CHEM 332 F – Spring, 2020

Organic Chemistry II

Class Time: Lecture: M,Th 8:00 am to 9:20 am, Science Complex C-121
Lab: M,Th 9:30 am 12:20 pm, Science Complex C-131

Required Materials:

For Lecture:

Text: e-text: Top Hat (available either on line or at TCNJ's Bookstore); Top Hat Platform (www.tophat.com); Join Code: 840867

Models: HGS Molecular Model Set 1003 (available at: https://www.maruzen.info/hgs/catalog/product_info.php?products_id=654

For Lab:

Text:	Multiscale Operational Organic Chemistry, 2nd Ed. (Lehman; Loose-Leaf) - available at TCNJ Bookstore
Safety equipment:	Safety glasses or goggles (see me if you wear contacts) Lab apron (provided); lab coat (optional)
Other:	Lab notebook (bound, not loose-leaf or spiral) Calculator

Instructor: Professor David Hunt
Office: C-204
Office Hours: *Drop in or:*
Other times by appointment
Phone: 771-3174
e-mail: hunt@tcnj.edu

Course Description:

Organic Chemistry 332 is the second of a two-semester sequence at the sophomore-junior level for chemistry, biology, and pre-healing arts students. The course will focus on conjugated systems, organic synthesis with a focus on reactions of aromatic compounds, carbonyl compounds, carboxylic acids and related derivatives, the chemistry of amines and phenols, and special topics, including organometallic chemistry and organic chemical applications to compounds of biological interest.

Prerequisite for CHE 332: C- or better in CHE 331 (Organic Chemistry I)

General:

- Recognize the importance of organic chemistry applications to other scientific disciplines (inside and outside of chemistry)

- Further understanding organic chemistry mechanisms through the study of several classes of compounds
- Further develop synthetic and retrosynthetic expertise in organic analysis

Specifically:

- Understand the nature and properties of aromatic compounds
- Explore electrophilic aromatic substitution reactions, substituent effects and synthetic applications of these reactions
- Understand nucleophilic addition reactions of aldehydes and ketones
- Knowledge of the formation and reactions of enols/enolates derived from aldehydes and ketones
- Explore the relationships between carboxylic acid derivatives to understand the nucleophilic addition-elimination reactions that they undergo
- Master the chemistry of enolate reactions of β–dicarbonyl compounds and the Michael reaction
- Appreciate the physical properties, structure and reactions of amines
- Understand the nature of phenols and aryl halides, and how they relate to nucleophilic aromatic substitution
- Explore special topics including electrocyclic and cycloaddition reactions, organometallic chemistry, polymer chemistry and biological molecules including carbohydrates, amino acids and proteins

NOTE: All TCNJ classes operate as one course unit that equates to 3 hours of classroom instruction and a 4th hour of alternate instruction. The "4th hour" for this course consists of the 3-hour laboratory component.

TCNJ Policies:

TCNJ's attendance policy is available on the web:
http://www.tcnj.edu/~recreg/policies/attendance.html

TCNJ's academic integrity policy is available on the web:
http://www.tcnj.edu/~academic/policy/integrity.html.

TCNJ's final examination policy is available on the web:
http://www.tcnj.edu/~academic/policy/finalevaluations.htm

TCNJ's Americans with Disabilities Act (ADA) policy is available on the web:
http://www.tcnj.edu/~affirm/ada.html .

TENTATIVE CLASS SCHEDULE

Week	Part 1	Part 2	Lab
1	**01.27.20** Orgo I Problem Review	**01.30.20** Ch 14– Alcohols/Organometallics	**Check-in; NMR Data Processing of Vanillin**
2	**02.03.20** Ch 14 - Alcohols/Organometallics Ch. 15 - Ethers	**02.06.20** Ch 15 – Ethers Ch. 19 - Conjugated Unsaturated Systems	**Grignard Chemistry – Preparation of Benzoic Acid**
3	**02.10.20** Ch 19- Conjugated Unsaturated Systems; Ch. 20 - Aromatics	**02.13.20** Ch 20 – Aromatics Ch. 21 – Reactions of Aromatics	**Finish Grignard Chemistry; Minilab 27 – Diels-Alder Reaction of Maleic Anhydride and Furan – pp. 546-547**
4	**02.17.20** Ch 21 – Reactions of Aromatics	**02.20.20** Ch 21 – Reactions of Aromatics	**Complete Minilab 27*; Aromaticity Worksheets***
5	**02.24.20** **Exam 1 (Ch 14-15; 19-20)**	**02.27.20** Ch 22 – Aldehydes and Ketones	**Exp. 35 – Directive Effects in the Bromination of Vanillin; NMR data comparison vs. Week 1 Spectrum**
6	**03.02.20** Ch 22 - Aldehydes and Ketones	**03.05.20** Ch 24 – Carboxylic Acids	**Identification of an unknown diaryl ketone by $NaBH_4$ reduction and melting point (Handout)**
7	**03.09.20** Ch. 24 – Carboxylic Acids	**03.12.20** Ch 25 – Carboxylic Acid and Derivatives	**Exp. 46 Part I: Preparation of N,N-diethyl-m-toluamide (DEET)**
8	**03.16.20** **Spring Break**	**03.19.20** **Spring Break**	**No Lab**
9	**03.23.20** Ch. 26 – Reactions at the α-Carbon of Carbonyls	**03.26.20** Ch 26 - Reactions at the α-Carbon of Carbonyls *Last day to drop with a "W"*	**No Lab (ACS Mtg) – Alternate Assignment**
10	**03.30.20** **Exam 2 (Ch 21-22; 24-25)**	**04.02.20** Ch. 26 – Reactions at the α-Carbon of Carbonyls	**Exp. 46 Part II: Preparation of N,N-diethyl-m-toluamide (DEET)**
11	**04.06.20** Ch. 26 – Reactions at the α-Carbon of Carbonyls	**04.09.20** Ch 23 – Amines	***Mechanism/Synthesis workshop***
12	**04.13.20** Ch 23- Amines	**04.16.20** Transition Metal Compounds	**Synthesis of Dilantin (Exp from Handout)**
13	**04.20.20** Ch. 27 - Polymer Chemistry	**04.23.20** Ch 28 - Biomolecules	**A solvent-free reductive amination – identification of amine– aldehyde coupling partners (Handout)**
14	**04.27.20** **Exam 3 (Ch 23; 26-27)**	**04.30.20** Ch 28 - Biomolecules	**Minilab 43 – Reactions of monosaccharides with phenols/ Minilab 22 – Nylon Rope**
15	05.04.20 Ch 28 – Biomolecules	**05.07.20** General Review	**Check-out (Mandatory for <u>all</u> students)**

Provisions of this syllabus are subject to change. Any change will be announced in advance in the lecture, when possible. All students are responsible for any information given in class, whether they are present or not.

Students are held responsible for all material listed on the course outline **even if not explicitly discussed in class.** Likewise, during the semester, some ancillary topics outside of the course outline may be discussed. Students are likewise held responsible for this material.

It is suggested that you work as many of the end of chapter problems as possible

Absence Policy (lecture):

Absences from class should be avoided at all costs. You are expected to be present for all class exams, and **NO MAKE-UPS WILL BE GIVEN, PERIOD! Please don't ask!** In case of illness or death in the family, please notify the Department Chair (that would be me) or Assistant Dean (Ms. Laurel Leonard) and bring documentation from that office upon your return to class. A medically excused absence is granted for significant illness or injury and requires healthcare attention *at the time of* the illness or injury. For these excused absences, your remaining exams will be weighted more heavily to account for the missed exam. Excused absences **do not include** early departures or late returns from weekends, social functions, family reunions, etc.

Course Grading Policy:

Grades will be calculated as follows: a class average will be determined and curved to an average of 75% (middle C to C+) unless, of course, the class average is $\geq$ 75%. This may be subject to change at my discretion depending on class performance compared to expectations, performance of previous classes, and known standards. Any changes will be announced to the class. Lab grades will **not** be curved. **FINAL GRADES ARE NOT SUBJECT TO NEGOTIATION. PERIOD; AND NO…….I DON'T CURVE THE CURVE (yes….this has been asked).**

Since this is a lab-based course, attendance for all labs is mandatory. Labs cannot be made up, period. Should you miss a lab, you will receive a zero (20-25 pts possible). ***Two absences from lab will result in an F for the entire course.***

Course Grading:

Each regular exam (16.67% of your final grade) is worth 100 points. The final exam is worth 30% of your final grade. The lecture portion of the course accounts for 80% of the final grade, with the lab portion accounting for the remaining 20%.

Should an exam be missed, the grade that will be used for final grade calculations will be the lower of the 2 remaining exam grades (after curve, if applicable).

The final is comprised of an ACS standardized multiple-choice examination. A portion

of the final exam score (60%) will be determined by scaled score based on national percentiles (see formula below), while the remaining 40% will be based on the actual exam percentage.

$$\text{Scaled Score} = \text{ACS Percentile} + \left[(100 - \text{ACS Percentile}) \left(\frac{\text{ACS Percentile}}{100} \right) \right]$$

In summary:

3 hour exams @ 16.67 % each	= 50%
Final exam @ 30%	= 30%
Lab @ 20%	= 20%

Scale:

A	90-100
B	80-89
C	70-79
D	60-69
F	<60

Please Note: (+) and (-) grades can be assigned within all grade ranges (except for grades of D- which will not be given). These descriptors can be used for grades within 1 scale point of the lowest grade in each range at the instructor's discretion.

Absence Policy (labs):

Since labs are incredibly difficult to make up, **NO MAKE-UPS WILL BE POSSIBLE**. A medically excused absence is granted for significant illness or injury and requires healthcare attention *at the time of* the illness or injury. For these excused absences, your remaining labs will be weighted more heavily to account for the missed exam. Excused absences **do not include** early departures or late returns from weekends, family reunions, etc.

PLEASE NOTE: If a person is more than 15 minutes late for lab, they will automatically be marked as absent without excuse. It is absolutely essential that every student be present for the discussion at the beginning of the laboratory period.

Lab Grading Policy:

Since this is a lab-based course, attendance for all labs is mandatory. As indicated above, labs cannot be made up, period. Should a lab session be missed, you must contact me as soon as possible to discuss alternatives, if possible. Should you miss a lab, you will receive a zero (typically 20 pts possible). The lowest (or missed) lab will be dropped. ***Two unexcused absences from lab will result in an F for the entire course.***

Lab Grading:

The lab grade will count for 20% of the overall course grade *and is not curved*.

Grading methodology is as follows:

Occasional lab quizzes are worth 5 points. Before you come to lab, review the background material and experiment. *Random lab sessions may begin with a quiz to insure that this has been accomplished (worth 5 points).* You will complete the assignment much faster if you are prepared ahead of time and understand the basics of the experiment you are about to perform.

Pre-labs are worth 5 points

The experimental write-up in the lab notebook (data, spectra, analysis, conclusions) is worth up to 15 points (depending on whether post-lab questions are required).

Post-lab questions can be assigned (instructor's discretion) and are worth 5 points.

TOTAL = up to 25 points if post-lab questions are to be included

Reports are due no later than the conclusion of the following lab period. **LATE PRELABS, EXPERIMENTAL WRITE-UPS, AND QUSTIONS THAT ACCOMPANY THE WRITE-UPS WILL NOT BE ACCEPTED – PERIOD!** IT IS YOUR RESPONSIBILITY TO TURN IN YOUR WORK ON TIME. IF YOU CANNOT BE AT A LAB FOR AN EXCUSED ABSENCE, CONTACT A CLASSMATE TO HAVE THEM TURN IT IN FOR YOU OR YOU CAN PLACE IT IN MY MAILBOX BY GIVING IT TO MS. CATHIE ALLISON, THE DEPARTMENTAL SECRETARY, FIRST FLOOR, C-108, CHEMISTRY WING.

Lab Notebooks/Reports: (see lab text pp. 912-913)

Lab Report Particulars

Since there will be 12 lab teams (2 persons/team), lab grades will be given on a team basis (*sans* quiz grade). That is, I will collect a single lab report from each team, alternating between each team member. *The report will consist of a Xerox copy of the actual notebook pages kept for each experiment as detailed below.* However, this does not excuse the other team member from keeping a proper lab notebook. All lab reports are due one week after the completion of the lab experiment. Please include the title of the experiment (from the syllabus) and the date completed. The name of your team member must also be included on the report. The format of the lab report is outlined below—common sense will dictate what to include. There are no page limitations; however, writing for the sake of writing is not helpful.

Laboratory Notebooks:

EVERYTHING MUST BE WRITTEN IN YOUR LAB NOTEBOOK.
IF I SEE YOU WRITING THINGS ON SCRAPS OF PAPER, IN THE TEXTBOOK OR ANYTHING OTHER THAN YOUR NOTEBOOK,

YOU WILL GET AN AUTOMATIC 0 FOR THE LAB!
NO APPEALS, NO DISCUSSION, NO OPINION, NO COMMENTARY

Importance of the Laboratory Notebook

The laboratory notebook is an important record of work that has been completed in the laboratory. It will serve as a valuable resource for someone who may try to reproduce your work at a later time, so it should be clear and legible. It is also considered to be a legal document in both academic and industrial settings. Each entry must be signed (your signature), dated, and witnessed (my initials).

General

1) The notebook must be bound (not spiral or loose-leaf). Write your name, laboratory section and your instructor name on the outside cover of the notebook.
2) Number all pages in the notebook (front side of page only). You will write your experimental work on the front side of each page, you may use the back of the pages for class notes and calculations.
3) Leave the first 4 pages blank for a "Table of Contents". Each experimental entry should have a title, page number, and date the experiment was conducted.
4) Begin every new experiment on a new page.
5) Write all notebook entries in blue or black INK (not erasable). Pencil is not acceptable!
6) Never tear out pages from your notebook. If you make a mistake, carefully cross it out with a single line, initial and date. Use of White-Out is prohibited.

Notebook Format

1) Pre-lab (5 points)

This portion of the laboratory notebook must be completed **prior to the beginning** of the laboratory period. *This **should not** be done during the lab or prelab lecture.* It will be reviewed, dated and signed by your instructor at the beginning of the laboratory period to indicate that it has been completed. An incomplete pre-lab will result in a dismissal from the lab and a grade of "0" for the experiment.

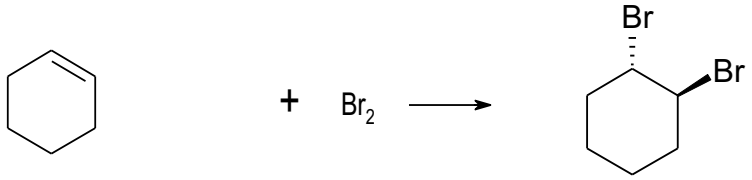
Your pre-lab should include the following:

a. Heading - Include a descriptive title of the experiment, the date, an appropriate reference (text or journal, author, page) and your name.
b. Purpose – Write a brief (one or two sentences) description of the general goals and procedures of the lab.
c. Chemical reaction (if applicable) - Include the balanced chemical equation for the reaction being studied.
d. Calculations (if applicable) – Include a detailed determination of both the limiting reagent for the reaction and the theoretical yield of the product. Use the

amounts given in the procedure being followed to make these calculations.

Entries "c" and "d" optimally should be summarized and organized in a table as shown below.

Example:



Mass to be used (g)			NA
d (g/mL)			NA
MW (g/mol)			
Mmol			
Mp or bp (°C)			
Actual Amt (g or mL)			
Actual mmol			

e. Table of chemical structures and safety concerns for reactants and products
This information can generally be found in the Merck Index, CRC Handbook of Chemistry and Physics or the Aldrich Chemical Co. catalog. In addition to having copies in the laboratory, these books are on reserve in the library. You may also find helpful information at the following sites: http://www.chemfinder.com and http://www.aldrich.com. Remember to always indicate the source(s) that you use.

f. Flow chart or schematic (as applicable) - This is a convenient way to represent an experimental procedure in a very organized manner. Whenever possible, a flow chart should be included (see p. 922-923).

g. Any other assignment that may be given prior to the laboratory period in the pre-lab Assignment

2) Procedure, Observations and data collection

In your own words, write exactly how you performed the experiment. This could be in a bullet form or a paragraph form. Any special laboratory diagrams should be drawn or referenced to an appropriate page in the text. Be sure to write in the third person passive voice (example-"The flask was heated for 30 min" is correct, not "I heated the flask for 30 min"). Observations are an important part of your laboratory notebook. You should note any color changes, formation of precipitates, the evolution of heat or gas, the formation of a new layer, etc.

As you take your notes, keep in mind that your written procedures, references and observations should be sufficient for a person to reproduce the experiment.

3) Lab report (15 points)

A good lab report will include all of the following sections:

- Introduction (pre-lab)
  - Significance of the experiment—historical background
  - Objectives—Why are you doing the experiment
  - Outline how you will achieve those objectives

- Procedures (pre-lab)
  - It is sufficient to reference the lab text or handout provided—you do not need to rewrite this information
  - Modifications to the procedures should be noted.

- Data/ Results
  - Tabulate your data whenever possible
  - Graphs/Charts as appropriate
  - All data must have descriptive labels, titles and units
  - Yields of products should be reported with both weight and percentages (include calculations).
  - Measured physical properties, such as melting and boiling points are reported here as well as the corresponding literature values.
  - Provide a brief summary of the results referring to the data.

- Discussion and Conclusions
  - Your interpretation of the data (including all spectra and chromatograms)
  - Did you meet your objectives?
  - Is the theory of the experiment consistent with your data?
  - What conclusions can you draw from your data?
  - Note any possible sources of error in the experiment that may have affected your results
  - Discuss the limitations of the experiment and offer suggestions for improvement—are there better ways to analyze the same problem?

- Spectral data and chromatograms should be stapled to your lab report.

4) <u>Post Lab Questions</u> (optional at discretion of instructor; up to 5 points)

- ***Your instructor will indicate whether or not you are responsible for these questions at the end of each experiment. Whether they are assigned or not, you are responsible for them—meaning they are fair game for exams.***

TOTAL = 20-25 points

At the conclusion of the lab period, clean up your lab area, the common areas near your hood, and your equipment so that it is ready for use on the next assignment. **Your lab team will be penalized 5 points if your general lab area (i.e., your hood and nearby common areas) is not clean at the conclusion of the experiment**. *Make sure that common areas and equipment are as clean, if not cleaner, than you found them.* A little courtesy in the lab goes a long way in having the experiment run smoothly for all parties

concerned. On request, you should be prepared to give your lab notebook to me to inspect and initial. Should the lab book not be in order, you will be instructed to remedy the cited deficiencies. Should you perform calculations outside of the lab or work up data, be sure to enter these in your notebook.

Most lab time should be devoted to experimental work rather than performing write-ups. However, it is useless to perform the work unless the data is properly recorded for later use and reflection. Not only should essential measurements (mass, volume, time) and precise procedures be recorded, but also all conceivably pertinent observations. A slight change in the procedure, a seemingly insignificant observation, etc. can be crucial in the final outcome of the experiment.

A number by itself is meaningless in the lab; therefore, the units, corrections, and information, which make its interpretation meaningful, should be carefully noted. There should be sufficient information about conditions, reagents, and equipment that the experiment can be repeated to give essentially the same results.

At the beginning of each lab period a brief pre-lab lecture will take place. However, prior to coming to the lab, thoroughly read the experiment which is to be undertaken with a clear understanding of the property or properties which are to be measured, the results which are to be calculated, and the manner by which these are performed. More often than not, you can and should refer to your course text for underlying principles since the lab very closely parallels the lecture. The pre-lab is the best time to ask questions.

Hazards in the Laboratory:

Organic chemistry labs are potentially much more hazardous that other science labs you have encountered. It is important to be aware of all possible hazards around you at all times. Among the key hazards:

1. *Flammable chemicals* – Most organic compounds are flammable, particularly the commonly used solvents such as ethers, alcohols, acetone, and ethyl acetate. Based on the flammability aspects of these materials, heating must be performed with water/steam baths, hot plates, sand baths, or heating mantles.
2. *Toxic chemicals* – Many of the compounds with which you will be working are poisonous. Vapors of many of the solvents are toxic and breathing them must be kept to a minimum. **USE YOUR HOOD AS A TOOL TO PROTECT YOURSELF!** Likewise, avoiding contact with solids is a good general rule of thumb.
3. *Corrosive and Irritating Chemicals* – The well-known dangers in handling strong acids and bases must be kept in mind. Some organic chemicals act as vesicants (skin irritants) and must be handled carefully with gloves.

General Safety Precautions:

1. Protective glasses must be worn in the lab at all times – ***NO EXCEPTIONS!!!!!!*** Failure to comply with this rule will constitute sufficient grounds for dismissal from the lab and a zero for the experiment.
2. Know the location of the fire extinguisher nearest to your work area, as well as the location of the eye wash stations, safety showers, and fire blankets.
3. All injuries, no matter how trivial, *must* be reported to the instructor immediately.
4. *Food or beverages are not permitted in the lab at any time.*
5. Unauthorized experiments are not permitted.
6. In case of fire or accident, ***immediately*** notify the instructor.
7. Working alone in the laboratory in expressly forbidden.
8. Do not taste anything in the lab (don't laugh…..I've seen it done). Exercise caution in noting odors and avoid breathing fumes.
9. Shoes completely covering the feet should be worn in the lab. No flip-flops or open-toed shoes are permitted.
10. Long pants (jeans) are advisable in the lab.
11. A lab apron or lab coat, if available, should be worn when wearing easily combustible clothing and afford desirable protection at all times.
12. Long hair should be tied back.
13. A laboratory is a dangerous place intended for serious study. ***HORSEPLAY WILL NOT BE TOLERATED!***

I. Guidelines for Personal Apparel in the Laboratory

A. Students must wear approved safety glasses or goggles (over regular eyeglasses) and should wear approved laboratory aprons or cotton lab coats (not lab jackets) at all times in the laboratory. **NO EXCEPTIONS FOR GLASSES!!!!!!** Failure to comply with this rule will constitute sufficient grounds for dismissal from the lab and a zero for the experiment.

B. The use of contact lenses in the laboratory is strongly discouraged. In the event of a chemical splash or vapor release, contact lenses can increase the degree of injury to the eye and may prevent prompt first aid and eye-flushing procedures. If you feel you must wear contacts, then you should wear goggles instead of safety glasses.

C. Students should wear cotton clothing that provides protection from chemical spills. Clothing which completely covers the legs must be worn at all times in the laboratory. Shorts and skirts that do not completely cover the leg are inappropriate apparel in the laboratory and are not permitted.

D. To avoid exposure to hazardous materials, open-backed shirts, bare midriff shirts, or shirts that expose areas of the torso are not permitted.

E. Wear shoes which completely cover the feet. Sandals, perforated shoes, open-toed shoes, open-backed shoes, or high-heeled shoes are not permitted in the laboratory.

F. For your safety, hair longer than shoulder length and loose sleeves must be confined when working in the laboratory.

G. Wear disposable gloves that are provided in each laboratory when working with hazardous chemicals. Inspect the gloves for defects before wearing. Be sure to notify your instructor if you have an allergy to latex. Remove gloves before exiting the laboratory. Upon removal, discard the disposable gloves in the wastebasket.

H. You are advised to avoid wearing synthetic fingernails in the chemistry laboratory. Synthetic fingernails can be damaged by solvents and are made of extremely flammable polymers that can burn to completion and are not easily extinguished.

I. For your protection, jewelry should not be worn in the laboratory. Dangling jewelry can become entangled in equipment and can conduct electricity. Chemicals can seep under the jewelry, cause injuries to the skin, and ruin jewelry and change its composition.

II. Procedures to Avoid Exposure to Hazardous Chemicals

A. Minimize all chemical exposure. Avoid ingestion, injection, inhalation, eye contact and skin contact with all hazardous materials in the laboratory.

B. No chemical should ever be tasted. ***Never*** pipette by mouth in the laboratory; use a pipette aid.

C. When you are instructed to smell a chemical, you should gently waft the vapors toward your nose using your gloved hand or a folded sheet of paper. Do not place the container directly under your nose and inhale the vapors.

D. Use the fume hood when there is a possibility of release of toxic chemical vapors, dust, or gases. When using the fume hood, the sash opening should be kept at a minimum to protect the user and to ensure the efficiency of the operation. Keep your head and body outside of the hood face. All chemicals and equipment should be placed at least six inches from the hood face to ensure proper air flow.

E. If any chemical spills onto the skin, immediately flush the affected area with water and notify the instructor.

F. Eating, drinking, smoking, chewing gum, applying cosmetics, and using smokeless tobacco products are prohibited in the laboratory. Beverage containers,

cups, bottled water, and food containers are not permitted in the laboratory. *Never* use laboratory glassware for eating or drinking purposes.

G. Remove gloves before exiting the laboratory. Dispose of gloves in a wastebasket, not in the solid waste container. Do not reuse gloves.

H. Notify your instructor if you spill any chemicals. Clean up chemical spills (including water) immediately. Do not leave spilled chemicals on the bench top or floor. At the termination of your experimental work, the desk top and student hood must be thoroughly cleaned before you leave the laboratory. The instructor will advise you of the proper manner to dispose of the cleaning materials.

I. Notify the instructor about any sensitivity that you may have to particular chemicals prior to the start of the particular laboratory experiment.

J. Due to possible contamination of laboratory coats with chemicals, students are advised that they should not wear laboratory coats outside of the chemistry lab and that they should not wash laboratory coats with personal clothing items.

K. Always wash your hands at the end of each laboratory session before you exit the laboratory.

III. General Guidelines for Laboratory Procedures

A. Do not enter the laboratory room without the supervision of your instructor. Working in the laboratory without supervision by the instructor is expressly prohibited. The performance of unauthorized experiments and the use of any equipment in an unauthorized or unsafe manner are strictly forbidden.

B. When diluting concentrated acids always pour the acid slowly into the water with stirring. Never add water to concentrated acids because of the danger of splattering.

C. When cutting glass tubing, always protect your hands with a towel or heavy gloves. When inserting rods, tubing, or thermometers into stoppers, the glass must be lubricated with soapy water or glycerol. Tubing ends must always be fire-polished. Make sure that the glass is cool before you touch it. Hot glass looks just like cool glass. Do not attempt to dry glassware by inserting a towel wrapped around a glass rod.

D. Glass tubing should extend well through rubber stoppers so that no closure of the tube can occur if the rubber swells.

E. All water, gas, air, electrical, and other service connections must be made in a safe and secure manner.

F. Practical jokes, boisterous conduct, and excessive noise are prohibited. The use of personal audio and visual equipment without instructor permission is prohibited in the laboratory.

G. Gas valves must be kept closed except when a burner is in use.

H. ***NEVER*** heat flammable liquids with a Bunsen burner or other open flame. If in doubt about the flammability of a liquid, consult your instructor.

I. Dispose of waste chemicals in the containers that have been provided and labeled for this purpose. Do not dispose of waste chemicals in the sinks or the wastebaskets. Paper towels and gloves should be placed in the wastebasket, not the chemical waste containers. Used filter paper and weighing dishes must be placed in the containers that are marked for this purpose.

J. Examine all apparati for defects before performing any experiments. Do not use damaged, cracked or otherwise defective glassware. Dispose of broken glassware in the containers provided in the laboratory. If you break a thermometer (or find a broken thermometer), report it to your instructor immediately.

K. Do not insert medicine droppers into reagent bottles unless they are specifically supplied with the bottles.

L. Never return unused chemicals to the stock reagent bottles. Take only what you need. Use the quantities of reagents recommended in your laboratory manual. Do not waste chemicals.

M. Do not remove stock reagent bottles from the dispensing areas without the permission of the instructor.

N. All materials (i.e., chemicals, paper, towels, broken glass, stoppers, and rubber tubing) must be kept out of the sinks at all times to minimize the danger of plugging drains. Such items are to be kept away from positions where they might fall into the sinks or drains.

O. Maintain clean glassware. When cleaning glassware with water, wash your equipment with tap water. Use distilled water only for rinsing. Do not use more distilled water than is necessary. Ethanol and acetone rinses must be placed in the appropriately labeled container in the laboratory as directed by the instructor.

P. Heavy pieces of glass apparatuses and filter flasks should be supported with clamps suitably protected with rubber or plastic pads. Heavy pieces of glass apparatus that are not sitting directly on the bench top should have appropriate bottom supports, such as a rings or tripods.

Q. Coats, bags and other personal items should be stored in the lab vestibule.

R. When heating or carrying out a reaction in a test tube, never point the test tube toward your neighbor or yourself.

S. All containers containing chemicals or solutions of any kind that are retained between laboratory sessions must be labeled so that the contents can be identified by chemistry personnel. The label must also contain the date and the name of the responsible person.

T. Caps must be kept firmly in place on all reagent bottles and waste containers when not in use.

U. Clean and return all of your equipment and glassware to your student drawer. Lock your drawer at the end of each laboratory session.

V. At the end of the laboratory session, return all common equipment to the common equipment drawer. Do not place the common equipment in your assigned student drawer.

IV. Departmental and Institutional Laboratory Policies

A. Know the location of the fire extinguisher nearest to your work area, as well as the location of the eye wash stations, safety showers, and other safety equipment. Plan an emergency exit route from the laboratory.

B. When the fire alarm sounds you must evacuate the building via the nearest exit. Extinguish all flames and turn off all equipment, as appropriate, before exiting.

C. All personal injuries and illnesses (however slight) occurring in the laboratory must be reported immediately to the instructor.

D. Report any accident (such as fires, explosions, a chemical spill, or the breaking of equipment) to your instructor immediately.

E. No chemical should ever be poured down the laboratory drains or placed in the wastebaskets. Properly dispose of all waste chemicals in the containers that have been provided in the laboratories.

F. Visitors, including children and pets, are not permitted to enter laboratory rooms.

G. As a reminder of institutional policy, smoking is prohibited in all campus buildings.

H. Do not take laboratory equipment, glassware, or chemicals from the laboratory room without the permission of the instructor.

"...and, as you go out into the world, I predict that you will, gradually and imperceptibly, forget all you ever learned at this university."

General Information:

Active cell phones and pagers are prohibited in the classroom. An audible cell phone tone during class or an exam is grounds for immediate dismissal from the classroom.

PLEASE READ THIS SECTION CAREFULLY. I HAVE NOT WRITTEN THIS SECTION FOR MY HEALTH OR TO FILL SPACE. THIS IS FOR YOUR BENEFIT!

Many of you may have heard the horror stories about how hard organic chemistry is. While many of you no doubt believe that General Chemistry was a bit of a review of your high school course of study and may not have been that much of a challenge, don't make the same assumption about organic chemistry. Organic chemistry (lovingly referred to as "O-Chem", "Orgo", or "Organic" by veterans of the subject) is unlike any other subject you have studied up to this point in your academic careers. It is often compared to learning a foreign language for the first time. For many students, there is no middle ground…..you either love it or hate it. Nonetheless, the study of organic chemistry provides the cornerstone for further study not only in chemistry, but in allied fields as well (particularly biology). In addition, mastery of the subject sends a clear signal to graduate and professional school admissions committees: you have developed the requisite study and reasoning skills to succeed at the next level. While it's true that many students find organic chemistry one of the most difficult courses they have ever taken, many others enjoy organic chemistry and many do well. One of the most rewarding and confidence-building experiences you can have in your education is to tackle a difficult subject and master it (a good thing to learn early in your career). Below are some time-tested suggestions on how you can make sure that your organic chemistry experience is as rewarding as possible.

- Attendance in class is up to you, but those who regularly attend do much better on exams than those who don't (of course, occasional absences due to illness or extracurricular activities are understandable). While I don't take attendance or

give surprise quizzes (except for lab), this should not dissuade you from routinely attending class. While the slides used as an outline for class lectures are posted, they are there as a study aid and are not intended as a substitute for attending lectures. Learning organic chemistry is an interactive exercise, and you are engaged more as a proactive learner than a passive learner. I will treat you like responsible adults who are able to fulfill your obligations to yourselves and your families without anyone looking over your shoulders. Please respond accordingly.

- On your first or second class day, exchange your phone number with at least one other student in the class. In case you miss a class, you can call that person and inquire about notes, announcements, and assignments.
- You cannot cram organic chemistry! If you do not keep up with the material daily and then try to cram the night before an exam, *you will fail*.
- Read or skim through the appropriate section of the book *before* you come to class. If you know what to expect when you come to class, you will absorb it much more easily.
- Don't try to write every last thing said in class or written on the blackboard. If you do this, you won't be really listening to what is said. That is why the lecture slides are posted on CANVAS. Print these out and take notes on them.
- If you have purchased a supplemental text, use the margins of your book – another great place to take notes.
- Rewrite your class notes the evening *after* class. When you do, you will realize that there are some points that you don't understand. Make note of these points, and ask me about them next time you see me (or make an appointment to see me). Your rewritten notes will also be much more useful to you when you study for exams.
- ***Work problems, then work more problems, and then work even more problems!*** Working problems is the best way to master the material. Reading the book and the lecture notes is fine, but work the problems without looking up the answers in the solutions manual until you have made a real effort to solve the problem yourself. After you have looked up the answer and you think you have understood it, set aside the problem for a few days and then work it again. Knowing the answer to a problem is not the same as being able to solve a problem yourself. Look in other textbooks in the library and on the CANVAS course website to find additional problems. Experience has demonstrated that to truly learn chemistry, one must do chemistry. In a lecture setting, this means that students must do problems. Simply listening to lectures, reading textbooks, and studying notes will not get the job done. *Problems must be worked out*. Time must be spent participating in the process of discovery and learning. Should you choose not to follow this advice, you do so at your own risk!
- If possible, form a study group (*very important!*). Studies conducted at Harvard University show that students who productively study with others tend to perform better on exams compared to those who study alone. Asking each other questions and working problems in a collaborative effort to establish a dialog and keeping the discussion going until consensus understanding is achieved is a great way to learn and is often used in law schools and med schools as a study method (strength in numbers!). A good group size is 3-5 students. Larger groups tend to be counterproductive (more socialization than study). The study carrels in the

library and study areas scattered throughout the Science Complex are great places for group study.

- Get help if you don't understand something. I am available to answer questions after the lectures, by appointment, by e-mail, or though periodic study sessions. I strongly encourage you to make an appointment to visit with me; you will not be disturbing me since this is the primary reason I am here. Don't be intimidated from coming to ask me for help. It is my job to help you learn the material, and I want to do that job the best I can. You're paying for my services; use them! Likewise, TCNJ tutors are available and have been selected based on their mastery of the subject material; use them as well!
- Mastering organic chemistry requires a curious mix of memorization and reasoning. If you do only one or the other, you may have a difficult time. Understanding why compounds behave in the way they do will enable you to apply the same logic to compounds that you haven't seen before.
- Molecules are three-dimensional objects. Make use of your molecular model kit in order to learn how to think about the two-dimensional images we write on paper in three-dimensional terms.
- Your grade is not determined by the performance of your classmates. I do not conspire with the medical or pharmacy school admissions committees to limit qualified candidates. It is not my goal to ensure that only a small fraction of you can achieve your dreams of a career in medicine, pharmacy, or whatever. I would be overjoyed if the entire class earned As and Bs. On the other hand, I am willing to give a majority of the class Cs, Ds, or even Fs, if the performance of the class warrants it. Your performance and yours alone determines your grade.
- The amount of effort you put into this course is directly proportional to the grade (and satisfaction) that you obtain. Organic chemistry is very study intensive and should on average require a **minimum** of 10-15 *hours per week* study outside of class (more is better) during a regular semester (14-15 weeks).
- Don't let organic's reputation intimidate you. Many people do very well in organic chemistry and enjoy it. There's no reason why you can't! (Some of us even do it for a living!)

How to Succeed in Organic Chemistry: Students' Perspective (Courtesy of Southern Oregon University)

Make Organic Chemistry a daily thing.
Study all the time.
Take good notes.
Do Study Guide Problems.
Go to every class.
Listen in class-it is so much easier if you try to understand the material as it is being presented to you than trying to cram for the test.
Write down everything.
Review class notes the same day after class or immediately before the next lecture.
Make flashcards.
Pay attention in class, try to grasp concepts.
Read textbook before going to class.

Be aware of syllabus.
Don't try to cram for organic.
Go to correct exam room.
Never! Never! Never fall behind!
Keep up with this class.
Write down all of your questions. Try to get extra help. Go to office hours even for the simplest of questions even if you think you don't need to.
Learn to write fast.
Leave plenty of room for note taking, don't squish the pictures.
If you don't understand something, ask right away before new material is introduced. It all builds up and you will not be able to catch up afterwards.
Begin studying at least four days before each exam.
Learn HOW to study, like math, reading won't help you, you MUST work problems.
The theory that you learn in the first 3/4 of the class is essential, initially the class may seem easy, but it is critical to understand from the beginning what is being taught.
Re-read the chapters.
Review all old exams ahead of time.
Always keep in mind that Organic Chemistry is a vital part of the MCAT.
Have a positive attitude going into the class, be open to reading the book, and practice problems.
Don't think too deeply about how much work it may take, just do a little everyday.
There must be plenty of time spent reviewing the material-daily is best, but especially right after class when the material is still fresh in your mind.
Do not take this class unless you absolutely have to.
The 5 days before the exam should be review time NOT study time.
Work the problems without looking at the answers.
Take this class during a semester in which you have the necessary time to devote to it.
Organic isn't that hard, it just requires dedicated effort.
Read the text for clarification.
Form study groups b/c you will be more motivated to study. Meet once/week and go over what you learned that week.
Do not sleep in class, pay attention.
Do not take this as an elective.
Be able to apply concepts.
Know Periodic Table trends very well.
Buy the study guide.
It's all about practice and learning how to manage your time.
Think in 3D.
Talk with former Organic Students.
Learn the rules and vocabulary early on.
This class covers more material more quickly than any other class you've taken before, be disciplined and study a few hours every day.
Go over the exams immediately after they are returned to you.
Pay attention to MO theory and hybridization.
Make a composite review sheet, just 2-3 pages, focusing on key points and trouble spots.
Keep a running list of reactions.
Don't forget anything you learn in the beginning of the semester.
Minimize outside distractions.

Read other textbooks.
Learn to draw chairs.
Learn your reactions backwards and forwards.
Have set study hours specifically for this class.
Sit in the front of the class.
Use molecular models.
Get to know your prof.
Make practice exams for yourself.
Know your acids and bases.
Combine class notes with chapter materials.
Study like you never have before.
Write out mechanisms over and over.
Take notes in class of what is said out loud.
Pay special attention to prof's hints.
Be optimistic.
Pay particular attention to reagents and solvents.
Don't procrastinate; it is too hard to catch up.
Use the blank sheet of paper approach after every lecture.
Actually work out the problems, mechanisms.
Take good notes.
There is a great degree of comparison b/w concepts, so it is critical to understand each basic concept.
Know nomenclature, it is easy and will boost your exam grade.
Confidence is key.
The first exam is the easiest, so try your best to do well on it.
1 week of slacking off = 2 weeks of catch-up.
Recopy class notes.
Understand the major concepts before worrying about the minor exceptions.
Do all the practice problems you can find.
Don't just memorize-understand why the reactions occur.
Never give up.

One final comment: an e-mail from a former TCNJ organic student who "got it":

I feel I need to explain myself when I said that organic chem has taught me a lot about life. It sounds like a crazy statement, but I'm really serious! You see, this class is by far one of the most challenging courses I've taken. Ever since my failing score from my first exam, I made it a personal goal to do well in your class. I know this sounds generic but orgo taught me to change my study habits and work actively. And as pathetic as my situation seemed in the beginning, I couldn't lose heart. I tried to use my failure constructively. I got extra resources and started to do a lot more problems. In fact, the first exam really motivated me to prove myself as a student who can step up to the challenge. I wanted to learn using the mentality that I could tutor this material to someone else. My standing goal: learn once, learn forever. I want to take what I learn to heart and be able to apply it anywhere, even if that includes a nerdy joke. It's a work in progress.

Here's another thing: I learned to put my pride aside and get a tutor. Isn't it funny that myself being a tutor, I was so unwilling to admit that I had trouble? In any event, I didn't care how dumb I felt; I just wanted to understand orgo. I went up to other students and asked them to help me as well. In doing so, I surprised myself in the new friendships I've made. When you open up to someone and show them that you trust them enough to ask for help, they respond positively. I have some upperclassmen friends I've really grown close to over the semester because I simply reached out to them. If an underclassman did that to me, that seemingly insignificant action would mean a lot to me. I'd be more than willing to do anything I could to help because I'd recognize that this person values my opinion and trusts me enough to ask for advice. Maybe I'm looking too far into this, but it's something I've noticed. One friend once suggested that I look at the overall goal when I think about synthesis and mechanisms--do I want to end up with a cycloalkene, for example? So how would I get to that? That brings me to another lesson in life: don't get lost in the details...keep the big picture in mind.

Wow, I think I'm going to stop here before I write a novel. But I hope this proves my point--orgo is applicable to life. Your class has meant a lot to me. Although it's been a love/hate relationship with organic chem, the outcome has been very rewarding. When things start to come together and make sense, it's the best feeling! Makes you even forget all the frustration you felt earlier…..well, most of the time.

Postscript……..in case you're wondering – this student earned an "A"

The College of New Jersey
Safety Rules for Undergraduate Students
in Organic Chemistry Laboratories (January 2017)

I have read and I understand the Safety Rules for Undergraduate Students in Organic Chemistry Laboratories issued by the Department of Chemistry at The College of New Jersey. In consideration of being allowed to take this course, I will abide by these guidelines and policies.

_____ DATE_____
Student Signature

_____
Name (print)

_____
Student ID Number

Course Number

Room Number

Lab Hood #

Return this completed form to your instructor.
This form will be maintained as a permanent record.