

IPESL Final Report
August 31, 2007

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Project Title: Using application and problem solving exercises to enhance critical thinking skills and learning in an allied health chemistry course

Purpose of the project:

The purpose of this project was to enhance student learning through the development of application and problem solving exercises which increase comprehension, information literacy, communication, and critical thinking skills. The application exercises were designed to enhance study skills and improve the understanding of key concepts. The target audience was the spring Chemistry 111 students, a class of approximately 90 pre-nursing, pre-dental hygiene, pre-athletic training, and dietetic majors.

Results:

I. Application Exercises

Description

The course is organized into six units. In the first two weeks of each unit, students were asked to complete a weekly study outline and to apply their understanding of key concepts. These were group exercises although some students chose to do them individually. The instructor collected these on Wednesday and they were evaluated that night and returned to students in their laboratory sections on Thursday. Students were quizzed on the material in the last 20 minutes of their Friday class. In the third week of the unit they prepared a study outline for the end of unit concepts and reviewed for the unit test.

The note review was organized into subsections with titles which reflected the learning goals and included practice problems from the text. The applications were chosen to complement student interests. Because the student population included pre-majors in athletic training, nursing, and dental hygiene, the applications in these exercises and as well as many in the critical thinking exercises were directed to these populations.

Examples of the some of the application exercises are given in Appendix A.

Assessment

The purpose of these application exercises was to improve student study skills and enhance learning. Many chemistry 111 students are not prepared to study and apply concepts. They expect to find answers in a text or on the Web rather than learn a concept and apply it to a new, but related problem which has relevance in their lives. They are overwhelmed by information and need a mechanism to “package” definitions, rules, and concepts. Many students were very surprised to see that the weekly material could be organized into content that covers a single typed page.

Were these note/ application exercises useful tools for student learning? Students were asked to evaluate this question at the end of the semester using a scale of 1-5 (with 1 being the lowest rating). Seventy responses were received and recently tabulated. The majority of the students (90%) found these exercises to be very useful. Over 60% of the students gave this the highest rating.

Table 1. Student Evaluation of Note/Application Exercises

Rating	5	4	3	2	1
Number of students	43	19	5	2	1

Did these exercises help with student success in the course? This evaluation is complicated by the inability to test the same group of students and by students who perform well below the average. In this assessment, two of the four sections in each class were evaluated. Averages of three quizzes and two exam scores have been calculated and summarized in Table 2 below. In each case, the sections which included the learning community students were used. Comparison of the spring semester Chemistry 111 grades with those of the previous spring semester do not support better student success. More data could be considered. These could include all quiz and test scores, median scores instead of average scores, as well as data from the other two lab sections. However, because so many variables exist including different exams, different student populations, different policies for nursing student admission, it may be worthless to use this as an assessment tool.

Table 2. Comparison of Quiz and Exam Score Averages

	<i>Quiz 2</i>	<i>Quiz 5</i>	<i>Quiz 8</i>	<i>Exam 3</i>	<i>Exam 4</i>
<i>Spring 06</i>	79%	79%	79%	80%	73%
<i>Spring 07</i>	83%	76%	83%	75%	78%

II. Critical thinking Exercises

Description

The students were introduced to critical thinking exercises the first day of class when they were asked to do the following group exercise which specifically targeted dental hygiene learning community students.

 Colgate claims that its Total Clean Mint Toothpaste is the one most recommended by dentists. Is it the best toothpaste?

How would you answer that question?

Discuss and list key issues and questions to consider and research.

Label of Colgate Total Clean Mint Toothpaste

Active ingredients: sodium fluoride, .24% (.14% fluoride ion) triclosan .30%

Inactive ingredients:

Water, hydrated silica, glycerin, sorbitol, PVM/MA copolymer,
 Sodium lauryl sulfate, cellulose gum, flavor, sodium hydroxide,
 Propylene glycol, carrageenan, sodium saccharin, titanium dioxide

Label of Crest Pro-Health Toothpaste

Active ingredient: stannous fluoride, .45% (.16% fluoride ion)

Inactive ingredients:

Glycerin, hydrated silica, sodium hexametaphosphate, propylene glycol, PEG-6, water, zinc lactate,
 trisodium phosphate, flavor, sodium lauryl sulfate, polyethylene, sodium gluconate, carrageenan, sodium
 saccharin, xanthan gum, titanium dioxide, red 40

 These exercises were evaluated to see if students could recognize the key questions and if they could distinguish between assumptions and the need to research to test assumptions. The results are summarized in Table 3 below. There were 34 group responses.

Table 3: Evaluation of initial group critical thinking exercise

Question	Assumption made	Recognized need for research	Not recognized as an issue
Does triclosan improve the effects of fluoride?	7	9	18
Does the amount or type of fluoride matter In terms of effectiveness?	4	2	28
Is research which test effects on Cavities /plaque necessary or are dentists' recommendations sufficient?	8	13	13
Do the inactive ingredients contribute to quality of other issues like whiteness, flavor?	2	2	30
Is research needed to test for other issues like whiteness, freshness of breath, etc?	0	9	25

Recognition of key issues was difficult for students. Many students did not use the label information and therefore did not specifically cite the need to research the ingredients. Others assumed that two active ingredients were better than one or that higher amounts of fluoride were better.

After this exercise, three critical thinking exercises were assigned at different times during the semester. A fourth option was made available to students. Only the top two grades were used in the final grade evaluation. The first three exercises are given below.

Critical Thinking Exercise Unit 1: Due Tuesday, February 6, 2007

Is E85 a better fuel than regular unleaded gasoline? Your argument should consider all aspects of the issue and should be based on facts and at least one scientific study. You are encouraged to communicate with others but this should be your argument.

Critical Thinking Exercise Unit 2: Due February 27, 2007

Sports drinks are very popular. Which would be better for an athlete to consume, water, green tea, or a sports drink? Assume that the athlete is a sprinter. In your argument consider performance, general health, and dental health as the key issues. Your argument must be based on at least one scientific study per key issue and should specify the chemical ingredients in the beverages being compared. At least one study should be from a primary research article which is focused on the specified drinks or on some of their chemical components.

Critical Thinking Exercise- Unit 4 Due April 10, 2007

Enzyme therapy is currently used in the treatment of sphingolipidoses and other lysosomal storage diseases. These include Hurler's, Hunter's, MPS VI, Fabry's and Gaucher's disease. You are a medical professional counseling a couple with limited health insurance, one affected child, and two other children who do not have the disease. Would you counsel them to use the enzymatic treatment, no treatment, or some other alternative treatment? Your argument must be based on scientific studies and ethical reviews. At least one scientific study must come from a primary research article and should consider all issues including ethical issues. (You may choose the disease.)

Several handouts were given to students to attempt to provide information about the critical thinking process. This was done after the initial group exercise and after each of the critical thinking exercises. Examples are given in Appendix B. Evaluations suggested that students were struggling with obtaining articles from on-line databases. They needed to be given a one page summary sheet explaining how to obtain full text articles without cost. This was part of their reluctance to use on-line databases. Students often made statements which were not supported by data. They were very reluctant to use numbers and consider the significance of numbers. They often did not consider both sides of an issue. It was also difficult for students to identify all the key questions in each of the exercises.

In my evaluations of the student work, I found it helpful to read through all the exercises first and create a list of key issues and assumptions. Examples of these are given in Appendix C. These were used to help assign rubric values to each student paper.

Two rubrics were used to evaluate the critical thinking exercises. The assigned rubric was used. However, because this rubric lacked assessment of the literacy component, a second rubric was used which can be found in Appendix D.

Assessment:

In the first assignment, this rubric was adjusted to include half points. While some students found relevant articles, they did not always use the research or describe the data in their arguments.

The assigned rubric was evaluated for the first and third critical thinking assignments. Some students chose to do a fourth assignment, but this was optional. The results are given in the table 4 below.

Table 4: Evaluation of critical thinking exercises 1 and 3 using the assigned rubric

	4	3	2	1
Assignment 1	10	21	33	4
Assignment 3	11	34	22	1

Approximately, twenty percent of the students scored lower by one rubric point; approximately forty percent scored higher by an average of 1.3 rubric points; the rest of the students scored the same on both assignments.

In end of semester student evaluations, students were asked to rate the value of the critical thinking exercises and also were asked to rate improvement in their critical thinking skills overall. Those results are given in the table below. (The highest rating is 5; the lowest rating is 1.)

Table 5: Student Evaluation of critical thinking exercises and critical thinking skills

	5	4	3	2	1
Value of Critical thinking exercises	22	22	16	7	3
Improvement in Critical thinking skills	37	21	11	1	0

A large percentage of the students felt the course improved their critical thinking skills. This course is listed as a general education critical thinking course so this validates that designation.

Sixty percent of the students felt that the critical thinking exercises were very valuable learning tools.

The second rubric was used to evaluate literacy skills. The results of that rubric are given below:

Table 6: Evaluation of critical thinking exercises using the literacy skill rubric

	3.5-4	2.5-3	1.5-2	1
Assignment 1	8	27	31	2
Assignment 3	23	33	10	2

These data clearly show a marked improvement in literacy skills for many of the students in the class. When students were asked to evaluate the course for improvement in their library research skills, they gave the following ratings. These were compared to their perceived improvement in writing skills in Table 7. Again students indicated that the exercises greatly improved their library research skills and somewhat improved their writing skills.

Table 7: Student evaluation of literacy and writing skills

	5	4	3	2	1
Improvement in library research skills	38	21	10	1	0
Improvement in writing skills	19	27	15	8	1

Issues and Suggestions for Future Work:

There are several suggestions which can be made with respect to this critical thinking project. A partial list is given below:

- This is a lot of work for both the students and the instructor. Although the course was originally designed with 5 critical thinking exercises, this was quickly reduced to 3 with and an optional 4th assignment.
- It is not easy to teach critical thinking in this type of format with large classes. Doing this every semester would lead quickly to “burnout”.
- It is difficult for students to recognize all the key issues. In the future the instructor may need to limit some of the issues.
- In retrospect, the process may be subdivided into different assignments. The first would be the initial identification of key issues and assumptions, the second would be the research, the third would be the editing of key assumptions, and the fourth would be the writing of the paper. Some of the first three might be done in groups to make the workload feasible for the instructor and the students.
- The rubrics need work. There should be a rubric for the identification of key issues, one for the research, and one for the argument.
- The students need to be given more information early in the course. Some handouts were given to students during the semester, but this needs to be done earlier. This should include a training session on how to access pdf files of articles from on-line databases as well as library support help stationed in the department.
- Students also need more exercises with feedback to prepare them for the critical thinking exercises. These should include exercises in understanding the difference between results and conclusions. Students need more exercises in recognizing the difference between recommendations and opinions and conclusions supported by unbiased scientific studies.

Dissemination:

I am interested in sharing my progress and reflections with other colleagues. This could be done through a community of practice, IPESL Website, and publication. I am interested in support mechanisms that exist that would help in dissemination.

Appendix A

Notes and Applications- Unit 1/Quiz 2

I. Naming (review geometry handout from lab)

Molecular formulae -----> SF

Fully saturated MF

Double bond

Triple bond

Cycle

Alkyl groups Rule: prefix + _____

propyl	isopropyl	butyl	Sec-butyl	Isobutyl	Tert-butyl

IUPAC Rules

Alkene and alkadiene

Alkynes

Practice Problems Ch. 10 : 57-89 Ch. 11 41-57

II. Isomers and Conformations- Definitions

Conformations

Structural isomers

Geometric Isomers

Practice Problems: Ch 11 51-55

III. Reactions

Give general reactions with SF below:

Combustion:

Halogenation (substitution)

Halogenation (addition)

Hydrogenation (addition)

Hydration (addition)

Polymerization

Practice Problems: Ch 10: 103-109 Ch. 11 59-85

Applications:

1.a. Hydrocarbon components of gasoline. List four examples from at least three different hydrocarbon classes. Give octane ratings (see <http://www.elmhurst.edu/~chm/vchembook/>)

Name of hydrocarbon	Structural formulae	Octane rating

b. Show a combustion reaction with one of the components and describe its relevance with respect to the use of gasoline.

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2. Alkene derived polymers for medical or sport applications. (A good polymer site is <http://pslc.ws/macrogcss/sports.html>)

Name of polymer	Structural formulae of monomer	Structural formulae of polymer	Application/use/properties

3. Haloalkanes-

a. Fill in the table describing two haloalkanes found in refrigerants or swimming pools. (See your text, including the critical thinking problems.)

Structural formula	Common or generic name	IUPAC Name	Safety or environmental issue

b. Show a synthesis reaction for the production of one of the haloalkanes. It may have multiple steps.

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Names:

Section no.

Notes and applications- Unit 3/ Quiz 5

I. Naming of carboxylic acids and esters Practice Problems: Ch. 14: 45-53 and 69-73 (odd)

Summarize the naming rules below:

IUPAC Rule for CA	Prefix=	Infix=	Ending =
Common Rule for CA	Prefix=	Common prefixes	Ending=
IUPAC Rules for ester	First word	Second word - ic acid	Ending=
Common rules for esters	First word	Second word - ic acid	Ending=

Dicarboxylic acids and generic acids (incl. aromatic and fatty acids and metabolic acids) Give SF

Name	SF	Name	SF
Oxalic acid		Lactic acid	
Malonic acid		Pyruvic acid	
Succinic acid		Terephthalic acid	
Glutaric acid		Salicylic acid	
Arachidonic acid		Palmitic acid	
Oleic acid		Stearic acid	

II. Physical properties Practice Problems: Ch. 14:31-37 (odd)

Rank order boiling points of ethers, alkanes, alcohols, thiols, and carboxylic acids of similar size

Class: > > > >

Interactions:

III. Reactions: Practice Problems: Ch. 14:55-65 (odd), 75-89 (odd), 105,107, CT. 2,4

Summarize the reactions below using SF:

CA- acid-base	
Beta keto acid-decarboxylation	
Ester synthesis	
Ester hydrolysis (base catalyst)	
Thioester synthesis	
Thioester hydrolysis (base catalyst)	
Phosphate ester synthesis	
P. ester hydrolysis	
Phosphoanhydride synthesis	
Phosphoanhydride hydrolysis	

Applications:

Question 1:

List SF and IUPAC and common names of two omega 3 fatty acids which are good for your health. Also list two trans fatty acids which are not good for your health.

SF	IUPAC Name	Common Name

Assume that one of these is found in a phosphoglyceride. Show the hydrolysis by phospholipase A2 (this is specific for the second ester position.)

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Question 2:

Draw the SF for propionic acid and for benzoic acid. Show the products of each of these made by acid base reactions. Give the functions of each of the products.

	SF	Product	Function
stearic acid			
Benzoic Acid			

Show the two step synthesis of benzoic acid from benzyl alcohol:

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Note; Review lipids in Ch. 17 (practice problems: 25-31 (odd), 35,39, 41,45,49-53(odd))

Question 3: Show a hydrogenation reaction with trilinolein which results in a triglyceride containing trans fatty acids:

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Give the structure of a cholesteryl palmitate.

Show the diagrammatic structure of the membrane bilayer containing this lipid.


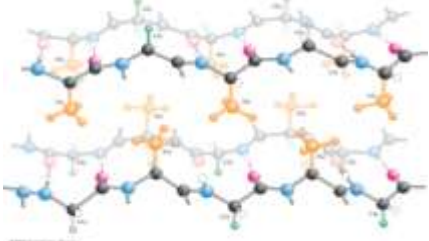

Give the diagrammatic structure of the LDL containing this lipid.

Cholesteryl palmitate	Surfactant diagram	Emulsifier diagram

Unit 4- quiz 7 Notes and Applications (Due March 28, 2007)

NOTES

I. Summary Table for Fibrous proteins (Fill in the table.) Problems 18:45-51 (odd)

			
Name of Proteins			
Location			
Primary structure			
Secondary Structure			
----- Description of secondary	-----	-----	-----
Superstructure interactions			

Molecular Explanation of : (Describe the molecular defect and symptoms)
Osteogenesis imperfecta:

EDS

Draw the hydrolysis of a procollagen chain with an endopeptidase which hydrolyzes between leu and pro.

II.Ionic structures of peptides (see handout) acids are deprotonated at pH values above their pKa

III.Tertiary structure, interactions, and denaturants (fill in the table.) Ch. 18:53,55,57,63,65,85,87,89

	Ionic	Hydrogen bond	Disulfide	Id-id
Pair of R groups with SF				
Names of R groups				Phe R / Leu R
Denaturant which disrupts				Heat (no specific one)

IV.Hemoglobin and Mb Ch. 18: 59, 69-79 (odd)

Describe the quaternary structure of Hb oxy vs. deoxy:

Draw the binding curve for stripped Hb and Hb plus BPG to the right.

What does BPG do for the p50 value and the function of hemoglobin?

Where does BPG bind? _____

What two different R groups bind BPG? _____

Why does fetal Hb bind less BPG? _____

Why is this important for the fetus? _____

Applications

_____/ 8 pts.

Question 1

_____/ 1 pts.

Name two blood proteins (not discussed in class) which are related to disease and describe their functions.

Name		
Function		

Question 2: _____/ 3 pts.

See posted picture 1 (HIV and antibody)

Give **the name of the protein** which function as antibodies: _____

Look at the posted diagram:

Identify the HIV protein with a name: _____

Describe the type of secondary structure found in the region of the antibody proteins which interacts with the HIV protein: _____

The two interact through hydrogen bonds (10 of them). Show one possible interaction between the antibody chain and the HIV protein chain. Use SF for the R groups:

Why is it significant to study the interactions and shape?

Question 3: _____/ 4 pts.

See posted picture 2(serotonin's protein receptor)

Look at the protein ribbon diagram for serotonin's protein receptor.

What **type of secondary structure does the transmembrane domain** of this receptor have? _____

What is **the function** of this region? _____

What **type of polarity** must exist in some of this domain? _____ Why? _____

Serotonin binds to the other domain. What type of secondary structure does this region have? _____

It binds to five non-polar aromatic amino acids. **Name the key aromatic (in purple)** _____

This changes the conformation in the transmembrane domain. What amino acid is isomerized? _____

How does this isomerization change the conformation and allow for the function of the protein?

In reality, the protein has five subunits which create the pore and provide 5 different leucines. **What level of structure does this represent?** _____

Question 4: (PRACTICE ONLY, no points)

Draw glutathione in its ionic form at a pH value of 10.

Names:

Unit 5 -Quiz 9 Notes and Applications

Chapter 21: all odd Ch. 22:23-47 (odd)

I. Net Reactions for Carbohydrate Metabolism Give the net reactions for each pathway.

Aerobic glycolysis	
Anerobic glycolysis	
gluconeogenesis	
PPP- 1 st phase	
glycogenolysis	
glycogenesis	
PDH	
TCA Cycle	

II. Key Reaction examples

dehydrogenation	Aerobic glycolysis	
Dehydrogenation	Anerobic glycolysis (only)	
Dehydrogenation with acyl transfer	PDH and TCA	
Dehydrogenation Of alkane	TCA	
Dehydrogenation of alcohol	TCA	
Phosphorylation Uses up ATP	Aerobic glycolysis	
S.L. phosphorylation	Aerobic Glycolysis TCA Cycle	
Carboxylation	gluconeogenesis	
Hydrolysis of phosphate ester	gluconeogenesis	

Applications

1. Give the reaction catalyzed by glycogen phosphorylase:

--

2. Give two glycogen storage diseases, their defective enzymes and reactions, and their symptoms:

Disease Name	Defective enzymatic reaction	Symptoms

3. Use a diagram to show the reciprocal regulation of glycogen synthase and glycogen phosphorylase under starvation conditions in the liver. Start with the release of glucagon:

Glucagon binds to its receptor →				

4. Fructose is metabolized and eventually enters aerobic glycolysis. Using structures show the reactions which must occur for fructose to enter glycolysis. You will need the the following enzymes: fructokinase (adds phosphate at the 1st position); aldolase B (splits f-1-P), glyceraldehyde kinase (adds phosphate to glyceraldehyde).

Give the net reaction for 1 fructose combining entry reactions and reactions in aerobic glycolysis.

Appendix B- Handouts on the Critical thinking Exercise Process

Handout 1: Chemistry 111 Critical Thinking Exercises- Introduction

In each of the critical thinking exercises, you will be given a problem or question. You must identify the key issues and find evidence to support your argument. Your argument must consider counter-arguments.

This first exercise must address the question:

Is E85 a better fuel than regular unleaded gasoline? Your argument should consider all aspects of the issue and should be based on facts and at least one scientific study. You are encouraged to communicate with others but this should be your argument. In the first exercise it should cover several domains of the issue including economic issues, ethical issues, scientific issues, and political issues. It must be supported by data from literature (evidence) and at least one scientific study or model.

To research the key issues, it is recommended that you identify the issues first. If you try to search with the key word ethanol, there will be too many citations to review.

The library has a number of online databases which are useful. These include: ACS Web Editions (Chemical and Engineering NEWS), Science, Academic Search Premier, Google Scholar, Medline (CSA), and Science Direct.

These can be found on the Library home page.

Journals such as *Science*, *Chemical and Engineering News*, *PNAS*, *Scientific American* as well as some technology journals may have useful articles. Several of these articles can be obtained free as long as they are accessed through the library on-line databases.

If the article is available in pdf format, save the article in that format since it will include tables and graphs that you might need. The articles must be submitted with your argument in a two pocket folder.

Your argument must include citations. Credit your sources with author name and page number.

You can share your research with other students, but they should credit your work.

Asking the appropriate questions (list these in your introduction)

Using the appropriate resources to research the questions (list these in the cited references)

Write an argument which is supported by data and at least one scientific study

If you share questions and resources give credit to the student who did the work.

Your paper should be typed and should be 2-3 pages excluding references and data tables. You must include copies of articles and resources along with the paper in a two pocket folder with your name and section number on the front of the folder.

Handout 2: What can be learned from the first group critical thinking exercise?

The question: Is Colgate Total Clean Mint Toothpaste the best toothpaste? The label claims it is the toothpaste recommended the most by dentists.

As some of you recognized, it is important to define best.

Question 1: Is it the best in active ingredients?

The active ingredients are supposed to prevent tooth decay and gingivitis.

Looking at the two labels, there is a difference in the amount and types of active ingredients.

Questions to be researched in the literature would include:

Does the addition of triclosan improve the effects of fluoride?

Does the amount of fluoride matter? Does the form of fluoride salt matter in terms of effectiveness against tooth decay and gingivitis?

The research must be an appropriate controlled study and should not be biased (not conducted by the manufacturers of Colgate.)

Should the definition of best also include the inactive ingredients?

Do these contribute to other important issues important to the consumer such as white teeth, sensitive teeth, taste, and cost?

Questions to be researched in the literature would include;

What are the functions of the inactive ingredients?

How important are these to the consumer?

How do costs compare?

Be careful of your previous beliefs. Asking your dentist is not sufficient unless he or she can refer you to a scientific study.

Handout 3: Comments on Critical Thinking Exercise 1:

It is important to have reliable, unbiased sources. Biased sources may help identify key issues. For example:

Statement: E85 is a clean, energy efficient, renewable fuel. It costs less at the pumps than regular unleaded gasoline.

These statements help identify some key questions:

Is E85 a cleaner fuel than unleaded gasoline?

Is E85 energy efficient?

Is E85 renewable?

Is the consumer paying less for this source of fuel?

However, you cannot assume these statements are fact. You must look at each of these issues with unbiased sources which provide real numbers from scientific studies. For example:

In addressing the question of a cleaner fuel for the environment, there is research to support a decrease in green house gases. You should present this table of numbers and discuss the magnitude of the differences. However, some of these studies also show that nitric oxides increase and formaldehyde and acetaldehyde also greatly increase although they are not as toxic as some of the carcinogens released by unleaded gasoline.

For each issue, you must present the pros and cons and make your judgment about the issue.

Don't present only pros for one issue and cons for another issue.

You can't make statements without providing evidence. Be careful of media and biased sources. Be sure to have sources which look at both sides of the issue. Share resources with others.

You must provide numbers and explain them in your argument. You must have one primary research article. This is an article where the authors have done the work themselves.

You must look at all the key issues.

Handout 4: Critical Thinking Exercises- The Process

Step 1- Identification of the key issues using the stated problem. This may require educating yourself about the science in the subject.

Which of the three drinks is better for athletic performance?

Which of the three drinks is better for dental health?

Which of the three drinks is better for general health?

Step 2- Researching the issues using on-line library databases like Science Direct, Medline (CSA), Academic Premier, Google Scholar, etc.

Use multiple key word searches (in the advanced mode) Ex. Green tea and dental health

Order full text articles through interlibrary loan if not available on-line

Get pdf files of online articles

NOTE: STATEMENTS and OPINIONS are NOT SCIENTIFIC EVIDENCE. REVIEWS CAN BE VERY HELPFUL WHEN THE ORIGINAL STUDY IS DESCRIBED. IF A CITATION IS NOT GIVEN IN A REVIEW, IT IS NOT A RELIABLE SOURCE. STUDIES DONE BY THE MANUFACTURER OF THE PRODUCT OR DRUG ARE BIASED. MANY MEDIA SOURCES ARE FAULTY OR JUST OPINIONS. Look carefully at the problem statement; sprinting is not equivalent to a marathon.

Step 3- Read the articles, especially the abstract or summary and the introduction and discussion sections. In your reading, identify key assumptions in each of the issues. Look for evidence which provides both pros and cons. If all you have are abstracts, you are going to fail miserably in this endeavor. Topics have been chosen which are controversial and provide evidence for both pros and cons. You might even have a hypothesis. **You are testing your assumptions using scientific data (not opinion).**

Step 4- Share research; search more databases for key issues or assumptions which are not covered. Read and modify assumptions.

Step 5- Organize and outline the argument. If numbers are not available in the summary, go to the results section of the articles to obtain data.

Step 6- Write the argument in your words. (NO LONG QUOTES OR PLAGIARISM). Support your argument with both qualitative and quantitative evidence from the articles. YOU MUST CITE WITH AUTHOR AND PAGE NUMBERS.

Appendix C- Instructor's List of Assumptions

Assumptions- Critical Thinking exercise- Unit 2

Athletic performance

- Assumption 1: Dehydration results in poorer performance
Evidence- Pro or Con
- Assumption 2: Sports drinks rehydrate better than water or green tea
Evidence- Pro or Con
- Assumption 3: Glucose becomes limiting during exercise
Evidence- Pro or con
- Assumption 4- Sports drinks restore blood glucose levels
Evidence- Pro or con
- Assumption 5- Sport drinks enhance all athletic performance
Evidence- Pro or Con
- Assumption 6- Green tea doesn't enhance athletic performance
Evidence- Pro or Con
- Assumption 7- There are no side effects to drinks
Evidence- pro or Con

Dental Health

- Assumption 8- Sport drinks erode enamel
Evidence- Pro or Con
- Assumption 9- Sport drinks and other drinks with sugars cause caries
Evidence- Pro or Con
- Assumption 10- Fluoride is good for dental health
Evidence- Pro or Con

General Health

- Assumption 11- Drinking lots of water or water based drinks is good for the health
Evidence- Pro or Con
- Assumption 12- Drinking polyphenols in green tea is good for the health
Evidence- Pro or Con

Assumptions- Critical Thinking Exercise unit 4

- | | |
|---|-----------|
| All forms of the disease require treatment | pros/cons |
| ERT improves health short term | pros/cons |
| ERT improves health long term | pros/cons |
| All forms of the disease respond to ERT | pros/cons |
| ERT is cost prohibitive | pros/cons |
| ERT has no side effects | pros/cons |
| ERT technology exists and is optimized | pros/cons |
| SRT (or other) improves health short term | pros/cons |
| SRT (or other) improves health long term | pros/cons |
| SRT is less expensive | pros/cons |
| All forms of the disease respond to SRT | pros/cons |
| SRT has no side effects | pros/cons |
| SRT technology exists and is optimized | pros/cons |
| Long term hope for better technology | pros/cons |
| All who need ERT should get ERT | |
| Regardless of cost | pros/cons |
| Drug vacations can be taken or therapy | |
| Can be delayed | pros/cons |
| It is easy to predict who needs early treatment | |
| Based on genetics and symptoms | pros/cons |
| Ethical issues exist for gene therapy | pros/cons |
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Appendix D: Rubric for Literacy Skills

Literacy/ Identification of key questions/ use of literature

4	<p>Consistently does all or almost all of the following:</p> <ul style="list-style-type: none">➤ Identifies the problems and all key issues inherent within it➤ Finds articles which focus on the problem and key issues➤ Research provides adequate evidence for a balanced argument➤ Data from the research articles is well used in the argument
3	<p>Does many of the following:</p> <ul style="list-style-type: none">➤ Identifies the problem and some of the key issues inherent within it➤ Finds at least one article with data which focus on the problem and some of the key issues➤ Research provides some evidence for a balanced argument➤ Some data from research articles is used in the argument
2	<p>Does many of the following:</p> <ul style="list-style-type: none">➤ Identifies the problem but fails to recognize many of the key issues➤ Finds relevant articles for one side of the issue➤ Research provides evidence for an argument but not relevant Counter arguments➤ Conclusions (not data) are used in the argument
1	<p>Consistently does all or almost all of the following:</p> <ul style="list-style-type: none">➤ Fails to recognize the key issues and problem➤ Scientific sources do not focus on the key issues➤ Research is inadequate to support an argument➤ Research is not used to support the argument made