Climate Change & Agriculture *Lesson Plan*

Students learn about the impacts of climate change on Florida agriculture.

Lesson Summary: The agricultural and natural resource industries of Florida produce food, fiber, and mineral commodities. These are linked to a broad range of other economic sectors for food and kindred product manufacturing, wholesale and retail distribution, input supplies, support services, and nature-based recreation. In this lesson, students will investigate the potential of climatic change to affect Florida's agricultural industries.

Grade Level: High School (9^{th}–12^{th})

Time Allotted: Approximately 100 Minutes

Performance Objectives

References are to the Next Generation Sunshine State Standards (2007).

Science

SC.912.E.7.4	Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans.
SC.912.L.17.8	Recognize the consequences of the losses of biodiversity due to catastrophic events, climate changes, human activity, and the introduction of invasive, non-native species.
SC.912.L.17.20	Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.
SC.912.L.17.16	Discuss the large-scale environmental impacts resulting from human activity, including waste spills, oil spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

Social Studies

SS.912.G.1.4	Analyze geographic information from a variety of sources including primary sources, atlases, computer, and digital sources, Geographic Information Systems (GIS), and a broad variety of maps.
SS.912.G.2.3	Use geographic terms and tools to analyze case studies of regional issues in different parts of the world that have critical economic, physical, or political ramifications.
SS.912.G.2.5	Use geographic terms and tools to analyze case studies of debates over how human actions modify a selected region.
SS.912.G.3.2	Use geographic terms and tools to explain how weather and climate influence the natural character of a place.
SS.912.G.3.3	Use geographic terms and tools to explain differing perspectives on the use of renewable and non-renewable resources in Florida, the United States, and the world.

SS.912.G.4.5	Use geographic terms and tools to analyze case studies of the development, growth, and changing nature of cities and urban centers.
SS.912.G.5.2	Analyze case studies of how changes in the physical environment of a place can increase or diminish its capacity to support human activity.
SS.912.G.5.3	Analyze case studies of the effects of human use of technology on the environment of places.
SS.912.G.5.6	Analyze case studies to predict how a change to an environmental factor can affect an ecosystem.

Prior Knowledge

No prior knowledge necessary.

Topic Overview: Climate is arguably Florida's most important physical resource. In winter, the state has approximately double the amount of hours of sunlight than states in the Northeastern U.S., and far milder temperatures, attracting tourists and seasonal residents. Florida's agriculture, heavily based on winter warmth, supplies not only citrus but also winter vegetables to the rest of the nation. The main factors governing Florida's climate are latitude, land and water distribution, prevailing winds, storms and pressure systems, and ocean currents.

Florida ranked first in the United States in the value of production of oranges, grapefruit, tangerines, sugarcane for sugar and seed, squash, watermelons, sweet corn, fresh-market snap beans, fresh-market tomatoes, and fresh-market cucumbers (Source: Florida Dept. of Agriculture and Consumer Services).

The agriculture and mining industries of Florida produce food, fiber, and mineral commodities. These are linked to a broad range of other economic sectors for food and kindred product manufacturing, wholesale and retail distribution, input supplies, support services, and nature-based recreation. Since this is the case, students will investigate the impact of climatic change on Florida's agricultural industries.

Key Vocabulary

Climate
The long-term average of conditions in the atmosphere, ocean, and ice sheets and sea ice described by statistics, such as means and extremes.

Climate change
A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or

external forces, or to persistent anthropogenic (human-caused) changes in the composition of the atmosphere or in land use.

Environment
All the external conditions-physical and biological-that affect an organism's life, development, and survival in its ecosystem.

Greenhouse effect
The warming of the Earth's atmosphere that may be taking place, caused by the buildup of carbon dioxide and other gases in the atmosphere since the Industrial Revolution of the late 1800s.

Greenhouse gases
Gases such as carbon dioxide, methane, chlorofluorocarbons, and nitrous oxides that accumulate in the atmosphere and may be contributing to global warming.

Materials

- Computer with Internet Access

References

The following references may be found on the Orange County Water Atlas:

2010—2030 Comprehensive Plan Future Land Use Map, Orange County, FL. 2011. Retrieved from http://www.orangecountyfl.net/

Bellarby, Jessica, and Bente Foereid, Astley Hastings and Pete Smith. 2008. Cool Farming: Climate impacts of agriculture and mitigation potential. Greenpeace. Retrieved from http://www.greenpeace.org/

Borisova, Tatiana, Norman Breuer, and Roy Carriker. Economic Impacts of Climate Change on Florida: Estimates from Two Studies. 2008. University of Florida Institute of Food and Agricultural Sciences.

Climate Literacy: The Essential Principles of Climate Sciences. 2009. U.S. Global Change Research Program.

Fraisse, Clyde, and David Zierden, Norman Breuer, John Jackson, and Charles Brown. 2004. Climate Forecast and Decision Making in Agriculture. Retrieved from http://edis.ifas.ufl.edu/

Fraisse, C.W., N.E. Breuer, D. Zierden, K.T. Ingram. 2009. From Climate Variability to Climate Change: Challenges and Opportunities to Extension Retrieved from http://www.joe.org/

Orange County Water Atlas Land Use map layer

Other references:

Orange County Agricultural Assessment. Florida Department of Agriculture and Consumer Services.

Agriculture & Climate Change: Impacts & Opportunities at the Farm Level. 2009. National Sustainable Agriculture Coalition.

Cook, John. Skeptical Science: Getting Skeptical About Global Warming Skepticism. Website. Accessed June 2011.

Intergovernmental Panel on Climate Change. Website. Accessed June 2011.

Power Up Florida (Orlando/Orange County web portal to sites for electrical efficiency, solar usage, electric vehicles, clean technology, Climate Change Education Center, etc.). Accessed July 2011.

Stanton, Elizabeth K., and Frank Ackerman. Florida and Climate Change: The Cost of Inaction. 2007. Tufts University Global Development and Environment Institute and Stockholm Environment Institute—US Center.

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Procedure

Engage/Elicit

Lead students in the following exercise:

1. Brainstorm a list of the types of agriculture operations/practices that are taking place within Orange County, Florida.
2. How might fluctuations in climate affect these agricultural operations?
3. How might the practices of these operations affect greenhouse gas production?
4. How might the success or failure of these agricultural businesses affect the local economy?

Explore

Guide students to the Orange County Water Atlas website. Allow students to work in small groups (3-4 students each) to explore changes in land use of Orange County, Florida. Direct them to:

Step 1: Browse to http://www.orange.wateratlas.usf.edu/
Step 2: Under **Popular Tools**, select **Advanced Mapping**
Step 3: Click on **Planning and Infrastructure** to show map layer choices.
Step 4: Enable the **Land Use Cover 1995** map layer and refresh the map; answer questions 1-2 below
Step 5: Disable Land Use Cover 1995, enable **Land Use Cover 2000** (or the latest year available) and refresh the map
Step 6: Answer questions 2–5 questions below

1. What are the most dominant land uses in Orange County in 1995?
2. In what areas of Orange County are agricultural and rangeland land uses most prevalent?
3. How has the proportion of agricultural and rangeland land use types changed in Orange County from 1995 to 2000 (or later)?
4. What may have caused some of these differences in land use cover from 1995 to 2000?
5. How might climatic changes contribute to these changes over these years?
6. How might human activities contribute to some of these changes? Are these changes for the better of the community? Why or why not?

Explain

1. Instruct students to read the letter to the editor from the Palm Beach Post.
2. Tell each student that they should take a position on the issue and make the case that the benefits to agriculture and/or society of greenhouse gas mitigation do/do not justify its costs. Tell students they must back up each of their arguments with facts, and that they should be prepared to identify the sources of their information. Choose an appropriate format for their arguments, or let students decide (e.g., position paper, slide presentation, video, oral presentation to class, etc.)
3. Once students have completed their arguments, have several of them share their work with the class, and lead them in a whole class discussion on the issue of greenhouse gas regulation.

Extend

1. Identify one or more agricultural operations near your school, either large or small. The chart in the handout gives an idea of the number and types of agricultural operations that exist in Orange County. *(Source: Florida Department of Agriculture and Consumer Services)*
2. Invite a representative from one of the businesses you have chosen to visit your class to speak about their operation. Let them know that the students are studying climate change and would like to ask them questions about their business as it relates to the topic.
3. Have students prepare for the visit by:
    a. Considering what positive and negative impacts the business might have on greenhouse gas production.
    b. Considering what positive and negative impacts climate change might have on the successful operation of the chosen business.
    c. Preparing a list of questions they would like to ask.
4. Introduce your visitor and ask him/her to give the students an overview of their business. Allow students to ask their questions. Instruct everyone in the class to take careful notes.
5. Assign students the task of summarizing what they learned from the visit. What opportunities and challenges exist for the businesses that are related to climate change issues?

Exchange/Evaluate

1. Have students share their reports with the class for feedback from teacher and classmates
2. Post students' reports on the Orange County Water Atlas Watershed Excursion.

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