DRAFT

CLASSROOM HATCHERY PROGRAM

GRADE 5 LESSON GUIDE

Made possible through funding from:

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Lesson Summaries

Lesson 1: **Meet the Atlantic Salmon**	Students will be introduced to basic fish biology and identification to assist them to identify an adult Atlantic Salmon. They will then label the fins of an Atlantic Salmon diagram. Next the students will compare and contrast major organs of humans and Atlantic almon.	50-60 Minutes
Lesson 2: **Degree Days**	A math lesson that teaches the students to use temperature information to predict how long it will take Atlantic Salmon to reach developmental milestones. Included worksheet takes the student through simple calculations.	50-60 Minutes
Lesson 3: **Poster Project**	Students will be divided into groups and each group assigned a topic relating to Lake Ontario Atlantic Salmon. Topics cover identification, life cycle, history, geography, habitat, and restoration. The groups will teach the class and other classes about their section of the project.	3 hours
Lesson 4: **A Day in the Life of an Atlantic Salmon**	Using their imagination, students will write a short story about a day in the life of an Atlantic salmon for a particular stage of its life cycle.	60-120 Minutes
Lesson 5: **Stewardship Discussion**	Students learn about the relationships between Atlantic Salmon, society, habitats, and environmental stewardship. In groups they are given a question to discuss. They then share their thoughts with the class.	60 Minutes
Lesson 6: **Who is Eating Who**	A dynamic tag game teaches the students about predators and prey that are involved in the life of Lake Ontario Atlantic Salmon.	60 Minutes

Grade 5 Curriculum Connections

Curriculum	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6
Science & Technology						
UNDERSTANDING LIFE SYSTEMS HUMAN ORGAN SYSTEMS						
Expectations						
2. investigate the structure and function of the major organs of various human body systems	X					
2.4 use appropriate science and technology vocabulary, including circulation, respiration, digestion, organs, and nutrients, in oral and written communication	X					
UNDERSTANDING MATTER AND ENERGY PROPERTIES OF AND CHANGES IN MATTER						
Expectations						
1. evaluate the social and environmental impacts of processes used to make everyday products					X	
Social Studies						
PEOPLE AND ENVIRONMENTS: THE ROLE OF GOVERNMENT AND RESPONSIBLE CITIZENSHIP						
Expectations						
B1. Application: assess responses of governments in Canada to some significant issues, and develop plans of action for governments and citizens to address social and environmental issues					X	
B1.3 create a plan of action to address an environmental issue of local, provincial/territorial, and/or national significance specifying the actions to be taken by the appropriate level (or levels) of government as well as by citizens, including themselves					X	
B2. Inquiry: use the social studies inquiry process to investigate Canadian social and/or environmental issues from various perspectives, including the perspective of the level (or levels) of government responsible for addressing the issues			X		X	

B2.3 analyse and construct maps in various formats, including digital formats, as part of their investigations into social and/or environmental issues			X			

Mathematics

NUMBER SENSE AND NUMERATION

Expectations

round decimal numbers to the nearest tenth, in problems arising from real-life situations		X				
solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 100 000		X				
solve problems involving the addition, subtraction, and multiplication of whole numbers, using a variety of mental strategies		X				
divide three-digit whole numbers by one-digit whole numbers, using concrete materials, estimation, student-generated algorithms, and standard algorithms		X				
demonstrate an understanding of simple multiplicative relationships involving whole-number rates, through investigation using concrete materials and drawings		X				

Language

ORAL COMMUNICATION

Expectations

1. listen in order to understand and respond appropriately in a variety of situations for a variety of purposes;	X		X		X	
Active Listening Strategies 1.2 demonstrate an understanding of appropriate listening behaviour by adapting active listening strategies to suit a range of situations, including work in groups	X		X		X	
Demonstrating Understanding 1.4 demonstrate an understanding of the information and ideas in oral texts by summarizing important ideas and citing a variety of supporting details	X		X		X	
2. use speaking skills and strategies appropriately to communicate with different audiences for a variety of purposes	X		X		X	
Interactive Strategies 2.2 demonstrate an understanding of appropriate speaking behaviour in a variety of situations, including paired sharing, dialogue, and small- and large group discussions	X				X	

Clarity and Coherence 2.3 communicate orally in a clear, coherent manner, presenting ideas, opinions, and information in a readily understandable form	X		X		X	
Appropriate Language 2.4 use appropriate words and phrases from the full range of their vocabulary, including inclusive and non-discriminatory language, and stylistic devices suited to the purpose, to communicate their meaning accurately and engage the interest of their audience	X		X		X	

Language

WRITTEN COMMUNICATION

Expectations

1. generate, gather, and organize ideas and information to write for an intended purpose and audience			X			
Purpose and Audience 1.1 identify the topic, purpose, and audience for a variety of writing forms			X			
Developing Ideas 1.2 generate ideas about a potential topic and identify those most appropriate for the purpose			X			
Developing Ideas 1.2 generate ideas about a potential topic and identify those most appropriate for the purpose			X			

Health and Physical Education

LIVING SKILLS

Expectations

1. demonstrate personal and interpersonal skills and the use of critical and creative thinking processes as they acquire knowledge and skills in connection with the expectations in the Active Living, Movement Competence, and Healthy Living strands for this grade.						X
Personal Skills 1.1 use self-awareness and self-monitoring skills to help them understand their strengths and needs, take responsibility for their actions, recognize sources of stress, and monitor their own progress, as they participate in physical activities, develop movement competence, and acquire knowledge and skills related to healthy living						X

Personal Skills 1.2 use adaptive, management, and coping skills to help them respond to the various challenges they encounter as they participate in physical activities, develop movement competence, and acquire knowledge and skills related to healthy living						**X**
Interpersonal Skills 1.3 communicate effectively, using verbal or non-verbal means, as appropriate, and interpret information accurately as they participate in physical activities, develop movement competence, and acquire knowledge and skills related to healthy living						**X**
Interpersonal Skills 1.4 apply relationship and social skills as they participate in physical activities, develop movement competence, and acquire knowledge and skills related to healthy living to help them interact positively with others, build healthy relationships, and become effective team members						**X**
Critical and Creative Thinking 1.5 use a range of critical and creative thinking skills and processes to assist them in making connections, planning and setting goals, analysing and solving problems, making decisions, and evaluating their choices in connection with learning in health and physical education						**X**

Class size:	Unlimited
Setting:	Classroom

BRING BACK THE SALMON LAKE ONTARIO supported by ONTARIO POWER GENERATION

Grade 5 Classroom Hatchery Activities

Lesson 1: Meet an Atlantic Salmon

Lesson Objectives:

- Familiarize students with the identification of Atlantic Salmon
- Familiarize students with basic fish biology, identification, and terminology
- Assist students with recognizing the value of proper species identification
- Compare and contrast organ systems of humans and Atlantic Salmon

Materials:

- Projector connected to computer or printed presentation (found below)
- 3 page handout (found below - print enough for student groups of 2 - 4)
- Pencils

Background

Ontario is home to nearly 150 fish species; 129 are native. Proper identification of species is useful for species monitoring (species presence and location, population size, fish health, etc), and for complying with fishing regulations. Identification can also help build a deeper connection with a species as we learn about different patterns in their life stories. It can also be a lot of fun!

Fish just like all other living things have unique physical characteristics that distinguish one species from another. Size, colouration, shape, and presence or absence of particular features are some of these characteristics. Atlantic Salmon like other salmon have an adipose fin (the small fin on the back of fish just in front of the tail) and a soft dorsal fin. The Atlantic Salmon has dark spots on a lighter coloured body, only 2-3 large spots on the gill cover, a mouth that stops at the back of the eye, and a long narrow caudal peduncle (the part of the fish that connects the body with the tail). These characteristics are shown in the presentation below.

It is important that scientists and anglers can properly identify Atlantic Salmon to give them the best level of care and so that anglers can follow fishing regulations. Anglers with proper identification skills can be valuable citizen scientists who can greatly contribute to monitoring efforts.

Internally the Atlantic Salmon share some similarities with our own bodies. Like us they are vertebrates and have a similar (but slightly different) digestive and circulatory system (fish have a 2 chambered heart versus our 4). They also have some major differences. The basic difference is that fish are cold blooded versus humans which are warm blooded. Most fish have gills for breathing in the water and no lungs for breathing in air (there are a few exceptions!). The fish also have a swim bladder to control bouncy; it serves a similar function as a SCUBA diver's buoyancy control device.

Teaching and Learning Sequence

Part A. Share this **Cool Atlantic Salmon Fact:** *Atlantic Salmon are known as the "leaper". They can jump out of the water 3 metres high! That is as high as a basketball net!!*

Part B. Ask these **Guiding Questions:**

1. Has anyone ever seen and Atlantic Salmon?
2. How might you tell the difference between an Atlantic Salmon and another fish?

Part C. Present **"Basic Fish ID"** (on a projector screen or print/display to class).

1. Print off the 3 pages of "***Meet an Atlantic Salmon"*** below where it says "copy me" (enough copies to have groups of 2-4 students).
2. Page 1 of Presentation: Allow time for the students to talk about what they see. You are not looking for specific answers; rather you are engaging their observation skills;.
3. Page 2- 4: Show the 1 or 2 characteristics identified on each fish. This can be done quickly and is intended to show the students some of the main physical differences between fish. Atlantic Salmon being our focus fish has more characteristics identified.
4. Page 5 shows the fins of the Atlantic Salmon. The presence of these fins are characteristic of all the salmon species. Point out and define the ***adipose fin =*** *a small fleshy fin just ahead of the tail. Found on only a small number of fish species including salmon*.
5. Have the students get in groups of 2 – 4.
6. Give each group a copy of the handouts and have them try to work through them.
7. Take the activity up as a class and have the students share their thinking and correct any errors.

ANSWERS

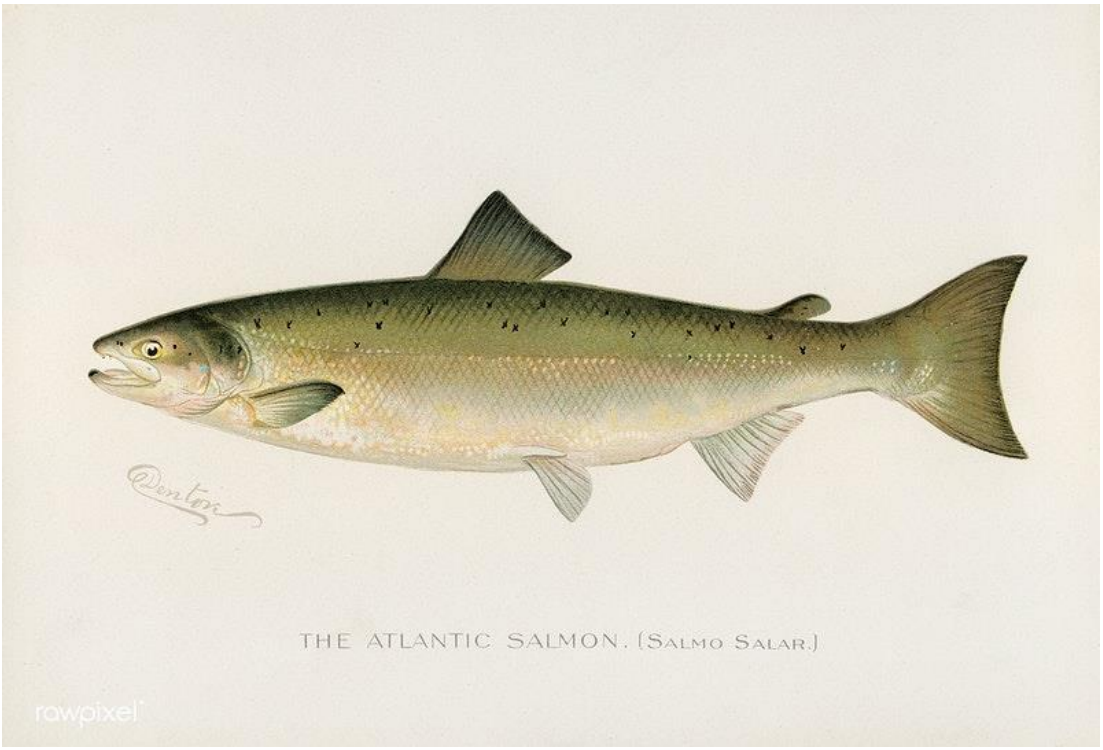
A. Use the presentation slide. **B.** Can include: heart; liver; kidney; brain; intestines; eyes; gall bladder; stomach. **C.** (C, I, K, D, F, A, L, J, E, B, H, G,) **D.** 1. Kidney; 2. Swim bladder; 3. Brain; 4. Eye; 5. Olfactory system; 6. Gills; 7. Heart; 8. Liver; 9. Stomach; 10. Spleen; 11. Intestines; 12. Muscle. **E. Can include:** Humans: lungs; arms; legs; fingers; toes; ears. Atlantic Salmon: fins; swim bladder; gills; lateral line; otolith. Both: heart; kidney; liver; stomach; intestines; brain; eyes; gall bladder; vertebrate.

Part D. Ask these **Reflection Questions** (can be done as a Think, Pair, Share):

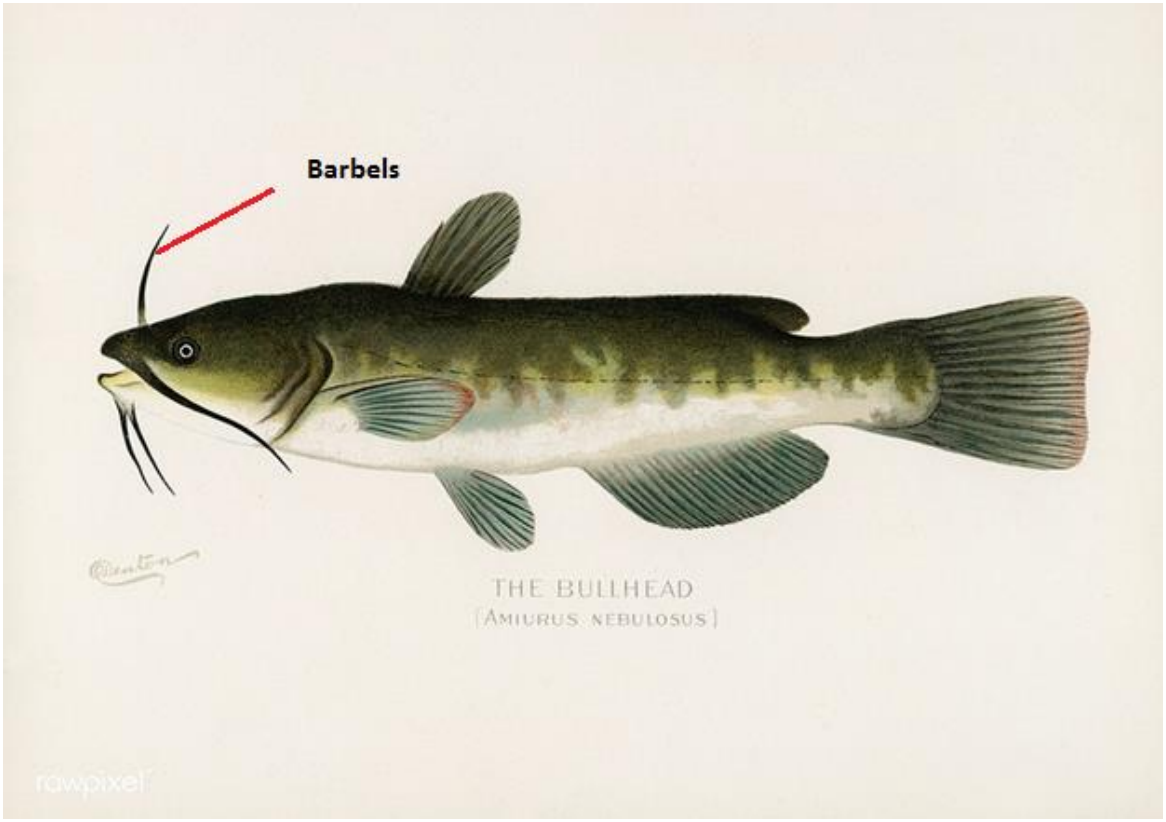
1. Why is the proper identification of fish important?
2. Name some identifying characteristics of an adult Atlantic Salmon.
3. How are Atlantic Salmon and humans different? How are they the same?

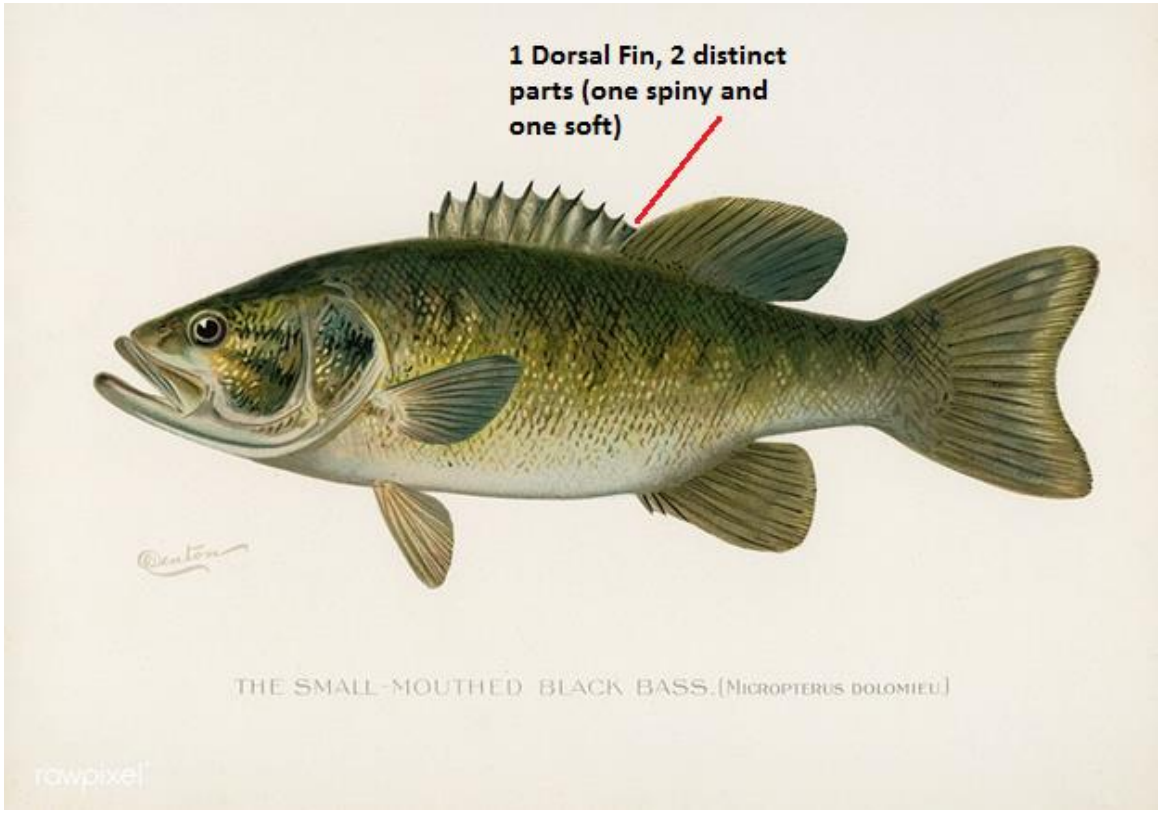
Presentation: Basic Fish Identification

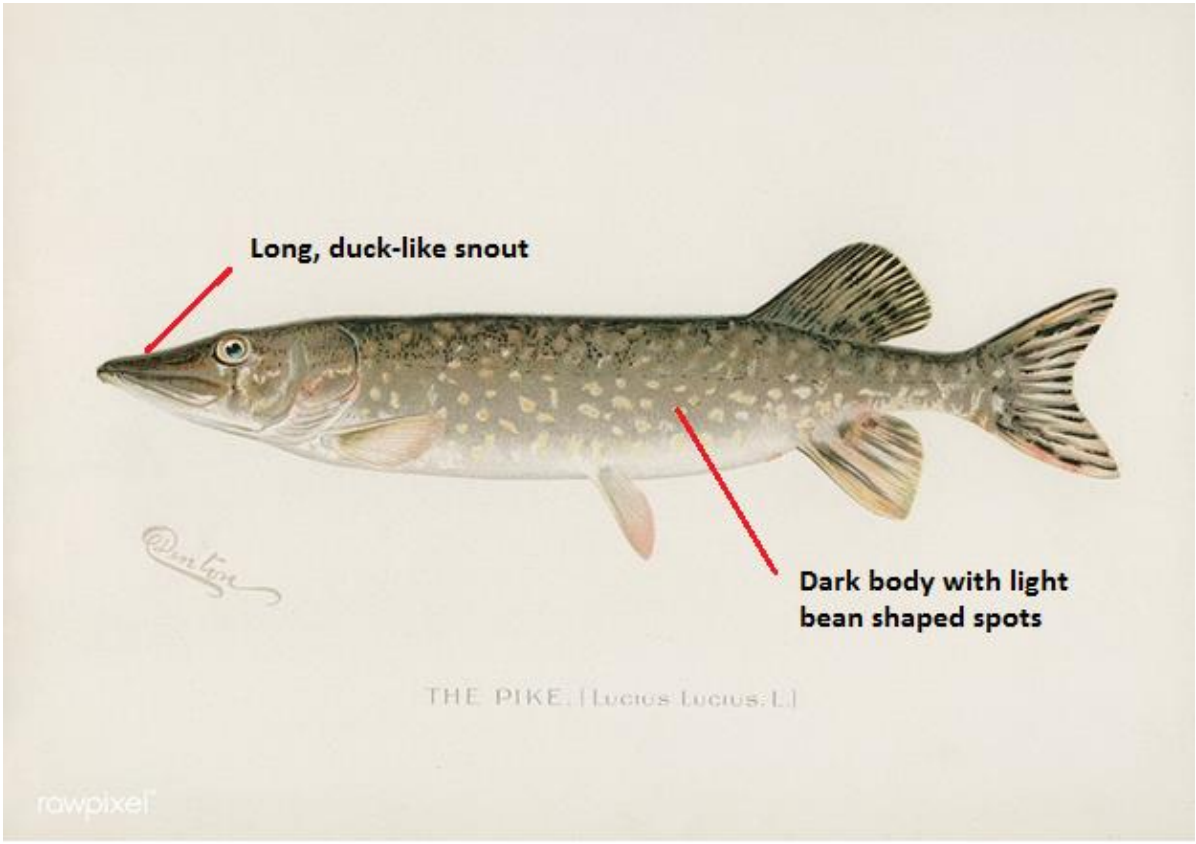
What Differences Do You See?

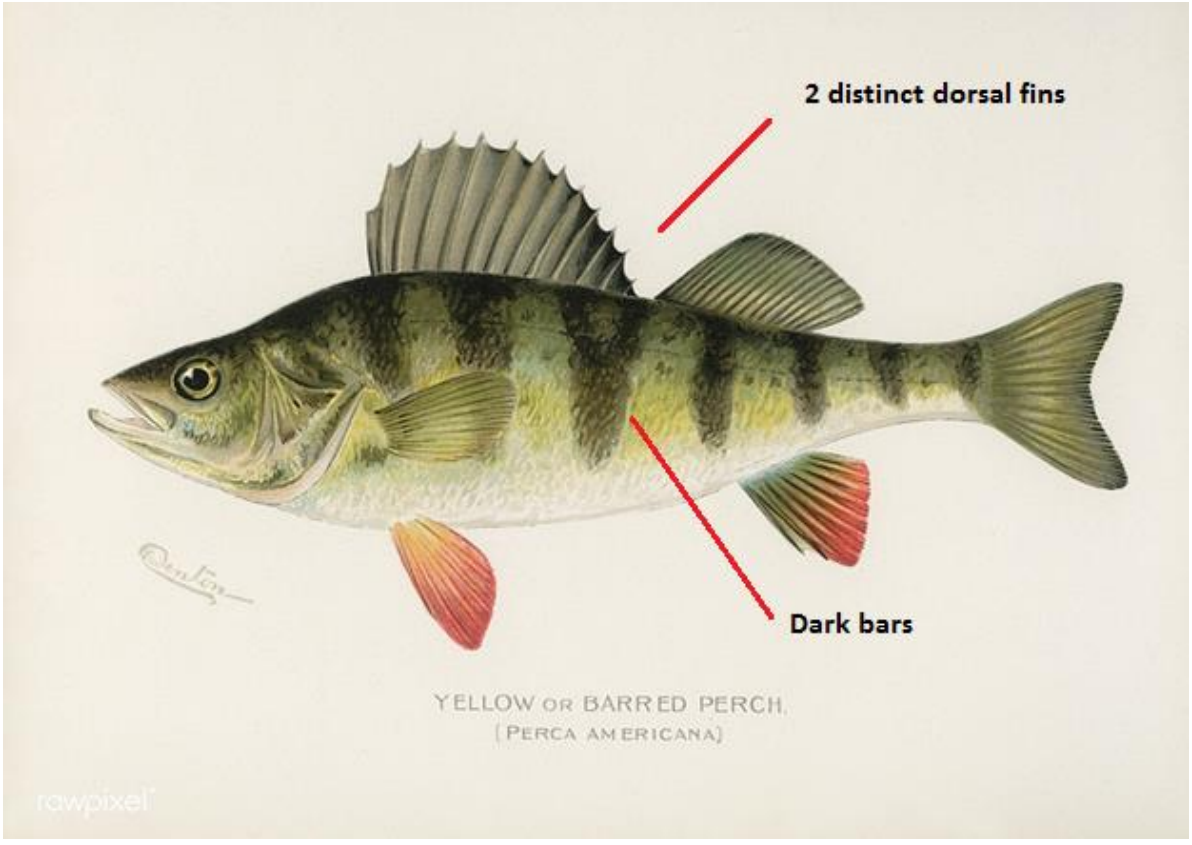


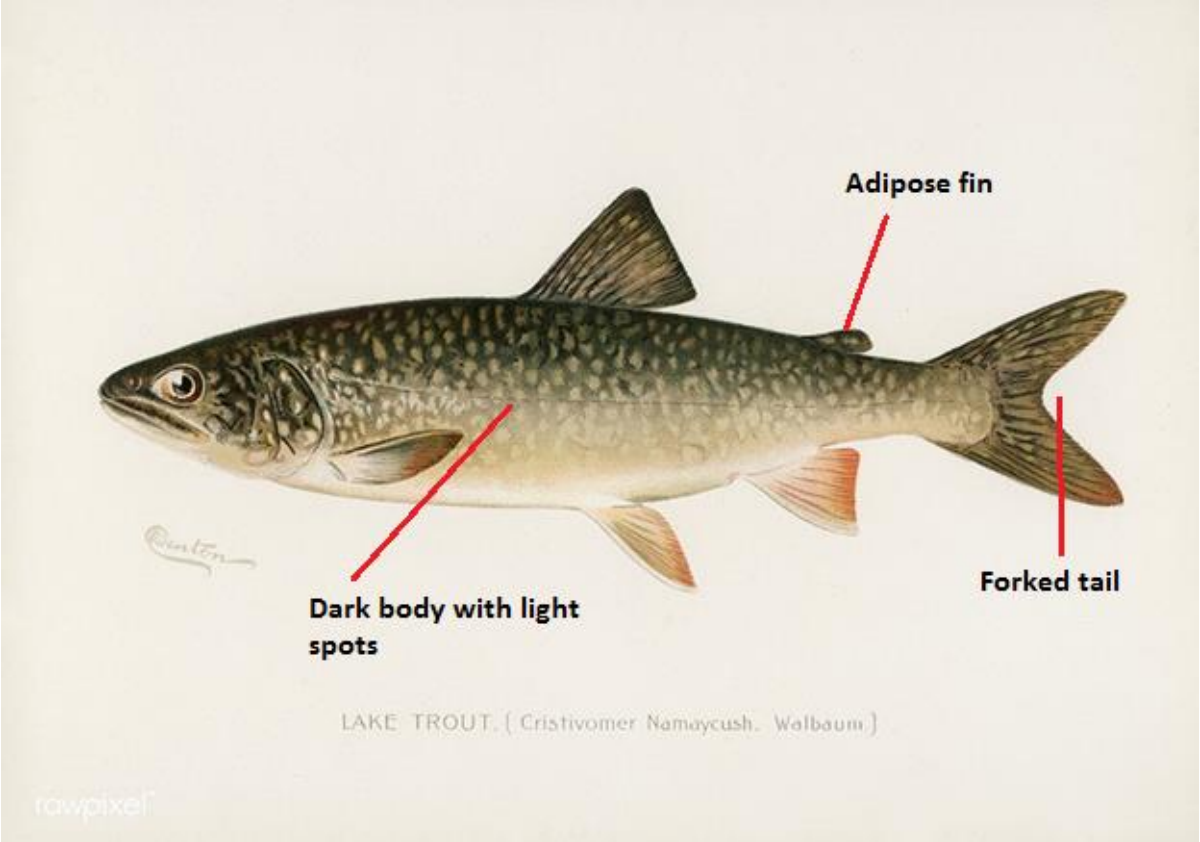
Some Basic Physical Characteristic Differences

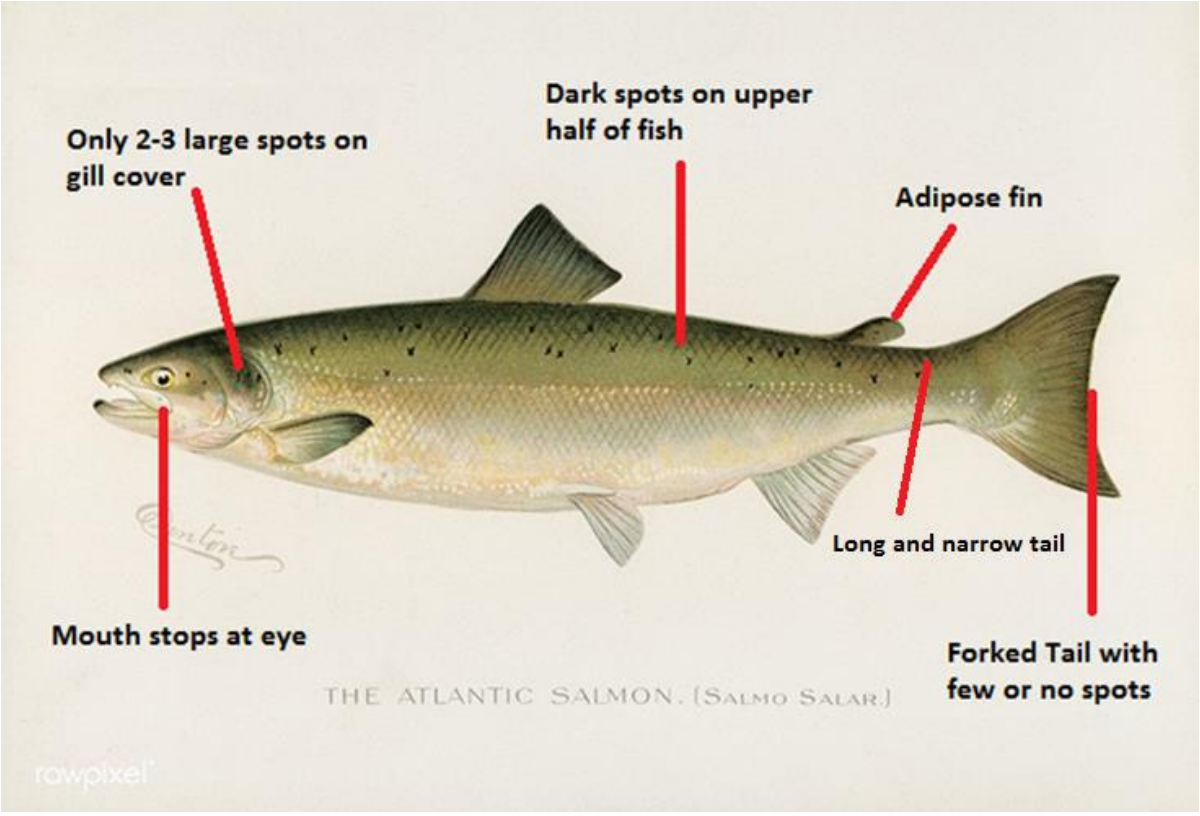




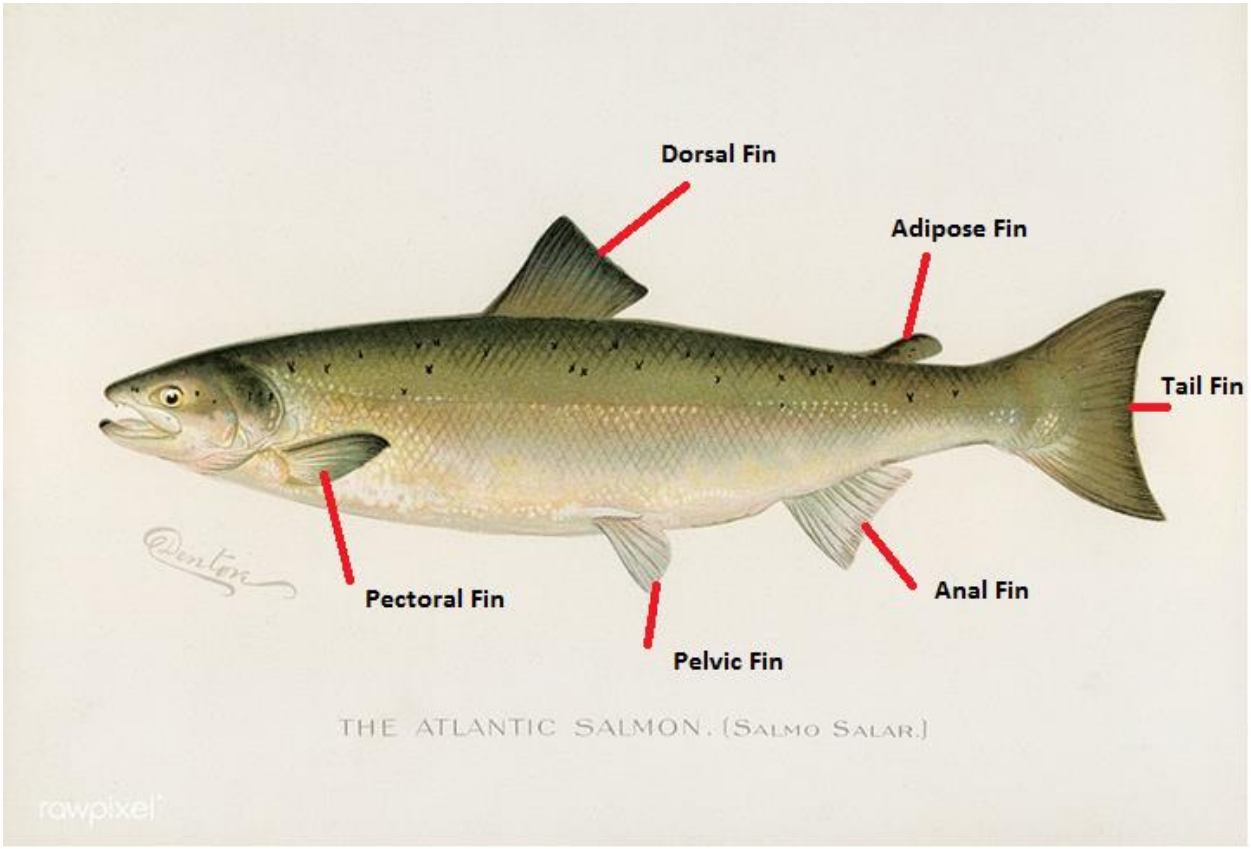

Long, duck-like snout
Dark body with light bean shaped spots
THE PIKE. [Lucios Lucius. L.]


2 distinct dorsal fins
Dark bars
YELLOW OR BARRED PERCH.
[PERCA AMERICANA]


Adipose fin
Forked tail
Dark body with light spots
LAKE TROUT. [Cristivomer Namaycush. Walbaum.]


Only 2-3 large spots on gill cover
Dark spots on upper half of fish
Adipose fin
Long and narrow tail
Mouth stops at eye
Forked Tail with few or no spots
THE ATLANTIC SALMON. [Salmo Salar.]

Fins of a Salmon



Fish Illustrations from Game Birds and Fishes of North America; illustrated by Sherman F. Denton (1856–1937)

Student Name(s):

COPY ME

Meet an Atlantic Salmon

A.

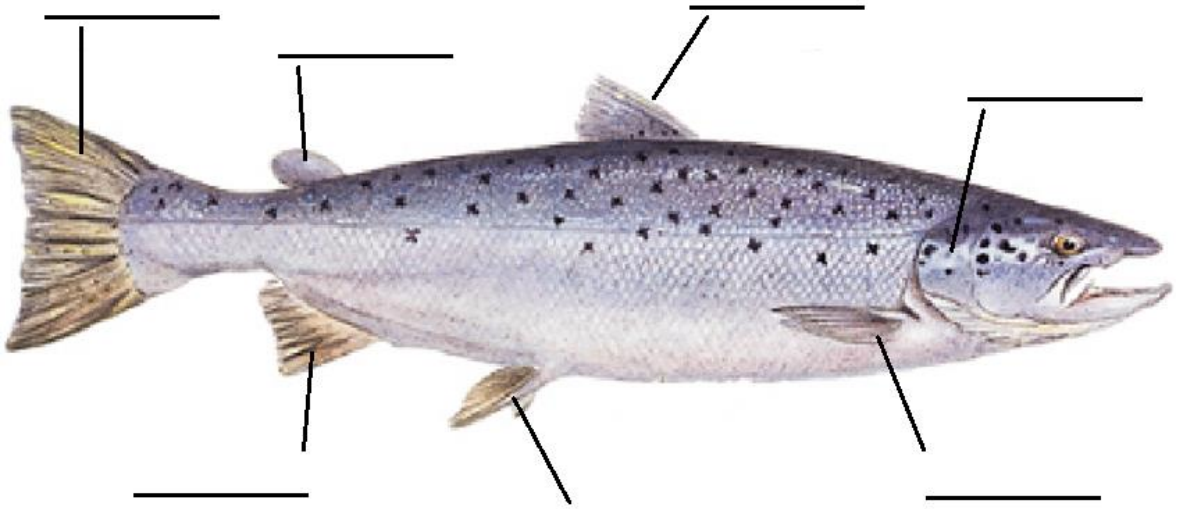


ILLUSTRATION: CURTIS ATWATER
www.natureartists.com/atwaterc.htm

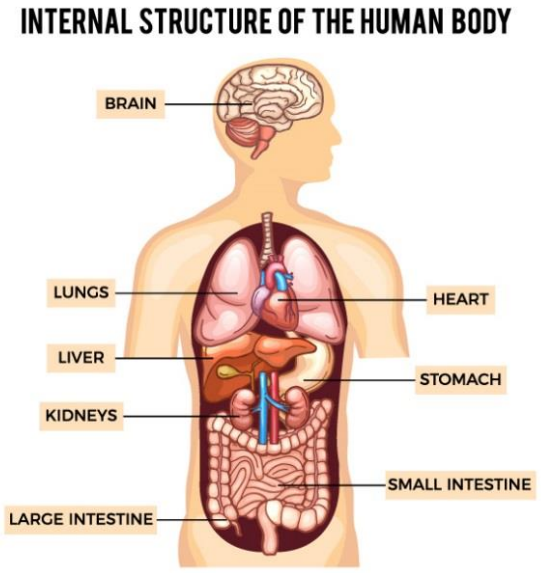
Label the fish above appropriately with the words below:

Anal Fin	Dorsal Fin
Tail Fin	Pelvic Fin
Adipose Fin	Gill Cover
Pectoral Fin	

B.

How is an Atlantic Salmon's organ system like a humans? List 3 organs that humans have that you think a fish also has.

1) _____
2) _____
3) _____

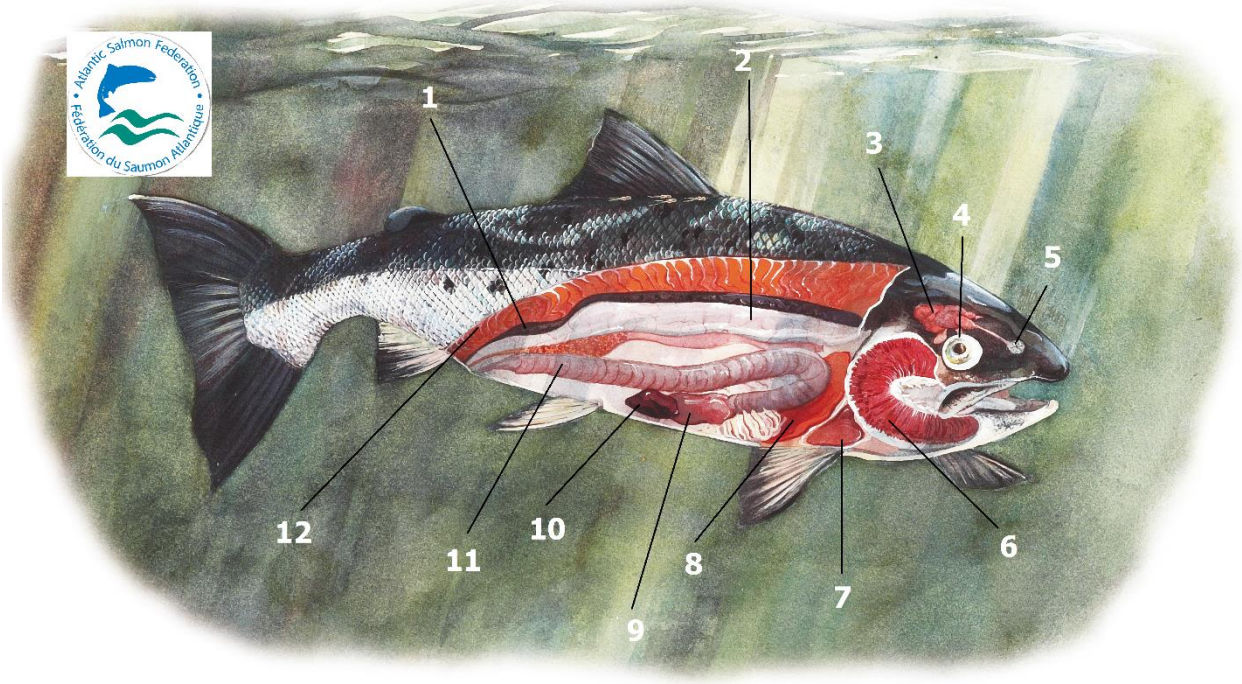


COPY ME

C.	**Word Match**	
A. Heart		*A gas filled sac used to control buoyancy*
B. Gills		*Responsible for part of the digestion*
C. Swim Bladder	K	*Organ responsible for sight*
D. Spleen		*Part of immune system involved in production and removal of blood cells*
E. Olfactory System		*Tissue that enables motion and force*
F. Muscle		*Pump for circulation of blood through the body*
G. Liver		*Centre of the nervous system that controls the body*
H. Kidney		*Tube running from the stomach to the anus where nutrients are absorbed*
I. Stomach		*Organ responsible for the sense of smell*
J. Intestines		*Extracts oxygen from water for respiration*
K. Eye		*Removes waste and regulates water and salt*
L. Brain		*Detoxifies the body and aids in digestion*
Write the letter from each word in front of the correct description.		

D. Fish Organs

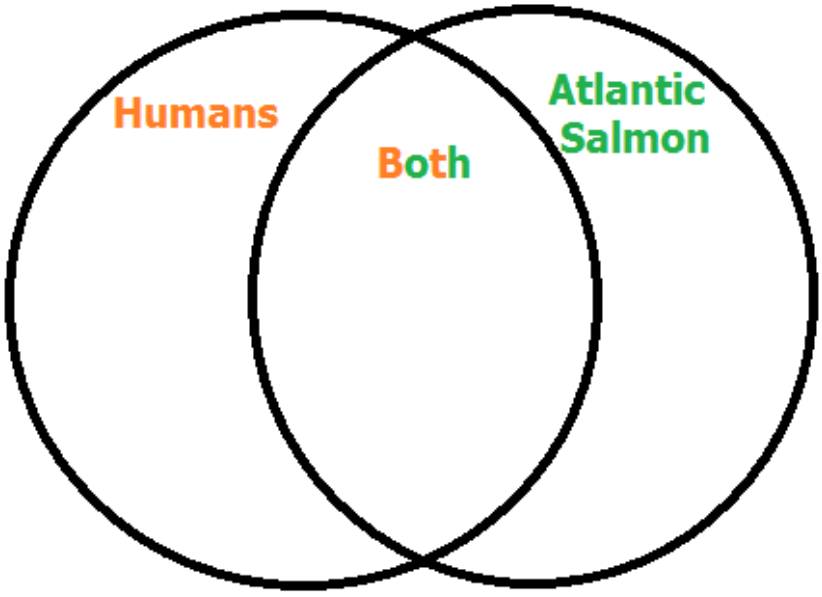
COPY ME



Using the definitions and diagram above try your best to match the numbers in the diagram to the correct organs in this list: Heart; Gills; Swim Bladder; Spleen; Olfactory System; Eye; Muscle; Liver; Kidney; Stomach; Intestines; Brain

1. _____	5. _____	9. _____
2. _____	6. _____	10. _____
3. _____	7. _____	11. _____
4. _____	8. _____	12. _____

E. Compare and contrast anatomy including organs of humans and Atlantic Salmon by listing in the circles to the right. Use the diagrams of the Atlantic Salmon and the human in this activity. What other anatomy can you think of?



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Grade 5 Classroom Hatchery Activities

Lesson 2: Degree Days

Lesson Objectives:

- Understand the relationship between water temperature and growth rate in fish
- Apply math to scientific ideas
- Add and divide numbers that model real-life phenomena

Materials:

- Degree Days worksheet (attached)
- Calculators
- Projector or chalk board to do sample problems

Background

The growth and development of fish is dictated by a combination of time and the temperature of its environment. Most fish are **ectotherms** (there is one known exception). **Ectotherms** (also known as cold-blooded) are animals that rely on the external temperature of their environment to regulate their body temperature. Where and when possible they move to areas where the temperature is warmer or cooler when needed (think about a snake basking in the sun to get more warmth, or a fish hiding in the shade under a log). Atlantic Salmon have body temperatures very close to the temperature of their environment – the water! Other **ectotherms** include reptiles, amphibians, and invertebrates.

Comparatively, humans are **endotherms**, which means we use heat that we generate inside our bodies to regulate our temperature. We are able to maintain a steady body temperature independent of the external environment. We sweat to cool down and shiver to warm up. Other **endotherms** include other mammals and birds.

The term **metabolic rate** refers to how quickly the body's fuels (food) are broken down to provide energy and materials that support growth. An animal's **metabolic rate** will determine how quickly it grows and develops. The **metabolic rate** of an **ectotherm** is largely determined by the ambient temperature of its environment. Generally, **metabolic rate** will increase with temperature until a certain point where the temperature is too high and then the metabolic rate will decrease. Growth will therefore also increase with warmer temperatures up to a certain point.

At the beginning of our classroom hatchery program the temperature is kept low to simulate the winter conditions the fish would experience in a natural environment. Once the eggs hatch (alevin stage) and begin to develop they use their yolk sac for nourishment. In the cold water growth will be slow. If the temperature is increased the alevin will use up their yolk sac more quickly and need to feed. Unfortunately some of the fish will not take to an unnatural food and will starve. Feeding at this point will also cause water quality issues in the tank. For these reasons we keep the tank temperature low until closer to the release day, when we start slowly raising the temperature so that the alevin have used up their yolk and become fry

right before release. It is important to monitor the tank temperature closely so that the fish develop at the proper rate and have the best chance for survival when they are released.

While temperature is one of the most important environmental factors influencing growth rate, other factors also play a part. This may include dissolved oxygen levels, ammonia concentration, salinity, competition for food supplies, food availability, food quality, photoperiod, and age of the fish. The **degree day** method of calculating growth is simplified, showing the relationship between temperature and growth without considering fluctuations in any of these other variables, but it is still fairly accurate. The number of degree days a fish has been alive will determine its development.

Degree Day Calculations

Degree days are calculated by the formula $\boldsymbol{DD = \left(\frac{T_{max}+T_{min}}{2}\right) - T_0}$

The variables in this formula represent:

T_{max} = maximum daily ambient temperature (what was the warmest temperature of your tank today?)

T_{min} = minimum daily ambient temperature (what was the coldest temperature of your tank today?)

T_0 = the base/threshold temperature; a temperature constant under which growth or development is nonlinear and effectively zero, but above which growth begins in a linear fashion. The base temperature for our Atlantic Salmon (*Salmo salar*) is **0°C**.

Sample Degree Day Calculation

Today you are nearing your release date, and you are slowly warming your tank up. After morning announcements your tank was at **7°C**, and you aim for a temperature of **8°C** on your chiller. At the end of the day you check the temperature again, and you have been successful! The tank is now at **8°C**.

Your **T_{min} = 7°C** Your **T_{max} = 8°C**

Your **T_0 = 0°C** (remember this is our constant for Atlantic Salmon)

Now substitute your known variables into the degree days equation and solve!

$$DD = \left(\frac{T_{max} + T_{min}}{2}\right) - T_0$$
$$DD = \left(\frac{8°C + 7°C}{2}\right) - 0°C$$
$$DD = \left(\frac{15°C}{2}\right) - 0°C$$
$$DD = (7.5°C) - 0°C$$
$$DD = 7.5$$

For days when you do not change the temperature of your chiller, the DD value will be equal to the temperature of the tank that day, because the degree day calculation essentially gives

an average of the daily temperature because T_0 is zero. You can demonstrate this to the class by substituting in T_{max} and T_{min} values that are the same. For younger students, a simplified explanation of degree day calculations could be that it is the average or mean temperature of the day, easily calculated by adding the two temperature measurements from the day and dividing by 2.

For **cumulative degree days**, just add the degree days calculated for all previous days. We keep track of **cumulative degree days** because we can use this to estimate the development of our fish. After a certain number of degree days we would expect our salmon to have reached certain milestones such as hatching or finishing their yolk sac. Below is a summary of some important milestones for Atlantic Salmon. Don't be too concerned if your fish don't meet each of the milestones precisely, they are only approximate. While a huge difference between the expected milestones and the actual milestones of your fish can be an indicator of something wrong, there are many factors that could cause this. Make sure all components of the aquarium are functioning, your math was correct for each degree day calculation, and your tank has not suffered any power outages.

Important Degree Day Values for Atlantic Salmon

Milestone	Number of Degree Days Required
From the **beginning of incubation** to **hatching** (how long our salmon will be in the ***egg life stage***)	500
From **hatching** to **first feeding** (how long our salmon will be in the ***alevin life stage***)	285

Based on these degree day milestones, if you have your tank at 5°C to incubate your eggs, it would take approximately 100 days for them to hatch. (Remember that they started incubation in November/December in Harwood Fish Culture Station.) If you incubated your eggs at 10°C, they would take approximately 50 days to hatch. Looking at the alevin life stage, if your tank was held at 7.5°C, it would take approximately 38 days for your salmon to finish their yolk sac and be ready to feed.

Teaching and Learning Sequence

Part A.

1. Present the information in the background section to the students.

Part B. Ask these **Guiding Questions:**

1. How many days do you think it will take for our salmon eggs to hatch? Think about the amount of time they were incubating at the hatchery and the time they have spent in your tank too.
2. How long do you think it will take the salmon to finish their yolk sac? (Answer: it really depends on the temperature of their environment, but any guesses the students have that are close to about 100 days for hatching and 40 days for the yolk sac would be good.)

Part C.

1. Complete a couple sample problems on the chalk board or projector to demonstrate how to use the degree days equation. Explain the whole equation to the students but practice with the simplified version without the constant to subtract. Explain the equation as the average of the minimum and maximum temperature from a given day.
2. Hand out the worksheet and have students work through it.
3. Once all students have finished, take up the answers.
4. Discuss the importance of degree days as you go through the questions, explaining how we can use math to predict when fish are going to reach their milestones.

Part D. Ask these **Reflection Questions** (can be done as a Think, Pair, Share):

1. Why don't we use degree days to look at human growth? (Answer: endotherms vs. ectotherms, humans can regulate their body temperature so the environmental temperature doesn't impact our growth.)
2. Would it be easier to monitor the temperature of wild salmon or hatchery-raised salmon as they grow from eggs to alevin and then fry? Think about how you would monitor the temperature of their environment. (Answer: it would be more difficult in the wild due to more variables affecting the temperature of the water. In a hatchery they can keep the water at a constant temperature.)

Name: _____ Date: _____

Atlantic Salmon Degree Days Worksheet

Degree days are calculated by the formula $\mathbf{DD} = \left(\frac{\mathbf{T_{max}+T_{min}}}{\mathbf{2}}\right)$

The variables in this formula represent:

T_{max} = maximum daily ambient temperature (what was the warmest temperature of your tank today?)

T_{min} = minimum daily ambient temperature (what was the coldest temperature of your tank today?)

1a.) Calculate the following degree day values (the average temperature of each day). They are based on temperatures that you will be increasing your aquarium to before your release date. The first example is done for you.

T_{max}	T_{min}	**Degree Days**
4°C	5°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$ $\mathrm{DD} = \left(\frac{5°\mathrm{C} + 4°\mathrm{C}}{2}\right)$ $\mathrm{DD} = \left(\frac{9°\mathrm{C}}{2}\right)$ $\mathrm{DD} = (4.5°\mathrm{C})$ $\mathrm{DD} = 4.5$
5°C	5°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$

5°C	6°C	$DD = \left(\frac{T_{max} + T_{min}}{2}\right)$
6°C	6°C	$DD = \left(\frac{T_{max} + T_{min}}{2}\right)$
6°C	7°C	$DD = \left(\frac{T_{max} + T_{min}}{2}\right)$
7°C	8°C	$DD = \left(\frac{T_{max} + T_{min}}{2}\right)$
8°C	9°C	$DD = \left(\frac{T_{max} + T_{min}}{2}\right)$

9°C	10°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$
10°C	11°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$
11°C	12°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$
12°C	12°C	$\mathrm{DD} = \left(\frac{\mathrm{T_{max}} + \mathrm{T_{min}}}{2}\right)$

1b.) Pretend that the 11 values calculated in this chart were for the temperatures over the past 11 days. Add them all up to get the cumulative number of degree days over these 11 days. How many degree days is that in total? Show your work.

2a.) **EXAMPLE**: Now that you know from question 1 that the degree day value for a day when the temperature has a maximum and a minimum of 5°C is **5 degree days**, figure out how many days it would take for a fish to reach **285 degree days** if the temperature stayed at 5°C the whole time.

You will have to divide the total number of degree days (285) by the number of degree days your fish gains each day (5).

285 degree days ÷ 5 degree days per day = 57 days.

We count degree days because they tell us when our fish will reach important life milestones. Once the eggs hatch, about 285 degree days later our fish will be done their yolk sac and ready to hunt for their own food! This is when we want to release them into the stream.

2b.) Use the value you calculated in the table in question 1 for a day when the maximum and minimum temperature is **6°C** to see how many days it would take for a fish to reach **285 degree days** (follow the example in 2a).

2c.) Use the value you calculated for a day when the maximum and minimum temperature is **12°C** to see how many days it would take for a fish to reach **285 degree days** (follow the example in 2a).

2d.) How does the number of days required to reach 285 degree days change as the temperature increases? Circle the correct answer.

*As the temperature increases, fish need **more / less** time to reach their degree day milestones.*

Answer Key

1.)

T_{min}	T_{max}	Degree Days
4°C	5°C	4.5
5°C	5°C	5
5°C	6°C	5.5
6°C	7°C	6.5
7°C	8°C	7.5
8°C	9°C	8.5
9°C	10°C	9.5
10°C	11°C	10.5
11°C	12°C	11.5

1b.) 69 degree days

2a.) 285 ÷ 5 = 57

Each day at 5°C equals 5 degree days. So dividing 285 degree days by 5 degree days per day will give an answer of 57 days to reach 285 degree days.

2b.) For 6°C it would take 47.5 days (285 ÷ 6 = 47.5).

2c.) For 12°C it would take 23.75 days (285 ÷ 12 = 23.75).

You can explain to the students that if the temperature stayed at 5°C it would take 57 days after the eggs hatch for the salmon to use up their yolk sac and be ready to feed. This is the ideal time to release the salmon into the stream. If the temperature was warmer, it would take fewer days after the eggs hatch for the salmon to use their yolk sac. We don't want them to use their yolk sac too quickly so we keep the temperature low. We also don't want them to still have their yolk sac when we release them, so we have to make sure the temperature gets increased enough before we release them. We are trying to mimic the temperature of the stream as it warms in the springtime.

Class size:	Unlimited
Setting:	Classroom

BRING BACK THE SALMON
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Grade 5 Classroom Hatchery Activities

Lesson 3: Poster Project

Lesson Objectives:

- Connect students with the story of Lake Ontario Atlantic Salmon and the purpose of the restoration project
- Have the students, in groups, research topics relating to Lake Ontario Atlantic Salmon
- Have the students share their findings with the rest of the class and other classes within the school

Materials:

- Access to computers with internet for research
- 36" high x 48" wide project display board
- Paper, scissors, glue, markers

Background:

Around 12,000 years ago a large sheet of ice from the last glacial period was melting in Canada. Atlantic Salmon swam up the flooded rivers from the Atlantic Ocean and made Lake Ontario home. The waters in the rivers, creeks, and streams were clean and cold.

Atlantic Salmon adults live out in the deep waters of the lake growing big on a diet of fish. Eventually the urge to spawn comes over them and they swim upstream jumping rapids and waterfalls up to 3 metres high! The females search for ideal locations for a "redd"; the males search for females. The ideal redd location consists of a gravel bottom where the female can use her tail to dig a 10-30cm deep nest. The female lays between 2,000 and 8,000 eggs. The male fertilizes the eggs and the female covers the redd with gravel. The eggs start to develop and soon become eyed eggs (you can see the eyes in the egg). A few months after being deposited in the redd the eggs begin to hatch. When the baby salmon hatch from the egg they bring with them a yolk sac attached to their bellies. For the next few months this will be their food. These baby fish, known as *alevin,* are fragile and vulnerable. They hide in the gravel of the redd. The yolk sac is slowly absorbed. Its rate of usage corresponds to water temperature. In warmer temperatures the yolk is absorbed faster. As water warms, small aquatic invertebrates also become abundant which is good for the salmon as once the yolk sac is gone this is their food. These little fish, now known as *fry,* need to hunt for their own food. They hide in the rocks to avoid predators (like bigger fish, birds, and small mammals) and to catch the aquatic invertebrates.

The fry grow larger throughout the summer and develop dark "parr" marks. At this stage they are called *parr*. The parr stay in the stream for 1 – 3 years using the same strategy as the fry – eat and don't get eaten! When the parr get large enough they will become *smolts.* At this life stage they lose the parr marks and turn the more silvery colour of the adult fish. The smolts migrate downstream to the lake to eat fish, grow big, and become adults. When they are ready to spawn they will return to the same place that they were born.

Atlantic Salmon thrived in Lake Ontario and became a major food source for indigenous populations. Lake Ontario Atlantic Salmon were a very important species ecologically and culturally from around 10,000 years ago until they disappeared just over 120 years ago! European settlers started to establish settlements in the Lake Ontario region in the 1700s. They found clean, clear, and cold waters loaded with fish, notably Atlantic Salmon. The rivers, creeks, and streams were surrounded by healthy forests. Settlers benefitted from the bounty of fish. They caught them by the hundreds.

The settlers first started to clear the land of trees for farms and small settlements, then for larger settlements and industry. The loss of the tree cover warmed the water to temperatures that had a negative effect on the development and survival of cold water fish like Atlantic Salmon. Tree roots hold together the soil of riverbanks. With the loss of trees the soil eroded, covering up the gravel beds that the Atlantic Salmon depend on for their eggs and for fry to hide in.

The settlers built dams to power mills, which harnessed the energy of rivers to grind grains and saw logs into boards. The dams created barriers that even the Atlantic Salmon could not get past. Ponds created behind the dams warmed the waters even further.

By the early 1800s people were noticing that this once extremely abundant fish was declining. Efforts to help the population were undertaken throughout the century; however, the combination of overfishing, warmer water, soil erosion, barriers to migration, and increased water pollution was too much. The last of the original Lake Ontario Atlantic Salmon was caught in 1898!

Throughout the 20th and into the 21st century several attempts have been made to bring back Atlantic Salmon to Lake Ontario. Habitat improvements such as tree planting, removal or alteration of dams to allow for fish passage, restriction and regulation of pollution, education, fishing regulations, and stocking (raising fish in a hatchery and releasing them) will hopefully re-establish a naturally reproducing population!

Teaching and Learning Sequence

Part A. Ask the students:

1. What do they know about Atlantic Salmon?
2. Where did Atlantic Salmon come from?
3. How did they get to Lake Ontario?
4. What are the habitat needs of Atlantic Salmon?
5. Why are we hosting a classroom hatchery?

Part B. Introduce the poster project as a way that as a whole class the students will research various aspects of Atlantic Salmon. They will teach each other and other classes and display this information in the classroom.

- Divide the class into 6 groups:
    1. Biology
    2. Geography
    3. History – Cultural
    4. History – Extirpation
    5. Habitat
    6. Restoration
- Give each group their research questions (below). Inform them that each group will be putting their section together with the other sections on the presentation display.
- Internet resources containing the information they will need is included in each group assignment.
- Each group will elect one member to join the "display committee". This committee will work together to decide on a layout to display the work of the 5 groups and to add a title to the board.

Part C. Presentation

- When all sections are complete and glued to the board each group will take a turn presenting their section to the class;
- At the end of each section students and teacher ask questions about the topic. The group answers the question if they can.
- The group records relevant questions. If they do not know the answer they go back to research.
- Once all groups have presented and answered questions, invite other classes, higher and lower, to come in and observe the presentation.
- Display project board near the classroom hatchery.

GROUP 1: **Biology**

Mission: Your group will be researching components related to the biology of Atlantic Salmon. Your tasks are listed below.

- Research the following:
  1) Name 1 identifying feature of salmon.
  2) List 3 features that differentiate Atlantic Salmon from other salmon.
  3) Describe the life cycle of an Atlantic Salmon.
- Include 2 diagrams: These diagrams can be pictures from the internet or hand drawn.
  1) One diagram showing identification of an Atlantic Salmon.
  2) One diagram showing the life cycle of Atlantic Salmon.

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title); OFAH Salmon School Grade 5 Lesson 1 "Meet an Atlantic Salmon".

GROUP 2: **Geography**

Mission: Your group will be researching components related to the geography of Atlantic Salmon. Your tasks are listed below.

- Include 2 diagrams: These can be printed or hand drawn.
  1) One range map showing the global distribution of wild Atlantic Salmon. On this map identify your location ('we are here').
  2) One map showing the restoration river where your classroom fish will be released (ask your teacher where your release takes place). Identify on the map the location of your school, the location of your release site, and the river pathway from the release site to Lake Ontario that your fish will travel when they old enough (when they are smolts).
- Research the following:
  1) The names of 5 countries shown within the global distribution on the range map.
  2) The name and population of the largest urban area that your release stream passes through.

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title); google maps.

GROUP 3: **History – Cultural**

Mission: Your group will be researching components related to the cultural history of Atlantic Salmon. Your tasks are listed below.

- Include 2 diagrams:
  1) One picture showing a cave carving of an Atlantic Salmon.
  2) One picture of a human catching a fish.
- Research the following questions:
  1) How old is the cave carving?
  2) Where is the cave carving?
  3) When did Atlantic Salmon start to live in Lake Ontario?
  4) How were Atlantic Salmon important to people of the Lake Ontario region?

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title); google search.

GROUP 4: **History – Extirpation**

Mission: Your group will be researching components related to the extirpation of Atlantic Salmon. Your tasks are listed below.

- Include 2 diagrams:
  1) One picture showing a human made dam on a river.
  2) One picture showing pollution of a waterway.
- Research the following questions:
  1) When did Atlantic Salmon disappear from Lake Ontario?
  2) What led to their extirpation? (list 4 reasons).

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title); google search.

GROUP 5: **Habitat**

Mission: Your group will be researching components related to the habitat of Atlantic Salmon. Your tasks are listed below.

- Include 2 diagrams:
  1) One picture showing an ideal creek for Atlantic Salmon.
  2) One showing a prey species that Atlantic Salmon eat.
- Research the following:
  1) Name and describe two distinct habitats that Atlantic Salmon require.
  2) Name 2 elements that make habitat ideal for juvenile Atlantic Salmon.
  3) List 3 prey species that Atlantic Salmon eat.

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title).

GROUP 6: **Restoration**

Mission: Your group will be researching components related to the restoration of Atlantic Salmon habitat. Your tasks are listed below.

- Include 2 diagrams:
  1) Two pictures showing people participating in a restoration project.
- Research the following:
  2) List six ways in which habitats can be restored.
  3) List 2 ways in which you, or anyone in your class could get involved in restoring the health of Atlantic Salmon habitat.

Resources: Bring Back the Salmon website; Nature Conservancy of Canada website (search Lake Ontario Atlantic Salmon); American Salmon Federation website; The Atlantic Salmon in the History of North America by R.W. Dunfield (google search title).

Class size:	Unlimited
Setting:	Classroom

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Grade 5 Classroom Hatchery Activities

Lesson 4: A day in the Life of a Salmon

Lesson Objectives:

- Connect students with the life story of Lake Ontario Atlantic Salmon
- Have the students write a short story from the perspective of an Atlantic Salmon, choosing a life stage from the salmon's life cycle
- Engage imagination and creativity
- Have the students share stories

Materials:

- Lined paper
- Pens/pencils

Background

Adult Atlantic Salmon live out in the deep waters of the Atlantic Ocean or in large lakes where they grow big on a diet of fish. Eventually the urge to spawn comes over them and they swim upstream jumping rapids and waterfalls up to 3 metres high! At this time they eat less and change colour from light and silvery to a deep bronze. Reddish spots may appear on the head and body. The head of the male elongates and the lower jaw becomes enlarged and hooked. This hook is called a kype.

The females search for ideal locations for a "redd"; the males search for females. The ideal redd location consists of a gravel bottom where the female can use her tail to dig a 10-30cm deep nest. The female lays between 2,000 and 8,000 ***eggs***. The male fertilizes the eggs and the female covers the redd with gravel. The eggs start to develop and soon they become ***eyed eggs*** (you can see the eyes in the egg). A few months after being deposited in the redd the eggs begin to hatch. When the baby salmon hatch from the egg they have a yolk sac attached to their bellies. For the next few months this will be their food. These baby fish, known as ***alevin,*** are fragile and vulnerable. They hide in the gravel of the redd. The yolk sac is slowly absorbed. Its rate of usage corresponds to water temperature. In warmer temperatures the yolk is absorbed faster. Once the yolk sac is gone these little fish, now known as ***fry,*** need to hunt for their own food. As temperatures warm, small aquatic invertebrates also become abundant which is good for the fry as this is their food. The fry hide in the rocks to avoid predators (like bigger fish, birds, and small mammals) and to catch the aquatic invertebrates.

The fry grow larger throughout the summer and develop dark "parr" marks. At this stage they are called ***parr***. The parr stay in the stream for 1 – 3 years using with the same strategy as the fry – eat and don't get eaten!

When the parr get large enough they will become ***smolts.*** At this stage they lose the parr marks and turn the more silvery colour of the adult fish. The smolts migrate downstream to the lake to eat fish, grow big, and become adults. When they are ready to spawn they will return to the same place that they were born.

Teaching and Learning Sequence

Part A. Ask the students:

1. What would it be like to be an Atlantic Salmon?
2. What hazards and hardships do Atlantic Salmon face?

Part B. Engage their senses:

- Encourage the students to imagine themselves as an Atlantic Salmon. Have them close their eyes and imagine the cool water and the pull of the current on their skin; take a deep breath and smell the water; see under a log and beside a large rock; watch other fish swim by; etc.
- Describe the life cycle story in the background above.
- Have the students select a life stage and write a short (4 – 6 paragraphs) story about a day in a life of the fish. Elements of the story could include hunting for food, avoiding a predator, getting past an obstacle to migration, or interacting with another fish. They can also choose names for their fish.

Part C. Share:

- Ask a few of the students to share their story with the class.

Class size:	Unlimited
Setting:	Classroom

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Grade 5 Classroom Hatchery Activities

Lesson 5: Stewardship Discussion

Lesson Objectives:

- Familiarize students with the idea of environmental stewardship and encourage them to be caretakers of the natural world
- Engage the students to think of ways in which they can help restore and maintain the health of the habitats that supports the Atlantic Salmon
- Have the students participate and practice respectful discussion and decision making

Materials:

- Bristol board
- Coloured construction paper
- Lined paper
- Pens, pencils, markers

Background

Human activity has changed the world and some of these changes have resulted in severe ecological degradation.

When European explorers first arrived in the Lake Ontario region, the rivers were teeming with Atlantic Salmon. These fish had arrived around 11,000 years earlier. The explorers met Indigenous Peoples who had been living in the area for thousands of years. These people had developed deep and important relationships with the land, waters, and other living things where they lived, fished, and hunted. They were active members of the ecological communities that surrounded them. They took care of the environment that took care of them.

Accompanying the explorers were a number of diseases and viruses that were foreign to the Indigenous Peoples. This, combined with wars that followed the Europeans to the New World, resulted in a large decline in the population of Indigenous Peoples in the region. European settlements started to establish in what is now Ontario in the mid-1700s. Major waves of immigration flooded into the area in the late 1700s/early 1800s. Many of the new settlers did not have the relationship with the natural environment that the Indigenous Peoples had. Large changes to the health of the land and water started to happen quickly. Forests were cut for timber, heating, cooking, and to make room for farming and dwellings. The deforestation removed habitat for terrestrial wildlife, warmed streams, and allowed soil to wash from the land into the waterways.

During the 1700s the Industrial Revolution brought in a new era of manufacturing of textiles and lumber products. To power this manufacturing, mills were built along the rivers to utilize the power of the moving water to turn the mills. Dams were built to facilitate the mills. The

dams caused further warming of the water and created barriers to the movement of fish. Many Atlantic Salmon were cut off from their spawning grounds.

The abundance of fish (and wildlife, and trees) led to a mindset that the natural resources of the Americas were inexhaustible. Within a time span of 100 years, animal populations plummeted; some species disappeared completely. Atlantic Salmon disappeared from Lake Ontario in the late 1800s.

Deforestation, dams, pollution, and overfishing resulted in the extirpation (local extinction) of Atlantic Salmon from Lake Ontario. However human impacts on the environment need not only be negative. With awareness and a desire to make things better we can restore the health and integrity of the world around us. This has many benefits for humans and for the wide range of biodiversity that we share this planet with. We can restore our deep relationship with the natural world and become good caretakers of the environment that takes care of us – all of our food, drinking water, clothing, building materials, and all other products ultimately come from the earth!

Environmental stewardship means taking care of the environment. Author and wildlife ecologist Aldo Leopold coined the phrase "land ethic" which states that humans have a moral responsibility to care for nature. Environmental stewardship and restoration ecology are critical pieces of the project to bring back the Atlantic Salmon.

Good environmental stewardship involves becoming a positive member of the ecological community and has benefits for the environment and for the steward. The health of habitats can be improved to help support greater biodiversity and abundance. Humans benefit from healthier water, food, and air; increased and improved recreational opportunities; and on an individual level a sense of accomplishment, involvement, self-worth, purpose and belonging.

Teaching and Learning Sequence

Part A. Share the information in the background.

Part B.

1. Break the class into 5 groups.
2. Write on the top of the bristol board "Stewardship Actions to Help the Atlantic Salmon".

Part C.

1. Give each group one of the questions (below) to discuss as a group.
2. Each group writes down their question at the top of their coloured paper.
3. Each group discusses their questions and makes a list of stewardship actions they can take, e.g. pick up garbage near a stream.
4. As a group choose their best 3 actions.
5. Once all groups are done, one group at a time goes to the front of the room and reads the class their question followed by their selected actions.
6. The group tapes their coloured sheet on the bristol board before taking their seat.
7. Display the board by the hatchery unit.

Discussion Questions

1. What can individuals (you) do to help Atlantic Salmon survive and thrive?

2. What can your school do to help Atlantic Salmon survive and thrive?

3. What can communities do to help Atlantic Salmon survive and thrive?

4. What can governments do to help Atlantic Salmon survive and thrive?

5. Why should people be involved in environmental stewardship?

Class size:	Unlimited
Setting:	Outdoors or gym

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Grade 5 Classroom Hatchery Activities

Lesson 6: Who's Eating Who

Lesson Objectives:

- Connect students with the predator-prey community that Lake Ontario Atlantic Salmon live with
- Familiarize students with food webs
- Assist students in participating in a dynamic and active game developing personal and interpersonal skills

Materials:

- 30 small items to be used as salmon eggs such as ping pong balls, stones, or pieces or paper
- Rope, pylons, mats or similar, to designate as "safe spaces" x 3

Background

Adult Lake Ontario Salmon live in the open waters of Lake Ontario. In the fall they travel up streams to spawn and lay eggs. In doing so they bring nutrients from the lake ecosystem into the stream ecosystem in the form of eggs that they lay in the stream spawning beds. These eggs may become food for a variety of animals in the creek. Eggs that survive hatch into juvenile salmon that may become food sources for many different fish, mammals, birds, and reptiles.

The growing juveniles depend on aquatic invertebrates as a food source. If they survive to become smolts they migrate downstream to the lake. As they gain size there are fewer animals capable of predating on them, especially when the fish are in deep water away from aerial predators such as osprey and bald eagle. When the adults return to the streams to spawn they are more exposed to predation from mammals such as otters. Where tree cover isn't thick aerial predators like osprey and bald eagles may take them.

Throughout its whole life, an Atlantic Salmon's greatest threat comes from humans! Humans degrade and destroy the environment and overharvest fish.

Teaching and Learning Sequence

Part A. Share this **quote:** "When we try to pick out anything by itself, we find it hitched to everything else in the Universe." John Muir, Naturalist and Author.

Part B. Ask these Guiding Questions:

1. What does the above quote mean? Are you part of this connection? How?
2. What is prey? What is a predator? Name some species. Can they be both?

Part C.

1. Select an activity area. An area (50mx100m – 100mx100m) of open or lightly forested area is ideal; however a gym can also be used. Prior to class, explore the area to ensure that it is free of hazards such as sharps and toxic plants. Identify any tripping hazards. Also be aware of areas that may be habitat for ticks.
2. Making sure the students are appropriately dressed for the conditions, proceed to the play area. Point out tripping and other hazards.
3. Describe the habitat, predator, and prey relationship of Atlantic Salmon from the background section.
4. Explain the instructions of the game as described below.
    a. The objective of this game is to collect the most prey at your home base. Each predator species (juvenile salmon, bass, and osprey) will have a home base and will be hunting (tagging) their prey. Prey that is tagged will be taken to the predator's home base. Juvenile salmon and bass are both a predator and a prey species in this food web, so they will have to be careful when they're hunting for food that they aren't caught by their predator. Adult salmon have to watch for osprey as they bring their eggs to the spawning ground. Since this is their spawning run, adult salmon will not be eating, they will be relying on stored energy to get as many eggs to the spawning ground as they can. Juvenile salmon can eat aquatic invertebrates. Bass can eat eggs, juvenile salmon, or aquatic invertebrates. Osprey can eat bass or adult salmon.
    b. Divide the students into the following groups: aquatic invertebrates (inverts); juvenile salmon; adult bass; adult salmon; and osprey. Assign more students as invertebrates, reducing the numbers through each group to osprey (eg. 8,6,4,3,2).
    c. Using the rope or pylons designate a "safe" home base for the juvenile salmon and another separate one for the bass. The osprey also get a home base. Choose one end of the play area to designate as the lake for the adult salmon (they are safe in this area) and a spot on the opposite end as the spawning bed.
    d. The juvenile salmon will be hunting inverts and bringing them back to their base; bass will be hunting eggs (one at a time and must be brought back to their base), juvenile salmon and inverts; osprey will be hunting bass and adult salmon. Adult salmon are bringing eggs (use the ping-pong balls, stones, or paper) from the lake to the designated spawning bed, one at a time (in reality the females lay between 2,000 and 8,000 eggs in the creek). When a student is tagged they must be brought back to the predator's home base for keeping score. Play until all students are caught. See how many eggs survive! Play multiple rounds, switching up roles as time allows.

Part D. Ask these **Reflection Questions** (can be done as a Think, Pair, Share):

1. What would happen if one or more species were removed?
2. How do salmon impact the creek community?
3. How does the biodiversity of the creek affect the resilience of the community?