Edwin S. Kite | Teaching and Mentoring Statement

How I teach is influenced by instruction received at Cambridge, Caltech, MIT, and Berkeley. I saw that the very best teachers addressed a diversity of learning styles, rather than just their preferred style. Drawing on their example, I aim to teach key course concepts in each of at least four ways: intuitive (give me an image that will let me grasp the idea), practical/hands-on, historical/inductive, and deductive. I strive toward the following:-

Advising: Growing promising students into independent scientists requires student research projects that have a clear structure, but also headroom for creativity and flair. Almost any planetary landform can be approached by a combination of detailed geological work and numerical analysis, with the relative emphasis chosen according to the talents and preferences of the student. At UChicago, I have been fortunate to work with smart and driven graduate students. For these people, I devise a self-contained "starter project" when they enter grad school, with the intent that they will complete and submit a paper well before the qualifying exam. The purpose is to gain confidence with all aspects of the scientific process, and also to start the snowball rolling for their professional development. I err on the side of letting graduate students "run with" projects that they have contributed to devising, even if I believe (sometimes wrongly!) that more science would get done if they worked on projects that I conceived. So far the benefits of increased student energy and motivation have greatly exceeded the cost of time lost running up blind alleys. While I emphasize freedom during project creation, I admit to being meticulous during data analysis and write-up. So far this balance has been fruitful. For example, the work of each of the four graduate students who have worked with me on projects during their first year – Sam Holo, Megan Mansfield, Megan Barnett, and Sasha Warren – has led to a paper based on that work (Holo, Kite, et al., Earth and Planetary Science Letters 2018; Mansfield, Kite, et al., JGR Planets 2018; Kite & Barnett PNAS 2020; Warren, Kite et al. JGR Planets 2019). In any lab, there is always checklist-type work that needs to get done, but in my lab such work is done by postdocs, undergraduate research assistants, and myself.

To adapt my advising to each student, and to get feedback and improve on short timescales, I use a quarterly progress discussion meeting. Each meeting includes discussing, revising, and agreeing answers to $\sim$30 questions regarding the student $\leftrightarrow$ advisor relationship, covering communication, general work expectations, funding, collaboration/dual-advising practices, research politics, charting the future, professional development, evaluation, and additional expectations (in both directions). The answers differ for each student, and change as they progress. I also ask the student to bring their own agenda to each quarterly meeting, and we discuss their points first before discussing the Q&A.

Not only is working with grad students great fun, I have found it to be also scientifically productive. Therefore, I have an open-door for students working with other PIs who are interested in pursuing side projects with me. This openness has led to enjoyable collaborations and interesting results working with UChicago student Andy Heard on the evolution of Mars (Heard & Kite, Earth and Planetary Science Letters 2020), working with UChicago student Megan Mansfield after she switched to astronomy on the detectability of rocky-exoplanet clouds (Mansfield, Kite, et al., Astrophysical Journal 2019), and working with Imperial College London visiting graduate student Gaia Stucky de Quay on ancient rivers on Mars (Stucky de Quay, Kite, et al. JGR-Planets 2019).

Publication practices can have a big influence on student career outcomes. I believe students' professional interests are best advanced by not burying their work inside big-team papers, but rather highlighting their individual contributions. Similarly, students working with me are never asked do work for my proposals because such work is low-payoff for the student. On the other hand, I assist student applications for fellowships - Sasha Warren, a graduate student working with me, is a 2020-2023 recipient of the Future Investigators in NASA Earth and Space Science and Technology (FINESST) fellowship.

I am proud of the professional outcomes for my group alumni so far: the two postdocs who have worked with me both now work at JPL (NASA/Caltech), the terrestrial graduate student who visited Chicago for six months is now a planetary science postdoc at U.T. Austin, and the two technical staff who worked with me are now at USGS Astrogeology and in the planetary science PhD program at UCLA.

I have served on the advisory committee for fourteen students. When not the primary advisor, my aim is to provide intellectual and professional feedback, be open to the possibility of side projects, and to help the student ensure that their finished thesis has a quality that they can always be proud of. Overall, my philosophy is to encourage students to work with multiple faculty, so they can be exposed to different scientific styles, compelling them (through their choice of who if anyone to emulate in their own work) to make independent decisions.

While essential, feedback from current students is not enough. Therefore, I learn as much as I can from mentorship role models (people who have exceptional track records of advising students who go on to become successful scientists), by requesting and reading their own teaching statements, talking to them at conferences e.t.c., and getting feedback on my own written expectations Q&A. This has led to several changes in my written expectations and other practices, for example, adding a written commitment to assist group members throughout their careers, including with issues pertaining to racism and sexism.

In upper-division courses: At UChicago, I teach two upper-division courses: "GEOS 32060: Planetary Habitability" (entirely revamped course; Winter 2016, Spring 2018, Spring 2019, Winter 2020, and Winter 2021) and "GEOS 38600: Earth & Planetary Surface Processes" (new course; Winter 2017, Fall 2018, Winter 2020, and Spring 2021). Both involve computer programming labs, and student reading and presentation of papers. My lecture notes are freely available. Both courses received positive student evaluations; one Planetary Habitability student went on to enter a planetary science PhD program motivated in part by the course. In homeworks and exams, I de-emphasize precise calculations and instead emphasize order of magnitude calculations that are set up to produce surprises, and so to expand the students' conceptual understanding. I deliberately turn student questions into free-form discussions because these often turn up new and interesting questions to which *neither* of us knows the answer. My proudest moments as a teacher are when I find out that a student has chosen to pursue one of those questions themselves as a research project, in one case as an Oxford University PhD.

In introductory/survey courses: People who teach survey courses in astronomy, planetary science, and earth and environmental science are fortunate because the things we study are so compelling. Students arrive intrigued and enthusiastic: the challenge is to give a coherent account of the phenomenology and underlying principles without overloading students. One startling message from research into undergraduate education is that we can teach more by saying less. Interspersing short student activities has been shown to improve learning and retention. Although I have not yet taught an introductory/survey course, I feel strongly that the near-real-time feedback these exercises naturally provide is essential. For non-science majors (who are common at UChicago), I believe that transmitting enthusiasm, the bones of the subject, and a sense of the methods being used to solve unresolved problems, are the top priorities. I was inspired by lecturing in the "Fossils To Fermi's Paradox" survey course, and plan to organize a survey course on "Energy For Civilization" (from the beginnings of agriculture to Dyson spheres).

Computer modeling is an essential third branch of modern science, and one best introduced early. I infuse MATLAB (and Python) into every course I teach. To accommodate students who have not programmed before, I write 'fill-in-the-blanks' code, at least initially. Spacecraft data make computer labs easy to construct, and fun.

All my teaching and advising is linked by the goal to empower people to take control of their own education. To do this I aim (at all levels) to communicate inspiration, communicate fundamentals, provide coaching on tools, and to tailor capstone projects to make people think for themselves and synthesize.