

## BIOL-L104: Cancer Research

The general topic of this course is scientific research (i.e., experiments and studies) that has been conducted about cancer, and the main purposes of this course are to provide opportunities to inquire about such research and to improve your skills of inquiry.

**Inquiry** has been described as “**A self-directed, question-driven search for understanding**” [From Hudspith, B. & Jenkins, H. (2001). *Teaching the Art of Inquiry*. p. 9. Halifax, Nova Scotia: Society for Teaching and Learning in Higher Education].

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This course is largely meant to prod you to continually practice the following activities and dispositions that support searching for understanding in self-directed and question-driven ways:

- Actively looking for and recognizing things that you do not understand
- Generating, crystallizing, identifying bases for, considering implications of, and prioritizing questions (and ideas about possible answers) about what you do not understand; Developing hypotheses
- Being in charge of deciding your specific information needs (in the context of addressing those hypotheses that you have decided are of highest priority for you to investigate), developing plans to find information that you seek, and squarely confronting difficulties that you have in finding it

An additional, more fuzzy goal is to create and support a class community, one in which each of us feels valued and respected. I would hope that we will end up also feeling more connected to larger communities of people who are interested in and affected by cancer research.

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Below is information about various course elements, which we will call **In-class work, the Breakthrough Paper, the Letters, the Experiment Paper, the Lists, and the Inquiry Journal**.

### **In-class Work (~25% of course grade)**

We will use much class time to practice inquiry activities in small-group and whole-class discussions. Another general function of discussions will be to promote and support a sense of community that, among other things, helps us to be more enthusiastic about work that we do for this course. (It seems clear that we are social creatures who tend to be more engaged in our work when others want to discuss and understand it.)

As the semester progresses, whole-class discussions will tend to deal with specific figures and tables of data presented informally by individual students. Some class time will also be used to discuss recent news articles, and some time will be used for giving feedback about classmates' writings (as well as used, if we have time, to develop assessment rubrics for such writings).

Notes: I expect everyone to come to every class meeting and to arrive on time. Please let me know by e-mail (at [adbender@indiana.edu](mailto:adbender@indiana.edu)) if you ever need to miss, or if you have to be late to, a class meeting.

## The Breakthrough Paper (~8% of course grade)

This writing assignment is for explaining the biggest breakthrough that you had, in terms of helping you to figure out or make sense of something that you had struggled with.

Let us posit that each breakthrough should involve a *change of mind* concerning a prior view that you held rather than involve something more akin to simply *acquiring new information* or *adding* a view. (So, something along the following lines would *not* count as a breakthrough: “Here is something that I previously did not know that now I do know.”)

The following guidelines for creating your Breakthrough Paper assume that your breakthrough will involve the realization of a *mistaken assumption*. (It seems to me that most breakthroughs really do involve the realization that an *assumption* that one had made, and for which one had reasons to consider to be correct, is actually *not* correct.)

### Format for the Breakthrough Paper:

1. The title, which will be a statement of your mistaken assumption, in the following form:  
“Mistaken Assumption: \_\_\_\_\_”
2. A drawing of your own creation that depicts that assumption (that you now judge to be wrong). The drawing should be completely of your own creation, not involving any images (even clip art) made by anyone else.
3. A written description of that assumption
4. Description of specifically what did not make sense that you were struggling to figure out. Include the main question that you came up with that got at the heart of what you were struggling to figuring out. Then, discuss the ideas about possible answers that you came up with. Include in your discussion reasons why each idea made sense as well as reasons why each idea did not make sense.
5. Reasons that you had in support of the assumption. (Why did the assumption make sense?)
6. Reasons why you now judge the assumption to be wrong

### Notes about Breakthrough Papers:

1. Each Breakthrough Paper should focus on a single mistaken assumption. If there is more than one mistaken assumption that you could write about, choose whichever one seems to be most basic.
2. The Breakthrough Paper should be on the order of 250-500 words long and should be printed single-spaced.
3. You will have one chance to revise your Breakthrough Paper based on comments from classmates, and you will have another chance to revise it based on feedback from me.
4. The plan is to post Breakthrough Papers from this class on the following website, along with other sorts of writings that students have created in previous semesters:  
<http://www.bio.indiana.edu/~bender/resources/SignificantInsights.html>
5. Have the breakthrough for your paper be one that nobody else has already described in any of the papers posted at the above site.
6. Most of the writings that are posted at the above site do not fit this semester’s guidelines for Breakthrough Papers. For example, some of the previously posted writings are simply about claims that students had heard and that they had subsequently decided were not true. So, do not expect posted writings to serve as guides for how to create your own Breakthrough Paper in this semester’s class.

## The Letters (~30% of course grade)

These papers are called “Letters,” because they are meant to be written as though for a community who shares your interests in cancer research.

To provide an overview of your inquiry, each Letter should discuss the following:

- What do you not understand that you want to understand?
  - *Why* do you want to understand that?
- What is the main idea (i.e., your main idea *of a possible answer*) that you came up with that gets at the crux of what you do not understand?
- What specific reasons do you have in support of and against that idea?
- What specific information do you seek?
- What specific information do you predict that you will find? Why?

Each letter should then provide a more complete picture of the questions, ideas (of possible answers), and assumptions that underlie, extend from, and are otherwise connected to whatever is the main idea that you are planning to investigate:

- **Why did you choose this particular idea** to investigate? What other questions and ideas did you come up with, and why do you judge the idea that you did choose to be more important to investigate than those other questions and ideas? For example, why do you consider the question and idea that you did choose to be more fundamental, and/or to be getting more to the crux of what you do not understand, than are your other questions and ideas?
- **What assumptions form bases** for the main idea that you chose to focus on?
- **What would be implications** for your understandings if your main idea turns out to be correct versus if it turns out to be incorrect? For example, what would now become your most important question and idea to investigate if your current main idea turns out to be correct versus if it turns out to be incorrect?

Notes:

- There will be five Letter assignments. Each Letter should be 500-1000 words long, printed single-spaced.
- The Letters help you and me to see the movement/progress that you are making throughout the semester. Letters should not be overly repetitive with one another, but each Letter should be connected to the previous one. (We will probably want to consider how to define “not overly repetitive” and “connected to.”)

## The Experiment Paper (~8% of course grade)

This assignment provides a framework for explaining and analyzing a specific experiment or study from a primary article. [A note about terminology: A primary article typically presents *multiple* experiments, with data for each experiment displayed in a separate figure or even in a separate *panel* of a figure. The Experiment paper assignment is meant to deal with a single experiment (or with one part of a study) and should focus on a single set of data that addresses a single question.]

### Format for the Experiment Paper:

- A. Presenting the experiment (or part of a study).
  1. Give the reference for the article. (Authors. Year. Title of Article. Name of journal in which the article appears. Journal volume number. Page numbers.)
  2. State the main specific hypothesis that the experiment that you chose is meant to address.
  3. Explain briefly the general strategy that the authors used to test that hypothesis, and explain what criteria you think would be reasonable to use to decide whether the hypothesis is correct.

4. Show a copy of just the relevant table, graph, or figure.
5. Indicate (e.g., by circling or underlining) whichever specific pieces of data (e.g., which specific pair of numbers) are most important to compare to one another to allow one to decide whether the hypothesis is correct.

B. Explain what specific pieces of information the authors left out or did not present clearly enough to allow you to fully understand and evaluate the experiment. Go from the most important pieces of information that were left out or not presented clearly to the less important such pieces of information.

- Info need for comprehending the actual table, graph, or figure, itself  
Consider what is being shown, including meanings of the various terms and symbols.
- Info about how the data were obtained  
Consider what sorts of raw data were collected. Consider what entities were detected and/or measured, and consider how those entities were detected and/or measured.
- Info about how the raw data were processed for analysis and display

Appendix: Provide a copy of the whole article. For each of the following questions, indicate (e.g., by circling or underlining) the specific bits of the article (and *only* those specific bits) that provide information about the following questions:

1. What is the main specific hypothesis that is addressed by the set of data that you chose?
2. What is being displayed in the figure or table? (How does one read the figure or table?)
3. How did the authors obtain the data?
4. How did the authors process the data?
5. What happened in the experiment? What were the results?
6. What do the results mean? What are possible interpretations of them?

### **The Lists (~9% of course grade)**

These list-making assignments are meant to complement the somewhat *formal* Letters assignments and the *not-so-formal, reflective* Inquiry Journal assignment. The hope is that creating these lists will help you to “see” more concretely (or to “put on the table” for examination) thoughts that might otherwise reside, perhaps only vaguely, only in the back of your mind.

The current, *cumulative* version of each List below will be turned in only four times during the semester. However, continually add to the lists throughout the semester (e.g., doing so *at least* once per week). Please give the date for each item that you make in each list. (When you add an item to a list, put the date of the entry next to that item.)

List A: Things that I do not understand

List B: Vague questions that I have, and my best-guess idea about what the answer will turn out to be (or at least what it will turn out to “look like”) for each question

List C: Specific Yes/No questions (or hypotheses or “idea questions”?) that I have, and my best guess about which answer will turn out to be correct for each question

List D: Predictions about what information I will find

List E: Problems that I have had inquiring, and ideas about possible solutions to each problem

List F: Assumptions that underlie the following: my questions, my ideas about possible answers, my predictions about what information I will find, and my ideas about possible solutions to problems

List G: Incorrect ideas, incorrect predictions, mistaken assumptions, breakthroughs, realizations, insights, new perspectives, and new appreciations

## **Inquiry Journal entries (~20% of course grade)**

The Inquiry Journal is for you to practice *using writing to think* and for *making visible such thinking*. So, the Inquiry Journal is for reflection; it is *\*not\** for plopping down information. (Obviously, though, to communicate your thinking, you may need to present some information about the object of your thought, such as information that is needed to understand what you are working to figure out.)

Some ways to use your Inquiry Journal:

- Identify/generate and put into words things that you do not understand that you would like to understand
- Come up with questions and ideas about possible answers about what you do not understand
- Consider implications of your ideas being correct and implications of them being incorrect
- Identify assumptions that form bases for your questions and ideas
- Generate more-and-more-specific questions and ideas that help you work to develop hypotheses (or Yes/No questions)
- Consider what information would allow you to decide whether or not a hypothesis is correct
- Predict what information you might actually find, and consider reasons for your predictions
- Consider possible ways to find desired information
- Identify and frame problems that you are having inquiring, including problems finding desired information
- Reflect on how your work is going
  - What is interesting to you?
  - What is challenging about what you are doing (and/or what is challenging about what you *think* that you *should* be doing)?
  - How well is your inquiring moving along?
  - Stepping back a bit... What is your path of inquiry for the whole semester looking like?
- Assess your work

Each Inquiry Journal entry should also include at least a bit of information about how, when, and for how long you worked outside of class for this course since turning in your prior Inquiry Journal entry. Provide that information in the heading of each Inquiry Journal entry.

Suggested header for each Inquiry Journal entry:

**Name:**

**Journal #:** (The schedule indicates when each entry is due.)

**Date:** (The date that you are turning in this entry)

**Time:** (Periods of time, from when till when on which days, spent doing what?)

Notes about the Inquiry Journal:

Except for the week of Thanksgiving, an entry of the Inquiry Journal will be due *each* Thursday throughout the semester (even on those Thursdays when you have other writing assignments due).

There is no specific format for the body of each Inquiry Journal entry.

The average length of Inquiry Journal entries should be 500-1000 words, and entries should be printed single-spaced.

I expect for you to work on this course outside of class a) at least **1.5 hours between each class meeting** and b) **at least 4.5 hours total each week** (since the previous Thursday's class meeting).

### **Instructor Contact Information:**

Instructor: Professor Alan Bender

Office: Morrison Hall room 211 (Meetings by appointment)

adbender@indiana.edu

Mail box: Jordan Hall room 142

## Schedule

			<u>Inquiry Journal</u> <u>entry #</u>		
1.	Tues.	Sept. 1	---		
2.	Thurs.	Sept. 3	Consider possible areas of cancer research	1	
3.	Tues.	Sept. 8	“		<b>Lists v.1</b>
4.	Thurs.	Sept. 10	Consider possible primary articles to read parts of	2	
5.	Tues.	Sept. 15	Choose an article and work on the Experiment Paper		
6.	Thurs.	Sept. 17	“	3	
7.	Tues.	Sept. 22	<b>Experiment Paper</b>		
8.	Thurs.	Sept. 24	<b>Revised Experiment Paper</b>	4	
9.	Tues.	Sept. 29	<b>Letter 1</b>		
10.	Thurs.	Oct. 1	<b>Revised Letter 1</b>	5	
11.	Tues.	Oct. 6	Inquire		<b>Lists v.2</b>
12.	Thurs.	Oct. 8	Inquire	6	
13.	Tues.	Oct. 13	<b>Letter 2</b>		
14.	Thurs.	Oct. 15	<b>Revised Letter 2</b>	7	
15.	Tues.	Oct. 20	Inquire		
16.	Thurs.	Oct. 22	No Class (because I'll be at a conference)	8	
17.	Tues.	Oct. 27	<b>Letter 3</b>		
18.	Thurs.	Oct. 29	<b>Revised Letter 3</b>	9	
19.	Tues.	Nov. 3	<b>Breakthrough Paper</b>		
20.	Thurs.	Nov. 5	<b>Revised Breakthrough Paper</b>	10	<b>Lists v.3</b>
21.	Tues.	Nov. 10	Inquire		
22.	Thurs.	Nov. 12	Inquire	11	
23.	Tues.	Nov. 17	<b>Letter 4</b>		
24.	Thurs.	Nov. 19	<b>Revised Letter 4</b>	12	
25.	Tues.	Nov. 24	Thanksgiving break		
26.	Thurs.	Nov. 26	Thanksgiving break		
27.	Tues.	Dec. 1	Inquire		
28.	Thurs.	Dec. 3	Inquire	13	
29.	Tues.	Dec. 8	<b>Letter 5</b>		
30.	Thurs.	Dec. 10	<b>Re-revised Breakthrough Paper</b>	14	<b>Lists v.4</b>

Note: **Bold** = Documents to turn in