 2018

Semester

Second semester

Assessment method

The exam consists of an oral exam in which the student presents a teaching program on a topic proposed by him or her in consultation with the instructors.
The student will be assessed based on the following criteria: knowledge of the subject matter; appropriateness of the proposal for the students' educational level; ability to identify the conceptual core of the topic addressed, including in the context of the literature on educational research; ability to propose innovative ways to overcome students' learning difficulties; ability to connect different concepts and create connections with other disciplines; presentation skills; independent analysis and judgment; ability to use scientific language correctly.
The oral exam grade is assigned based on the following criteria:
18-22: sufficient knowledge of the subject matter; teaching program poorly suited to the indicated academic level; conceptual core not well defined; predominantly transmissive teaching methods; inappropriate language.
23-25: adequate knowledge of the subject matter; teaching program sufficiently suited to the indicated academic level; Conceptual issues identified, but teaching methods proposed are ineffective; appropriate language.
26-27: solid knowledge of the subject matter; teaching approach appropriate to the indicated grade level; conceptual issues identified and effective teaching methods; appropriate language.
28 – 30/30L: excellent knowledge of the subject matter; teaching approach appropriate to the indicated grade level; clearly identified conceptual issues and innovative proposals to overcome students' learning difficulties within an interdisciplinary perspective.

Office hours

By mail appointment (luca.degioia@unimib.it, ugo.cosentino@unimib.it)

Sustainable Development Goals

QUALITY EDUCATION