Syllabus—Senior Seminar

HB = corresponding handbook page. Students: use http://drjreid.com/PDF/Seminar_Packet_web.pdf if you didn't receive your packet.

Session:

1 What senior seminar is, including a model presentation.

Guiding Questions:

- What is science (a big question that will only be answered in part)?
- How do we approach the creation and completion of our own research projects?
- What does a senior seminar project look like?

Goals:

- Students begin to consider what science is as process.
- Students understand what the major objectives of the course are.

Assign HW 1, which is a Beacon Science article study. HB 4

2 What mentorship is; brainstorming a project idea.

Guiding Questions:

- What is mentorship in science, and why is this necessary?
- What is the timeline of senior seminar?
- What are we interested in researching as a class and as individuals?

Goals:

- Students are assigned mentors and understand what mentorship is.
- Begin to understand what all of our interests in life—as these interests relate to science—are.
- Organizationally, we are starting to see what should be accomplished by when.

- Pick up parent **letters**.
- Mentorship sheet is on HB 21
- Students begin their forum threads online.
- Students begin working on their HWs needed for their mentors to sign (See HB 21)

3 Brainstorming continued—webquesting an idea.

Guiding Questions:

- What are we interested in researching, as a class and as individuals (continued)?
- Which of us have similar interests?
- What is the general structure and scope of the final senior seminar paper?

Goals:

- Finish getting to know everyone's interests.
- For everyone to gain a more solid understanding of everyone's scientific interests.
- To foster student collaboration.
- For students to begin writing and answer questions that belong to their list of 30 questions.
- For students to use their HW's as tools to support their final project.

Assessment: Students are meeting with mentors. Students who haven't met should be asked about this.

4 Concept mapping an area of interest.

Guiding Questions:

- How do we discover ideas that are from our knowledge and our interests in science?
- What is pseudoscience?
- What are some criteria of science as will apply for senior seminar?

Goals:

- To use concept mapping to help 1 or 2 students discover a project, and for other students to experience the generation of a hypothesis.
- To foster a debate about pseudoscience.
- To provide students some guidelines about acceptable science (Rutledge's published 9 points, see the ABT manuscript).

Materials needed:

- Rutledge's 9 points about what we should agree science is (see ABT manuscript).
- Scientific paper for discussion and contrast to the umbrellology article.
  - **Umbrellology** lesson and discussion. HB 16**.**

5 The senior seminar literature library.

Guiding questions:

- Where and how can students find scientific literature?
- How are files moved between computers using FTP?
- Can students find a few sources that the instructor improves of?

Goals:

- Students will be able to find articles relevant to their science project.
- Students will be able to use the computers to move files as needed.
- Students will be aware of the materials available list, and begin to consider the materials they will need as a check to ensure that the project is feasible.

- Students are frequently still searching for ideas—this is directed reading about student interests.
  - Goal is to provide interesting **articles to students**, and have them consider potential projects.
  - I have scanned or archived .pdf articles that I keep on a **shared hard-drive** that is networked to any computer in the school. Also, I have scanned a semester of student final papers that students have access to. Because all papers are submitted to **turnitin.com** (see HB 40), we have minimized plagiarism problems.
  - **Journal use**, e.g. Science magazine arises. HB 25
    - Show students how to use pubmed.com, google scholar, NY science times, Science News, American Family Physician, Scientific American, and their library cards.
  - Explain **use of the computers**, if necessary. If irregularly meeting in the computer lab, show students where the HB in the packet is with respect to FTP. HB 23
  - Finding ideas on **drjreid.com**. See ABT manuscript; use http://www.drjreid.com/senior_science_capstone.htm
    - Show students where the **materials available list** is: http://www.drjreid.com/PDF/Student_Materials.pdf

6 Solidifying the hypothesis.

Guiding questions:

- What were the hypothesis of other students?
- Has another student had a hypothesis that is similar to each students current hypothesis idea?
- How can students use another student's paper to focus their own writing and ideas?

Goals:

- Students will be able to find a previous student research paper that is relevant to their science project.
- Students will be given advice about their project idea in class.
- Students will be aware of the week 3, week 4 and week 5 homework assignments and deadlines.

CENTRAL GOAL: students will have a hypothesis formed by the end of this week.

"Students, remember--all of your work is a means to the same end—your reading becomes your writing, your homework assignments become your paper and project."

- **Paper check out** lesson—I keep a box of student papers from the year before, and announce titles to the class. Students are given about 20 minutes to look at papers that are of interest to them over.
- The last paragraph of the Lizzette **Matos paper** is discussed, and we discuss the merit and soundness of her hypothesis. HB 8
- To close the lesson, students work on their homework assignments. HB 42, 43, 44.

7 Writing the literature review and word splash for project ideas (helps students struggling for an idea):

Guiding questions:

- Does outlining assist the writing of a technical paper?
- Where am I (as a student) with respect to my project idea?
- Can project ideas stem from brainstorming?

Goals:

- Students will identify 5 major areas to write about for their literature reviews.
- Students will post a brief statement about their own progress report on the forum (this could be done on paper).
- Students will help a student brainstorm an idea for a project.

- Activity: **Outlining** the literature review; begin using **HW week 5** (due in the 5th week) HB 44
  - Use HB 24 (an explanation of the literature review format)
  - What 5 central questions (which belong to the 30 questions) are being used to write the literature review?
    - Goal: students can learn to shed less-great questions for the better ones, and saving the others for later.
    - History: students struggle with the writing of the **problem statement**. Ask students individually: why is this issue a problem or important for us to learn about?
- Activity: your **anecdotal**…post on the forum what I (the teacher) should say about the progress of your hypothesis. *Anecdotals are progress reports at Beacon that are given to student, advisor, and parent. They form a record of student progress in all courses. I use this progress report as a formative assessment for my students.*
  - Teacher goal: email advisors and mentors if students are struggling with an idea.
- Assessment: **Collect** signed mentorship sheets.

8 Literature for the literature review.

Guiding questions:
- What were the hypothesis of other students?
- Has another student had a hypothesis that is similar to my current hypothesis idea?
- How can I use another student's paper to focus my own writing and ideas?

Goals:
- Students will be able to use google scholar to find literature.
- Students will be aware of other journal sources to find literature.
- Students will be aware of the week 3, week 4 and week 5 homework assignments and deadlines.

Student preparation for class:
- Bring sources to class for approval if any have been found.

  - Help students complete **HW week 5** (HB 44) and ensure that the 5 content areas that students will be researching to write about are content rich and content appropriate. I do give some suggestions about what they could write about.
  - *Important: limit **Wikipedia** citations to 2 per paper. Students need **10 quality citations**. Two citations must be **original scientific journal articles**. Because much of the literature requires expert knowledge, **review articles** are useful. Some students will search for a book on amazon.com if they are in the market for one.*
  - Explain HB 24 (a re-explanation of the lit review), Walk through an explanation of HB 26 (format and referencing),
  - What 5 central questions (which belong to the 30 questions) are being used to write the literature review?
  - Some students should have begun their experimental research.

9 Prediction of the data sets

Guiding questions:
- Can we "see" our hypothesis by drawing predicted data on the board and on paper?
- How do 2 data-sets tell a story together?
- How can a student use another student's paper to focus their own writing and ideas?

Goals:
- Students will be able to find a previous student research paper that is relevant to their science project.
- Students will be given advice about their project idea in class.
- Students will be aware of the week 3, week 4, and week 5 homework assignment rationale and deadlines.

  - Use of the homework to help guide what all students 2 data sets might look like HB 42
  - Show (again) where the **materials available list** is: http://www.drjreid.com/PDF/Student_Materials.pdf .
  - Students should also be aware of HW Week 6, **hypothesis revised** HB 45
  - Any extra class time is for students to write.

Assessment: be aware of the quality and status of each student's project idea.

10 Report Generation.

CENTRAL GOAL: Students have their project experimentation underway by the end of this week.

Guiding questions:

- What were the hypothesis of other students?
- Has another student had a hypothesis that is similar to their current hypothesis idea?
- How can student's use another student's paper to focus their own writing and ideas?

Goals:

- Students must analyze whether they have chosen a suitable project that is appropriate for the time-frame of senior seminar.
- Students will generate a report that is framed around the central question of their project.

Student preparation for class:

- Students should be aware of the days activities before-hand so that they have the activity in mind.

- Activity: Students are given the hour to do the follow writing exercise, which is given to the instructor for feedback.
- Start: the following 3 questions are placed on the board, for students to respond to using the class forum.
- Board question 1: What is the question that is the crux of your hypothesis?
- Board question 2: What methods will you use to answer your question?
- Board question 3: Where will you obtain the necessary materials?
    - Ensure students know when the literature review is due. [Due day 15].

Assessment: Due: Hypothesis Revised homework. Use/see HB 45. This homework is signed by the mentor before handing this in. Students improve their hypothesis and return to their mentors for returned to their mentors for their signature.

11 Consulting science writing partnerships.

Guiding questions:

- What were the hypothesis of other students?
- How can students productively write and organize their experimental plan with the help of a consulting scientist?
- How can students effectively incorporate the suggestions from their partner and the seminar instructor into their paper?

Goals:

- Students will outline their papers.
- Students will be given the opportunity to discuss their homeworks-in-progress with the instructor.

Student preparation for class:

- Bring sources to class for approval if any have been found.
- Be aware that literature reviews need to be of high quality for the next session, when we peer review.

- Students are given time to write their literature reviews, because peer review (when other students look over a peer's literature review) is the next meeting.
- Provide students with their presentation dates, so that they know when they will be presenting.
- Re-explain the need to present, and take questions.
- A good day to model a student's data, if the need is there.

12 Peer review of literature reviews.

Guiding questions:

- What were the hypothesis of other students?
- Has another student had a hypothesis that is similar to my current hypothesis idea?
- How can I use another student's paper to focus my own writing and ideas?

Goals:

- Students will be able to use google scholar to find literature.
- Students will be aware of other journal sources to find literature.
- Students will be aware of the week 3, week 4 and week 5 homework assignments and deadlines.

Student preparation for class:

- Bring sources to class for approval if any have been found.
- Student reminder: final projects require **evidence** with respect to experimental outcomes: these may include photographs, teacher-witnessed data, or another form of evidence that both student and teacher agree upon.

- During the entire session, students are expected to have brought a very good copy of their literature review for editing by other students. Start: Student partners (frequently consulting scientists, other times friends if the review will be constructive) edit the paper and leave feedback. The use of the web is encouraged for students who have minimal

knowledge about what is being written about. It is best to partner students with interests and projects that are as similar as possible.

- Assessment: Edited copies are checked at the end and throughout the period to note student contributions; these drafts are due for a participation grade when the literature reviews are due.
- Extension: students struggling with their writing and haven't brought a strong literature review draft are directed to work on their homeworks if these are incomplete; use HB 42-46.

13 Good-data exercises # 1

Guiding questions:

- How do we plan a team experiment (the experiment is ice-core sampling in Antarctica)?
- How do we consider time as a variable with research planning?
- What is standard deviation and error bars?

Goals:

- Students will be able to generate a graph from raw data that is the result of a team-collection endeavor.
- Students will discuss all the interpretations of the graph that they generate, and this analysis will form a foundation for scientific results section and a discussion section.

Materials needed:

- Handbooks, so that pages 31-35 can be used for data analysis and discussion. Handbooks should be assembled with graph paper after handbook page 32.
- White board, multiple-colored markers for students to construct a graph on the board with.
- The good data handout is found both in the Handout (HB 31-35) and the excel guidelines are found on http://drjreid.com/seminar_documents.htm as "The Good Data Handout 1". These handouts are needed for both day 13 and day 14.
  - I use HB 31-32 for the Antarctica explanation.
  - Science content. Concepts addressed in the conversation: An explanation of ice core sampling, a revisitation of the concept of global warming (previously learned about), carbon dating, ice deposition, glacial melting vs. sea-ice melting, and **sampling** [ensues].
  - We discuss how we could collect adequate data on our expedition.
  - Each team Determines how many samples to collect (I remind them of the expense and need for analysis).
    - We agree that students will sample different regions of Antarctica, and collectively we agree on the rational behind sampling at points such as A, B, and C. One point is intended to represent the **Larsen ice shelf**, which rapidly collapsed into the sea. The data is arranged to indicate a more rapid accretion of CO_2 in the ice shelf.
      - Have students read about the ice shelf on Wikipedia for a moment, if the computers are there.
  - All students then plot the data that is on HB 32, on scrap paper within the handbook.
  - Students also plot these data on the board, using different colors for each location that we agreed upon.
  - We then discuss which data points we "believe". The data is organized so that some averages will have larger **standard deviations**. Students then draw the **error bars**, so that we can discuss range about the mean.
  - Assessment: for participation, students will have drawn their own graphs, and listed their own interpretations, as these compare to the group-constructed graph on the whiteboard.

14 Good-data exercises # 2—excel and graphing.

CENTRAL GOAL: By the end of this week, all students have given the instructor paper versions of their literature review.

Guiding questions:

- Can students make graphs from data that has been averaged, and with calculated standard deviations, using Microsoft Excel?
- What happens when the standard deviations of an experiment are greater, comparing a similar experiment?
- Does increasing the sample size decrease the effect of an outlier?

Goals:

- Students will be able to independently create graphs using Excel.
- Students will be calculate averages and standard deviations using Excel, and know the meaning of "error about the mean."
- Students will archive their excel files for assistance when graphing their own data.

Student preparation for class:

- Students should consider how their own data will appear when graphically represented.
- 30 questions lists are due today, 15 questions and answers are expected. Answers should each be a few sentences.

Materials needed:

- HB 33-35 ; projector and computer so that the class can simultaneously construct the Excel file in the handbook.

- Students use the HB data to build their own excel graphs in class. Start: I project and model the use of excel, and students produce the same graphs. Then, students can save the file for when they work on their own projects. We go back to this file, which allows us to have a graph to copy and paste into excel, and also for when students are adding their own data to other graph types.
  - The end product are excel graphs that include calculated averages and standard deviations.
  - See HB 33-35 --
- Assessment: ***Midterm—collect 30 questions lists, which should be about ½ complete.***

15 How to assemble the 9 page paper: discovery of life on mars?

Guiding questions:
- What is the shape and format of the final paper, which is the format of a scientific journal?
- What tenses and headings are used in technical writing?
- What organization strategies should students use when writing their final papers?

Goals:
- Students should understand the format of the final paper.
- Students will be able to use an example document to shape their own paper.

Student preparation for class:
- Read HB pagess 36-41 before class.

Materials needed:
- Today's conversation requires a whiteboard, where the instructor can sketch example figures that represent the data shown in an example document.

- Start: Using HB's 36-41, I have students read to the class a paper that describes the discovery of life on Mars.
  - This paper is remarkably parallel to actual Cell and Science papers that have discussed these results, except I am able to culture the microbe on Earth. While I don't believe we have discovered life on Mars yet, http://aem.asm.org/cgi/content/full/68/8/3663 (*Applied and Environmental Microbiology*, August 2002, p. 3663-3672, Vol. 68, No. 8) is a good article for discussing data about life on Mars, and the investment of at least $820 million for the Mars Exploration Rovers. Have students look at this article during the lesson. The article that I've fabricated for our study is written in the senior seminar format, and is how a senior seminar student would report the finding of microbial life on Mars from a Meteorite.
    - Begin by having students read the article see HB 36, with a student reading aloud. Questions to ask after their reading of the **abstract** include: *Can we cite in the abstract? Will the article explain what scanning-electron microscopy is? Does the abstract including findings? Does the abstract include a conclusion or argument?*
      - Questions for the **methods** section include: Does it make sense to separate these procedures, as has been done? Why are some of the materials shown to have been acquired from locations parenthetically shown, while we don't explain where other materials were obtained from? (It isn't necessary to do this for items that are easily or routinely obtained.)
      - Questions for the **results** section include: How are figures included in the writing? Are we able to identify portions of figures within sentences? Does the separation of the major findings using headings make sense? (Remember: in the results, we show and say what we see, but we do not interpret these here.)
      - Questions for the **discussion** include: Can we interject the opinion of the authors in this section? Do we restate our findings from the results? (Yes, we do, but we don't have to fully explain everything we see.)
    - The utility of the Mars Rock document is that it provides a clean outline for students to use with respect to writing quality, referencing, use of headings, and language use (including tense and scope).
    - This is certainly the first explanation of the **discussion**, and what we are looking for here. While it is important to emphasize the components, tense, abbreviations, and language of the **methods** (by asking questions, and having students **label** the document with our joint-discoveries about the writing), it is always hard for me to reach the discussion because we wind up drawing the **figures** and what we would expect to see. This is generally where the students are about now…somewhat unsure about how to utilize both **picture data**, which can be actual data (that has to be appropriately sampled), and **graphical data** that accompanies and finishes telling the story that is described by the picture data.
    - Assessment approaching: Remind students that there will be a peer review of their final paper portions (with some beginning of the discussion having been started) on day 18.

16 ***Reserve lesson (if time allows): an analysis of a doctoral thesis.***

Guiding questions:
- What does a doctoral thesis in science look like?
- How are the components of a doctoral thesis similar to the shape of the final senior seminar paper?
- Why is *Mycobacterium tuberculosis* a public health concern, and what is bacterial pathogenesis?

Goals:
- Students will ask intelligent questions about my doctoral thesis, *The carbohydrate surface of M. tuberculosis: antigencity and antibody immunity*.
- Students will post responses to the presentation on the class forum. Each student should practice asking 3 questions about the presentation.
- To capture student interest in graduate scientific research by showing interesting data and settings; in my case this was the inside of a Biohazard-level 3 laboratory.

Assessment: for participation, 3 high-quality questions about the thesis presentation need to be posted on the forum.

17 ***Learning PowerPoint and the senior seminar PowerPoint template.***

Guiding questions:
- What will each students PowerPoint presentation look like?
- What are the components of a senior seminar presentation?
- What are some helpful communicative aspects of PowerPoint?

Goals:
- Students will create a template for their own PowerPoint presentations.
- Students will be able to use computer keyboard shortcuts when making a presentation.
- Students will understand how the PowerPoint presentation is a rubric in and of itself for their senior projects.

Student preparation for class:
- Bring sources to class for approval if any have been found.

Materials needed:
- Bring a few books off your classroom shelf to provide to students with respect to their interests.
- Bring a sign-out list so that you'll get your books back. A clipboard for this is a good idea.
- Mentorship sheets and student homeworks to return to students.

- Start: Beginning with a new, blank PowerPoint file, I show the basics of the program to the classmembers. They pick it up quickly, about 60% of the students have used PowerPoint before, but very few students know how to use shortcuts (such as Ctrl+S, Ctrl+C, Ctrl+V, Alt+Tab to change programs) or how to move images into PowerPoint. I model these activities and ensure that students are able to do this with their own files. By the end of the period, each student should have assembled nearly the same model PowerPoint file. The file should include a graph, a separate space for the second data set that is usually only anticipated at this point in the class, and all the elements of a final presentation.
  - Some essential points that I include in the model presentation are:
    - What images can you use to teach the class in your introduction? The 10 minute presentation isn't everything you are writing about, just the essentials. [I type these into the file, in various ways, to help the students learn PowerPoint.] In the future studies, I type the question: Here, if you were a professional scientist with resources, and you had obtained your results, what would you do next? Why is the beneficial?
- By having students outline their own presentations, they are able to generate an actual file that they can continue working on, and each student learns what the essential elements of the presentation template are.
- The essential elements are Introduction, Hypothesis, Methods, Evidence, Results (2 data-sets), and Future studies. ***The PowerPoint presentation is an excellent way to provide evidence that experimentation was fairly completed by the student.***

Assessment in progress: the quality of the presentation, like the 30-question list, is a constant assessment measure. Monitoring of the presentation quality, the 30-qustion list quality, and the quality of the paper drafts is an outstanding indicator of the project quality.

18 ***Peer review of final papers***

Guiding questions:
- What is the status of the papers of other students?
- Are students efficiently shaping their papers to be high quality?
- How is the experimental progress of student projects?

Goals:
- Students will be given the day to review each other's work and to write.
- Students will be have explained the status of their research progress to the instructor while students comment on each others papers.

Student preparation for class:
- Bring data to discuss with the instructor. Bring your paper to have peer reviewed, and to continue writing. Bring specific questions to ask the instructor.

Materials needed:
- Class handbook, so that notes can be made on each student's anecdotal report that is a running progress report.

CENTRAL GOAL: All students will have one complete data set in their manuscript.
- Start: Students are given the day to work on their writing, and are expected to produce drafts of their papers, as was done for the literature reviews on day 12.

Assessment: call parents if student's do not have a data set. Email this information to the advisor and the mentor.

19 The MRI talk.

Guiding questions:
- What does a scientific presentation look like?
- How are the components of a medical science presentation similar to the shape of the final senior seminar paper?
- What is MRI, and could this be used to evaluate a problematic pregnancy?

Goals:
- Students will ask intelligent questions about the presentation: *Value of specific MRI features in the evaluation of suspected placental invasion*.
- Students will post responses to the presentation on the class forum. Each student should practice asking 3 questions about the presentation.
- To capture student interest in graduate scientific research by showing interesting data and settings; in this case the research is about a magnetic resonance imaging study.

- Background and start: I was fortunate enough to co-author a paper that is in press (2006) for the journal Magnetic Resonance Imaging. I think it is a good idea for any science teacher to bring in an area of expertise that they find really fascinating, and present the science behind this. My rationale is to show a PowerPoint presentation, explain data, and give an example for how larger projects conducted by scientists look. The learning goal for the students is largely communicative (they become more comfortable with the idea of standing in front of everyone and presenting their science), but I've found that students learn a lot about MRI itself. I use a presentation of the data that was shown at a national medical meeting. Importantly, the students learn a lot about placental invasion and pregnancy.
    - The students who have previously had MRI's have stories to tell, and it is important to draw these out. E.g., why was the machine making that clicking sound? Were you worried about having any metal with you? How does an MRI work?
        - I wind up talking about T1 and T2 weighting, which has subatomic concepts, which they understand. After my students realize where in the atom I am, I don't think they understand the rest. But, I do believe they learn 1) to gesticulate when giving a presentation, 2) to describe graphs completely, 3) the importance of the introduction to understand the talk, and 4) how similar actual scientific presentations are to what they are doing.

Assessment: for participation, 3 high-quality questions about the thesis presentation need to be posted on the forum.

20 Day for working on PowerPoint files.
- The entire day is an open day for students to work on their PowerPoint files.
- Meet with students as needed during the lesson to help with experimental progress and challenges.

Assessment: speak with students individually about their data, especially students who do not have a solid plan for gathering both data sets. Some students may still be struggling with respect to how the 2nd data-set extends the story of the first; try to help students make decisions about how they should collect appropriate and quality data.

21 PowerPoint final day, and presentation tips.

Guiding Questions:
- What is the status of the student's PowerPoint files?
- What recommendations do we have for our first students who will present next time?

- For students needing guidance: should we schedule a time to meet?
- Which questions in your 30 questions are your best? Can your answers be used in your PowerPoint?

Goals:

- Students will finish their PowerPoint presentations.
- The creation of a graph using Excel will be modeled again, using the projector.
- The status of the 30 question list will be monitored and recommended questions will be given.

Assessment: for participation, 3 high-quality questions about the thesis presentation need to be posted on the forum.
CENTRAL GOAL: All students have made substantial progress on their PowerPoint presentations, which should appear nearly ready for presentation.

- Meet with the students who will be presenting next session (the first students to go)

22 In-class presentations.

- ***During all in-class presentations, students formulate questions about their classmates research.***

- Activity/Assessment: During the in-class presentations, students log 3 questions about each presentation on the forum. The next presenter is allowed to present only when 3 good questions have been asked by the class, by different students. These oral presentations are in addition to the forum questions.
  If computers are not available, use scrap paper that is collected for each student and stapled into a book. Students are able to view the books made by the class later, and the responses are helpful. Make sure to look for nasty remarks, and ensure that all papers or postings have names attached to the authors.
- Presentations are assessed on the spot, using the rubric (HB 39), which is the same rubric the assessor will use during assessment week.

23 In-class presentations.

- Teacher goal: assessors should now know who they will be assessing by the end of the year. The administration has worked out a good time for senior seminar assessments to take place, with respect to the other classroom and individual assessments in our portfolio school.

24 In-class presentations.
25 In-class presentations.
26 In-class presentations.
27 In-class presentations.

CENTRAL GOAL: All final papers are due. (Assessment.)

- Mention the final checklist sheet HB 40 and that students will learn who their assessor is during the last class.

28 In-class presentations.
29 In-class presentations.
30 In-class presentations.
31 In-class presentations (reserved day for stragglers and incompletes) .

- ***Collect 30 questions lists.***

32 30 question's day and scheduling of assessors.

- Assessment. Students learn who their assessors are, and **schedule** their assessment times on sheets that have been approved by each assessor.