Students' Version

ESPP 90D: Planetary Health: Understanding the human health impacts of accelerating environmental change

Spring 2018

Meeting Time: Wednesday 3:00-5:30

Location: Room 429, Harvard University Center for the Environment
26 Oxford Street, Cambridge 4th Floor

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Guest Speakers:

Dr. Jonathan Epstein, EcoHealth Alliance.

Hon. Tim Wirth, former US Senator from Colorado.

Dr. Jennifer Leaning, Dept. of Global Health and Population, HSPH.

Kelsey Wirth, Founder, Mothers Out Front

Terry Tempest Williams, American author, conservationist and activist

Gina McCarthy, Director of the Center for Health and the Global Environment

Hahrie Han, Anton Vonk Professor of Environmental Politics, University of California, Santa Barbara

Felicia Keesing, The David & Rosalie Rose Distinguished Professor of the Sciences, Mathematics, and Computing, Bard College; Adjunct Scientist, Cary Institute of Ecosystem Studies, Millbrook, NY (potential guest February 7)

Sanna Sokolow, Senior Research Scientist, Stanford University Woods Institute for the Environment

Course Rationale:

As the pace and scale of human impacts on Earth's natural systems continues to grow, there is increasing interest in understanding and quantifying the implications of these accelerating changes for human health. Recently this field has been termed "planetary health" and course leaders, Myers and Golden are directing a new effort based at the Harvard University Center for the Environment: The Planetary Health Alliance. In addition to the course material outlined below, we anticipate concrete opportunities for students who would like to become involved in the research, educational, and policy efforts that are at the core of the Alliance. The goal of this course is to provide exposure to this new interdisciplinary field and to provide opportunities for interested students to become involved.

Course Description:

Over the past several decades, the collective impact of humanity on the structure and function of Earth's natural systems has ballooned exponentially, and as a result we have entered a new epoch in which biophysical conditions are changing more rapidly than ever before in human history. Very rapid human population growth combined with even more rapid growth in per capita consumption are driving an extraordinary transformation of most of Earth's natural systems including its climate system, its oceans, land cover, biogeochemical

cycles, biodiversity, and coastal and fresh water systems. These are the biophysical systems that underpin global food production, our exposure to infectious disease and natural hazards, even the habitability of the places where we live, and there is growing concern that global environmental change is likely to be a major driver of the burden of disease over the coming century.

Note: This course is a discussion based seminar and intended for second through fourth year students (or first year students with significant interest and experience) who have taken intermediate level courses in natural and social sciences. All prospective students must submit a 2 paragraph application explaining their motivation for taking the course prior to receiving a position in the class. Send to golden@hsph.harvard.edu by midnight on January 24, 2018. Notification of acceptance will be provided January 25, 2018.

Pedagogy:

Throughout the course of the semester, students will engage in diverse materials from many types of examples of planetary health research, from nutrition and mental health, to infectious and non-communicable diseases. Using a case-study approach, we hope to tease out common themes around how changes in the structure and function of natural systems lead to impacts on different dimensions of human health. As we approach these case studies, students will be engaged in active processing of the material and in-class discussions to understand parallel themes from each successive week.

Overarching Themes:

Each class will follow a similar narrative, where an aspect of environmental change is associated with a human health outcome. Through successive case studies over the course of the semester, we expect that each student will become familiar with the subject content central to planetary health and will also become familiar with recurring, over-arching themes. We have listed the following seven themes that we will reinforce in every class throughout the semester.

1. **Planetary Health Lens**: We expect students to be able to use a planetary health lens to understand the connectedness between environmental change and human health outcomes. Students will be able to examine ecological determinants of human health and to predict the likely health consequences of certain types of environmental change. By the end of the course, we want students to understand that how humanity manages Earth's natural systems will be a primary determinant of future global health.

2. **Urgency and Scale**: The field of planetary health is driven by the sheer scale of environmental activities and their impact on human health, and the urgency which this presents to humankind. Examining the ways in which geographical scale, temporal scale, socio-cultural and economic context, and the selection of human health outcomes determine whether the presence of natural systems improves or degrades human health is an essential skill. We will also focus on framing these impacts in a cohesive framework called the Global Burden of Disease. In using this framework, we expect students to be able to assess whether some types of environmentally driven human health impacts will have a greater or less burden of disease.

3. **Winners and Losers**: We expect students to be thoughtful in understanding how these issues of scale (both geographic and temporal) and socio-cultural and economic context will lead some types of people to benefit from environmental change while others are burdened by it. Understanding who wins and who loses under what scenarios is a core objective of the course. One must always ask whose health is at stake?

4. **Equity and Ethics**: Planetary health science places us in new ethical terrain. Each decision we make about how we get around, what we eat, where we go on vacation, what we purchase, whether or not we own a pet, or even have children, impacts every other person, present and future on the planet in ways that are infinitesimally small, but collectively enormous. A corollary to this is that, in many instances, consumption practices of wealthier populations are placing less resourced people or future generations in harm's way. And that's deeply unfair. We hope to have each student develop an understanding of these ethical dimensions to planetary health.

5. **Bias**: We expect students to understand potential biases in planetary health research and the landscape of vested interests both in support of and against strong connections between environmental change and human health. Environmental change is not an apolitical process and it is important to think critically about whether this political dynamic may be driving the presentation of the topic. We want students to understand how the selection of case studies may in some ways predict the outcome that we find. There will be cases that demonstrate how the destruction of natural systems benefit human health; and other cases that demonstrate how the conservation or rehabilitation of natural systems benefits human health.

6. **Policy**: Planetary Health is intrinsically policy oriented. By quantifying the human health impacts of how we manage natural systems, we can identify policies and management strategies that optimize human health while maintaining sustainable natural systems. By the end of the course, we want students to be familiar with the policy implications of

planetary health research and be able to provide examples of ways that planetary health science informs changes in natural resource management.

7. **Surprises and Unintended Consequences**: Although Objective 1 expects students to be able to predict potential health impacts of environmental change, we recognize that a common theme in the case studies of this course are often surprising unexpected consequences that cascade out from environmental change. We want students to recognize that we will continue to be surprised by how the changing biophysical conditions on Earth will affect human health.

Class Schedule:

1/24	Class 1:	Introduction
1/31	Class 2:	Disease Ecology: Land-Use Change and Vector-Borne Disease
2/7	Class 3:	Disease Ecology: The Dilution Effect
2/14	Class 4:	Disease Ecology: Zoonotic Pandemics
2/21	Class 5:	Global Change and Nutrition: Global Wildlife Declines
2/28	Class 6:	Global Change and Nutrition: Climate Change and Agriculture
3/7	Class 7:	Displacement and Civil Strife
3/14	BREAK	
3/21	Class 8:	Science to Policy
3/28	Class 9:	Air Quality
4/4	Class 10:	Interventions and Making Change
4/11	Class 11:	Pollution and Co-Benefits
4/18	Class 12:	Mental Health
4/25	Class 13:	Spirituality, Happiness, and Constructing a New Narrative
5/4		****Final Projects Due at 5pm****

Syllabus:

1/24 Week 1: Introduction to Planetary Health and to the Planetary Health Alliance (Sam/Chris)

Introductions, course logistics, and a brief history of the evolution of research and practice at the intersection of global environmental change and human health. What is planetary health, where has it come from, and what characterizes it?

Readings:

1. Steffen, Will, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, and Cornelia Ludwig. 2015. The trajectory of the Anthropocene: The Great Acceleration. The Anthropocene Review:1-8.
2. Executive Summary of Rockefeller Foundation—Lancet Commission Report on Planetary Health. 2015. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation—Lancet Commission on planetary health. The Lancet 386 (10007):1973-2028.
3. Myers, S. S. (2017). Planetary health: protecting human health on a rapidly changing planet. The Lancet.
4. View video of Howie Frumkin's introduction to Planetary Health from the Inaugural Annual Planetary Health meeting. Link: https://vimeopro.com/planetaryhealthalliance/2017-conference-talks/video/217238318

Optional:

1. Myers, S. S., Gaffikin, L., Golden, C. D., Ostfeld, R. S., H. Redford, K., H. Ricketts, T., Turner, W. R., and Osofsky, S. A. (2013). Human health impacts of ecosystem alteration. Proceedings of the National Academy of Sciences 110, 18753-18760.

Assignments and announcements:

1. All prospective students must submit a 2-paragraph application explaining their motivation for taking the course prior to receiving a position in the class. Send to golden@hsph.harvard.edu by midnight on January 24, 2018. Notification of acceptance will be provided January 25, 2018.
2. Students are encouraged to register and attend a special film screening of Albatross on February 6. Please spread the word to fellow students in the college. Registration link here (please email Ben if the link or registration does not work)

1/31 Week 2: Disease Ecology: Land-Use Change and Vector-Borne Disease (Chris)

This week we will discuss the various ways in which land use change can influence the distribution of vector-borne diseases. We will discuss case studies illustrating the impacts of dams, demographic changes, climate change, and animal husbandry on the distribution and incidence of schistosomiasis. Sanna Sokolow will join the discussion: https://woods.stanford.edu/about/woods-faculty/susanne-sokolow

Readings (required for all):

1. CDC infopage on Schistosomiasis life cycle: https://www.cdc.gov/parasites/schistosomiasis/biology.html

Additional readings: (Chris will assign each student in the class two of these four readings)

1. Jiang Z, Zheng QS, Wang XF, Hua ZH. 1997. Influence of livestock husbandry on schistosomiasis transmission in mountainous regions of Yunnan Province. Southeast Asian J. Trop. Med. Public Health 28:291–95.
2. Zhou et al. Potential impact of climate change on schistosomiasis transmission in China. Am J Trop Med HygFebruary 2008 78 no. 2 188-194
3. Stauffer et al (2006). Schistosomiasis in Lake Malawi: Relationship of Fish and Intermediate Host Density to Prevalence of Human Infection. EcoHealth 3, 22–27, 2006
4. Sokolow, S. H., Jones, I. J., Jocque, M., La, D., Cords, O., Knight, A., ... & Collender, P. A. (2017). Nearly 400 million people are at higher risk of schistosomiasis because dams block the migration of snail-eating river prawns. Phil. Trans. R. Soc. B, 372(1722), 20160127.

2/7 Week 3: Disease Ecology: Dilution Effect (Sam; Potential Guest: Felicia Keesing)

How do changes in community composition of an ecosystem alter exposure to infectious disease? We will discuss case studies and explore the dilution effect hypothesis using Lyme disease and West Nile virus models and discuss the case of agricultural runoff and nutrient loading causing ecological changes in an aquatic system in Belize that favor malaria

transmission. Felicia Keesing may join in the discussion: http://www.feliciakeesing.com/people.html

Readings (required for all):

Note on the readings: these should be read in the order shown here to build understanding. The final two readings are an exchange of letters and are very short.

1. Ostfeld, R. S. and F. Keesing. 2012. Effects of host diversity on infectious disease. Ann. Rev. Ecol. Evol. Syst. 43:157-182.
2. Civitello, D. J., Jeremy Cohen, Hiba Fatima, Neal T. Halstead, Josue Liriano, Taegan A. McMahon, et al. 2015. Biodiversity inhibits parasites: Broad evidence for the dilution effect. PNAS, 112(28):8667-8671.
3. Salkeld, Daniel J., Kerry A. Padgett and James Holland Jones. 2013. A meta-analysis suggesting that the relationship between biodiversity and risk of zoonotic pathogen transmission is idiosyncratic. Ecology Letters. doi:10.1111/ele.12101.
4. Salkeld, Daniel J., Kerry A. Padgett, James Holland Jones and Michael F. Antolin. 2015. Public health perspective on patterns of biodiversity and zoonotic disease. PNAS, 112(46):E6261, available at pnas.org/cgi/doi/10.1073/pnas.1517640112.
5. Civitello, D. J., Jeremy Cohen, Hiba Fatima, Neal T. Halstead, Josue Liriano, Taegan A. McMahon, et al. 2015. Reply to Salkeld et al.: Diversity-disease patterns are robust to study design, selection criteria, and publication bias. PNAS, 112(46):E6262.

The following three articles will be assigned, one to each student, to three students to present as story slams in lieu of dilution effect debate; they are optional for everyone else:

1. Rejmankova, E., Grieco, J., Achee, N., Masuoka, P., Pope, K., Roberts, D., and Higashi, R. (2006). Freshwater community interactions and malaria. In "Disease ecology" (S. Collinge, K and C. Ray, eds.), pp. 90-104. Oxford University Press, Oxford. (Belize story)
2. Allan, B., Langerhans, R., Ryberg, W., Landesman, W., Griffin, N., Katz, R., Oberle, B., Schutzenhofer, M., Smyth, K., de St. Maurice, A., Clark, L., Crooks, K., Hernandez, D., McLean, R., Ostfeld, R., and Chase, J. (2009). Ecological correlates of risk and incidence of West Nile virus in the United States. Oecologia 158, 699-708 (West Nile virus story).
3. Ostfeld RS, Canham CD, Oggenfuss K, Winchcombe RJ, Keesing F. Climate, deer, rodents, and acorns as determinants of variation in Lyme-disease risk. PLoS Biology 2006; 4(6): e145. (Lyme Disease Story)

2/14 Week 4: Disease Ecology: Zoonotic Pandemics (Chris; Guest: Jonathan Epstein)

This week we will discuss the emergence of zoonotic pandemics including HIV, SARS, Ebola, Nipah and other diseases that arise from increasing human-wildlife interaction and the proliferation of livestock. Focus will be on the ecological mechanics of emergence and the social context of spillover and transmission. We will be having a guest lecture by Jon Epstein from the EcoHealth
Alliance: http://www.ecohealthalliance.org/personnel/dr-jonathan-epstein-2

Readings:

1. Wolfe, N. D., Daszak, P., Kilpatrick, A. M., & Burke, D. S. (2005). Bushmeat hunting, deforestation, and prediction of zoonotic disease. Emerging Infectious Disease, 11(12), 1822-1827.
2. Allen, T., Murray, K. A., Zambrana-Torrelio, C., Morse, S. S., Rondinini, C., Di Marco, M., ... & Daszak, P. (2017). Global hotspots and correlates of emerging zoonotic diseases. Nature Communications, 8(1), 1124.

Optional:

1. Pulliam, J. R., Epstein, J. H., Dushoff, J., Rahman, S. A., Bunning, M., Jamaluddin, A. A., ... & Daszak, P. (2011). Agricultural intensification, priming for persistence and the emergence of Nipah virus: a lethal bat-borne zoonosis. Journal of the Royal Society Interface, rsif20110223.
2. Shi Z, Hu Z. 2008. A review of studies on animal reservoirs of the SARS coronavirus. Virus Res. 133:74–87
3. Han, Barbara A. et al. Global Patterns of Zoonotic Disease in Mammals. Trends in Parasitology, Volume 32 , Issue 7 , 565 - 577

2/21 Week 5: Global Change and Nutrition: Global Wildlife Declines (Chris)

This week we will discuss the ways in which global wildlife declines on both land and sea will destabilize food security and exacerbate rates of malnutrition in the developing world. These effects will be most acutely felt by the rural poor, who live in areas distant from markets. We will draw on work by course leaders focused on quantifying the nutritional importance of bushmeat in the diet of a population in Madagascar and the ways in which environmental changes impacting global fisheries threaten the nutritional adequacy of diets for populations around the world.

Readings:

1. Ripple, William, et al. 2016. Bushmeat hunting and extinction risk to the world's mammals. Royal Society Open Science 3: 160498. http://dx.doi.org/10.1098/rsos.160498
2. Golden, CD, Allison, EH, Cheung, WWL, Dey, MM, Halpern, BS, McCauley, DJ, Smith, M, Vaitla, B, Zeller, D, Myers, SS. Fall in fish catch threatens human nutrition. Nature 534: 317-320 (2016).
3. A reading on how to approach and conceptualize interventions. The reading will be listed here in a future version

2/28 Week 6: Global Change and Nutrition: Climate Change and Agriculture (Sam)

This week will discuss the challenge of maintaining or improving global nutrition in the context of rapidly increasing food demand; increasing water scarcity and land degradation; and global climatic disruption. We will explore current trends in global nutrition and several pathways by which accelerating environmental change might impact the quality and/or quantity of food available for populations around the world. The lecture will describe Malthus and Ehrlich's predictions, the Green Revolution, and current concerns with focus on water scarcity, land degradation, and, briefly, climate change. We will discuss CO2 rise and nutritional implications.

Readings (required for all):

1. Samuel S. Myers, Matthew R. Smith, Sarah Guth, Christopher D. Golden, Bapu Vaitla, Nathaniel D. Mueller, Alan D. Dangour, and Peter Huybers. Climate Change and global food systems: Potential impacts on food security and undernutrition. Annual Reviews of Public Health 2017; 38(1): 259-77
2. Gleick, Peter H. and Meena Palaniappan. 2010. Peak water limits to freshwater withdrawal and use. Proceedings of the National Academy of Sciences 107 (25):11155-11162
3. In addition to this article, each student will be assigned one article from the primary literature which was used in the Myers article above to support the argument. Each student should read the primary article first, and then the relevant section of the Myers et al synthesis to see how it was used. The student should be prepared to present her/his paper to the group and comment on whether he/she agrees with how it was used to support the review article.
4. Jon Patz' 20 minute TED talk on "Climate Change is Affecting Our Health. Is There a Cure?". Link: Climate Change is Affecting Our Health. Is There a Cure? | Jonathan Patz | TEDxOshkosh
5. OR Courtney Howard's 16 minute TED talk on "Healthy Planet, Healthy People". Link: Healthy Planet, Healthy People | Courtney Howard | TEDxMontrealWomen

Optional:

1. Tai, A., P. K., Val Martin, M., and Heald, C., L (2014). Threat to future global food security from climate change and ozone air pollution. Nature Climate Change 4, 817-821.
2. Myers, Samuel S., K. Ryan Wessells, Itai Kloog, Antonella Zanobetti, and Joel Schwartz. 2015. Effect of increased concentrations of atmospheric carbon dioxide on the global threat of zinc deficiency: a modelling study. The Lancet Global Health 3 (10):e639-e645.
3. Medek DE, Schwartz J, Myers SS. Estimated effects of future atmospheric CO2 concentrations on protein intake and the risk of protein deficiency by country and region. Environmental Health Perspectives 2017; 125(8).
4. Smith MR, Golden CD, Myers SS. Potential rise in iron deficiency due to future anthropogenic carbon dioxide emissions. GeoHealth 2017; 1: 248-57.
5. Springmann, M., Daniel Mason-D'Croz, Sherman Robinson, Tara Garnett, H. Charles J. Godfray, Douglas Gollin, Mike Rayner, Paola Ballon, Peter Scarborough (2016). Global and regional health effects of future food production under climate change: a modelling study. The Lancet 387(10031), 1937-1946.

Optional popular articles:

1. Changing the Global Food Narrative. https://the-macroscope.org/changing-the-global-food-narrative-ae918e620b14
2. GMOs, Silver Bullets and the Trap of Reductionist Thinking. https://the-macroscope.org/gmos-silver-bullets-and-the-trap-of-reductionist-thinking-59d9ca08654c
3. The Complex Nature of GMOS Calls for a New Conversation. https://ensia.com/voices/the-complex-nature-of-gmos-calls-for-a-new-conversation/

3/7 Week 7: Population displacement and civil strife (Guest: Jennifer Leaning)

We will discuss the question of how accelerating environmental change may cause certain regions of the world to become at least temporarily uninhabitable through a combination of natural disasters (extreme heat, drought, floods, etc.) and crop failures. We will review the existing literature and have a guest lecture by Prof. Jennifer Leaning: https://www.hsph.harvard.edu/jennifer-leaning/

Readings:

1. Maldonado, J. K., Shearer, C., Bronen, R., Peterson, K. & Lazrus, H. (2013). The impact of climate change on tribal communities in the US: displacement, relocation, and human rights. Climatic Change, 120:601-614.
2. Hsiang, S. M., Meng, K. C., & Cane, M.A. (2011). Civil conflicts are associated with the global climate. Nature, 476:438-441.
3. https://www.nytimes.com/interactive/2017/11/25/climate/arctic-climate-change.html
4. Kelley CP, Mohtadi S, Cane MA, Seager R, Kushnir Y. Climate change in the Fertile Crescent and implications of the recent Syrian drought. Proceedings of the National Academy of Sciences 2015; 112(11): 3241

Optional:

1. de Sherbinin, Alex. (2014). Climate change hotspots mapping: what have we learned? Climatic Change, 123:23-37.
2. Jeffrey Gettleman, Drought and War Heighten Threat of Not Just 1 Famine, but 4. NY Times, 2017. Available at https://www.nytimes.com/2017/03/27/world/africa/famine-somalia-nigeria-south-sudan-yemen-water.html?_r=0
3. Anouch Missirian and Wolfram Schlenker. Asylum applications respond to temperature fluctuations. Science 358, 1610–1614 (2017)

3/14: BREAK

3/21 Week 8: Science to Policy (Chris; Guests: Senator Wirth and Gina McCarthy)

This week we will have two guest lecturers:

1. The Honorable Tim Wirth, former US Senator from Colorado who organized the congressional hearings on climate change in 1988. https://en.wikipedia.org/wiki/Tim_Wirth
2. Gina McCarthy, current director of the Harvard Center for Health and the Global Environment and former head of the EPA under the Obama administration. https://en.wikipedia.org/wiki/Gina_McCarthy

Students should come prepared with examples of environmental and planetary health problems and challenges, and during the class we will discuss how solutions can be brought about through connecting science with policy.

Student prep for class: Find an issue from the news or that we have touched upon in the class material that could benefit from a policy intervention, and identify the challenges in bringing such a policy into place.

Planetary Health event this week:

1. Women for Planetary Health Event - March 21 at 5:30pm. More details to come

3/28 Week 9: Air Quality (Sam)

We will explore mechanisms by which climate change is leading to changes in risks of allergic respiratory and cardiopulmonary disease through increased ground-level ozone formation, and increased pollen production. We will discuss the course leaders' research quantifying the health impacts of land use decisions in Sumatra and Kalimantan which are leading to fires and significant downwind morbidity and mortality. Finally, we will discuss the very significant human health benefits associated with climate mitigation that would accrue through air quality improvements.

Readings:

1. Marlier, Miriam, E., Ruth S. DeFries, Patrick S. Kim, Shannon N. Koplitz, Daniel J. Jacob, Loretta J. Mickley, and Samuel S. Myers. 2015. Fire emissions and regional air quality impacts from fires in oil palm, timber, and logging concessions in Indonesia. Environmental Research Letters 10 (2015):085005.
2. Koplitz, Shannon N., Loretta J. Mickley, Miriam E. Marlier, Jonathan J. Buonocore, Patrick S. Kim, et al. 2016. Public health impacts of the severe haze in Equatorial Asia in September–October 2015: demonstration of a new framework for informing fire management strategies to reduce downwind smoke exposure. Environmental Research Letters 11 (2016):094023.

Optional Readings (examples of different pathways through which the air quality-health relationship is affected by climate change):

1. Wayne, Peter, Susannah Foster, John Connolly, Fakhri Bazzaz, and Paul Epstein. 2002. Production of allergenic pollen by ragweed (Ambrosia artemisiifolia L.) is increased in CO2-enriched atmospheres. Annals of Allergy, Asthma and Immunology 88:279-282.
2. Kinney, Patrick L. 2008. Climate Change, Air Quality, and Human Health. American Journal of Preventive Medicine 35 (5):459-467.
3. Bell, M L, R Goldberg, C Hogrefe, P Kinney, K Knowlton, B Lynn, J Rosenthal, C Rosenzweig, and Jonathan A Patz. 2007. Climate change, ambient ozone, and health in 50 U.S. cities. Climatic Change 82:61-76.

4/4 Week 10: Interventions/Making Change (Guests: Kelsey Wirth and Hahrie Han)

This week we will focus on pathways to change, from policy to technology to activism. We will have a guest lecture from Kelsey Wirth, Founder of Mothers Out Front, and an interactive discussion featuring the theory of activism (led by Hahrie Han) and the practice of activism (led by Kelsey Wirth)

Readings:

1. Mothers Out Front. Available at http://www.mothersoutfront.org/
2. Mothers Out Front Facebook page. Available at https://www.facebook.com/mothersoutfront/
3. More readings TBD

4/11 Week 11: Pollution and Co-Benefits (Sam)

One of the defining features of the Anthropocene has been the production of wastes at rates that exceed our planet's capacity to absorb them: plastics, agrochemicals, greenhouse gases, toxicants, and on. This week we will explore the issue of global pollution, focusing on the scope and extent of the problem, its associated health effects, who benefits from polluting activities, who bears the burden, and what can be done. We will highlight the notion of co-benefits—that activities to reduce pollution can often have additional benefits as well.

For this class, we will break the class into three groups of five. Each group will tackle pollution in a different medium: air, water, and soil. And each group of five will be tasked with covering the following five questions: 1) what is the scope and extent of your pollution problem

globally; 2) what are its associated health impacts; 3) who benefits from polluting activities; 4) who bears the largest burden? 5) what can be done and are there co-benefits?

The class will have three main parts. The first part will be 2 minute presentations by each student, one group at a time (air, water, soil) summarizing the responses to the five questions. After a break, each group will compete for funds from the Gates Foundation (the instructors) for limited funds to reduce pollution and improve health. The groups will debate why addressing their problem is the most cost-effective use of the Gates pollution funds (so they'll need to listen to each other closely to make this argument effectively). In the third part, we will hear a presentation of a blog post about planetary health which closely follows our conceptual diagram for planetary health and explicates a particular example of a problem using that framework.

All students will score their colleagues from 0-100 on the strength of their story and the winning student will have her/his contribution posted on the PHA blog (this will take the place of our op-ed from last year). The blog post can be the seed of the case study they write up their final project and is an opportunity for them to start structuring their thinking for that project.

Readings:

1. Landrigan, P. J., Fuller, R., Acosta, N. J., Adeyi, O., Arnold, R., Baldé, A. B., ... & Chiles, T. (2017). The Lancet Commission on pollution and health. The Lancet.

4/18 Week 12: Mental Health (Chris)

People are deeply rooted in their environments through a profound psycho-social connection. This week we will explore the ways in which the environment affects mental health, and how we expect that ongoing and rapid environmental changes (urbanization, dispossession, natural disasters, forced migration, etc.) may influence the mental health burden of disease. We will also explore our own individual connections to nature through a deep discussion of the readings.

Student prep for class:

Ask students to think about their personal connections with nature in light of the Biophilia/Last Child readings, and be ready to discuss.

Readings:

1. Clayton, Susan and Myers, Gene. Conservation Psychology: Understanding and promoting human care for nature. Wiley-Blackwell, 2011. pp 1-10, 54-66.
2. Wilson, EO. Biophilia. Harvard, 1986. Ch 1 and 2.
3. Louv, Richard. Last Child In The Woods: Saving our children from nature-deficit disorder. Algonquin Books of Chapel Hill, 2005. pp 1-6, 99-114.
4. Carleton 2017 Crop-damaging temperatures increase suicide rates in India. PNAS

4/25 Week 13: Spirituality, Happiness, and the Need for a New Narrative (Guest: Terry Tempest Williams)

Most of our course has been science-based—an exploration of how changes in biophysical conditions ultimately impact human health and what we can do about it. But the challenges illustrated by planetary health science have more fundamental origins. What is the dominant Western relationship between humanity and Nature? How did we get there? What do we know about what truly makes us happy? Is it possible that to achieve planetary health, we need a new narrative about our place in the world? Where can we turn for alternative narratives to the one streaming into our homes daily from popular culture? What do indigenous cultures offer? What about faith traditions? Along with acclaimed writer and activist, Terry Tempest Williams, we will explore some of these questions.

Optional popular articles:

1. Men Resist Green Behavior as Unmanly. https://www.scientificamerican.com/article/men-resist-green-behavior-as-unmanly/

Assignments and Grading:

1. News events read outs (10%)

Each week, one or more students will be asked to share a news event from the prior two weeks which has a planetary health dimension and lead the class in a brief (5-minute time limit, exact) discussion consistent with our recurring themes: an environmental change shown to have a human health implication; whose health? Who stands to gain/lose by quantifying/publicizing these connections? Why do you think it was reported and who pushed the story? What policies and other types of interventions could address it? This assignment will constitute 10% of the final grade. This will be an individual assignment not done in pairs or groups. Articles should be from within the past two weeks.

2. Dilution effect hypothesis debate (10%)

In Week 3 (February 7) we will conduct a debate on the dilution effect hypothesis. The class will have been divided into two groups, and each group must prepare an opening argument and a closing argument ahead of time. All students not presenting opening or closing arguments must participate in the cross-examination section of the debate. In the week following the debate all students must write a reflection on the debate, specifically identifying the relevance of an Overarching Theme in the debate. This assignment will constitute 10% of the final grade.

3. Blog post (10%)

In Week 11 (4/12) students will write a blog post on the subject of planetary health (500-800 words). This will constitute 10% of the final grade. The post should closely follow the planetary health schematic from Figure 4 in Myers SS. Planetary health: protecting human health on a rapidly changing planet. The Lancet; 390(10114): 2860-8 (see below):

The blog posts will be presented in two minute presentations in class on week 11 and voted on by all students. The winning presentation will be posted on the Planetary Health Alliance blog.

4. Participation (20%)

There will be a heavy emphasis on participation which will constitute 20% of the final grade, including in-class activities, discussions and presentations. We understand that participation means different things to different people, but essentially it means reading the assigned material and engaging with the material and with your fellow students in a thoughtful way. Listening carefully and helping your peers is as, if not more, important than taking an opportunity to speak. If we have concerns about your participation, we will let you know.

5. Final project (50%)

The final project will be a formal research brief connecting a particular type of environmental change to a specific human health outcome, and will contribute 50% of the final grade. We want each student to:

- Describe a particular type of environmental change in a specific geographical region. Discuss its scope and rate of change, and any relevant historical, social, and economic drivers.
- Describe a specific human health outcome (or suite of health outcomes) expected to arise from this type of environmental change. Focus here on the evidence base linking the environmental change to its human health impact.
- Discuss how the environmental and human health dimensions of this process have been portrayed by the media, government, corporate interests, and scientific community. To what extent have the environmental and human health conditions been adequately connected? Explore any vested interests and their influence on the discourse of these various stakeholders.
- Propose a solution drawing on different dimensions and substantiate your argument for change. This multi-faceted solution should be comprehensive and include some components from policy, technology, economy, behavior change, and activism, among others.

Final projects will be due at 5pm ET on 5/4.

Summary of grading breakdown:

Debate and reflection (in class 2/7 and due 2/14)	10%
Blog post (assigned 4/4, due 4/11)	10%
News report on planetary health (in-class, assigned at beginning of semester)	10%
Final project (due 5/4)	50%
Participation	20%

Plagiarism and Collaboration

Any material submitted to meet course requirements — homework assignments, papers, projects, examinations — is expected to be a student's own work. Please see the University's policy on
plagiarism: http://isites.harvard.edu/icb/icb.do?keyword=k70847&pageid=icb.page355322

You are encouraged to consult with one another when completing assignments and working through the readings, and you may also share library resources. You may find it useful to discuss your chosen topics for assignments with your peers, particularly if you are working on the same topic as someone else, but you should ensure that the written paper you submit for evaluation is the result of your own research and reflects your own approach to the assignment.

Late work and unexcused absences

Without prior permission from one of the instructors, late assignments will be docked one full letter grade for each day they are late. Because participation is central to the exchange of ideas that we are looking for, attendance is critical, and each student is expected to attend each class unless something unforeseen and critical comes up.