Author: Nancy Hummel	Subject/Topic: Food Webs/Invasive Species Impact
Grade Level: Grade 9-12	

Lesson Summary:
Students construct a food web using common St. Lawrence River aquatic ecosystem species. Students are provided with a St. Lawrence River aquatic ecosystem invasive species and determine how that invasive species will affect the aquatic ecosystem. After researching their specific invasive species and its origins, impact and current research being conducted, they will present to their classmates and then demonstrate how their invasive species impacts the St. Lawrence River ecosystem.

Objectives:
Students will construct a regional aquatic food web. Students will learn how an invasive species impacts the aquatic ecosystem. Students will research and present information concerning their specific invasive species and how it impacts the region. Students write letter to contact research scientist via email to learn current research methods, technology and scope.

Assessment::
Students will construct an appropriate aquatic food web using species cards with containing information about energy requirements and trophic level.
Students will appropriately insert provided invasive species and identify the organisms and trophic levels affected by invasive species.
Students will research and present accurate information and data concerning their invasive species and its impact and remediation action to their classmates.
Students will report research scientist information concerning research methods, current technology used and scope of research.

Learning Standards:

<u>Living Environment: Standard 1</u>:
Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.
Key Idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.
Performance Indicator1.1: Elaborate on basic scientific and personal explanations of natural phenomena, and develop extended visual models and mathematical formulations to represent ones thinking.
Performance Indicator 1:2: Hone ideas through reasoning, library research, and discussion with others, including experts.
Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.
Performance Indicator 3.1: Use various methods of representing and organizing observations (e.g., diagrams, tables, charts, graphs, equations, matrices) and insightfully interpret the organized data.
<u>Living Environment Standard 4</u>: 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.
Key Idea 1: Living things are both similar to and different from each other and from nonliving things.
Performance Indicator 1.1: Explain how diversity of populations within ecosystems relates to the stability of ecosystems.
Key Idea 3: Individual organisms and species change over time.
Performance Indicator 3.1: Explain the mechanisms and patterns of evolution.
Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.
Performance Indicator 5.1: Explain the basic biochemical processes in living organisms and their importance in maintaining dynamic equilibrium.
Key Idea 6: Plants and animals depend on each other and their physical environment.
Performance Indicator 6.1: Explain factors that limit growth of individuals and populations.
Performance Indicator 6.2: Explain the importance of preserving diversity of species and habitats.
Performance Indicator 6.3: Explain how the living and nonliving environments change over time and respond to disturbances.
Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.
Performance Indicator 7.1: Describe the range of interrelationships of humans with the 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.

Performance Indicator 7.3: Explain how individual choices and societal actions can contribute to improving the environment.

Lesson Activities

Preparation/Materials Needed:

1. Attached is a PowerPoint presentation concerning the St. Lawrence river ecosystem and the impact that international shipping has on the aquatic ecosystem and the numbers of introduced species which have become invasive.

2. Attached is a PowerPoint (student) presentation of species cards containing pictures and trophic information concerning the trophic relationships within this St. Lawrence River ecosystem.

3. Students will receive three (3) worksheets (attached). They concern constructing the aquatic ecosystem, the introduction of an invasive species and a research project, including rubric.

4. PowerPoint slides of species need to be reproduced in Handout Print format to be cut out and glued by students. Each species should have a picture slide as the front and an information slide as the back of the card. Teacher should do the same for enough of the invasive species slides for later in the activity.

Procedure:

1. **Present St. Lawrence River ecosystem and international shipping PowerPoint to students. Students in groups of 2-3 will read (as a class or individuals) the Food Web Worksheet and complete the aquatic food web. Using chalk to draw the movement of energy among the species and trophic levels on the tables. Have students explain the energy transformations within the ecosystem and the role of each trophic level before giving students the invasive species card and the Disturbance Worksheet.**

2. **Students introduce the invasive species into their aquatic ecosystem and then remove the organisms affected (or potentially affected) by the invasive species. Students will explain how invasive species disrupts flow of energy.**

3. **Give students invasive species research project and time in the computer lab to develop a presentation to give to their classmates concerning their invasive species. This includes specifics concerning the origins of the species, its impact on the North American/New York regional area, remediation efforts, current research methods, findings and technology used.**

4. **Students present to their classmates and demonstrate how the invasive species impacts the food web and trophic levels.**

St. Lawrence Food Web Activity Name_____

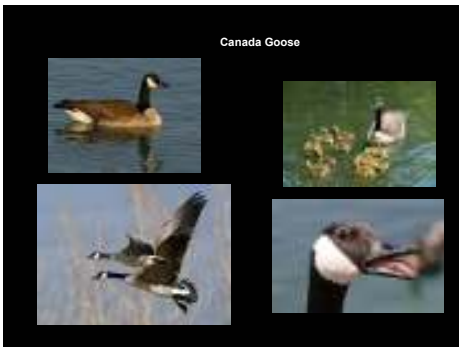
According to author of Pandora's Locks, Jeff Alexander, there is a new invasive species introduced into the St. Lawrence River ecosystem every 28 weeks. This waterway located in northern New York is the main portal for most of these species. They move throughout much of the North American continent disrupting or destroying many native species. By learning about how they are introduced and how some affect our aquatic ecosystems, we may learn how to control or stop further introductions and invasions.

You have been given a packet containing a number of native species pictures cards printed next to a card with the information about the native species.

Cut these cards along the horizontal lines between the rows as shown by the arrow below.

Each sheet will have 3 of these sections.

Cut off the extra white areas leaving behind the 2 card pieces as shown below.



Canada Geese are usually herbivores, eating grasses and seeds on land and seaweeds in the water. Sometimes they will eat small insects.

Their population has increased due to few predators.

They are considered by some to be an increased nuisance due to their aggressive behavior and fecal matter messes.

Take each of these individual sections and fold them in the middle with the unprinted parts on the inside. Tape the card at the open end so that you now have a card with a picture of a species on the front and a description of it on the back.

When you are finished, set your pieces aside to read the next directions.

The nature of an ecosystem is that there is an exchange of energy among the organisms within it. The **sun** is the energy source for most ecosystems in the biosphere, as shown in the diagram below.

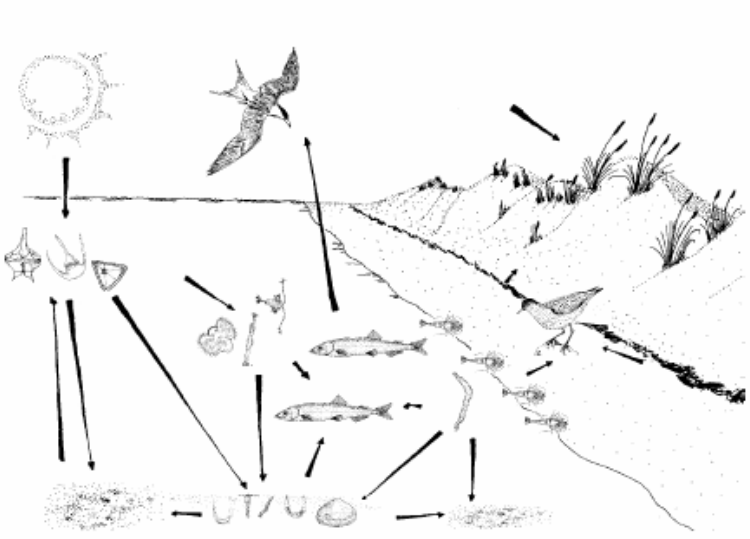


Image from: Fisheries and Oceans, Canada, Food Web, 2010. www.glf.dfo-mpo.gc.ca/e0005908

In many aquatic ecosystems, small unicellular algae and water plants capture the sun's light energy in the process of photosynthesis. These photosynthetic organisms are known as **PRODUCERS**. Since they are able to make their own energy molecules, they are also known as **AUTOTROPHS**. During the photosynthetic process, carbon dioxide [CO_2] is used to make carbohydrates, like glucose [$C_6H_{12}0_6$] and oxygen [O_2] is released to the water [H_2O]. This released oxygen is available to other organisms, like fish, in the water.

Most autotrophs are green due to presence of chlorophyll, a photosynthetic pigment. All other members of the ecosystem are dependent upon the autotrophs being able to turn light energy into energy molecules.

Any organism which does not make its own energy molecules and must take them from another organism is called a **HETEROTROPH**. If a heterotroph consumes plants, or autotrophs, then it is called a **PRIMARY CONSUMER.** An organism which preys on and eats an organism that eats plants is called a **SECONDARY CONSUMER**. Those species which prey on and eat secondary consumers are known as **TERTIARY CONSUMERS**. The species that are at the top of the food chain is called the **APEX /or TOP SPECIES** and do to not have any predators.

In your cards, you have a representation of some of the common species of the St. Lawrence River aquatic ecosystem. One side of each card has pictures of the species and on the other side are descriptions of their activities within the ecosystem. Some are the autotrophs and some are the heterotrophs.

First, your group needs to read all of the cards to find and sort out all of the autotrophs into a separate pile. Next, you need to separate out the primary consumers into a separate pile. Do the same for all consumers, like the secondary consumers, the tertiary consumers and the apex consumers. Once you believe that you have determined the role of all species cards, you will begin to build your food web.

Place the autotrophs in a row closest to you on your desk. In a new row above them, place a row of all primary consumers. Do the same for each successive level of consumers.

To construct your food web, you need to recheck your consumers to see what they eat so that you can draw an arrow with chalk on your table from the food to the species that is eating it. If you determine from the information of the species cards that any species could consume another species, then you must include an arrow from the 'food' to the consumer. You may have multiple arrows going from some species to consuming species.

Once you are done, draw your food web on the back of this sheet, using large circles to represent your species and labeling each species. Draw the arrows indicating which species are their sources of energy. Identify and label each trophic level: producers, primary consumers, secondary consumers, tertiary consumers and top/apex consumers.

Disturbance Cards Name_____

Each group will be given a different invasive species card as a disturbance to the food web.

Read the information on the disturbance card that your group has been given.

Identify which trophic level that this invasive species would fit in your food web. Place it into your food web and draw the arrows showing its energy source.

Since most invasive species have few or no predators, they become 'invasive' and take over the entire trophic level. This eliminates all of its competitors at its trophic level and does not pass the energy molecules onto the next higher trophic level.

By successfully invading, your invasive species has wiped out both its competitors and higher trophic level species. Remove all of its competitors and higher trophic species and draw your remaining food web as you did on the first portion of this exercise below.

1. Which species on the same trophic level did your invasive species compete with and eliminate?

2. Which species on higher trophic levels were eliminated by your invasive species?

3. In your own words, explain why invasive species can be harmful to any ecosystem's food web.

Invasive Species Web Project Name_____

Your group will be researching various aspects of your invasive species to present to your classmates, including a demonstration of its impact on the St. Lawrence River aquatic ecosystem using your food web cards.

Your presentation must include: (Check off your tasks on the lines next to the numbers as you complete them.)

_____1. What is the scientific name of your invasive species?

_____2. Where is the original habitat of this species?

_____3. How did it get to Great Lakes?

_____4. When did the invasive species arrive?

_____5. How far has it spread within the Great Lakes region? (A map can be used, but be sure to use a citation for this. I will give you the citation format.)

_____6. Which species are most affected by this invasive species?

_____7. What efforts are being made to control this invasive species?

_____8. Have any species developed into predators of this invasive species?

_____9. What scientists [like, SUNY-ESF or Cornell professors] are studying this invasive species? What are they studying and what are some of their findings?

_____10. What kinds of technology are they using in their studies? How are these tools being used? Are there other ways that they are using to learn about the impact of this invasive species?

9. and 10. can involve an email to these professors, with my approval of your email. If you receive a reply, please share this information in your presentation.

_____11. What does the future hold for this invasive species and its impact on the aquatic ecosystems it affects?

_____12. You will need to set up the original food web for your presentation, so that you can show the food web before and then after the introduction of your invasive species and then demonstrate its impact on the food web.

Invasive Species Project Rubric Name_____

5 points	4 points	3 points	2 points	1point
We used our time extremely efficiently in the Computer Lab by assigning tasks, working cooperatively and staying on task. Assignment was turned on time.	We used our time well in the Computer Lab by assigning tasks, working cooperatively and staying on task. Assignment was turned on time.	We used our time with some difficulty in the Computer Lab by assigning some tasks, working somewhat cooperatively and mostly staying on task. Assignment was turned on time.	We used our time inefficiently in the Computer Lab by assigning a few tasks, not working very cooperatively and somewhat staying on task. Assignment was turned on time.	We did not use our time in the Computer Lab well by not assigning tasks, working not cooperatively and not staying on task. Assignment was not turned on time.
The slide presentation had all 12 tasks shown in excellent detail and accurate grammar, spelling and punctuation.	The slide presentation had most 12 tasks shown in good detail and mostly accurate grammar, spelling and punctuation.	The slide presentation did not have all 12 tasks shown and lacked some detail. There were significant accurate grammar, spelling and punctuation errors.	The slide presentation had few of 12 tasks shown and lacked much detail There were many inaccurate grammar, spelling and punctuation errors.	The slide presentation had very few of 12 tasks shown in Detail. Many slides had inaccurate grammar, spelling and punctuation errors.
Pictures, map and charts were extremely appropriate and relevant in presentation which significantly added to viewer understanding. Citations were used as needed.	Pictures, map and charts were appropriate and relevant in presentation which added to viewer understanding. Citations were mostly used as needed.	Pictures, map and charts were somewhat appropriate and relevant in presentation which added to viewer understanding. Citations were somewhat used as needed.	Pictures, map and charts were rarely appropriate and relevant in presentation which s added to viewer understanding. Citations were rarely used as needed.	Pictures, map and charts were not appropriate and relevant in presentation and did not add to viewer understanding. No citations were used as needed.
The information provided was extremely accurate, in great detail and very appropriate to topic.	The information provided was mostly accurate, in good detail and mostly appropriate to topic.	The information provided was somewhat accurate, in some detail and somewhat appropriate to topic.	The information provided was rarely accurate, in little detail and rarely appropriate to topic.	The information provided was not accurate, in no detail and not appropriate to topic.
During the presentation, all members of group spoke clearly so that all members of class could hear well. All words were used and pronounced properly.	During the presentation, most members of group spoke clearly so that all members of class could hear well. Most words were used and pronounced properly.	During the presentation, some members of group spoke clearly so that all members of class could hear well. Some words were used and pronounced properly.	During the presentation, few members of group spoke clearly so that all members of class could hear well. Few words were used and pronounced properly.	During the presentation, no members of group spoke clearly so that all members of class could hear well. Many words were misused and mispronounced properly.