

This is a sample syllabus for CHM1020C. Students should reference the section syllabus provided at the beginning of the semester for specifics regarding assignments and grade assignments.

SYLLABUS

CHM 1020C Liberal Studies Chemistry

Department of Chemistry and Biochemistry

Florida State University

The *Liberal Studies for the 21st Century Program* at Florida State University builds an educational foundation that will enable FSU graduates to thrive both intellectually and materially and to support themselves, their families, and their communities through a broad and critical engagement with the world in which they live and work. Liberal Studies offers a transformative experience; this course has been approved as meeting the Liberal Studies requirements and thus is designed to help you become a critical appraiser of scientific theories and the facts that support them.

Welcome

Hello everyone and welcome to the most *awesome* course on campus or rather off. This CHM1020C online course is designed to be fun and entertaining and while you don't even notice it, teach you about some basic and even some not so basic chemistry. More importantly however you are being called upon to solve a murder. We will give you the training and the tools and your job will be to analyze the evidence and figure out who committed this heinous crime. While the course and all its components are online, I am still earthbound and more than willing to meet with those of you who need assistance as we progress through the course. Keep in mind we can meet in my office here at FSU or we can also meet in the Sheriff's office in the virtual world. Using whichever way is more convenient; don't hesitate to call on me for help. I really hope you enjoy this experience and of course learn something too. For those of you that are seriously interested in criminology or forensics as a career path be assured that all of the techniques we are presenting during the course are legit and were taken from law enforcement crime lab handbooks from around the country. We in the chemistry department are really excited about this new course and hope you will be too. Now let's go solve a crime...

The CHM1020C course is open to all majors and satisfies the liberal studies science and laboratory requirement as well as the computer competency requirement for the University.

Instructor's Name:

Telephone Number:

Email Address:

Office Hours (Day, Time, Location):

Course Web Site: The course will be hosted from the FSU Blackboard System available from: <http://campus.fsu.edu>

Course Materials: All materials for lecture and laboratory, including reading and examination materials will be presented through the second life “Liberal Studies Chemistry: A Forensic Academy” Program. You can purchase an access code directly from Pearson Education or through the University Bookstore.

Objectives:

Students upon completing this course and lab will demonstrate the ability to:

- think critically and cogently about causal relationships with scientific reasoning. [The laboratory portion of this course is a murder mystery. Students will be required to collect evidence acquired from a virtual crime scene and slowly process the evidence in experiments 1-7 to determine the cause of death, identity of both victim and killer and to identify the evidence that supports these conclusions]
- assess previous experimentation and published scientific results. [Students will be asked to read standard protocols used currently in today’s forensic laboratories. In several lab experiments they will need to identify the appropriate protocol to use in processing different types of evidence. They will also be asked to use published data to produce standard curves for use in analysis of their experimental results]
- critically examine and evaluate scientific observation, hypothesis or model construction. [At the conclusion of each lab experiment, students will be asked to examine their results and state the validity of those results- i.e. do the results make sense in terms of the stated hypothesis of the experiment]
- articulate a variety of issues created by the complex interactions among science, technology, and society. [In both lectures and labs, students will be introduced and tested on their recognition of the relationships between what a scientist can determine using his or her knowledge of chemistry and what the law will accept as evidence. Students will be asked to think deeply about whether all the evidence they have collected and processed in the lab give them the “proof” they need to make an arrest. Terms like “Burdon of Proof” and “Statistical Relevance” will be introduced several times throughout the course]

- use scientific perspectives to evaluate contemporary problems facing society. [Violent crime is a contemporary problem faced by society. This course will explain how science in general and chemistry specifically is being used to combat this problem]
- explain the process of scientific reasoning and apply scientific principles inside and outside of the laboratory or field setting. [Students in this virtual lab will be required to collect evidence from both the crime scene and also the autopsy of the victim. They will be required to use previously explained scientific principles and protocols for both the collection and storage of the evidence they collect.]
- systematically evaluate evidence for accuracy, limitations, and relevance, and identify alternative interpretations of evidence. [With each experiment a student performs, statistical analysis will be applied and students will be asked to determine the accuracy/validity of their experimental results]
- design and conduct experiments to make observations and test hypotheses, as well as to analyze and interpret data using quantitative and appropriate technological tools. [In several laboratories, students will be asked to determine the correct experimental protocol to perform (E.g. Lab 4 and Lab 7) based on their identification of the types of evidence they are processing]

Grading:

90.0%+ = A

80% - 89.9% = B

70% - 79.9% = C

60.0% - 69.9% = D

Anything below 60.0% = F

The overall course grade will be determined based on the traditional grading scale shown above. An average of 90% or greater in the course material will earn you an A, 80% or more up to 89.9% will garner you a B and so on. The way this average will be determined is shown in the example given below:

Example Grade Calculation:

Lecture Grades:

If your Quiz Average = 91.3% and your Exam Average = 84.7%

The overall Lecture Average = [0.913(20% Quiz)= 18.26%] + [0.847(80% Exam)=67.76%] = 86.02%

If your overall Lab Average = 92.6%

Then your final Overall Grade = 0.8602 (75% Lecture) + 0.926(25% Lab) = 87.65% = B

- Each of the exams, quizzes and assignments required in the course will be scored out of 100%.
- Lecture Quizzes will constitute 20.0% of the lecture grade and the Exams and Final the other 80%.
- The average scores for the quizzes and exams will be weighted to determine the overall average for the lecture component of the course.
- For the lab, each of the post-lab assignments are equally weighted so the average of those scores can be determined directly without further calculation.
- Once the Lecture and Lab component averages are determined they are then weighted as shown to calculate the 75% and 25% portion of the overall average for the course. It is this final overall percentage that will determine your grade in the course.

Quizzes and post-laboratory exercises will be completed and graded within the second life online system. A quiz will be given at the completion of each lecture for a total of 12 quizzes. A post-laboratory exercise will be given at the completion of each laboratory experiment for a total of 8 post-laboratory exercises. Grades for these quizzes and exercises will be posted to the Blackboard course site.

Exams will be completed at the FSU Center for Testing and Assessment. **ALL** students must submit a completed "Proctor Designation Form" to the FSU Center for Assessment and Testing prior to attempting the first examination. This form is available in the Course Library of the Bb course website. See "Proctored Exam Information" below. Local students simply choose the FSU CAT as their testing center. All students must read and understand the procedures for taking examinations at the FSU Testing Center (or any other offsite testing center); these instructions are posted below and in the Course Library of the Bb course website.

Section Exams: Three (3) section exams will be given during the term, each exam covering 3-4 chapters. Exam questions will be taken primarily from the Lecture and quiz materials.

Final Exam: A Cumulative Final Examination will also be given. See Schedule.

As shown in the Course Schedule, the exams are available starting from the beginning of the semester, and remain available until each course section is completed. You must attempt each exam before the deadline for that exam has passed:

Exam I: TBA

Exam II: TBA
Exam III: TBA
Final Exam: TBA

If you wait until the last day to take an exam at the FSU Testing Center, or show up too late in the day, you may not be able to take the exam since they are often very busy. **DO NOT WAIT UNTIL THE LAST DAY TO TAKE THE EXAMS. TAKING THE EXAMS IN A TIMELY MANNER IS YOUR RESPONSIBILITY.**

Procedures for On-Site Testing:

1. Students may come to the Test Center between _____. Any time limits will be imposed through the Second Life Online System. **NO BOOKS, NO CALCULATORS, NO PHONES!**
2. Students will present their FSU ID card to Reception (UCC 1200), who will use the card to check students in.
3. Students will sign a paper Distance Learning log.
4. CAT proctors will confirm students' identity and confirm the student is on the course roster.
5. After checking in (UCC 1200), students will enter the Test Center (UCC 1100) where a proctor will;
 - a. Reconfirm identification (and swipe the students in)
 - b. Distribute color-coded scratch paper/pencils (if instructor requests)
 - c. Escort students to their testing station
 - d. Enter password to enter the test after students navigate to their exam
 - e. Monitor examinees for signs of cheating
6. If there is a problem which CAT staff are unable to resolve, the student will be told to contact their instructor. *CAT will not be able to allow the student to test later.*

Computer Competency:

The final post laboratory of the semester requires the student to both navigate the system and analyze the sum total evidence collected during the entire semester. This analysis is done in both the Virtual (CNDG) software program as well as the Blackboard testing program. Students must complete this exercise to receive a final grade in the course. Students cannot pass the course without a passing score (70%+) on this assignment.

Rubric for Final Post Lab Exercise

Majority Missing (10%)

General statement of guilty or innocent with no supporting documentation.

Some detail but missing key components (30%)

General statement of guilty or innocent with some supporting information but lacks details or specifics. Drawing the wrong conclusion despite evidence to the contrary.

About half correct (55%)

General statement of guilty or innocent with some supporting information with some details, but only includes what the evidence was but not how it was interpreted or generated. May or may not have the correct guilty party.

Mostly there but lacks full understanding (85%)

General statement of guilty or innocent with supporting information in detail. Includes most of what the evidence was and how it was interpreted or generated. May or may not have the correct guilty party. Only missing minor details to fully support their conclusions.

Well Done and complete (100%)

Well-constructed and organized conclusion including: General statement of guilty or innocent with supporting information in detail. Includes all of the evidence and how it was interpreted or generated supporting the guilt of the correct guilty party.

NOTE: In order to receive a "C-" or better in the course, the student must earn at least a "C-" on the computer competency component of the course. If the student does not earn a "C-" or better on the computer competency component of the course, the student will not earn an overall grade of "C-" or better in the course, no matter how well the student performs in the remaining portion of the course.

“Attendance” Policy: The First Day Attendance link on the course web site has been activated, and will be open for 24 hours beginning at _____. You are required to verify your enrollment by logging on to <http://campus.fsu.edu>, navigating to CHM1020C online, and clicking on the First Day Attendance link. Enter the passcode CHM1020C when prompted.

Examination Attendance:

All exams are mandatory. Scheduling of exams is the responsibility of the student and no late or make-up exams will be given. Serious conflicts with the exam schedule must be discussed with the instructor and documentation provided for the conflict, preferably before the exam date(s).

Laboratory Attendance:

Upon registration in the Second Life “Liberal Studies Chemistry: A Forensic Academy” Program students will be presented with a list of available times to attend the online chemistry laboratory. Each Laboratory will be designed to take approximately 2 hours to complete and therefore students should be sure to select a time without any conflicts. Students will attend labs in groups of 24 and will be expected to work within teams of four (4) students to complete the exercises. Attendance during the assigned laboratory time is mandatory. A missed laboratory will result in a zero for the missed post-laboratory exercise. No Make Up labs will be provided. Students missing a lab for an

excusable reason should submit documentation to the instructor within 24 hours of the missed lab to have the post-laboratory exercise excused.

Syllabus Change Policy: Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.

University Attendance Policy:

Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official University activities. These absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Academic Honor Policy:

The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "...be honest and truthful and...[to] strive for personal and institutional integrity at Florida State University." (Florida State University Academic Honor Policy, found at <http://fda.fsu.edu/Academics/Academic-Honor-Policy>)

Americans with Disabilities Act:

Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Student Disability Resource Center; and (2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class. This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the: Student Disability Resource Center 874 Traditions Way 108 Student Services Building Florida State University Tallahassee, FL 32306-4167 (850) 644-9566 (voice) (850) 644-8504 (TDD) sdrc@admin.fsu.edu <http://www.disabilitycenter.fsu.edu>

Course Outline

Lectures:

Lecture 1: Introduction to Forensic Academy

- **Chemistry and Crime- A Brief History**
- **The Language of Chemistry**

- **The Scientific Method**
- **Types of Evidence**

Learning Outcomes:

- **After completing this lecture students will:**
- **Be able to state that Chemistry is the study of matter and the changes it undergoes. (Lecture I Quiz; Exam I)**
- **Be able to state the relationship between chemistry and forensic investigation (Lecture I Quiz; Exam I)**
- **Be able to classify matter as elements, compounds or mixtures. (Lecture I Quiz; Exam I)**
- **Be able to classify properties of matter as physical and chemical. (Lecture I Quiz; Exam I)**

SAMPLE

- Be able to identify the differences between the different states of matter. (Lecture 1 Quiz; Exam 1)
- Be able to state the definitions of pure substances, and homogeneous and heterogeneous mixtures. (Lecture 1 Quiz; Exam 1)
- Be able to generate the process of the scientific method (Lecture 1 Quiz; Exam 1)
- Be able to state the types of data that can be collected in a scientific investigation (Lecture 1 Quiz; Exam 1)

Lecture 2: Gathering Evidence

- Physical Evidence Collection: Mass, Weight and Units
- Analysis: Unit Conversions
- Experimental Results: Statistics of Evidentiary Information

Learning Outcomes:

- After completing this lecture students will:
- Be able to state the difference between the terms mass and weight (Lecture 2 Quiz; Exam 1)
- Be able to use the appropriate metric prefixes in a calculation (Lecture 2 Quiz; Exam 1)
- Be able to use IUPAC base units and derived units in calculations (Lecture 2 Quiz; Exam 1)
- Be able to perform simple unit conversions and numerical calculations involving numbers in scientific notation and/or units with common metric prefixes (Lecture 2 Quiz; Exam 1)
- Be able to state the importance of significant figures in data analysis (Lecture 2 Quiz; Exam 1)
- Be able to use statistics like average, standard deviation and percent error when applied to data sets (Lecture 2 Quiz; Exam 1)

Lecture 3: Chemical Basics

- Atomic Structure
- Isotopes
- Atomic Mass
- Electronic Structure
- Using Light to Investigate
- Spectroscopy

Learning Outcomes:

- After completing this lecture students will:
- Be able to state the structure of the atom: protons, neutrons and electrons (Lecture 3 Quiz; Exam 1)
- Be able to identify the electron configuration of an atom (Lecture 3 Quiz; Exam 1)
- Be able to state the definition and value of the terms Atomic Number, Atomic Mass Number and Isotope (Lecture 3 Quiz; Exam 1)

- Be able to state the definition of the mole and Avagadro's number (Lecture 3 Quiz; Exam I)
- Be able to state the relationship between atomic structure and spectroscopy (Lecture 3 Quiz; Exam I)

EXAM I (Lecture Material 1-3)

Lecture 4: Chemical Structure

- Lewis Structures
- Chemical Shapes
- Polarity
- Solubility
- Acids and Bases
- pH

Learning Outcomes:

- After completing this lecture students will:
- Be able to generate the structure of a molecule from its component atoms (Lecture 4 Quiz; Exam II)
- Be able to identify covalent and ionic compounds (Lecture 4 Quiz; Exam II)
- Be able to recognize, name and draw the Lewis structures of common molecules (Lecture 4 Quiz; Exam II)
- Be able to apply the rules of the VSEPR Theory to atoms in a molecular structure (Lecture 4 Quiz; Exam II)
- Be able to state the definitions of the terms electronegativity and polarity (Lecture 4 Quiz; Exam II)
- Be able to state the definition of the terms Acid and Base (Lecture 4 Quiz; Exam II)
- Be able to determine the pH of an aqueous solution (Lecture 4 Quiz; Exam II)

Lecture 5: Chemical Evidence – Solutions

- Water
- Chemical Reactions
- The Mathematics of Chemical Reactions
- Luminol and other Forensic Chemicals

Learning Outcomes:

- After completing this lecture students will:
- Be able to state many of the special properties of water (Lecture 5 Quiz; Exam II)
- Be able to calculate the concentrations of aqueous solutions (Lecture 5 Quiz; Exam II)
- Be able to write and balance chemical reactions (Lecture 5 Quiz; Exam II)
- Be able to use stoichiometry to determine the quantities of reactants and products used or produced in a chemical reaction (Lecture 5 Quiz; Exam II)

- Be able to identify the structure and reactions of special chemicals that are used in criminal investigations (Lecture 5 Quiz; Exam II)

Lecture 6: Chemical Evidence – Drugs

- Types of Drugs
- Structures and Functions
- Chemistry and the Law

Learning Outcomes:

- After completing this lecture students will:
- Be able to identify the chemical structure of common drugs (Lecture 6 Quiz; Exam II)
- Be able to state how the structure of the drug relates to its biochemical function (Lecture 6 Quiz; Exam II)
- Be able to correlate the relationship between the classifications of drugs, their functions and the law. (Lecture 6 Quiz; Exam II)

EXAM II (Lecture Material 4-6)

Lecture 7: Arson and the Chemistry of Fire

- Combustion
- Evidence of Arson
- Flammable Liquids, Why?
- Explosive Chemistry

Learning Outcomes:

- After completing this lecture students will:
- Be able to identify a combustion reaction of compounds in oxygen (Lecture 7 Quiz; Exam III)
- Be able to identify the chemical product residues created when combustion takes place (Lecture 7 Quiz; Exam III)
- Be able to state whether a reaction is exothermic or endothermic (Lecture 7 Quiz; Exam III)
- Be able to state the chemical properties of flammability (Lecture 7 Quiz; Exam III)
- Be able to state the chemical properties of explosives (Lecture 7 Quiz; Exam III)

Lecture 8: Time of Death

- Chemical Kinetics
- Death and Temperature
- Death and Preservatives
- The Evidence of Death

Learning Outcomes:

- After completing this lecture students will:
- Be able to state that the rates of reactions are varied (Lecture 8 Quiz; Exam III)

- Be able to state the relationship between chemical kinetics and temperature (Lecture 8 Quiz; Exam III)
- Be able to state the properties of a chemical preservative (Lecture 8 Quiz; Exam III)
- Be able to state the relationship between chemical kinetics and time of death (Lecture 8 Quiz; Exam III)
- Be able to state the principles chemical decomposition (Lecture 8 Quiz; Exam III)

Lecture 9: Weapons and Chemistry

- The Gun
- The Knife
- The Bat
- The ligature

Learning Outcomes:

- After completing this lecture students will:
- Be able to identify the chemical and physical properties of metals (Lecture 9 Quiz; Exam III)
- Be able to state the chemical composition of common weapons (Lecture 9 Quiz; Exam III)
- Be able to state and classify the evidence each type of weapon leaves after use (Lecture 9 Quiz; Exam III)

EXAM III (Lecture Material 7-9)

Lecture 10: The Biochemistry of Poisons

- Neurotoxins
- Cytotoxins
- Cardiotoxins
- Heavy Metals

Learning Outcomes:

- After completing this lecture students will:
- Be able to state the biochemical definition of a toxin (Lecture 10 Quiz; Final Exam)
- Be able to state the definitions of neurotoxins, cytotoxins, and cardiotoxins (Lecture 10 Quiz; Final Exam)
- Be able to identify the biochemical reactions of heavy metals (Lecture 10 Quiz; Final Exam)

Lecture 11: Identifying the Suspect: Part I

- The Chemistry of Fingerprints
- The Chemistry of Hair
- Fiber Analysis

Learning Outcomes:

- After completing this lecture students will:
- Be able to identify the chemical structure of lipids (Lecture 11 Quiz; Final Exam)
- Be able to choose the appropriate chemical analysis for different lipids (Lecture 11 Quiz; Final Exam)
- Be able to state the principles of chemical fiber analysis (Lecture 11 Quiz; Final Exam)

Lecture 12: Identifying the Suspect: Part II

- Blood Analysis
- DNA Structure and Function
- DNA Fingerprints
- Genetic Matches

Learning Outcomes:

- After completing this lecture students will:
- Be able to identify the components that control the biochemistry of blood (Lecture 12 Quiz; Final Exam)
- Be able to identify the structural components of DNA (Lecture 12 Quiz; Final Exam)
- Be able to state the biochemical function of DNA (Lecture 12 Quiz; Final Exam)
- Be able to state the basic principles of DNA analysis (Lecture 12 Quiz; Final Exam)

CUMULATIVE FINAL EXAM (Lecture Material 1-12)

LABORATORY

Lab 1: Introduction to the Facility and Rules

- Lab Safety
- Lab Equipment
- Collection Techniques
- Proper Storage of Evidence

Learning Outcomes:

- After completing this lab students will:
- Be able to state and comply with the rules of basic laboratory safety (Exp 1-8 Lab protocols**; Pre- and Post- Lab exercises 1)
- Be able to state the function of basic laboratory equipment: Microscope, GC-Mass Spectrometer, UV-Vis spectrometer, IR spectrometer, PCR thermocycler, Centrifuge (Exp 1-8 Lab protocols**; Pre- and Post- Lab exercises 1)
- Be able to state the principles used to properly collect evidence at a crime scene (Exp 1-8 Lab protocols**; Pre- and Post- Lab exercises 1)
- Be able to state the proper way to store chemical and physical evidence (Exp 1-8 Lab protocols**; Pre- and Post- Lab exercises 1)

**** In the virtual environment, students not complying with lab protocols (dress code, use of safety equipment etc.) will be ejected from the system and must log back in to continue the lab. Horse play or serious deviations from lab protocols will receive the same treatment. These rules will be enforced in all of the virtual laboratories.**

Lab 2: We Have a Crime Scene

- **Murder Site**
- **Collect all Evidence**
- **Go to Autopsy**
- **Collect all Evidence**
- **Store Evidence**

Learning Outcomes:

- **After completing this lab students will:**
- **Be able to apply scientific methods to process a crime scene (Exp 2 Lab protocols; Pre- and Post- Lab exercises 2)**
- **Be able to identify the various processes of a standard autopsy (Exp 2 Lab protocols; Pre- and Post- Lab exercises 2)**
- **Be able to identify the chemical and physical evidence collected during the process of an autopsy (Exp 2 Lab protocols; Pre- and Post- Lab exercises 2)**

Lab 3: Dirt and Fibers

- **Preparation of Samples**
- **Mass Spectroscopy**
- **Analysis of Content**

Learning Outcomes:

- **After completing this lab students will:**
- **Be able to prepare chemical solutions (Exp 3 Lab protocols; Pre- and Post- Lab exercises 3)**
- **Be able to state the basic principles of gas chromatography (Exp 3 Lab protocols; Pre- and Post- Lab exercises 3)**
- **Be able to state the basic principles of mass spectrometry (Exp 3 Lab protocols; Pre- and Post- Lab exercises 3)**
- **Be able to identify the components of a spectrogram (Exp 3 Lab protocols; Pre- and Post- Lab exercises 3)**

Lab 4: Crime Scene 2: Blood in the Car?

- **Processing the Car for Evidence**
- **Analysis using Luminol**
- **Analysis using Ninhydrin**

Learning Outcomes:

- **After completing this lab students will:**
- **Be able to process evidence using luminol (Exp 4 Lab protocols; Pre- and Post- Lab exercises 4)**

- Be able to process evidence using ninhydrin (Exp 4 Lab protocols; Pre- and Post- Lab exercises 4)
- Be able to identify the component parts of fingerprints (Exp 4 Lab protocols; Pre- and Post- Lab exercises 4)
- Be able to identify partial prints by fingerprint analysis (Exp 4 Lab protocols; Pre- and Post- Lab exercises 4)

Lab 5: Toxicology is In

- Fluids Analysis
- Liquid-liquid Extraction
- Chromatography – LC/MS
- Reinsch Screen

Learning Outcomes:

- After completing this lab students will:
- Be able to process an unknown fluid using standard toxicology analysis (Exp 5 Lab protocols; Pre- and Post- Lab exercises 5)
- Be able to state the basic principles of liquid-liquid extraction (Exp 5 Lab protocols; Pre- and Post- Lab exercises 5)
- Be able to perform a virtual liquid chromatography process (Exp 5 Lab protocols; Pre- and Post- Lab exercises 5)
- Be able to perform a virtual Reinsch Screen test

Lab 6: Combustion and the Forensics of Fire

- CO-Oximeter
- CO- Diffusion Cell
- CO- UV-Vis Spectrometer
- IR

Learning Outcomes:

- After completing this lab students will:
- Be able to state the proper procedure used to process evidence from a fire (Exp 6 Lab protocols; Pre- and Post- Lab exercises 6)
- Be able to state the proper use of an oximeter and CO diffusion cell (Exp 6 Lab protocols; Pre- and Post- Lab exercises 6)
- Be able to state the principles of UV-Vis Spectrometry. spectrometer (Exp 6 Lab protocols; Pre- and Post- Lab exercises 6)
- Be able to use a virtual UV-Vis spectrometer (Exp 6 Lab protocols; Pre- and Post- Lab exercises 6)
- Be able to state the principles and use of an IR spectrometer (Exp 6 Lab protocols; Pre- and Post- Lab exercises 6)

Lab 7: We Have a Suspect

- DNA Analysis Prep Samples
- PCR
- STR Analysis

- **CODIS**

Learning Outcomes:

- **After completing this lab students will:**
- **Be able to apply the basic principles of blood and hair sample preparation for DNA analysis spectrometer (Exp 7 Lab protocols; Pre- and Post- Lab exercises 7)**
- **Be able to state the principles of the Polymerase Chain Reaction (Exp 7 Lab protocols; Pre- and Post- Lab exercises 7)**
- **Be able to state the principles and use of Short Tandem Repeat Analysis (Exp 7 Lab protocols; Pre- and Post- Lab exercises 7)**
- **Be able to state the use of the CODIS database for determining the identity of suspects (Exp 7 Lab protocols; Pre- and Post- Lab exercises 7)**

Lab 8: How Did She Die?

- **Time of Death**
- **Method of Death**
- **Putting the Killer at the Scene(s)**
- **Reporting the Findings**

Learning Outcomes:

- **After completing this lab students will:**
- **Be able to state the importance and process for determining time of death (Exp 8 Lab protocols; Pre- and Post- Lab exercises 8)**
- **Be able to state the importance and process for determining cause of death (Exp 8 Lab protocols; Pre- and Post- Lab exercises 8)**
- **Be able to examine the cumulative evidence provided by the previously completed experiments and to correlate evidence and suspect (Exp 1- 8 Lab protocols; Pre- and Post- Lab exercises 8)**
- **Be able to state the proper way to express scientific findings: the scientific report suspect (Exp 1- 8 Lab protocols; Pre- and Post- Lab exercises 8)**

1) think critically and cogently about causal relationships with scientific reasoning.

Example question: Your car breaks down. Using the Scientific Method, describe a process by which to fix the car. Put all the steps below into a flow chart in the correct order to confirm your hypothesis:

Possible steps to take:

- a) Read the gas gauge
- b) Hypothesize that the car has stopped running because it is out of gas
- c) Hypothesize that the car has stopped running because the battery is dead
- d) Hypothesize the car has stopped running because the alternator (the car's electrical generator that charges the battery) is bad.
- e) Use jumper cables to charge the battery
- f) Test to see if the car will start
- g) The car won't start.
- h) The gas gauge indicates a half-full tank
- i) Listen to the car for a high pitched squeal (alternators whine when they go bad)
- j) The car starts