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The Wicked Problem of Global Food Security

Earth Educators Rendezvous

Albuquerque, New Mexico, July 2017

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This work is supported by a National Science Foundation (NSF) collaboration between the Directorates for Education and Human Resources (EHR) and Geosciences (GEO) under grant DUE - 1125331

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The Wicked Problem of Global Food Security

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Intro Level

2-3 Weeks

6 Units

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Summary

The 1996 World Food Summit declared food security to be "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life." Over the next several decades, food security will continue to be one of the the most pressing issues facing our planet. In this three-week module, we take an Earth systems approach to understanding and addressing world food insecurity issues, and explore how social, economic, and political factors impact decision-making and can improve or compromise the biogeochemical interactions provided by the Earth system as they pertain to food production. Students will explore the very factors that cause food insecurity (including climate, socio-economic, and physical) through readings, lecture, case studies, and geospatial analysis using ArcGIS Online. The module will culminate with a summative assignment where students will design a community-based action plan utilizing a variety of data sources addressing food insecurity in a location of their choosing.

Strengths of the Module

- This module prepares students from a variety of backgrounds to explore a global humanitarian problem using systems thinking. Sociopolitical and economic

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Instructor Materials: Overview of the Food Security Module

Module Goal

- Students will be able to **use systems thinking** to **evaluate and assess food insecurity** in a location by **analyzing authentic geospatial and socioeconomic data**; be able to **identify components, processes, and fluxes of Earth system science** and **apply these concepts** in a location and **assess** the role the Earth system plays in the food system and contributes to food insecurity; and be able to **propose plans** to promote food security in a locality that include an understanding of the present day food vulnerability, the interaction of human and natural systems, and impacts of climate change.

Teaching Strategies

- Flipped classroom model
- Team work and individual work
- Class discussions
- Systems diagrams
- Culminating team project
- Formative assessments for each unit

Six units

- Unit 1: The Basics of Global Food Systems
  - AGO modified 5x5
  - Make a map in AGO that illustrates the spatial dimensions involved in our global food system as it relates to your favorite chocolate bar.
- Unit 2: Systems Thinking to Address Wicked Problems
- Unit 3: Climate Change and Food Security: The Case of Chocolate
  - Map Activity: Climate Change and Cocoa Production in West Africa
  - Uses AGO data layer: Köppen-Geiger Observed and Predicted Climate Shifts (IPCC)
- Units 4-6: Food Security Case Studies
  - AGO based explorations of 3 case studies – New York City, Caribbean, Nebraska

Chocolate Bar AGO Assignment

Now that you have read a brief summary on the origins and distribution of chocolate, you will create a map using ArcGIS online. Your assignment is to make a map showing the global connections of your favorite brand of chocolate bar, essentially describing the global food system of chocolate.

Directions:

1) Determine what points you want to highlight on your map (Consider: Where did you buy your chocolate bar? Where did you eat it? Where was it made? Where were the ingredients sourced?). Points could include Côte d'Ivoire, Indonesia, Ghana, Philadelphia, Hershey, PA, etc.

2) Assemble URLs for images that will illustrate that particular location/process in your chocolate bar's journey. Wikimedia commons provides access to fair-use images with a URL.

3) Open an Excel Spread Sheet
a) Create headings (Name, Caption, etc.) exactly as you see them in the table below (anything different will result in errors in your final product). **Each record in the Excel file will define a point on your map.**
b) Under the heading "Name," write your point location in the table.
c) For each location under URL include the web address for the image that will illustrate that particular point or process.

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Unit 2: Systems Thinking and the Wicked Problem of Global Food Security

Compiled by Russanne Low, University of Nebraska, rlow2@unl.edu, Rebecca Boger, Brooklyn College, rboger@brooklyn.cuny.edu, and Amy E. Potter, Armstrong State University, amy.potter@armstrong.edu

Author Profiles

▶ This material was developed and reviewed through the InTeGrate curricular materials development process.

Summary

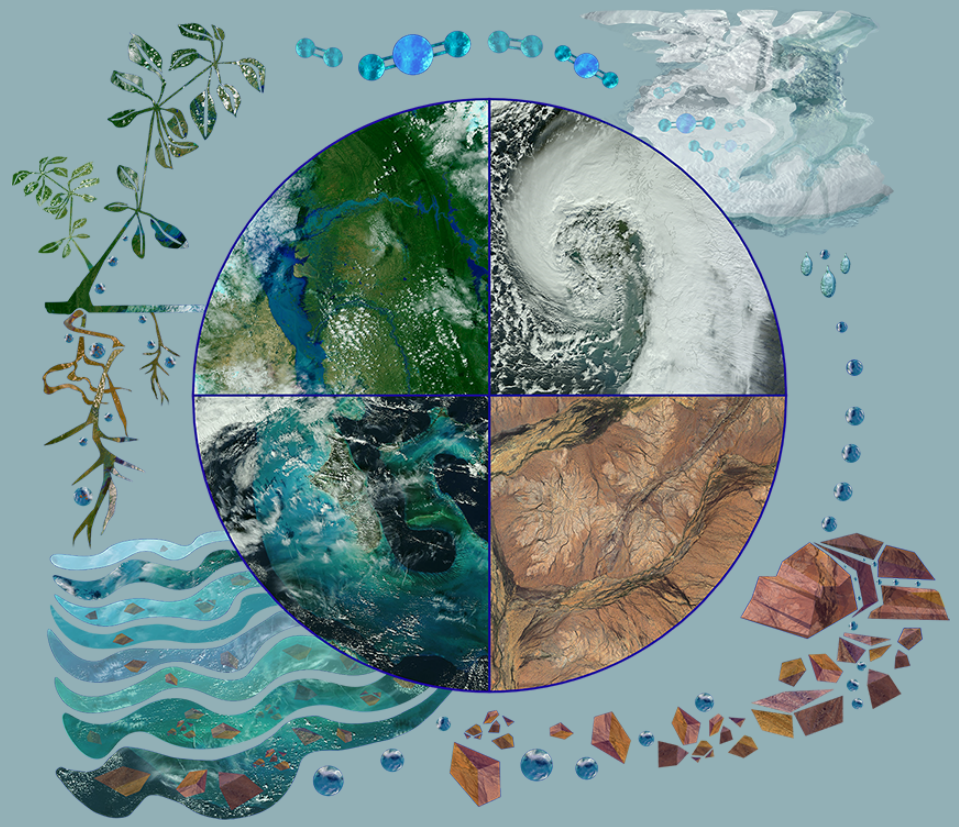
Armed with an overview of the complexity of issues associated with global food security, this unit begins by contextualizing food security as an example of a wicked problem. Wicked problems are problems that are unsolvable in the traditional sense, and have complex multiscalar causal factors that contribute to the creation of new issues as old ones are addressed. Both global food security and climate change are examples of wicked problems. This unit presents systems thinking as a way to identify complex problems and explore solutions. Using a flipped classroom model, students complete a self study tutorial that presents system concepts in the context of Earth system science. The slide stack includes two guided activities related to the carbon cycle and soils. A short reading, "Why Systems Thinking?" and a video clip is included in the tutorial. Authentic assessment of the homework activity is an Earth system diagram connected to one of the issues of global food security from Unit 1 that they will bring to class. After a short class discussion that introduces concepts of sustainability and ecosystem services as related to food production, students are broken into groups and are asked to create their own systems diagram of the global food system, using the organizational systems concepts they examined as homework and the introduction activities of Unit 1. After completing the diagrams, students examine a food system diagram example, and identify the components of the system using standardized systems language. Students can photograph their diagrams or make quick sketches so they have a working copy to include with their notes.

Learning Goals

After completing this unit, students will be able to:

1. Describe the major components of the Earth system.
2. Identify the parts of a system: flux, reservoirs, residence time, cycles, and feedback loop.
3. Apply systems thinking to wicked problems like global food security.
4. Create a diagram that identifies connections between the Earth system and the global food system.

Earth System Thinking



A Self-Guided Tutorial

Unit 4: Case Study Group Work-Problem Identification

Authors: Rebecca Boger, Brooklyn College, rboger@brooklyn.cuny.edu, Amy E. Potter, Armstrong State University, amy.potter@armstrong.edu, and Russanne Low, University of Nebraska, rlow2@unl.edu.

Author Profiles

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Summary

Units 4, 5, and 6 provide the opportunity for students to delve into a greater examination of food security at a regional level in small teams selecting one of the following locations (Caribbean, New York City, or Nebraska) OR a new location of their choice (provided that information and datasets are easily available and students will work with the instructor prior to the start of the unit) to apply skills and concepts taught in Units 1-3. Unit 4 materials are designed to provide a place-based overview for students to prepare them for the **summative assessment, to be submitted in Unit 6,** a community-based action plan of how the selected community can increase food security and lessen vulnerability.

Learning Goals

After students have completed Units 4, 5, and 6 they will be able to:

1. Brainstorm solution(s) to the wicked problem of food security using spatial tools.
2. Synthesize multiple data sets and types of background material.
3. Describe the various factors that influence food security in three different regional contexts.
4. Make connections between the Earth system and cultural, economic and political processes to understand the wicked problem of food security.

Instructor will introduce the regional areas that will be addressed in the work for the next three class periods using the illustrated slide stack provided in this module. The objective is to build interest in the regions. A target audience for the resulting food security plan will be identified for each region (ca. CARICOM, the Corn or Wheat Board, Farmer's Market association, etc.).

- Introduction to NYC Case Study Slides: NYC Overview (PowerPoint 2007 (.pptx) 15.6MB Dec2 16)
- Introduction to Nebraska Case Study Slides: Introduction to Nebraska Case Study Slides (PowerPoint 2007 (.pptx) 12.2MB Nov8 16)
- Introduction to Caribbean Case Study Slides: Caribbean Overview (PowerPoint 2007 (.pptx) 672kB Dec2 16)

4.3 Group Discussion (45 minutes total)

After the instructor introductions, students will break off into their case study groups and work through the following steps:

Students will work through the materials provided (See Materials for Regions 1, 2, and 3 below). Some of the materials in the documents were given as homework to get them started on their regions.

Case Study Materials for Unit 4

- Region 1 (New York): NYC background materials (Microsoft Word 2007 (.docx) 139kB Dec2 16)
- Region 2 (Nebraska): Nebraska background materiasl (Microsoft Word 151kB Dec2 16)
- Region 3 (Caribbean): Caribbean background materials (Microsoft Word 2007 (.docx) 157kB Dec2 16)

4.4 Team Brainstorm (30 minutes total)

In their teams of 3-6 members, students should first discuss food security issues or problems that they believe are salient to their region in the context of the assigned reading *Wicked Problems.* As a group, students should use a flip chart or white board to identify and describe **at least one of** the issues, using as many of the characteristics of wicked problems presented from the reading, as appropriate.

Based on these ideas, teams will then identify what aspect of food insecurity they would like to specifically explore in their analysis in the context of their community/regional plan. Before leaving class, each team should create a list of the types of data (each case study provides additional resources students can utilize) that they will need to assist in the development of the community/regional plan and distribute the tasks between members.

Combined Case Study Materials for Units 4, 5, 6: We have divided the case study materials among Units 4, 5, 6. Should the instructor want case study materials for all three units see combined file below:

- Region 1 (New York): NYC case study all materials (Microsoft Word 2007 (.docx) 85kB Dec2 16)
- Region 2 (Nebraska): Nebraska case study all materials (Microsoft Word 2007 (.docx) 162kB Dec2 16)
- Region 3 (Caribbean): Caribbean case study all materials (Microsoft Word 2007 (.docx) 163kB Dec2 16)

Description and Teaching Materials

5.1 Group Discussion (50 minutes)

Students will meet in their regional groups, and work through the AGO materials provided. After their analysis, students will create maps to be included in their final presentation.

- Region 1 (New York City): ArcGIS Online Activity: NYC AGO Activity (Microsoft Word 2007 (.docx) 165kB Dec2 16)
- Region 2 (Nebraska): Nebraska AGO Activity (Microsoft Word 2007 (.docx) 25kB Dec2 16)
- Region 3 (Caribbean): ArcGIS Online Activity Caribbean AGO Activity (Microsoft Word 2007 (.docx) 157kB Dec2 16)

5.2 Group Work (40 minutes)

The rest of the class period is provided for group work creating an action plan for a food insecurity issue teams have identified for their region.

5.3 Post-class Activity

Students will continue to work on their case studies as homework in preparation for the gallery walk.

Teaching Notes and Tips

Data sources for each case study region (New York City, Nebraska, and CARICOM) are provided to assist students in completing the AGO assignment. You may find it desirable to include your own community within a case study region, in which case you will need to identify resources with a regional focus beforehand. More detailed analysis is possible if students are assigned part of the work as a homework project and there is a week of time or more between Units 4 and 5 and the submission of the assignment in week 6.

Here are instructions on how to create an AGO activity for a new region: AGO template instructions (Microsoft Word 2007 (.docx) 22kB Dec2 16)

Each region is unique in terms of the types/quantity of data that are available for student analysis (particularly the Caribbean). This is an opportunity to have a discussion on the unevenness of data availability with your students.

Learn more about Gallery Walks from Pedagogy in Action http://serc.carleton.edu/sp/library/gallerywalk/index.html

Assessment

Instructors who wish to provide feedback on individual map products can apply the Universal Rubric for Assignments Units 1-5 (Excel 2007 (.xlsx) 40kB Dec1

Unit 5: New York City Case Study ArcGIS Online Activity

1. Go to this link (copy and paste): https://www.arcgis.com/home/webmap/viewer.html?webmap=f4ff7e932c9c4199a2194e2ae1f0b680&extent=-74.6606,40.33,-73.2393,41.1158
2. Sign into your AGO account

Here you will see layers for New York City. A table with the description of the data layers and associated variables is located below. These layers provide an exploration of issues around the topic of food insecurity, such as demographics (e.g., race, age, sex, income), health (obesity), and locations of farmers markets, food coops, and community gardens.

3. Explore the data sets.
    a. Look at the tables for each data set. You can click on a column heading to arrange in descending or ascending values.
    b. Change the color of the style for income and the US Census data. For instance, select the column for percent blacks in the census tracts within New York City. Display in a graduated color using natural breaks with 4 classes.
    c. Change the transparency of the top layer so that you can see what is below to identify possible relationships between layers.
    d. Move the order of the data layers in the table of contents to the left. Also, you can turn layers on or off the check mark next to the layer name.
    e. Use the filter function to find those census tracts that have over 30% white population.
4. After you get familiar with the data sets, see if you see any patterns within one data set, such as median income or percent obesity. Also see if you see any patterns between the data layers. To get you started, here is an example.
    a. Examine patterns in median income. Zoom into the southern Bronx nearby Hunts Point. Overall, what is the median income for the census tracts in this part of New York City? Next, look at the income of census tracts in Manhattan. How do they compare to the Bronx? What about other places in NYC? How do they compare?
    b. After looking at patterns of income, let's look at possible relationships between obesity and income. Examine again southern Bronx and Manhattan. There are

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- NYC food co-ops
- % Obesity by health districts

Obesity
- 30.2 - 36.1
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- 17.4 - 22.1
- 0 - 17.4

- GrowNYC community gardens, 2015
- NYC income, 2014

DATA_VALUE
- 118876 - 221176
- 81072 - 118875
- 57854 - 81071
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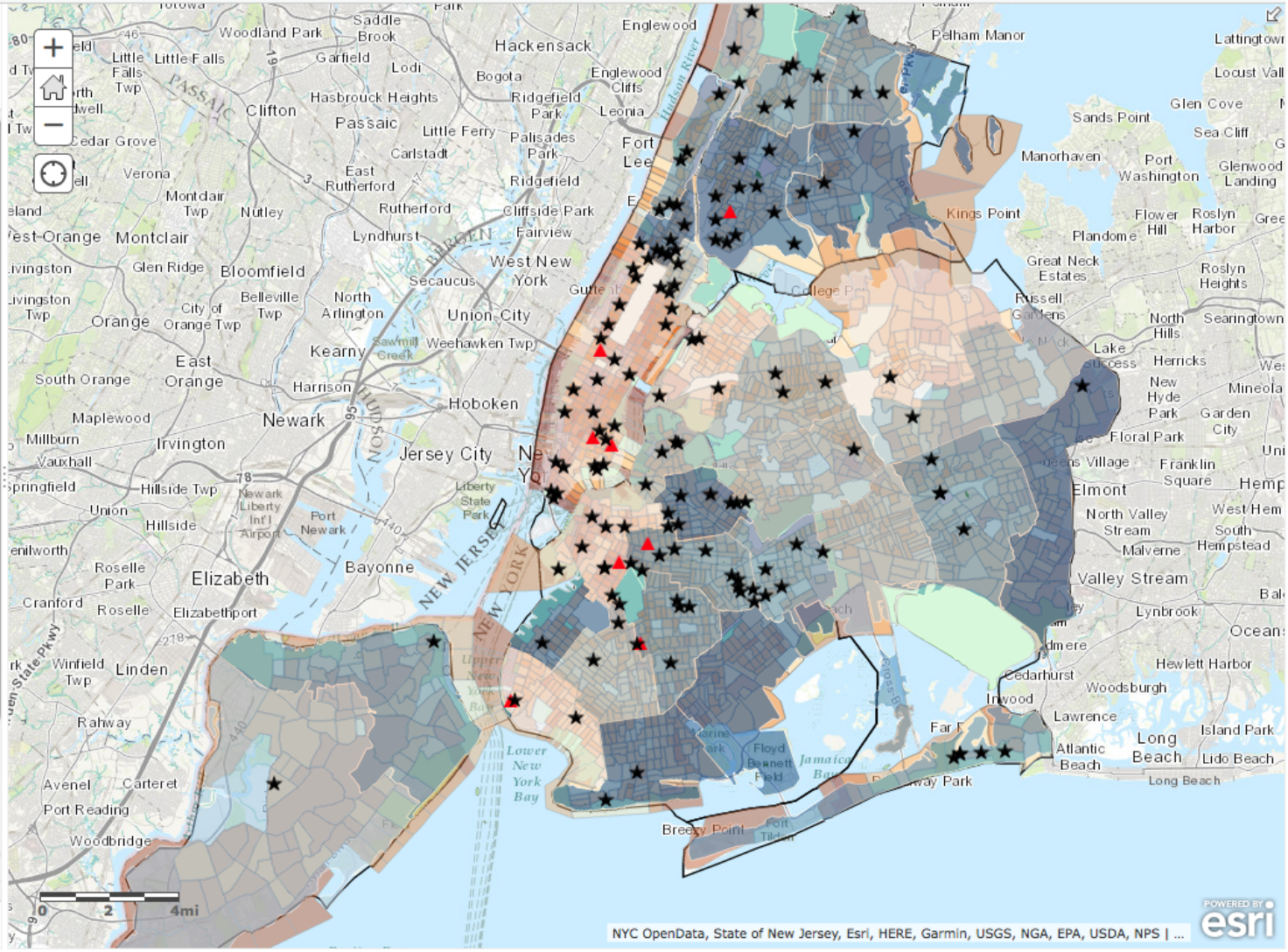
- Demographics, 2010



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Strengths of the Module

- This module prepares students from a variety of backgrounds to explore a global humanitarian problem using systems thinking. Sociopolitical and economic factors as well as Earth system concepts are examined as students explore what is meant by sustainable food production.
- The module employs a flipped classroom model. Students prepare for each class by conducting reading assignments and tutorials. These activities can be evaluated by the instructor and/or serve as the basis for discussion. Class sessions are reserved for group work and mapping activities, and opportunities for metacognitive reflection is built into assignments.
- In class, students work in groups to to build understanding of the complexity of the global food system, and learn how complex, multiscalar problems like global food security are "wicked problems"—where a solution may work for part of the problem but entail unforeseen consequences in other parts of the system.
- Data-enabled exercises set in place-based case study learning opportunities is also a strength. Individual and team assessment rubrics of student learning are included.
- Although designed as an integrated module, sufficient information and guidance is provided to enable instructors to incorporate individual units, activities, and components of activities into courses.
- Finally, a major strength of the module is its value in modeling the steps of a protracted research project to lower division students. Student teams examine primary literature, obtain spatial data and conduct original analyses using geospatial technologies, and present their findings to the class.

Students who learn with this module will:

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Assessment

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Rebecca Boger: Introduction to Urban Sustainability at CUNY Brooklyn College

The Introduction to Urban Sustainability, SUST 1001, is the first foundation course that students take for the new interdisciplinary program in urban sustainability. Reflecting the three pillars of sustainability (environmental, social, and economic) at the root of the sustainability concept, the course is jointly taught by professors in the departments of Earth and Environmental Sciences, Economics and Sociology. I am the lead instructor who has the primary responsibility of designing the course syllabus and assessment. The other two professors contribute to the course through their lectures and readings, and provide insights through the lens of his/her discipline. Since Brooklyn College is located in an urban setting, much of the course uses examples from New York City. The course is divided into thematic modules relevant for sustainability; one of the modules is food, and so this food security module is a perfect fit. I taught the food security module near the end of the semester.

Russanne Low: Science Systems Environment and Sustainability at University of Nebraska at Lincoln

Envr201, Science Systems: Environment and Sustainability is a large section (56+ students) 200-level course offered across campus and welcomes students from all majors. It fulfills the campus ACE requirement of a course that explores ethical principles, civics, and stewardship, and their importance to society. The module was used in the last four weeks of the semester as a structured capstone project, an activity that is especially useful for lower division students who have little experience in completing a research project that requires collection and analysis of original data. The course was offered as an asynchronous, online course. Two units were completed each week, and an additional research week was allowed for group project work prior to Unit 6, to accommodate the work schedules of online and remote students. The final team project served as a summative assessment not only for the module, but for the entire course.

Amy E. Potter: Geography 1100: World Regional Geography at Armstrong State University Geog 1100 World Regional Geography is an introductory-level course taught in small sections of 24 students. The course is part of the academic core focusing on global connections. The module was used the last three weeks of the semester as a capstone project.

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