

**GSCI 161 – Science Processes**  
**Course Syllabus – Summer 2013 (May 19 – May 30, 2014)**

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**Office Hours:**

- In person, on campus, by appointment
- 24/7 SMS Text to 703-835-6336 or gChat
- Or by appointment on Skype (videoconferencing) – most times of day/night!

### **NATURE OF COURSE CONTENT**

Science Processes, GSCI 161, emphasizes science process skills, covered in 8 modules that span the following topics: 1) observation, 2) classification, 3) measurement and calibration, 4) hypothesis testing, inference and prediction, 5) experimentation, 6) simulation and modeling, 7) communication and graphing and 8) consensus. The course is designed to address the first of the “Seven Strands” for the Virginia Science Standards of Learning (SOL’s): Scientific Investigation, Reasoning, and Logic. The class will introduce core science process skills for all science disciplines in a hands-on, integrated laboratory block.

This is a one credit, TWO WEEK online block class to launch your General Education and IDLS science sequence. It will be conducted asynchronously, meaning you can log into class whenever you want! **However, this doesn’t mean the class will be easy. You should plan on spending about 2-3 hours a day on this class and GSCI 162 over the next two weeks.** I will interact with you primarily through the Facebook group, but please feel free to call or text me as well. I am happy to talk to you about what you’re learning, and explain things in more depth if and when you have questions.

Since many of you will become educators, **the primary objective of this course is for you to build a PORTFOLIO that is meaningful to you**, which includes descriptions, examples, or stories related to each of the 7 modules we will cover: Observation, Classification, Simulation & Modeling, Measurement & Calibration, Hypothesis Testing & Inference, Experimentation, and Consensus. To help you, there are thought questions posted for each module on the course schedule, and resources (including readings, videos, and example exercises). Your portfolio can even INCLUDE the answers to your thought questions, arranged in useful and informative ways. Create an artifact that you will refer to when you are a teacher! (Most portfolios I have reviewed have been in powerpoint, but you can be creative.)

### **GOALS OF THE COURSE**

**Course Objectives**

1. Students will make observations involving fine discrimination between similar objects, using a variety of senses and technologies.

2. Students will distinguish between observations, inferences, and predictions.
3. Students will develop classification systems based on multiple attributes and use these systems to organize objects, materials, and living organisms.
4. Students will access and utilize published classification systems.
5. Students will plan and conduct investigations in which length, mass, volume, density, temperature, weight, and force are accurately measured and reported using the International System of Units (SI - metric)
6. Students will evaluate accuracy and precision of measurements.
7. Students will demonstrate ability to use appropriate units for reporting measurements.
8. Students will be able to construct alternative inferences based on observations.
9. Based on data and observations, students will be able to make predictions.
10. Given a description of an experiment, students will be able to identify the dependent and independent variables, and state the hypothesis which is being tested.
11. Students will use repeated trials in experimentation, and identify sources of experimental error.
12. After analysis of experimental data, student will be able to draw valid conclusions
13. Given a set of data, students will be able to construct an appropriate graph to represent that data, including title, variables, axes, units, scales, and statistical interpretation.
14. Results from experimentation will be presented in appropriate written form.
15. Given a graphical representation of data, explain in words the relationships between the variables.

**General Education, Cluster Three learning objectives pertinent to the course are:**

Objective 1: Describe the methods of inquiry that lead to mathematical truth and scientific knowledge and be able to distinguish science from pseudoscience.

Objective 2: Use theories and models as unifying principles that help us understand natural phenomena and make predictions.

Objective 5: Use graphical, symbolic, and numerical methods to analyze, organize, and interpret natural phenomena.

Objective 6: Discriminate between association and causation, and identify the types of evidence used to establish causation.

Objective 7: Formulate hypotheses, identify relevant variables, and design experiments to test hypotheses.

Objective 8: (the portion concerned with mathematics): Evaluate the credibility, use, and misuse of scientific and mathematical information in scientific developments and public-policy issues.

**Course Schedule (subject to minor changes)**

Module	Day	Focus on:
<b>1</b>	Monday, May 19	<p><b>OBSERVATION</b></p> <p>Videos: Moon Phases <a href="http://www.youtube.com/watch?v=nXseTWTZlks">http://www.youtube.com/watch?v=nXseTWTZlks</a> (3 min)</p>

		<p><b>Readings:</b>  Carpi &amp; Egger, pages 1-5  Carpi &amp; Egger, p. 117-128</p> <p>Pelli, D. G. (2005). What is observation? James Turrell's skyspace at PS1. In A. M. Torres(Curator), James Turrell. Valencia, Spain: Institut Valencia d'Art Modern.  <a href="http://www.psych.nyu.edu/pelli/pubs/pelli2005turrell.pdf">http://www.psych.nyu.edu/pelli/pubs/pelli2005turrell.pdf</a></p> <p>Rao, J. (2010). How to Observe the Moon (Saturday Night).  <a href="http://www.space.com/9136-observe-moon-saturday-night.html">http://www.space.com/9136-observe-moon-saturday-night.html</a></p> <p><b>Interactive Activities:</b></p> <p><b>1) Post your answer</b> to the following thought questions on Facebook:</p> <ul style="list-style-type: none"> <li>• What does it mean to <i>observe</i> something?</li> <li>• Pick something that can be observed. This can be a physical object, a personality trait, a medical condition, a phenomenon, anything! List ALL the different ways you can think of to observe that thing. Brainstorm... be creative... go beyond your own five senses.</li> <li>• What is the scientific method? What is the role of observation in the scientific method?</li> <li>• Why are the concepts of <i>observer</i> and <i>observation</i> so critical to quantum physics? What is the <i>uncertainty principle</i> and how does it relate to observation?</li> <li>• What is the relationship between <i>observation</i> and <i>contemplation</i>?</li> </ul> <p><b>2) Observe the moon!</b> First, figure out what phase the moon is in right now and how many days old it is (use an <b>ephemeris</b> on the internet). What times of day can you observe the moon (that is, when will it rise and when does it set)? What does the moon look like from your location, and what time are you observing it? What direction are you looking in (azimuth) and what is the elevation angle of the moon? What's the angular relationship between the Sun and the Moon during this observation? Is it a crescent (forwards C or backwards C), a half moon (lit on the left or lit on the right), or full? Log your observation on the Discussion Board. If it is cloudy, figure out when you might be able to see the moon and what it would look like, and then post that.</p>
<p style="text-align: center;"><b>2</b></p>	<p>Tuesday,  May 20</p>	<p><b>CLASSIFICATION</b></p> <p><b>Readings:</b>  Carpi &amp; Egger, p. 129-141</p> <p>Freedman, David H. (1998). The Atlantic Monthly; <i>February 1998; When Is a Planet Not a Planet?</i>; Volume 281, No. 2; pages 22 - 33.  <a href="http://www.theatlantic.com/past/issues/98feb/pluto.htm">http://www.theatlantic.com/past/issues/98feb/pluto.htm</a></p> <p>Margot, Jean Luc. <i>What Makes a Planet?</i>  <a href="http://www2.ess.ucla.edu/~jlm/epo/planet/planet.html">http://www2.ess.ucla.edu/~jlm/epo/planet/planet.html</a></p>

		<p>Pidwirny, M. (2006). "Soil Classification". <i>Fundamentals of Physical Geography, 2nd Edition</i>.  <a href="http://www.physicalgeography.net/fundamentals/10v.html">http://www.physicalgeography.net/fundamentals/10v.html</a></p> <p><b>Interactive Activities:</b>  <b>Post your answers</b> to the following thought questions:</p> <ul style="list-style-type: none"> <li>• What is the list of criteria that astronomers and planetary scientists NOW USE to classify planets and other bodies in the solar system? How did they determine this list of criteria? Has their classification criteria always been the same?</li> <li>• In the soil classification example, why is it important to be able to classify the soils? What are the purposes of these classification systems in practice?</li> <li>• Think about objects that you encounter, stores you shop in (physical or online), institutions you interact with (e.g. schools, the government, banks, the legal system), and the people you come in contact with every day. What are some practical reasons that you might want to develop a classification system to put these objects, people, or systems into categories? <b>Give one specific example.</b></li> <li>• What steps would you take to develop a new classification system? Pick a class of objects, people, or systems. Describe how you would develop a classification system for them and why it would be useful.</li> <li>• As an educator in elementary or middle school, what sorts of objects might you teach your students to develop classification systems for, and why?</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<p style="text-align: center;"><b>3</b></p>	<p>Wednesday, May 21</p>	<p><b>MEASUREMENT &amp; CALIBRATION</b></p> <p><b>Readings:</b>  Metrology – the science of measurement  <a href="http://en.wikipedia.org/wiki/Metrology">http://en.wikipedia.org/wiki/Metrology</a></p> <p>Calibration (from Access Science)  <a href="http://accessscience.com/content/Calibration/103800">http://accessscience.com/content/Calibration/103800</a></p> <p><b>Interactive Activities:</b>  <b>Post your answers</b> to the following thought questions:</p> <ul style="list-style-type: none"> <li>• What are units? Why are units important?</li> <li>• What is calibration? Why is it important that your instruments are calibrated?</li> <li>• What is the difference between <i>accuracy</i> and <i>precision</i>?</li> <li>• What instruments might you use to measure qualities that you can detect through your five senses? What might the units be?</li> </ul> <p><b>Respond to at least TWO</b> of your classmates' posts, providing a helpful</p>

		<p>counterargument or critical assessment.</p> <p><b>M&amp;M Observation &amp; Measurement (Optional).</b> Go to a store and purchase a 1.69oz bag of M&amp;Ms (the regular kind... NOT the peanut kind).</p> <ul style="list-style-type: none"> <li>Count and record the number of M&amp;Ms of each color.</li> <li>What are ALL THE THINGS you can think of that you might be able to <i>measure</i> regarding the M&amp;Ms (individually or the whole bag)? What instrument(s) would you use to perform the measurement(s)?</li> <li>POST YOUR COUNTS and any graphs or charts that you think might be useful to describe your data, or to make PREDICTIONS based on your data, to the Discussion Board.</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<p style="text-align: center;">4</p>	<p>Thursday, May 22</p>	<p><b>HYPOTHESIS TESTING, INFERENCE &amp; PREDICTION</b></p> <p>Readings: Carpi &amp; Egger, p. 159-197</p> <p>Tierney, D. (2011). "A Tarot Card Reading of America's Future." <i>The Atlantic</i>, June 16, 2011. <a href="http://www.theatlantic.com/national/archive/2011/06/a-tarot-card-reading-of-americas-future/240592/">http://www.theatlantic.com/national/archive/2011/06/a-tarot-card-reading-of-americas-future/240592/</a></p> <p>Interactive Activities: <b>Post your answers</b> to the following questions:</p> <ul style="list-style-type: none"> <li>What is the scientific method? WHEN was it first developed and/or used, and by whom? See how far back in history you can trace.</li> <li>What is inference? How can you distinguish between a <i>statement of fact</i> and a <i>statement of inference</i>?</li> <li>Can you ever prove that a hypothesis is true? Why or why not?</li> <li>What is extrapolation? Is this a good or bad thing to do when you're trying to make a prediction?</li> <li>What does the Tierney article suggest about how prediction is done in fields with a complex social context, such as politics?</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<p style="text-align: center;">5</p>	<p>Friday, May 23</p>	<p><b>EXPERIMENTATION</b></p> <p>Readings: Carpi &amp; Egger, p. 103-116</p> <p>Quinn, H. (2010). What is Science? <i>Physics Today</i>. <a href="http://www.asa3.org/ASA/topics/AboutScience/WhatisSciencePhysToday2009.pdf">http://www.asa3.org/ASA/topics/AboutScience/WhatisSciencePhysToday2009.pdf</a></p> <p>Letters in Response to Helen Quinn's Article: <a href="http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_63/iss_2/8_1.shtml?bypassSSO=1">http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_63/iss_2/8_1.shtml?bypassSSO=1</a></p>

		<p><b>Interactive Activities:</b></p> <p><b>Post your answers</b> to the following thought questions (you may have to consult resources outside your assigned readings... be sure to cite all sources you use):</p> <ul style="list-style-type: none"> <li>• What is the difference between <i>causation</i> and <i>correlation</i>?</li> <li>• What is an experiment? What is an observational study? How is an experiment DIFFERENT than an observational study? You can only determine causal relationships using one of these types of studies... which one, and why?</li> <li>• Provide an EXAMPLE of an experiment, and an EXAMPLE of an observational study. (If you get the examples by searching on the Internet, PLEASE cite your source.)</li> <li>• What are the main points of the Helen Quinn article? Why do you think you were asked to read her article? What does her experience tell you about how experiments are done in real life?</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<p style="text-align: center;"><b>6</b></p>	<p>Monday, May 26</p>	<p><b>SIMULATION &amp; MODELING</b></p> <p><b>Readings:</b> Carpi &amp; Egger, p. 143-158</p> <p><b>Interactive Activities:</b></p> <p><b>Post your answers</b> to the following questions:</p> <ul style="list-style-type: none"> <li>• What is modeling? What is simulation?</li> <li>• What is the relationship between the two? (<i>Hint: you can do one without the other, but you can't do the other without the first one!</i>)</li> <li>• Why might you choose to perform a simulation instead of an experiment? Provide at least one concrete example.</li> <li>• Search the internet to find one example that's interesting to you of how modeling and/or simulation solved a real world problem. Describe the example, and cite your source(s). Explain why you thought this was interesting.</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<p style="text-align: center;"><b>7</b></p>	<p>Tuesday, May 27</p>	<p><b>CONSENSUS &amp; SCIENTIFIC DECISION MAKING</b></p> <p><b>Readings:</b> Carpi &amp; Egger, p. 213-261</p> <p><a href="http://en.wikipedia.org/wiki/Consensus_decision-making">http://en.wikipedia.org/wiki/Consensus_decision-making</a></p> <p>Guliuza. R. J. "Consensus Science: The Rise of a Scientific Elite" <a href="http://www.icr.org/article/consensus-science-rise-scientific-elite/">http://www.icr.org/article/consensus-science-rise-scientific-elite/</a></p> <p>*Note: This article is sponsored by a religious advocacy organization and may contain bias. However, its description of consensus in science and its implications is thought provoking.</p>

		<p>“There is No Consensus on Global Warming”  <a href="http://noconsensus.org/what-is-consensus.php">http://noconsensus.org/what-is-consensus.php</a></p> <p><b>Interactive Activities:</b>  <b>Post your answers</b> to the following questions:</p> <ul style="list-style-type: none"> <li>• What is consensus? What is scientific consensus? Are the processes the same or different?</li> <li>• Why is consensus an important science process?</li> <li>• Do you need a unanimous vote to achieve consensus?</li> <li>• What is the role of the process of consensus when scientists publish new research results?</li> <li>• What do you think is the quickest and easiest way for a group to achieve consensus, and why?</li> </ul> <p><b>Observe the moon!</b> See instructions above and log your observation on the Facebook group.</p>
<b>8</b>	Wednesday, May 28	<b>PORTFOLIO</b> - Work on your portfolio, interacting with instructor as necessary to compile an excellent artifact of what you learned in this class.
<b>9</b>	Thursday, May 29	<b>PORTFOLIO</b> - Work on your portfolio, interacting with instructor as necessary to compile an excellent artifact of what you learned in this class.

## REQUIREMENTS & POLICIES

**Textbooks:** None. Videos and readings can be accessed online (see schedule below).

**Attendance Policy and Final Exam:** NO LATE WORK WILL BE ACCEPTED. This course is only two weeks – consider it a quick sprint – buckle down and just do it!

**Honor Code:** You are expected to abide by the JMU Honor Code at all times.

**Special Needs:** If you are a student who is registered with the Office of Disabilities, I need to be given written documentation to support your situation in order to provide you with any accommodations (this is required by law). Plans for any accommodations MUST be made within the first 48 hours of this course since it is so short.

**Contacting the Instructor:** You can contact any time (24/7) via email or SMS to 703.835.6336.

## METHODS OF EVALUATION

### Grading

**Your grade** in this course is ultimately based on my opinion of your professionalism as you participate in this class, and your ability to explain some of the key concepts at the end of the two week class timeframe. **My opinion will be based on** 1) the quality and timeliness of your posts to the Facebook group each day and your responses to your classmates' posts, and 2) the quality of your portfolio.

You are not competing with each other - so please feel free to share useful and interesting resources that you are adding to your portfolio that you think would be helpful to other IDLS students. Also, your instructor WANTS you to send her multiple drafts of your portfolio as it is in progress so she can provide feedback that ensures you are producing a high quality product.

There are a total of 30 points that can be earned in this course:

- 1 point for posting your thought questions to the Facebook group each of the 8 days
- 1 point for engaging in discussion on the Facebook group each of the 8 days
- 10 points for completing your portfolio to the instructor's satisfaction
- 2 points for posting and sharing your final portfolio with the class
- 2 points for posting and sharing your final "lessons learned" and reflections
- **Your points are "vested"** when you complete the reflection exercise and a short exit interview

**Grade scale:** 22+ points is an A, 17-21 is a B, 12-16 is a C, 7-11 is a D, 6 or below is an F.