

01:460:203 Building and Maintaining a Habitable Planet

Rutgers, the State University of New Jersey, Spring 2020
Mondays/Thursdays 12:00-1:20pm, Wright Labs 231, Busch Campus

Professor Robert Kopp

Email: Robert.Kopp@rutgers.edu / Twitter: @bobkopp

Office: 225 Wright Lab, Busch Campus / 203C Marine and Coastal Sciences, Cook Campus

Office hours by appointment (please email)

Course Description: Humanity has become a geological force, reshaping Earth's land, atmosphere, oceans and climate. Developing the capacity to manage these planetary changes in a wise, deliberate, and democratic manner is one of the most critical tasks of this century. This course will prepare you to be an informed global citizen, able to interpret the environmental changes humanity is effecting today in the context of our planet's 4.6-billion year history and to make informed decisions about policies to manage these changes. We will focus particularly on: how the climates of rocky planets like Earth, Mars, and Venus function, evolve, and shape planetary habitability; how humans are reshaping Earth's climate; and how choices made today may affect the future habitability of the planet for our own civilization. This semester will also include an examination of the climate footprint of the Rutgers community and opportunities to support the activities of the Rutgers President's Task Force on Carbon Neutrality and Climate Resilience.

Learning goals

The fundamental goal of this class is to equip you to interpret the environmental changes humanity is effecting today in the context of the long-term evolution of the planet's climate. In this course, you will fulfill the **Natural Sciences (NS)** core curriculum requirement by (1) applying the concepts of system feedbacks, energy, entropy, and carbon cycling to the Earth system in the planet's past and in the current Anthropocene epoch, and (2) identifying and critically assessing ethical and societal issues related to science, technology, and the global environment. In this course, you will also fulfill the **Our Common Future (CCO)** core curriculum requirement by analyzing the relationship science & technology have to a contemporary social issue (namely, the human reshaping of the global environment).



Texts

The two required texts for the course are:

Charles Langmuir & Wally Broecker (2012), *How to build a habitable planet* (ISBN 0691140065)

Adam Frank (2018), *Light of the Stars: Alien Worlds and the Fate of the Earth* (ISBN 0393609014)

Additional articles, podcasts, and videos will be posted on Canvas and assigned during the course of the term. These may include:

Jim Bell (2006), The Red Planet's Watery Past, *Scientific American* (Dec.), 63-69.

R. Benestad (2010), A simple recipe for the greenhouse effect, <http://goo.gl/zCaM>

T. C. Chamberlin (1890), The method of multiple working hypotheses. *Science* (old series) 15: 92.

James Hansen et al. (2013), “Assessing “Dangerous Climate Change”: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature,” *PLOS One*, 8:e86148.

Excerpts from T. Houser et al. (2015), *Economic Risks of Climate Change: An American Prospectus*.
<http://www.climateprospectus.org>.

J. Kasting et al. (1988), “How Climate Evolved on the Terrestrial Planets,” *Scientific American*, Feb. 1988: 90-97.

C. Kirkwood (1998), System behavior and causal loop dynamics. *System Dynamic Methods: A quick introduction*. Ventana systems.

E. Lakdawalla (2013). Mars' chemical history: Phyllosian, Theiikian, Siderikian, oh my.
<http://www.planetary.org/blogs/emily-lakdawalla/2013/12051108-mars-chemical-history.html>

Excerpts from J. Lovelock (1988), *The Ages of Gaia* (ISBN 0393312399)

Excerpts from O. Morton (2009), *Eating the Sun* (ISBN 0007163657)

Excerpts from N. Oreskes (2019), *Why Trust Science?* (ISBN 9780691179001)

Excerpts from C. Sagan (1996), *The Demon-Haunted World: Science as a Candle in the Dark* (ISBN 0345409469)

D. Sasselov and D. Valencia (2010). Planets we could call home. *Scientific American* (Aug), 38-45.

Will Steffen et al. (2011), “The Anthropocene: From global change to planetary stewardship,” *AMBIO* 40:739-761.

Preliminary Course Schedule

This schedule is a work in progress and will be updated on Canvas over the course of the term.

Day	Topic	Readings	Assignments
1/23/20	Introduction: Astrobiology and the Anthropocene		
1/27/20	How Does Science Work?	Sagan (1996) ch. 2; Chamberlin (1890); Oreskes (2019); Frank (2018) Intro, ch.1	
1/30/20	Astronomical and Geological Time	L&B ch.2, ch. 6.1-2, 14.1-2	
2/3/20	The Earth as a system	L&B ch. 1; Kirkwood ch. 1	
2/6/20- 2/10/20	Daisyworld	Lovelock (1988) ch. 2-3	
2/13/20- 2/17/20	The greenhouse effect	Benestad (2010); L&B ch. 9	Assignment 1: Daisyworld Simulation
2/20/20	EXAM 1		
2/24/20	Earth's climate feedbacks		`
2/27/20- 3/2/20	The planetary habitable zone	Kasting et al. (1988), Sasselov (2010), Frank ch. 2-4	
3/5/20- 3/9/20	Venus and Mars	Bell (2006), Lakdawalla (2013)	Assignment 2: Planetary climates
3/12/20	Natural climate variability	L&B ch 18	
3/16/20- 3/20/20	SPRING BREAK		
3/23/20	EXAM 2		
3/26/20- 4/2/20	Energetics of human civilization	Morton ch. 8	

4/6/20	Intro to global climate change	L&B ch. 20, Steffen et al. (2011)	Assignment 3: Energy audit
4/9/20	Science and Evidence: Consensus-Based Processes		
4/13/20-4/23/20	Global climate change: Projections, Impacts, Mitigation, and Adaptation	Hansen et al. (2013), NCA4 ch. 1, Houser (2015) Preface and ch. 2-4, IEA (2015)	
4/27/20-5/4/20	Carbon Neutrality and Climate Resilience at Rutgers		
TBD	EXAM 3 (on scheduled final exam date)		

What I Expect From You

1. You have read the syllabus and keep a copy of it for your referral.
2. You will be respectful towards your professors and your fellow students. Any behavior that disrupts the class and other students' learning will not be tolerated.
3. On average, you should spend 2-3 hours per each in-class hour (i.e., 6-9 hours per week) on your own work on activities related to the course (reading, studying, making notes, working on assignments, etc.).
4. You will share your personality, knowledge, skills, and special expertise with the rest of us throughout this class.

What You Should Expect From Me

1. I will give you the same respect that I ask you to give me and other members of this class.
2. I will encourage you and be receptive to constructive comments about my teaching.
3. I will do my best to help you, but I cannot learn the material for you.

Attendance: Much of the learning in the course will take place in the class sessions. We will engage in numerous in-class group activities, and if you are not here, your absence will be missed both by me and by the classmates with whom you are working.

Accordingly, you are expected to attend and participate in all class sessions and to show up to class on time. If you have a legitimate reason for not attending (e.g., illness, family emergency, etc.), please use the University absence reporting website (<https://sims.rutgers.edu/ssra>) to indicate the date and reason for your absence. An email will be sent to me automatically. Absent extreme extenuating circumstances, notification should be sent at least twenty-four hours in advance, and absent extreme circumstances, you will not be allowed to make up missed in-class activities. No unexcused make-up exams and recitations will be given.

Academic Integrity: All students are responsible for upholding the highest standards of student behavior, as specified under the University Code of Student Conduct (<http://studentconduct.rutgers.edu/>), including but not limited to strict adherence to the terms of the University's Academic Integrity Policy (<http://academicintegrity.rutgers.edu/>). Plagiarism is not acceptable on any assignment and on first occurrence will lead to a failing grade on the assignment. On collaborative assignments, all group members should be clearly identified and all are responsible for ensuring the integrity of all group products.

Electronic Devices: Please be respectful of me and your fellow students – do not use your phone in class unless very specifically stated. Laptop or tablet use in class is allowable only in support of class activities. Appropriate uses include taking notes or referring to readings. Examples of inappropriate uses include (but are not limited to) checking email, Facebook, Twitter, or GChat.

Accommodations for disabilities: Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation:

<https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>

Safe Learning Environment: Discrimination and Harassment: Rutgers faculty are committed to helping create a safe learning environment for all students and for the university as a whole. If you have experienced any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, know that help and support are available. Rutgers has staff members trained to support survivors in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, and more. The University strongly encourages all students to report any such incidents to the University. Please be aware that all Rutgers employees (other than those designated as confidential resources such as advocates, counselors, clergy and healthcare providers as listed in Appendix A to Policy 10.3.12) are required to report information about such discrimination and harassment to the University. This means that if you tell a faculty member about a situation of sexual harassment or sexual violence, or other related misconduct, the faculty member must share that information with the University's Title IX Coordinator. If you wish to speak to a confidential employee who does not have this reporting responsibility, you can find a list of resources in Appendix A to University Policy 10.3.12. For more information about your options at Rutgers, please visit endsexualviolence.rutgers.edu

Active Citizenship: Part of the goal of this course, and of your Rutgers education as a whole, is to facilitate your activities as an active global citizen. In a democracy, voting in elections is the most basic level of being a citizen. For those of you who are U.S. citizens, I strongly encourage you to make sure you are registered to vote, and to vote in the primary election on Tuesday, June 2. Voter registration applications must be postmarked by Tuesday, May 12. You may choose to register either at your home address or your college address. If you have moved since you last registered (including between dorms), you should update your registration. To check your registration in New Jersey, or to determine your polling location, visit <http://www.njelections.org/voting-information.html>. For more information, visit: <http://cyp.rutgers.edu/ru-voting/>

Assessment and Grading (Subject to Revision)

The grading metric will be subject to revision, but will be roughly:

- 10%: Reading questions
- 15%: Class participation

15%: Homework assignments
60%: Exams

We will have three exams in this class.

All assignments will either be collected in class (for in-class activities and examinations) or submitted online via Canvas. Deadlines for assignments are enforced by the submission system.

Reading questions

Reading questions will be posted on Canvas at least 1 week in advance and should be completed by 7:59am before each class session. This deadline is enforced by the submission system and has no exceptions. (I encourage you, however, to complete the questions significantly more in advance than this.) These questions are intended to prime you to come to class ready to engage with the material, and they will be graded on completion and thoughtfulness, not on correctness.

It is your responsibility to check Canvas regularly for reading questions – you should assume these will be posted regularly, and you may not be reminded of this regularly in class.

Homework assignments

The homework assignments complement class activities, giving you additional hands-on experiences with the relationships and quantitative mechanics of the Earth system. When specified, you are welcome to collaborate on the assignments. You can also use any resources available to you. Scientists collaborate with each other all the time; they just cite each other to avoid “stealing” ideas. Explicitly cite any ideas or hints you get from other people, books, the Internet, or other resources, in your homework. For writing assignments, your words must be your own.

Extra credit

You may obtain extra credit in the class by attending astrobiology and climate change-related seminars, lectures, and symposia on campus and writing 1 page summarizing and critiquing the concepts discussed in the event. These extra credit summaries should be submitted through Canvas. A number of extra credit events are denoted on the course schedule; I may add others, and you are welcome to highlight possibilities to me.

Policy on Classroom Etiquette Department of Earth and Planetary Sciences Rutgers University, The State University of New Jersey, Piscataway, NJ

The Department of Earth and Planetary Sciences is committed to teaching excellence, fostering close interaction between students and faculty. We demand that instructors AND students display appropriate respect and consideration for each other. Instructors should try to infuse students with an enthusiastic appreciation of the science, be well prepared for class, provide students with clear goals and expectations, listen carefully to student questions and comments, and conscientiously evaluate students' work. Students are expected to attend the scheduled classes and to behave courteously in class. Together, instructors and students will maintain an environment of openness and civility that encourages and honors the intellectual

achievement represented by the discipline of Earth and Planetary Sciences. We outline the following rules on exams, attendance, tardiness/leaving early, and integrity.

Exams: Every effort must be made to take exams when scheduled. No unexcused make-up exams will be given without WRITTEN documentation from a Rutgers University official. Those with valid excuses will be allowed to take exams in a method determined by the instructor.

Attendance: Students are expected to attend class; attendance is one of the best prognosticators of a student's performance. If a student cannot attend a class or must leave early, he/she should inform the instructor and ask to be excused. Instructors may require signed attendance sheets and may count attendance as part of the grade

Tardiness and Leaving Class Early: Our University is geographically challenged. Students must commute considerable distances between classes, and instructors are aware of problems that students encounter in trying to come to class on time. Students should try to not schedule courses on different campuses in adjacent periods. We recognize that some tardiness is inevitable; HOWEVER, habitually arriving in class late and departing early is disruptive and rude. We ask that once you make every effort possible to get to class on time, and once there, STAY.

Personal Conversation: It is rude and disruptive to engage in personal conversation during class. Students who persist in this disruptive behavior may be asked to leave the class and may be penalized as absent. Refusal to leave class once requested will result in disciplinary action at the Dean's level. Cell phones must be turned off in class.

Academic Integrity: Our department fully endorses a no-tolerance cheating and plagiarism policy. If you are caught cheating, the instructor may fail you and request disciplinary action.

Your Rights: We are all human and instructors and students both make mistakes. If you feel that you have been treated unfairly, contact the department chair, Dr. Gregory Mountain (gmtm@eps.rutgers.edu).