**How to Complete Technical Paper Evaluations**

**A. For Scientific Research Papers**

After reading an assigned **scientific research paper** in this course, please submit a technical paper evaluation of the paper.

Please answer the following questions:

1. *What question(s) is being asked? Are there other hypotheses that could explain the same phenomena?*
2. *What methods were used to answer the main questions? Can you think of better ways to answer the same questions? (Be realistic when you think about that – researchers have limited supplies of time and money.)*
3. *Does the interpretation of the data seem fair and accurate?*
4. *Are the conclusions justified by the data? Were the original questions answered?*
5. *What are the implications of the results for general issues in this field?*
6. *Are there further studies suggested by this work that might help to clarify things?*

Your evaluation must be **at least** two plus pages in length (**single-spaced**, 12 pt. font). A three-page submission is preferred.

Please copy the questions (with numbers) into your submission and answer the questions in the order shown above. You can add one line of space between questions.

Please do not forget to put your name on each evaluation submitted.

**B. For Technical Review Papers**

After reading an assigned **review paper** in this course, please summarize current knowledge on a specific topic.

As you read and familiarize yourself with the review article, please answer the following questions:

1. *What is the significance of this research topic?*
2. *Who is working in this area?*
3. *What methods are used to study the concepts described in the paper?*
4. *Does the review article lead to new questions or hypotheses in this technical area (by the authors, by other researchers)?*
5. *What are some practical applications of the research discussed in the article?*
6. *How does this topic relate to other areas of cell biology, bioengineering, or medicine?*

Your evaluation must be **at least** two plus pages in length (**single-spaced**, 12 pt. font). A three-page submission is preferred.

Please copy the questions (with numbers) into your submission and answer the questions in the order shown above. You can add one line of space between questions.

Please do not forget to put your name on each evaluation submitted.

**How to Read Scientific Papers**

You will be required to read several research papers this semester and evaluate what you have read. This is an important skill for you to develop as a professional engineer or scientist.

You should learn how scientific information is generated and improve your ability to critically evaluate scientific evidence. Critical evaluation does not necessarily mean a negative evaluation; rather, it should be one that recognizes both the strengths and weaknesses of the paper. Always keep in mind that the papers you read are written by normal people who don’t have all of the answers or all of the time and money needed to discover them; and they are not perfect. Often the work is performed based on the background of the authors and the equipment and facilities that are available to them.

Scientific papers are usually written in a fairly standard format and style. They are often written in a consistent format and concise style makes it easy for experienced readers to quickly locate information they are interested in.

**Scientific papers typically contain ~5 sections:**

**Abstract**: This section provides a brief summary of the material in the paper: the questions, general approach used, results, interpretation, and conclusions.

**Introduction**: Describes the general subject, reviews past work, and introduces the present study. It provides context for the questions asked in the study.

**Methods (procedure)**: Describes the study system (organisms, locations, time period) and techniques used (observational and/or experimental design and statistical tests). This section explains how the author(s) tried to answer their questions.

**Results and Discussion**: Presents results (data), describing them in prose and, normally, also in figures and tables. Interprets the results and relates them to previous work and relevant theory. Should provide answers to the original questions raised by the author(s) in the introduction. Should explain how the research described has advanced our understanding of the subject.

**Conclusions**: a summary of the paper in one to two paragraphs.

The main sections of a paper answer: Why, How, What, and Who Cares? The **Abstract** lets you decide quickly whether you even want to read the paper at all. You will encounter stylistic variations among journals on the standard format outlined above, but all of the information will still be there, though the level of detail does vary.

**How to get the most out of the papers:**

1. Read each paper at least twice. Initially, read it quickly to get a general understanding of the question, methods, results, and supposed significance of the paper. Your second (and subsequent) reading(s) should be from a critical and skeptical perspective. For me, it often takes 3 or more readings to completely understand everything in a paper. I try to read the paper at different times and days to help me put everything in perspective. I always look up one or two papers that are referenced at the end of the paper to see what were the building blocks for this current work.

2. Read the sections of a paper in whichever order works best for you. You don’t have to start at the beginning and read to the end. Some people like to read the abstract and then the discussion to see where the argument is headed. Others like to look and the data first – the graphs and tables – to get a feeling for the results, which then helps them, comprehend the story in the text. Try different approaches and find out what works best for you. I often read the abstract, the conclusions and then I dig into the data presented.

3. Pay special attention to the data, especially the tables and graphs. The data are the backbone of the paper and you need to understand them. Compare your impression of them with the author’s interpretation of them. Do you agree?

4. Make comments. Highlight or underline the parts that you think are important. Write notes in the margin. Use a question mark to note things that you don’t understand or disagree with.

5. As you read the paper, think critically. What assumptions does the author make? Are they valid? Can the techniques used really answer the questions the author poses? Are the arguments logical? Are possible alternatives considered?

6. Don’t get bogged down. A scientific paper should tell a story and the plot is more important than the details. Skip difficult parts to avoid loosing the story line. Come back to them later and see if you can reason them out, and if you can’t, ask about them during seminar – other students are probably confused, too. There are many scientific papers that are just written poorly. If you get hung up, realize it may not be you. Most scientists do not take advanced courses in writing.

7. For the purposes of this class, assume that any statistical analyses were appropriate and performed correctly. (I don’t want you to waste time worrying about the stats.)