FishBanks Simulation Guide

Overview

FishBanks is an online multi-user simulation (Figure 1) to explore the management of a marine fishery. The simulation, created through MIT, is available for educators to use at no cost. Students experience the difficulties of managing a renewable resource, seeing how short-term goals can interfere with long-term success. Each student team makes decisions with a goal of creating success for a fishing company. The tendency is for teams to overfish, not realizing the long-term problem until it's too late to reverse the diminished fish population in time to save the fish or their companies from bankruptcy. See "Additional Resources" in the Technical Guide for information about how to access the Introduction Video.

Learning Goals

- Interpret data on line graphs and in tables.
- Identify how decisions impact individual teams and the larger system as a whole.
- Design and justify policies to minimize negative human impacts on the health of the marine ecosystem.

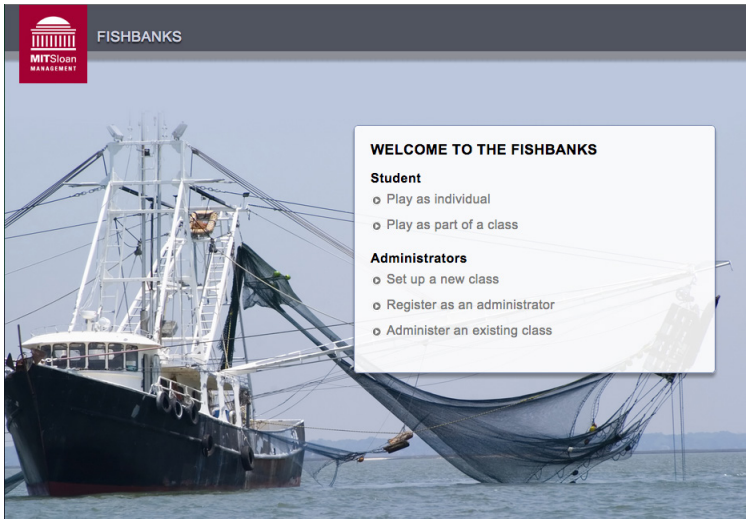

Figure 1: Log-in Screen

LESSON DETAILS

Age:
Grades 5 through 12

Time (approximate times)**:**
Introduction – 30-60 minutes
Community Creation – 1 hour
Simulation – 2 hours
Debrief – 1-2 hours
Assessment – varies

Materials:
- One computer for every 2-4 students
- Simulation online at http://bit.ly/fishbanks
- Handouts (Pages 8-15)
- Excel spreadsheet to create users
- Intro. and debrief slideshows
- Technical Guide (starting on Page 17)

Key system dynamics concepts and insights:
- Cause and effect are not closely related in time or space.
- Action is often ineffective due to the application of low-leverage policies.
- Conflicts arise between short-term and long-term goals.
- High-leverage policies are difficult to apply correctly.

Curricular connections*:
- NGSS - Human Impacts on the Environment
- Common Core ELA Standards

* Read more on Page 6.

Team Goal

Manage a fishing company, maximizing its total assets while competing with other companies that are working toward the same goal.

Lesson Details

Preparation

1. Follow the instructions in the Technical Guide (Page 17) for registering and setting up classes.
2. Go though the Intro Slideshow to familiarize yourself with the simulation and decisions students make.
3. Log in as the facilitator and test the simulation with all team computers before the first class period.
4. Copy handouts. *Note:* all handouts are optional. However, having students record information and reflections before, during and after the simulation can help them think more deeply about the dynamics experienced.
5. Divide students into teams of two to four students each. The maximum number of teams is 10. *Note:* smaller teams tend to stay more engaged since it's easier for all to see the data.

Introduction and Community Creation

1. Describe the project in which students will take on the role of managing a fishing company. Use the project requirements and rubric (Handout 1) if desired. Note: If you post learning goals in the classroom, it is recommended to wait on posting the last goal until the debrief.
2. Show the Intro Slideshow (Slides 1-7) to introduce students to simulation goals and logistics (Figure 2).
3. Have the teams meet to set up their company/town (Handouts 2 and 3). Although in reality, multiple companies might be based in the same town, the handout assumes that each company is in a different town. All these towns/companies rely on fishing success in the same ocean.

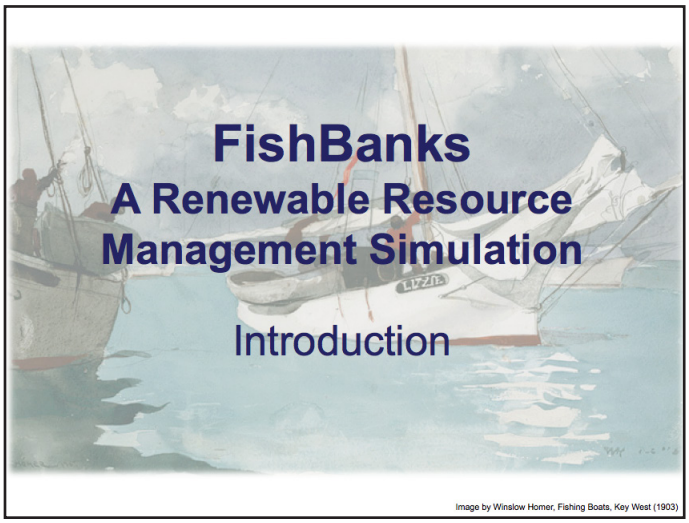

Figure 2: Intro Slideshow

Preparation for Next Day (See the Technical Guide for more information.)

1. Before students arrive to run the simulation, have all the computers ready to go.
2. Have the simulation administrator computer on, with the simulation started and ready for Year 1.
3. Have log-in information for teams up on a board or written on slips of paper, so teams can easily log onto the simulation.

Running the Simulation

1. Give students their record-keeping sheets (Handout 4). They'll use these as soon as they are logged into the simulation to record their total assets for the starting point (Year 1).
2. Have teams place their company's table tent in front of the group on the table/desk.
3. Project the Intro Slideshow from the second "teacher computer" and go to Slide 8 to show the log-in procedure.
4. After all teams have successfully logged in, continue going through the Introduction Slideshow, guiding students to complete the first round from the main Dashboard (Figure 3) and submit their decisions. Refer to "Running the Simulation" in the Technical Guide as needed.
5. After a couple of rounds, make sure that students are accessing all the tabs near the top of the main screen to view available data (Figure 4) as they make decisions.
6. Continue running the simulation until the fish populations are depleted in both the coastal area and the deep. This typically takes about 10-15 years (rounds) in the simulation, usually 1.5-2 class periods. Refer to the Technical Guide as needed.

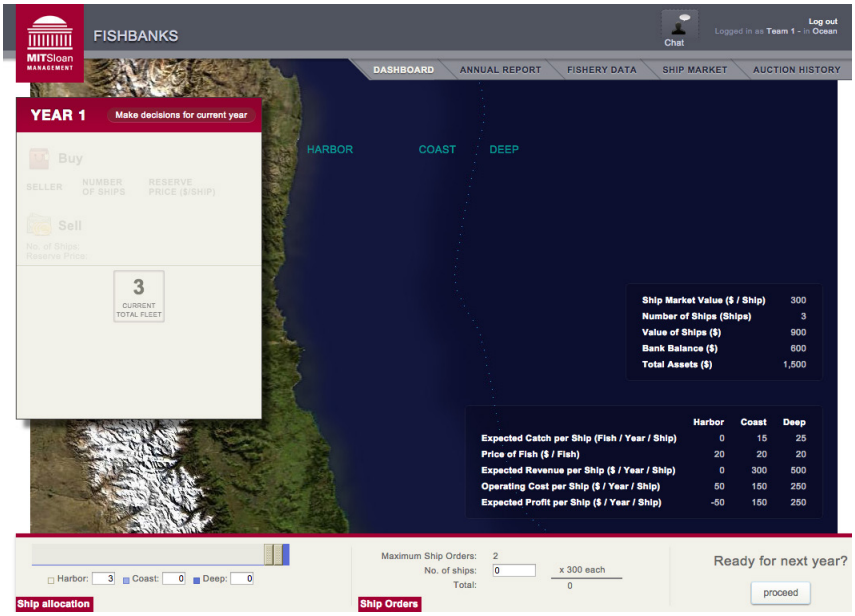

Figure 3: Main Dashboard

Debrief the Simulation

1. Have students complete their graphs to show their assets over time. They'll need to determine an appropriate scale for the y-axis, based on the table data.
2. Debrief the simulation experience using data from the simulation and the debrief slideshow. See also the "Debrief Questions to Consider" and "Assessment Ideas."

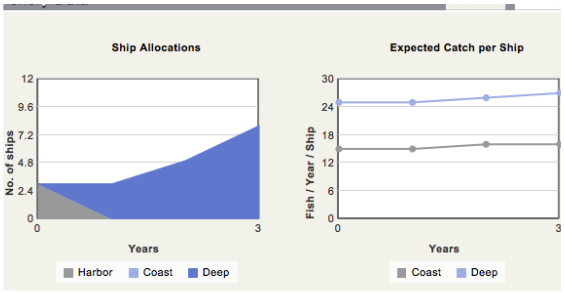

Figure 4: Example of Data that Students See

3. One highly recommended aspect of debriefing is to allow students to run the simulation again, using policies that they designed on Handout 5. The class can vote to decide what policy(s) to implement in the second run. Running it a second time can go very quickly since they are testing a very specific policy.
4. See examples for completing Handout 5 on the next page.

Debrief Questions to Consider

Processing What Happened

- What happened to the fish and the companies over time? Consider financial success, health of the fishery, etc.
- Which team had the highest total assets at the end? Why?
- Did any teams have a negative balance? Why?
- If the fish population crashed, whose fault was it?
- What were benefits and tradeoffs of different strategies for fishing and boat ownership?
- How were company goals seemingly in conflict with sustaining the fish population?

Considering Leverage Action

- How could you improve results for the fish?
- To what degree are those ideas reasonable within a real-world context?
- How could you save the fish and create economic success for the fishing companies?

Assessment Ideas

1. Self Assessment (Handout 1)
2. Community Creation (Handouts 2 and 3)
   Teams create a community that is supported by the fishing industry.
3. Simulation Documentation (Handout 4)
   Students track their assets over time during the simulation. After debriefing, students reflect on the success of their company and the impact on the fish population.
4. Connections (Handout 5)
   After the simulation, students identify cause and effect relationships.
5. Leverage Plan (Handout 6)
   After the fish population crashes, students identify how to prevent the tragedy of the commons.

Connection Circle and Loop Examples

Handout 5 provides one way for students to illustrate cause and effect relationships they note during the simulation. Each element around the circle is a key variable in the simulation. Each arrow they draw shows how one element causes a change in another element. For example, the more fish there are, the more fish they will likely catch. Note the blue arrow from the fish population to the fish that are caught (Figure 5). This diagram is meant to serve as an example only. Students may see different relationships than those shown here.

Conversely, a red arrow in the diagram indicates that an increase in the first variable causes the second variable to decrease. For example, the more fish that are caught, the more fish that are removed from the fish population.

From there, students can look for loops within their connection circle and draw them out separately. Figure 6 shows an example with two loops that are embedded in the full connection circle.

For additional information about how to create connection circles, see Lesson 10 in *The Shape of Change,* available here: http://www.clexchange.org/cleproducts/shapeofchange_lessons.asp

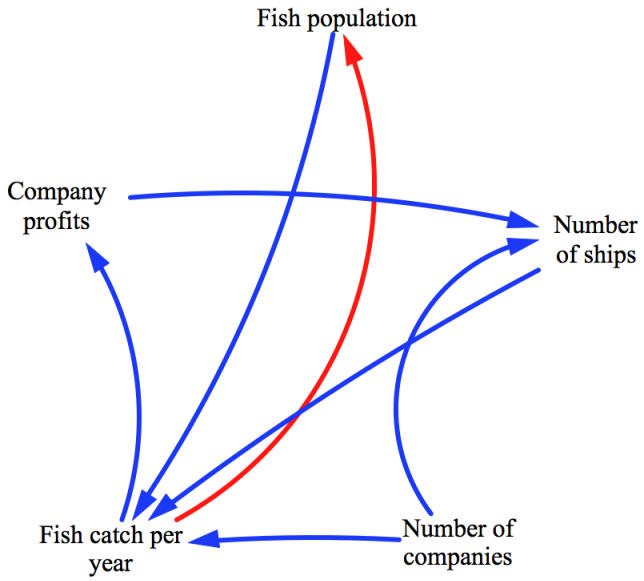

Figure 5: Example Connection Circle

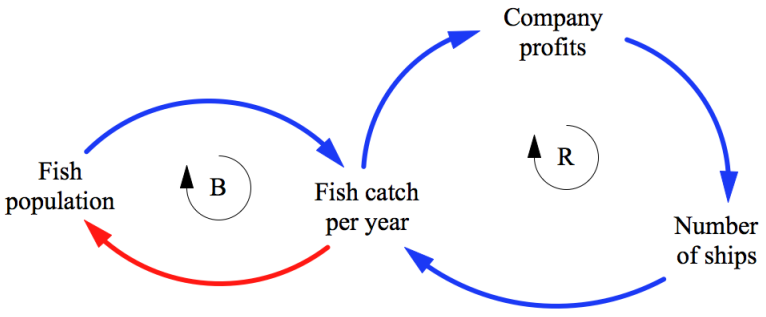

Figure 6: Example Loops

Curricular Connection Examples

Next Generation Science Standards (April 2013 Release)

Middle School.Human Impacts
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
Cross-cutting concepts:
Patterns
- Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)

Cause and Effect
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)
- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-ESS3-4)

High School.Human Impacts
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
Cross-cutting concepts:
Cause and Effect
- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

Systems and System Models
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

Common Core ELA Standards

Reading Standards for Literacy in History/Social Studies 6–12 [Similar connections for Science]
Integration of Knowledge and Ideas
Grades 6-8 Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.
Grades 9-10 Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text.
Grades 11-12 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

Acknowledgements

FishBanks Lesson Guide and Handouts for K-12 audience
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Written by Anne LaVigne

Inspired by many middle and high school teachers who have used various versions of FishBanks from Catalina Foothills School District, City High School and Dodge Middle School, Tucson, Arizona.

Credits:

FishBanks Resources:

FishBanks game originally developed by Dennis Meadows, Emeritus Professor of Systems Management, University of New Hampshire.

Web version developed by Prof. John Sterman (MIT Sloan School of Management), with help from Prof. Andrew King (Tuck School of Business), Dennis Meadows, Keith Eubanks, and Forio.com. Available from https://mitsloan.mit.edu/LearningEdge/simulations/fishbanks/Pages/fish-banks.aspx

Simulation screen shots from web version of FishBanks.

Original introduction slideshow developed by Dennis Meadows, Andrew King and John Sterman is available from Learning Edge.

Lesson, handouts, and slideshows adapted for middle/high school audience by the Creative Learning Exchange and distributed with permission from John Sterman, MIT.

Winslow Homer, *Fishing Boats, Key West* (1903).

Curriculum Connections:

Next Generation Science Standards available from http://www.nextgenscience.org/next-generation-science-standards

Common Core State Standards available from http://www.corestandards.org/

FishBanks Handouts

FishBanks Simulation Requirements

1. Complete a self-assessment (this handout)
   - Use the rubric below to assess how you feel you did for each of the areas below.
   - Attach a separate explanation, justifying your self-assessment.
2. Assemble all team handouts.
   - Community Creation – Handouts 2 and 3 (one per team)
   - Simulation Record-Keeping – Handout 4 (one per team)
   - Finding Connections – Handout 5 (one per team member)
   - Leverage Plan – Handout 6 (one per team member)

Project Assessment Rubric

	Novice	Basic	Proficient	Advanced
Community Creation	Community materials were missing entirely or very little was included.	We created a community, but a couple of components were missing or minimal.	We created a community with all the required components that have clear, logical explanations.	In addition, our community as a whole painted a strong image of what it would be like to live within that community.
Participation and Teamwork	I participated minimally, letting others on my team complete the required components.	I participated somewhat, helping with decisions.	I participated and worked well with my team throughout the intro, simulation, and debrief.	In addition, I took a leadership role, making sure that everyone on my team felt like they had a strong role on our team.
Simulation Record-Keeping	We didn't keep any records.	We recorded results that were mostly accurate.	We recorded results that were accurate and explained what happened.	In addition, we were able to analyze why our company did or did not meet its goal.
Leverage Plan	I didn't have a leverage plan or it was minimal.	My leverage plan was confusing or incomplete.	My leverage plan had specific strategies explained clearly.	In addition, my plan included realistic consequences, both now and into the future.
Team Assessment	My team members did not work well together.	Some of the team members worked together but one or more did little to nothing.	We worked well together to accomplish the tasks. Everyone had an equal role.	This was a great team, one of the best team experiences I've ever had.

Community Creation Tasks

Create a community that includes your company and the town where it is based. As a group, complete the first four tasks together. Divide the remaining tasks among members of your team. f you have fewer than three members, some individuals will have more than one job. Use all of the talents of your team to accomplish these tasks. In addition, complete the attached form as a summary of your work.

1. Name your company.

2. Select a board of directors.

3. Create a company mission statement that reflects the purpose and goals for your company.

4. Name your town.

5. Town Map
   - Create a map of the town, drawing important places (businesses—including your company—docks, marina, school, library, parks, government offices, homes, etc.) in your community.
   - Write a summary describing how your town relies on the fishing industry and how the fishing industry relies on the town resources. Include specific examples from the map.

6. Company History
   Write your company's history, making sure to include answers to the following:
   - When was your company founded?
   - Who founded your company?
   - How is your company important to the local town?
   - What service does your company provide for your town?

7. Company Logo and Sign
   - Design your company's logo.
   - Create a free-standing, table tent (using a sheet of 8.5" x 11" paper) that displays your company's name and logo on one side and names of team members on the other side.

Community Creation Summary

Company Name: **Town Name:**

Board of Directors:

CEO:

CFO:

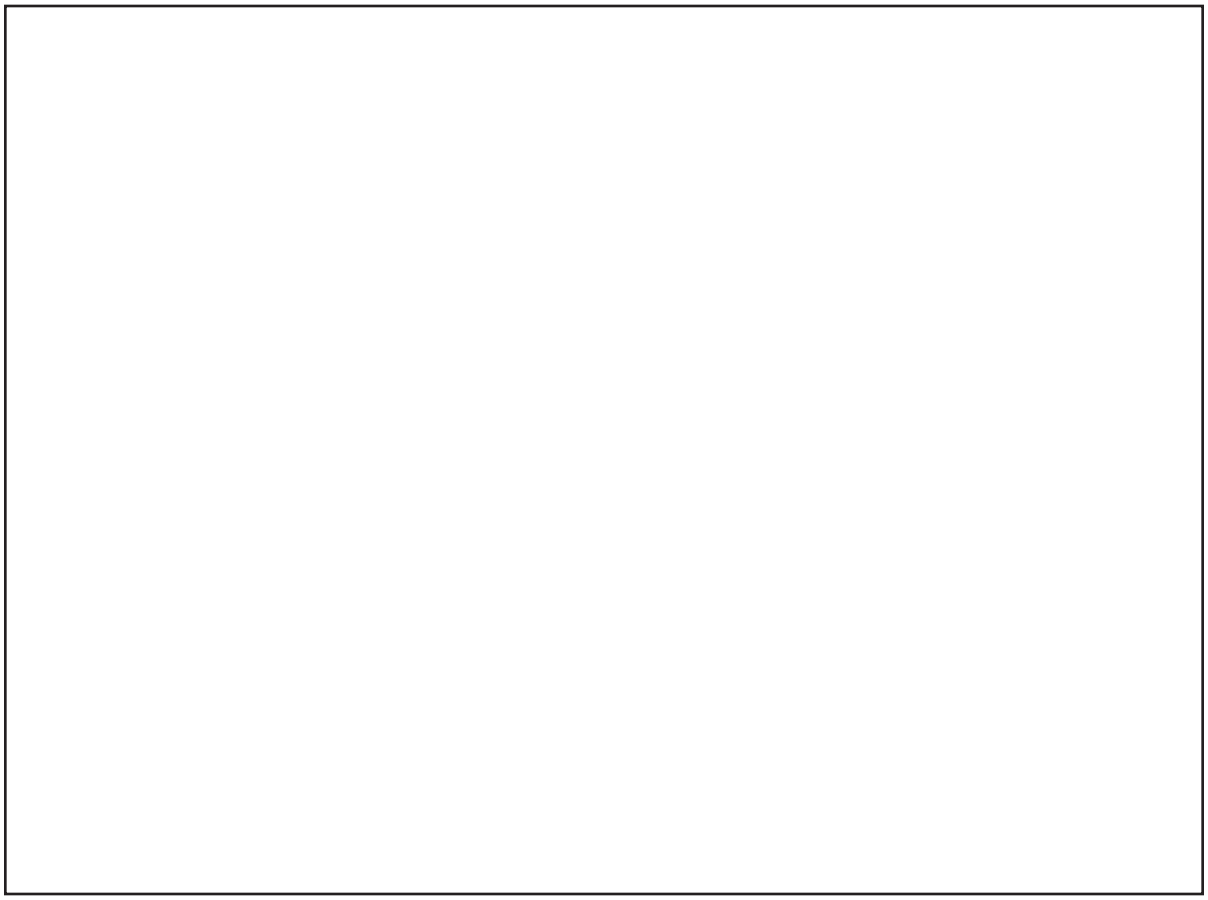
Purchasing Officer:

Fleet Commander:

Company Mission:

Company History:

Town Map (Draw in the space below)**:**



Town Summary:

Simulation Record-Keeping

Company Name:

Team Members:

Year*	Total Assets
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

* Note: record your assets one year behind, e.g. record the Year 0 value when you start Year 1.

What strategies did you use at the beginning of the simulation?

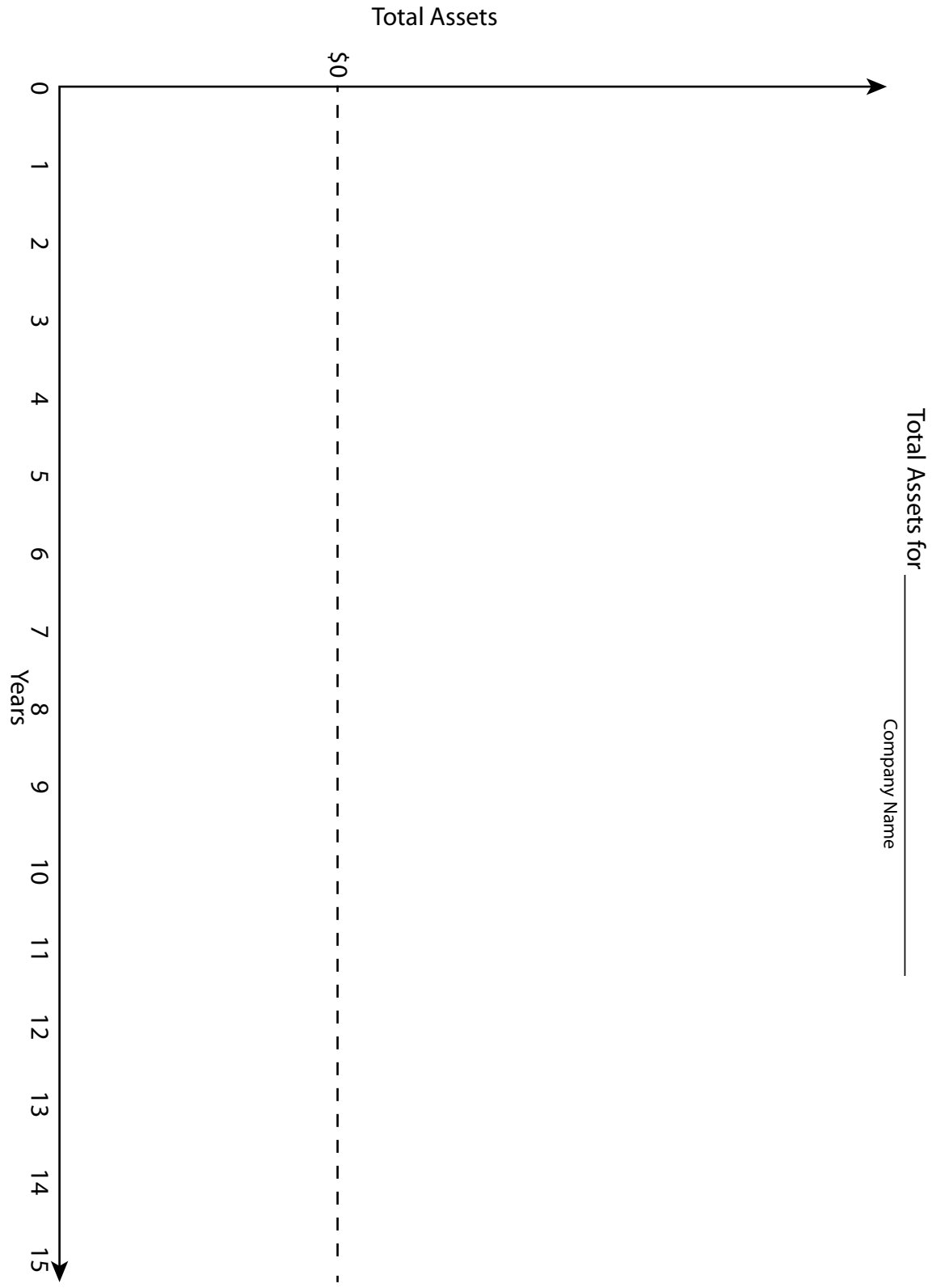
How well did they work?

How did you change your strategies over time?

How well did that work?

Overall, how successful was your company in meeting your goal of having the highest total assets at the end?

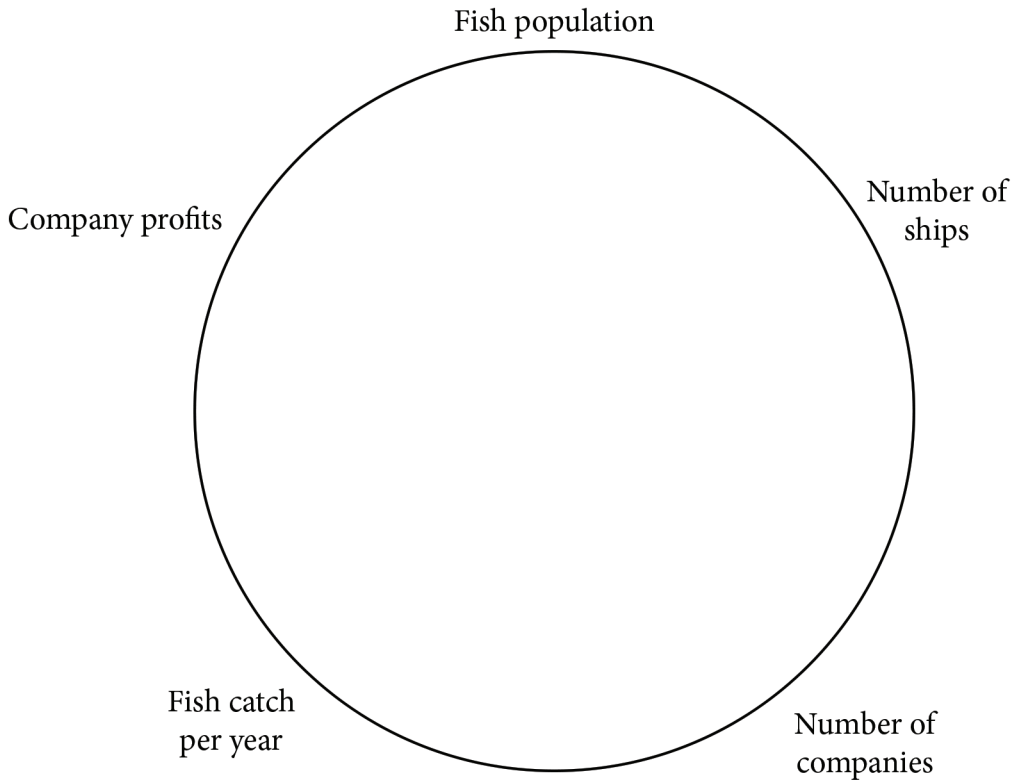
Explain why.


Total Assets
$0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Years
Total Assets for
Company Name

Name:

Finding Connections

Given these parts of the simulation, what are some cause and effect relationships? Draw an arrow from a cause to an effect. Can you find any loops? That is, starting with one variable, see if you can follow the arrows around until you get back to the original variable. Draw any separate loops below. Also, add one or more variables with arrows to show at least one possible policy that would help sustain the fishing industry.



Loops:

Name:

Leverage Plan

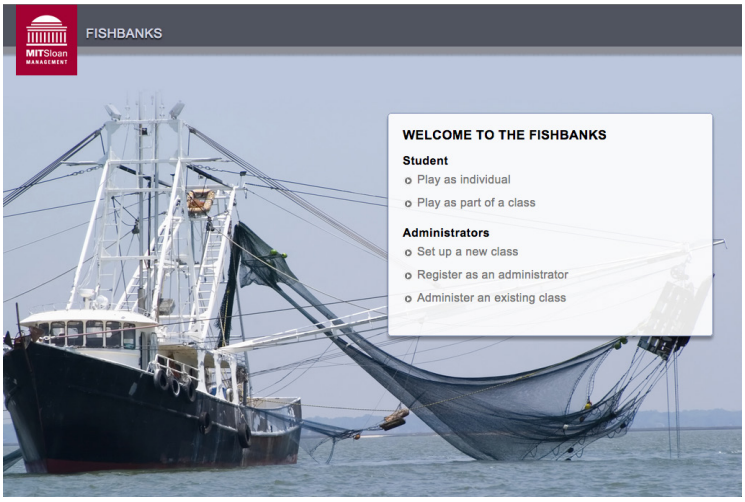
Proposed Policy:

Impact on the Economy in the Short-Term: in the Long-Term:
Impact on the Fish Population in the Short-Term: in the Long-Term:
Other Impacts in the Short-Term: in the Long-Term:

Technical "Quick Start" Guide

Register for an Administrator Account

1. Visit this page and "Register as an Administrator."
   http://forio.com/simulate/mit/fishbanks/simulation/login.html
   Note that it can take 48 hours to receive approval, so you'll want to do this several days in advance.



2. In addition to using your log-in to administer the simulation, you can also access all the additional teaching resources. These were originally designed for higher-educational audiences, but the video in particular is a helpful introduction to the simulation for the teacher. http://forio.com/simulate/mit/fishbanks/simulation/teaching-resources.html

Note: This technical guide is intended as a quick start set of instructions. For more detailed instructions, access the "Setup and Player Briefing" guide available from:
https://mitsloan.mit.edu/LearningEdge/Faculty%20Only/Fishbanks%20Simulation%20Instructors%27%20Guide.Setup%20and%20Player%20Briefing.pdf
Log-in using the same administrator account you set up above.

Set up Your Classes

1. Open the Log-in screen.
   http://forio.com/simulate/mit/fishbanks/simulation/login.html
2. Click, "Set up a new class" and enter your username and password.
3. Select the "Settings" tab. Select "Manual" (to control when the simulation advances) or "Automatic" (to have it go to the next round automatically). Select the number of teams for this class.
4. Open the user-template.xlsx spreadsheet and enter your school name where indicated by brackets in column 1. You can remove the brackets.

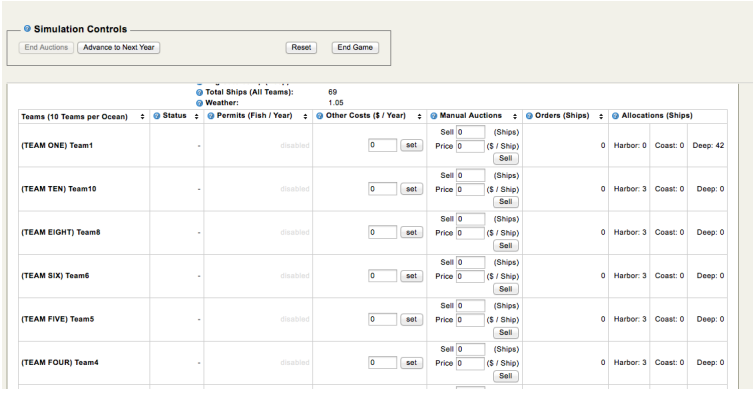
5. Highlight all the data except the first row with headings.

Email (fake or real)	First Name	Last Name	Password	Ocean #	Team #
T1@[insertyourschoolname].org	Company	One	c1	1	1
T2@[insertyourschoolname].org	Company	Two	c2	1	2
T3@[insertyourschoolname].org	Company	Three	c3	1	3
T4@[insertyourschoolname].org	Company	Four	c4	1	4
T5@[insertyourschoolname].org	Company	Five	c5	1	5
T6@[insertyourschoolname].org	Company	Six	c6	1	6
T7@[insertyourschoolname].org	Company	Seven	c7	1	7
T8@[insertyourschoolname].org	Company	Eight	c8	1	8
T9@[insertyourschoolname].org	Company	Nine	c9	1	9
T10@[insertyourschoolname].org	Company	Ten	c10	1	10

6. Copy, using the "Edit" menu or the key command (e.g., Command-C on a MAC or CTRL-C on a PC).
7. Go back to the administrator screen and select the "Users" tab.
8. Click into the white box on the "Upload User List" screen and paste (e.g., Command-V or CTRL-V).
9. Select "Assign Users" and check that all the data came into the list correctly. You should see all the same data that was in the spreadsheet, except for the passwords. Especially check that the team numbers make sense and align with the account email.

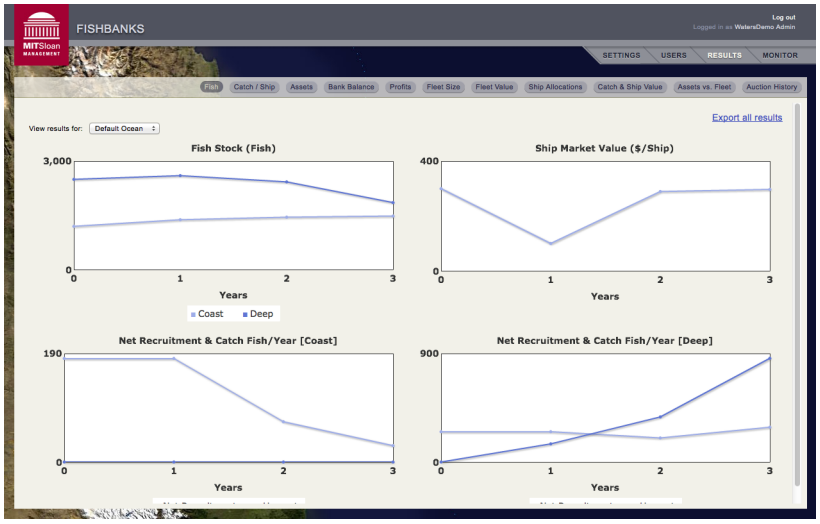
Run the Simulation

1. Select the "Monitor" tab.
2. Click "Reset" to start a new game. You should now see a table with all the teams and an option for an auction at the bottom.



3. At this point, students can log into the simulation with their username (fake email address for their team) and password.
4. At the bottom of the screen, set up the first auction and click "Add Auction." See "Auction" section for more information.

5. Let students know that the auction is open and they can begin bidding. Give them a couple of minutes to make their bids and warn them when the auction is about to close.
6. Click, "End Auctions" (and OK) when you are ready.
7. Students can now decide where to send their ships and whether to order any new ones from the factory. Once they have made their decisions, they'll click "proceed."
8. Watch as teams in the table are "Ready to Advance." If you selected manual in the settings, you'll need to click, "Advance to the Next Year" once all the teams are marked ready. Otherwise, the year will automatically advance when all teams have checked in.
9. Repeat the steps in this section, starting with Step 4.
10. When you have finished running the simulation, you can click, "End Game."
11. At any point, you can visit the "Results" tab to check on how the fish population and other elements are changing over time. You can also randomly announce which team is winning, i.e., has the most assets. t is not recommended that you tell students what is happening over time to the fish population. They need to deduce that from the data they see on their screens.



Auctions

Holding an auction (usually every round/year) is one assured way to get more ships out on the ocean fishing. In order for the students to experience the fish population crashing, a large number of ships must be out on the ocean competing for the resource. This tends to happen naturally when students focus solely on making money, but making sure they have access to ships is another aspect.

You can choose how many ships to auction, but a general guideline is to auction 3-5 ships in each round. Ships cost $300 to build and are ready in a year, so setting the reserve any higher than that is not recommended. Generally, you can set the reserve price pretty low, say $100 or

so. Note that the reserve price is per ship, so when students bid, they are actually bidding the

Price *x* Total number of ships auctioned = Total Cost

In addition, students can put their own ships up for auction. Other teams can choose to bid on them or not. If no one bids, then the original team keeps its ships.

General Technology Guidelines/Troubleshooting

1. Games can be played in one or more periods across multiple days if desired.
2. Students can log in or log out at any time, but if the simulation advances before they've made decisions, they cannot go back and redo them at that point.
3. A "chat" function is available for teams to communicate with one another. There is no way to disable this function, but the teacher can see all the chat logs from the Monitor screen. You may want to check this periodically to make sure students are communicating appropriately. Some teachers have chosen to direct students not to use the chat function, but this choice is completely up to the individual teacher.
4. If using laptops, you will likely need access to power cords, as a typical charge will not last for the entire day.
5. Some browsers tend to work with the simulation better than others. Test fully on the browser you intend to use. The simulation requires an Adobe Flash plug-in. Most computers have this as part of a standard installation, but iPads do not. To run the simulation on an iPad, you'll need to purchase a separate Flash-based browser.
6. If something goes wrong in the middle of the simulation for students or the administrator, just refreshing the browser screen can clear up the problem. If not, the student can also log out and log back in again on the same or a different computer. This latter strategy might be needed in the case of a laptop battery going dead in the middle of a class session.

Additional Resources

1. Introduction Video
   If you would like to see an introduction to the simulation before signing up as an administrator, you can do the following:
   - Go to http://forio.com/simulate/mit/fishbanks/simulation/login.html. Note that the Firefox browser does not work. You can use Chrome or Safari to test.
   - Select, "Play as an individual." Type in any screen ID and click "Login."
   - Click, "Help" in the bottom-left corner to view the video.
2. Simulation overview with links to simulation, video and higher-ed teaching guides are also available. Use the same administrator login/password to access these materials. https://mitsloan.mit.edu/LearningEdge/simulations/fishbanks/Pages/fish-banks.aspx