Systems Education Experiences

PROJECT FEED 1010

Institute for Systems Biology

CURRICULUM SUPPLEMENT SERIES:

MODELING SUSTAINABLE FOOD SYSTEMS

Students take an interdisciplinary approach to understand a global issue and learn that systems thinking is helpful in identifying influences and interactions within the food security system. After critically examining the environmental tradeoffs involved with various food production techniques, students build an aquaponic system (optional) to evaluate the potential of scaling up aquaponics to fill the future food gap. Next, students examine the origins of food and resources required to produce it. Throughout this module, student groups investigate the various aspects of the food crisis in a specific country, which culminates in a UN council meeting to propose a solution.

COURSE INTEGRATION

Statistics, Human Geography, Biology, AP Biology, Environmental Systems, AP Environmental Science, Agriculture, Social Studies

LESSON 1: INTRODUCTION TO FOOD SECURITY

TIME

50 minutes - 1 class period

STANDARDS

- NGSS HS-LS2D Social interactions and group behavior
- NGSS HS-ESS3.C: Human impacts on earth systems
- CCSS MATH.CONTENT.7.RP.A.2 Recognize and represent proportional relationships between quantitites

OBJECTIVES

What students learn

Students understand the definition of food security and that it is influenced by many factors including poverty, geography, society, climate, and politics.This is a global problem that needs addressed in *their* lifetime.

What students do

Students formulate their own definition of food security using videos and class discussions to guide them. They also use global statistics to compare and contrast food security in countries around the world and research 1 country with high food insecurity.

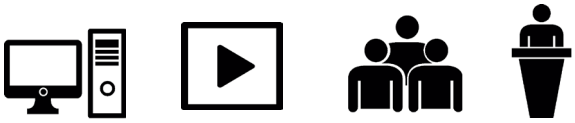
LESSON 2: CRITICALLY EVALUATING FOOD PRODUCTION TECHNIQUES

TIME

90 minutes - 2 class periods

STANDARDS

- NGSS HS-LS2D Social interactions and group behavior
- NGSS HS-ESS3.C: Human impacts on earth systems
- CCSS MATH.CONTENT.7.RP.A.2 Recognize and represent proportional relationships between quantitites



OBJECTIVES

What students learn

Students revisit the 3 pillars of food security and recognize there are various strategies used to mitigate the food crisis. They learn that some methods are more sustainable than others. If time allows, an optional lab guides students through building an aqauponic system.

What students do

Students respond to *Food for Thought* video questions and work together to research various food production techniques to evaluate their environmental impact and efficiency. Students share their findings and assign sustainability scores to each method, then use a graphic organizer to determine what all methods have in common.

DO IT YOURSELF: CREATING AN EFFICIENT SYSTEM (OPTIONAL LAB)

TIME

90 minutes - 2 class periods, weekly monitoring

STANDARDS

- NGSS HS-LS2D Social interactions and group behavior
- NGSS HS-ESS3.C: Human impacts on earth systems
- CCSS MATH.CONTENT.7.RP.A.2 Recognize and represent proportional relationships between quantitites

OBJECTIVES

What students learn

Students learn the inputs, outputs, and components of an aquaponic system, and the importance of system stability. They learn that bacteria and the Nitrogen cycle are key to maintaining a stable system.

What students do

Students apply systems biology approaches to illustrate an aquaponic system network. Groups present their graphics and build an aquaponic system in groups or as a class.

LESSON 3: WHO CARES? STAKEHOLDERS!

TIME
50 minutes - 1 class period

STANDARDS
- NGSS HS-ESS3.C: Human impacts on earth systems
- NGSS HS-ESS3.D: Global climate change
- NGSS HS-ETS1B Engineering Design: developing solutions
- CCSS ELA-LITERACY.RI.11-12.1 Key ideas and details in text

OBJECTIVES
What students learn
Students recognize the influence of stakeholders in decision making, as well as learn more about the various stakeholders involved in the global food security crisis.

What students do
Students are assigned the role of a stakeholder. They critically examine their stakeholder's background information in order to present their case: *will an increase in food production alone solve the global food crisis?*

LESSON 4: FOOD SECURITY AS A SYSTEM

TIME
90 minutes - 2 class periods

STANDARDS
- NGSS HS-LS1A Negative and positive feedback loop models
- NGSS HS-LS2C Ecosystem dynamics functioning and resilience
- NGSS HS-LS2D Biodiversity and humans

OBJECTIVES
What students learn
Students learn the 13 habits of a systems thinker and the 6 steps used to anallyze systems, along with various strategies for illustrating systems. They also understand interactions and tipping points within systems.

What students do
Students relate systems thinking habits to everyday situations, make a food security systems diagram usina a new illustration approach, and work as a class to create a large, causal loop map of the food crisis.

LESSON 5: WHY DON'T WE JUST GROW MORE?

TIME
50 minutes - 1 class period

STANDARDS
- HS-LS1A System structure and function, HS-LS2C-Ecosystem dynamics, functioning, resilience, HS-LS2D-Biodiversity & humans, HS-LS4C Adaptation, HS-ESS2C Water & Earth's surface processes, HS-ESS2D Weather/climate, HS-ESS2E Biogeology, HS-ESS3A Natural resources, HS-ESS3C Human impacts on Earth's systems, HHS-ESS3D Global climate change, CCSS ELA-LITERACY.RI.11-12.1 Key ideas and details in text

OBJECTIVES
What students learn
Students recognize that solving the global food security crisis is complex and that most decisions will affect many stakeholders. Students learn some network nodes have more influence than others.

What students do
Students work in groups to analyze *The Great Balancing Act*, from the World Resources Institute. They discuss how their stakeholders would be affected by the scenarios and connect these concepts to Lesson 4's food security network.

LESSON 6: WHERE DOES OUR FOOD COME FROM?

TIME
50 minutes - 1 class period

STANDARDS
- NGSS HS-LS1: C: organization for Matter and Flow, D: Information processing, NGSS HS LS2: A: Interdependent relationships in ecosystems, B: cycling of matter and energy transfer in ecosystems, C: ecosystem dynamics, functioning and resilience, NGSS HS ETS 1: B developing possible solutions, NGSS: HS ETS 2: A interdependence of science, engineering and technology, B: Influence of engineering, technology and science on society and the natural world.

OBJECTIVES
What students learn
Students understand the environmental and economic costs associated with production and consumption of food products and how external variables can effect them.

What students do
Students become business people and are challenged to purchase ingredients and make sustainable food products in the face of rising food prices and changing environmental conditions while incorporating ethics and morals.

SUMMATIVE ASSESSMENT: UNITED NATIONS COUNCIL MEETING