Term Information

Effective Term	Spring 2023

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

We are proposing that this course be part of the Theme - Number, Nature, and Mind

What is the rationale for the proposed change(s)?

The course content and goals align with those of the proposed GE category.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

None

Is approval of the requrest contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Linguistics
Fiscal Unit/Academic Org	Linguistics - D0566
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	4052
Course Title	Linguistics and the Scientific Method
Previous Value	*Lingistics and the Scientific Method*
Transcript Abbreviation	Scientific Method
Course Description	Provides a strong grounding in fundamental principles of scientific reasoning illustrated through concrete examples across the Natural and Social sciences with emphasis on Psychology and Linguistics. This course is suitable for students from all backgrounds including non-science majors. Students will gain understanding of what it means to "do science."
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week, 7 Week, 6 Week, 4 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster
Previous Value	*Columbus*

Prerequisites and Exclusions

Prerequisites/Corequisites	
Exclusions	
Electronically Enforced	No

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	16.0102
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Requirement/Elective Designation

Number, Nature, Mind

The course is an elective (for this or other units) or is a service course for other units

Previous Value

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- to construct valid and logical arguments through use of deductive and inductive reasoning processes
- to practice and increase general problem solving skills
- to develop sophistication in evaluating scientific scholarship in any domain
- to gain a thorough understanding of the Scientific Method

Content Topic List

- Scientific Thinking
- Logical Systems and The Scientific Method
- The Science of the Mind
- Information Processing Models
- The Science of Language

Sought Concurrence No

Attachments

- 4052Syllabus_Numbers_Theme.pdf: syllabus

  (Syllabus. Owner: Sims,Andrea Dorothy)

- 4052_ELOs.pdf: GE Rationale

  (Other Supporting Documentation. Owner: Sims,Andrea Dorothy)

Comments

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Sims,Andrea Dorothy	06/23/2022 11:58 AM	Submitted for Approval
Approved	Sims,Andrea Dorothy	06/23/2022 11:59 AM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	08/26/2022 10:31 AM	College Approval
Pending Approval	Cody,Emily Kathryn Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	08/26/2022 10:31 AM	ASCCAO Approval

LING 4052: Linguistics and the Scientific Method
Spring 20xx

Instructor: Dr. Becca Morley
morley.33@osu.edu
Oxley 310

Weekly Schedule: T R 11:10-12:20 Oxley 103

Office Hours: by appointment, email morley.33@osu.edu

Course Description

What does it really mean to 'do Science'? And what counts as a scientific discipline? How do we know that one theory is better than another? And what does it take to discredit a theory once and for all? The aim of this course is to provide a strong grounding in some of the fundamental principles of scientific reasoning, illustrated through concrete examples across the Natural and Social Sciences. We will go on to investigate how these principles can be applied to the study of entities that cannot be directly observed or measured. The human mind is the ultimate 'black box' about which we can only make indirect inferences. This presents particular challenges for a science of the mind, of which Linguistics is considered to be one branch.

The course is divided into a series of connected modules. The first of these covers the philosophy of science, inductive and deductive reasoning, cause and effect, and the nature of knowledge. The second is focused on the logic of the scientific method itself, with special focus on the concept of falsifiability. From there, a number of different symbolic systems are introduced in simplified form, e.g., base-x numbering systems, Boolean Logic, set theory, alphabets, etc. We go on to consider the representations and algorithms that might be instantiated in both the brain (hardware), and the mind (software). The last module is an introduction to the study of the human capacity for language. Here all the strands are brought together and applied to an existing debate in the literature that hinges on the correct interpretation of specific linguistic data.

This course is suitable for students from all areas, including non-science majors. No background in linguistics is assumed. Through group discussion of assigned readings we will work as a class to assess and understand the arguments that are made both against, and for, specific theories. Students will practice high level critiques of the quality of the argumentation, the validity of the conclusions, and the relevance of the results, even in cases where they may be unfamiliar with certain details of the subject matter.

Required Reading
We will read excerpts from a number of sources, many of them original works. All readings will be available in pdf form on Carmen. See attached bibliography.

Grading & Evaluation

Numerical scores for this course will be calculated out of a total of 400 points. Grades will be calculated from those scores using the Standard OSU Grading Scheme (in percentages):

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

- **42%** Reading Assignments (168 points total)
  - **12%** Prep. Assignment 1 (~ 7 pts each): summary paragraph of reading + questions (7; first 8 weeks[1])
  - **12%** Prep. Assignment 2 (16 pts each): P.A. 1 + assessment of argumentation (3; weeks 9-11)
  - **18%** Prep. Assignment 3: (24 pts each): P.A. 2 + connections to previous readings; consideration of falsifiability (3; weeks 12-15)
- **34%** Synopses (135 points total): A synopsis for each of the three case studies. See attached rubric for more details. You will be developing the skills to complete these assignments as the semester progresses. Therefore, it is not expected that you will be (**P)roficient** in all aspects to start. To provide a more equitable and inclusive grading approach that does not penalize lack of experience, you will be graded only on reaching a certain level of proficiency by the end of the semester. To receive full credit (135 points) on this set of assignments you will need to achieve a total of at least **10 Ps** combined across the 3 synopses and the 5 rubric categories (Organization, Communication, Concepts, Evaluation, Synthesis). Out of that total, there must be **at least one P for every unique category**. Otherwise the P's can be distributed across the synopses in any configuration[2]. An **Exemplary** can replace any P. Each **E** is worth **3% extra credit.**
- **24%** In-class (and take home) problem sets (about 7, each worth about 14 pts; 96 points total). We will start these assignments collaboratively in class; any material that is not completed will become a take-home assignment (typically due the following day).

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[1] In weeks 1 and 2 you will only be asked to submit questions from the readings. Each of these two assignments will be scored as half a P.A. 1 assignment, i.e., around 4 points each.

[2] For those of you who want the gory details now, this shakes out to 15% for each unique category P, and 10% for each additional P. This means that any category for which you have received 0 Ps lowers your grade by 15%; and any P you are missing to make up the total of 10, lowers your grade by 5%. For example, if you got 1 P for Organization on Synopsis 1, a P for Organization and a P for Communication on Synopsis 2, a P for Concepts, a P for Synthesis, and a P for Communication on Synopsis 3, your total grade would be 70% for this category: a missing P for Evaluation (-15%) and 3 additional Ps (-5%*3).

Assignments

In-class problem sets can be turned in physically or submitted online. They will all be started collaboratively in class, but may be finished off-line. Your synopses and reading assignments should be submitted online. **All files submitted online must be in pdf format, but can be handwritten on a tablet, or handwritten on paper and scanned if you prefer (using an actual scanning app, please, and not your phone's camera!)**

The reading assignments will get progressively more complex. For the first 8 weeks they will consist of a summary paragraph of the reading, and any questions you had (P.A. 1). In weeks 9-11 you will be asked to add an assessment of the argument structure (P.A. 2). In weeks 12-15 you will add connections to previous readings, and consider the falsifiability of claims made in the reading (if relevant) (P.A. 3). This progression is designed to transition you to writing a full synopsis.

A grading rubric for the 3 synopsis assignments is provided at the end of this syllabus. We'll also go over this in class. **The most important thing about synopses is that they are NOT book reports.** They are to be clear descriptions of the argument structure of the reading, explaining the reasoning of the author, the theoretical assumptions, the linking hypotheses between experiment and theory (as relevant), the type and quality of evidence used, the conclusions, links to other work, and any shortcomings or problematic issues in the claims of the paper. Synopses should be between 1-3 pages in length. Example synopses will be provided as guidelines.

Class discussions should help to clarify the essential claims and arguments of the reading. They should also serve to answer questions about the content of the material. Students are expected to use the discussions as a jumping off point for their writing. **You will also have the option to submit a revised version of any synopsis within 1 week after it is returned to you**. Revised synopses are expected to address my written and oral comments, and will be re-graded, with the new grade substituting for the old.

Note Taking & Questions

I expect you to ask questions if you have them. I rely on you to let me know when what I'm saying doesn't make sense[3]. I will probably slip up and use a term that you don't know from time to time. Ask in class. If you're struggling with anything, or just have a few questions, email me to chat, or to set up a meeting (in person or virtual). Office hours are by appointment only because fixed office hours typically don't work for half the class. Holding office hours is part of my job, and you should take full advantage of them.

Note taking is something of a dying art. But being able to take good notes is a very useful skill. It will consolidate the material better for you in memory, and will help in completing your assignments – especially the synopses. Therefore, if I'm going too quickly for you to take good notes, please let me know. I am always happy to slow down, try a slightly different way of explaining something, or back track to the point where things stopped making sense.

Special Considerations & Late Work

In-class problem sets will be (for the most part) completed during class and collected then. If you miss class the day I assign the problem set you can do it on your own and turn it in online by the end of the following day. Otherwise, **I do not accept late work as a general rule**. Homework can be

[3] Believe me, you will not be the only one.

turned in early if you know that you will be absent that day. The exceptions to this policy are actual emergencies, health issues, family stuff, and maybe other things if you **let me know about them in advance, or as soon as you know about them.**

Accommodation

If you need, or think you might need, an accommodation, let me know now – not halfway through the semester. The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Health and Safety Requirements

All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (https://safeandhealthy.osu.edu), which includes following university mask policies and maintaining a safe physical distance at all times. Non-compliance will be warned first and disciplinary actions will be taken for repeated offenses.

Mental Health Services

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you, or someone you know, is suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the **Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.**

Ethics

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated

by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Respect

You should treat everyone in this classroom with respect. That means, among other things, using everyone's preferred name and preferred gender pronoun (PGP). You should also be aware of the norms of respectful address for your instructors. Don't use their first names unless you're given explicit permission. If you're not sure whether your instructor has a PhD or not, err on the side of caution; Professor and Doctor are always acceptable. If you *do* know that your instructor has a PhD *do not* use Mr., Mrs., Miss, or even Ms.

Learning Objectives

Goals of the Number, Nature and Mind Theme GE:

1. Successful students will analyze the nature of mathematics and/or mathematical reasoning at a more advanced and in-depth level than in the Foundations component.

2. Successful students will integrate approaches to number, nature, and mind by making connections to their own experience of mathematical thinking and its application in the world, and by making connections to work they have done in previous classes and/or anticipate doing in the future.

3. Successful students will experience and examine mathematics as an abstract formal system accessible to mental manipulation and/or mathematics as a tool for describing and understanding the natural world or human cognition.

Expected Learning Outcomes

Successful students are able to…

1.1 Engage in critical and logical thinking about the nature and/or application of mathematical reasoning.
1.2 Engage in an advanced, in-depth, scholarly exploration of the philosophical and/or cognitive foundations of mathematics and/or the application of mathematics in understanding the natural world or human cognition.
2.1 Identify, describe, and synthesize approaches to or experiences of the role of mathematics and mathematical reasoning in different academic and non-academic contexts.
2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.
3.1 Analyze and describe how mathematics functions as an idealized system that enables logical proof and/or as a tool for describing and understanding the natural world or human cognition.

Under the "Number, Nature, and Mind" GE, this course will examine the "cognitive and linguistic aspects of mathematics and logic" as well as "the philosophical foundations of mathematics, logic, and natural science". You will be introduced to the information-processing view of the human mind and the three levels of description (computational, algorithmic, and implementational) developed for analyzing information-processing systems. You will learn how to apply logical and mathematical models to theories of the mind, beginning with data from more "concrete" domains such as biology and ethology. By learning to manipulate unfamiliar symbol systems, such as non-base-10 arithmetic, non-alphabetic writing, and phonetic transcriptions of speech, you will see that the symbols we normally take for granted are only one way to represent abstract concepts like number and language. This course is designed to teach you how to develop, test, and critically assess theoretical work, uncovering implicit assumptions in the work of others, as well as in your own thinking.

Week	Topics/Readings	Assignments
	Introduction	
Scientific Thinking		
Week 1	Selections from Mill's *Systems of Logic* Vol II. Book V. On Fallacies • Of Fallacies in General pp. 481-484 • Classification of Fallacies pp. 484-488 • Fallacies of Generalization pp. 514-526	Reading questions
Week 2	Selections from Mill's *Systems of Logic* Vol I. • Book III. Of Induction. Ch 1. pp.185-188 • Ch.3: Of the Ground of Induction pp.200-206 • Ch 11. Of the Deductive Method pp. 299- 305	In-class problem set
	Selections from Hume's *Treatise of Human Nature* Book I. Part III. Of Knowledge & Probability pp.151-174 • Of the impressions of the senses and memory • Of the inference from the impression to the idea • Of the nature of the idea or belief	Reading questions
Mathematical Reasoning & The Scientific Method		
Week 3	Boole, G. An Investigation of the Laws of Thought. Ch 1. Nature and Design of this work. pp.1-23	P.A. 1
	Popper, K. Conjectures & Refutations: The Growth of Scientific Knowledge • Ch 3: Three Views Concerning Human Knowledge. pp. 97-114 • Ch 10: Truth, Rationality and the Growth of Scientific Knowledge pp. 215-222 In Klee, Robert (Ed). "Scientific inquiry: Readings in the philosophy of science." (1999) • Popper, K. Falsificationism. pp 65-71	P.A. 1
Week 4	Poincare, H. Science & Method (1921). • Ch. 1 The Selection of Facts pp. 15-24 • Ch. 2 The Future of Mathematics pp. 25-31 Poincare, H. Science & Hypothesis (1905). ○ Part I Ch I: on the nature of mathematical reasoning. pp 1-16	P.A. 1

	Adler, Irving. "Thinking machines, a layman's introduction to logic, Boolean algebra, and computers." (1961). • Ch. 4 Numbers and Numerals pp.32-42 • Ch. 5 Algebra of Numbers pp.43-49 • Ch 8 Algebra of Classes pp.76-86	In class problem set
Case Study 1		
Week 5	*Gregor Mendel's Experiments on Plant Hybrids* • Background Reading (Corcos & Monaghan (1993): • Translation by Abbot & Fairbanks (2016) pp .407-422 o Skip p. 415 second column – p.416 middle first column "…combination of characters united through fertilization" o Skip Section: "Experiments on Hybrids of Other Plant Species" • Skip p. 421, middle of first column "In conclusion, special mention is deserved…" - end	Synopsis 1
Brain & Behavior		
Week 6	• Adler, Irving. "Thinking machines, a layman's introduction to logic, Boolean algebra, and computers." (1961). • Ch 8 Algebra of Classes pp 87-101	In class problem set
	• Rosenblatt, Frank. "The perceptron: a probabilistic model for information storage and organization in the brain." *Psychological review* 65.6 (1958). Pp.386-391 • Hebb, Donald O. The Organization of Behavior (2005). Ch.2 Summation and Learning in Perception pp.17-18; and 31- 37	P.A. 1
Representations and Symbols		
Week 7	• Churchland, P.S., and T.J. Sejnowski. *The Computational Brain* o Pp. 141-148 o Pp. 157-167 • Gallistel, Charles R., and Adam Philip King. *Memory and the computational brain: Why cognitive science will transform neuroscience*. Vol. 6. John Wiley & Sons, 2011. o Ch. 11 The Nature of Learning pp.187-197 only; Skip "Distributed Coding"	P.A. 1
	Readings from Marr (1982) • *General Introduction*	P.A. 1

Week 8	• *The Philosophy & The Approach* • *In Defense of the Approach*	
	• Turing, A.M., 1950. Computing machinery and intelligence. *Mind*, *59*(236), pp.433-460. • Adler, Irving. "Thinking machines, a layman's introduction to logic, Boolean algebra, and computers." (1961). Ch 3 Getting an Idiot to Think Pp. 21- 31	In-class problem set
Week 9	• Gallistel, Charles R., and Adam Philip King. *Memory and the computational brain: Why cognitive science will transform neuroscience*. o Pp. 107-120 • Haugeland, *Artificial Intelligence* pp.65-71	P.A. 2
	• Adler, Irving. "Thinking machines, a layman's introduction to logic, Boolean algebra, and computers." (1961). o Ch 9 Algebra of Propositions pp 115-134 • Fodor, J.A. & Z.W. Pylyshyn. Connectionism and cognitive architecture: a critical analysis. pp. 33-50	In-class problem set
Week 10	**Case Study 2**	
	Frisch, Karl von. *Bees: Their vision, chemical senses and language*. (1971). Chapter 3: Bottom of page 84-115	Synopsis 2
	Simon, H. A., & Newell, A. (1971). Human problem solving: The state of the theory in 1970. *American Psychologist*, *26*(2)	P.A. 2

Week 11	• Bechtel, W., & Abrahamsen, A. (1991). *Connectionism and the mind: An introduction to parallel processing in networks*. ○ Ch. 1: Pp.1-12 ○ Ch. 3: pp.54-58 ○ Ch. 4: pp. 106-109 • Cummins, Robert, and Denise D. Cummins. "Minds, brains, and computers: An historical introduction to the foundations of cognitive science." (2000). ○ Part II Introduction. Pp.171-177 ○ Smolensky: pp. 286-290	P.A. 2
	Readings from De Saussure. "Course in General Linguistics." (1911/2013). • pp. 65-83 • pp101-122	P.A. 3
Week 12	• Readings from Sapir (1921/2004) I: Introductory; Language Defined pp.3-23 http://www.gutenberg.org/ebooks/12629 • Readings from Sweet, H. "A Primer of Phonetics." (1906). pp 1-6 • Readings from Bell. "English Visible Speech in 12 Lessons. (1899) pp. VI-VIII; Lesson III p.22	In class problem set
	• Readings from De Saussure. "Course in General Linguistics." (1911/2013). Pp. 38-49 • Readings from "The Indispensable Foundation." E.J.A. Henderson (Ed). (1971). pp.228-236	P.A. 3
Week 13	Chomsky, N. & M. Halle. *The Sound Pattern of English* (1968) • Ch 1. Setting pp. 3-14 • Ch 8. Principles of Phonology pp.330-340	In-class problem set
Case Study 3		
Week 14	Everett, D., 2005. Cultural constraints on grammar and cognition in Pirahã. *Current Anthropology*, *46*(4), pp.621-646.	Synopsis 3
	Nevins, A., Pesetsky, D. and Rodrigues, C., 2009. Pirahã exceptionality: A reassessment. *Language*, *85*(2) • pp. 355-376 only	
Week 15	Chomsky, N. *Aspects of the Theory of Syntax*. Ch 1 pp. 3-46 http://quod.lib.umich.edu.proxy.lib.ohio-state.edu/cgi/t/text/text-idx?c=acls;idno=heb08421.0001.001	P.A. 3

Bibliography by Topic

Science & the Scientific Method

Mill, John Stuart. *System of Logic: Ratiocinative and Inductive, Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation*. Longmans, Green, 1898.

Hume, David. "1739. A treatise of human nature." *London: John Noon* (1978).

Popper, Karl. *Conjectures and refutations: The growth of scientific knowledge*. Routledge, 2014.

Popper, Karl R. "Falsificationism." In Klee, R. (Ed). *Scientific Inquiry: Readings in the Philosophy of Science*. *London: Hutchinson* (1959). Pp. 65-71.

Mathematical Reasoning

Boole, George. *An investigation of the laws of thought: on which are founded the mathematical theories of logic and probabilities*. Dover Publications, 1854.

Poincaré, Henri. *Science and Method*. Courier Corporation, 2013.

Poincaré, Henri. *Science and Hypothesis*. Science Press, 1905.

Adler, Irving. "Thinking machines, a layman's introduction to logic, Boolean algebra, and computers." (1961).

Brain & Behavior

Churchland, P. S., & Sejnowski, T. J. (2016). *The computational brain*. MIT press.

Rosenblatt, Frank. "The perceptron: a probabilistic model for information storage and organization in the brain." *Psychological review* 65.6 (1958): 386.

Hebb, Donald Olding. *The organization of behavior: A neuropsychological theory*. Psychology Press, 2005.

Gallistel, Charles R., and Adam Philip King. *Memory and the computational brain: Why cognitive science will transform neuroscience*. Vol. 6. John Wiley & Sons, 2011.

Psychology & Cognitive Science

Marr, D. "Vision, 1982." *Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*.

Turing, A.M., 1950. Computing machinery and intelligence. *Mind*, *59*(236), pp.433-460

Pinker, S., & Mehler, J. (Eds.). (1988). *Connections and symbols* (Vol. 28). MIT Press.

Bechtel, W., & Abrahamsen, A. (1991). *Connectionism and the mind: An introduction to parallel processing in networks*. Basil Blackwell.

Simon, H. A., & Newell, A. (1971). Human problem solving: The state of the theory in 1970. *American Psychologist*, *26*(2), 145.

Cummins, Robert, and Denise D. Cummins. "Minds, brains, and computers: An historical introduction to the foundations of cognitive science." (2000).

Language & Linguistics

De Saussure, Ferdinand. *Course in general linguistics*. Columbia University Press, 2013. (reconstruction from student notes, of lectures given between 1906- 1911)

Sapir, Edward. *Language: An introduction to the study of speech*. Courier Dover Publications, 2004.

Sweet, Henry. *A Primer of Phonetics*. Clarendon Press, Oxford. 1906.

Sweet, Henry. *The Indispensable Foundation: A Selection from the writings of Henry Sweet*. Henderson, E.J.A (Ed). Oxford University Press, London. 1971

Bell, Melville A. *English Visible Speech in Twelve Lessons*. The Volta Bureau, Washington, D.C. 1899.

Chomsky, N. and Halle, M. *The Sound Pattern of English*. Harper & Row. 1968

Chomsky, Noam. *Aspects of the Theory of Syntax*. No. 11. MIT press, 1965.

Cohen, David. *Explaining linguistic phenomena*. Halsted Press, 1974.

Everett, D., 2005. Cultural constraints on grammar and cognition in Pirahã. *Current anthropology*, *46*(4), pp.621-646.

Nevins, A., Pesetsky, D. and Rodrigues, C., 2009. Pirahã exceptionality: A reassessment. *Language*, *85*(2), pp.355-404

Biology and Ethology

Abbott, S., & Fairbanks, D. J. (2016). Experiments on plant hybrids by Gregor Mendel. *Genetics*, *204*(2), 407.

Frisch, Karl von. *Bees: Their vision, chemical senses and language*. (1971).

Assessment of Synopsis Scoring Template

A "synopsis" is a clear description of the argument structure in an article. It explains (1) the reasoning structure of the author, (2) the theoretical assumptions, (3) the type and quality of evidence used, (4) the conclusions made, (5) how the article relates to other course materials and (6) an assessment of the strengths and weaknesses of the argument. This last element requires that you formulate and express an opinion about the reading. This opinion should be based on **specific** aspects of the experimental methodology, evidence, analysis and/or theoretical claims. You should also keep in mind that the synopsis, as with the traditional essay, should begin with a thesis statement that is subsequently elaborated in the following paragraphs. All technical terms you use must be defined, and you should avoid using direct quotes from the reading whenever possible. Your job is to translate what you have read into your own words.

The following rubric will be used to grade each synopsis that you write.

Performance Element	Exemplary	Proficient	Developing	Emerging	Not Present
I. Organization	Contains a thesis statement; is coherently and logically ordered; all terms are adequately defined; sufficient supporting details and examples are provided.	Contains a thesis statement, but relationship between ideas is not always clear; some terms not clearly defined or explained.	There is no explicit thesis statement, but the ideas are ordered in a reasonable way. There are some examples.	No main idea is identified; concepts, terms, and evidence are not organized in any discernible way.	Lacks any sort of structure; provides no explanation of terms, or elaborating details.
II. Communication	Writing is clear and concise; sentences are not overly long; statements are not unnecessarily repeated; but connections between ideas and paragraphs are made clear; language is exact and not vague	Writing is easy to follow; vague language is avoided; statements are not unnecessarily repeated.	Writing is more or less understandable, although vague in places	The writing is difficult to understand and circuitous; sentences typically contain too many different ideas	The writing is almost impossible to follow and words and phrases are mis-used
III. Concepts	Correctly identifies main argument versus peripheral arguments; accurately describes critical elements of chain of reasoning; Describes conclusions and evidence.	Identifies main argument; describes most of the critical steps of reasoning, the conclusion, and the most important evidence.	Identifies only peripheral rather than main arguments; describes part of the evidence and conclusions. (Records parts of the text verbatim, rather than paraphrasing)	Identifies a part of the argument; incorrectly describes the reasoning, or not at all. (Excessive use of quotations from the text)	Mis-characterizes the argument, conclusions, reasoning and/or evidence.
IV. Evaluation	Insightfully interprets the evidence and conclusions; identifies overt as well as hidden assumptions; identifies possible shortcomings	Offers a personal interpretation of the data; Identifies overt assumptions; identifies a possible shortcoming	Provides a superficial interpretation; expresses an opinion on the reading	Provides little to no interpretation; incorrectly identifies shortcomings, or fails to do so.	Provides no evaluation of the work at all.
V. Synthesis	Insightfully relates concepts and ideas from previous texts; suggests alternative explanations	Makes some connections from previous texts; considers a different explanation	Only superficial reference to previous texts;	Identifies a few similar texts, but without discussion.	Makes no connections to other work; does not critically evaluate conclusions.

Theme Proposal: Number, Nature, and Mind
LING 4052: Linguistics and the Scientific Method

Background

I designed this class in 2016 as a 3 credit Honors course at the 2000 level in the Quantitative Reasoning GE, and have taught it three times since. While student feedback has been quite positive, it quickly became clear that the material was better suited to a 4000 level designation. Additionally, class enrollment was quite low. I believe this is due, in large part, to insufficient advertising of the course. As it stands, 2052/4052 satisfies the requirements for a Foundations-level course. However, I believe it is better suited for a Themes-level designation due to the reading level and load, as well as the expectation for high-level critique and synthesis. See below for more details.

LING 4052 is designed for a discussion format. There are no formal lectures. We read original work for the most part, and the reading load is heavy. Students are required to participate in class discussion, submit short assignments on the readings, complete in-class problem sets, and complete 3 longer-form assignments, assessing three different original experiments (see attached syllabus for more detail on the course requirements, as well as the topics listed below).

LING 4052 doubly satisfies the "Number, Nature, and Mind" GE by examining the philosophical underpinnings of mathematical/logical thought, and by demonstrating the application of such formal abstract systems to the study of human cognition. Below, specifics are provided regarding how this course will satisfy the GE Expected Learning Outcomes.

The following topics are covered.

- Weeks 1 and 2:
  - Inductive and inductive reasoning
  - Cause and effect
  - Logical fallacies
- Weeks 3 and 4:
  - The scientific method
  - Falsifiability
  - Algebras of numbers, and classes
- Week 5:
  - *Gregor Mendel's Experiments on Plant Hybrids*
- Week 6 and 7:
  - Continuation of Algebra of classes
  - Neurons
  - Learning and memory
- Week 7 and 8:
  - Visual Perception
  - Turing Machines
- Week 9:
  - Artificial intelligence
  - An algebra of propositions
- Week 10:
  - *Honey bee navigation and communication. Karl von Frisch.*
- Week 11:
  - Neural networks
  - Introduction to Linguistics
- Week 12:
  - Introduction to Linguistics con't
  - Phonetics and transcription
- Week 13:
  - Phonological Feature theory
- Week 14:
  - The Pirahã language: is it exceptional?
- Week 15:
  - Language Acquisition

Goals that apply to all themes

GOAL 1: Successful students will analyze an important topic or idea at a more advanced and in-depth level than the foundations.

This class was first developed to fill a gap I saw in student knowledge (and existing course coverage) for fundamental concepts such as multiple levels of description, falsifiability, reasoning from data to theory, and an underdeveloped ability to identify logically flawed reasoning. Because the course was developed as a (Honors) GE, it has been listed at the 2000 level. However, the course is better suited to a 4000 level designation. This is in part due to the difficulty of the written material, but also to the expectation of sophisticated argumentation. The course covers advanced content across several different areas. Additionally, much of the reading is from original sources, requiring high levels of reading comprehension and effort. These aspects also make a Theme, rather than a Foundations designation, more appropriate. Most importantly, I stress synthesis in this course– the topics come together in sometimes clear, sometimes less obvious, ways as the semester progresses. Students are expected to find connections themselves between readings and discussions at the beginning of the semester, and readings and discussions later in the semester, and in such a way that they make use of methods of analysis and reasoning that they may not have been familiar with before. I view synthesis as a very advanced skill, more appropriate to the Themes level of instruction.

ELOs shared by all themes courses

ELO 1.1 Engage in critical and logical thinking about the topic or idea of the theme	Students will engage in logical and critical thinking through their own assessments of the class reading, beginning with brief summaries in weeks 1- 8 (Prep. Assignment 1), building to assessments of the argument structure, the falsifiability of the hypotheses, and connections to previous readings in weeks 12-15 (Prep. Assignment 3).
ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or idea of the theme	Students will engage in in-depth exploration of the topics of this theme via close reading of scholarly material coupled with in-class discussions, which will provide immediate feedback on their own assessments, walking through hypotheses, argument, conclusions, and (explicit and implicit) assumptions made by the authors. Students will also practice manipulating new formal systems through in-class problem sets which will be completed as a group. Such hands-on assignments will deepen the level of student engagement with the material.

GOAL 2: Successful students will integrate approaches to the theme by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.

The topics of this course are foundational ones in mathematics, cognitive science, artificial intelligence, linguistics and philosophy. They are broadly applicable to theory development in any scientific field, and to reasoning and critical thinking within, and outside of, academia. Within the course, students will apply these concepts to empirical phenomena of very different kinds. In a series of three assignments, they will develop high-level synopses of published work in biology (*Gregor Mendel's Experiments with Plant Hybrids*), ethology (*Frisch's experiments with honey bee navigation*), and linguistics (*an ongoing debate on the linguistic exceptionality of the Pirahã language*).

ELO 2.1 Identify, describe, and synthesize approaches or experiences as they apply to the theme.	Explicit connections will be made between successive readings and, as the course progresses, students will be asked to identify connections on their own, via their daily assignments. There are three case studies that represent applications of the ideas and tools introduced in this course: one in genetics/biology, one in ethology, and one in linguistics. For each of these cases, students will submit 2-3 page synposes, providing a more in-depth analysis that focuses on the interpretation of the results in each case, and how they provide evidence for specific theoretical claims.
ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.	Students are expected to become more and more sophisticated in their critiques, which will be reflected in their daily assignments and in-class discussion. Through exposure to areas of study with which they are not familiar, they will develop the skills to assess argument structure in any domain, and problem-solving skills that are generally applicable.

Specific goals for Number, Nature, and Mind Theme:

Goal 1: Successful students will analyze the nature of mathematics and/or mathematical reasoning at a more advanced and in-depth level than in the Foundations component.

This course covers several explicitly mathematical concepts which form the basis for scientific reasoning. These concepts will not be learned passively, within a lecture format that identifies the important pieces and make connections for the students. Rather, as a class, we will approach original readings in a critical way, building up, piece by piece, our particular philosophy of science. In many instances, a given idea is far better understood with concrete examples. These will take the form of specific theories to which we can apply the concepts we have learned (in biology, ethology and linguistics; more details below). And it will also take the form of more traditional problem sets in mathematics, where students will work together on learning the specific algorithms, and how to apply them (see below for more details).

ELO 1.1 Engage in critical and logical thinking about the nature and/or application of mathematical reasoning.	Throughout the course students will engage with the following logical/mathematical systems. In weeks 1 & 2 they will learn about the two types of **reasoning: inductive** and **deductive**. We will focus on the types of fallacies to which human reasoners are prone, and students will identify instances of faulty reasoning in cartoons, newspapers or other modern sources (week 2 problem set). In Week 4, students will learn how to perform basic mathematical operations (addition, subtraction, etc.) in non-base 10 numeral systems (week 4 problem set). Over weeks 4, 6 and 9, students will learn about diverse Algebras, beginning with the familiar **algebra of numbers** (week 4 problem set), transitioning to the **algebra of classes** (week 6 problem set), and then to the superset class of **Boolean algebras**, which can be algebras of anything. From there, students will engage with a specific Boolean algebra, the two-element **algebra of propositions** (week 9 problem set), which forms the basis of semantic analysis within linguistics. In week 8, we will cover **Turing machines**, which, like Boolean algebras, are universal, and can instantiate any type of machine. Students will build and operate simple Turing machines on paper (week 8 problem set). In week 12, students will explore different types of **writing systems**, testing different abstract symbol systems for representing English words, and words in other languages (week 12 problem set). In week 13, we will compare different symbol systems linguists have proposed for **representing sounds** that occur in any human language; students will learn to manipulate phonological symbols and features (week 13 problem set).

ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the philosophical and/or cognitive foundations of mathematics and/or the application of mathematics in understanding the natural world or human cognition.	In weeks 1-4 students will critically engage with original philosophical works by Mill, Hume, Boole, Poincare, and Karl Popper. As a class we will critically examine and discuss the deepest foundations of how we think about the world: the nature of cause and effect, how we reason from different types of evidence, what can be definitively proven, and what can only be determined to be highly (un)likely. Students will individually summarize each reading prior to class (these prep assignments are described in the syllabus). They are limited to a single paragraph, so that they must grapple with decisions about what the most important parts are. Through discrepancies between their individual work and the points we discuss as a class, they will receive immediate feedback on how close to the mark they were. Students will also be encouraged to share whether they agreed or disagreed with the authors, based on their own intuitions and/or personal experience. As we move into the "mentalistic" sciences of Psychology and Linguistics, starting in week 7, readings and discussions will shift to the role computational/mathematical thinking plays in theories of cognition. Students will be introduced to the model of cognitive faculties as information-processing systems. This begins with Marr's levels of description, highlighting the independence of the material of which the system is constructed (implementation), the specific operations by which the information-processing system completes its task (algorithmic), and the function the information-processing system was designed to perform (computational). Starting in week 8, students' reading prep assignments will expand to include critical assessment of argumentation (P.A. 2: weeks 9-11), and then explicit connections to previous readings (P.A. 3: weeks 12-15).

Goal 2: Successful students will integrate approaches to number, nature, and mind by making connections to their own experience of mathematical thinking and its application in the world, and by making connections to work they have done in previous classes and/or anticipate doing in the future.

Class discussions will be driven by students' current intuitions and experiences. I have found that students naturally try to understand new concepts in terms of their own experiences, as well as ideas they have internalized from other courses. Students will be encouraged to express such intuitions, but also to try to put those intuitions into specific terms. Collaboratively, the class will determine whether a given hypothesis is consistent with others, and whether it is consistent with what is argued in the reading. In adopting or rejecting such a hypothesis, we will also analyze its implications, and whether we agree with those implications. It is expected that students' mathematical thinking and theoretical sophistication will evolve over the course of the semester. Thus their intuitions will change, in a transparent way that they can reconstruct. They will take this new world view to future courses they take, and filter it through future experiences.

ELO 2.1 Identify, describe, and synthesize approaches to or experiences of the role of mathematics and mathematical reasoning in different academic and non-academic contexts. **and** **ELO 2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts.**	These two ELOs are very closely linked in the course design, so I address them both here. Content in this course is cumulative. Students will become more and more sophisticated in their critiques, which will be reflected in their daily assignments and in-class discussion. Explicit connections will also be made between successive readings and, as the course progresses, students will be asked to identify connections on their own (P.A. 3 assignments. Weeks 12-15). As student competence grows, student contributions to class discussion will increase, and they will determine the direction of those discussions. This daily practice will allow students to gradually build competencies that they can apply to their three longer assignments. For each of three case studies, students will submit 2-3 page synposes, providing a more in-depth analysis that focuses on the interpretation of the results in each case, and how they provide evidence for specific theoretical claims. These assignments require synthesis of material, and application of concepts to new domains: genetics/biology, ethology, and linguistics. Synopsis 1 (*Gregor Mendel's Experiments with Plant Hybrids*) is due in week 5. Students are expected, at this point, to be able to generate a high-level summary of the work: identifying the hypothesis or thesis of the author(s), and what the author(s) concludes. For other required

	elements of the synopsis (see grading rubric at end of syllabus), students are not expected to be fully proficient at this point. Synopsis 2 (*Frisch's experiments with honey bee navigation*) is due in week 10. By then students are expected to be able to describe the chain of reasoning, start to identify hidden or missing links in that chain, and consider whether the conclusions are justified. At this point, students should also be able to make more explicit links to concepts and results from previous readings. Synopsis 3 (*on Pirahã linguistic exceptionality*) is due in week 14. Students should be proficient in all elements at this point: identifying relevant strands of previous works, able to assess the strength of argumentation, to identify hidden assumptions, and to evaluate the conclusions.

Goal 3: Successful students will experience and examine mathematics as an abstract formal system accessible to mental manipulation and/or mathematics as a tool for describing and understanding the natural world or human cognition.

In this course, mathematics is presented both as an abstract formal system in its own right, and as a tool for doing science of various kinds. Due to over-familiarity, the most common usages of certain systems become equated with just a few of their functions: mathematics as arithmetic, alphabets as orthography. They also become associated with a specific representative of each class: base-10 numeral systems; the English alphabet. As students are exposed to, and learn to manipulate, new formal systems, they will see the connections that tie such specific instantiations to a more abstract, and much more powerful, mode of mathematical reasoning.

Insofar as cognition can be described as information processing, the central questions are how exactly such information is represented, and how those representations are manipulated mentally. Arguments for the necessity of a specific type of architecture, or for a specific type, or level of specificity, in representations, are arguments that rely on definitively showing that the empirical data cannot be explained in any other way. Students will critically assess arguments of this type in the second half of the semester (see more details below), applying the type of mathematical reasoning that they have been learning since the beginning of the semester. Beyond class discussion, students will also learn to construct arguments of this kind in written assignments: Prep 3 assignments, Synopsis 2 (the mental representations of honeybees), and Synopsis 3 (the presence or absence of abstract linguistic units).

ELO 3.1 Analyze and describe how mathematics functions as an idealized system that enables logical proof and/or as a tool for describing and understanding the natural world or human cognition.	Through the introduction of a variety of different symbolic systems, students will be exposed to unfamiliar ways of describing aspects of the world. For example, they will learn how to do arithmetic in non-base-10 systems (week 4 problem set), assess different ways of transcribing the acoustic properties of speech (week 13 problem set), and explore non-alphabetic writing systems (week 12 problem set). Equivalencies within each type of system reveal the underlying abstract formalisms that can be used to describe and analyze entities in the world. Case Study 1 (Week 5) provides an early example of mathematical thinking as applied to a phenomenon in the natural world: the inheritance of physical traits in pea plants – prior to the discovery of the gene. In week 6, the class transitions to topics on the brain and mind. Central to this area is the question of the nature of mental representations, and how such representations are physically realized in networks of neurons. The same abstract formalisms introduced in weeks 2-6 will appear in arguments for and against specific theories of cognition: learning and memory (weeks 6-7); visual perception (weeks 7-8). In Case Study 2 (week 10), the navigational system of the honeybee provides an accessible example for the analysis of whether (and what kind of) abstract mental symbols are required to explain a certain type of animal behavior. In Case Study 3 (week 14), the question will be whether empirical linguistic data successfully shows that speakers of a particular language lack a type of representation that is present in all other human languages.