

GREETINGS SENIORS!

In order to prepare you for the rigorous curriculum during your senior year, I have prepared the following materials to help you gear up for what will be a rather unique experience as we cover organic chemistry, biochemistry, and environmental chemistry during your final year at the Governor's School. The fact that you are getting ready for another school year studying even more advanced topics in chemistry tells me that you thrive on challenges, and I will do my best to help you achieve success in your chemistry class for your senior year.

As you enjoy your well-deserved summer vacation, I have prepared an assignment that I would like you to complete before the start of the new school year. Some of the problems you encounter in this summer assignment may be familiar to you, and it is possible that your notes from General Chemistry may help you complete them. Keep in mind that these problems are at the introductory level and are general enough so that you can find whatever solutions you need to solve the problems on the internet and/or a chemistry study guide. If you find yourself having to use a resource to solve a problem, please cite when and where you used the resource.

I look forward to seeing everyone on the first day of class! Do not forget to relax and have fun during your summer vacation, but also do not lose your academic edge. Complete your summer assignment and learned the topics covered in the assignment to get a head start for the upcoming school year. Email me if you need help. I do check my work email over the summer, so I will respond to your messages whenever I can.

In addition to your summer assignment, please continue brainstorming possible ideas for your mentorship project. If you have any questions as to whether select research project topics are allowed in a basic chemistry laboratory, please do not hesitate to email me about it. We will discuss the mentorship project at the start of the school year.

Good luck, have fun, and I will see everyone when classes resume.

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SUMMER ASSIGNMENT
CHEM 104: INTRO TO ORGANIC CHEMISTRY AND BIOCHEMISTRY

Topic 1. Introduction to Organic Chemistry

1. In your own words, please describe or explain what you think is Organic Chemistry.
2. What are 6 atoms that are commonly found in organic molecules?
3. State one reason why polar, non-polar, and semi-polar bonds are similar.
4. State two reasons why polar, non-polar, and semi-polar bonds are different.

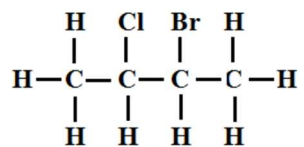
Please fill in the following information specified in the table below:

Basic organic families	Typical atoms found in the family	Describe the bond type between the carbon atoms
Alkanes		
Alkenes		
Alkynes		

Adding a few additional atoms to the organic molecule can not only change its properties, but also turn the molecule into a different type of molecule altogether. Please fill in the following information specified in the table below:

Organic families	Name of family's characteristic functional group	Draw the arrangement/structure of the atoms making up the characteristic functional group
Alcohols		
Aldehydes		
Ketones		
Ethers		
Esters		
Amines		
Amides		
Carboxylic acids		
Nitro		

5. The following molecule is named 2-bromo-3-chlorobutane. The name may be broken down into 4 parts: 2-bromo, 3-chloro, but, and -ane. Do some research and justify this four-part name.



- a. Explain why the molecule name is 2-bromo-3-chlorobutane and NOT 2-chloro-3-bromobutane.

Topic 2. Functional Group Priorities in Nomenclature

As you have observed during the organic chemistry bootcamp sequence during your junior year, organic molecules are classified into specific types of compounds based on the identify of the main functional group on the molecule. As we work with more complex molecules, there is a good possibility you will encounter a compound with multiple functional groups on its structure. To determine which of the functional groups will be the main functional group, the functional group priority rules need to be followed. The functional groups featured in this table refers to functional groups with carbon in the central atom position. A good rule of thumb to follow in terms of priority is to take the oxidation state of the central carbon into priority determination; the higher the oxidation state of the central carbon, the higher the priority of the functional group. This is why carboxylic acids have a higher priority than alcohols.

Priority	Functional Group	Formula	Prefix	Suffix
1	Cations e.g. ammonium	-NH_4^+	-onio- -ammonio-	-onium -ammonium
2	Carboxylic acids	-COOH	Carboxy-	-oic acid
3	Carboxylic acid derivatives e.g. esters, amides	-COOR -CONH_2	R-oxycarbonyl- Carbamoyl-	-amide
4	Aldehydes	-CHO	Formyl-	-al
5	Ketones	$>\text{CO}$	Oxo-	-one
6	Alcohols Thiols	-OH -SH	Hydroxy- Sulfanyl-	-ol -thiol
7	Amines	-NH_2	Amino-	-amine
8	Ethers Thioethers	-O- -S-	-oxy- -thio-	
9	Peroxides Disulfides	-OO- -SS-	-peroxy- -disulfanyl-	
10	Alkenes Alkynes	$\text{C}=\text{C}$ $\text{C}\equiv\text{C}$		-ene -yne

Topic 3. Introduction to Biochemistry

1. In your own words, please describe or explain what you think is Biochemistry.
2. Explain how an unsaturated fat is different from a saturated fat?
3. How is a carbohydrate oil different from a carbohydrate fat?
4. How are omega-3 fish oils different from omega-6 fish oils?
5. Compose an information booklet about the different macromolecules with the following information:
 - a. Research about the following macromolecules – carbohydrates, lipids, nucleic acids, proteins.
 - b. For each of the four macromolecules, include the following information:
 - i. A general description of the macromolecule
 - ii. General structure (a diagram is fine)
 - iii. General nomenclature
 - iv. Examples of macromolecules
 - v. Physical and chemical properties
 - vi. Biochemical role
 - vii. Interesting facts

CHEM 155: ENVIRONMENTAL CHEMISTRY

Scavenger Hunt:

Directions: Try your best to find the following items for the scavenger hunt. It is alright if you do not locate all of them by the end of summer break, but try to find as many items as you possibly can. As you locate these items, check them off the list and make a little note beside each item detailing something significant about the item. You can also use the internet's resources (such as current event articles in the news) for your scavenger hunt as well.

1. An herbivore eating a producer
2. Growing crops
3. An organic food item in the grocery store
4. A genetically modified food item
5. 3 pieces of litter from a public place
6. Product made from recycled materials
7. Renewable energy
8. A source of freshwater
9. Nonpoint or point source of pollution
10. Decomposition
11. Reuse of potential waste
12. A tree you cannot put your arms more than halfway around
13. A mineral that came from a mine
14. An electric or hybrid vehicle in use (i.e. not merely at a dealership, but can be parked)
15. An environmentally positive sight (i.e. something that you think is helping the environment)
16. An LEED certified building
17. Source of air pollution that is NOT an automobile
18. Invasive species
19. Endangered species
20. A nonhuman thing in the environment that you find extraordinarily beautiful

Practice Making Graphs:

Use the following tips to generate graphs and answer the questions for each of the problems below. It is recommended that you use Excel for these exercises in order to save yourself some time. Your answers to the questions will go on a separate answer sheet.

1. Identify the variables. Remember that the independent variable is controlled by the experimenter and the dependent variable changes as the independent variable changes. The independent variable will go on the x-axis and the dependent variable on the y-axis.
2. Determine the variable range. Subtract the lowest data value from the highest data value.
3. Determine the scale of the graph by looking at the range of your data points. Sometimes Excel will automatically provide you with a range that does not necessarily fit your data range, so make the proper adjustments accordingly. The graph should use as much of the available space as possible, so use what works best for the given data.
4. Number and label each axis. Make sure to include units when applicable.
5. Plot the data. If there are multiple sets of data on one graph, use a different color for each data set.
6. Include a best-fit line for each data set.
7. Title the graph. The title should explain exactly what the graph is showing and can sometimes be long. Do not be afraid of a long title!
8. Create a key to the graph if there is more than one set of data.

Problem 1

Age of the tree (years)	Average thickness of the annual rings in Forest A (cm)	Average thickness of the annual rings in Forest B (cm)
10	2.0	2.2
20	2.2	2.5
30	3.5	3.6
35	3.0	3.8
50	4.5	4.0
60	4.3	4.5

The thickness of the annual rings indicate what type of environmental situation was occurring at the time of its development. A thin ring is indicative of a rough period of development from lack of water, forest fires, or a major insect infestation. On the other hand, a thick ring indicates the opposite.

- A. Make a line graph of the data.
- B. What is the dependent variable?
- C. What is the independent variable?
- D. What was the average thickness of the annual rings of 40-year-old trees in Forest A?
- E. Based on this data, what can you conclude about Forest A and Forest B?

Problem 2

pH of water	Number of tadpoles
8.0	45
7.5	69
7.0	78
6.5	88
6.0	43
5.5	33

- A. Make a line graph of the data.
- B. What is the dependent variable?
- C. What is the independent variable?
- D. What is the average pH in this experiment?
- E. What is the average number of tadpoles in this sample pool?
- F. What is the optimum water pH for tadpole development?
- G. Between what two pH readings is there the greatest change in tadpole number?
- H. Approximately how many tadpoles would you expect to find in water with a pH reading of 5.0?

Problem 3

Amount of ethylene in ml/m ²	Wine sap Apples: Days to Maturity	Golden Apples: Days of Maturity	Gala Apples: Days of Maturity
10	14	14	15
15	12	12	13
20	11	9	10
25	10	7	9
30	8	7	8
35	8	7	7

Ethylene is a plant hormone that causes fruit to mature. The data above concerns the amount of time it takes for fruit to mature from the time of the first application of ethylene by spraying a field of trees.

- A. Make a line graph of the data.
- B. What is the dependent variable?
- C. What is the independent variable?