



Laboratories Assignments *Administered By the Chemical Technology Program*

The following is a list of laboratory assignments delivered throughout the Chemical Technology Program at Cape Fear Community College. All students prepare their own solutions, assemble their own glassware apparatuses, perform their own data analysis including maintaining and troubleshooting all equipment and instrumentation, generate Excel spreadsheets representing data and statistical analysis, and work independently without laboratory partners.

Basic Chemistry I & II Series (CTC 111 and CTC 112 respectively)

CTC 111: Basic Chemistry I: This course is the first course taken in the Chemical Technology Program. All laboratories are chosen based on introductory methods and preparation for more advanced laboratory work.

- Laboratory 1: Alchemy: Changing a Penny into Gold
- Laboratory 2: Solubility Properties of Various Substances
- Laboratory 3: Measuring Viscosity
- Laboratory 4: Reporting Physical Changes
- Laboratory 5: Proper Measurement Techniques
- Laboratory 6: Calculating Densities of Unknown and Irregular Substances
- Laboratory 7: Performing a Quantitative Separation of a Heterogeneous Mixture
- Laboratory 8: Measuring Melting Point by Thiele Tube and Fisher John Apparatus
- Laboratory 9: Identification of an Unknown Substance by Various Physical Properties
- Laboratory 10: Qualitative Analysis using Flame Tests
- Laboratory 11: Identifying Cations in Solution
- Laboratory 12: Identifying Anions in Solution
- Laboratory 13: Determining the Formula of Hydrate
- Laboratory 14: Gravimetric Titration to Determine the Test for Vitamin C
- Laboratory 15: Studying the Copper Cycle
- Laboratory 16: Analysis of a Fertilizer
- Laboratory 17: Preparation of Alum

- Laboratory 18: Determining the Empirical Formula of a Compound
- Laboratory 19: Analysis of Single Replacement Reactions
- Laboratory 20: Analysis of Double Replacement Reactions
- Laboratory 21: Gravimetric Analysis of Nickel Dimethylglyoxime
- Laboratory 22: Titrating Vinegar
- Laboratory 23: Calculating the Amount of Phosphoric Acid in Soda
- Laboratory 24: Studying the Ideal Gas Law using Magnesium
- Laboratory 25: Determining the Formula Weight of a Gas Using the Ideal Gas Law

CTC 112: General Chemistry II: This is the second course taken by students enrolled in the Chemical Technology Program. During this semester students perform more advanced procedures and laboratory exercises. This is also the first semester students are introduced to the UV-VIS Spectrometer.

- Laboratory 1: Qualitative Analysis: Group I, II, III, IV, and V
- Laboratory 2: The Clock Reaction of Iodine
- Laboratory 3: The Rate Law of Crystal Violet Using the UV-VIS Spectrometer
- Laboratory 4: LeChatelier's Principle
- Laboratory 5: Colorimetric Determination of Cobalt (II) Chloride using the UV-VIS Spectrometer
- Laboratory 6: Determination of an Equilibrium Constant
- Laboratory 7: Introduction to Acids, Bases, and pH.
- Laboratory 8: Standardization of Sodium Hydroxide
- Laboratory 9: Titration of an Antacid
- Laboratory 10: Titration of Hard Water Using EDTA
- Laboratory 11: Determination of an Acid Dissociation Constant Using a UV-VIS Spectrometer
- Laboratory 12: Titration of a Polyprotic Acid
- Laboratory 13: Determination of a Solubility Product Constant Using a UV-VIS Spectrometer
- Laboratory 14: REDOX Titration I:
- Laboratory 15: REDOX Titration II:
- Laboratory 16: REDOX: Determining Iron
- Laboratory 17: Introduction to Galvanic Cells
- Laboratory 18: In-Depth Galvanic Cells, Dry Cells, and Batteries
- Laboratory 19: Heat of Solution
- Laboratory 20: Heat of Neutralization

Organic Processes and Organic Chemistry I, II, & III Series (CTC 140, CTC 120, CTC 220, and CTC 230 respectively)

CTC 120: Organic Chemistry I: This is a lecture course only.

CTC 140: Organic Processes: This is the first organic chemistry laboratory course taken by students enrolled in the Chemical Technology Program. All laboratories are chosen to enforce the basics of organic synthesis including recrystallization, liquid-liquid extraction, liquid-solid extraction, reflux, fractionation, and organic qualitative analysis, with a strong focus on green initiatives. More advanced techniques such as Soxhlet and Dean Stark Extraction are also performed. This is the first semester that students are introduced to the proper usage of an infrared (IR) spectrometer and polarimeter.

- Laboratory 1: The Effect of pH on a Food Preservative
- Laboratory 2: Qualitative Tests for Alkenes
- Laboratory 3: Electrogravimetry
- Laboratory 4: Separating the Components of 'Panacetin' & Identifying a Component of 'Panacetin'
- Laboratory 5: Heating Under Reflux: Synthesis of Salicylic Acid
- Laboratory 6: A Green Synthesis of Camphor
- Laboratory 7: Identification of a Petroleum Hydrocarbon
- Laboratory 8: Fractionation
- Laboratory 9: Isolation and Identification of the Major Constituent of Clove Oil
- Laboratory 10: Separation of an Alkane Clathrate
- Laboratory 11: Testing Markovnikov's Rule
- Laboratory 12: Calculating the Percent of Water in Fruits: A Dean Stark Trap
- Laboratory 13: Isolation of Peanut Oil: Soxhlet Extraction
- Laboratory 14: Synthesis of Ethanol by Fermentation
- Laboratory 15: Structures & Properties of Stereoisomers
- Laboratory 16: Stereochemistry of Bromine Addition to *trans*-Cinnamic Acid
- Laboratory 17: Polarimeter of Sugar Solutions & Percent of Sugars in Soft Drinks

CTC 220: Organic Chemistry II: This is the second organic chemistry laboratory course taken by students enrolled in the Chemical Technology Program. With a strong emphasis on organic synthesis, more advanced techniques are introduced including the use of gas chromatography. All experiments are chosen to compliment the lecture material and include topics such as aromatics, carboxylic acids, and alcohols. The Grignard and Wittig reaction are also introduced during this semester.

- Laboratory 1: Two Methods for the Synthesis of "Phenacetin"

- Laboratory 2: Studying SN1 and SN2 Reactions
- Laboratory 3: Determining the Alcohol Content of Beers and Wine
- Laboratory 4: Reactions of Butanols with Hydrobromic Acid
- Laboratory 5: Dehydrating Cyclohexanol
- Laboratory 6: Friedel-Crafts Acylation of Anisole
- Laboratory 7: Determination of the Structure of a Natural Product in Anise Oil
- Laboratory 8: Directive Effects in the Bromination of Vanillin
- Laboratory 9: Nitrating Acetanilide or Methyl Benzoate
- Laboratory 10: pKa of Weak Organic Acids
- Laboratory 11: Synthesis and Identification of an Unknown Carboxylic Acid
- Laboratory 12: A Wittig Reaction of trans-Cinnamaldehyde
- Laboratory 13: Nucleophilic Addition to Carbonyl: Grignard Reaction with Aldehyde
- Laboratory 14: Preparation of the Insect Repellent "6-12"

CTC 230: Organic Chemistry III: The final course in the organic series incorporates a biological point of reference concerning common biomolecules including amino acids, proteins, enzymes and DNA. Students are trained on the use of thin layer chromatography (TLC), revisit Soxhlet extraction and UV-VIS, and extensively study common qualitative tests concerning these molecules. Gel electrophoresis is introduced toward the end of the semester. Students also undergo an in-depth water community water study as part of the laboratory experience.

- Laboratory 1: Qualitative Analysis of a Carbohydrate
- Laboratory 2: Structure of an Unknown D-Hexose
- Laboratory 3: Qualitative Analysis of Amino Acids & Proteins
- Laboratory 4: Amino Acid Identification by Paper Chromatography
- Laboratory 5: Studying Amino Acids Using UV Spectroscopy
- Laboratory 6: Rennin Activity & Digestive Enzymes
- Laboratory 7: Enzymatic Reactions: A Chiral Carbon from a Ketone
- Laboratory 8: Qualitative Analysis of Lipids
- Laboratory 9: Soxhlet Extraction of Fat in Hamburger
- Laboratory 10: DNA Isolation, Amplification, and Electrophoresis
- Laboratory Project: Community Water Analysis

CTC 240: Industrial Analysis I: This course discusses common analytical spectroscopy instrumentation found in a laboratory setting. Students are trained on the use, operation, and maintenance of common spectrophotometers including Ultra-Violet/Visible (UV-VIS), infrared (IR), atomic absorption and emission (AA/AE), mass spectrometry (MS), and nuclear magnetic resonance (NMR). Students work independently in the

laboratory, making their own calibration solutions, preparing samples, running samples, and analyzing all data utilizing Excel. A strong statistical aspect concerning data is weaved throughout the entire semester.

- Laboratory 1: Statistical Analysis on a Carbonate Determination: Acid/Base Titration
- Laboratory 2: Statistical Analysis on Weight % of Concentrated and Dilute Acids
- Laboratory 3: Statistical Analysis and Label Validation on Weight % of Acetic Acid in Vinegar
- Laboratory 4: UV-VIS Introduction: Organic Spectra
- Laboratory 5: UV-VIS Caffeine and Acetaminophen
- Laboratory 6: Synthesis and Spectral Analysis of Acetylsalicylic Acid
- Laboratory 7: UV Spectroscopy: Pharmaceuticals & Dissolution
- Laboratory 8: UV-VIS Chromium & Manganese Mixture
- Laboratory 9: Caffeine Extraction from Tea: A Simplified Procedure
- Laboratory 10: Investigating a Chemical Bond by Infrared Spectroscopy
- Laboratory 11: Atomic Absorption: Non-Linearity of Copper
- Laboratory 12: Atomic Absorption: Iron Analysis of a Nail
- Laboratory 13: Atomic Absorption: Iron Determination by Standard Addition
- Laboratory 14: What's in a Penny? Investigation Using Atomic Absorption, UV-VIS, Electroanalyzer, and Gravimetry
- Laboratory 15: Atomic Emission of Sodium Chloride

CTC 250: Industrial Analysis II: This course discusses common analytical chromatography instrumentation found in a laboratory setting. Students are trained on the use, operation, and maintenance of common chromatography instruments including high performance liquid chromatography (HPLC), gas chromatography (GC, GC/MS), and ion chromatography (IC). Students are also trained on thin layer chromatography (TLC).

- Laboratory 1: Isolation of Lycopene from Tomato Paste using Column Chromatography
- Laboratory 2: Identification of Unknown Ketones using Thin Layer Chromatography
- Laboratory 3: Percent Composition of Solvent Mixtures Using Gas Chromatography
- Laboratory 4: Preparation and Confirmation of Synthetic Banana Oil
- Laboratory 5: TCE and PCE in Groundwater Using Gas Chromatography/Mass Spectrometry
- Laboratory 6: Flavor Compounds in Citrus Using Gas Chromatography/Mass Spectrometry
- Laboratory 7: Arson Investigation Using Gas Chromatography/Mass Spectrometry
- Laboratory 8: Gasoline Investigation Using Gas Chromatography/Mass Spectrometry
- Laboratory 9: Mint Investigation Using Gas Chromatography/Mass Spectrometry
- Laboratory 10: Percentage of Fluoride in Toothpaste Using Ion Chromatography

- Laboratory 11: Altering Selectivity with the Aid of Crown Ethers Using Ion Chromatography
Laboratory 12: Calculating the Concentration of Phosphoric Acid in Cola Drinks Using Ion Chromatography
Laboratory 13: Discovering Organic Acids in Wine Using Ion Chromatography
Laboratory 14: Paraben Exercise: Varying Mobile Phase for HPLC
Laboratory 15: Artificial Sweeteners Using HPLC
Laboratory 16: Label Validation of Acetaminophen Tablets Using HPLC

ANNUAL WATER STUDY

During the spring semesters, all students enrolled in the Chemical Technology Program participate in a community water study, targeting samples within New Hanover and Pender Counties. All experiments come from the Environmental Protection Agency (EPA). Methods are listed below:

METHOD 300.1:

Determination of Inorganic Anions in Drinking Water by Ion Chromatography

METHOD 524.2:

Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry

METHOD 525.2:

Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry



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