

## Supplemental Material

### Student Perceptions of Benefits of a Learner-Based Writing Experience in Organic Chemistry

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## Organic Chemistry 212 Research Paper Guidelines on a Selected Pharmaceutical

1. Write a 5-6 page paper on an organic chemical used as a pharmaceutical. The paper should be 5-6 pages, typewritten (12 point font). Some possible topics are listed at the bottom of the page or you may select another topic of your own choice (subject to instructor approval).
2. The following guidelines should be observed:
  - Generate the structure in a chemical drawing program such as ChemSketch;
  - Identify all functional groups, examples of bond types and stereogenic centers;
  - Include the properties and uses of the compound and its CAS number;
  - Obtain a synthesis (or partial synthesis) of the compound;
  - Information from a primary reference (a peer-reviewed journal);
  - Include an analysis of the health and/or environmental effects of the selected chemical; the eClass page has links to several helpful websites;
  - Include a risk-benefit analysis of the compound. This section should include more than an encyclopedic list of possible deleterious effects of the compound; it should include a thoughtful discussion of when to prescribe (or not prescribe) the compound.
  - Obtain an infrared spectrum of the compound and identify the absorption bands of functional groups. Obtain an NMR spectrum and identify the major chemical shifts in the molecule.
3. Use MLA in-text citation style with a Works Cited page at the end of the paper.
4. Internet sources must be referenced correctly: Ex. Author (if any), Title of Site, URL (accessed date), any other identifying information.
5. In addition to content, grading will include an evaluation of writing skills, including appropriate spelling, grammatical usage, and sentence construction. Write the paper in an interesting, creative style; try to avoid a cut and paste presentation. The title page should include title of paper, your name, date, and name of the class.
6. The paper is due \_\_\_\_\_.
7. Possible topics:

• Cocaine	6-Mercaptopurine
• Morphine	Thyroxine
• Hydrocortisone	Any steroid hormone
• Allegra	Prozac
• AZT	Thalidomide
• Penicillin	Cholesterol
• Sulfanilamide	Melatonin
• Phenobarbital	Fentonyl
• L-dopa	Epinephrine
• Crixivan	Isotretinoin
• Captopril	Naproxen
• Lovastatin or other statin drug	5-Fluorouracil
• Digoxin	Natural products used in homeopathic medicine
• Coumadin	Taxol
• Lipitor	Quinine
• Librium	Ritalin
• Topic of your own choice (instructor approval required)	
• For other suggestions, medicinal chemistry textbooks are available in instructor's office.	

## Rubric for Assessment of Research Paper on Pharmaceutical

GRADING CATEGORIES	Exemplary	Competent	Acceptable	Unacceptable	Not Attempted
Structure (20%)	All functional groups and bond types identified; formula drawn in ChemSketch or other drawing program	Most functional groups and bond types identified; structure drawn in ChemSketch or other drawing program	Some functional groups and bond types identified; structure drawn in ChemSketch or other drawing program	Few functional groups and bond types identified; structure not drawn with ChemSketch or other drawing program	No structure included; functional groups not identified
Bond types and stereochemistry (10%)	All bond types and stereogenic centers identified correctly	Most bond types and stereogenic centers identified correctly	Some bond types and stereogenic centers identified correctly	Incorrect identification of bond types and stereogenic centers	Not attempted
Infrared and/or NMR spectroscopy (10%)	All spectra included; data identified correctly	Most spectra included; data included and identified correctly	Some of the data included and identified correctly	Data inaccurately presented	No data included
Synthesis or biosynthesis (5%)	Logical synthesis included	Partial synthesis included	Partial synthesis attempted but some steps incorrect	Wrong synthesis	Not attempted
Properties and uses (CAS No., M.W., density, mp, bp, solubility, color) (10%)	All data and major uses included	Most data and uses included	Some data and uses included	Minimal data and uses included	No data included
Health/environmental effects of pharmaceutical (10%)	Accurate, relevant, and thorough information	Accurate and relevant information	Information partially accurate	Inaccurate information	None included
Risk/benefit analysis (contraindications) (10%)	Major risks identified	Most risks included	Some risks included	Incorrect risks	Not attempted
References and documentation; Minimum three references including one peer-reviewed) (10%)	All sources listed and one attached; proper citations including date of access; no plagiarism	Most sources listed; appropriate citations; few errors; no plagiarism	Some sources listed; appropriate citations; few minor errors; no plagiarism	No sources listed and only one attached; major errors or sources quoted incorrectly	References not attached; no primary reference; sources not quoted
Writing (10%)	Demonstrates excellence and creativity in writing with no grammatical or spelling errors	Demonstrates proficiency in writing with only minor grammatical and spelling errors	Adequate writing with few grammatical and spelling errors	Numerous grammatical and spelling errors	No attempt made to present acceptable writing
Presentation (5%)	Computer generated paper; excellent presentation	Neat, computer generated; no staple	Adequate but somewhat disorganized presentation; computer generated; no staple	Not computer generated	Completely unacceptable presentation
Total (100 %)					

## Organic Chemistry 212 Research Paper on Toxic Chemical

1. Topic Selection: select one organic chemical on which to write a 3-5 page paper. You may choose a topic of your own selection or use the list at the bottom of the page. Write the paper from the position of a government regulator who is advocating a change in regulatory standards. Following is a list of links to assist you in your research.

<http://www.nlm.nih.gov/> (National Library of Medicine)

<http://hazmap.nlm.nih.gov/>

<http://toxstown.nlm.nih.gov/>

<http://www.epa.gov/> (Environmental Protection Agency)

<http://www.atsdr.cdc.gov/> (Agency for Toxic Substances and Disease Registry)

<http://www.osha.gov/> (Occupational Safety and Health Administration)

<http://www.iarc.fr/> (International Agency for Research on Cancer)

2. Include

1. Structure generated with a chemical drawing program, physical properties, uses and CAS number of the compound;
2. Functional groups, stereogenic centers in the molecule (are all enantiomers toxic?);
3. Method of synthesis (if available) and manufacturer of the chemical;
4. Available or predicted spectral data (IR, NMR)—functional groups from infrared spectrum and basic chemical shifts from NMR spectrum;
5. Historical toxicity background (e.g., how toxicity was discovered, statistical data, epidemiological data, etc.);
6. Effects of toxicity including cells, organs or systems affected;
7. Biochemical mode of action if known;
8. Toxicity data:  $TC_{50}$  and  $LD_{50}$ , OSHA Permissible Exposure Limits (PEL) [usually available from the Material Safety Data Sheet (MSDS)], and the IARC Toxicological category if compound is a carcinogen;
9. One primary (peer-reviewed paper) with information from that source. Attach at least one page of the article to the paper.

3. Formatting: use MLA style to identify sources. Include date of access in all Internet sources.

4. Due date: The paper is due \_\_\_\_\_. Rubric for assessment is available on the eClass page and should be attached to the paper. Upload the paper to the following website: [www.turnitin.com](http://www.turnitin.com).

Class ID Number \_\_\_\_\_

Class enrollment password: \_\_\_\_\_

5. Possible Topics

Benzene

Vinyl chloride

Acrylamide

N-Nitroso dimethylamine

Formaldehyde

Trichloroethylene

2, 4-Dichlorophenoxy acetic acid (2,4-D)

Dimethyl phthalate (or other phthalate ester)

Perfluorooctanoic acid

Dioxins

Xylene

1,4-dioxane

Benzyrenes

Formaldehyde

Ethylene oxide

Perchloroethylene

Methyl bromide

Methylene chloride

Trichloroacetic acid

Benzo[a]pyrene

Progesterone

polychlorinated biphenyls (PCBs)

## Rubric for Assessment of Research Paper on Toxic Chemical

GRADING CATEGORIES	5	4	3	2	0-1
Structure and functional group identification (10%)	Structural formula drawn (ChemSketch); all functional groups identified	Structural formula drawn (ChemSketch); most functional groups identified	Structural formula drawn (ChemSketch); some functional groups identified	Structural formula drawn (ChemSketch); functional groups not identified correctly	No structure included; functional groups not identified
Bonding and Stereochemistry (10%)	All bond types and stereogenic centers identified correctly	Most bond types and stereogenic centers identified correctly	Some bond types and stereogenic centers identified correctly	Incorrect identification of bond types and stereogenic centers	Not attempted
Infrared and NMR spectroscopy (10%)	All spectra included; data identified correctly	Most spectra included; data included and identified correctly	Some of the data included and identified correctly	Data inaccurately presented	No data included
Synthesis (including manufacturer) (5%)	Logical synthesis included	Partial synthesis included	Partial synthesis attempted but some steps incorrect	Wrong synthesis	Not attempted
Properties and CAS No. (M.W., density, mp, bp, solubility, color) (5%)	All data included	Most data included	Some data included	Minimal data included	No data included
Uses (5%)	Major uses	Most major uses	One major use	Wrong uses	None included
Toxicity information (historical and statistical information) (15%)	Accurate, relevant, and thorough information	Accurate and relevant information	Information partially accurate	Inaccurate information	None included
Risk/benefit analysis (MSDS information, effects of toxicity) (15%)	Major risks identified	Most risks included	Some risks included	Incorrect risks	Not attempted
References and documentation: (Minimum: three references including one peer-reviewed) (10%)	All sources listed and one attached; proper citations including date of access; no plagiarism	Most sources listed; appropriate citations; few errors; no plagiarism	Some sources listed; appropriate citations; few minor errors, no plagiarism	No sources listed and only one attached; major errors or sources quoted incorrectly	References not attached; no primary reference; sources not quoted
Writing (10%)	Demonstrates excellence and creativity in writing with no grammatical or spelling errors	Demonstrates proficiency in writing with only minor grammatical and spelling errors	Adequate writing with few grammatical and spelling errors	Numerous grammatical and spelling errors	No attempt made to present acceptable writing
Presentation (5%)	Stapled, computer generated	Neat, computer generated, no staple	Poor presentation, no staple	Not computer generated	Neatness lacking
Total (100%)					