

GEO170 Earth Science and Society

Sample Syllabus

(Departmental approval for Common Core submission: March 12, 2025)

Course Description

3 hours, 3 credits. Structures and interactions between four main Earth layers: hydrosphere, atmosphere, biosphere and lithosphere in the context of societal activities.

Course Texts

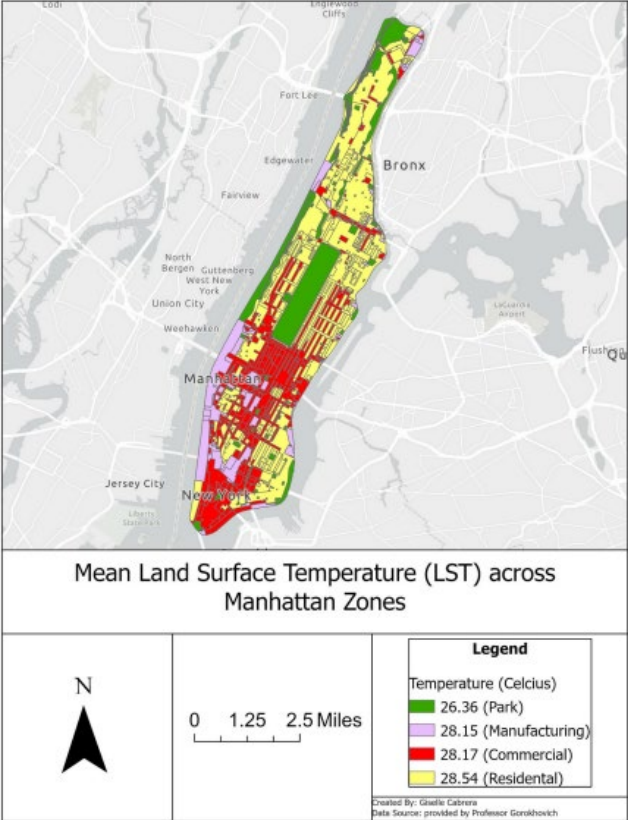
1. The Essential Guide to Planet Earth, by Benjamin J Burger, Open Educational Resource, available at, <https://open.umn.edu/opentextbooks/textbooks/the-essential-guide-to-planet-earth>
2. Science, Technology, and Society, by Bill Freedman and Nick Baker, Open Educational Resource, available at: <https://ecampusontario.pressbooks.pub/sciencesociety/front-matter/preface-2/>
3. Introduction to Environmental Sciences and Sustainability, by Emily P. Harris, Open Educational Resource, available at: <https://pressbooks.uwf.edu/envrioscience/front-matter/introduction/>
4. Selected peer-reviewed articles related to Earth Science and societal issues will be provided for students during the course.

Learning Outcomes

- Demonstrate understanding of main Earth layers, associated societal needs and pressing issues.
- Demonstrate understanding of Earth Science terminology.
- Demonstrate understanding of global earth data.
- Demonstrate understanding of the role and use of global earth data in decision-making.

Course Schedule

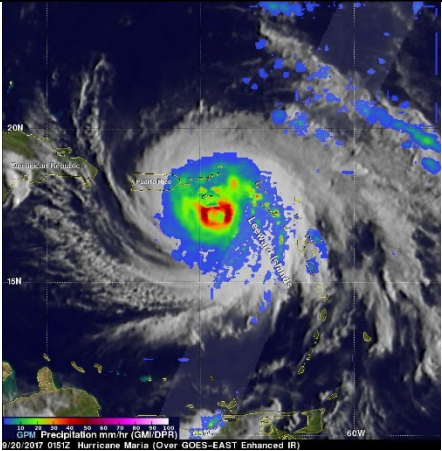
Week	Topic	Societal Relation
1	Earth Science history. Development of ideas about the Earth systems evolution and processes. Noosphere, Gaia, Anthropocene, Anthropocentric vs Ecozoic. Development of scientific method. Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: Students will learn the fundamental concept of the Earth Science postulating the interconnectedness between Earth System elements such as hydrosphere, lithosphere, atmosphere and biosphere. This interconnectedness is a basis for our understanding of the link between society and planet Earth. Students will, for example, review historical works of Alexander von Humboldt (1769 – 1859) and Vladimir Vernadsky (1863–1945) who were the first among other scientists who noticed and described the connection between earth system elements. In addition, students will be introduced to scientific method and methodology of the short- and long term of measurements in Earth Science. Students will have to complete weekly quizzes, 20 min each. Here is an example of the assessment using multiple choice: Question: Which one relates to scientific method? Potential Answers: 1. series of steps 2. lab analysis - statistical analysis 3. statistical analysis 4. mathematical algorithm <u>Homework assignment 1</u>: students will be provided with a map (data) showing various mean surface temperatures in Manhattan,	• Perception on earth science through ages and its relationship with earth system elements, such as atmosphere, hydrosphere, biosphere and lithosphere. • Globalization of society and need for global data on earth system

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	measured by satellite Landsat; it also includes a legend explaining various land surface covers (e.g. residential area, park, etc.).  Mean Land Surface Temperature (LST) across Manhattan Zones Legend Temperature (Celsius) 26.36 (Park) 28.15 (Manufacturing) 28.17 (Commercial) 28.54 (Residential) Created By: Giselle Cabrera Data Source: provided by Professor Gorokhovitch Using this data on the map students should apply scientific method to investigate the association between land surface temperature and land cover. The written assignment should include the following sections: - Observation (from the map) In this section students should write observation from the data depicted on the map. Here is an example of such answer: “My observation of the map is that the land surface temperature is lower in the park and higher in other areas in Manhattan where is manufacturing, residential and commercial areas are. Upon comparison of temperature values, I see that in parks temperature is lower by approximately 2 degrees Celsius.” - Question	

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	After observing the surface temperature distribution in Manhattan students should formulate a scientific question. Here is an example of the answer: “The question that I pose is: Why park areas have lower surface temperature than other areas?” 3. Hypothesis In this section students formulate a hypothesis. For example: “My hypothesis is that in parks we have more vegetation than in areas of residential, manufacturing and commercial activities; vegetation absorbs less heat, therefore the surface temperature is lower” OR “My hypothesis is that in parks we have fewer concrete surfaces; concrete absorbs and retains more heat from the sun, therefore the surface temperature in concrete surfaces is higher than in parks.” 4. Experimental design (variables) Following lecture materials students should write an experimental setting and define which variable is depending and which is independent. For example: My experiment will consist of the following: I need to measure and compare heat absorption in vegetation and concrete. My dependent variable is heat absorption and my independent variable is a material type, i.e. vegetation and cement or various land cover surfaces, such as forest (vegetation), commercial areas (concrete), etc.” 5. Data collection (methods) Since students are not able to collect field data or work with remote sensing data they can use literature search to find comparison between heat absorption in concrete and vegetation from at least three sources. They can use Google Scholar or Scopus and provide references for their findings. The idea of literature search to find data from other scientists when we are not able	

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	to conduct experiment by ourselves will also be highlighted in lecture material. 6. Analysis Using collected data students should write analytical part of the written assignment. For example: "Analysis of data from (Reference list) shows that measured heat absorption of the concrete is higher than vegetation by (they will indicate %)". 7. Conclusion In this section students will write conclusion, for example: "Using three independent research data on heat absorption in concrete and vegetation we conclude that the concrete has higher heat absorption rate than vegetation. This leads to the higher surface temperature in park areas and lower surface temperature in commercial and residential areas. This finding might be useful in urban planning to reduce "heat island" effect in cities." <u>Homework assignment 2:</u> I. Compile list of violations of research ethics and unbiased assessment by analyzing reasons for retraction of research papers from earth science journals. 1. Visit site Retraction Watch at: https://retractionwatch.com/ 2. Scroll down to Retraction Watch Database and click View the Database 3. Download file retraction_watch.csv and save to the hard drive. 4. Open the file in Excel 5. Go to Data and click Filter; you should see in the upper row multiple black triangles at the right side of the column title. 6. Find column "Subject", click black triangle and choose filter: (ENV) Environmental Sciences;(PHY) Geology 7. Find column "Article Type", click the black triangle and choose filter: Research Article.	

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	8. Look at the columns "Reason" and list all unique occurrences of the reason for retracting the paper. 9. Calculate number of selected retractions in the database. 10. What are three most frequent ethical/research violations? II. Analyze and interpret the impact of retractions on scientific community 1. On the main page click "Top 10 most highly cited retracted papers" 2. Look at the column "Citing Articles before retraction"; it shows number of citations since article was published, before its retraction. 3. What is your conclusion about the significance of these citations of retracted paper for scientific community? III. Discuss the potential violations of research ethics and unbiased assessment in cases of private and governmental funding. Specifically, what can cause these violations? Can we abstain of these violations? How?	
2	Earth science data collection and analysis: review of local and global data methods collections and measurements Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. <u>Homework assignment:</u> students will use free NASA software Panoply to visualize propagation of the hurricane Helene, 2024, using three time stamps: approach to the North Carolina coast, landfall and dissipation. Upon successful visualization students will analyze hurricane movement and precipitation. The visualization is a map showing hurricane rotation and precipitation levels. Here is an example showing a different hurricane at a specific time stamp:	• Role of data in decision making • Environmental impact and assessment, natural resources management and conservation, natural hazards, political importance of earth systems, global measurements*

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	 Description of the anticipated homework and lab report structure: 1. Gathering data: download data from NASA web site, open in Panoply and select a variable for visualization (i.e. precipitation), map coordinate system and spatial extent. 2. Analyze: read precipitation scale and make observation about its rate (min/max) and spatial distribution across hurricane pattern (i.e. where do you see max and where min rates). 3. Interpreting: in which direction hurricane moves and rotates? Why? How does precipitation changes with hurricane propagation from the coast to the land? What causes this change?	
3	Lithosphere: structure and its main elements Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on how earthquake hazard and geologic composition affect urban design in Manhattan.	• Patterns of settlements, natural hazards, global measurements
4	Lithosphere: earth materials and soils Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on how rare metals in Ukraine (their source and availability) played role	• Mining, agriculture, landfills (including hazardous sites), urban growth, economics, politics, global measurements

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	in negotiations between USA and Russia to stop the current war.	
5	Lithosphere: surface processes Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on how landslide hazards are linked with all four spheres of the earth.	Impact of natural hazards, global measurements
6	Hydrosphere: water cycle and humans Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on the role of rain forests in global hydrologic cycle and methods of global observation.	Role of water in society from the life origin to space explorations, global measurements
7	Hydrosphere: surface and ground water Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on New York City (NYC) water supply, methods of monitoring and associated political conflict between NYC and upstate communities.	Agriculture, water supply, global measurements, fisheries
8	Hydrosphere: natural hazards Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on flood hazards, human impact and climate change with at least two local/regional examples.	Droughts, floods, hurricanes, climate change, global measurements
9	Atmosphere: atmospheric structure Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on the role of atmospheric structure on climate change	Space exploration, weather predictions, climate change, global measurements

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10	Atmosphere: atmospheric chemistry Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on the role of aerosols in human health and climate change; where data come from?	Climate change (contributions to greenhouse gases), impact of volcanic eruptions, global measurements
11	Atmosphere: atmospheric processes and hazards Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on jet streams and atmospheric rivers in weather predictions	Hurricanes, tornadoes, jet streams, climate change, global measurements
12	Biosphere: origin and evolution Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on biologic evolution in connection with modifications in lithosphere, hydrosphere and atmosphere for the past 4.5 billion years	Extinctions, bio and natural hazards, global measurements
13	Biosphere: structure and elements Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on global measurements of the biosphere elements by NASA.	Landcover, land use, population, biomes, global measurements
14	Biosphere: interaction with hydrosphere, atmosphere and lithosphere Assessment: quiz with multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc. Homework: a brief essay on relationship between globalization and environmental degradation.	Natural hazards, climate change, globalization, politics and environmental conservation/degradation, geoengineering

* **global measurements:** NASA observation systems (including collaborative projects with European Space Agency and other international partners)

Weekly Quizzes

Weekly quizzes will be conducted at the beginning of each class for 15-20 minutes. They will cover material learned in previous lecture in a series of multiple-choice, multiple answer, true/false, calculated formula, fill in the blank, etc.

Weekly Homework Assignments

Homework assignments consist of a specific problem solving, paper/data review or analysis that students can work on during the week between classes and submit as a short essay, graph, diagram or map.

Term paper (optional)

Term paper should highlight research on one of the topics that we covered in class. It should include literature review, a hypothesis and analytical part with methodology, data analysis, discussion and conclusions.

Grading

Weekly Quizzes: 50%

Weekly Homework Assignments: 35%

Term Paper (optional, extra credit): + 15%

Attendance and Participation: 15%