

**John Abbott Science Program 200.BO**

***Forensic Chemistry***

# 

Discipline: Chemistry Semester: Fall 2022

Course Code: 202-DDP-05 Instructor: M. Bronet

Objectives: 00UV, 00UU Office: H-414

Ponderation: 3-2-3 Tel: (514) 457-6610 ext. 5869

Credits: 2.67 Office Hours: to be announced

Pre-requisite: 202-NYB-05 & 202-NYA-05 Lecture: T, Th 14:30-16:00 (H422)

Email: [murray.bronet@johnabbott.qc.ca](mailto:murray.bronet@johnabbott.qc.ca) Lab (2 hours): W 8:30-12:30 (AME429)

**Please use MIO and not MS Teams for communication. Please check your MIO regularly.**

**A. General information:**

John Abbott College is located on unceded Indigenous lands, the traditional territory of both the Kanien’kehá:ka (“Mohawk”) and the Anishinabeg (“Algonquin”) peoples.

Note on terminology: Parts of this document are written in the active voice. “I” or “me” refers to the course instructor. “You” refers to a student enrolled in the course. “We” or “us” refers to the community of the students and the instructor.

This course will be delivered using a blended learning format with some lectures, labs, and/or other activities online and some in person and on campus. A webcam and microphone are required. A computer and reliable internet connection are also required.

Students will be able to meet with the teacher in both face-to-face in class and by using MS Teams for virtual hours. MIO’s will be used to contact the teacher for any communication outside of office hours. LEA will be used as the course official gradebook; no other gradebook will be considered valid.

**B.Introduction:**

Forensic Chemistry is an option course in the science program, specifically designed to partially fulfill the requirements of objective 00UV. As such it is normally taken by science students after they have completed at least two semesters of the program.

Forensic Chemistry is essentially the application of chemistry to all matters of law. The California Association of Criminalists describes the criminalist profession as “That profession and scientific discipline directed to the recognition, identification, individualisation and evaluation of physical evidence by the application of natural sciences to law science matters”. This course provides students with an excellent opportunity to apply what they have learned in their studies in the natural sciences. Centered on the discipline of chemistry, the course nevertheless makes use of the principles of physics, appeals to the logic of mathematical analysis and involves reflection on issues that often include chemical, biological, and biochemical puzzles. Presented partly in the form of case studies, students are able to follow the methods used in actual situations and test their ability to apply what they have learned.

Comprehensive Assessment and Integration in the Science Program

The Ministry of Education requires every student to pass a program comprehensive assessment and a program integrating activity (Exit Profile Competency 14: “to apply what has been learned to new situations” and Ministry objective 00UU: “to apply acquired knowledge to one or more subjects in the sciences”). The Ministry introduced these requirements because it recognized the importance of connecting the various components within each program.

The various competencies to be addressed in the Science Program are outlined in the outcomes and standards of the Science Program Exit Profile and are listed below. They are divided into two groups: those competencies that are taught and assessed in virtually every course in the program, and those that will be the primary focus of the option courses

The following competencies are taught and assessed in most courses of the program:

1. To apply the scientific method.
2. To apply a systematic approach to problem solving.
3. To use appropriate data processing techniques.
4. To reason with rigour, i.e. with precision.
5. To learn in an autonomous manner.
6. To display attitudes and behavior compatible with the scientific spirit and method.
7. To apply what has been learned to new situations.

The following competencies will be the special focus of the option courses of the program:

1. To communicate effectively.
2. To work as a member of a team.
3. To recognize the links between science, technology and the evolution of society.
4. To develop a personal system of values.
5. To put into context the emergence and development of scientific concepts.

Rather than impose a major exam or paper at the end of the Science Program, or requiring a single course to fulfill these requirements, John Abbott College has integrated the fulfillment of these requirements into the option courses taken late in the program. These courses have been designed so that by passing any three option courses a student will have met the above requirements of the program.

C: OBJECTIVES STANDARDS

**Statement of the Competency: General Performance Criteria:**

To apply the scientific method to criminal investigations and proceedings. (00UV)

• Appropriate choice of concepts, laws and principles

• Rigorous application of the concepts, laws and principles

• Appropriate use of terminology

• Adequate mathematical or graphical representation

• Coherence, rigour and justification of the problem-solving methods

• Respect for the scientific method and experimental protocol

• Justification of the method

• Critique of the credibility of the results

Use of an interdisciplinary approach (00UU)

Elements of the Competency:

1. To apply the laws and principles of natural sciences to law sciences.

2. To recognise and evaluate physical evidence from crime scenes using methods of natural sciences.

3. To investigate the balance between the neurological and social factors in determining the workings of the criminal mind.

4. To apply experimental techniques of the natural sciences to crime solving.

5. To undertake an interdisciplinary project that integrates current learning and which demonstrates competence in three specific goals of the exit profile at the advanced level (00UU)

D. Evaluation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment** | **Ponderation\*** | **Competency** | **Tentative date** | \*Base ponderation. See following paragraphs for exceptions. |
| Term Test 1 | 10% | 1,2 | ~Week 6-7 |
| Term Test 2 | 10% | 1,2,3 | ~Week 13-14 |
| Quizzes & Assignments & Activities/Tasks | 15% | 1,2 | Weekly |
| Final exam\*\* | 30% | 1,2,3 | Exam Period |
| Laboratories\*\* | 20% | 4 | Weekly |
| Comprehensive Projects  Class Paper/Project    Laboratory Project | 15% | 4,5 | Week 12-14 |  |

**\*Base ponderation. Subject to modification under the conditions listed below.**

Please Note:

• If a student fails to write a term test (with a valid reason), then the student must write the final exam worth 40% (10% for missed test and 30% for final). No make-up tests will be scheduled. This is not available for a student assigned a grade of zero on a unit test because of cheating.

• To pass the laboratory portion of the course, a minimum of 60% of the total laboratory grade must be obtained. Failing this, a laboratory grade of zero will be given and a maximum grade of 55E will be allowed for the course.

• If a student passes the laboratory portion of the course, a grade of 60% or more on the final exam will guarantee a pass in the course.

• Late work will be marked as a zero or have late penalties applied unless otherwise specified in the assessment instructions, or prior arrangements have been made with the instructor.

\*\* The final evaluation for this course is comprised of the Final Exam (30%) and the Laboratories (20%).

E. Course Content

1. Forensic Science

1.1 Discussion of the scope, history and development of forensic science.

1.1.1 Gain an understanding of the historical

1.1.2 Describe the general workings of a crime lab (fingerprinting, forensic toxicology, microscopy, serology, and explosives).

1.1.3 Outline the role of the forensic scientist in the recognition, collection, preservation, and analysis of physical evidence.

1.1.4 Discuss the validity of the scientific evidence.

1.2 Description of what is done at a crime scene.

1.2.1 Observe, sketch, and measure evidence at the crime scene.

2. Physical Evidence

2.1. Description of the common types of physical evidence.

2.1.1 Describe the chemical and physical properties of trace evidence (finger prints, foot prints, glass, etc.) as related to the crime scene

2.1.2 Summarise the analytical techniques used to characterise trace evidence.

2.1.x Calculate gas quantities and concentrations using the Ideal Gas Law

2.1.x Determine and balance chemical reactions including redox reactions using the half-reaction method

2.1.x Use stoichiometry to calculate quantities of reaction products or reactants

2.1.x Calculate the density of mixtures and proportions

2.1.3 Describe the physical and chemical properties of polymer fibres and hair.

2.1.4 Summarise the analytical techniques used to characterise polymer fibres and hair.

2.1.5 Describe the chemical constituents of gunshot residues.

2.1.6 Summarise the analytical techniques used to analyse gunshot residues.

2.1.7 Describe the chemistry and detection of arson accelerants and explosives.

2.1.x Calculate simplest and molecular formulas from percentage composition, combustion products, or colligative property experimental data

2.1.x Calculate amounts and concentrations based on the kinetic decomposition behaviour

2.1.x Calculate electrochemical deposition/consumption amounts based on Faraday’s Law

2.1.8 Describe the chemistry of blood and other bodily fluids.

2.1.9 Describe the chemical and physical properties of blood spatter as related to the crime scene

2.1.x Describe the characteristics of glass, bullet holes, etc.

2.1.10 Outline the role of DNA typing in forensic science.

3. Brain Chemistry

3.1 Interpretation of the relationship between the biochemistry of the brain and the criminal mind. 3.1.1 Describe the important neurotransmitters responsible for emotional well-being.

3.1.2 Describe the specific biochemical activity of the neurotransmitters.

3.1.3 Outline the relationships between brain chemistry and the criminal mind.

3.2 Discussion of toxicology in forensic science

3.2.1 Identify common recreational narcotics and stimulants such as heroine, cocaine, amphetamines, marijuana, alcohol...

3.2.2 Explain structure and activity relationships of the drugs.

3.2.3 Understand the function of neurotransmitters.

3.2.4 Discuss addiction and tolerance.

3.2.5 Describe analytical techniques and instrumentation used to identify drugs.

3.2.6 Identify various poisons, such as cyanide, mercury, nerve poisons, etc.

4. Experimental Work

4.1 Observation and measurement.

4.1.1 Discuss significant figures as applied to scientific calculations.

4.1.2 Perform logical and deductive analysis.

4.2 The use of instrumentation to study fingerprints, gunshot residues, drugs, poisons, and aerosols. 4.2.1 Use a microscope to characterise solid substances such as fibres, hair, etc.

4.2.2 Use of physical tests such as solubility and/or density to identify and/or characterise substances.

4.2.3 Use of chemical tests to identify and/or characterise substances such as latent or invisible fingerprints (techniques like iodine fuming, cyanoacrylate fuming, dusting powders, etc.).

4.2.4 Characterise gunshot residues

4.2.5 Perform paper chromatography for ink analysis in document examination.

4.2.6 Understand the principle behind the breath analyser using UV/VIS spectroscopy.

4.2.7 Perform thin layer chromatography on substances such as analgesics and lipsticks.

4.2.8 Characterise organic compounds using infrared spectroscopy.

4.2.9 Perform blood typing and detection.

4.2.10 Perform blood spatter analysis to determine angle, direction, and point of origin.

4.2.11 Detection of salicylates in simulated blood using UV/VIS spectroscopy.

5. Integration, Comprehensive Assessment and Exit Profile Goals

5.1 Recognition of the links between science, technology and the evolution of society.

5.1.1 Discuss the power and the limits of science and technology in solving crimes.

5.1.2 Discuss the implications of science and technology for the evolution of society.

5.2 Development of a personal system of values.

5.2.1 Clearly identify and summarize two sides of an issue.

5.2.2 Develop an opinion on an issue and the arguments to defend the position.

5.2.3 Be aware of and understand the social and ethical implications of scientific work.

5.3 Application of acquired knowledge to a new situation.

5.3.1 Demonstrate clearly the application of the natural sciences to forensic science.

**F. Required text & Course cost:**

There is no formal text book for this course. Notes will be provided on the course platform Moodle, Teams, or Omnivox. Laboratory experiments have been prepared and are available on Moodle.

A laboratory notebook is NOT required for completed laboratory reports. Reports will be submitted either on paper or online. A lab coat is required, which can be purchased at the Bookstore, for about $25. Safety glasses (or googles) are required and can be purchased at the Bookstore for about $11.

**G. Bibliography:**

Students who wish to do additional reading may find the following books rewarding, all of which are available at the John Abbott Library (at the Front Desk).

1. Forensic chemistry: fundamentals and applications, edited by Jay A. Siegel 2016 (E-book).

2. Forensic analytical methods, editors: Thiago R.L.C. Paixão, et al. 2019 (E-book).

3. Complete crime scene investigation handbook, [Baxter, Everett](https://jac.cegep.opalsinfo.net/bin/search/searchPage?zid=;kw0=Baxter,%20Everett;sf0=1003), HV 8073 .B39 2015

4. The scientific Sherlock Holmes: Cracking the case with science and forensics, O'Brien, James F. 2013 (E-book).

6. Forensics for Dummies, D.P. Lyle, Wiley, 2004

Videos available at John Abbott College.

1. DNA fingerprinting. DVD RA 1057.55 .D63 2010

2. Drug Forensics. New York, N.Y, Films Media Group, 2012 (E-Video)

3. Evidence and Forensics: Due Process. New York, N.Y, Films Media Group, 2012 (E-video)

4. The Poisoner's Handbook. New York, N.Y, Films Media Group, 2014 (E-video)

5. Flawed Forensics. Al Jazeera America (Television network), 2015 (E-video)

**H. Teaching Methods:**

This Course Being Offered in the Blended Learning Format. The goals of this course are to: 1. Promote active, self-directed learning by providing you with an effective combination of in-class teaching and online learning. 2. Shift some topics into the online format with a resultant reduction in face-to-face time. 3. Use the reduced lecture and tutorial hours more efficiently to focus on the material that is more effectively presented in a face-to-face format. 4. Provide you with more flexibility by allowing you to do more of your work from home and to complete online learning activities at times that best suit your weekly schedule and learning preferences.

It is important to remember that: 1. All students in this course must have access to the internet. You must use the Moodle & Omnivox sites regularly between classes to keep up with the announcements and to complete the assigned activities. 2. Less time spent in lectures does NOT mean less work. You may find that the time spent in online activities will be considerable, but it is expected that your active participation will enhance your learning. 3. Learning is not a spectator sport. You are expected to take the responsibility to actively use the online learning material and to manage your time so that you complete assigned reading and online activities between the face-to-face sessions. Although the format of the course is a bit different than the traditional delivery of only face-to-face classes, the homework commitment of an average of 3 hours total per week should remain in force.

The course will be 75 hours, divided into lecture and laboratory periods. Assignments will be mostly administered through the Omnivox or Moodle sites for the course. Students will be directed to various websites for supplemental information as needed. The lecture and laboratory sessions are described below:

Lectures: (45 hours)

Two 1.5-hour periods per week; at least one of which will be in-person and in the assigned classroom, consisting of the introduction of new material and revision of previously learned material. In addition, preparation for upcoming laboratory sessions may be discussed during lecture time. Cooperative learning techniques such as group work, paired interview and peer evaluation will form an integral part of the lecture period.

Laboratory sessions: (30 hours)

In general, there will be five or six in-person two-hour laboratory session over the course of the semester. In-person laboratory sessions will span a two-week period. Students in their lab section will either attend the lab in-person or do some homework assignment. Students will alternate in-person/homework sessions. These sessions will apply the scientific method to some simple “crimes”. Periodically, laboratory sessions will be used for workshops that will help the student cope with the course material.

**I. Departmental Policies:**

a) There is no guarantee that make-up tests, quizzes or laboratory periods will be available. If a student fails to write the mid-term test (with a valid reason), then the student must write the final exam worth 40% (10% for missed test and 30% for final). No make-up tests will be scheduled. This is not available for a student assigned a grade of zero on a unit test because of cheating.

b) Periodically there will be workshops held during the laboratory period. Attendance is required. Quizzes or assignments may be given during these workshops.

c) A special note concerning the use of chemicals: this course uses chemicals as part of its normal teaching practices. If a student has experienced allergic reactions in the past due to any particular chemical or chemicals he or she must inform the instructor. In the event that an allergic reaction is experienced at the college, the student should report to Campus Security immediately (local 6911 or 9-514-457-6911).

d) Students are expected to behave respectfully towards their classmates and teachers. In case of inappropriate behaviour a student may be asked to leave the Teams class, the face-to-face class, or the lab session. If an assessment is planned for this session, a mark of zero will be given in that case.

**J. College Policies:**

Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. The normal attendance expectations are outlined above and your teacher will inform you of any modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the fall semester.

Please note that course outlines may be modified if health authorities change the access allowed on-site.

In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.

Online Civility & Student Code of Conduct– “Students are expected to behave as if they are in class and show respect and decorum online as in class; this includes private and public chat. If a student misbehaves, a teacher may remove access to the student’s camera and microphone during a class and report serious incidents to the administration. NEVER invite others to join your classes unless authorized by your teacher. Please see the college’s document on ONLINE CIVILITY & STUDENT CODE OF CONDUCT” (<https://departments.johnabbott.qc.ca/wp-content/uploads/2020/06/Online-civility-and-student-code-of-conduct-Conted-June-12-2020.pdf>). Also refer the course “Netiquette” file on our Moodle course page.

Policy No. 7 – IPESA, Institutional Policy on the Evaluation of Student Achievement: <http://departments.johnabbott.qc.ca/wp-content/uploads/2017/08/Policy-7-IPESA.pdf>

1. Changes to Evaluation Plan in Course Outline (Article 5.3). Changes require documented unanimous consent from regularly attending students and approval by the department and the program dean.
2. Evaluation (Article 6)

Teachers should evaluate and enter grades for a sufficient number of assessments in Gradebook in order that the College may advise DEC students of their progress by mid semester as per the ACADEMIC PROCEDURE: Academic Progress by Mid Semester.

1. Religious Holidays (Article 3.2)

Students who wish to miss classes in order to observe religious holidays must inform their teacher of their intent, in writing, within the first two weeks of the semester.

1. Student Rights and Responsibilities (Article 3.2 and Article 3.3)

It is the responsibility of students to keep a copy of all assessed material returned to them and/or all digital work submitted to the teacher for at least four (4) weeks past the grade submission deadline (See current Academic Calendar) in the event that they request a Final Grade Review (Refer to Article 8)

Students have the right to receive graded evaluations, for regular day division courses, within two weeks after the due date or exam/test date, except in extenuating circumstances. A maximum of three (3) weeks may apply in certain circumstances (ex. major essays) if approved by the department and stated on the course outline

1. Cheating and Plagiarism (Article 9)

Cheating and plagiarism are serious infractions against academic integrity which is highly valued at the College; they are unacceptable at John Abbott College. Students are expected to conduct themselves accordingly and must be responsible for all of their actions.

Cheating means any dishonest or deceptive practice relative to examinations, tests, quizzes, lab assignments, research papers or other forms of evaluation tasks. Cheating includes, but is not restricted to, making use of or being in possession of unauthorized material or devices and/or obtaining or providing unauthorized assistance in writing examinations, papers or any other evaluation task and submitting the same work in more than one course without the teacher’s permission. It is incumbent upon the department through the teacher to ensure students are forewarned about unauthorized material, devices or practices that are not permitted.

Plagiarism is a form of cheating. It includes copying or paraphrasing (expressing the ideas of someone else in one’s own words), of another person's work or the use of another person’s work or ideas without acknowledgement of its source. Plagiarism can be from any source including books, magazines, electronic or photographic media or another student's paper or work.

**K. Proviso**:

1. Attendance: Due to the COVID-19 health crisis, attendance policies may need to be adjusted by your teacher. The normal attendance expectations are outlined below and your teacher will inform you of any modifications as needed. Please note that attendance continues to be extremely important for your learning, but your teacher may need to define it in different terms based on the way your course is delivered during the semester.
2. Please note that course outlines may be modified if health authorities change the access allowed on-site. This includes the possibility of changing to an entirely online format.
3. In addition to LEA, Teams and Moodle, additional software may be used for the submission of essays or projects or for testing. Further details will be provided if applicable.
4. Classes on Teams may be recorded by your teacher and subsequently posted on Teams to help for study purposes only. If you do not wish to be part of the recording, please let your teacher know that you wish to not make use of your camera, microphone or chat during recorded segments. Any material produced as part of this course, including, but not limited to, any pre-recorded or live video is protected by copyright, intellectual property rights and image rights, regardless of the medium used. It is strictly forbidden to copy, redistribute, reproduce, republish, store in any way, retransmit or modify this material. Any contravention of these conditions of use may be subject to sanction(s) by John Abbott College.

**John Abbott College - Department of Chemistry**

**Forensic Chemistry Class Schedule – Fall 2022**

Online content, assessments, individual and group activities/assignments will be mostly delivered and administered through the Moodle platform, however, some external online resources may be used to support the pedagogical objectives. Class quizzes are all individual work and are either completed on paper or online.

 Syn  SynLT Icon

Description automatically generated SynLab  Asyn

Syn: synchronous, face-to-face (F2F); students come to the classroom to review material, learn new concepts, work in F2F groups, do individual assessments and activities.

SynLT: synchronous, online Learning Team Meeting; students meet in a specially created Teams channels to video and/or text chat, store documents, and share information to do Group assessments and activities.

SynLab: synchronous, face-to-face, in the laboratory; students will either do individual or paired laboratory experiments.

Asyn: asynchronous, online, individual work.

| **Class #**  **Date** | **Week** | **Format** | **Learning Activity** | **Assessment** |
| --- | --- | --- | --- | --- |
| 1 | 1 | Synchronous F2F | Introduction  Course Outline  CSI: Truths and Myths  Review Assignment #1 |  |
|  | Icon  Description automatically generated  synchronous, face-to-face, in the laboratory | Masterpiece Theft | Masterpiece Laboratory Report |
| 2 | Synchronous F2F | Eyewitness evidence  Basics  Evidence  Crime Scene Analysis | Eyewitness Quiz (online; individual)  Fundamentals Quiz (online; individual) |
| 3 | 2 | Synchronous F2F | Fiber PowerPoint  Review Assignment #2  Wayne Williams Case | Quiz #1: Basic Concepts (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Fiber Laboratory | Fibre Laboratory Report |
| 4 | synchronous, online Learning Team Meeting | Trace Evidence:   * Foot prints * Tire marks * Bite marks * Etc   Ted Bundy Case  Russell Williams Case | Trace Evidence Wiki (online; group)  Bite Mark Forum Discussion (online; group) |
| 5 | 3 | Synchronous F2F | Review Assignment #3  Sherlock Holmes’ Clocks Activity | Quiz #2: Density (F2F; individual)  Clocks Activity (F2F; group) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Hair Laboratory | Hair Laboratory Report |
| 6 | synchronous, online Learning Team Meeting | Hair PowerPoint  Leanne Tiernan Case | Tiernan Forum Discussion (online; group) |
| 7 | 4 | Synchronous F2F | Review Assignment #4  Stoichiometry Review & Practice | Quiz #3: Gas (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Identification of Royal Court Ions  Take fingerprints (old) | Royal Court Ions Laboratory Report |
| 8 | asynchronous, online, individual work | How to Commit the Perfect Murder Video | Video Worksheet (online; individual) |
| 9 | 5 | Synchronous F2F | Review Assignment #5  Sherlock Holmes’ The Case of the Mine Death Activity | Quiz #4: Stoichiometry (F2F; individual)  Mine death (F2F; group) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Fingerprint Laboratory | Fingerprint Laboratory Report |
| 10 | synchronous, online Learning Team Meeting | Fingerprints PowerPoint: Basics, Classification, Detection  Will West Case  Crime Scene Finger Prints  Suspect's Finger Print Cards  Jeffrey MacDonald Video | Pattern Recognition (online; individual)  Finger Print Matching Exercise (online; group)  Video Worksheet (online; individual) |
| 11 | 6 | Synchronous F2F | Review Assignment #6  Firearms Lecture | Quiz #5: 2-step Stoichiometry (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Gunshot Residue Laboratory | Gunshot Residue Laboratory Report |
| 12 | synchronous, online Learning Team Meeting | Robert Blake Case  Peter Jennings: Beyond Conspiracy Film  Worksheet | Film Worksheet (online; group) |
| 13 | 7 | Synchronous F2F | **TEST #1** | TEST #1 |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Iodometric Titration Laboratory | Iodometric Titration Laboratory Report |
| 14 | synchronous, online Learning Team Meeting | Explosives PowerPoint  Crimes of the Century Video - Oklahoma City Bombing (43 minutes)  Ted Kaczynski - The Unabomber (16 minutes) | Forum discussion on Domestic vs Foreign Terrorism (online; group) |
| 15 | 8 | Synchronous F2F | Review Assignment #7  Combustion Analysis  REDOX equation balancing (1/2 rxn method) | Quiz #6: Beer’s Law (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Breathalyzer Laboratory | Breathalyzer Laboratory Report |
| 16 | synchronous, online Learning Team Meeting | Kinetics of Crime PowerPoint | Holmes’s Christmas Story (online; group) |
| 17 | 9 | Synchronous F2F | Review Assignment #8  Mole Airlines Activity | Quiz #7: Kinetics (F2F; individual)  Mole Airlines Activity (F2F; group) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Thin Layer Chromatography | Thin Layer Chromatography Laboratory Report |
| 18 | synchronous, online Learning Team Meeting | Thin Layer Chromatography (TLC)   * TLC Theory from LibreTexts * TLC PowerPoint File   TLC Lecture Voice Over | Thin Layer Chromatography Forum (online, group) |
| 19 | 10 | Synchronous F2F | Review Assignment #9  Blood & Blood Spatter | Quiz #8: Empirical Formula (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Blood Analysis | Laboratory Report |
| 20 | asynchronous, online, individual work | Excedrin Killings Video | Excedrin Killings Worksheet |
| 21 | 11 | Synchronous F2F | Review Assignment #10  Faraday`s PowerPoint | Quiz #9: Colligative Properties (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Blood Spatter Part I | Blood Spatter Part I Laboratory Report |
| 22 | synchronous, online Learning Team Meeting | Holmes’  Blackwater Escape | Holmes’  Blackwater Escape (F2F; group) |
| 23 | 12 | Synchronous F2F | Arson PowerPoint  Hunt for a Serial Arsonist Video | Quiz #10: Electrochemistry (F2F; individual) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Blood Spatter | Blood Spatter Part II Laboratory Report |
| 24 | synchronous, online Learning Team Meeting | Glass PowerPoint | Getting Away with Murder Video  Worksheet |
| 25 | 13 | Synchronous F2F | DNA   * DNA/FBI/Quebec Connection * General DNA information including protein synthesis (~5 minutes) * DNA to Protein (2:41 minutes)   DNA "fingerprinting" & Electrophoresis (theory | DNA Identification Worksheet (online, group)  DNA Conviction Worksheet (online, group) |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | DNA analysis | DNA analysis Laboratory Report |
| 26 | synchronous, online Learning Team Meeting | Acids & Bases | Group Assignment (online, group) |
| 27 | 14 | Synchronous F2F | **TEST #2** | TEST #2 |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Comprehensive Assessment |  |
| 28 | Synchronous F2F | Comprehensive Assessment Preparation |  |
| 29 |  | Synchronous F2F | Arson PowerPoint  Arson Analysis   * Todd Willingham Videos * GC Composition Analysis * Video of GC theory   Hunt for a Serial Arsonist Video | Arson Activity (F2F; group) |
| 30 | 15 | Synchronous F2F | Review |  |
|  | Icon  Description automatically generated  Synchronous, face-to-face, laboratory | Comprehensive Assessment Presentations | Comprehensive Assessment Evaluation |
| Extra |  |  |  | **FINAL EXAM** |