

<b>Author: Nancy Hummel</b>	<b>Subject/Topic: Evolution within Small Populations/Muskellunge In St. Lawrence River</b>
<b>Grade Level: High School</b>	
<p><b>Lesson Summary:</b>  <b>Students will simulate ‘fishing’ for muskellunge using the New York State regulations for catch and release to determine their effects on fish sizes within the population. Students then simulate ‘fishing’ for muskellunge using the Catch and Release Program to determine its effects on the fish sizes within the population.</b></p>	
<p><b>Objectives:</b>  <b>Students will simulate population changes due to human action to determine the shift in sizes of fish remaining in reproducing population.</b></p>	
<p><b>Assessment::</b>  <b>Students will graph the fish caught in 10 seasons appropriately with appropriate x and y scale and title for both simulations.</b>  <b>Students will respond to questions based upon the results of the simulation’s changes in the fish population.</b></p>	
<p><b>Learning Standards: New York State Core Curriculum/ The Living Environment</b></p> <p><b>Living Environment: Standard 1:</b>  <b>Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.</b></p> <p><b>Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.</b>  <b>Performance Indicator 1.1:</b> Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent ones thinking.</p> <p><b>Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.</b></p> <p><b>Living Environment Standard 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.</b></p> <p><b>Key Idea 1: Living things are both similar to and different from each other and from nonliving things.</b>  <b>Performance Indicator 1.1:</b> Explain how diversity of populations within ecosystems relates to the stability of ecosystems.</p> <p><b>Key Idea 3: Individual organisms and species change over time.</b>  <b>Performance Indicator 3.1:</b> Explain the mechanisms and patterns of evolution.</p> <p><b>Key Idea 6: Plants and animals depend on each other and their physical environment.</b>  <b>Performance Indicator 6.1:</b> Explain factors that limit growth of individuals and populations.</p> <p><b>Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.</b>  <b>Performance Indicator 7.1:</b> Describe the range of interrelationships of humans with the</p>	

living and nonliving environment.

**Performance Indicator 7.2:** Explain the impact of technological development and growth in the human population on the living and nonliving environment.

**Appendix A:**

Collects, organizes, and analyzes data, using a computer and/or other laboratory equipment.  
Organizes data through the use of data tables and graphs.  
Analyzes results from observations/expressed data.

**Lesson Activities**

Preparation/Materials Needed:

1. The greatest amount of time needed here is the printing, cutting and counting out of the muskie cards by size. [These cards can be reused in multiple classes. Have students recount and replace the initial muskie fishing population into a POND container when they are finished.]
2. For this, print Large/Medium/Small Muskie Cards found below -- at least 50 muskie cards of each size per group. Place 10 large, 10 medium and 10 small muskie cards into a container, known as the pond. Students may also find making the desk tops or lab table tops the pond so that they are better able to mix up the muskie cards. Separately place remaining cards into plastic bags according to size. Label each plastic bag: large, medium and small. These three [3] plastic bags will be the reproducing population.
3. Print each student a copy of the Muskie Game Worksheet-pages 3-9.
4. Print a copy of the Trophy Muskellunge Group Official Weighing Station for each group.
5. This activity takes about 40 minutes for students to complete, but may run for a double period, depending upon the amount of time spent in directions and answer completion.

**Procedure:**

1. Divide students into groups of 3 or 4.
2. Give each student a copy of the Muskie Game Simulation worksheet.
3. Give each group a pond filled with 30 muskies-10 large, 10 medium and 10 small muskies.
4. Give each group 3 separately labeled plastic bags with remaining 40 large, medium and small muskie cards.
5. Read information on worksheet about the Muskie population in the St. Lawrence River ecosystem and demonstrate-as needed-the fishing data collection with removal and replacement of fish caught according to the directions.



Image from: [www.fergusonfishingcharters.com/contact.html](http://www.fergusonfishingcharters.com/contact.html) Image from: [www.1000islandsclayton.com/.../?page\\_id=46](http://www.1000islandsclayton.com/.../?page_id=46)

Muskie fishing is a popular sport in the fall in the St. Lawrence River ecosystem. According to NYS Department of Environmental Conservation, from the 3rd Saturday in June until the 15th of December, 1 muskellunge over 48 inches may be taken per day.

To stock your fish pond, place 10 small, 10 medium and 10 large muskie cards upside down on your desk to simulate your fishing pond. Swirl the 'water' in your pond to mix the 30 cards **well**.

Fish by closing your eyes and picking 10 cards to represent a fishing season.

Record, in your fishing catch chart below, the number of small, medium and large muskies that were caught this first 'season.'

Remove only the large muskies from your catch [Those which are at least 48 inches or longer.] and place them on 'trophy weigh station.'

To represent a muskie season's reproduction, count the number of small and medium sized muskie cards that you caught. From your reproducing muskie population cards, count out the same number of each card type to show reproduction to 'add' to the fish pond. [You have doubled your caught small and medium populations and put them back in the pond.]

So, if you caught 4 small and 4 medium muskies, you add 4 more small and 4 more medium muskie cards to the pond, but you REMOVE the 2 large muskies from the pond totally and place in your trophy pile.

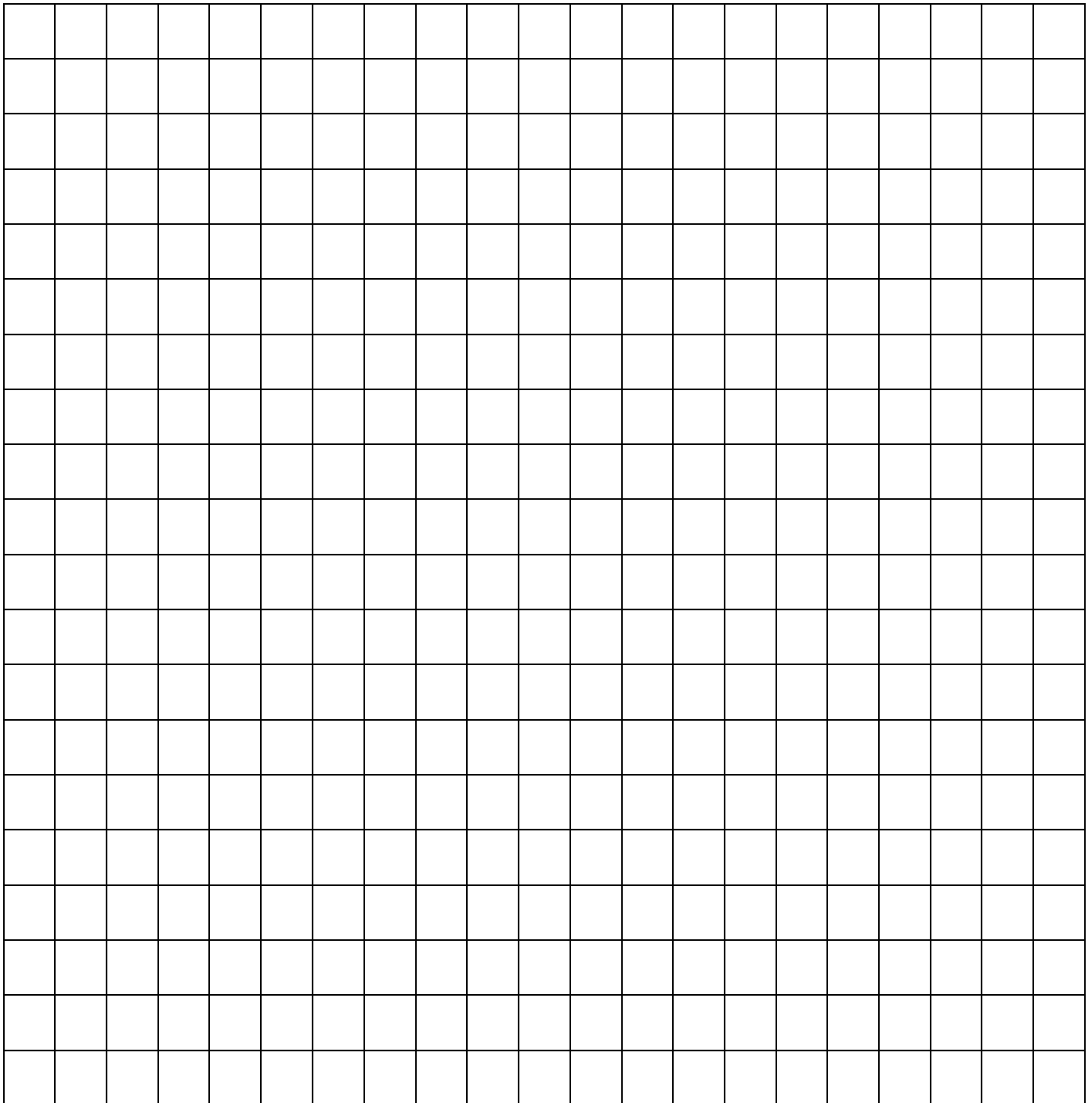
Fish again, repeating the same process of removing the large muskies caught to the trophy weigh station and adding cards for the small and medium muskie cards. Record your results in the chart. When you stop catching any fish of any of the fish sizes for 2 seasons in a row, you can stop. Stop at 10 seasons if you do not run out of any fish sizes in the pond.

### Muskie Fishing Catch by Fishing Seasons Data Chart

<b>Fishing Seasons</b>	<b>Small Muskies</b>	<b>Medium Muskies</b>	<b>Large Muskies</b>
<b>Season 1</b>			
<b>Season 2</b>			
<b>Season 3</b>			
<b>Season 4</b>			
<b>Season 5</b>			
<b>Season 6</b>			
<b>Season 7</b>			
<b>Season 8</b>			
<b>Season 9</b>			
<b>Season 10</b>			
<b>Fish Totals</b>			

Now you need to graph the Muskie population by size for all seasons fished on the graph below marking an appropriate scale for the number of seasons and for the number of fish and writing appropriate title below.

**Title:**



Next, you are going to restock the fish pond and start over, except you are going to put in 10 small muskies, 10 medium muskies and 2 large muskies. This will represent the effects of removing the largest muskies from the fish pond over a period of years.

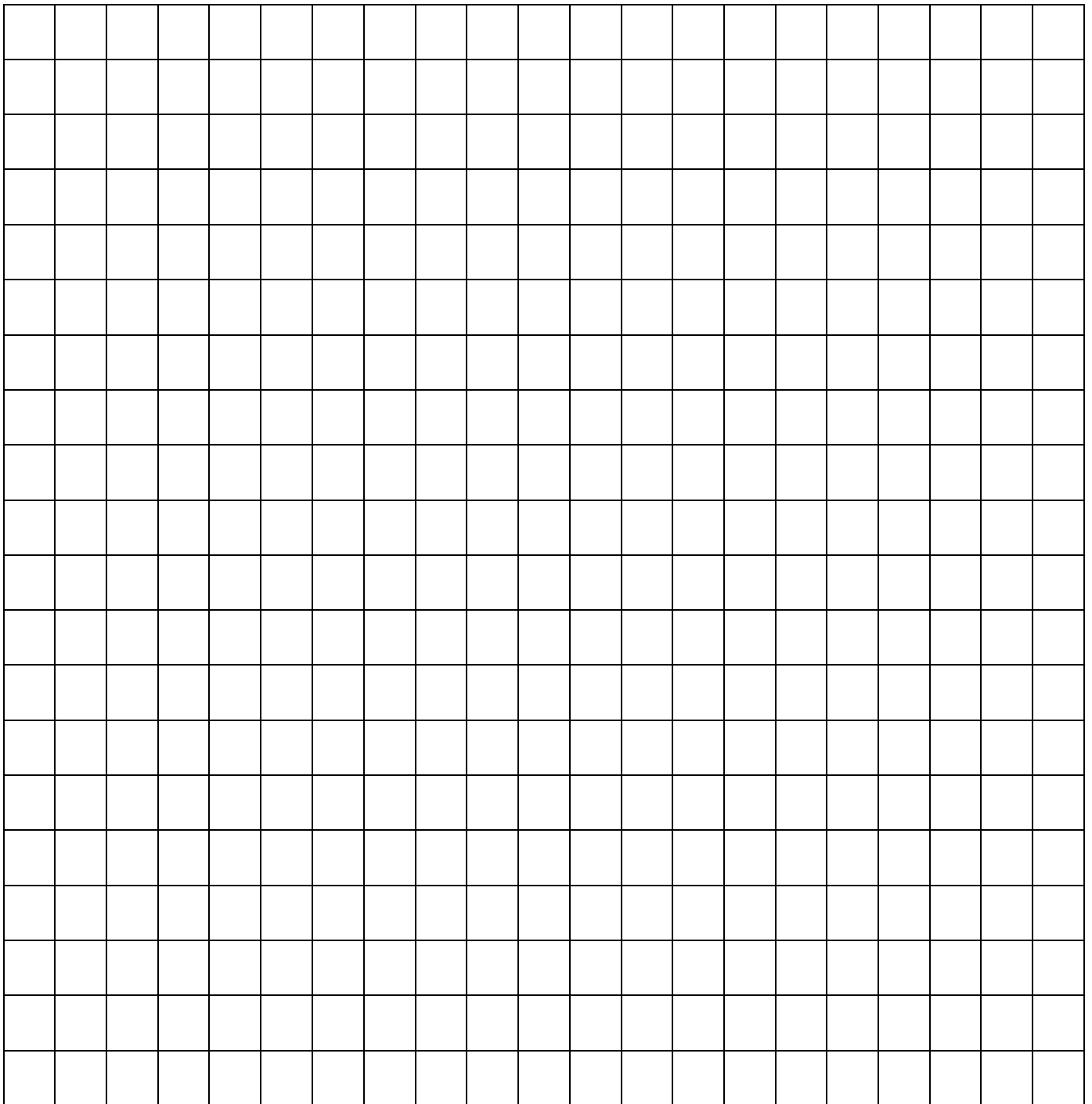
This time, you will be catching and releasing all sizes of fish with reproduction for all fish caught.

Record your results. Keep fishing until you are catching all 3 sizes of fish in fairly equal amounts (3, 3, 4 ratio). You can stop fishing. It may not take 10 seasons.

<b>Fishing Seasons</b>	<b>Small Muskies</b>	<b>Medium Muskies</b>	<b>Large Muskies</b>
<b>Season 1</b>			
<b>Season 2</b>			
<b>Season 3</b>			
<b>Season 4</b>			
<b>Season 5</b>			
<b>Season 6</b>			
<b>Season 7</b>			
<b>Season 8</b>			
<b>Season 9</b>			
<b>Season 10</b>			
<b>Fish Totals</b>			

Now you need to graph the Muskie population by size for all seasons fished on the graph below marking an appropriate scale for the number of seasons and for the number of fish and writing an appropriate title below.

**Title:**



## Analysis:

1. Describe what happens over time to the large muskie population caught when only the large muskies are removed and not allowed to reproduce.

2. What happens over time to the caught small and medium muskie populations when the large muskies are removed from the reproducing population leaving only the small and medium muskies are allowed to reproduce?

3. In 1974, there was a decision by New York State Department of Environmental Conservation, professional fishing guides and fishermen to have muskie fishermen release back to the water all fish less than 36 inches caught and keep all of the 36 and larger muskies in the St. Lawrence River. Explain what you think happened to each population segment of muskies when only the very small muskies were returned to the river. Check your fish caught totals for the 1<sup>st</sup> fishing simulation for your data for your answer.

4. In 1987, Save The River, a non-profit non-governmental organization (NGO), along with SUNY-ESF Thousand Islands Biological Station (TIBS), proposed that **all** legal sized muskies caught would be released. Fishermen who documented doing so would receive a Michael Ringer, a local artist, limited edition Muskie print as a trophy instead. What do you believe would happen to each population segment of the muskie population if this was done? Check your fish caught totals for the 2<sup>nd</sup> fishing simulation for your data for your answer.



5. How many seasons did it take for the larger muskies to become more common? Why?

6. Compare how the catch and keep programs with the catch and release programs. How does each affect the evolution of the size of muskies in the St. Lawrence River?



Image from: [www.1000islandsfishing.com/muskiephotos2.htm](http://www.1000islandsfishing.com/muskiephotos2.htm)

**This fish measured 57-1/2" and was caught and released on Oct. 13, 2001.**

***The last day of the 2001 season ended with a 57-1/2", 28" girth.***



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



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*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
at least 48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
between 36-48 inches long



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



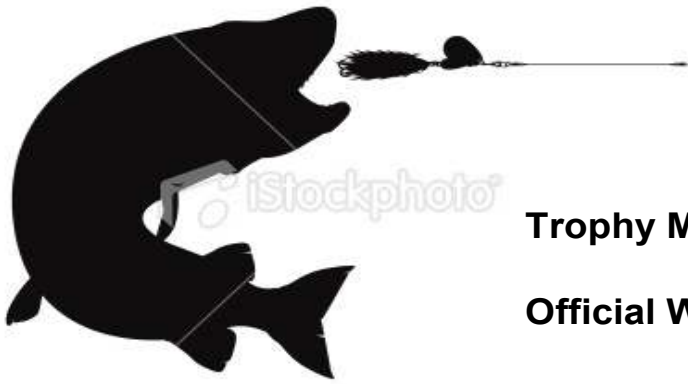
**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Muskellunge**  
*Esox masquinongy*  
Under 36 inches



**Trophy Muskellunge Group**

**Official Weigh Station**