

# CHEM M13: INTRODUCTORY CHEMISTRY II

**Originator**

csjoiner

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**College**

Moorpark College

**Attach Support Documentation (as needed)**December\_2021\_C-ID\_Newsletter (4).pdf  
Chem102.pdf**Discipline (CB01A)**

CHEM - Chemistry

**Course Number (CB01B)**

M13

**Course Title (CB02)**

Introductory Chemistry II

**Banner/Short Title**

Introductory Chemistry II

**Credit Type**

Credit

**Start Term**

Fall 2022

**Catalog Course Description**

Introduces fundamental concepts of general chemistry including kinetics, equilibria, pH, thermodynamics, electrochemistry, and nuclear chemistry. Covers topics in organic and biochemistry including structure, nomenclature, and reactions of organic compounds and metabolism of carbohydrates, lipids, proteins, enzymes, and nucleic acids.

**Additional Catalog Notes**

Course Credit Limitation: No credit if taken after CHEM M07A or CHEM M07B.

**Taxonomy of Programs (TOP) Code (CB03)**

1905.00 - Chemistry, General

**Course Credit Status (CB04)**

D (Credit - Degree Applicable)

**Course Transfer Status (CB05) (select one only)**

A (Transferable to both UC and CSU)

**Course Basic Skills Status (CB08)**

N - The Course is Not a Basic Skills Course

**SAM Priority Code (CB09)**

E - Non-Occupational

**Course Cooperative Work Experience Education Status (CB10)**

N - Is Not Part of a Cooperative Work Experience Education Program

**Course Classification Status (CB11)**

Y - Credit Course

**Educational Assistance Class Instruction (Approved Special Class) (CB13)**

N - The Course is Not an Approved Special Class

**Course Prior to Transfer Level (CB21)**

Y - Not Applicable

**Course Noncredit Category (CB22)**

Y - Credit Course

**Funding Agency Category (CB23)**

Y - Not Applicable (Funding Not Used)

**Course Program Status (CB24)**

1 - Program Applicable

**General Education Status (CB25)**

Y - Not Applicable

**Support Course Status (CB26)**

N - Course is not a support course

**Field trips**

Will not be required

**Grading method**

(L) Letter Graded

**Alternate grading methods**

(O) Student Option- Letter/Pass

(P) Pass/No Pass Grading

**Does this course require an instructional materials fee?**

No

**Repeatable for Credit**

No

**Is this course part of a family?**

No

**Units and Hours**

**Carnegie Unit Override**

No

**In-Class**

**Lecture**

**Minimum Contact/In-Class Lecture Hours**

70

**Maximum Contact/In-Class Lecture Hours**

70

**Activity****Laboratory****Minimum Contact/In-Class Laboratory Hours**

52.5

**Maximum Contact/In-Class Laboratory Hours**

52.5

**Total in-Class****Total in-Class****Total Minimum Contact/In-Class Hours**

122.5

**Total Maximum Contact/In-Class Hours**

122.5

**Outside-of-Class****Internship/Cooperative Work Experience****Paid****Unpaid****Total Outside-of-Class****Total Outside-of-Class****Minimum Outside-of-Class Hours**

140

**Maximum Outside-of-Class Hours**

140

**Total Student Learning****Total Student Learning****Total Minimum Student Learning Hours**

262.5

**Total Maximum Student Learning Hours**

262.5

**Minimum Units (CB07)**

5

**Maximum Units (CB06)**

5

**Prerequisites**

CHEM M11 or CHEM M12 or equivalent college course

**Entrance Skills****Entrance Skills**

CHEM M11 or CHEM M12

**Prerequisite Course Objectives**

CHEM M11-analyze and apply the scientific method to chemistry problems, including developing a hypothesis, hypothesis testing, evaluation, and modeling.

CHEM M11-list the basic units of measurement in the metric and English systems, perform unit conversions within and between systems, and express results appropriately with significant figures and in scientific notation.

CHEM M11-classify the states of matter, distinguish between chemical and physical changes, identify the basic components of the nuclear atom, identify the symbols of common elements, predict atomic trends, name simple inorganic compounds.

CHEM M11-draw valid Lewis structures of common molecules, identify bond polarities using electronegativity values, predict the molecular geometry of molecules using VSEPR (Valence Shell Pair Electron Repulsion).

CHEM M11-classify and predict double displacement and acid-base reactions of inorganic compounds, perform stoichiometric calculations for reactions, calculate changes in ideal gases using the ideal gas law, rank the strength of intermolecular forces.

CHEM M11-identify common acids and bases, calculate the pH of solutions, predict the pH of important physiological fluids.

CHEM M11-experiment with acids and bases, alkanes, alkenes, alcohols, aldehydes, ketones, amines, carboxylic acids and their derivatives, proteins, DNA, and enzymes in a hands-on environment.

CHEM M11-conduct various quantitative and qualitative hands-on experiments with adherence to safety protocols, record observations and express numerical values appropriately, analyze acquired data, and formulate proper conclusions through written expression of results.

CHEM M11-apply hands-on laboratory techniques such as chromatography, spectrophotometric analysis, filtration, differential solubilities to separate and analyze mixtures, organic synthesis and product characterization, and molecular modeling.

CHEM M12-analyze and apply the scientific method to chemistry problems, including developing a hypothesis, hypothesis testing, evaluation, and modeling.

CHEM M12-list the basic units of measurement in the metric and English systems, perform unit conversions within and between systems, and express results appropriately with significant figures and in scientific notation.

CHEM M12-use dimensional analysis to perform mathematical conversions and solve problems involving density, energy, stoichiometry, quantum mechanics, solids, liquids, gases, and solutions.

CHEM M12-classify matter, distinguish between physical/chemical changes and properties, and comprehend the principles of chemical reactions and energy relationships.

CHEM M12-list and describe the distinguishing characteristics of solids, liquids, gases, and solutions.

CHEM M12-describe the quantum mechanical model and construct the historical development of the nuclear atom, explain the nature of atomic spectra, and account for trends in chemical periodicity involving atomic and ionic radii, ionization energy, and electronegativity.

CHEM M12- identify the symbols of common elements, the structures of molecules and ions, and name various inorganic compounds.

CHEM M12-write balanced molecular, ionic, and net-ionic equations for synthesis, decomposition, combustion, single-replacement, double-replacement, and oxidation-reduction reactions.

CHEM M12-apply Lewis and VSEPR (Valence Shell Electron Pair Repulsion) theories to draw structures and shapes, label electronic and molecular geometries, and predict polarities for molecules and ions.

CHEM M12-state the general principles of Arrhenius and Bronsted-Lowry acid/base theories, explain the nature of the pH scale as well as perform pH calculations, and identify buffer solutions.

CHEM M12-conduct various quantitative and qualitative hands-on experiments with adherence to safety protocols, record observations and express numerical values appropriately, analyze acquired data, and formulate proper conclusions through written expression of results.

## Requisite Justification

### Requisite Type

Prerequisite

### Requisite

CHEM M11 or CHEM M12 or equivalent college course

### Requisite Description

Course in a sequence

### Level of Scrutiny/Justification

Required by 4 year institution

## Student Learning Outcomes (CSLOs)

Upon satisfactory completion of the course, students will be able to:

- |   |   |
|---|---|
| 1 | demonstrate a mastery of rate laws and reaction mechanisms, equilibrium problems, Le Chatelier's Principle, and acid-base theories.   |
| 2 | standing of how many intuitive ideas about the molecular world are incorrect, and how chemical experiments can provide more useful concepts to replace those ideas. Students will summarize their hands-on laboratory experiments in clear and precise scientific language. |
| 3 | demonstrate a basic knowledge of the thermodynamics and electronic properties of molecules, and how those properties affect reactivity. Students will be able to categorize and identify biologically important molecules and the major classes of organic chemicals.       |

**Course Objectives**

Upon satisfactory completion of the course, students will be able to:

- |    |  |
|----|--|
| 1  | determine how rates of chemical reactions are measured and written, as well as describe the transition state and collision theory of reactions. Write and solve equilibrium constant expressions for chemical reactions; distinguish between a steady state and an equilibrium system; and apply Le Chatelier's Principle to various mixtures. |
| 2  | write and solve equilibrium constant expressions for chemical reactions; distinguish between a steady state and an equilibrium system; and apply Le Chatelier's Principle to various mixtures.   |
| 3  | state the general principles of Arrhenius and Bronsted-Lowry theories; explain the nature of the pH scale as well as perform various pH calculations; identify buffer solutions and predict their pH; and predict whether substances are acidic, basic, or neutral.  |
| 4  | state the First, Second, and Third Laws of Thermodynamics; define enthalpy, entropy, Gibbs Free Energy, and calculate changes in enthalpy, entropy, and Gibbs Free energy in a chemical reaction for standard conditions in order to determine overall spontaneity.  |
| 5  | identify types of radioactive decay; discuss radioactive decay rates and their half-life; determine how nuclear radiation is detected and measured; and compare and contrast the processes of nuclear fission and fusion.  |
| 6  | analyze, name, and draw structures for saturated hydrocarbons, unsaturated hydrocarbons, aromatic compounds, alcohols, ethers, and esters; predict the outcome of various organic reactions.   |
| 7  | classify carbohydrates, lipids, proteins, nucleic acids, and examine their usage in the human body. Determine what forces influence the folding of proteins into active forms. Categorize the bonds within a carbohydrate chain using standard notation. Understand how the properties of complex carbohydrates arise from their structure.    |
| 8  | state how genetic information is transmitted from the DNA to RNA and then translated into proteins. Identify key enzymes in this process, as well as the effects of incorrect transcriptions. Name nucleotides and nucleosides.  |
| 9  | demonstrate an understanding of metabolism and biochemical energy production. Decide which metabolic pathways are active depending on what environment a cell is in. Draw the products and by-products of metabolic cycles. Understand the linkage between metabolic diseases and metabolic cycles.  |
| 10 | experiment in a hands-on environment with kinetics, acids and bases, buffer solutions, redox reactions, alkanes, alkenes, alcohols, ethers, esters, carbohydrates, lipids, proteins, and enzymes.  |

**Course Content****Lecture/Course Content**

6.00% Chemical Kinetics:

Rates of Chemical Reactions

Factors that Affect Reaction Rates

6.00% Rate Law Determination using Method of Initial Rates

Activation Energy

Reaction Mechanisms

Effect of Catalysts

8.00%

Principles of Chemical Equilibrium:

Mass Action Expression;

Steady State versus Equilibrium System

Equilibrium Constant Determination

Le Chatelier's Principle

8.00%

Acid-Base Equilibrium:

Arrhenius and Bronsted-Lowry Theories

The pH Scale

Strong and Weak Electrolytes and their Reactions

Acid-Base Properties

Buffer Solutions and their expected pH

Titrations

6.00%

Chemical Thermodynamics:

First, Second, and Third Laws of Thermodynamics

Enthalpy, Entropy, Gibbs Free Energy, and their Applications to

Spontaneity

6.00%

Nuclear:

Types of Radioactive Decay, Rates, and Half-life

Radiation

Nuclear Medicine;  
Fission and Fusion

8.00%

Organic:

Saturated Hydrocarbons - Alkanes  
Nomenclature, Structural Formulas, and Isomerism

8.00%

Organic:

Unsaturated Hydrocarbons - Alkenes, Alkynes, and Aromatic  
Hydrocarbons  
Nomenclature, Structural Formulas, and Isomerism

8.00% Organic:

Alcohols, Ethers, and Esters - Properties and Reactions

6.00%

Biochemistry:

Carbohydrates - Classification and Chemical Properties of  
Monosaccharides  
Disaccharides and Polysaccharides  
Metabolism via Glycolysis  
The Citric Acid Cycle  
Electron Transport Chain

6.00%

Biochemistry:

Lipids - Characteristics and Reactions of Lipids  
Soaps and Detergents  
Water-soluble versus Lipid-soluble Vitamins  
Steroids  
Metabolism via Beta-Oxidation

9.00%

Biochemistry:

Proteins - Characteristics of Proteins  
Amino Acids and Peptide Formation  
Levels of Protein Structure  
Protein Catabolism  
Enzymes

9.00% Biochemistry:

Nucleic Acids - Characteristics of Nucleic Acids  
Primary, Secondary, Tertiary, and Quarternary Structures of Nucleic  
Acids  
DNA Double Helix  
Replication of DNA, RNA, and Protein Synthesis

6.00%

Biochemistry:

ATP Production  
Citric Acid Cycles  
Electron Transport Chain  
Glycolysis  
Consumption of Pyruvate  
Lipid Metabolism

**Laboratory or Activity Content**

10.00% Hands-On Kinetics Reactions:

The Iodine Clock Reaction and Effects of Catalysts

6.00% Hands-On Equilibrium Reactions:

Le Chatelier's Principle

24.00%

Hands-On Reactions with Acids and Bases:

Relative Strengths of Acids and Bases, Acid-Base Titrations, and pH  
Indicators

10.00% Hands-On Electrochemistry Reactions:

Redox Reactions and Electrochemical Cells

6.00% Organic Chemistry:

Molecular Models

14.00% Hands-On Organic Chemistry Reactions:  
 Synthesis of Esters and Synthesis of Soap  
 Comparison of Saturated, Unsaturated, and Aromatic Hydrocarbons

30.00% Hands-On Biochemistry Reactions:  
 Determination of Vitamin C in Foods  
 Fermentation  
 Food Tests  
 Effects of Penetrating Radiation and Use of the Geiger Counter  
 Isolate DNA from plant materials and measure its physical properties

## Methods of Evaluation

**Which of these methods will students use to demonstrate proficiency in the subject matter of this course? (Check all that apply):**

Written expression  
 Problem solving exercises  
 Skills demonstrations

**Methods of Evaluation may include, but are not limited to, the following typical classroom assessment techniques/required assignments (check as many as are deemed appropriate):**

Computational homework  
 Essay exams  
 Group projects  
 Individual projects  
 Journals  
 Laboratory activities  
 Laboratory practical examinations  
 Laboratory reports  
 Objective exams  
 Oral analysis/critiques  
 Oral presentations  
 Problem-solving exams  
 Problem-solving homework  
 Quizzes  
 Reports/papers  
 Research papers  
 Simulations  
 Skills demonstrations  
 Skills tests or practical examinations  
 Written analyses  
 Written compositions  
 Written homework  
 Classroom Discussion  
 Projects  
 Participation  
 Reports/Papers/Journals

## Instructional Methodology

**Specify the methods of instruction that may be employed in this course**

Audio-visual presentations  
 Case studies  
 Class activities  
 Class discussions  
 Collaborative group work  
 Computer-aided presentations  
 Demonstrations  
 Dialog  
 Distance Education  
 Field trips  
 Group discussions  
 Guest speakers  
 Instructor-guided interpretation and analysis  
 Instructor-guided use of technology  
 Internet research  
 Laboratory activities  
 Large group activities

Lecture  
 Modeling  
 Observation  
 One-on-one conference  
 Oral Drills  
 Practica  
 Problem-solving examples  
 Readings  
 Small group activities  
 Web-based presentations

**Describe specific examples of the methods the instructor will use:**

Chemical demonstrations performed by instructor.

Instructor will utilize a variety of instructional methods such as PowerPoint, whiteboard, and over-head projector to deliver lecture content.

Instructor will observe lab students to ensure proper hands-on data collection and analysis.

Instructor will demonstrate the use of Excel for graphing of data to determine trends.

## Representative Course Assignments

### Writing Assignments

write short essays explaining how chemicals interact in the body. A sample topic would be: write a brief summary explaining how a mis-translation of a single codon in the DNA can create a pathological condition for carriers of that mutation.

describe observations and answer questions from laboratory experiments.

write the definition of chemical terms, such as enthalpy and entropy, using correct technical language.

### Critical Thinking Assignments

analyze the outcome of chemical reactions and analogize the results to predict the outcome of new reactions. An example assignment would be: Based on the reactions of the carboxylic acids and alcohols you have conducted, predict and draw the structure of the esters that would form when the following acids and alcohols react.

apply knowledge gained in lecture and in reading to analyze current cultural trends in health and fitness. An example assignment would be: The sales of "alkaline water" have become popular in recent years. Using your knowledge of buffers, pH, and acid-base chemistry, prepare a succinct argument that explains why (or why not) this product has health benefits and be prepared to present it to the class next week.

describe and apply a series of steps for obtaining the solution to quantitative chemical problems.

### Reading Assignments

research relevant background material related to a hands-on experiment performed in lab and use this to write an introduction to a laboratory report.

use the chemical literature to determine the relative strengths of a series of acids and compare to the strengths determined in lab.

### Skills Demonstrations

demonstrate proper use of glassware while measuring volumes and masses of various solid and liquid substances.

follow a provided procedure to isolate DNA from an onion and analyze its properties.

## Outside Assignments

### Representative Outside Assignments

create an electronic presentation on a topic related to the course. An example would be: Using properly sourced citations, create a PowerPoint presentation on the topic of which type of macronutrient raises glucose levels in the blood most quickly. Include details and diagrams of all metabolic pathways discussed.

complete additional problem sets provided by the instructor.

## Articulation

### C-ID Descriptor Number

CHEM 102

### Status

Approved



**Equivalent Courses at 4 year institutions**

University	Course ID	Course Title	Units
CSU Fresno	CHEM 3B & 3BL	Introduction to Organic and Biochemistry and Lab	3, 1
CSU Chico	CHEM 108	Organic Chemistry for Applied Sciences	4
CSU Sacramento	CHEM 6B	Introduction to Organic and Biological Chemistry	5
San Jose State Univ.	CHEM 30B	Introductory Chemistry	3
CSU Northridge	CHEM 104 & 104L	Introductory Chemistry II & Lab	3/1

**Comparable Courses within the VCCCD**

CHEM V21 - Introduction to Organic and Biochemistry  
 CHEM V21L - Introduction to Organic and Biochemistry Laboratory  
 CHEM R112 - Elementary Organic and Biological Chemistry

**Equivalent Courses at other CCCs**

College	Course ID	Course Title	Units
West Los Angeles College	CHEM 066	Organic and Biochemistry for Allied Health	5

**Attach Syllabus**

13\_syllabus\_s18.docx

**District General Education****A. Natural Sciences****A2. Physical Science**

Approved

**B. Social and Behavioral Sciences****C. Humanities****D. Language and Rationality****E. Health and Physical Education/Kinesiology****F. Ethnic Studies/Gender Studies****Course is CSU transferable**

Yes

**CSU Baccalaureate List effective term:**

F1995

**CSU GE-Breadth****Area A: English Language Communication and Critical Thinking****Area B: Scientific Inquiry and Quantitative Reasoning****B1 Physical Science**

Approved

**B3 Laboratory Activity**

Approved

**Area C: Arts and Humanities**

**Area D: Social Sciences**

**Area E: Lifelong Learning and Self-Development**

**Area F: Ethnic Studies**

**CSU Graduation Requirement in U.S. History, Constitution and American Ideals:**

**UC TCA**

UC TCA  
Approved

**IGETC**

**Area 1: English Communication**

**Area 2A: Mathematical Concepts & Quantitative Reasoning**

**Area 3: Arts and Humanities**

**Area 4: Social and Behavioral Sciences**

**Area 5: Physical and Biological Sciences**

**Area 5A: Physical Science**  
Approved

**Area 5C: Laboratory Science**  
Approved

**Area 6: Languages Other than English (LOTE)**

**Textbooks and Lab Manuals**

**Resource Type**  
Textbook

**Description**  
Bettelheim, Frederick A., et al. *Introduction to General, Organic, and Biochemistry*. 12th ed., Cengage, 2020.

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**Resource Type**  
Textbook

**Description**  
Smith, Janice Gorzynski. *Principles of General, Organic and Biological Chemistry*. 3rd ed., McGraw-Hill Education, 2023.

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**Resource Type**  
Textbook

**Description**  
Moorpark College Chemistry Department. *Chemistry M13 Laboratory Manual*. 2nd ed., L.J. Williamson, 2013.

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## Library Resources

### Assignments requiring library resources

Research using the library's print and online resources.

### Sufficient Library Resources exist

Yes

### Example of Assignments Requiring Library Resources

Use the Library's print and online resources to research and report on the relevant chemistry and background material in the introduction section of a written laboratory report about, for example, carbohydrates.

## Distance Education Addendum

### Definitions

#### Distance Education Modalities

Hybrid (1%–50% online)

### Faculty Certifications

Faculty assigned to teach Hybrid or Fully Online sections of this course will receive training in how to satisfy the Federal and state regulations governing regular effective/substantive contact for distance education. The training will include common elements in the district-supported learning management system (LMS), online teaching methods, regular effective/substantive contact, and best practices.

Yes

Faculty assigned to teach Hybrid or Fully Online sections of this course will meet with the EAC Alternate Media Specialist to ensure that the course content meets the required Federal and state accessibility standards for access by students with disabilities. Common areas for discussion include accessibility of PDF files, images, captioning of videos, Power Point presentations, math and scientific notation, and ensuring the use of style mark-up in Word documents.

Yes

### Regular Effective/Substantive Contact

#### Hybrid (1%–50% online) Modality:

Method of Instruction	Document typical activities or assignments for each method of instruction
Asynchronous Dialog (e.g., discussion board)	Students may be required to post their ideas or solutions for class-related material on the course discussion boards. Students may also be required to comment on the posts of other students, including constructive criticism.
E-mail	The instructor may email students with announcements about the course or other college events and opportunities and answer student questions. Students may email questions and possibly assignments or projects, depending on the nature of the class, directly to the instructor.
Face to Face (by student request; cannot be required)	Students may have the option to visit the instructor in their office on campus for office hours or to discuss other class-related items.
Other DE (e.g., recorded lectures)	The instructor may use other instruction methods appropriate to the subject matter. For example, pre-recorded lectures may be posted perhaps leading to a class discussion on the discussion boards.
Synchronous Dialog (e.g., online chat)	The instructor may hold class in a regular schedule but in an online format using a program such as ConferZoom. Office hours may also be held in this manner or with an online chat tool.
Telephone	Students may have the option to call the instructor and/or the instructor may call students to facilitate office hours or to discuss other class-related items.
Video Conferencing	The Instructor may hold class in a regular schedule but in an online format using a program such as ConferZoom. Office hours may also be held in this manner.

## Examinations

### Hybrid (1%–50% online) Modality

On campus  
Online

### Primary Minimum Qualification

CHEMISTRY

## Review and Approval Dates

### Department Chair

03/25/2022

### Dean

03/25/2022

### Technical Review

04/21/2022

### Curriculum Committee

5/3/2022

### DTRW-I

MM/DD/YYYY

### Curriculum Committee

MM/DD/YYYY

### Board

MM/DD/YYYY

### CCCCO

MM/DD/YYYY

### Control Number

CCC000432382

### DOE/accreditation approval date

MM/DD/YYYY