MASTERS COURSE

NS350: Advanced Empirical Analyses

TERM
Fall 2020

CREDIT
4

Course Description

Empirical Analyses focuses on thinking creatively. You will become familiar with the central methods used in the natural and social sciences, enabling you to frame problems effectively, develop and test hypotheses, and engage in informed conjecture.

An overview of the Foundation Year curriculum, including the schedule of Units, Lessons, and Big Questions for this course, can be found on the Cornerstone Curriculum Map on the Hub.

Note: this syllabus is subject to change.

Course Objectives & Learning Outcomes

Prerequisites & Working Knowledge

Students must pass the summer assessments in coding and writing or take the Structured Study Sessions. All summer preparation resources for coding, writing, and mathematics can be found on The Hub: https://hub.minerva.kgi.edu/academics/m23-summer-preparation/

Assignments

There are four types of HC assessments in Cornerstone courses: HC-scored class polls and activities, signature assignments, location-based assignments, and the final project. Assignments will be weighted relative to HC-scored class polls and activities based on the values shown in the table below. All assessments will be scored based on the quality of HC application. For more information, see the "Assessment" section in the policies below.

- **HC-scored Class Polls and Activities**: Each 90-minute class session will be taught on the Minerva Active Learning Forum. During each class, students will answer a preparatory assessment poll and a reflection poll, which occur at the beginning and end of class respectively. These polls may be HC scored. In addition, some class activities will be selected for video scoring. Students will be alerted to scored activities when scores on polls and activities are released.
- **Signature Assignments:** These are original works (e.g., essays, short papers, problem sets or models) that consolidate the student's work on a combined set of HCs. The work is graded against a mandatory set of HCs that must be addressed. In addition, the student may address other HCs introduced earlier in this, or any other, Cornerstone course.
- **Location-based Assignment:** All Minerva courses include a location-based assignment (LBA). Each location-based assignment involves engaging in an activity in the student's current city of residence, and targets application of HCs in a new, real-world, context. LBAs are estimated to require at least 5 hours with your city of residence, as well as additional time for preparation, research, and writing up the work product to submit.
- **Final Project:** Each semester, students complete a single Final Project across all four cornerstone classes. Final Projects will appear as a separate course on the dashboard of the Active Learning Forum.

Note: Sunday is considered the beginning of the academic week for determining due dates.

ASSIGNMENT TITLE	WEIGHTING	IMPORTANT DATES
Problem Solving	9x	**Released:** Week 2, Thursday **Due:** Week 5, Thursday
Scientific Proposal	12x	**Released:** Week 8, Wednesday **Due:** Week 11, Tuesday
Final Project: HC synthesis	10x	**Released:** Week 11, Monday **Due:** Week 15, Friday

Required Texts

Schedule of Topics and Readings

This course meets for 2 class sessions each week.

Unit 1: Problem Solving

In this unit, students acquire tools that facilitate a methodical and systematic approach to problem solving, which is an important skill for any career direction.

Session 1:
1.1 EA Introduction

Learning Outcomes

HCs

Readings, Videos, and other preparation resources:

Case, N. (2018). How to Remember Anything Forever-ish. Retrieved from
https://ncase.me/remember/

Read the Course Syllabus (linked on the course page on your dashboard).

Ossola, A. (2014). Scientists are more creative than you might imagine. *The Atlantic*. Retrieved July 11, 2016 from
http://www.theatlantic.com/education/archive/2014/11/the-creative-scientist/382633/

Session 2:
1.2 Science of Learning

Learning Outcomes

HCs

#scienceoflearning : Evaluate and use effective strategies to learn or teach specific types of material. (H) EA [Introduced]

Readings, Videos, and other preparation resources:

Kosslyn, S. M. (2017). The science of learning. In S. M. Kosslyn & B. Nelson (Eds.), *Working universities: Minerva and the future of higher education.* Cambridge, MA: MIT Press.
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00069173-9345/kosslyn--s.--2017-.-the-science-of-learning.pdf

Minerva Schools at KGI (2019). Evaluating commonly used study techniques.
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00122597-6983/common-learning-techniques--using--scienceoflearning-to-make-the-most-of-your-study-time.pdf

Ted-Ed. (2015). How memories form and how we lose them - Catharine Young. [Video file]. In *YouTube*. Retrieved July 2017 from
https://www.youtube.com/watch?v=yOgAbKJGrTA

Burger, N. (2011).*Limitless Trailer*. [Video file]. Retrieved from
https://www.youtube.com/watch?v=t1UwmfF-MYM

#scienceoflearning: Evaluate and use effective strategies to learn or teach specific types of material.
https://seminar.minerva.kgi.edu/app/outcome-index/scienceoflearning

Miyatsu, T., Nguyen, K., & McDaniel, M. A. (2018). Five popular study strategies: Their pitfalls and optimal implementations.*Perspectives on Psychological Science*,*13*(3), 390-407. Available through Claremont libraries, CrossRef database

Session 3:
2.1 Identifying the right problems and subproblems

Learning Outcomes

HCs

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Introduced]

#rightproblem : Characterize the nature of the problem. (H) EA [Introduced]

Readings, Videos, and other preparation resources:

Minerva Schools at KGI (2019). Using #rightproblem to characterize complex problems.
https://drive.google.com/file/d/1jhYyWl1XbXpMjUnZrx8xc8Sz6oYcU64p/view?usp=sharing

Teksta, I. (nd). Problem solving. Retrieved from http://www.razvojkarijere.bg.ac.rs/stranice/uploads/678964ProblemSolving(1).pdf
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00072394-7367/tekstaproblemsolving.pdf

Ahuja, A. (2015). "Breaking down problems: Fishbone Diagrams and Outlines." Minerva Schools at KGI
https://course-resources.minerva.kgi.edu/cb/mke/25/BreakingDownaProblemFishboneDiagramsandOutlines.pdf

Foley, J. A. (2011). Can we feed the world and sustain the planet? *Scientific American*. Available through Claremont libraries, CrossRef database.

#rightproblem: Characterize the nature of the problem
https://seminar.minerva.kgi.edu/app/outcome-index/rightproblem

#breakitdown: Organize problems into tractable components and design solutions
https://seminar.minerva.kgi.edu/app/outcome-index/breakitdown

Session 4:
2.2 Gaps and Constraints

Learning Outcomes

HCs

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Introduced]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Introduced]

Readings, Videos, and other preparation resources:

Mauria, A. (2015, December 16). How to achieve breakthrough by embracing your constraints. Retrieved from https://blog.leanstack.com/how-to-achieve-breakthrough-by-embracing-constraints-c6382eeab5e9
https://leanstack.com/how-to-achieve-breakthrough-by-embracing-your-constraints/

Optional Review: Foley, J. A. (2011). Can we feed the world and sustain the planet? *Scientific American*. Available through Claremont libraries, CrossRef database.

Spradlin, D. (2012). Are you solving the right problem? *Harvard Business Review*. Retrieved July 2017 from https://hbr.org/2012/09/are-you-solving-the-right-problem
https://hbr.org/2012/09/are-you-solving-the-right-problem

Gahl, M. K. (2018). "Gap analysis". Minerva School at KGI.
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00070957-3505/ns50-2.2-gap-analysis--2-.pdf

#gapanalysis: Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required.
https://seminar.minerva.kgi.edu/app/outcome-index/gapanalysis

#constraints: Identify and apply constraint satisfaction as a way to solve problems.
https://seminar.minerva.kgi.edu/app/outcome-index/constraints

Session 5:
3.1 Synthesis 1: How can we feed the world?

Learning Outcomes

HCs

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

Readings, Videos, and other preparation resources:

Review: Foley, J. A. (2011). Can we feed the world and sustain the planet? *Scientific American*. Available through Claremont libraries, CrossRef database.

Terrascope. (2014). Background & Problems. *Mission 2014: Feeding the World.*
http://12.000.scripts.mit.edu/mission2014/problems

Optional: Ayres, I., & Nalebuff, B. (2004). Principled problem solving. *Scientific American Special Edition,14*(1). Available through Claremont libraries, Academic Search Complete database.

Read the assignment: Problem Solving on your dashboard and come prepared to answer and ask questions about the assignment in class.

Session 6:
3.2 Synthesis 2: How should we allocate water?

Learning Outcomes

HCs

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

Readings, Videos, and other preparation resources:

Plumer, B. (2015). A guide to California's drought and water crisis. *Vox.*
http://www.vox.com/cards/california-drought-water/california-water-crisis

Schwartz, N.D. (2015, May 6). Water pricing in two thirsty cities: In one, guzzlers pay more and use less. *The New York Times*.
http://www.nytimes.com/2015/05/07/business/energy-environment/water-pricing-in-two-thirsty-cities.html

Speed, R., Li, Y., Le Quesne, T., Pegram, G., & Z. Zhiwei. (2013). Basin water allocation planning: Principles, procedures and approaches for basin allocation planning. Paris: UNESCO.
http://unesdoc.unesco.org/images/0022/002208/220875e.pdf

Session 7:
4.1 Using analogies in problem solving

Learning Outcomes

HCs

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Extended]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Extended]

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Extended]

#analogies : Use analogies in problem solving appropriately. (C) EA [Introduced]

#rightproblem : Characterize the nature of the problem. (H) EA [Extended]

Readings, Videos, and other preparation resources:

Gavetti, G., & Rivkin, J. (2005). How strategists really think: Tapping the power of analogy. *Harvard Business Review,* 83, 54-63.
https://hbr.org/2005/04/how-strategists-really-think-tapping-the-power-of-analogy

Optional: Freeman, C. (2008). *California's water: A legislative analyst's office primer*.
http://www.lao.ca.gov/2008/rsrc/water_primer/water_primer_102208.pdf

NASA Science News (2000). Water on the Space Station.
http://science.nasa.gov/science-news/science-at-nasa/2000/ast02nov_1/

#analogies: Use analogies in problem solving appropriately
https://seminar.minerva.kgi.edu/app/outcome-index/analogies

Session 8:
4.2 Creative Heuristics

Learning Outcomes

HCs

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Continued]

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Introduced]

Readings, Videos, and other preparation resources:

Ness, R. B. (2015). Promoting innovative thinking. *American Journal of Public Health, Suppl 1, 105*, S114-S118. Available through Claremont libraries, by searching for American journal of public health, WorldCat database.

Minerva Schools at KGI (2019). Creative heuristics for novel solutions.
https://drive.google.com/file/d/1qBGgC5HDNs_jm0eCO1j4MzLoqMzRcYAF/view?usp=sharing

Cutraro, J. (2012). How creativity powers science.*Science News for Students*. Retrieved July 2017 from
https://www.sciencenewsforstudents.org/article/how-creativity-powers-science

Optional: Duke University. (2017, February 21). Creative People Have Better Connected Brains. *NeuroscienceNews*. Retrieved February 21, 2017 from
http://neurosciencenews.com/neural-network-creativity-6137/

Ossola, A. (2014). Scientists are more creative than you might imagine.*The Atlantic*. Retrieved July 11, 2016 from
http://www.theatlantic.com/education/archive/2014/11/the-creative-scientist/382633/

#heuristics: Identify when to use heuristics and when to avoid them
https://seminar.minerva.kgi.edu/app/outcome-index/heuristics

Session 9:
5.1 heuristics: making decisions

Learning Outcomes

HCs

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Continued]

#scienceoflearning : Evaluate and use effective strategies to learn or teach specific types of material. (H) EA [Continued]

Readings, Videos, and other preparation resources:

Martinez, M. (1998). What is problem solving? *The Phi Delta Kappan*, 79(8), 605-609. Available through Claremont libraries, ERIC database.

Behavioral Science Solutions (n.d.). Read the following sections:
1. Fast and frugal: https://www.behavioraleconomics.com/resources/mini-encyclopedia-of-be/fast-and-frugal/
2. Recognition heuristic: https://www.behavioraleconomics.com/resources/mini-encyclopedia-of-be/recognition-heuristic/
3. Satisficing: https://www.behavioraleconomics.com/resources/mini-encyclopedia-of-be/satisficing/

Marcatto, F. (2017). Decision making: Easier and faster decisions are possible. Retrieved from
https://mindiply.com/blog/post/easier-and-faster-decisions-are-possible

Review: Minerva Schools at KGI (2019). Common Learning Techniques: Using #scienceoflearning to Make the Most of Your Study Time
https://drive.google.com/a/minervaproject.com/file/d/1d0SDcy-yvhT5vAj1da5XphrG_JfCd_8a/view?usp=sharing

Review: Kosslyn, S. M. (2017). The science of learning. In S. M. Kosslyn & B. Nelson (Eds.), *Working universities: Minerva and the future of higher education. *Cambridge, MA: MIT Press.
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00069173-9345/kosslyn--s.--2017-.-the-science-of-learning.pdf

Optional Review: Plumer, B. (2015). A guide to California's drought and water crisis. *Vox.*
http://www.vox.com/cards/california-drought-water/california-water-crisis

Optional Review: Schwartz, N.D. (2015, May 6). Water pricing in two thirsty cities: In one, guzzlers pay more and use less. *The New York Times*. Retrieved from:
http://www.nytimes.com/2015/05/07/business/energy-environment/water-pricing-in-two-thirsty-cities.html

(optional) Ted-X. (2017). Self Worth Theory: The Key to Understanding & Overcoming Procrastination -Nic Voge . [Video file]. In *YouTube*. Retrieved Sept 2019
https://www.youtube.com/watch?v=52lZmIafep4

Session 10:
5.2 Problem Solving Synthesis

Learning Outcomes

HCs

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

#analogies : Use analogies in problem solving appropriately. (C) EA [Synthesized]

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

Readings, Videos, and other preparation resources:

Lakhani, K. & Jeppeson, L. (2007). Getting unusual suspects to solve R&D puzzles. *Harvard Business Review*.
https://hbr.org/2007/05/getting-unusual-suspects-to-solve-rd-puzzles/ar/1

Fox, S. (2015). Nine real NASA technologies in 'The Martian'. NASA.
http://www.nasa.gov/feature/nine-real-nasa-technologies-in-the-martian

Mars One. (n.d.). Retrieved August 05, 2016, from http://www.mars-one.com/
http://www.mars-one.com/

Session 11:
6.1 No class

Learning Outcomes

HCs

Readings, Videos, and other preparation resources:

Session 31:
16.1 Making Decisions and Designing Solutions

Learning Outcomes

HCs

#heuristics : Identify when to use heuristics and when to avoid them. H (EA)

#scienceoflearning : Evaluate and use effective strategies to learn or teach specific types of material. (H) EA

Readings, Videos, and other preparation resources:

Martinez, M. (1998). What is problem solving? *The Phi Delta Kappan*, 79(8), 605-609. Available through Claremont libraries, ERIC database.

Ted-X. (2017). Self Worth Theory: The Key to Understanding & Overcoming Procrastination -Nic Voge . [Video file]. In *YouTube*. Retrieved Sept 2019
https://www.youtube.com/watch?v=52lZmIafep4

Optional Review: Freeman, C. 2008.*California's water: A legislative analyst's office primer*.
http://www.lao.ca.gov/2008/rsrc/water_primer/water_primer_102208.pdf

*Optional Review:*Plumer, B. (2015). A guide to California's drought and water crisis.*Vox.*
http://www.vox.com/cards/california-drought-water/california-water-crisis

Review Minerva Schools at KGI (2019). Common Learning Techniques: Using #scienceoflearning to Make the Most of Your Study Time
https://drive.google.com/file/d/133xVWTazt9Xs-GJzJF_opmRWlrnYAYE_/view?usp=sharing

*Review*Kosslyn, S. M. (2017). The science of learning. In S. M. Kosslyn & B. Nelson (Eds.),*Working universities: Minerva and the future of higher education.*Cambridge, MA: MIT Press
https://course-resources.minerva.kgi.edu/uploaded_files/mke/00069173-9345/kosslyn--s.--2017-.-the-science-of-learning.pdf

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Unit 2: Scientific Method

The second unit explores the scientific method. It begins with the foundations of empiricism: observations, perceiving patterns, formulating hypotheses about future observations, and testing those hypotheses. Students learn that observations are theory-driven, how values and contexts inform what we observe, and what kinds of patterns we seek. We discuss the desirable properties of scientific hypotheses, including testability, accuracy, simplicity, consistency, and fruitfulness. We also explore the relationships among facts, hypotheses, theories and scientific laws.

Session 12:
6.2 Evaluating Evidence

Learning Outcomes

HCs

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Introduced]

Readings, Videos, and other preparation resources:

Carpi, A., & Egger, A. (2009). Theories, hypotheses, and laws.Visionlearning. Vol. POS-2 (9).
https://www.visionlearning.com/en/library/Process-of-Science/49/Theories-Hypotheses-and-Laws/177

N. (2012, July 02). Climate Change: Lines of Evidence. [Video file]. In *Youtube*. Retrieved from: https://www.youtube.com/watch?v=gIUN5ziSfNc
https://www.youtube.com/watch?v=gIUN5ziSfNc

The University of California Museum of Paleontology. (2015).Misconceptions about science.
https://undsci.berkeley.edu/teaching/misconceptions.php#a1

The University of California Museum of Paleontology. (2015). Reviewing test results.
https://undsci.berkeley.edu/article/0_0_0/howscienceworks_10

Naughton, J. (2017). 'Facts' and the production of ignorance. *Medium. *Retrieved from
https://medium.com/@jjn1/facts-and-the-production-of-ignorance-c3e277131f32

boyd, d. (2019). Agnotology and epistemological fragmentation. *Medium. *Retrieved from
https://points.datasociety.net/agnotology-and-epistemological-fragmentation-56aa3c509c6b

Oliver, J. (2014). Climate change debate. [Video file]. *Last Week Tonight with John Oliver (HBO)*. Retrieved from
https://www.youtube.com/watch?v=cjuGCJJUGsg

Session 13:
7.1 Data Visualization 1: Evaluating Visualizations

Learning Outcomes

HCs

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Introduced]

#variables : Identify and classify the relevant variables of a system, problem, or model. (H) FA [Extended]

Readings, Videos, and other preparation resources:

Caprette, D. (1997). Experimental Biosciences resources: Using figures - the basics.
http://www.ruf.rice.edu/~bioslabs/tools/data_analysis/using_figures.html

Egger, A. E., & Carpi, A. (2017, February 12). Using Graphs and Visual Data in Science | Process of Science.
https://www.visionlearning.com/en/library/Process-of-Science/49/Using-Graphs-and-Visual-Data-in-Science/156

Department of Biology, Bates College. (2002). Almost everything you wanted to know about making tables and figures. How to write a paper in scientific style and format.
http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtablefigs.html

National Centers for Environmental Information. (n.d.). What Are "Proxy" Data? In *NOAA. *Retrieved from: https://www.ncdc.noaa.gov/news/what-are-proxy-data
https://www.ncdc.noaa.gov/news/what-are-proxy-data

National Centers for Environmental Information. (n.d.). Did You Know? In* NOAA*. Retrieved from: https://www.ncdc.noaa.gov/monitoring-references/dyk/anomalies-vs-temperature
https://www.ncdc.noaa.gov/monitoring-references/dyk/anomalies-vs-temperature

*Review: *N. (2012, July 02). Climate Change: Lines of Evidence. [Video file]. In *Youtube*. Retrieved from: https://www.youtube.com/watch?v=gIUN5ziSfNc
https://www.youtube.com/watch?v=gIUN5ziSfNc

#dataviz: Interpret, analyze, and create data visualizations.
https://seminar.minerva.kgi.edu/app/outcome-index/dataviz

Session 14:
7.2 Data Visualization 2: Creating Visualizations

Learning Outcomes

HCs

#variables : Identify and classify the relevant variables of a system, problem, or model. (H) FA [Extended]

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Continued]

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Continued]

Readings, Videos, and other preparation resources:

Review: Department of Biology, Bates College. (2002). Almost everything you wanted to know about making tables and figures. *How to write a paper in scientific style and format.*
http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtablefigs.html

(Optional) Resource for Google Sheets: Sowash, J. (2012). Inserting charts into Google spreadsheets. [Video file]. In *Youtube.* Retrieved from: https://www.youtube.com/watch?v=57-PnwILchs
https://www.youtube.com/watch?v=57-PnwILchs

(Optional) Resource for Excel: Microsoft Office Tutorials. (2015). Create a chart from start to finish.
https://support.office.com/en-us/article/Create-a-chart-from-start-to-finish-a745775f-98d9-4c63-bfa8-9c00cd03ff0c?CTT=5&origin=HA010342187&CorrelationId=551a7d44-50f3-40f5-891f-9eb27173d3cd&ui=en-US&rs=en-US&ad=US.

Caprette, D. (1997). Experimental Biosciences resources: Graphic Examples. Retrieved July 11, 2015 from
http://www.ruf.rice.edu/~bioslabs/tools/data_analysis/graphic_examples.html

Shaftel, H., Jackson, R., and Callery, S. (2019). NASA Global Climate Change - Responding to climate change. *Retrieved from*
https://climate.nasa.gov/solutions/adaptation-mitigation/

Session 15:
8.1 Data Visualization 3: Data processing

Learning Outcomes

HCs

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Continued]

#variables : Identify and classify the relevant variables of a system, problem, or model. (H) FA [Extended]

#descriptivestats : Calculate and interpret descriptive statistics appropriately. (H) FA [Extended]

Readings, Videos, and other preparation resources:

McCandless, D. (2010). TEDGlobal2010: The beauty of data visualization. In *TedTalks*. Retrieved from: http://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization?language=en
http://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization?language=en

*Review: *Egger, A. E., & Carpi, A. (2017, February 12). Using Graphs and Visual Data in Science | Process of Science.
https://www.visionlearning.com/en/library/Process-of-Science/49/Using-Graphs-and-Visual-Data-in-Science/156

Aisch, G. (n.d.). Using Data Visualization to Find Insights in Data. In *Data Journalism*. Retrieved from: https://datajournalism.com/read/handbook/one/understanding-data/using-data-visualization-to-find-insights-in-data
http://datajournalismhandbook.org/1.0/en/understanding_data_7.html

Review: Caprette, D. (1997). Experimental Biosciences resources: Using figures - the basics.
http://www.ruf.rice.edu/~bioslabs/tools/data_analysis/using_figures.html

Review: Caprette, D. (1997). Experimental Biosciences resources: Graphic Examples.
http://www.ruf.rice.edu/~bioslabs/tools/data_analysis/graphic_examples.html

Session 16:
8.2 Developing Hypotheses 1: Patterns in data

Learning Outcomes

HCs

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Introduced]

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Continued]

Readings, Videos, and other preparation resources:

The University of California Museum of Paleontology. (2015). *Science works with testable ideas.*
http://undsci.berkeley.edu/article/0_0_0/%3C?%20echo%20$baseURL;%20?%3E/whatisscience_05

The University of California Museum of Paleontology. (2015). The core of science. In *The University of California Museum of Paleontology.* Retrieved from: https://undsci.berkeley.edu/article/%3c?%20echo%20$baseURL;%20?%3E_0/coreofscience_01
http://undsci.berkeley.edu/article/%3C?%20echo%20$baseURL;%20?%3E_0/coreofscience_01

The University of California Museum of Paleontology. (2015). *Putting the pieces together.*
http://undsci.berkeley.edu/article/0_0_0/%3C?%20echo%20$baseURL;%20?%3E/coreofscience_02

The University of California Museum of Paleontology. (2015). *Digging into data.*
http://undsci.berkeley.edu/article/0_0_0/howscienceworks_09

The University of California Museum of Paleontology. (2015). *Reviewing test results.*
http://undsci.berkeley.edu/article/0_0_0/howscienceworks_10

The University of California Museum of Paleontology. (2015). *Real world results.*
http://undsci.berkeley.edu/article/real_world_results

Indiana University at Bloomington Library. (n.d.). Narrowing a topic and developing a research question. Retrieved from: https://libraries.indiana.edu/sites/default/files/Develop_a_Research_Question.pdf
https://libraries.indiana.edu/sites/default/files/Develop_a_Research_Question.pdf

Jacobi Jayne & Company. (n.d.). Living with Birds: House Martin. Retrieved from
https://www.livingwithbirds.com/tweetapedia/21-facts-on-house-martin

#hypothesisdevelopment: Evaluate the link between hypothesis-driven research and the theories or observations that motivate it.
https://seminar.minerva.kgi.edu/app/outcome-index/hypothesisdevelopment

Session 17:
9.1 Testing Hypotheses: Study Types

Learning Outcomes

HCs

#interventionalstudy : Design and interpret experimental studies. (C) EA [Introduced]

#observationalstudy : Design and interpret observational studies. (C) EA [Introduced]

Readings, Videos, and other preparation resources:

Lesh, M. (2015) Observational vs. Experimental Study. [video file] Retrieved from:
https://www.youtube.com/watch?v=71CZQZSrOy0

Khan Academy (n.d.). Observational Studies and Experiments.
https://www.khanacademy.org/math/ap-statistics/gathering-data-ap/types-of-studies-experimental-vs-observational/a/observational-studies-and-experiments

McLeod, S. A. (2019, Aug 03).*Case study method*. Retrieved from
https://www.simplypsychology.org/case-study.html

Gross, C. (2013) The Long and Short of Memory. *The Nation.* Retrieved From:
https://www.thenation.com/article/long-and-short-memory/

Queensland Brain Inst. (2018) Types of Memory. Retrieved from:
https://qbi.uq.edu.au/brain-basics/memory/types-memory

Center for functional MRI (n.d.). What is fMRI?. *UC San Diego School of Medicine.* Retrieved from:
http://fmri.ucsd.edu/Research/whatisfmri.html

#observationalstudy: Design and interpret observational studies.* Outcome Index. *
https://seminar.minerva.kgi.edu/app/outcome-index/observationalstudy

#interventionalstudy: Design and interpret experimental studies*. Outcome Index*
https://seminar.minerva.kgi.edu/app/outcome-index/interventionalstudy

Session 18:
9.2 Developing Hypotheses 2: Theory Testing

Learning Outcomes

HCs

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Continued]

#induction : Analyze and apply inductive reasoning. (C) FA [Synthesized]

Readings, Videos, and other preparation resources:

The University of California Museum of Paleontology. (2015). *Even Theories Change.*
http://undsci.berkeley.edu/article/0_0_0/howscienceworks_20

NASA/WMAP Science Team. (2010).Cosmology: The Study of the Universe
https://map.gsfc.nasa.gov/universe/

NASA/WMAP Science Team. (2010). Universe 101: Big Bang Theory: Big Bang Tests.
http://map.gsfc.nasa.gov/universe/bb_tests_exp.html

(Optional, but highly recommended). NOVA. (2004). Origins: Back to the beginnings. NOVA. In *Youtube*. Retrieved from: https://www.youtube.com/watch?v=621maypRngs
https://www.youtube.com/watch?v=621maypRngs

Kenyon College, 5 Colleges of Ohio. (2003). Introduction Section. In *Reading the primary literature in biology. *Retrieved from: http://biology.kenyon.edu/Bio_InfoLit/hypothesis/index.html
http://biology.kenyon.edu/Bio_InfoLit/hypothesis/index.html

Las Cumbres Observatory Global Telescope Network. (2015). Cepheid variable stars, supernovae, and distance measurement. Retrieved October 30, 2019 from
https://lco.global/spacebook/distance/cepheid-variable-stars-supernovae-and-distance-measurement/

Read the Scientific Proposal Assignment on your Dashboard

Session 19:
10.1 Testability

Learning Outcomes

HCs

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Introduced]

#observationalstudy : Design and interpret observational studies. (C) EA [Continued]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Continued]

Readings, Videos, and other preparation resources:

The University of California Museum of Paleontology. (2015). *Science relies on evidence.*
http://undsci.berkeley.edu/article/0_0_0/whatisscience_06

The University of California Museum of Paleontology. (2015). *Testing scientific ideas*.
http://undsci.berkeley.edu/article/howscienceworks_06

The University of California Museum of Paleontology. (2015). *Predicting the past.*
http://undsci.berkeley.edu/article/0_0_0/coreofscience_03

The University of California Museum of Paleontology. (2015). *Arguments with legs to stand on.*
http://undsci.berkeley.edu/article/0_0_0/coreofscience_04

BBC Radio 4. (2015). Karl Popper's Falsification. [Video file]. In *Youtube. *Retrieved from: https://www.youtube.com/watch?v=wf-sGqBsWv4
https://www.youtube.com/watch?v=wf-sGqBsWv4

Hadhazy, A. (2015). Relativity's long string of successful predictions. In *Discover*. Retrieved October 2017 from: http://discovermagazine.com/2015/april/12-putting-relativity-to-the-test
http://discovermagazine.com/2015/april/12-putting-relativity-to-the-test

#testability: Evaluate whether hypotheses lead to testable predictions
https://seminar.minerva.kgi.edu/app/outcome-index/testability

Session 20:
10.2 Plausibility

Learning Outcomes

HCs

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Continued]

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Introduced]

Readings, Videos, and other preparation resources:

The University of California Museum of Paleontology. (2015). *Competing ideas: a perfect fit for the evidence*.
http://undsci.berkeley.edu/article/0_0_0/howscienceworks_11

The University of California Museum of Paleontology. (2015). *Competing ideas: other considerations*.
http://undsci.berkeley.edu/article/0_0_0/howscienceworks_12

The University of California Museum of Paleontology. (2015). *Making assumptions.*
https://undsci.berkeley.edu/article/0_0_0/howscienceworks_13

NASA/WMAP Science Team. (2010). Universe 101. In *NASA*. Retrieved from: https://map.gsfc.nasa.gov/universe/universe.html
https://map.gsfc.nasa.gov/universe/universe.html

Veritasium. (2011). Physics Nobel Prize 2011: Brian Schmidt [Video file]. In *YouTube*. Retrieved October 2017 from: https://www.youtube.com/watch?v=YHBvOOX3RJQ
https://www.youtube.com/watch?v=YHBvOOX3RJQ

#plausibility: Evaluate whether hypotheses are based on plausible premises or assumptions
https://seminar.minerva.kgi.edu/app/outcome-index/plausibility

Session 21:
11.1 Synthesis: Testability, Plausibility, Hypothesis development

Learning Outcomes

HCs

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Synthesized]

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Synthesized]

Readings, Videos, and other preparation resources:

Tate, K. (2014). Cosmic inflation: How It Gave the Universe the Ultimate Kickstart (Infographic). In *Space*. Retrieved from: https://map.gsfc.nasa.gov/universe/universe.html
http://www.space.com/25075-cosmic-inflation-universe-expansion-big-bang-infographic.html

Frank, A. and Gleiser, M. (2015). A crisis at the edge of physics. *New York Times*
http://www.nytimes.com/2015/06/07/opinion/a-crisis-at-the-edge-of-physics.html?smid=nytcore-iphone-share&smprod=nytcore-iphone&_r=1

Ellis, G., Silk, J. (2014). Scientific method: Defend the integrity of physics. *Nature, 516*, 321–323. doi:10.1038/516321a.
https://www.nature.com/news/scientific-method-defend-the-integrity-of-physics-1.16535

Goldhill, J. (2016). Philosophers want to know why physicists believe theories they can't prove. *Quartz*.
http://qz.com/590406/philosophers-want-to-know-why-physicists-believe-theories-they-cant-prove/

Dawid, R. (2015). Physics theory: "Simple" or "elegant" criteria are not valid. *Nature, 518*, 303. doi:10.1038/518303d.
https://www.nature.com/articles/518303d

NASA/WMAP Science Team. (2010). Universe 101: Big Bang Theory. Inflation.
http://map.gsfc.nasa.gov/universe/bb_cosmo_infl.html

Optional background: NASA/WMAP Science Team. (2010). Universe 101: Big Bang Theory. Acceleration.
http://map.gsfc.nasa.gov/universe/uni_accel.html

Optional: Green, B. (2005). Making sense of string theory [Video file]. In *Ted*. Retrieved from: https://www.ted.com/talks/brian_greene_on_string_theory/transcript

Hubble Discoveries. (n.d.). Fate of the universe. *HubbleSite*. Retrieved November 13, 2019 from
https://web.archive.org/web/20190127172708/http://hubblesite.org/hubble_discoveries/dark_energy/de-fate_of_the_universe.php

Session 22:
11.2 Modeling 1: Model types

Learning Outcomes

HCs

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Extended]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Introduced]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Continued]

Readings, Videos, and other preparation resources:

Egger, A., and Carpi, A. (2008). Modeling in Scientific Research. In *Visionlearning*. Retrieved from:
http://www.visionlearning.com/en/library/Process-of-Science/49/Modeling-in-Scientific-Research/153/reading

Wikipedia. (n.d.). Model Organism. Retrieved from:
https://en.wikipedia.org/wiki/Model_organism

University of Ottawa. (2015). Outbreaks, epidemics, and pandemics. *Society, the Individual, and Medicine*. Retrieved from:
https://web.archive.org/web/20190207035549/http://www.med.uottawa.ca/sim/data/Pandemic_e.htm

Optional: Passini, E., Rodriguez, B., Benito, P., Wellcome Trust Senior Research Fellow in Basic Biomedical Sciences, & University of Oxford. (2018, June 15). Why computer simulations should replace animal testing for heart drugs. Retrieved from
https://theconversation.com/why-computer-simulations-should-replace-animal-testing-for-heart-drugs-93409

Optional: Lewis, T. (2016). Will Organs-in-a-Dish Ever Replace Animal Models? (n.d.). In *The Scientist*. Retrieved from
https://www.the-scientist.com/news-analysis/will-organs-in-a-dish-ever-replace-animal-models-33168

Optional: N. (2017, March 02). Watch This Guy Build a Massive Solar System in the Desert | Short Film Showcase [Video file]. Retrieved from: https://www.youtube.com/watch?v=Kj4524AAZdE
https://www.youtube.com/watch?v=Kj4524AAZdE

Differences between in vitro, in vivo, and in silico studies. (n.d.). Retrieved from
https://mpkb.org/home/patients/assessing_literature/in_vitro_studies

(Optional) Callaway, E. (2019). 'Make Ebola a thing of the past': first vaccine against deadly virus approved. *Nature*, Retrieved November 15, 2019 from
https://www.nature.com/articles/d41586-019-03490-8

#modeling: Recognize how models can be used to describe a system, explain a set of data, and generate predictions.
https://seminar.minerva.kgi.edu/app/outcome-index/modeling

Session 23:
12.1 Modeling 2: Generating predictions from computer simulations

Learning Outcomes

HCs

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Continued]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Extended]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Extended]

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Extended]

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Extended]

#observationalstudy : Design and interpret observational studies. (C) EA [Extended]

Readings, Videos, and other preparation resources:

Wilensky, U. (1998). NetLogo Virus model. In *Center for Connected Learning and Computer-Based Modeling. *Northwestern University, Evanston. Retrieved from: http://ccl.northwestern.edu/netlogo/models/Virus
http://ccl.northwestern.edu/netlogo/models/Virus

University of Ottawa. (2015). Routes for spread of infectious disease. In *Society, the Individual, and Medicine. *Retrieved from: https://coursebuilder.minerva.kgi.edu/courses/925/#plan-10-2-anchor
https://web.archive.org/web/20190310130340/http://www.med.uottawa.ca/sim/data/Infection_spread_e.htm

Rosling, H. (2009). Insights on HIV, in stunning data visuals [Video file]. In *TedTalks*. Retrieved from: https://www.ted.com/talks/hans_rosling_the_truth_about_hiv?language=en
http://www.ted.com/talks/hans_rosling_the_truth_about_hiv?language=en

Optional: Wikipedia. (n.d.). Basic reproduction number.
https://en.wikipedia.org/wiki/Basic_reproduction_number

Review: Egger, A., & Carpi, A. (2008). Modeling in Scientific Research. In *Visionlearning*. Retrieved from: http://www.visionlearning.com/en/library/Process-of-Science/49/Modeling-in-Scientific-Research/153/reading
http://www.visionlearning.com/en/library/Process-of-Science/49/Modeling-in-Scientific-Research/153/reading

Wikipedia. (n.d.). Mathematical modelling of infectious disease.
https://en.wikipedia.org/wiki/Mathematical_modelling_of_infectious_disease

Session 24:
12.2 No Class

Learning Outcomes

HCs

Readings, Videos, and other preparation resources:

Session 25:
13.1 Modeling 3: Evaluating Models

Learning Outcomes

HCs

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Extended]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Continued]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Extended]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Extended]

Readings, Videos, and other preparation resources:

Wikipedia. (n.d.). Vaccine.
https://en.wikipedia.org/wiki/Vaccine

Haelle, T. (2014). Measles cases are spreading, despite high vaccination rates. What's going on? In *The Washington Post.* Retrieved from: https://www.washingtonpost.com/national/health-science/measles-cases-are-spreading-despite-high-vaccination-rates-whats-going-on/2014/06/23/38c86884-ea97-11e3-93d2-edd4be1f5d9e_story.html
https://www.washingtonpost.com/national/health-science/measles-cases-are-spreading-despite-high-vaccination-rates-whats-going-on/2014/06/23/38c86884-ea97-11e3-93d2-edd4be1f5d9e_story.html

Venosa, A. (2016). I'm sick, but with what? Difference between bacterial, parasitic, and viral infections. In *Medical Daily*. Retrieved from: http://www.medicaldaily.com/viral-infection-im-sick-pathogens-384531
http://www.medicaldaily.com/viral-infection-im-sick-pathogens-384531

Review: Egger, A., & Carpi, A. (2008). Modeling in Scientific Research. In *Visionlearning.* Retrieved from: http://www.visionlearning.com/en/library/Process-of-Science/49/Modeling-in-Scientific-Research/153/reading
http://www.visionlearning.com/en/library/Process-of-Science/49/Modeling-in-Scientific-Research/153/reading

Review: Wikipedia. (n.d.). Mathematical modelling of infectious disease.
https://en.wikipedia.org/wiki/Mathematical_modelling_of_infectious_disease

Session 26:
13.2 Semester Synthesis 1: Sea Level Rise and Biosphere 2

Learning Outcomes

HCs

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Synthesized]

#observationalstudy : Design and interpret observational studies. (C) EA [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

#analogies : Use analogies in problem solving appropriately. (C) EA [Synthesized]

#interventionalstudy : Design and interpret experimental studies. (C) EA [Synthesized]

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Synthesized]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Synthesized]

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Synthesized]

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Synthesized]

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

Readings, Videos, and other preparation resources:

San Francisco Planning Department. (2016). Sea level rise action plan. In *City County of San Francisco.* Retrieved from: http://default.sfplanning.org/plans-and-programs/planning-for-the-city/sea-level-rise/160309_SLRAP_Final_ED.pdf
http://default.sfplanning.org/plans-and-programs/planning-for-the-city/sea-level-rise/160309_SLRAP_Final_ED.pdf

Smith, J. (2010). Life under the bubble. In *Discover Magazine*. Retrieved from: http://discovermagazine.com/2010/oct/20-life-under-the-bubble
http://discovermagazine.com/2010/oct/20-life-under-the-bubble

(Optional) Retro Report. (2013). Biosphere 2: An American space odyssey [Video file]. *The New York Times*. Retrieved September 2017 from http://www.nytimes.com/2013/06/10/booming/biosphere-2-good-science-or-bad-sense.html
http://www.nytimes.com/2013/06/10/booming/biosphere-2-good-science-or-bad-sense.html

Session 27:
14.1 Semester Synthesis 2: Pandemic Preparedness

Learning Outcomes

HCs

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Synthesized]

#analogies : Use analogies in problem solving appropriately. (C) EA [Synthesized]

#scienceoflearning : Evaluate and use effective strategies to learn or teach specific types of material. (H) EA [Synthesized]

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Synthesized]

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Synthesized]

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

#interventionalstudy : Design and interpret experimental studies. (C) EA [Synthesized]

#observationalstudy : Design and interpret observational studies. (C) EA [Synthesized]

Readings, Videos, and other preparation resources:

Gates, B. (2015). The next outbreak? We're not ready [Video file]. In *TedTalks*. Retrieved from: https://www.ted.com/talks/bill_gates_the_next_disaster_we_re_not_ready?language=en
https://www.ted.com/talks/bill_gates_the_next_disaster_we_re_not_ready?language=en

University of Ottawa. (2015). Infectious disease control. In *Society, the Individual, and Medicine*. Retrieved from: http://www.med.uottawa.ca/sim/data/Infectious_Diseases_e.htm
https://web.archive.org/web/20170601203123/http://www.med.uottawa.ca/sim/data/Infectious_Diseases_e.htm

Stone, J. (2014). Germs, Microbes Compete With Athletes in Sochi Olympics. In *Scientific American*. Retrieved from: http://blogs.scientificamerican.com/molecules-to-medicine/germs-microbes-compete-with-athletes-in-sochi-olympics/
http://blogs.scientificamerican.com/molecules-to-medicine/germs-microbes-compete-with-athletes-in-sochi-olympics/

Review the descriptions and rubrics for EA HCs introduced this term.

Session 28:
14.2 Semester Synthesis 3: Cretaceous World

Learning Outcomes

HCs

#gapanalysis : Identify and evaluate whether there are suitable existing solutions to a problem or whether a creative new solution is required. (C) EA [Synthesized]

#evidencebased : Identify and appropriately structure the information needed to support an argument effectively. (H) MC [Synthesized]

#heuristics : Identify when to use heuristics and when to avoid them. H (EA) [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#dataviz : Interpret, analyze, and create data visualizations. (C) EA [Synthesized]

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA [Synthesized]

#rightproblem : Characterize the nature of the problem. (H) EA [Synthesized]

#breakitdown : Organize problems into tractable components and design solutions. (H) EA [Synthesized]

#constraints : Identify and apply constraint satisfaction as a way to solve problems. (C) EA [Synthesized]

#analogies : Use analogies in problem solving appropriately. (C) EA [Synthesized]

#observationalstudy : Design and interpret observational studies. (C) EA [Synthesized]

#plausibility : Evaluate whether hypotheses are based on plausible premises or assumptions. (H) EA [Synthesized]

#modeling : Recognize how models can be used to describe a system, explain a set of data, and generate predictions. (C) EA [Synthesized]

#testability : Evaluate whether hypotheses lead to testable predictions. (H) EA [Synthesized]

#interventionalstudy : Design and interpret experimental studies. (C) EA [Synthesized]

Readings, Videos, and other preparation resources:

Initial information for our Dinosaur exploration
https://docs.google.com/document/d/1HjdvlNdI4xRbARoBQPDU3SSEQ3kcqCNh6i1AnyZimyI/edit?rm=embedded

Session 32:
16.2 Testing Hypothesis

Learning Outcomes

HCs

#hypothesisdevelopment : Evaluate the link between hypothesis-driven research and the theories or observations that motivate it. (C) EA

#casestudy : Design and interpret case studies. (C) EA

#observationalstudy : Design and interpret observational studies. (C) EA

#interventionalstudy : Design and interpret experimental studies. (C) EA

Readings, Videos, and other preparation resources:

Lesh, M. (2015) Observational vs. Experimental Study. [video file] Retrieved from:
https://www.youtube.com/watch?v=71CZQZSrOy0

Khan Academy (n.d.). Observational Studies and Experiments.
https://www.khanacademy.org/math/ap-statistics/gathering-data-ap/types-of-studies-experimental-vs-observational/a/observational-studies-and-experiments

McLeod, S. A. (2019, Aug 03).*Case study method*. Retrieved from
https://www.simplypsychology.org/case-study.html

Gross, C. (2013) The Long and Short of Memory. *The Nation.* Retrieved From:
https://www.thenation.com/article/long-and-short-memory/

Queensland Brain Inst. (2018) Types of Memory. Retrieved from:
https://qbi.uq.edu.au/brain-basics/memory/types-memory

Center for functional MRI (n.d.). What is fMRI?. *UC San Diego School of Medicine.* Retrieved from:
http://fmri.ucsd.edu/Research/whatisfmri.html

#casestudy : Design and interpret case studies. *Outcome Index.*
https://seminar.minerva.kgi.edu/app/outcome-index/casestudy

#observationalstudy: Design and interpret observational studies.* Outcome Index. *
https://seminar.minerva.kgi.edu/app/outcome-index/observationalstudy

#interventionalstudy: Design and interpret experimental studies*. Outcome Index*
https://seminar.minerva.kgi.edu/app/outcome-index/interventionalstudy

Policies

Professional Behavior

Minerva expects students to follow guidelines of professional behavior. With respect to academics, this means you are required to prepare appropriately for each class and actively participate in them. You should read all assigned materials, watch assigned videos, and complete all assigned pre-class work, including solving assigned problems and answering study guide questions. Because all of our classes are seminars, all students must be prepared to be full participants—to shirk on preparation not only short-changes you, it also undermines the experience for the other students. You are also required to adhere to assignment guidelines and deadlines, and to contact the appropriate administrator promptly should you wish to request an extension. Additional information, and consequences for failing to meet requirements are described below.

Absence Policy

See this flowchart for a visual summary of the absence policy.

Students are expected to be logged on to the ALF, ready to participate in class, by the class's scheduled start time. They should arrive a few minutes early to ensure that they have sufficient time to respond to any potential technical issues (see sections below for policies). A student is considered absent if the student arrives more than 2 minutes after the start of class time or leaves at any time during the class session.

All absences require make-up work. The make-up work is: (a) watch the video recording of the class; and (b) write a 400- to 500-word paper that summarizes how the HCs/LOs covered in the class session were applied in the activities, and that addresses the following questions:

1. What was the most interesting thing you learned from this class session and how does it connect to/expand upon the assigned preparatory material and pre-class work (if applicable)?
2. What aspect of the material covered in this session do you want to explore further and why?
3. What topic in this session did you find most confusing, and how do you plan to address your confusion?

The deadline for make-up work is determined by the dean of the master's program, with the date set a minimum of one week and a maximum of 1 month from the original deadline. Failure to complete satisfactory make-up work will result in the absence being counted as two absences.

For 4-unit courses (Advanced Empirical Analyses, Advanced Formal Analyses, and Advanced Complex Systems), students are allowed four absences per semester. For 2-unit courses (Research Methods), students are allowed two absences per semester. Any absences beyond the relevant limit will result in a student's being administratively withdrawn from the course.

Pre-Class Work Policy

During classes for which there was specific pre-class work to bring to class, students will be asked to show they have done the work by answering a related poll question, submitting their pre-class work (or some portion of it) as a poll response, or adding their pre-class work into a document in the main classroom or breakout notes. If a student has not completed the pre-class work, or has done so grossly inadequately, faculty will mark the student as absent for that session.

Late/Missing Assignment Policy

See this flowchart for a visual summary of the late/missing assignment policy.

All assignments are required. Students may request assignment deadline extensions, as long as the request is filed at least 48 hours prior to the assignment due date. To submit a request for an extension, please e-mail your professor and CC the Dean of Graduate Studies.

For 4-unit courses (Advanced Empirical Analyses, Advanced Formal Analyses, and Advanced Complex Systems), students are allowed two extensions per semester. For 2-unit courses (Research Methods), students are allowed one extension per semester.

Assignment deadline extensions may not be used for final projects or any other assignment due in week 15. Students with a documented emergency preventing them from submitting a final project by its deadline will be administratively withdrawn unless they petition for, and receive, an incomplete from the Academic Standards Committee (ASC).

A student who fails to submit all assignments by their original or extended deadlines will be administratively withdrawn from the course.

Policies for Technology and Network Issues

Disruptions of class due to widespread technical or network problems (e.g., ALF is down) will not be counted as absences. Absences due to a student's computer or internet failure will count as absences.

To minimize the chance of technical difficulty, students should follow these best practices:

- Restart the computer before class and close unnecessary apps and tabs
- Use the ALF app (as opposed to Chrome)
- Connect via ethernet (turn wifi off)
- Consult tech support immediately for any problems, via live chat if possible, or via email to helpdesk@minerva.kgi.edu in the worst case.
- Only attend class from locations in which your internet connection is reliable. If you are away from home or in a new location, run the A/V connection test while logged in at least 10 minutes prior to class to determine the suitability of the connection. Student-side connection failures do not constitute a valid reason for missing class.

Audio-Only Policy

Technical support staff, the professor, and the ALF system will have the ability to place a student on audio-only mode during class, should the student's bandwidth not be high enough to be on video.

Honor Code

The Minerva Honor Code rests on four pillars: honesty, integrity, mutual respect, and personal responsibility. Minerva students are expected to conduct themselves with the highest levels of these qualities both inside and outside the classroom. Each student serves as an ambassador to the community for Minerva. When one student exhibits inappropriate behavior outside the university, it reflects badly on every student and the institution as a whole (the public tends not to differentiate between individuals in these situations, and attributes bad behavior to the entire student body).

Minerva students are citizens of an academic community whose members are expected to challenge themselves and one another to achieve greatness with honesty, integrity, mutual respect, and personal responsibility. Each individual who joins the Minerva community accepts this commitment in an effort to sustain and enhance personal, professional and institutional reputations.

Principles inherent in this Honor Code include:

- Students shall treat all members of the community with respect and without malicious intent to ensure that all students share equal opportunities.
- Students shall conduct themselves in a manner that upholds their reputation for honesty and integrity in order to promote an environment of trust.

To assist students in understanding their responsibilities under the Honor Code, the following is a list of conduct pertaining to academic matters that violate the Honor Code. A more detailed guide for avoiding these violations can be found here.

Prohibited conduct includes, but is not limited to the following:

Plagiarism

- Knowingly appropriating another's words or ideas and representing them as one's own
- Use of another's words without acknowledging the source
- Paraphrasing the ideas of another without clear acknowledgment of the source
- Falsification or fabrication of a bibliography

Cheating

- Unauthorized collaboration on assignments
- Use of unauthorized resources during class and on coursework
- Use of previously submitted coursework for alternate purposes without prior approval

Obstruction of Honor Code

- Making false statements to an Honor Code investigator

Falsification of Information

- Knowingly making false statements or submitting misleading information related to academic concerns to Minerva faculty or staff
- Submission of falsified documents, such as transcripts, applications, petitions, etc.

It is not a defense to charges of violating this Honor Code for students to claim that they have not received, read or understood this Code, or is otherwise ignorant of its provisions. A student is held to have notice of this Honor Code by enrolling at Minerva. Students must fully cooperate with investigations into potential violations of the Honor Code.

Collaboration policy

We strongly encourage students to discuss the ideas they learn in class with their classmates. Learning in groups is always beneficial. However, although discussing pre-class work or assignments is acceptable, students must produce the work products they submit on their own unless otherwise indicated in the assignment instructions. For essay assignments and research papers, student must always draft their work products independently. Unless otherwise instructed, it is acceptable to give and receive peer feedback on assignments if drafts have been completed by all parties involved in producing and reviewing the work. For all other types of assignments, students may neither look at others' work products, nor share work products with any students who are not acting in an official Minerva capacity as a peer tutor unless indicated in the assignment instructions. For example, while it is acceptable to discuss different approaches to a coding assignment, it is not acceptable to look at another student's code or to share code with a student who is not acting as a peer tutor for the course. In addition to violating the Honor Code, if a student submits an assignment that is not the student's own work, it misrepresents the student's understanding of the concepts, and prevents faculty from giving beneficial feedback.

Students with Disabilities

Students with documented disabilities who would like to request accommodations are asked to submit an Accommodations for Disabilities Request form. The policy, guidelines, request form and other needed documents are found in Prepare at the beginning of each year, and on the Hub in the Student Center under Student Services. Students may request accommodations at any time during the year. The request and documentation are reviewed by our learning disability specialist, who determines whether accommodations are warranted, and contacts the student and assigned faculty members to facilitate all necessary arrangements. Please see the Student Handbook for more details. If you believe that you may have a disability that warrants accommodations but have not yet requested them, please contact Melissa Billings, Student Services Manager, for information (melissa@minerva.kgi.edu) or review the information on the Hub.

Video Recording Policies

In order to provide formative assessment of classroom discussion contributions in context, each Minerva class session will be video recorded. These recordings will be made available to students enrolled in the recorded class section so that students can view the personalized feedback/assessments written by the professor and later review the class discussion. These recordings are not to be shared/distributed by students without the explicit written permission of the course faculty member and college dean overseeing the course.

The video recording of a class section will be made available to the students enrolled in that section shortly after the class, and will remain accessible to the students until the first day of the following academic year. Access to a recording from previous academic years can be requested for the purpose of appealing a grade or selecting video clips to include in a personal academic portfolio. Requests will be reviewed by the dean of the associated college. The Video Access Request Form is available on the registrar site, registrar.minerva.kgi.edu.

Assessment

Assessing Learning Outcomes

Letter grades are based entirely on outcome scores (on HCs or LOs) assigned using the mastery rubrics. The general template for these rubrics is as follows (see the HC Index on the ALF for rubrics specific to each HC):

1-(Lacks knowledge) Does not recall or use the skill or concept when prompted or does so mostly or entirely inaccurately.

2-(Superficial knowledge) Recalls or uses the skill or concept only somewhat accurately or uses the skill or concept in a way that fails to address the relevant problems or goals.

3-(Knowledge) Accurately or effectively uses the skill or concept in a way that addresses the relevant problems or goals.

4-(Deep knowledge) Accurately or effectively uses the skill or concept in a way that addresses the relevant problems or goals and demonstrates a deep grasp of the skill or concept by analyzing, explaining, or justifying the application in a way appropriate to the given context.

5-(Profound knowledge) Uses the skill or concept in a creative and effective way, relying on a novel perspective.

Students will receive HC/LO scores for in-class verbal contributions (approximately one activity a week will be scored), for preparatory assessment poll responses at the beginning of each class, and for reflection poll responses at end of each class. Preparatory assessment polls test understanding of pre-class readings and other assigned materials. Reflection polls provide students with the opportunity to synthesize the in-class activities and summarize a major take-away they learned from class. All in-class scores will have a weight of 1X. HC/LO scores for assignments will typically have a higher weighting, as specified in the Schedule of Assignments.

Grades

Final grades are based on a student's weighted mean of HC scores for the HCs introduced in that course, irrespective of the course in which the HC was assessed. That is, HC scores assigned in one course can influence the grade in another course. Letter grades according to the following scale:

Max (>)		Min (≥)	Grade
5.00	-	4.20	A+
4.20	-	3.75	A
3.75	-	3.50	A-
3.50	-	3.25	B+
3.25	-	3.00	B
3.00	-	2.8	B-
2.6	-	2.8	C+
2.5	-	2.6	C
2.25	-	2.5	C-
2	-	2.25	D
2	-	0	F

Grades for the Research Methods course are based on the weighted mean of scores earned in Course Objectives (COs). The score for each CO is the weighted mean of Learning Outcome (LO) scores falling under that CO.

Students must earn a C- or better in every course to qualify for the Master's degree.

Early Warning Notices

Each semester has a designated grading review period ending after six weeks. At this time, each student's progress will be reviewed by faculty to determine course standing. Students not making adequate progress in the course will be contacted and placed on Early Warning. See the Student Handbook for more details.