

# GEOL 130 - THE NATURE OF SCIENTIFIC INQUIRY

## SPRING 2020

This course is designed for anyone with an interest in the physical sciences. The course considers the nature of scientific inquiry in comparison to other “world views” and the relationship of science to other aspects of human knowledge. We explore how science is done, how new scientific paradigms (broad scientific frameworks) are developed and older paradigms discarded or changed, and the limitations and boundaries of science. We then examine the history of the main scientific ideas about how our universe functions. Examples of scientific ideas and paradigm shifts will largely come from the physical science (astronomy, physics, chemistry, earth sciences). By the end of the semester I hope that all of you acquire a modern scientific perspective about the natural world around us, a better understanding of what we know and don't know about our universe, and that you develop a more questioning attitude with regards to the methods by which we attempt to learn about the universe.

**Lecture:** SAL101. MW 10:00AM – 11:50AM. Full participation in lecture is strongly encouraged. You will be expected to participate in class activities, including at least 10 surprise quizzes.

### Grading:

3 Exams 60% (15% for first, 20% for second, and 25% for third exam),

Lab 30% (attending and passing the lab is required to pass the course)

Class Participation (e.g., questions, 10 pop quizzes in lecture) 10%

Extra Credit (see options below): worth a maximum of 5% added to the above

- 1) Read physical science stories in class (1 point for each story, maximum of 5)
- 2) JEP: A JEP representative will discuss this program in lecture. Successful completion of this option bumps your grade up one quantum level (e.g., B to B+). Contact the JEP office and apply online immediately if interested (<http://uscdornsife.usc.edu/secure/JEP/>) since spaces are limited. This year an environmental option is also available.
- 3) I always offer other extra credit assignments such as optional homework assignments, IMAX movies, talks or other activities related to course topics. Feel free to make suggestions if you hear about something going on in our community related to science during the semester.

Grading for exams, labs, and the course is on a curve. Typically, at the end of the course at least 50% of students will get A's and B's. At the end of the course, students falling on the border between two grades are eligible (at my discretion) to receive the higher grade based on the following: (1) showing continued improvement in midterm scores, (2) strong class participation, and (3) regular, collegial participation in labs.

**Scott Paterson:** Office Hours: TBA.

Office: ZHS 307, phone: 213-740-6103; email: [paterson@usc.edu](mailto:paterson@usc.edu)

## Class Schedule

### The Beginnings of Science:

Week 1 (Jan. 13)	Introduction to course & meet your crazy professor
Week 1 (Jan. 15)	Topic 1: What is Science?
Week 2 (Jan. 20)	No class – MLK Day
Week 2 (Jan. 22)	Topic 2: How Do We ‘Do’ Science?
Week 3 (Jan. 27)	Topic 3: The Origin of Science in Ancient Greece
Week 3 (Jan. 29)	Topic 4: Ancient Greek Science – 500 Years After its Beginnings
Week 4 (Feb. 3)	Topic 5: The Development of Theories and Paradigms
Week 4 (Feb. 5)	Topic 6: The Scientific “Dark Ages”? and/or review for midterm
Week 5 (Feb. 10)	<b>First Midterm Exam</b> (Topics 1-6)

### Scientific Revolutions:

Week 5 (Feb. 12)	Topic 7: The First Revolution - Astronomy of Copernicus/Galileo
Week 6 (Feb. 17)	USC holiday
Week 6 (Feb. 19)	Topic 8: The Second Revolution - Motion from Galileo to Newton
Week 7 (Feb. 24)	Topic 9: The Nature of Light and the Special Theory of Relativity
Week 7 (Feb. 26)	Topic 10: The General Theory of Relativity
Week 8 (Mar. 2)	Topic 11: Nature of Matter: Changing Views
Week 8 (Mar. 4)	Topic 12: Nature of Matter: New Paradigm (Bohr Atom)
Week 9 (Mar. 9)	Topic 13: A Quantum Mechanical View of Matter
Week 9 (Mar. 11)	Topic 14: The Double-Slit Experiment, Causality, and Schrodinger's Cat
Week 10	SPRING BREAK
Week 11 (Mar. 23)	Catch up lecture and review for midterm 2
Week 11 (Mar. 25)	<b>Second Midterm Exam</b> (Topics 7-14)

### Science’s Ever Changing View of Our Universe:

Week 12 (Mar. 30)	Topic 15: Measuring Time: Changing Ideas about the Age of Objects in Our Universe
Week 12 (Apr. 1)	Topic 16: Earth: The Change from Static to Dynamic Views of Earth Evolution
Week 13 (Apr. 6)	Topic 17: The Plate Tectonics Paradigm Shift
Week 13 (Apr. 8)	Topic 18: Big Bang, A New Dynamic Universe
Week 14 (Apr. 13)	Topic 19: Black Holes, QM, and the Universe
Week 14 (Apr. 15)	Topic 20: Chaos Theory: A Chaotic Paradigm Shift in progress
Week 15 (Apr. 20)	Topic 21: Fractals in the Universe around us.
Week 15 (Apr. 22)	Topic 22: 20 <sup>th</sup> Century Science and class summary
Week 16 (Apr. 27)	Topic 23: 21 <sup>st</sup> Century Science: the future and/or review for midterm
Week 16 (Apr. 29)	<b>Third Midterm Exam</b> (Topics 15-23)

## **Reading Assignments**

- Topic 1: Wolpert, Ch 1, 2; Dewitt, Ch.1-2;  
Topic 2: Wolpert, Ch. 3; Dewitt, Ch. 3-8;  
Topic 3: Wolpert, Ch. 4-7; Dewitt, Ch. 9-13.  
Topic 4: Dewitt, Ch. 9-13  
Topic 5: None required: Optional – Kuhn, T., “The Structure of Scientific Revolutions”  
Topic 6: None required  
Topic 7: Hawking, Ch. 1; Dewitt, Ch. 14-18.  
Topic 8: Dewitt, Ch. 19-21  
Topic 9: Gribbin, Ch. 1; Dewitt, Ch. 22-23; Gammow/Stannard, Ch. 1-2.  
Topic 10: Hawking, Ch. 2; Gammow/Stannard, Ch. 2-5.  
Topic 11: Gribbin, Ch. 1- 3.  
Topic 12: Gribbin, Ch. 4; Gammow/Stannard, Ch. 8-9.  
Topic 13: Gribbin, Ch. 5-7; Hawking, Ch 4, 5; Gammow/Stannard, Ch. 9-12, optional 13-16.  
Topic 14: Dewitt, Ch. 24-29; Gribbin, Ch. 8-11.  
Topic 15: Hawking, Ch. 1-3; Gammow/Stannard, Ch. 4-5.  
Topic 16: Hawking Ch. 1; optional - any intro geology text  
Topic 17: None required; optional - any intro geology text  
Topic 18: None required; optional - any intro geology text  
Topic 19: Hawking, Ch. 6-9; Gammow/Stannard, Ch. 7.  
Topic 20: Wolpert, Ch. 8, 9.  
Topic 21-22: None required: optional Gleick, J. “Chaos - Making a New Science” Ch. 1-11.  
Topic 23: Gribbin-epilogue; Hawking, Ch. 10-11; Gammow/Stannard, Ch. 13-16.

## **Sources for Readings**

- Gamow, G., and R. Stannard, *The New World of Mr Tompkins*, Cambridge University Press, 1999.  
Gribbin, J., *In Search of Schrodinger's Cat*, Bantam Press, 1984.  
Hawking, S., *A Brief History of Time* (tenth anniversary edition), Bantam Press, 1996.  
Wolpert, L., *The Unnatural Nature of Science*, Harvard University Press, 1992.  
Dewitt, R., *Worldviews*, Blackwell Publ., 2004.

Web and Wiki: lots of great information on these topics plus many U-tube videos. But be careful to cross check this information with materials presented in class.

## **Student Support Services:**

*Disability Services and Programs (DSP)*: Students requesting academic accommodations based on a disability are required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP when adequate documentation is filed. Please be sure the letter is delivered to me as early in the semester as possible. All DSP students are expected to remind me in advance regarding special arrangements needed for midterm exams. DSP is open Monday-Friday, 8:30-5:00. The office is in 3601 Watt Way, Grace Ford Salvatori Hall, 120, the phone number is (213) 740-0776, and email is [ability@usc.edu](mailto:ability@usc.edu).

*Academic Conduct:* Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, “Behavior Violating University Standards” [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

*Support Systems:* Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call  
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. [engemannshc.usc.edu/counseling](http://engemannshc.usc.edu/counseling)

*National Suicide Prevention Lifeline* – 1 (800) 273-8255: Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. [www.suicidepreventionlifeline.org](http://www.suicidepreventionlifeline.org)

*Relationship and Sexual Violence Prevention Services (RSVP)* – (213) 740-4900 – 24/7 on call. Free and confidential therapy services, workshops, and training for situations related to gender-based harm. [engemannshc.usc.edu/rsvp](http://engemannshc.usc.edu/rsvp)

*Sexual Assault Resource Center:* For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: [sarc.usc.edu](http://sarc.usc.edu)

*Office of Equity and Diversity (OED)/Title IX Compliance* – (213) 740-5086: Works with faculty, staff, visitors, applicants, and students around issues of protected class. [equity.usc.edu](http://equity.usc.edu)

*Bias Assessment Response and Support:* Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. [studentaffairs.usc.edu/bias-assessment-response-support](http://studentaffairs.usc.edu/bias-assessment-response-support)

*The Office of Disability Services and Programs:* Provides certification for students with disabilities and helps arrange relevant accommodations. [dsp.usc.edu](http://dsp.usc.edu)

*Student Support and Advocacy* – (213) 821-4710: Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. [studentaffairs.usc.edu/ssa](http://studentaffairs.usc.edu/ssa)

*Diversity at USC:* Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. [diversity.usc.edu](http://diversity.usc.edu)

*USC Emergency Information:* Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. [emergency.usc.edu](http://emergency.usc.edu)

*USC Department of Public Safety* – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime. Provides overall safety to USC community. [dps.usc.edu](http://dps.usc.edu)