

# CHEM-131L: GENERAL CHEMISTRY LABORATORY II

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## Cuyahoga Community College

**Viewing: CHEM-131L : General Chemistry Laboratory II**

**Board of Trustees:**

January 2022

**Academic Term:**

Fall 2022

**Subject Code**

CHEM - Chemistry

**Course Number:**

131L

**Title:**

General Chemistry Laboratory II

**Catalog Description:**

Basic laboratory experiments which correlate with chemical concepts, principles and processes of General Chemistry II with an emphasis on technique and procedures.

**Credit Hour(s):**

1

**Lecture Hour(s):**

0

**Lab Hour(s):**

3

**Other Hour(s):**

0

## Requisites

**Prerequisite and Corequisite**

CHEM-130L General Chemistry Laboratory I, and CHEM-1310

General Chemistry II or concurrent enrollment; or departmental approval: equivalent knowledge or skills.

## Outcomes

**Course Outcome(s):**

Develop preparative skills to safely and effectively use various experimental techniques to collect laboratory data required to support chemical concepts and principles. To use these skills in advanced scientific studies and/or real world applications.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Demonstrate knowledge of rules of safety in the laboratory.
  2. Measure and calculate using the metric system.
  3. Demonstrate an understanding of chemical nomenclature.
  4. Record data to the correct number of significant figures.
  5. Acquire knowledge of basic statistics.
  6. Perform basic laboratory techniques.
  7. Use various types of laboratory equipment and computer software to acquire data.
  8. Perform experiments related to the topical outline for hands-on experience.
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**Course Outcome(s):**

Develop analytical skills required to interpret, evaluate, and report experimental results.

**Essential Learning Outcome Mapping:**

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

**Objective(s):**

1. Calculate using rules of significant figures.
  2. Calculate average, average deviation, and standard deviation of a data pool.
  3. Evaluate laboratory results for accuracy and precision by completing a statistical review and error analysis.
  4. Demonstrate graphing techniques.
  5. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
  6. Develop an appreciation for the laboratory as a means of supporting theoretical phenomena.
  7. Formulate experimental methods to collect, represent, and interpret data.
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**Course Outcome(s):**

Apply preparative skills and experimental techniques safely and effectively to acquire laboratory data to support chemical concepts and principles.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Demonstrate knowledge of rules of safety in the laboratory.
  2. Measure and calculate using the metric system.
  3. Demonstrate an understanding of chemical nomenclature.
  4. Record data with the correct number of significant figures.
  5. Acquire knowledge of basic statistics.
  6. Perform basic laboratory techniques.
  7. Use various types of laboratory equipment and computer software to acquire data.
  8. Perform experiments relating to the topical outline.
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**Course Outcome(s):**

Apply laboratory skills and techniques in advanced scientific studies and/or real-world applications.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Demonstrate knowledge of rules of safety in the laboratory.
  2. Use the metric system when performing experiments.
  3. Apply chemical nomenclature to experiments.
  4. Use various types of laboratory equipment and computer software to acquire data.
  5. Perform experiments relating to the topical outline.
  6. Use laboratory techniques to complete experiments or scientific studies.
  7. Apply statistical analysis to experiments results to determine the validity of data.
  8. Apply statistical analysis to examine the reproducibility of experimental data.
  9. Use significant figures appropriately during data collection and data analysis.
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**Course Outcome(s):**

Evaluate experimental results and communicate the analysis and conclusions effectively using appropriate scientific language.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

**Objective(s):**

1. Calculate using rules of significant figures.
2. Calculate average, average deviation, and standard deviation of a data pool.
3. Determine the accuracy and precision of a set of measurements.
4. Demonstrate graphing techniques.
5. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
6. Describe the purpose of the laboratory as a means of supporting theoretical phenomena.
7. Collect, organize, and interpret data.

**Course Outcome(s):**

Apply the scientific method to solve a problem, develop experimental procedures, and explain the design of scientific studies.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

**Objective(s):**

1. Calculate using rules of significant figures.
2. Calculate average, average deviation, and standard deviation of a data pool.
3. Determine the accuracy and precision of a set of measurements.
4. Demonstrate graphing techniques.
5. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
6. Describe the purpose of the laboratory as a means of supporting theoretical phenomena.
7. Collect, organize, and interpret data.
8. Describe the scientific method including the basic steps of the process.
9. Apply the steps of the scientific method to solve a problem.

**Course Outcome(s):**

Evaluate and differentiate between credible and non-credible sources of scientific arguments, use the gathered scientific information effectively, and appropriately cite the source of the information.

**Essential Learning Outcome Mapping:**

Information Literacy: Acquire, evaluate, and use information from credible sources in order to meet information needs for a specific research purpose.

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

**Objective(s):**

1. Determine the accuracy and precision of a set of measurements.
2. Demonstrate graphing techniques.
3. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
4. Describe the purpose of the laboratory as a means of supporting theoretical phenomena.
5. Collect, organize, and interpret data.
6. Locate and review credible, scientific information relevant to a specific purpose.
7. Use credible, scientific information to advance the purpose of a research project or to solve a problem.
8. Use information ethically including citing sources using the appropriate format.
9. Differentiate between scholarly, scientific information and popular, non-scientific information.
10. Understand the importance of utilizing scholarly, scientific information in advanced scientific studies and the application of chemistry in society.

**Course Outcome(s):**

Utilize the fundamental knowledge of chemistry to analyze chemical reactions and associated properties and develop critical thinking skills to predict and determine the causes of physical and/or chemical changes.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.

**Objective(s):**

1. Examine the chemical principles and scientific method used in experiments.
  2. Predict the outcomes of an experiment using chemical principles.
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**Course Outcome(s):**

Develop interpretative skills to apply mathematical methods to solve problems in other scientific studies and/or real-world applications.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

**Objective(s):**

1. Examine the chemical principles and scientific method used in experiments.
  2. Predict the outcomes of an experiment using chemical principles.
  3. Calculate using rules of significant figures.
  4. Calculate average, average deviation, and standard deviation of a data pool.
  5. Determine the accuracy and precision of a set of measurements.
  6. Demonstrate graphing techniques.
  7. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
  8. Describe the purpose of the laboratory as a means of supporting theoretical phenomena.
  9. Collect, organize, and interpret data.
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**Course Outcome(s):**

Apply the principles of chemistry to advanced scientific studies and/or applications of chemistry in society.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Examine the chemical principles and scientific method used in experiments.
  2. Predict the outcomes of an experiment using chemical principles.
  3. Observe chemical reactions, identify the products, and summarize the change by a chemical equation.
  4. Describe the purpose of the laboratory as a means of supporting theoretical phenomena.
  5. Collect, organize, and interpret data.
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**Methods of Evaluation:**

1. Laboratory assignments
2. Laboratory reports
3. Laboratory Notebook
4. Quizzes
5. Examinations
6. Case Study
7. Research Paper

**Course Content Outline:**

1. Laboratory safety
  - a. Safety procedures
  - b. Safety equipment
  - c. Correct handling of chemicals
  - d. Waste disposal
2. Metric system

- a. Measurements
- b. Conversions
3. Significant figures
  - a. Raw data
  - b. Calculations
4. Physical Measurements
  - a. Accuracy
  - b. Precision
  - c. Uncertainty
  - d. Significant Figures
    - i. Raw Data
    - ii. Calculations
5. Statistics
  - a. Average
  - b. Average deviation
  - c. Standard deviation
  - d. Error analysis
    - i. Percent Error
    - ii. Percent Yield
6. Graphical analysis
  - a. Preparation of a graph
  - b. Data abstraction
7. Chemical nomenclature
  - a. Inorganic
  - b. Organic
  - c. Coordination compounds
8. Basic Equipment Use
  - a. Analytical balance
  - b. Bunsen burner
  - c. Volumetric glassware
  - d. Class A pipettes
  - e. Variable micropipettes
  - f. Centrifuge
  - g. Buret
  - h. pH meter
9. Experiments (Based on lab facilities.)
  - a. Synthesis of alum
  - b. Determination of an equilibrium constant
  - c. LeChatelier's principle
  - d. Acids and bases
  - e. Acid-Base titration: pH meter
  - f. Determination of  $K_{sp}$  of calcium hydroxide or other compounds
  - g. Colligative property: freezing point depression
  - h. Electrochemistry
    - i. Potentiometric determination of iodide ion
    - j. Kinetics: initial rate method – determination of rate, rate law, and activation energy
    - k. Kinetics: graphical method – determination of rate law
    - l. Synthesis and structural analysis of a coordination compound
  - m. Qualitative cation analysis
  - n. Qualitative anion analysis
  - o. Radiation Shielding
  - p. Intermolecular Forces and Vapor Pressure
  - q. Predicting Spontaneity and Equilibrium
  - r. Using Freezing Point-Depression to Determine Molecular Weight

## Resources

Speight, James, ed. *Lange's Handbook of Chemistry*. 17th ed. New York: McGraw-Hill, 2017.

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Billo, Joseph E. *Excel for Chemists*. 3rd ed. New York: John Wiley Sons, Inc., 2011.

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Haynes, William, ed. *CRC Handbook of Chemistry and Physics*. 102nd ed. Boca Raton: CRC Press, 2021.

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Murov, Steven. *Experiments in General Chemistry*. 6th ed. Boston: Cengage Learning, 2015.

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Hansen-Polcar, Lois. *Laboratory Experiments for General Chemistry Laboratory II*. 3rd ed. Parma: CCC West, 2017.

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Ebbing, Darrell. *Experiments in General Chemistry*. 10th ed. Belmont:Brooks/Cole Publishing, 2013.

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Randall, Jack. *Advanced Chemistry with Vernier*. Beaverton:Vernier Software and Technology, 2016.

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Allotta, Paula; Difrancesco, Dale; Distler, Anne; Emmer, Elizabeth. *Laboratory Experiments for General Chemistry*. Open Source, 2021.

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## Instructional Services

### OAN Number:

Ohio Transfer 36 TMNS and Transfer Assurance Guide OSC009 (Course 2 of 2, both must be taken), OSC023 (4 of 4, all must be taken)

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