

S15658: Saving the World with the Science of Sustainability!

Syllabus

Summer HSSP 2023
MIT Educational Studies Program

Basic Information

Instructors: Carlos Daniel Díaz-Marín, Michael Bichnevicius, Shomik Verma, Simo Pajovic

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Dates and Times: Sundays from 1:00 PM to 2:30 PM
Jul. 9th to Aug. 13th
Virtual

Course Description

Climate change is one of the most significant challenges in human history. In recent years, it has become clear that our way of life is not 100% sustainable and that something needs to change. This course will introduce you to sustainability and the science behind it. We will cover a wide range of topics, including:

- climate change;
- electricity generation and its decarbonization;
- water scarcity and water harvesting;
- the role of materials in engineering clever climate solutions.

By the end of this course, you will have learned about the science underpinning these applications, including heat transfer, thermodynamics, mechanics, and materials science. More importantly, we hope you will walk away able to talk about sustainability and feeling inspired to create the changes necessary to make society more sustainable and save the world!

Course Schedule

Day	Date	Instructor	Seminar Topic
1	Jul. 9 th	Simo	Climate Change & Renewable Energy
2	Jul. 16 th	Shomik	Industrial Decarbonization
3	Jul. 23 rd	Michael	Power Generation, Storage, & Hydrogen
4	Jul. 30 th	Simo	Cool Materials for Thermal Applications
5	Aug. 6 th	Carlos	Water Scarcity & Water Harvesting
6	Aug. 13 th		Panel Discussion

Suggested Readings

Each seminar will have a set of suggested readings and videos, which are linked below. We recommend that you read or watch at least some of them before each seminar, but they are not required to understand the course material as presented by the instructors. Recommended books (in orange) are also listed; of course, you are not required to buy them, but they are there for those who are interested in further reading.

Climate Change and Renewable Energy (Jul. 9th)

- U.S. Energy Information Administration: www.eia.gov
- NASA: climate.nasa.gov
- YouTube: [Who Is Responsible for Climate Change?](#)
- YouTube: National Geographic has many sobering videos about the impacts of climate change

Industrial Decarbonization (Jul. 16th)

- Center for American Progress: [The Pathway to Industrial Decarbonization](#)
- Science: [Net-zero emissions energy systems](#)
- US Department of Energy (DOE): [Industrial Decarbonization Roadmap](#)
- YouTube: [Steel production](#)
- YouTube: [Cement production](#)
- YouTube: [Aluminum production](#)

Power Generation, Storage, & Hydrogen

- Book: [Electrical Power Generation](#)
- Book: [Energy Conversion Engineering](#)
- [US Department of Energy Hydrogen Program](#)

Cool Materials for Thermal Applications (Jul. 30th)

- Some great chemistry and physics review from LibreTexts that you may find useful. The basic readings are intended to give you a broad overview of topics we'll talk about a bit more in class. The more advanced readings are intended to give you some depth and a starting point for your own exploration.
 - (Basic) [Atomic structure](#), [Atomic bonding](#), [Energy and heat](#), [Solids, liquids, and gases](#), [Quantum mechanics](#)
 - (More advanced) [Electronic structure](#), [The periodic table and its trends](#), [Covalent bonding](#), [Characteristics of molecules](#), [Phase transformations](#), [Intermolecular interactions](#)
- Materials science topics, some from LibreTexts and some from other sources. This will be the meat of the lecture, so if you're eager to get started, have a read!
 - (Basic) [Materials classification](#), [Anisotropy](#), [Crystals](#), [Thermal conductivity](#), [Heat capacity](#), [Viscosity](#), [Thermal expansion](#), [Thermoelectric materials](#)
 - (More advanced) [Anisotropic thermal conductivity](#), [Phonons](#), [Blackbody radiation](#)
- *Fundamentals of Materials Science and Engineering: An Integrated Approach* by William D. Callister and David G. Rethwisch
- *The New Science of Strong Materials: Or Why You Don't Fall through the Floor* by J. E. Gordon (this one is more about mechanical properties, but it is a fantastic introduction to materials science and very easy to read)

Water Scarcity and Water Harvesting (Aug. 6th)

- Watch:
 - [This Device Pulls Clean Water Out Of Desert Air](#)
 - [Explained: World's Water Crisis](#)
- Listen: [Many podcasts](#), including a few episodes of the popular "Stuff You Should Know" podcast
- Read: [SDG 6 Synthesis Report 2018 on Water and Sanitation](#)
- Get Involved: MIT Water Club's Junior Water Scholar Program, if interested, sign up to learn more here: <http://mitwater.org/contact>
- Further study: [Desalination and Water Purification on MIT OCW](#)

Policies

Participation: We strongly encourage you to ask questions and participate in Zoom polls. The best way for you to get what you want out of this course is to ask questions, and we'll do our best to answer.

Conduct: Although this is an online course, we expect the same level of respect and proper conduct as in real life. All students and instructors should treat one another with honesty and respect. Harassment of any kind will not be tolerated, and you will be asked to leave for inappropriate behavior.