Farming for Ecosystem Services: 50-90 minutes

Objectives:
Students will assess the importance of ecosystem services
Students will explore the effects of climate change and invasive pest impacts on ecosystems
Students will explore the resilience of various ecosystems to climate change impacts
Students will assess the long term revenue among various land use classifications

Materials

- Calculators
- Student Blank game boards (2 farm templates per student, but begin with one)
- Student score card (score cards are for two years and each student needs one; print double-sided)
- Student Croptions Menus
- Game pieces (crop squares, buffer strips, bee hives)
- Supplemental PPT (to pre-teach and the rules (beginning slide 15) of the game)

Explanation

- Prep Time: 20 minutes
- Class Time: 50 (Round I)-90 minutes (Round II)
- Summary: Students work toward the optimization of several different plots of land, given the multiple choices of crop/agricultural resources, to maximize annual revenue. Introduction of climate and/or pest calamities, however, pose risk to the overall ecosystem, and thus annual revenue. Students will move through the game to optimize revenue while maintaining the health of their ecosystems. *Note that imposed climate and/or pest calamities will be imposed randomly, and students will not see it coming (i.e. as happens in the real world).*
- Before Class:
    - Print all materials; laminate if possible for future use
        - Croptions Menu (1 per group)
        - Score Card (1 per group; double sided)
        - Blank game boards (2 per group, not double sided)
        - Game Pieces
    - If using laminated materials, get vis-a-vis or expo markers (one per group)
    - Divide students into groups of about four people. Each group will need two blank student board games, a croptions menu, and a student score card (print these double sided; side 1 is year one, and side 2 is year two).
    - Assign each student in the group a role. Students could also choose roles. Roles can be:
        - Treasurer and calculator – persons that handle and calculate the money
        - Speaker - this person will speak on behalf of the group to the teacher
        - Everybody in the group contributes to decision making about which crops to plant on the farm

- During class:

- Instruct students that they will work as a group to design a profitable farm. They are given a parcel of land that is currently a woodlot. There is space for them to purchase and plant up to six crops and up to three ecosystem services (riparian buffer strip, floral strip, and/or beehives).
- Each group is given $2,000 to spend on crops. Students will choose what crops or ecosystems services to plant based on cost/benefit analysis from their 'Croptions Menu.' Note that students may also choose to leave a woodlot on their farm, they do not have to fill up all of their spaces. This will have a benefit as outlined on the Croptions Menu.
- As students choose their crops, they should simultaneously be filling out their 'Score Card.' They'll fill out the first two empty lines with the number of each crop they purchased the the total amount spent per crop.Students will have a lot of questions and may need assistance with calculations.
- After they calculate the costs of their purchases, have students calculate their profits (green line; 'Year 1 profits'). These values are prior to subtracting additional costs.
- Pull a 'Climate Cost Card' to see what environmental cost students will have to account for. These include torrential rain, drought, or late frost. Each climate cost card has different costs on each crop. Note that there is only one 'Climate Cost Card' pulled per year. See 'Climate Cost Cards.' Students will use the blue line on their 'Scorecard' to track the cost of the climate during their first year of farming growth.
- Pull a 'Pest/Disease Cost Card' to see what pest or disease costs students will have to account for. These include locusts, honey bee colony collapse, mad cow disease, or corn borers. Note that there is only one 'Pest/Disease Cost Card' pulled per year. See 'Climate Cost Cards.' Students will use the orange line on their 'Scorecard' to track the cost of pest/disease during their first year of farming.
- After having pulled the Climate Cost Card and Pest/Disease Cost Card, have students calculate their 'Year 1 Column Subtotals,' which is the sum of all the boxes with dashed outlines.
- Have students calculate the Nitrogen penalties from their farm from cows, corn, or tomatoes. Costs go down if students bought a riparian buffer. They'll multiply the % penalty by the column subtotal.
- Have students calculate the new sub-total for each column (green cell - penalty, if applicable).
- If students made money, they can continue onto year two and gain another plot of land! Students that were in monetary deficit remain with single plot of land, and can buy crops/agriculture if allowance is feasible. Students should also be writing in science journals regarding the results/learning of the game.

Discuss

- Climate change impacts on farmland and ecosystems are poorly quantified, and are seemingly random (as demonstrated in the exercise). What might we do to mitigate against these impacts in the future?
- Initial reactions or reflections on the game?
- Were you surprised by an outcomes?

- How would your farm have fared if a different climate or pest/disease card had been drawn?
- How can we grow enough food while protecting ecosystem services (beyond those actions described in the game)?
    - This might include crops that were resilience to climate/pest calamities, while contributing to annual revenue.
- Why is it difficult for farmers to protect all ecosystem services?
- How do you think climate change affects how farmers make decisions?
- How much do you think ecosystem services are worth?
- Integrated into Planet Texas 2050: Making Texas resilient
    - If Texas' population is projected to double by 2050, how does this affect farming resources and resources associated within farmland?
    - What are some of the positive impacts of farming?
    - What are some of the negative impacts of farming?
        - How can we mitigate those negative effects?
            - Pesticides, insecticides
            - Fertilizers
    - What about water necessary to grow our food? How much water is needed? Where does that water come from? How can we keep that water clean?

How can we evaluate these activities to get the students thinking about climate change and things that they can do?

Source
http://kbsgk12project.kbs.msu.edu/blog/2015/06/10/farming-for-ecosystem-services/

Texas Assessments of Academic Readiness Resources - TEKS

§112.19. Science, Grade 7, Adopted 2017

(a) Introduction.

(E) Organisms and environments.

(i) Students will understand the relationship between living organisms and their environment. Different environments support different living organisms that are adapted to that region of Earth. Organisms are living systems that maintain a steady state with that environment and whose balance may be disrupted by internal and external stimuli. External stimuli include human activity or the environment. Successful organisms can reestablish a balance through different processes such as a feedback mechanism. Ecological succession can be seen on a broad or small scale.

(b) Knowledge and skills.

(10) Organisms and environments. The student knows that there is a relationship between organisms and the environment. The student is expected to:

(A) observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms;

(B) describe how biodiversity contributes to the sustainability of an ecosystem;