APPENDIX B: Student Pages

ACTIVITY I: Are These Resources Renewable?

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DEBRIEFING FISH BANKS

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ACTIVITY VII: Tragedy of the Commons

EXTENSION: Comparing Both Sides of the Issue – *The Lorax* and *Truax*

ACTIVITY I: *Are These Resources Renewable?*
STUDENT PAGE

In the space provided, please indicate whether the resource listed is renewable or nonrenewable.

	Renewable	Non-Renewable
Bobwhite Quail	_____	_____
Oak Tree	_____	_____
Rockfish	_____	_____
Coal	_____	_____
Soil	_____	_____
Uranium	_____	_____
Blue Crab	_____	_____
Water	_____	_____
Natural Gas	_____	_____
Gasoline	_____	_____
Canada Goose	_____	_____
Menhaden	_____	_____
Water	_____	_____
Wind & Solar Energy	_____	_____
Eastern Oyster	_____	_____
Copper	_____	_____

ACTIVITY I: *Are These Resources Renewable?*

STUDENT PAGE

1. Complete, *Are These Resources Renewable*, Student Page.

2. Answer the following questions:

   a. What do the terms renewable and nonrenewable resources mean?

   b. What does the term sustainable mean?

   c. How does sustainability apply to both renewable and nonrenewable resources? Can both be managed sustainably? How?

   d. How are the resources that are listed in the exercise used by humans?

ACTIVITY II: Fish Banks Briefing
Instructions and Questions
STUDENT PAGE

1. You will be participating in a group computer simulation that illustrates the complex interactions and overlap of systems. In this particular case, we are looking at the interactions between environmental, social, and economic systems.

2. With your Team/Company, review your Role Description and Briefing/Introduction (Video, PowerPoint, or PDF). Here you will learn about the goals of the game and the steps of play.

3. You will be assigned a number for your company. Create a company name and logo, and post it where the class can see it.

4. Develop (draw) a city of where your company is located on paper provided by your teacher. This doesn't need to be completed right away. You can work on this throughout the game.

5. Depending on the version of the simulation used the procedure will either require that you enter your fishing decisions on a paper form or online. Your teacher will let you know which version you'll be using and provide you with detailed instructions.

SUMMARY OF TEAM ROLES
- Team Roles
- Team Goals
- Financial Information – income and costs
- Fishing Fleet
- Catch and Ship Effectiveness
- Fishing Areas
- Fish Population
- Regeneration

SUMMARY OF STEPS OF PLAY

A. *Fish Banks Game Board*
- Record data from computer printout
- Collect ships and money
- Bid for auctioned ships
- Buy or sell ships in trading session

- Place orders for new ship construction
- Calculate and record fleet size
- Allocate ships among fishing areas and harbor, and record on the decision sheet
- Place ships on the game board
- Give decision sheet to the computer operator
- Develop your company strategy for maximizing your assets

B. *Fish Banks Online Simulation*

- Initial fishing company data is available online in the game simulation; students enter their decisions into the computer, rather than on a paper decision sheet.
- Bid for auctioned ships – live or Web-based
- Buy or sell ships in trading session
- Place orders for new ship construction
- Allocate ships among fishing areas and harbor
- Update decisions
- Develop your company strategy for maximizing your assets

DEBRIEFING
STUDENT PAGE

ACTIVITY III: Debriefing Fish Banks – Student Insights

Discuss your experience playing the game by answering the following questions.

1. How did the employees in your company work together? Did everyone on your team have an active role?

2. Was there collaboration among companies developed over time, or was the game driven by competition?

3. Did you notice declines in the catch over time? If so, did you negotiate with other companies to regulate the harvest at that time?

4. How did weather affect your catch each year?

5. If the goal of the game was to maximize your assets, did you consider how the fishery was an important component of the system?

6. Discuss your company's strategies while playing the game for years 3, 6, and 9.

    a. How did your strategies/decisions affect the fish populations?

        Year 3:

        Year 6:

        Year 9:

    b. Did strategies change when, or if you noticed a decline in the fishery? Why?

    c. Did other companies have similar or different strategies? Did one strategy seem more effective than another? Explain.

7. How did your personal beliefs and values compare to that of the team as a whole during the game? Was there any internal struggle for you personally?

8. Did any of the companies "win" the game? Why or why not?

DEBRIEFING
STUDENT PAGE

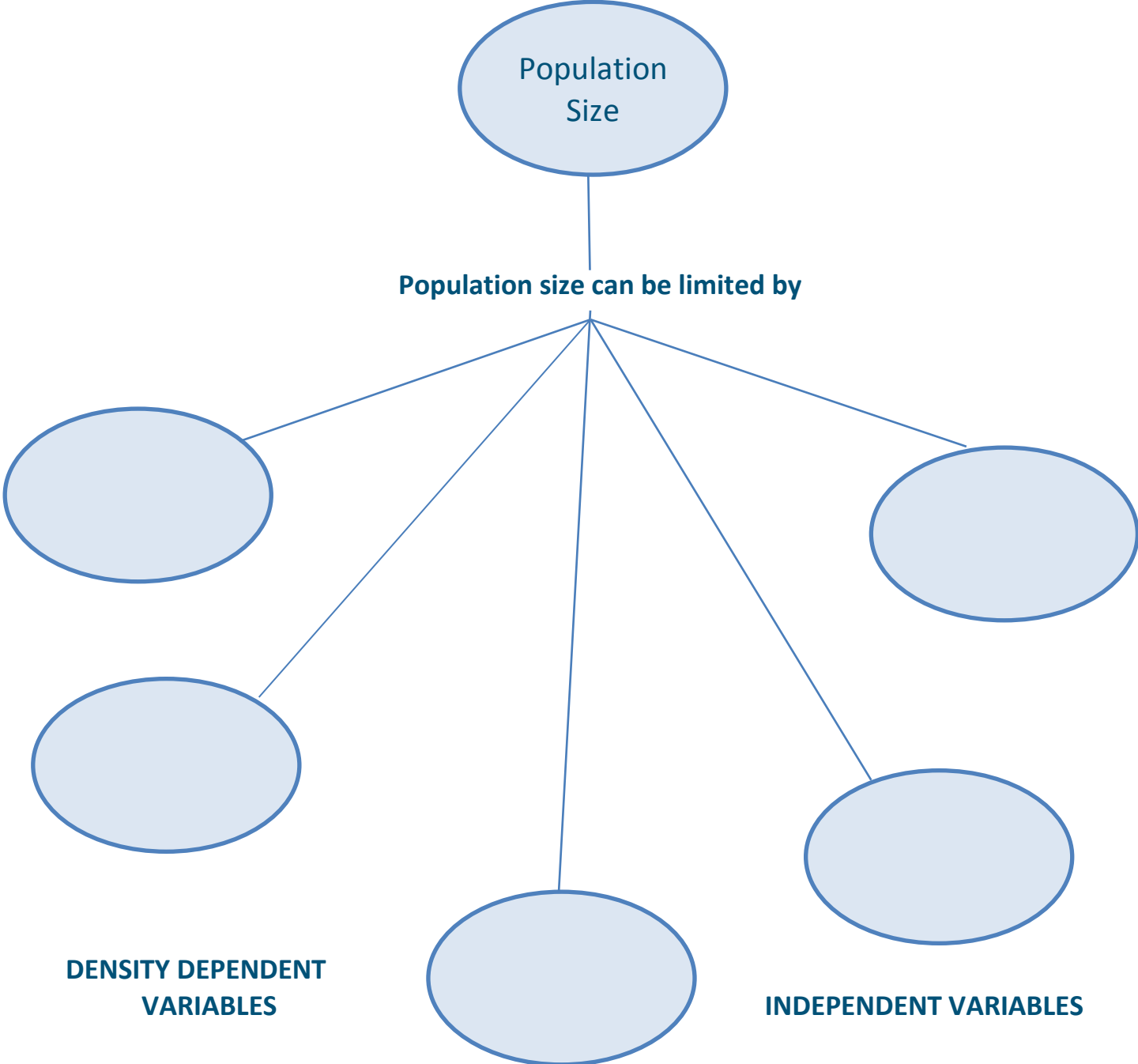**ACTIVITY IV:** Debriefing Fish Banks – Analyzing the Data

1. Watch the Debriefing video or PowerPoint presentation.

2. Fishing Companies should share the total asset data they accrued during each fishing season. Using the data recorded from the game, create a table that includes the following information:

   a. Fishing season (e.g., 1-10)

   b. Company name and number

   c. Total number of ships fishing each season

   d. Value of total assets (i.e., sum of money made from catch and salvage value of ships)

3. Graph the number of ships and total assets for each company for each fishing season.

4. Graph the expansion of the fleet, catch over time, and recruitment using indexes provided by your teacher.

5. Explain how these factors affected one another in the system.

   a. How did the number of ships in the fleet affect the catch?

   b. How did the catch affect recruitment?

   c. During what fishing season did the population begin to decline?

6. Were there actions that could have been taken to address population declines?

ACTIVITY V: Debriefing Fish Banks – Limiting Factors

The maximum population size of a species that the environment can sustain indefinitely, given the food, water, and other habitat requirements available, is called *carrying capacity*. We will discuss the factors in the game that affected the carrying capacity of the fish in both the deep sea and coastal populations.

Graphs from the Debriefing video or presentation show different types of population growth that can occur in a system. *Limiting Factors* determine the carrying capacity of the environment for a species.

1. In a class discussion, identify the following:

   a. Identify underlying causes of behavior and limiting factors that contributed to the decline in the fishery.

   b. Identify other limiting factors that may not have been included in the Fish Banks simulation, but affect the fishery in a natural system.

   c. Use the diagram on the following page to label the Limiting Factors. Identify both dependent and independent variables.

LIMITING FACTORS – STUDENT PAGE

Graphs from the Debriefing video or presentation show different types of population growth that can occur in a system. *Limiting Factors* determine the carrying capacity of an environment for a species. Label the limiting factors that could apply to fish in a system. Consider your experience in the Fish Banks simulation.

Population Size

Population size can be limited by

DENSITY DEPENDENT VARIABLES

INDEPENDENT VARIABLES

DEBRIEFING
STUDENT PAGE

ACTIVITY VI: Debriefing Fish Banks – Stakeholder Beliefs and Values

1. How did *stakeholders, beliefs, and values* play into the game, and how did it affect the decisions your team made? (How did your beliefs and values as a fishing company compare to articles you have read regarding the oyster industry, and the beliefs and values held by actual stakeholders involved with the issue?)

2. As a group, brainstorm a list of ideas that would result in changing the adverse aspects of game behavior.

3. How would these solutions be applied in real systems?

4. From what you have learned with regard to stakeholders, and their beliefs and values thus far, what are the difficulties in developing and implementing these solutions?

5. Determine the extent to which the same problems and events also occur in the real system by comparing the simulation to the management of the Eastern oyster in Chesapeake Bay.

6. Decide what limiting factors in the game were responsible for those problems. Are these same factors also present in real systems?

7. Indicate the corresponding changes that could be made in real systems.

8. What actions would you take to gain commitment and cooperation from other fishing companies in the simulation to change the outcome? Could negotiations involve other stakeholder groups? What would be their role?

9. Identify possible solutions to reversing the declining trend of oysters, or other fisheries in the Chesapeake Bay.

10. Read *Oyster Restoration Debate Rages on in Maryland* in the Bay Journal, http://www.bayjournal.com/article/oyster_restoration_debate_rages_on_in_maryland.

   Matt Pluta, the Choptank Riverkeeper, spoke in favor of continuing oyster restoration in the Tred Avon River. Construction had been suspended in Fall 2015 after watermen argued that sanctuaries were failing to meet intended goals of restoration. See *Corps Shifts Funds for Halted Maryland Oyster Project to Virginia*, http://www.bayjournal.com/article/corps_agrees_to_delay_md_oyster_restoration_warns_of_funding_risk.

   Pluta stated, "Short-term economic gains should not overshadow long-term ecological benefits, which we are trying to achieve here."

   How would this statement apply to the Fish Banks simulation?

11. Watch "What Happened to the Grand Banks Cod?" (YouTube Video) https://www.youtube.com/watch?v=L5wR8Iu2Q00

   How does this behavior compare to behavior with current fisheries management problems? http://www.fldoe.org/core/fileparse.php/7662/urlt/0071787-limitsyourspecies.pdf

DEBRIEFING
STUDENT PAGE

ACTIVITY VII: Fish Banks Debriefing – Tragedy of the Commons

1. *The Tragedy of the Commons*, http://www.sciencemag.org/content/162/3859/1243.full, by Garrett Hardin was published in the Journal, *Science*, in 1968. Hardin discusses how a *Commons* will ultimately fail if all of those using the commons do not recognize their combined effects on the resource and the overall system, or on the integration of systems. Read *The Tragedy of the Commons*.

   a. Write an essay comparing *The Tragedy of the Commons* to oyster management during the Oyster Wars, (see Module 1: *An Historical Perspective of Oyster-Related Environmental Issues – The Oyster Wars of Chesapeake Bay*), ***OR***

   b. Take a position, and argue your position in class with your peers based on evidence from the articles and the Fish Banks simulation.

EXTENSION: Debriefing Fish Banks – Comparing Both Sides of the Issue – *The Lorax* and *Truax*

Evaluate both sides of an issue related to sustainable resource management.

1. Read *The Lorax* by Dr. Seuss, or watch *The Lorax, https://www.youtube.com/watch?v=FSSrYnc1yQs,* as a class on YouTube.

    a. Write an essay that compares the environmental issue in the book to that of the game played today; or, compare *The Lorax* to the Eastern oyster.

    b. Using the *Causal Loop Diagram* from the *Debriefing*, develop a causal loop depicting the behavior observed in *The Lorax*. (See the Systems Thinking manuals and resources from either Fish Banks game version for the diagram).

    c. Read *Truax*, http://woodfloors.org/truax.pdf, the National Wood Flooring Association's response to The Lorax. Compare the beliefs and values in both stories.

    d. What were the events, problems, and issues?

    e. Who were the stakeholders, and what were their beliefs and values.

    f. How does considering "both sides of an issue" help you make an informed decision about how to solve an environmental problem?

    g. Write your own children's story about over-harvesting of a resource that you value.

2. Read, Rosenberg, et al (5 November 1993). *Achieving Sustainable Use of Renewable Resources*, Science, Volume 262, pp. 828-829.
    http://www.sciencemag.org/site/feature/data/sust/pdf/262-5135-828.pdf

    If sustainability is the goal of renewable resource management, what management practices were suggested in this reading, and how does it compare to current Chesapeake Bay oyster restoration related issues?