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Teaching Report Writing in Undergraduate Labs

Dr. Amber Genau, University of Alabama at Birmingham

Dr. Amber Genau is an associate professor in the Materials Science and Engineering Department at the University of Alabama at Birmingham. She received her B.S. and M.S. from Iowa State University and Ph.D. from Northwestern University, all in materials engineering. Before coming to UAB, Dr. Genau spent two years as a guest scientist at the German Aerospace Center in Cologne, Germany, working on metal solidification and microstructural characterization. She is particularly interested in broadening participation in engineering and providing international experiences and perspectives to undergraduate students.

Teaching Report Writing in Undergraduate Labs

Abstract

For undergraduate engineering students in lower level laboratory classes, writing up the results from their lab activities is often far more of a challenge than performing the activity itself or even analyzing the results. The instructor's challenge is therefore not just to teach concepts like tensile testing or cooling curve analysis, but also to teach technical communication and the accepted reporting standards and vocabulary of the field. Over the last decade, the author has repeatedly taught an Introduction to Engineering Materials course for materials majors, which is typically taken by students in the spring of their sophomore year, and is the first course where students are expected to write full technical lab reports. This paper will discuss the steps that the author has taken to scaffold the experience of report writing for students, including the creation of a 4-page department-wide technical writing guide. Other steps including assigning students to read and answer questions about a short technical journal article, requiring peer review of classmates' reports, and multiple graded and ungraded mandatory submission steps for each report. These activities have resulted in significant improvement in students' lab report writing ability as observed in subsequent lab courses.

Motivation

As a faculty member in the Materials Science and Engineering Department at the University of Alabama at Birmingham, over the past ten years I have been responsible for teaching MSE 281 (Physical Materials I) nine times. Although this is the second required materials course in the undergraduate curriculum, it is the first taken solely by materials majors, and the first with a laboratory component. The course is taken primarily by students during spring semester of their sophomore year, but a smaller section is also taught during summer semester. During this time period, I taught primarily the spring version (20-30 students each class) but also the summer version twice (5-10 students per class). It is a four credit class, with two 75 minute lecture periods and one three hour lab period each week. During the 14-week semester, eight of the lab periods are devoted to four major lab activities, with the remaining weeks being devoted to related activities which do not require a lab report (lab safety, crystallography, CES Edupack, etc.) The lab activities are fairly standard for an introductory materials course, and include Charpy testing, tensile testing, Jominy testing and mapping cooling curves to a eutectic phase diagram. The first three use some of the same materials (1018, 1045 and 1095 steel, for example) and all topics are well connected to the material covered during lecture. The textbook for the course is *The Science and Engineering of Materials* by D. Askeland and W. Wright.

When I first began teaching MSE 281, I quickly learned that writing these lab reports represents an enormous challenge for the students. Many have no experience with lab reports beyond the minimal, highly scripted reports required for freshman chemistry. Although all students in this class have taken two freshman composition courses, most do not see the connection between the content learned there and writing in a technical context, and many have difficulties with basic grammar and punctuation. Moreover, only students in our university's Science and Technology Honors Program are currently allowed to meet one of the freshman comp requirements with a technical writing course, so most students entering this class are entirely unfamiliar with the style and tone of formal, scientific writing (for example, writing in the third person). They are also mostly unaware of how to caption figures and tables and how to cite figures in the text. Understanding which pieces of information go into which section is also particularly challenging.

Initially, when grading student lab reports, I relied on extensive written feedback and requiring students to revise and resubmit their work until it reached an acceptable level. This was possible because of the relatively small size of my classes, but still took enormous amounts of time and often required meeting individually with students. Over the years, I have developed a number of tools to help familiarize students with technical writing, make my expectations clear, scaffold their initial attempts, and provide feedback to each other. This has significantly reduced the workload on me, because the initial lab reports that I am grading are much better. In nearly all cases, I still require students to revise and resubmit their reports to ensure they read and understand the feedback I give them. These revisions are required but not graded. I remind students of the bold-faced statement in the syllabus, "All labs must be completed and ***passing reports handed in*** to receive a passing grade in MSE 281." The lab for this class does not receive a separate grade on students' transcripts, but rather accounts for 25-30% of their course grade.

The remainder of this paper outlines the current versions of the activities that I use to support student writing in MSE 281. All of the full documents are included at the end as appendices.

Initial Exposure to Technical Writing

Just before students begin working on their first lab report, I assign them a technical journal article to read [1] and a set of questions about the article to answer. The article is short (3.5 pages including many graphs) and related to a topic that we are currently covering in lecture (solid state diffusion). The article I use was found with help from my university's engineering librarian. The students must answer questions related to both the content of the article (e.g. What is the diffusivity of copper when the carbon content is 0.6% and the temperature is 1213K?) and the formatting of the article (e.g. Find and copy down the sentence from the paper where Figure 1 is mentioned and explained to the reader (not the caption itself).). My framing of the questions on the assignment include a lot of exposition (e.g. The paragraph at the beginning between the horizontal lines is called the abstract and is a summary of the paper. […] According to the abstract, what are the two important findings of this paper?) A copy of this assignment is included in Appendix 1. After grading and returning this assignment, I go over the correct answers in detail during class.

Interactive Lecture on Lab Report Expectations

The first major lab of the semester is Charpy impact testing. This activity is spread out over two weeks, with the first devoted to breaking samples in the lab and recording data, and the second split between analyzing and imaging the fracture surfaces, an in-depth explanation of what my expectations are for lab reports generally, and time where the students sit with the collected data on their laptops as I walk them through how to graph the data and what the correct conclusions are that they should be drawing from the data. I also provide screen capture videos in Canvas showing students step-by-step how to create the Excel graphs, as this is a point of major frustration for many of them. During this time together in lab, I am very explicit with the students about what the five parameters are that they tested, what the conclusions are that they should be drawing, how these conclusions relate to the concepts about crystal structure and defects that they have been learning in class, as well as what the sources of error are. I discovered that expecting the students to both interpret the data and write about it correctly for the first report it too much, so I tell them exactly what they should be writing and what section of the report it belongs in.

I spend about an hour during the second week of this lab activity going through a series of Powerpoint slides that explain my expectations for lab reports. These slides are available to the students via the Canvas course page. The slides cover goals in technical report writing, sections of a technical report, what type of information belongs in each section, what constitutes a figure or table, how to format and caption these correctly, how to refer to figures or tables in the text, and how to handle references. I provide a list of common errors and provide real examples from past student reports, asking students to identify the problem in a statement like "In Charpy testing, temperatures above T_g tend to be stronger." I also show examples of poorly formatted graphs and tables from the Charpy labs of previous students, followed by examples of better ones.

Detailed and Consistent Report Guidelines

After the Powerpoint presentation, I pass out copies of what used to be called "Dr. Genau's Guidelines for Writing a Good Lab Report" but is now called the "MSE Technical Writing Guide." Several years ago, the faculty in my department decided to standardize our expectations for lab reports and adopted a slightly modified version of the do's and don'ts list I had developed for MSE 281. It is now distributed in all of the department's lab classes, so I no longer have junior and senior students coming into my office asking, "Hey, can I get a copy of that handout about report writing that you gave us back in 281?" The current version of these guidelines are included as Appendix 2 and cover lab report sections (both content and formatting), rules for figures and tables, considerations for including statistics, language (grammar) issues, and general formatting. With my MSE 281 students, I walk through this list point by point, providing commentary for any points that are not self-evident. Whatever mistakes my students make on their report, I don't want any to be because I didn't tell them otherwise.

Content Scaffolding within Lab Handout

For each lab, the students receive a printed handout, explaining the principles being tested and the steps of the activity. The handout also includes a section specifying exactly what is expected for each section of the report. For the Charpy lab, for example, part of this section reads

The "Introduction" section should include:

- *Description of impact testing, in general, and its usefulness*
- *Specific description of how Charpy testing works*
- *Advantages and disadvantages of Charpy testing as a method to investigate the properties of a material*

- *Description of what questions this work intended to answer*

Under "Results" the students are told exactly which plots to include and which data to put in each plot. As the semester progresses, this section of the lab handout becomes less detailed, as students learn to make decisions on their own about how best to present and interpret data. The complete handout for the Charpy lab is included as Appendix 3.

Peer Review and Revision

After the second lab session related to Charpy testing, students have one week to complete and submit their report via Canvas. The detailed explanation of the peer review process as it is provided to students is included as Appendix 4. The students are graded on the quality of the reviews that they provide to their classmates, not how highly their own report is rated by others. The composite grade for each lab is based on three things: the student's initial submission (10%), the quality of their peer review (20%) and the quality of the report after it has been revised based on peer feedback (70%). The initial submission score is based only on whether or not the student has submitted a complete report with all of the necessary sections and graphs. To receive full credit on the peer reviews, a student must complete all sections of a rubric on Canvas, provide both positive and negative/constructive feedback in the Canvas comments section, and make a certain number on annotations directly on the report (useful for pointing out typos). By creating rubrics for initial submission and peer review process, it not only makes my expectations clear to students, but allows a TA to grade these activities.

The process of peer review provides each student with feedback from three classmates, which they can use to improve their report before resubmitting it for evaluation by the instructor. In addition, it also lets them see (anonymously) three other people's reports, and what those students did well or poorly and gives them practice in critically evaluating the quality of a piece of writing. Students are given about a week and a half to provide the peer reviews and then revise their reports. I then read each report carefully and provide detailed feedback in the form of comments and annotations. Unless an initial report is truly outstanding, I require all students to revise and resubmit their reports for a third time to make sure they are reading and incorporating my changes. Students know they will receive an incomplete in the course unless they complete the submission process for all four labs.

Helping Students Understand Relevance

By about the third lab report, many students are audibly wondering why I didn't become an English professor instead of an engineering professor, because I'm so picky about their writing. In an attempt to help students understand the importance of being able to express their ideas clearly and correctly in writing, I created a short Canvas assignment called "Why I'm Such a Stickler about Lab Reports and Writing." The assignment links to a copy of a 1.5 page article entitled "I Won't Hire People Who Use Poor Grammar. Here's Why." by Kyle Wiens [2]. The author explains that anyone who can't be bothered to learn and/or use correct grammar by the time they're applying for a job in his company is unlikely to pay attention to other details either, and therefore he doesn't want them as employees, even though he predominately hires computer programmers who won't do much writing as part of their job. The students must provide an answer to the prompt, "Sum up in one sentence why the author of this article thinks grammar is so important," before Canvas will unlock the link for them to submit the first draft of their fourth and final lab report.

Summary and Reflections

Even with the best tools, teaching writing is a time consuming task, but a necessary one for engineers in the 21st century. Although my department has done no formal assessment of the gains made by students with the instructional materials described here, the faculty who teach upper level lab courses have been vocal in confirming the consistent difference they see in the technical writing abilities of students who have taken MSE 281 with me. These activities and the subsequent adoption of the department-wide lab reporting guidelines were highlighted in the report for our recent successful ABET reaccreditation, which highlights "an ability to communicate effectively" as one of the seven student outcomes outlined in Criterion 3. It would be beneficial to shift some of these activities, like the assignment which has students read and answer questions about a journal article, to an actual technical writing class, so that more time could be devoted to materials science content in the Introduction to Materials Science class. Efforts are underway at UAB to make such a class available for non-honors students, either through the English department or the School of Engineering.

References

1. E.M.A. Rassoul, *Effect of carbon on the diffusion of copper in different carbon-steels*, J Mat Sci **32** (1997) 6471-6474.
2. K. Wiens, *I Won't Hire People Who Use Poor Grammar. Here's Why.* Harvard Business Review, July 20, 2012. https://hbr.org/2012/07/i-wont-hire-people-who-use-poo

Appendix 1: Journal Article Questions

Analysis of a formal technical report

Due in lab on Friday

This paper has a similar layout and style as the lab reports that I will ask you to write for MSE 281. The topic is directly related to the material that we will be covering in Chapter 5. Read the paper carefully and answer the questions below.

1. The paragraph at the beginning between the horizontal lines is called the abstract and is a summary of the paper. It starts with a general statement about the importance of the topic being studied. Then it describes what experiments were done, giving increasing levels of detail. The final sentences summarize the most important results that were found. According to the abstract, what are the two important findings in this paper?

2. What are the six major sections of this paper (including the abstract)? Each report that you write for MSE 281 will also have these same sections, although <u>for this class the results and discussion section must be separated</u>.

3. In the Introduction section, the authors start by explaining some history related to the research that they did. They end the introduction by explaining what specific piece of information they are adding to the historical body of knowledge with this paper. Pay particular attention to how they cite work by other authors. You will use the same convention of putting citation numbers in square brackets. For the cited paper written by Anand and Agarwala, list the full name of the journal, the volume of the journal in which the article was published, the year of publication, and the page on which the article began.

4. The Experimental Procedures section gives enough information that the experiment could be repeated by someone else. In 3 sentences, sum up as well as you can the experimental procedure used by the authors. <u>Do not copy word for word from the paper.</u>

5. The Experimental Procedures section contains a diagram of the experimental apparatus. Any figure or table that you include in a report must be mentioned in the text. Find and copy down the sentence from the paper where Figure 1 is mentioned and explained to the reader (not the caption itself).

6. In the Results section, find and copy down the sentence where Figure 2 is mentioned and explained to the reader.

7. The Results section mentions two important diffusion equations (the first is Fick's second law, not the kinetic equation). Find each of these equations in Ch. 5 of your textbook and copy down the equations as written in your textbook, including the equation number (Eq 5-?) and the definition of each variable. Also write out the other Arrhenius type equation that we have discussed in MSE 281 so far.

8. Look at the figures and the tables in the paper. Notice that each one has a label (Figure 1, Figure 2, Table 1, etc.) and a caption which describes the figure or table. The figures and tables are labeled in the order in which they are mentioned in the text. Where are the labels and captions positioned with respect to the figures? Where are the labels and captions for the tables positioned?

9. What is the diffusivity of copper when the carbon content is 0.6% and the temperature is 1213 K? Be sure your answer includes units. If this were a plain carbon steel, what would the 4-number designation be?

10. Looking only at Figure 9, what conclusion can you draw about the effect of carbon content in steel on the diffusivity of copper? What about the effect of carbon content on activation energy?

11. The conclusions section summarizes the most important conclusions of the paper. What do the authors say about the relative effects of temperature vs. carbon concentration on the diffusion of copper?

12. This paper was published in 1997. Based on the dates of the papers cited in the References section, would you say that at that time, this was a very active area of scientific investigation or not?

Appendix 2: Materials Departmental Reporting Standards

MSE Department Technical Writing Guide

Lab Report Sections

- **Title**: should be descriptive and not include the word "Lab" or "Laboratory"

- **Abstract**: must contain an explicit statement of what was done and a summary of the most important results.
  - Single paragraph
  - Max 150 words
  - No citations

- **Introduction:** gives necessary background to explain work
  - Avoid statements like "The purpose of this lab was…" You've moved past that kind of lab report. Do not talk about "the lab."
  - Begin section with general information about the topic and get more specific towards the end.

- **Procedure:** explain what was done to the samples and how the data was collected
  - Always completely in past tense.
  - Avoid the word "should." Talk about what was done, not what should be done.
  - Don't describe specifics of how to run the equipment, i.e. "Then the green button was pushed."
  - No bulleted or numbered lists; keep information in paragraphs or table form

- **Results:** reporting of what you found
  - Must contain sentences in paragraphs describing the results; cannot just be figures and tables.
  - Every single figure and table must be referred to and described in the text.
    - "The hardness was shown to decrease with distance (see Figure 1)."
    - "The hardness, as shown in Figure 1, was found to be…"
  - Present the table or figure first. Then describe the important features.
    - "The average hardness values for all samples are graphed in Fig. 2. Steels with higher carbon content have higher hardness values at all depths."

- **Discussion:** why the results came out as they did and their significance.
  - Give scientific explanations of results
    - Example: If results show that adding carbon makes steel more brittle, explain how strain on the lattice from the interstitial atoms blocks dislocation movement.
  - Describe sources of error (do results support theory? if not, why not?)
  - Explain significance of results (design implications)

- **Conclusion:** summarize both what was done and the main results
    - Similar to abstract
    - No citations
    - This section is the Conclusion, not "Conclusions."

- **References:** not to be labeled 'Works Cited' or 'Bibliography'
    - Numbered list with references in the same order they are referenced in the report
        - Only list references which are actually cited in text.
    - Follow CSE scientific citation style
        - Helpful citation website: http://writing.wisc.edu/Handbook/DocCSE_CitationSystems.html
    - Only specific facts or the work of specific researchers need to be cited in the text.
        - *"Impact tests are used to evaluate the performance of a material under different loading conditions."* No citation necessary.
        - *"The sample must be placed in the machine no more than five seconds after being removed from the temperature source [1]."*
            - ✓ Cite references using square brackets inside punctuation marks.
    - It is almost never appropriate to quote a source word-for-word in scientific writing. Paraphrase and cite the source of the information if necessary.

Figures and Tables

- Every figure and table must have a label and a **separate** caption that describes it.
    - Correct: *Table 1. Average hardness values for all metallic materials*.
    - Incorrect: *Table 1 is a graph of the average hardness values.*
- Captions should give enough information to stand alone in describing the figure or table.
- Figure captions should not simply repeat the axes of a graph.
    - Poor caption: *Graph of impact energy versus temperature for steel.*
    - Better: *Effect of carbon content on the impact energy of plain carbon steel.*
- Figure captions go below the figure. Table captions go above the table.
- Figures need to be labeled in the order in which you reference them in the text.
- The words *table* and *figure* are capitalized when referring to specific tables or figures.
    - *"The data is displayed in **F**igure 2."*

- Graphs and pictures are types of figures. Label them as figures.
- Crop photos and micrographs to remove empty space around the edges.
- Include a scale bar in any pictures of samples.
- Hold down the shift key while resizing images in Word to lock the aspect ratio (and keep the figure from getting distorted).

- Select reasonable, round numbers for scale bars and graph axes.
- Pay attention to significant figures in tables and along graph axes.
- No boxes around figures. *(In Excel: "Format Chart Area…" -> Border -> No Line)*
- Choose the appropriate type of graph for the data set.
- No Excel titles on graphs. That's what the caption is for.
- Axes usually should not run through the center of a graph.

- Each axis needs a label including units
- Include legend only when graphing more than one set of data.

- Format tables so data can be easily compared. Don't have tables spread across two or more pages.
- Put units in the header of each table column.
- Units should be consistent and abbreviated correctly.
  - mPa and MPa are different
  - second is *s* not *sec*, hour is *h* not *hr*, etc. (lists of unit abbrev can be found online)

Statistics

- For each data point, report the number of measurements made or samples tested (n), even if n is only 1.
- If n is small, report (via table or graph) each individual data point.
- If n is large, report at least the average (mean) value and standard deviation.
- Use error bars to include standard deviation on graphs. Always specify in the caption what the error bars represent (standard deviation, confidence interval, etc.)

Language Issues

- Text of lab report must use complete sentences in complete paragraphs.
  - Sentences need subjects and verbs and agreement between them. Be especially careful of singular/plural agreement between nouns, verbs and pronouns.
  - One or two sentences do not constitute a paragraph. Group sentences by topic.
  - Include paragraph breaks in any section longer than 5 or 6 lines.
  - Numbers that begin sentences must be written out as words.
  - Semicolons are used to separate two complete but related sentences.
  - Rule of thumb for colons: use only after nouns, not verbs.
    - Incorrect: *"The types of steel tested were: 1018, 1045, and 1095."*
    - Correct: *"Three plain-carbon steels were chosen for the experiment: 1018, 1045, and 1095."*
    - If you cannot replace a colon with a period and have a complete sentence, you are using the colon incorrectly.

- Statements of what you did or found must be in past tense. General statements about the way things are should be in present tense.
  - "*Type K thermocouples are made from chromel and alumel."*
  - *"Type K thermocouples were used to obtain a cooling curve for each sample."*
- Do not float between verb tenses (past, present, future, conditional). When in doubt, stick with past tense.
- No personal pronouns (me, I, you, we, our).
- No contractions. This is formal writing.
- Avoid informal words and phrases (i.e. kind of strong, really huge, seems like, great technique).

- Capitalization
    - Names of tests and equipment are not capitalized unless they are brand names or named after people (Charpy test vs. tensile test vs. Instron tester).
    - Anything abbreviated with capital letters is not capitalized when written out
        - ductile to brittle transition temp vs. DBTT
        - Elements: cadmium vs. Cd
- Always write out the full term before using an abbreviation for the first time.
    - *"The polystyrene (PS) was tested in the differential scanning calorimeter (DSC)."*
    - Note that even though the letters of the abbreviation are capitalized, the written-out words are not.
- *Affect* is a verb. *Effect* is a noun.
    - *"Cooling rate affects hardness. The effect of cooling rate is significant."* (There are exceptions to this, but none that will likely affect your lab reports.)
- Avoid judgmental words like best/worst when referring to material properties unless it is in regard to suitability for a specific application.

Formatting

- Font type and size should be uniform throughout report.
- One line of white space between paragraphs.
- Center title.
- Left justify section headings.
- No section requires its own page.

Appendix 3: Charpy Lab Handout with Report Guidelines

Charpy Impact Testing
MSE 281 Lab

Before Lab

1. Read lab handout carefully and completely.
2. Find and download the PDF version of ASTM E23, the standard that describes impact testing. ASTM standards are available on the UAB campus through our library's subscription to the digital database ***ASTM Compass***. (Note: This document is 26 pages long including appendices. You are not expected to read the entire thing in detail. Practice skimming, watching out for things that look most important. Some of those important things will appear on the quiz.)
3. Read Sections 6-9 and 6-10 in the textbook.
4. Complete online pre-lab quiz.

Goals of this Lab

1. Study the behavior of metallic materials under impact loading conditions, including the effect of temperature on impact energy and failure mode.
2. Use impact energy measurements to determine:
   a. the ductile to brittle transition temperature (DBTT) for three plain carbon steels, AISI/SAE 1018, 1045, and 1095;
   b. the role of (i) steel heat treat condition and (ii) carbon content on impact energy for plain carbon steels;
   c. the presence or absence of a DBTT in FCC metals aluminum alloy 6061-T651 and 304 stainless steel
3. Examine fractured specimens to compare surface characteristics for ductile and brittle failure modes.

Procedure

Materials (see alloy composition table on last page)

1. AISI/SAE 1018, 1045, and 1095 in the normalized condition
2. AISI/SAE 1018 and 1045 in a cold-finished condition
3. AISI/SAE 1095 in a spheroidized condition
4. 304 stainless steel
5. AA 6061-T651

Steel Normalization (General Procedure)

1. Normalize 1018 at 915°C, 1045 and 1095 at 860°C (done together) in a stainless steel bag.
2. Place samples into the furnace and allow the furnace to return to temperature.
3. Hold for one hour.
4. Remove from the furnace and allow to air cool.

Charpy Testing (General Procedure)

1. Reset the measuring arm using the dial on the front face by turning counterclockwise.
2. Quickly place a Charpy bar of the desired temperature in the holding apparatus so that the notched side faces away from the impact point.
3. Release the pendulum by pressing the green “go” button.
4. Record the energy necessary to break the bar from the energy indicator using the 150 kJ scale. If the sample jams in the holder, no value can be recorded.

Testing of Samples

1. Bring one Charpy bar of each metal alloy type to the desired temperatures
   a. 250°C (oven)
   b. 100°C (boiling water)
   c. 22°C (room temperature)
   d. 0°C (ice water)
   e. -196°C (liquid nitrogen)
2. Test per the procedure above.
3. Retrieve the Charpy bar pieces and, once the samples have returned to a moderate temperature, label with composition and testing temperature.

Further Analysis of Samples and Fracture Surfaces

1. Inspect the fracture surface under the stereomicroscope. Make note of the appearance of the fracture surface and the amount of deformation (if any) adjacent to the fracture surface.
2. Record macrophotographs of both the fracture surfaces and one of the sides perpendicular to the fracture surfaces.
3. Any additional pictures taken with a digital camera should include a ruler in the photo to indicate scale.

Report

The “Introduction” section should include:

- Description of impact testing, in general, and its usefulness
- Specific description of how Charpy testing works
- Advantages and disadvantages of Charpy testing as a method to investigate the properties of a material
- Description of what questions this work intended to answer

The “Results” section should include the following tables and figures:

- A table summarizing the impact energies of all tested materials and the estimated DBTT for each material, if applicable.
- A table with descriptions of the fracture surfaces.
- A plot of absorbed energy as a function of temperature for each of the normalized steels (1018, 1045, and 1095), with the experimentally determined DBTT for each alloy indicated on the graph.
- A plot of absorbed energy as a function of temperature for the normalized and cold-rolled steels AISI/SAE 1045, with the experimentally determined DBTT for each condition indicated on the graph.

- A plot of absorbed energy as a function of temperature for AA 6061-T651 and 304 stainless steel.
- Appropriate statistics for any data set with more than one sample tested per temperature.
- Representative stereo images of the fracture surfaces.

The “Discussion” section should address the following areas from your data:

- Correlation between fracture surface (ductile, brittle, or mixed) and impact energy.
- Role of carbon content and heat treatment on behavior of steels. Include the scientific explanations for observed trends.
- Any unusual or unexpected data points or trends. What are the potential sources of error?
- Ways in which test did or did not conform to ASTM standard.
- Comparison of the impact energies of steels and aluminum for engineering applications at various temperatures. How would impact behavior affect the selection of various materials for use in cryogenic applications?

The “References” section must include (1) the applicable ASTM standard, (2) an appropriate ASM Handbook, and (3) at least one additional reference. All references must be cited somewhere in your report.

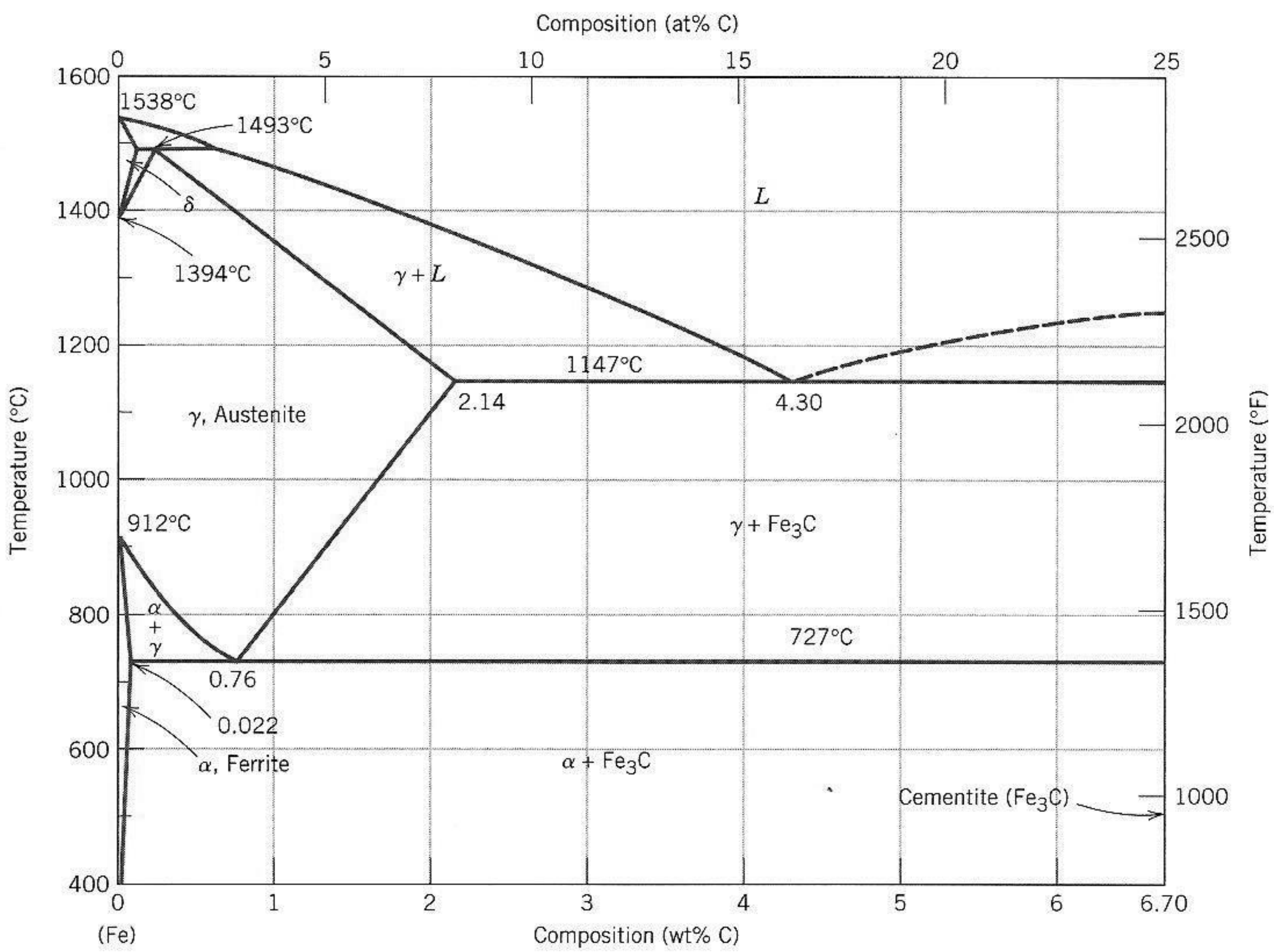
Helpful Reference Materials

1. Your textbook, particularly Sections 6-9, 6-10, and 7-2.
2. ASM Handbooks: Available online from on-campus locations only at http://www.mhsl.uab.edu/2009/databases/K/ Click on Knovel, then search for ASM Handbook
    a. Mechanical Testing and Evaluation, Volume 8, ASM International. (Note: to search directly for this volume, type in ASM Handbook “Volume 08”)
    b. Properties and Selection: Irons, Steels, and High-Performance Alloys, ASM Handbook, Volume 1, ASM International.
3. Standard Test Methods for Notched Bar Impact Testing of Metallic Materials, E 23-07, 2007 Annual Book of ASTM Standards, American Society for Testing and Materials.
4. Structure and Properties of Engineering Alloys, Second Edition, William F. Smith, McGraw-Hill, 1993. (MSE 464 Metals and Alloys Textbook)
5. Gannon, Robert. “What Really Sank the Titanic?” Popular Science 246, no. 2 (February 1995): pp 49-55.

<u>Alloy Compositions</u> (weight %)

	Alloy	Remainder	C	Mn	P (max)	S (max)	Cr	Ni
Low carbon (mild) steel	1018	Fe	0.15/0.20	0.60/0.90	0.04	0.05		
Medium carbon steel	1045	Fe	0.43/0.50	0.60/0.90	0.04	0.05		
High carbon steel	1095	Fe	0.90/1.03	0.30/0.50	0.04	0.05		
Stainless steel	304	Fe	max 0.08	max 2.0	0.045	0.03	18.0/20.0	8.0/10.5
			Mg	**Si**	**Cu**	**Cr**	**Fe**	**Zn**
Precipitation hardened aluminum	6061-T651	Al	0.8/1.2	0.4/0.8	0.15/0.4	0.04/0.35	max 0.7	max 0.25

*T651 Heat treatment = Solution heat treated, stress-relieved by stretching, and artificially aged



Appendix 4: Peer Review Process and Rubrics

MSE 281 Lab Report Submission and Grading

You are required to submit each lab report for this class *at least* twice. The first submission will be used for peer review. Once you have submitted your report, Canvas will assign you three classmates' reports for peer review. Your classmates will be able to use your feedback to improve their report before resubmitting it to the instructor for grading. Your grade for each lab report is based on your first submission (5 pts), your peer review (10 pts) and your second submission (35 pts).

Grading of Lab Report Submitted for Peer Review

Peer review doesn't work well if you don't submit a finished version of the report for review. Therefore, the grade for it is based entirely on whether or not you submit a finished report. A maximum of 5 points are possible for this submission. If you do not submit your report before the deadline, you will not be able to complete the peer reviews, meaning you automatically lose 30% of the possible points for the lab.

	5	3	1	0
First Lab Submission	Full report submitted, including all required figures and tables, with captions and appropriate text	All report sections present, but missing a required component such as a figure, table, references, captions, OR text in any section is significantly too short	One or more sections missing or contain no text	No report submitted

Completing a Peer Review

There are three components to completing a successful peer review. Your comments and scores *will not* affect the grade received by your classmate. Although these peer reviews are anonymous, you should still keep your feedback civil and constructive.

1. Rubric

Consider the following questions and use the rubric provided by Canvas to answer them. Remember, the scores you give will not affect the person's grade.

- **How many formatting errors did you notice in this report?** Scale (1-3)
- **How many typos were in this report?** Scale (1-3)

- **How is the writing in this report? Consider sentence structure, grammar, word choice, etc.** Scale (1-5)
- **Did this report accurately convey what was done during the experiment?** Scale (1-5)
- **Were the scientific explanations correct?** Scale (1-5)
- **Overall, what is your opinion of this report?** Scale (1-5) For this question, consider that the scores roughly correspond to letter grades: 5 = A 4 = B 3 = C 2 = D 1 = F

	3	**2**	**1**
Formatting	None	A few	Many
Typos	None	A few	Many

	5	**4**	**3**	**2**	**1**
Writing	Clear and concise				Confusing / Many errors
Accuracy	Clear and correct				Lots of errors
Overall	Great!	Good	So-so	Needs significant work	Completely unacceptable

2. Comment Section

Answer the following two questions in the open comment text box section.

- **What was done well in this report?**
- **What advice would you give the author for improving this report?**

3. Annotations

The peer review software allows you to make comments directly on the paper. These are the same marking tools that I use to provide feedback when grading. These tools can be used to point out particular typos or formatting mistakes, ask questions, or compliment specific things.

Peer Review Grading

Your peer review comments will not affect the grade of the person you are reviewing. However, you are graded on the quality of your reviews. Each peer review that you complete will be graded out of 10 according to the following criteria. The three reviews will be averaged together for your overall peer review score (10 total points).

	4	**3**	**2**	**1**	**0**
1. Rubric			All sections completed	Some sections completed	No sections completed
2. Comment Section	Several sentences of thoughtful, actionable comments addressing both positive and negative aspects of the report	Longer responses addressing at least two points for each question	Approx 15 word answers reasonably addressing both questions	Very short (less than 15 word) answers and/or one question missing	No comments
3. Direct Annotation	8 or more specific and useful marks recognizing both positive and negative aspects of the report	At least 6 marks	At least 4 marks which are mostly correct and helpful	At least 2 marks	No marks

Submission of Revised Report

After receiving the peer review reports for your own lab, you will have several days to revise and resubmit it via a new link on Canvas. This report will be read and graded by the instructor and returned with detailed feedback. It is worth a maximum of 35 points. If the report contains significant problems, you will be required to revise and resubmit it once again. Reminder: As explained in the syllabus, submission of passing lab reports is required to receive a passing grade in the course.