

Molecular Capstone Course (CHEM 4890)

Guided Practice Pre-Class Activity

Overview: To come prepared for class, please study and learn the different sub-disciplines / areas / branches of Chemistry: Analytical, Physical, Inorganic, Organic, and Biochemistry

Time estimate to complete this assignment: about 1 hour.

Learning Objectives

Basic objectives (tied to pre-class activities)

1. Understand what chemistry is and what can be done with chemistry.
2. Remember each chemistry sub-discipline.
3. Define each chemistry sub-discipline.
4. Name one career associated with a particular sub-discipline of choice.
5. Recall one laboratory instrument/equipment associated with a particular sub-discipline of choice.

Advanced objectives (tied to in-class and post-class activities)

1. Recognize journal articles based on the different chemistry sub-disciplines.
2. Apply the “lens” of each of the sub-disciplines of chemistry to the reading of a journal article.
3. Apply a scientific tool from the point of view of each sub-discipline.
4. Understand/read journal articles more critically (long-term goal).

Preparatory Activities and Resources:

1. Watch two videos that will give you an overview of the definition of chemistry:

What is Chemistry? The Science Classroom Video (2:32 min)

<https://www.youtube.com/watch?v=GFg5HfvAXYE>

What is Chemistry? Emerald Robinson (1:59 min)

<https://www.youtube.com/watch?v=j7d6RETP6PQ>

2. Read definitions of the different chemistry sub-disciplines, found here:

ACS Areas of Chemistry – Technical Disciplines

<https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry.html>

ASBMB Career Paths

<https://www.asbmb.org/careers/paths/>

3. EXERCISE – Be ready to submit in CLASS. Make a list of the different sub-disciplines and briefly define each.
4. Watch one video on different tools used to study chemistry.

Chemistry Series: Getting to Know Your Common Lab Equipment (3:24 min)

<https://www.youtube.com/watch?v=Vim6awpJlLg>

5. EXERCISE – Be ready to submit in CLASS. Find and Print the following five journal articles (see bibliography for full details of articles below):
 - a. Kalra 2002
 - b. Duarte 2017
 - c. Zheng 2016
 - d. Bian 2018
 - e. Alfonso 2017
6. EXERCISE – Be ready to submit in CLASS. Briefly scan each article, make a list of the laboratory assays and/or instruments used to carry out the research described in each article.
7. Watch the following video

The Map of Chemistry (12:57 min)

<https://www.youtube.com/watch?v=P3RXtoYCW4M>

Optional videos:

Chemistry Lesson – 1 – What is Chemistry? (8:05 min)

<https://www.youtube.com/watch?v=4SbyQ9eVP7Q>

What is Physics? (3:37 min)

<https://www.youtube.com/watch?v=yWMKYID5fr8>

Exercises: Please complete all seven steps prior to class time.

Journal Article Worksheet

Name(s): _____

Instructions: using the assigned article, answer the following questions:

Name of journal article:

First Author:

Main goal of the study:

Main findings:

Assays / equipment used to do this research:

Description of Assay or type of equipment	Purpose of Assay	Results

Does their data match what they claim in the abstract?

Molecular Capstone Course (CHEM 4890)

Lesson Plan

Cecilia Zurita-Lopez

Department of Chemistry & Biochemistry

Lesson: The different Sub-disciplines or Areas or Branches of Chemistry: Analytical, Physical, Inorganic, Organic, and Biochemistry

Timeframe: This lesson plan is for three 50 min instruction sessions (in-class) and approximately 1 hr of outside student preparation including pre-class and post-class activities.

Materials Needed:

- Links describing each of the sub-disciplines in chemistry.
- ACS Areas of Chemistry – Technical Disciplines
 - <https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry.html>
- ASBMB Career Paths
 - <https://www.asbmb.org/careers/paths/>
- Video that puts chemistry into context.
- Links describing jobs associated with each of the sub-disciplines (see links above)
- Four journal articles corresponding to each of the four main sub-disciplines on the same chemical/biological agent.

Learning Objectives

Basic objectives (tied to pre-class activities)

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4. Name one career associated with a particular sub-discipline of choice.
5. Recall one laboratory instrument/equipment associated with a particular sub-discipline of choice.

Advanced objectives (tied to in-class and post-class activities)

1. Recognize journal articles based on the different chemistry sub-disciplines.
2. Apply the “lens” of each of the sub-disciplines of chemistry to the reading of a journal article.
3. Apply a scientific tool from the point of view of each sub-discipline.
4. Understand/read journal articles more critically.

Background (situation):

This is an upper division course with no more than 25 students in the class. Students typically take it in their last year. It is also a writing intensive (WI) course that fulfills a WI GE requirement. Students sit in movable desks. There is a white board/chalk board, overhead projector, a computer with Internet access and projector.

Students are required to take Writing for Chemistry (CHEM 3600) as a pre-requisite for this course. In CHEM 3600, students become familiar with the typical components of a journal article, and are expected to write up a report similar to a primary journal article. In this course, students use their knowledge from reading/examining journal articles and are expected to compare/contrast at least two sub-disciplines as they apply it to a real-world problem. Students are given freedom in choosing a real-world problem and write what is considered a “review article” where they act as experts.

Introduction to Lesson:

The purpose of the content is to familiarize students with each of the chemistry sub-disciplines. Prior to class, students will explore two links from the American Chemical Society (ACS) and the American Society for Molecular Biology and Biochemistry (ASBMB) that describe the different sub-disciplines. They will be asked to fill out a worksheet based on the information they find (Appendix A). They will also take a quiz prior to the start of class that will test them on the different sub-disciplines (Appendix B).

Since they are required to write a culminating research paper where they choose a current event based on chemical/biological warfare agents, and compare/contrast at least two sub-disciplines, this lesson will prepare them for identifying journal articles for this larger project. Students will need to understand what a good journal article looks like and will need to review each of the components of a journal article.

Procedure

Pre-Class Individual Space Activities and Resources:

Major steps for preparatory activities, ensuring steps lead to mastery of the basic learning objectives.

Steps (due prior to in-class group space meeting)	Purpose	Estimated Time	Learning Objective
1. Watch two videos that give students an overview of the definition of chemistry: What is Chemistry? The Science Classroom Video (2:32 min) https://www.youtube.com/watch?v=GFg5HfvAXYE What is Chemistry? Emerald Robinson (1:59 min) https://www.youtube.com/watch?v=j7d6RETP6PQ	An overview of chemistry. A definition of chemistry.	~6 min	#1 (basic)
2. Read definitions of chemistry sub-disciplines, found here: ACS Areas of Chemistry – Technical Disciplines https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry.html ASBMB Career Paths https://www.asbmb.org/careers/paths/	Explanation of the sub-disciplines of chemistry.	25 min.	#2 & #3 (basic)

Make a list of the different sub-disciplines.			
3. Watch one video on different tools used to study chemistry. Chemistry Series: Getting to Know Your Common Lab Equipment (3:24 min) https://www.youtube.com/watch?v=Vim6awpJlLg	Understand the types of tools used to study matter (chemistry).	3:24 min.	#4 (basic)
4. Print the following five journal articles: a. Kalra 2002 b. Duarte 2017 c. Zheng 2016 d. Bian 2018 e. Alfonso 2017 Briefly scan each article, make a list of the laboratory assays and/or instruments used to carry out the research described in each article.	One article based on each sub-discipline. Prerequisite for in-class assignments and group space discussion.	20 min.	#5 (basic)
5. Watch the following video The Map of Chemistry (12:57 min) https://www.youtube.com/watch?v=P3RXtoYCW4M	An overview of chemistry. Reflection of general chemistry as a discipline.	~13 min	#1 (basic)

Optional videos:

Chemistry Lesson – 1 – What is Chemistry? (8:05 min)

<https://www.youtube.com/watch?v=4SbyQ9eVP7Q>

What is Physics? (3:37 min)

<https://www.youtube.com/watch?v=yWMKYID5fr8>

In-class Group Space Activities and Resources (50 minutes):

Steps	Purpose	Estimated Time	Learning Objective
1. Short quiz (5 questions) conducted using Kahoot (https://kahoot.com/). Optional collect and grade.	Reinforcement of material introduced in individual space.	~10 min.	All Basic Los
2. Working in small (3 student) groups, students review a different journal article that they printed out. The challenge is to	Have students apply understanding of	20 min.	All LOs.

understand the main goal of the journal article and compare the list of assays/lab instruments used. Finally, decide what discipline the article falls under: physical, biochemistry, analytical, etc.	the sub-disciplines to the article.		
3. Review of all journal articles and their sub-discipline.	Reinforce the concepts and approach to research based on sub-discipline.	15 min	All LOs.

Closure (5 min).

Describe the class-work in the upcoming weeks. In the following weeks students will be reading the journal articles they printed out and reviewed in groups. We will review one article per week and students will be assigned a different figure to present.

Analysis:

Note what you think will work, and challenges you anticipate.

Students often put off reading journal articles because they are intimidated. This method should help them understand how to approach journal articles for the purpose of writing their culminating research paper. In the weeks following this activity, we will all go over all five of the journal articles they printed. Also, they are expected to start researching their topic and analyzing the data so that they can write the research paper. I've purposely picked journal articles with lots of breath so that students will be introduced to different methods/assays/techniques. However, I anticipate that students will be intimidated and will need help understanding the background, context and especially the data figures.

Post-Class individual Space Activities:

Students will bring in their own research articles and summarize them using the worksheet provided below.

Connections to Future Lesson Plan(s):

Since this will be the beginning of lots of researching for their culminating research paper. I anticipate that this exercise will provide them with some necessary guidance. It directly ties into future lesson plans because we will be learning about different chemical and biological agents throughout the semester and these journal articles review organophosphates or sarin nerve gas.

Appendix A
Sample Pre-class Quiz Questions

Short answer

Why is chemistry called the “central science?”

ANSWER: For full credit, must provide a definition of chemistry: Chemistry is the study of matter; also mention what can you do with chemistry: make medicines, develop new types of energy sources or fuels (for living systems or for transportation), solve the mysteries of the universe!!

T or F

Matter is anything that has mass and takes up time <i>False (matter is anything that has mass and takes up space)</i>		T	F
Organic chemistry is the study of compounds that do not contain carbon <i>False (organic chemistry includes compounds that contain carbon)</i>		T	F
Alchemy is considered a precursor to chemistry <i>True (alchemy is considered an early form of chemistry and magic)</i>		T	F

Multiple Choice

The different types of matter are

- a. Solids
- b. Liquids
- c. Gasses
- d. Plasma
- e. All of the above

ANSWER: e = all of the above

Which of the following has a definite shape, but lacks volume?

- a. Solid
- b. Liquid
- c. gas
- d. plasma
- e. All of the above

ANSWER: c = gas

Which of the following are considered chemical reactions

- a. Fire
- b. Metalworking
- c. Glass
- d. Eating

- e. All of the above

ANSWER: e = all of the above

Which of the following would be used to weigh out a chemical?

- a. A rubber policeman
- b. a scoopula
- c. a test tube rack
- d. a volumetric flask
- e. All of the above

ANSWER: b = a scoopula

Appendix B Group Space Activity

Students will receive worksheets (see following page) for the in-class group space activity. The purpose of the activity is for them to apply what they've learned about chemistry and apply it as they approach reading and understanding journal articles.

Students will be assigned one of the journal articles they were asked to print at home and work in small (3 person) groups to understand the journal article. Specifically, they should state the main goal of the paper and discuss the assays and lab equipment used to carry out the research in the study. Some students may need to look up the purpose of the assays while others may need to read the abstract to understand the main goal/findings.

After about 20 minutes, the instructor will point out various key features of each of the articles with the help of the students from the corresponding group.

This activity is then repeated at home using an article of their choice.

Journal Article Worksheet

Name(s): _____

Instructions: using the assigned article, answer the following questions:**Name of journal article:**

First Author:

Main goal of the study:**Main findings:****Assays / equipment used to do this research:**

Description of Assay or type of equipment	Purpose of Assay	Results

Does their data match what they claim in the abstract?