

0.1 Assignments, Research Methods, Fall 2009

Inquiry 1: Home Discovery

Description: Home Inquiry (Assignment 1 of Chapter 1)

Due: In Lab, week of August 31

- Use paper clips but not staples.
- Print and copy on one side of the page and use standard-weight letter-sized paper.
- Put your name in the header of each document so that it appears on each page, and number pages.
- Please obtain a file or binder. Keep in it the drafts of each inquiry, and all the comments obtained from instructors and peers on each inquiry. Bring this file to each lab period.

Background. For this assignment, you need to perform a bit of scientific inquiry away from an academic setting. Write a paper (you can think of it as a lab write-up) that describes what you learned. It is up to you to decide what you will investigate, as well as the format for the write-up. The results do not have to be terribly long. One to two typed pages should do.

Selecting a topic: Here is the hard part. BE CURIOUS!! You do not need anything more than what can readily be accomplished around the house, dorm, or outdoors. Let your curiosity take hold and use Feynman for inspiration. However, **do not carry out any project involving human subjects or vertebrate animals** unless you verify with your instructor that there are no safety concerns with your idea.

Length: 1–2 typed pages

Yes, you are being asked to do an assignment before you have learned anything in this course. This effort will give you an opportunity to find out just how much you already know, or don't know, about science in action. If you take a look at the course outline, you will be learning about Experimental Design, Statistics, Modeling, and Presentation as the semester goes along. For now, though, please don't do anything other than what you already know how to do. You can use this assignment for comparison with assignments you produce after you learn more. In other words, this write-up may not be very good, but that's OK.

Comments: We are modeling the assessment technique of designing authentic pre- and post-assessments and comparing student work samples before and after a unit or course. While not all students perform well on standardized tests or other forms of traditional assessments, authentic assessments based on measurable change in student work provide an alternative and powerful measure of what students really know and can do after instruction.

Grading: This inquiry will be evaluated according to the Inquiry 1 Grading Checklist. This checklist has fewer items on it than the checklists that will be used as the course progresses. By the end you will be responsible for many elements of scientific research, but for the moment you will mainly be held accountable for a good-faith effort to investigate something, turn in the paper on time, and write the results up clearly. In most cases, including a graph is valuable to explain the results clearly.

Homework 1: Inquiry Grading

Description: Assignment 2 of Chapter 1 in the course notes. The paper you are to evaluate is called "Seilman Inquiry" and is available for download at uteach.utexas.edu/ResearchMethods. In addition to your written comments, assign points either using the full course rubric, or else with the Inquiry 4 Grading Checklist, also available at the course website. Note that points on the rubric and checklist do not add to 100. In categories where there are errors, you subtract points from 100 (until you reach 0).

Due: In lab, week of Sept 7

Inquiry 2: Independent Laboratory Investigation,

Description: Laboratory Inquiry (Assignment 1 of Chapter 2 in the course notes)

Due Dates:

- Week of Sep 7, initial proposal due in lab. For guidelines on how to write the proposal, see 5.2 in Chapter 5.
- Lab, week of Sep 29, first draft. Bring two copies of the draft, one for instructors, and one for your inquiry grading partner. Please *do not staple* the papers. Any extensions desired for this draft must be negotiated with your inquiry grading partner because **their** homework depends upon **your** draft.
- Oct 19, in-class oral presentations
- Week of Oct 26, in lab, final draft

Guidlines:

- Use paper clips but not staples.
- Print and copy on one side of the page and use standard-weight letter-sized paper.
- Put your name in the header of each document so that it appears on each page, and number pages.

Purpose: Create a quantitative data set in a controlled laboratory setting and subject it to statistical analysis.

Background This assignment takes place in a formal laboratory setting. Your instructors will tell you what scientific equipment you have available to select from. The questions you can ask will be constrained by the equipment. However, your ability to collect quantitative data should improve because you will be able to work with instruments not typically available at home. You may not be as inventive as you can be when pursuing questions that make you curious at home, but you should be able to perform more precise work.

You should perform an investigation chosen from the first and third types listed in Chapter 1; investigate an hypothesis, as in Section 1.3, or measure a function as in Section 1.3. Plan to use statistics in evaluating your results, and take your data with the idea in mind that you will subject them to statistics later on.

Length: 3 – 5 typed pages. It is generally not a problem to exceed this length.

Report: Please include the following sections:

1. Title.
2. Abstract. This paragraph should explain the purpose of your inquiry, and then summarize the main results. It should be written in present or past tense. Write this section after you have completed all the work. Imagine that you are trying to prepare a single paragraph that will be published by itself in a newspaper to explain to huge numbers of people what you have found.
3. Introduction. This section should explain the motivation for your inquiry, and should incorporate background information including theories and models. An introduction explains the “hook” to the reader— in other words, what is the significance of this inquiry and why did you decide to spend time investigating it? It also provides enough essential background information to ground the reader about current research in the field.
4. Experimental design. Imagine in writing this section of your report that you are preparing a lab manual. Your goal is to enable other people to reproduce your experiment. Therefore, you will need to include a description of all the materials you used, and diagrams that explain how the apparatus was constructed. It is perfectly appropriate for you to explain wrong steps that you took, so as to warn others away from repeating your mistakes.
5. Analysis, including an appropriate statistical treatment of the data and explanation of whether your findings are statistically significant.
6. Conclusions. State in this section what you found in your experiment and what you have learned. You should set yourself the goal of being honest. On the one hand, you should not minimize the effort you have put into the experiment, and you should not dismiss or underestimate your own results. On the other hand, you should not claim to have found things that your results do not support. You are free to write about how you might do the experiment otherwise if you could do it again, and to make suggestions for yourself or others to pursue in the future.

7. **Data.** You should include enough raw data to enable evaluators to check your results. You can either include the data in the body of the report, or else in an appendix. In some cases, you may choose to provide the instructors with electronic copies of your data.

Comments on Project: For this assignment, you may use equipment in PAI 4.14, which is similar to the kind of technology and equipment you will have access to in a well-supplied science or mathematics department in secondary schools. After a first laboratory session in which you explore equipment, you should turn in a brief description of the experiment you intend to perform. This proposal will give us the chance to provide some preliminary advice on the direction you are taking.

Comments on Report:

Introduction. From the perspective of UTeach master teachers who have guided several hundred students through science fair projects, it is the introduction that illustrates how well or how poorly a student is prepared to conduct an experiment. Again, as you learn to write introductions that provide context for your own inquiries, you will develop skills in assessing your own students' abilities to provide a rationale for their work.

Experimental design. For a teacher, the ability to provide a clear and accurate description of an experiment is very important, both so that you can guide your own students, and also so that you can describe innovative projects you have developed to other teachers.

Analysis: Students in this class sometimes view statistical analysis as cumbersome and irrelevant. The UTeach Master Teachers have found that most high school students struggle mightily with this aspect of inquiry reports. Many high school students can master the technical skill of putting data into a calculator or spreadsheet and punching buttons to spew out their stats but few to none are capable of explaining what these mysterious values tell them about their data. This fatal flaw has caused more than one aspiring science fair student to not make the final cut for the next level of competition. Your experience with the discussion of your own data through statistical analysis will provide you with the requisite skills to guide your students through similar explanations, allowing them to draw conclusions that are supported by their work.

Master Teachers become truly masterful when they can demonstrate that their innovations in teaching are impacting student achievement in their classroom significantly. As you experiment with innovation in your classroom, you will want to gather data and apply appropriate statistical techniques to determine if your innovations are working. A cogent discussion of statistical techniques employed to analyze your data will convince colleagues to follow your example, administrators to support your efforts and provide resources that you need. In addition, the more prestigious education research publications require statistical analysis of data. Well-documented studies that are statistically validated will also enhance your applications for grants and allow you to get even more funds for your classroom.

Grading: This inquiry will be evaluated according to the Inquiry II Grading Checklist. You will be paired with another student in the class, and the two of you will read and assess each others' assignments. The instructors will grade your first draft by checking that you made a good faith effort to complete each of the major sections of the report, and by checked that you turned the assignment in on time. The peer grade of your draft will not enter directly into your grade, but it will play a role in the grade of your final writeup. Your final draft will be evaluated attentively. Instructors will pay particular attention to whether corrections suggested concerning the first draft have been implemented in the final writeup. These suggestions can come from peer and instructor evaluation of the first draft, or from comments during the oral presentation.

Note that your final inquiry writeup need not be accepted if you have not submitted a draft on time, or have not delivered a presentation, or have not graded your partner's inquiry.

Homework 2: Excel

Description: Assignments 1, 2, and 3 of Appendix A.

Due: Week of Sep 14, in lab

Turning it in: Put the three exercises in one file. Name the file using the following format: HW2_your_name.xls, e.g. HW2_Sed_Keller.xls. Put Exercise 1 in the first tab (Sheet 1), Exercise 2 in the second tab (Sheet 2), and

Exercise three in the third tab (Sheet 3). Please check that your file is no more than 200kB in size, and email it to Deanna Buckley, buckleyd@mail.utexas.edu

Homework 3: Human Subjects Training

Description: Assignment 3 in Chapter 2 in the course notes.

Due: Sep 21

Homework 4: Statistics

Description: Assignments 2–5 in Chapter 3 in the course notes.

Due: Sep 28

Inquiry 3: Surveying and Testing

Description: **Surveying and Testing** (Assignment 1 of Chapter 3 in the course notes.)

Due: In lab, week of Oct 12

Guidelines:

- Use paper clips but not staples.
- Print and copy on one side of the page and use standard-weight letter-sized paper.
- Put your name in the header of each document so that it appears on each page, and number pages.
- Turn in your permission forms and survey sheets

Purpose: Conduct and carry out a survey of opinion, knowledge, or learning and employ statistics to analyze the results.

Background: In this inquiry, you should build upon your knowledge of statistics as you apply it to one of the most important and controversial areas of research, the investigation of people's opinions and knowledge.

Teamwork: You may choose a partner for this assignment. Together with your partner, you should settle on some question that involves other peoples' opinions or knowledge. Design a survey or assessment instrument that provides you information to answer your question. If you work in a team, it is highly recommended that your partner should be someone in the same laboratory section. Teams larger than 2 are discouraged, as it becomes easier for one or two in the team to do almost all the work

Factors: Although you have very broad freedom in what sorts of questions you address, you should include at least one potentially significant factor in your survey or test. For example, you might see whether men and women respond to something similarly or differently. You might look for variations based upon age, or on which instructor students have had.

Ethical Treatment of Human Subjects: Before beginning your survey, you will need to provide instructors with evidence that you have completed NIH training on ethical treatment of human subjects. You must conduct this survey in accord with the guidelines that govern research on human subjects in an academic setting. In particular, you must obtain signed consent from every participant, and you must conduct the survey in such a way that the responses of all participants are anonymous, but any participant who chooses to withdraw from the study after it is completed can do so. Procedures and forms to assist in this process are on page 33.

Length: The report should be 2 – 4 typed pages.

Report Requirements: Although you may design your surveys or tests in teams, please type up individual reports. The interpretation and discussion of the data should be yours, although the data may be shared.

Please include the following sections

1. Title

2. Abstract. This paragraph should explain the purpose of your inquiry, and then summarize the main results. It should be written in present or past tense.
3. Introduction, including background information.
4. Survey. A copy of the survey or test you developed, with a discussion of why you settled on its final form.
5. Analysis. Statistical discussion of results, especially discussion of whether factors you investigated were statistically significant.
6. Conclusions.
7. Survey sheets. You must turn in the permission forms and response sheets from which you compiled your survey so that the instructors can verify that you properly followed procedures concerning ethical treatment of human subjects.

Schedule: Use the first lab period to construct your survey, and the second one to deliver it, or to analyze the results

Comments: Although your questions may seem as though they could never hurt anyone, and the procedures for protecting human subjects may seem like too much work, they are required, for example, in secondary science fair projects involving human subjects, so you may as well learn them now.

As you enter your classroom and begin to explore teaching, you will want to experiment with innovative lessons and instructional techniques. The development and implementation of these innovations should be carried out in a professional manner so that lessons learned from your classroom experiments can be presented at teaching conferences or published in educational journals. Your school district as well as the journals in which you may wish to publish will require that you obtain appropriate permissions from students (and their parents) who participate in your classroom experiment. The lessons learned in this inquiry will provide you with the requisite knowledge and skills to carry out such classroom research projects.

Grading: This inquiry will be evaluated according to the Inquiry 3 grading checklist. Please note that you must acknowledge your team members, if any, and explain their contributions to the project. You must turn in your survey sheets to avoid penalties for the first item on the checklist.

Homework 5: Peer Grading

Description: Assignment 2 of Chapter 2 in the course notes.

Due: Oct 5

Comments: Your instructor will assign you an inquiry grading partner, and you will be responsible for evaluating the first draft of their second inquiry. The goal is for you to obtain some practice grading papers on open-ended topics. This is not an easy task, but every most teachers must learn to do it, and it is the basic skill underlying the peer-review process for scientific publication. The more constructive advice you offer the person you are evaluating, the better their final paper will have a chance to be.

Homework 6: χ^2 Test

Description: Assignments 6 and 7 of Chapter 3 in the course notes.

Due: Oct 12

Presentation 1: Inquiry 2

Description: You will give an oral presentation of your work on Inquiry 2 to the class.

Preparation: You should prepare roughly 2-4 PowerPoint slides, describing the title and motivation for the work, and describing the main results. See Chapter 5.5.

Length: The presentation should last 2-3 minutes.

Due: Oct 19

Homework 7: Literature Search

Description: Assignment 4 of Chapter 5 in the course notes.

Due: Week of Oct 19, in lab

Choose a challenging or open scientific question, either from the list in the assigned problem or from the list in Assignment 2. First, search using Google and describe the best information you find. Next, search using professional databases made available through your library and describe the best information you find.

You must turn in a brief description of the sorts of information you found in your Google and database searches, and a minimum of two complete references to recent articles from the peer-reviewed literature. For each article, locate the full text electronically, print out the first page and hand it in.

Homework 8: Order of Magnitude Estimates

Description: Assignment 2 of Chapter 4 in the course notes.

Due: Nov 2

Homework 9: M&M Decay

Description: Assignment 4 of Chapter 4 in the course notes.

Due: Nov 9

Homework 10: Open Questions Paper

Description: Assignment of 5 Chapter 5 in the course notes.

Description: Write a 2-3 page paper on an open or challenging question in science or mathematics. You may adopt a question from the list provided, or with instructor approval choose another question of your own. You must make use of a minimum of 4 articles from the peer-reviewed literature. The paper must cite the articles and provide clear evidence that you have read the articles and make use of them in formulating your arguments.

Due: Nov 23; on or before day of presentation.

Presentation 2: Open Questions Presentation

Description: You will give an oral presentation on the topic you have researched for Homework 10.

Length: Ask your instructor. You will have 3-5 minutes for your presentation, depending on the size of the class, with a few minutes for questions. You are encouraged to make use of graphs or pictures to explain your arguments, and may use the computer or document camera.

Due: Weeks of Nov 23 and Nov 30. *Yes*, there will be presentations the Monday before Thanksgiving.

Grading: You will be graded according to the Presentation Checklist. Note that you must make clear use of arguments from peer-reviewed scientific articles for full credit.

Homework 11: Peer Grading

Description: Assignment 2 of Chapter 2 in the course notes.

Due: Week of Nov 30, in lab

Comments: Your instructor will assign you an inquiry grading partner, and you will be responsible for evaluating the first draft of their final inquiry. They will evaluate yours. Please highlight or indicate in bold specific changes that should be made to improve the final draft. Your partner's final grade will depend upon taking seriously your suggestions. More specifically, for entries in the Grading Checklist where you make valid and reasonable suggestions for change, if your partner does not make these changes in the final draft, he or she will get no credit.

Inquiry 4: Final Inquiry

Description: Final Project (Assignment 1 of Chapter 5 in the course notes.)

Due Dates:

- Oct 19, first proposal. For guidelines on how to write the proposal, see 5.2 in Chapter 5.
- Oct 26, second proposal
- Nov 30, first draft. Bring two copies of the draft, one for instructors, and one for your inquiry grading partner. Please *do not staple* the papers. Any extensions desired for this draft must be negotiated with your inquiry grading partner.
- Final Exam Day, final draft
- Final Exam Day, oral presentation of project

Guidelines:

- Please type your report
- Use paper clips but not staples.
- Print and copy on one side of the page and use standard-weight letter-sized paper.
- Put your name in the header of each document so that it appears on each page, and number pages.

Purpose: Carry out final project, incorporating skills gained during class.

Background: You have carried out a number of inquiries of different types during the semester. Your goal is now to combine the skills gained in these different inquiries into a final project. These projects begin with **curiosity**, proceed with **experimental design and taking of data**, continue with **statistical analysis and modeling**, and the ability to **access the scientific literature**. You now should combine what you have been learning in a final project.

Length: 5 – 10 typed pages. It is generally not a problem to exceed this length.

Report: Please include the following sections

1. Title.
2. Abstract.
3. Introduction.
4. Experimental design.
5. Analysis, including an appropriate statistical treatment of the data.
6. Conclusions.
7. References. You should make use of the peer-reviewed literature as appropriate.
8. Data either in the body of the report, or as an appendix

Comments:

1. You have signed up for credit in Physics, Chemistry, or Biology, and **you must carry out a final project relevant to the discipline for which you have signed up**. If you want to carry out a project in Earth Sciences, please contact the instructors.
2. It is best if you design a project that can be carried out in Painter 4.14 so that instructors can check your progress each week. If your project is carried out in another space, it is particularly important that you check in with the instructors every week during lab.

Grading: This inquiry will be evaluated according to the Inquiry 4 grading checklist. The instructors will grade the first draft by checking that you have made a good faith effort to complete the major sections of the report. The peer grade of your draft will not enter directly into your grade, but it will play a role in the grade of your final writeup. Your final draft will be evaluated attentively. Instructors will pay particular attention to whether corrections suggested by your grading partner on the first draft have been implemented in the final writeup. Your final grade will depend upon taking seriously your partner's suggestions. More specifically, for entries in the Grading Checklist where your partner has made valid and reasonable suggestions for change, if you do not make these changes in the final draft, you will get no credit.

Note that your final inquiry writeup need not be accepted if you have not submitted a draft on time, or have not delivered a presentation, or have not graded your partner's inquiry.

Presentation 3: Inquiry 4

Description: You will give an oral presentation of your work on Inquiry 4 to the class.

Preparation: You should prepare roughly 10-20 PowerPoint slides, describing the motivation, background, design, results, analysis, and conclusions.

Length: The presentation should last 5-8 minutes, depending upon the size of the class. Consult your instructor to learn the time available.

Due: Final Exam period

Grading: You will be graded according to the Oral Presentation Checklist