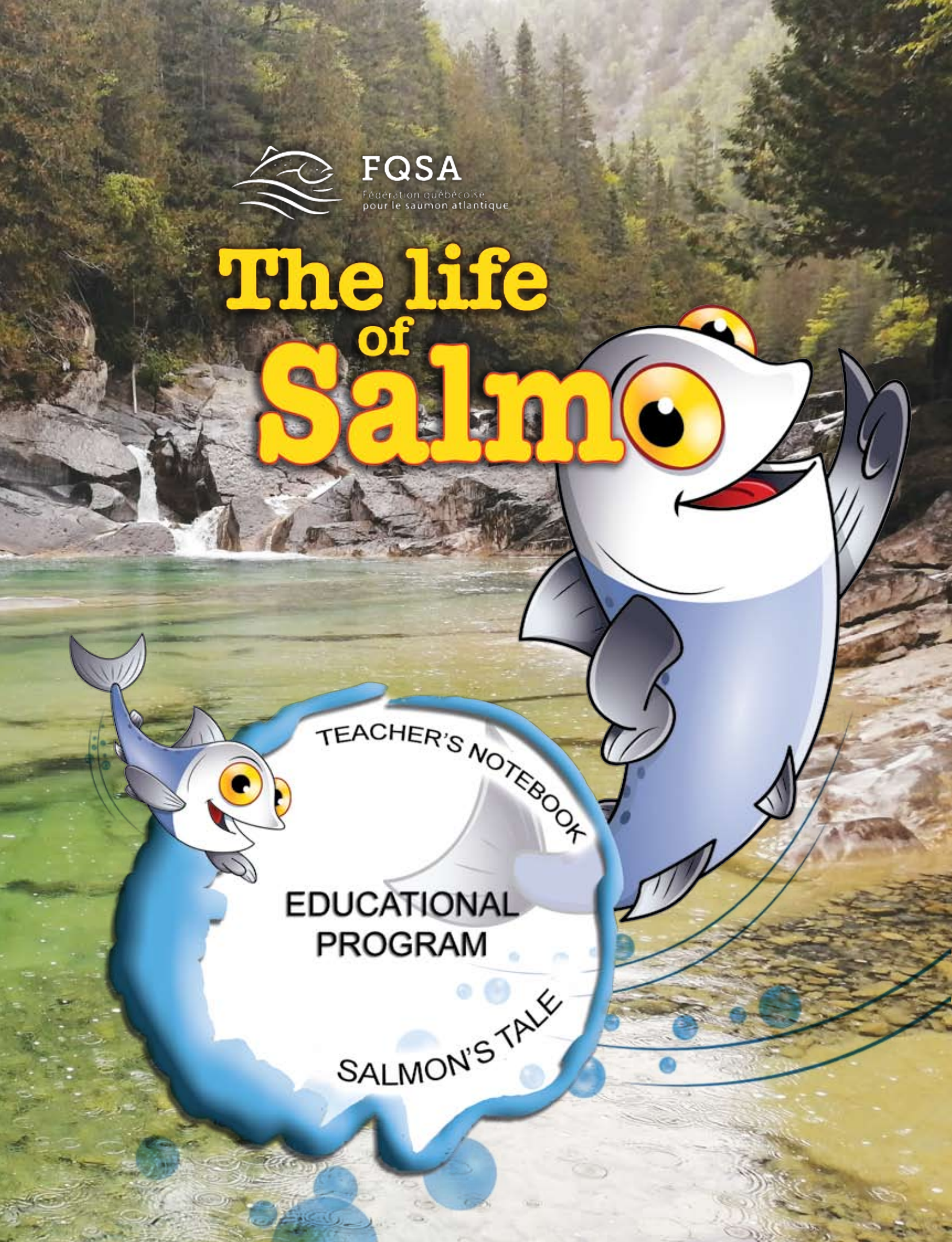
FQSA
Fédération québécoise pour le saumon atlantique

The life of Salmo



TEACHER'S NOTEBOOK

EDUCATIONAL PROGRAM

SALMON'S TALE

THANK YOU TO ALL OF OUR PARTNERS IN THE FIELD WHO MAKE IT POSSIBLE FOR SALMO TO LIVE IN SO MANY RIVERS HERE IN QUEBEC!

Aquamérik

Association de gestion halieutique autochtone Mi'gmaq et Malécite (AGHAMM)

Association forestière de la Gaspésie (AFG)

Conseil de l'Eau du nord de la Gaspésie (CENG)

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Organisme des bassins versants de Kamouraska, L'Islet et Rivière-du-Loup (OBAKIR)

Société de gestion de la rivière Matane (SOGERM)

Société de gestion des rivières de Gaspé

Société saumon de la rivière Romaine (SSRR)

Station Piscicole de Tadoussac et de Coaticook (MFFP)

And to all the extraordinary teachers and volunteers that continue to tell the story of salmon.

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You can follow us on our website **www.saumonquebec.com** and our **Facebook** page to be up to date with the latest news!

Table of contents

1. Learning objectives

1. Introduce students to the life cycle of Atlantic salmon
2. Become aware of the Atlantic salmon environment
3. Raise student accountability and awareness of the environment and the issues associated with it

2. Summary of the topic

1. Knowing some of the characteristics of Atlantic salmon
   - Salmo salar: from the Latin word salire, which means "leaper"
   - Anadromous fish: they live in the ocean (salt water) and return to the river (fresh water) to reproduce
2. Naming the different stages of the Atlantic salmon life cycle
   - Spawning
   - Eggs and Incubation
   - Alevins & Fry
   - Parr
   - Smolt and outmigration
   - Large salmon and migration
   - Kelts
3. Describing the characteristics of the Atlantic salmon spawning period
   - The spawning period is the time of reproduction
   - Happens in the fall

- Upstream of the rivers, on spawning grounds
- Spawning areas typically have fast and shallow water flowing over gravel and pebbly riverbeds

4. Describing the characteristics of Atlantic salmon eggs
   - Orange color
   - 5 to 7 mm in diameter
   - 1500 to 1600 eggs per kg of body weight
   - The liquid inside the yolk sac is called vitellus
5. Describing the characteristics of the Atlantic salmon egg incubation period
   - During the winter, between 70 and 160 days depending on the water temperature
   - On the spawning grounds
6. Discussing the concept of hatching and degree days
   - Spring hatch
   - On the spawning grounds
   - The daily sum of water temperatures (degree days) is used to predict when the eggs will hatch
   - Eggs will remain in the incubation period for 429 degree days
7. Describing the characteristics of Atlantic salmon in the fry stage
   - Fry are born in the spring
   - In the river
   - They are called alevins or sac fry after hatching:
     - They measure from 2 to 4 cm in length
     - The alevin feeds from its attached yolk sac
     - The liquid inside the yolk sac is called vitellus

- The alevin remains hidden in the riverbed gravel for 5 to 6 weeks until the yolk sac is resorbed
- Fry then go on to feed on microorganisms such as zooplankton
- Fry compete with one another

8. Describing the characteristics of Atlantic salmon parr

- Fry become parr late in their first summer
- They live in the river
- Measure 4 to 12 cm
- Remain parr for 1 to 3 years
- Spend winter hiding under big rocks

9. Recognizing the differences between parr and brook trout (also known as speckled trout)

- Parr: no marks on dorsal fin, forked tail, black spots on the opercula, corner of the mouth in line with the center of the eye
- Brook trout: black marks on dorsal fin, tail is nearly flat, no speckles on the opercula, corner of the mouth goes beyond the eye

10. Describing the characteristics of a smolt

- They measure from 12 to 20 cm
- Silver color
- Smolts are the equivalent of adolescent salmon. They will change color and take on the appearance of adult salmon as they head out to the ocean

11. Describing the outmigration of smolts

Period when smolts leave their native river

- In the spring, after spending 2 - 3 years in the river
- They will head out to sea in the North Atlantic to

find the ocean's main feeding area near the coast of Greenland.

12. Describing some of the characteristics of grilse and large salmon, and their different migration routes
    - Grilse :
        - o One-sea winter (1SW)
        - o 50 to 63 cm long
        - o Predominantly males
        - o Migration to Newfoundland
    - Large salmon :
        - o Multi-sea winter (MSW)
        - o More than 63 cm long
        - o Up to 1.83 meters
        - o Migration to Baffin Island and Greenland

13. Describing the characteristics of the salmon run
    - Salmon return to their native river to spawn
    - Between June and September
    - Salmon are silver upon returning to the river
    - Salmon do not feed while in the river, rather they live off the food reserves made in the ocean

14. Explaining how salmon can find the way back to their home river
    - Salmon can find the way back to their native river using their sense of smell (olfactory memory)

15. Knowing how to differentiate males and females during the spawning season
    - Male
        - o Bright colors, ranging from green and yellow, to orange and red
        - o The lower jaw develops into a hook-like shape (kype)
    - Female
        - o Colors are less vivid, ranging from brown to green, some-

times grayish

16. Describing the post-reproduction period

- After spawning, kelts are also referred to as "black salmon" due to their darker color.
- Kelts can stay in the river over the winter and migrate back out to the ocean in the early spring.
- Unlike Pacific salmon, which will all die after spawning, Atlantic salmon may return to spawn more than once (fewer than 10%) after being back out into the ocean again.

17. Depicting the survival rate of wild Atlantic salmon

- • Survival rate: number of individuals out of 100 that survive to the next life stage:
  - Eggs-Fry (alevins): 6%
  - Fry-Parr: 24%
  - Parr-Smolts: 42%
  - Smolts-Adult salmon: 8%

18. Identifying the salmon's life cycle stage from one of its scales

- The space between growth rings corresponds to the intensity of growth. The larger the space, the stronger the growth.
- Line concentrations correspond to winters at sea and help in determining the age of salmon.

3. Disciplinary and subject-specific competencies

1. English
   - Reads and understands various types of texts
   - Writes various types of texts
   - Interacts orally

2. Mathematics, science and technology
   - Solves a situational problem
   - Applies mathematical concepts and processes
   - Proposes explanations for or solutions to scientific or technological problems
   - Communicates in the languages used in science and technology
   - Makes the most of scientific and technological tools, objects, and procedures

3. Personal development
   - Takes an informed stand on situations involving a moral issue
   - Discusses and debates issues of moral concern

4. Subject-specific competencies and time required for each activity

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Activité	Temps requis (période)	Compétences disciplinaires
Sais-tu qui je suis ?	¼	Français Sciences de la nature
L'étymologie des mots	½	Français
Quelques prédictions	½	Mathématiques
L'éclosion des œufs	½	Mathématiques Français Sciences de la nature
Les alevins vésiculés	½	Français Sciences de la nature
Omble ou tacon ?	½	Mathématiques Français Sciences de la nature Bricolage
Salmo grandit	½	Français Sciences de la nature
L'alimentation de Salmo	½	Sciences de la *nature*
Le saumon voyageur	½	Géographie Sciences de la nature
Mâle ou femelle ?	¼	Sciences de la nature
La vie de Salmo	1	Français Sciences de la nature
Mon écaille raconte ma vie	1	Mathématiques Français Sciences de la nature
La survie de Salmo	1	Mathématiques
Un peu d'histoire !	½	Français Histoire
Qui suis-je ?	½	Français Sciences de la nature
Mise en situation « le conflit environnemental	1½	Français Sciences de la nature

5. Role-playing activity

This role-playing exercise is meant to stimulate students prior knowledge about salmon. It also helps spark students interest and curiosity about one of our most precious natural resources, the Atlantic salmon.

Some students living in certain rural areas may have family members who work or have worked on a salmon river. Others might know someone who is a salmon angler or might even have been introduced to salmon fishing by a close family member or friend.

We suggest that you introduce the subject by asking a few questions to the classroom :

- Have you ever heard of Atlantic salmon? What do yo know about this species?
- Have you ever seen salmon at the grocery store? Is it always the same kind (or species) of salmon?
- Have you ever eaten Atlantic salmon?
- Is it a fish that lives in the ocean, in a lake, or in the river?
- Are there any salmon near where you live?
- Can you draw an Atlantic salmon?

You can invite students to come forward and show their drawing, you can draw a salmon on the board or you can hang the drawings on the wall, and you can repeat this exercise later to see how their drawings and their depiction of salmon have evolved.

- What do you know about the life cycle of Atlantic salmon?
- What would you like to know or find out about them?

6. A description of Salmo salar

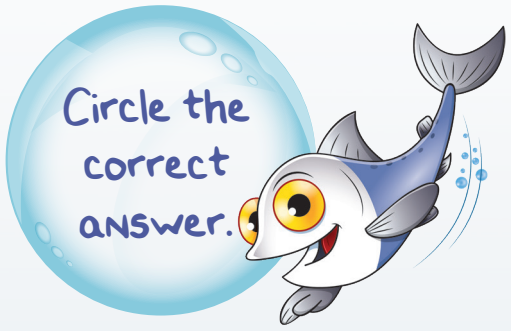
Salmo salar is the scientific name for Atlantic salmon. Both names, genus and species, come from the Latin word salire, which means "leaper", as in when the salmon moves up the river and over waterfalls. Everywhere in the world we use Latin in scientific naming for species. It serves as a way to avoid translation errors between languages.

The name for Atlantic salmon is built somewhat like our own: its first name is salar, which is specific to the species, and Salmo is its family name, or genus. Other species of fish have the same family name, such as brown trout - Salmo trutta.

The Atlantic salmon's life cycle causes it to spend its life between the fresh water of the river, where it spawns and the juveniles grow, and the salt water of the ocean, where it matures and grows rapidly before returning to its native river.

This is why salmon are called anadromous fish: they go out into the ocean to feed and return to the rivers to reproduce. There are other species of anadromous fish, such as sturgeon and rainbow smelt. The opposite of anadromous is catadromous, which means that the fish reproduces in salt water and grows in fresh water, like eel for example.

6.1 Answer sheet: Who am I?



1) What is the language used in science to name species?

a) Spanish
b) Latin
c) French

What is the scientific name given to salmon?

Salmo salar

2) I live my life both between fresh and salt water. In fact, I was born and spent my early days in the river, and then I grew up as an adult while I was out in the ocean. The term used to describe fish returning to rivers from the ocean in order to spawn is :

a) catadromous
b) anadromous

3) Which of these fish behaves contrary to salmon, i.e., it lives in fresh water and spawns in salt water?

a) The american eel
b) The yellow perch
c) The pike

7. Etymology of words

Etymology is the scientific study about the origin of words. The Greek word étumon means "sense of truth" and logia stands for "the study of", or "science". Knowing the origin of words allows us to better understand their meaning.

Now, let's look at the etymology of the word "anadromous". The Greek prefix ana means "upward, up in place or time" and dromos is a Greek suffix meaning "running". The opposite of anadromous, catadromous, uses the prefix cata, which means "down, downward or against".

The etymology of words allows us to understand many other words in our vocabulary, such as velodrome and hippodrome for example, and other words from the student notebook!

7.1 Answer sheet: Etymology of words

Words in English often have Latin or Greek roots, which is what we refer to as their etymology. Using a dictionary or by searching online, find the etymology of the following words. Then write down the actual definition of the words.

A) BIOLOGY

Etymology: from the Greek words bios "life" and logos "study".

Definition: the study of all living things. Biologists

work in a wide variety of fields, from the natural sciences to cells, animals, and climate change.

B) INSECTIVORE

Etymology: from the Latin insecta "insect" and voro "devour".

Definition: an animal or plant that feeds on insects.

C) KILOGRAM

Etymology: from the Greek kilo "thousand" and gramma "that which is drawn or written".

Definition: unit of measurement of mass that equals one thousand grams.

D) PISCICULTURE

Etymology: from the Latin piscis "fish" and cultura "cultivating, agriculture".

Definition: fish farming.

E) OVIPAROUS

Etymology: from the Latin ovum "egg" and pario "to lay"

Definition: an animal that lays eggs

F) POIKILOTHERMIC

Etymology: from the Greek poikilos "changing, varying" and thermos "heat".

Definition: an organism that has an internal body temperature that fluctuates with the temperature of its environment. It is often said that they are "cold-blooded" animals.

G) CENTIMETER

Etymology: from the Latin centum "cent" and metrum, and from the Greek metron "measure".

Definition: a unit of measurement of length equal to one hundredth of a meter.

8. The salmon life cycle

Suggested activity : watch the short film "Jusqu'à la mer" by Normand Bergeron and Francis Bérubé, available on the FQSA website! This 20-minute film describes the life of salmon from their birth to smolt's migration out of the river and into the ocean. This is a great introduction to the life of salmon.

8.1 Eggs and spawning

The salmon spawn (or spawning), which is the salmon's time of reproduction, takes place in the fall, generally around the month October in Quebec's rivers. However, spawning is triggered by changes in water temperature, which drops to around 6 -7 °C. The salmon then begin to move onto the spawning grounds. Spawning areas have shallow, fast-flowing, and well-oxygenated water flowing over a bed of rocks and gravel, so that the eggs are protected from predators and have the oxygen they need to develop. Salmon will avoid sandy environments because they often cause spawning beds to become silted. The eggs could be buried in the sand, preventing sufficient oxygenation. Spawning grounds are generally located in the upper sections of a river or a stream and serve as breeding grounds for the offspring of the salmon that spawn there.

The female will dig a nest that is about 15 to 30 cm deep using their tail, also called caudal fin. She will lay

her eggs inside the nest, and the male will be able to fertilize these eggs at the same moment. The female then covers the nest with gravel to protect the eggs from predators and harsh conditions in the months to come.

A female can dig several nests until she has laid all her eggs, and the male can fertilize several nests.The eggs of Atlantic salmon measure between 5 and 7 mm in diameter, which is fairly big for fish eggs. In comparison, the eggs of tomcod, another species found in Quebec, are much smaller. They measure 1.5 mm in diameter, while northern pike eggs have 2.5 to 3 mm diameter.

Salmon eggs are about the size of the eraser on a pencil. Students could be asked to give examples of objects that are around the same size. They have a pale orange or amber color and do not have a shell-like bird eggs do.

How can we explain the difference between the two? The hard shell around the egg of a chicken protects it against dehydration by preventing it from being in direct contact with the air. Fish eggs, however, are immersed in water and do not need the protection of a shell.

The eggs are fertilized by the milt (sperm) produced

by the male. The eggs then remain in the spaces between the rocks and stones where they were nested.

The number of eggs produced by the female salmon is directly related to her weight. She will lay between 1,500 and 1,600 eggs for every kilogram of her own weight. The size of breeding females depends on several factors and varies from river to river. We can say, however, that breeding females generally weigh between 2 kg and 5.5 kg and produce between 3,700 and 8,500 eggs as a result. In comparison, the Atlantic sturgeon, which can weigh up to 150 kg, is able to produce between 800,000 and 2.4 million eggs!

ENRICHMENT

The size and number of fish eggs varies greatly from one species to another. Some fish can lay thousands or even millions of eggs, while chickens or birds lay only a few eggs (rarely more than 10).

HOW TO EXPLAIN THIS PHENOMENON?

These are just some of the different reproductive strategies that occur in nature! The more eggs a species produces, the smaller they will be. Its offspring will also be smaller and more fragile and therefore less likely to survive difficult conditions.

Some other fish species will produce larger and fewer eggs. The offspring of these specieswill be bigger and stronger, making them more likely to survive. However,

this strategy is much more energy consuming than the other.

For example, lake sturgeon, which are about the same size as salmon, have much smaller eggs (2.5 to 2.6 mm). A female sturgeon weighing 5 kg will lay 50,000 eggs, while a female salmon of the same weight will lay about 8,000 eggs.

By the way, real caviar comes from sturgeon eggs! However, these are unfertilized eggs that we eat! Yum-my! We could also talk about salmon caviar..

8.2 Answer sheet: A few predictions

We can produce between 1500 and 1600 eggs per kilogram (kg) of body weight. Can you help us find out how many eggs each of us will produce? Don't forget to write down the steps you used to find your answer.

1) FIND THE AVERAGE NUMBER OF EGGS PER KG THAT IT WILL PRODUCE.
   (1 500 + 1 600) ÷ 2 = 1 550 eggs on average per kg of body weight
2) I WEIGH 7 KG. HOW MANY EGGS DO YOU THINK I WILL PRODUCE?
   1 550 X 7 = 10 850 eggs
3) IF A FEMALE WEIGHS 12 KG, HOW MANY EGGS WILL IT PRODUCE?
   12 X 1 550 = 18 600 eggs
4) HOW MANY EGGS WILL A 23.5 KG FEMALE LAY ?
   23,5 X 1 550 = 36 425 eggs
5) HOW MANY EGGS WILL THE THREE OF THESE FEMALES PRODUCE IN TOTAL?
   10 850 + 18 600 + 36 425 = 65 875
6) HOW MANY EGGS WILL THEY EACH PRODUCE ON AVERAGE?
   65 875 ÷ 3 = 21 958 eggs

8.3 Incubation and hatching

Eggs develop in the gravel nests during the winter months. It takes between 70 and 160 days for the embryo to develop inside the egg. We call this period the incubation period.

The egg membrane is breathable, which means that it allows oxygen that is found in the water to pass through. This is what allows the embryo to breathe. The liquid inside the egg is called the yolk or vitellus.

To assess the time of hatching of the eggs, the water temperature must be recorded every single day starting from the moment of the spawn. Those daily temperatures are then added together, which we call degree days, until we obtain 429 degree days in total - the moment when the eggs should hatch. Temperatures must remain between 0 and 6 °C. The warmer the water temperature, the faster these eggs will develop. The moment of hatching is directly subject to water temperature, but it cannot be too high, otherwise it could cause damage or even death to the embryos.

For example, if the eggs are subjected to a daily temperature of 3.9 °C, they will take 110 days to hatch (429 degree days ÷ 3.9 degrees = 110 days).

However, salmon eggs are very resistant to temperature variations. In fact, when salmon lay their eggs in the

nests, the water temperature is usually around 6 or 7 °C, but can drop as low as 0 °C in the middle of winter. It is easier for eggs to withstand cooling temperatures than it is to withstand increases in temperature. Ideally, the temperature should be kept between 4 and 6 °C, which is best for these small salmon eggs.

Then in the spring, the river's temperature will gradually warm up again as summer begins to set in.

ENRICHMENT: THE HUMAN EMBRYO

When you were still just a little baby in your mother's womb, the doctor was able to project your date of birth. Using the ultrasound technique, the doctor could see inside your mom's belly and measure the size of some of your baby bones such as the skull and femur. Because the doctor knows the growth rate of these bones, he can predict how many days before the baby will be big enough to be born.

Suggested activity: you can watch a video on human embryonic development; there are some very nice ones on the Internet.

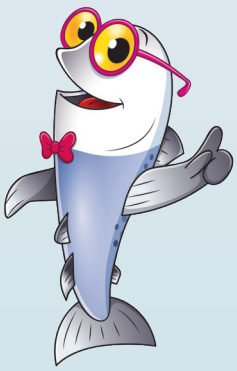
8.4 Answer sheet: Hatching of the eggs

The age of the eggs is calculated in degree days, namely the sum of the average temperatures recorded for each day. For this reason, it is important to maintain a constant temperature in the incubator and to record those temperatures. Salmon spawning takes place in the fall, around the month of October. At the hatchery, the water temperature is recorded every day until the eggs are delivered to your school. That is when you need to step in!

You should take note of the following information:

Egg delivery date:

Here is a calendar showing the degrees per day for the month of April at St-Salmo Salar school.



	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	Total °C /WEEK
week of 1st to 7th day	5	5	5	5	5	5	5	35
week of 8th to 14th day	6	6	6	6	6	6	6	42
week of 15th to 21st day	5	6	5	7	4	4	4	35
week of 22th to 28th day	4	3	5	2	3	4	4	25
Week of 29th to 31st day	3	2						5

1) How many degree days did the eggs get during the month of April?
35 + 42 +35 +25 + 5 = 142 degree days

2) Eggs hatch on average at 429 degree days. Can you tell the birth date of the fry if the temperature remains constant?
- Week 1 (1st to 7th) : 325 + 35 = 360
- Week 2 (8th to 14th) : 360 + 42 = 402
- Week 3 (15th to 21st) : 402 + 5 + 5 + 6 + 7 + 4 = 429 degree days = April 19th

3) When did the fry delivered to your school begin to hatch? On what date?

_____

4) What would have happened if the temperature had been 2 degrees warmer ?
The eggs would have hatched sooner. You can do the calculation with an average temperature of 6 °C instead of 4 °C (or the calculation based on the incubator temperature) to see the difference in time between the two hatching dates.

8.5 Alevins

In the early spring, usually by April, the salmon eggs begin to hatch and give birth to the sac fry, also called alevins. These are small fish measuring less than 2 cm in length that live under the gravel for this early stage of their growth (5 to 6 weeks). Their food needs are met by the yolk sac that is still attached to their bodies. As with the egg, the liquid inside is called vitellus. Because of this ventral pouch, the alevin cannot move around too much, which is why they remain hidden in the river bottom until it's no longer attached to them.

Alevins possess gills that serve the same function as the human lungs, allowing them to breathe and extract oxygen from the water.

By the end of May or early June, the alevins have used up all the reserves contained in their yolk sac, and their bodies have now reabsorbed it. Now, they can swim freely in the river as fry. Once they've emerged from the river bottom, they go on to feed on algae-coated rocks. Shortly after, their diet changes as they begin to swallow microorganisms such as zooplankton.

Fry are territorial from the moment they are born and will fight for the best holding places in the river.

Alevins live from the yolk (vitellus) contained in their ventral pouch. Do you know if it is the same for baby chicken growing inside their eggs? Indeed, the vitellus used by the salmon in its early life stage is just like the yolk inside the chick's egg!

Suggested activity: Show students how the yolk sac is resorbed by playing the role of an alevin! Inflate a balloon, place it on your throat and let it deflate slowly.

8.6 Answer sheet: Alevins

1) DO YOU KNOW HOW EGGS GET THE OXYGEN THEY NEED?
   The membrane of the egg is permeable to oxygen, meaning that it allows oxygen to pass through.

2) WHERE DOES THIS OXYGEN COME FROM?
   It is dissolved in water.

3) A SALMON EGG NEEDS BETWEEN 70 AND 160 DAYS TO DEVELOP. WHY DO EGGS HAVE DIFFERENT INCUBATION PERIODS IN DIFFERENT SPAWNING GROUNDS? HERE'S A CLUE... THINK OF WHAT IMPACTS THE GROWTH RATE OF EGGS IN THE RIVER.
   The incubation period varies according to the temperature of the water in the river.

4) HOW DO ALEVINS FEED?
Using the reserves contained in the yolk sac.

5) FOR HOW LONG?
For 5 to 6 weeks.

6) WHERE DO THEY HOLD DURING THIS PERIOD OF THEIR LIFE CYCLE?
They remain in the gravel bottoms in which they were born.

7) DO YOU KNOW WHY THE ALEVIN DON'T MOVE AROUND MUCH?
Because of the yolk sac that is still attached to them.

8.7 Parr

After the alevin have emerged and became fry, they begin to feed actively and grow larger in size. At the end of their first summer, they are called parr and measure about 4 cm. They remain in this state for 1 to 3 years. At the end of this life stage, they will reach about 12 cm in length. Parr are very active during the summer: they are often found around a large rock (called home rock) where they gravitate to look for food. However, in the winter they spend most of their time hiding under the rocks. We could say that this is a kind of fossorial behavior.

At this life stage, parr can be mistaken for brook

trout, also known as speckled trout.

8.8 Answer sheet: Trout or Parr?

Parr can often be confused with brook trout, also known as speckled trout.

Here are some of the characteristics of PARR :

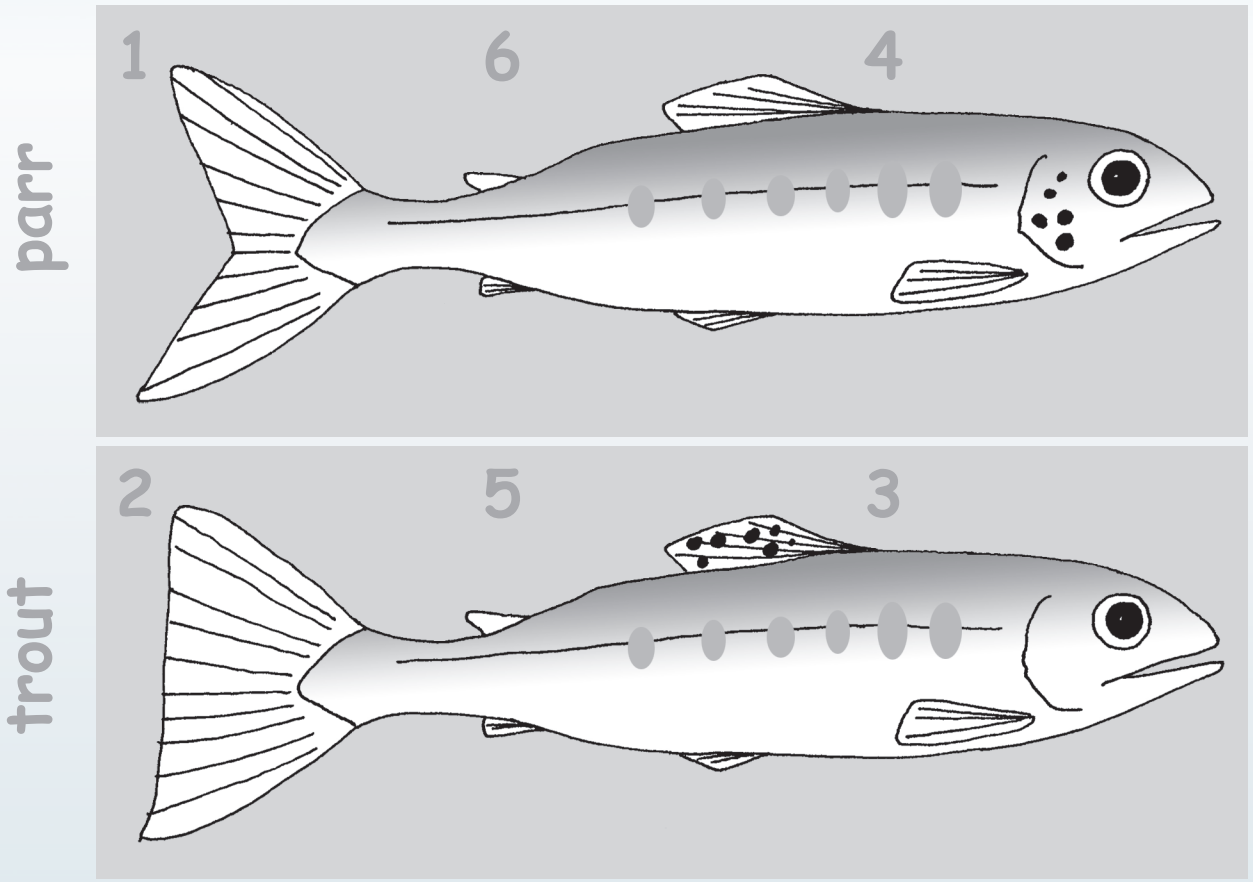
- no marks on the dorsal fin
- forked tail
- black spots on the opercula
- corner of the mouth in line with the center of the eye

and BROOK TROUT :

- black marks on dorsal fin
- tail is nearly flat
- no speckles on the opercula
- corner of the mouth goes beyond the eye

On the next page, you will find a picture showing the differences between the bodies of brook trout and parr.

From these two pieces, try to recreate a brook trout and a parr according to their relative features. Cut out the pieces, and glue them inside the two boxes below.



8.9 Smolts

In the spring, after spending 3 or 4 years in the river, the parr are now big enough to begin their migration to the ocean. They will go through a series of important changes, much like the years of adolescence! This is when the fish take on a silvery color and the slender appearance of adult salmon. Internal changes also occur in order to adapt to life at sea. At this point in their life cycle, they are called smolts.

They travel down their native river and out into the ocean and, in some cases, some even go as far as the I

coast of Greenland. At the time of their outmigration, smolt measure between 12 and 20 cm.

It is also at this time that they undergo internal transformations allowing them to eliminate the salt that they will absorb while at sea.

ENRICHMENT

Human kidneys play an important role in the process of filtration. In producing urine, the kidneys help eliminate waste and toxins from the bloodstream. The excess salt that we absorb in our bodies is filtrated by the kidneys and eliminated through our urine. We use a lot of our bodies' water when we do this, which releases urine that is diluted. However, if we drank sea (salt) water, we would lose more water doing so through our urine, than the amount we would be able to drink. That is why we cannot quench our thirst with ocean water! Instead, we would become dehydrated if we drank it.

It is different with salmon: their kidneys do not work the same whether they are in a fresh water (river) or salt water (sea) environment! When they are in fresh water, they urinate regularly to eliminate water. Otherwise, water would accumulate in their bodies and they would swell up to death. And when they are at sea, to retain the maximum amount of water in their body and stay hydrated, their urine becomes more concentrated.

It is similar to what happens with camels in the desert:

they keep all the water in their bodies and excrete only the waste from the bloodstream.

8.10 Adult salmon and life at sea

In the ocean, the abundance of food (shrimp, capelin, smelt) will allow the salmon to grow quickly and often reach impressive sizes.

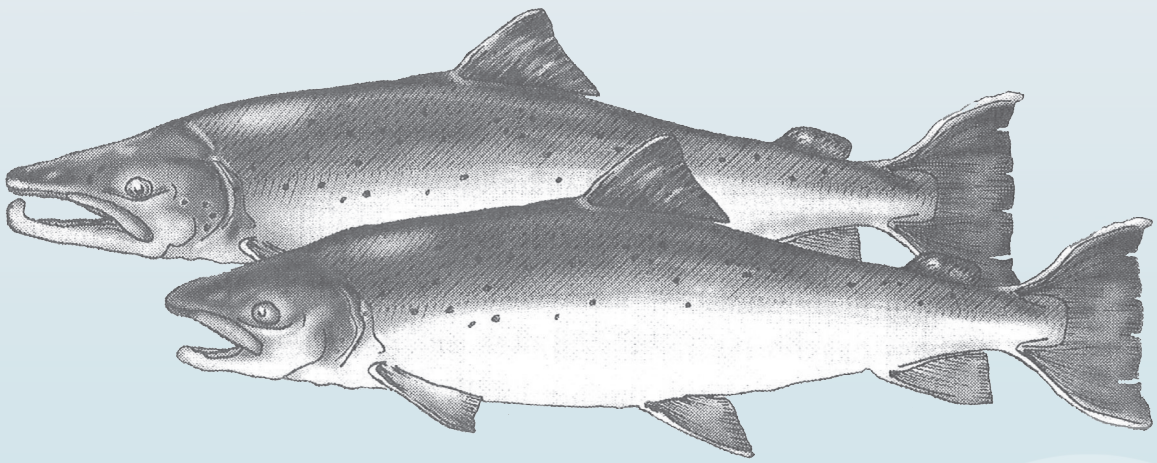
If the salmon returns to its native river after spending one winter at sea, it is called a 1-sea-winter salmon or a grilse. Its size varies between 50 and 63 cm long. This salmon most likely made its journey all the way to Newfoundland and Labrador. Grilse are predominantly male.

When salmon remain at sea for more than a year, they will travel past Newfoundland and along the coast of Labrador to reach their destination: the waters of Baffin Island and Greenland. They now measure over 63 cm in length, hence the name large salmon, or multi-sea-winter salmon (meaning they've spent more than one winter at sea).

Atlantic salmon are also widely found in European countries, and these salmon also migrate to the south of Greenland. This is the main feeding area for all Atlantic salmon, regardless of where they come from.

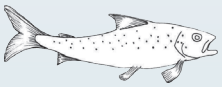
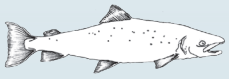
Large salmon can weigh between 3 and 34 kg and measure anywhere from 63 cm to 1.85 m in length. However, salmon measuring over 1 meter are becoming increasingly rare.

The largest salmon returning to the rivers are mostly female, while the smaller ones are usually male. Indeed, as the number of eggs is proportional to their weight, females are better off coming back with more weight on them so they can produce as many eggs as possible during the spawn.



8.11 Answer sheet : Salmo's growth

Place the salmon's life cycle stages in order by numbering each box. Then, match these stages to the corresponding sizes.

A) Order of stages		B) Size
 Fry	3 / 2 to 4 cm	63 cm >
 Egg	1 / 5 to 7 mm	4 to 12 cm
 Large salmon	7 / 63 cm <	5 to 7 mm
 Smolt	5 / 12 - 20 cm	2 cm >
 Parr	4 / 4 to 12 cm	2 to 4 cm
 Grilse	6 / 63 cm >	3 cm <
 Alevin	2 / 2 cm >	12 to 20 cm

1) Which of these stages take place in fresh water?
   Egg, alevins, fry, parr, smolt

2) Which stages happen in salt water?
   Grilse, large salmon

8.12 Answer sheet: Salmo's diet

The salmon's diet changes according to its life stage.

Egg and alevin

Fry

Parr and smolt

Adult salmon at sea

Adult salmon in the river

It feeds on small microorganisms such as zooplankton

It eats small fish, such as capelin and herring, and small crustaceans

It does not feed

It eats insects like mayfly larvae and dragonflies

It feeds on the vitellus/yolk (liquid that surrounds it)

8.13 Answer sheet: The traveling salmon

The map below shows some of the countries where Atlantic salmon can be found around the world.

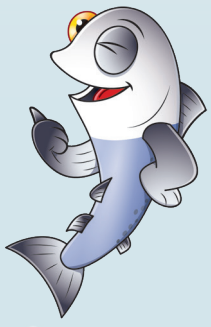
Using an atlas, can you name some of these countries?

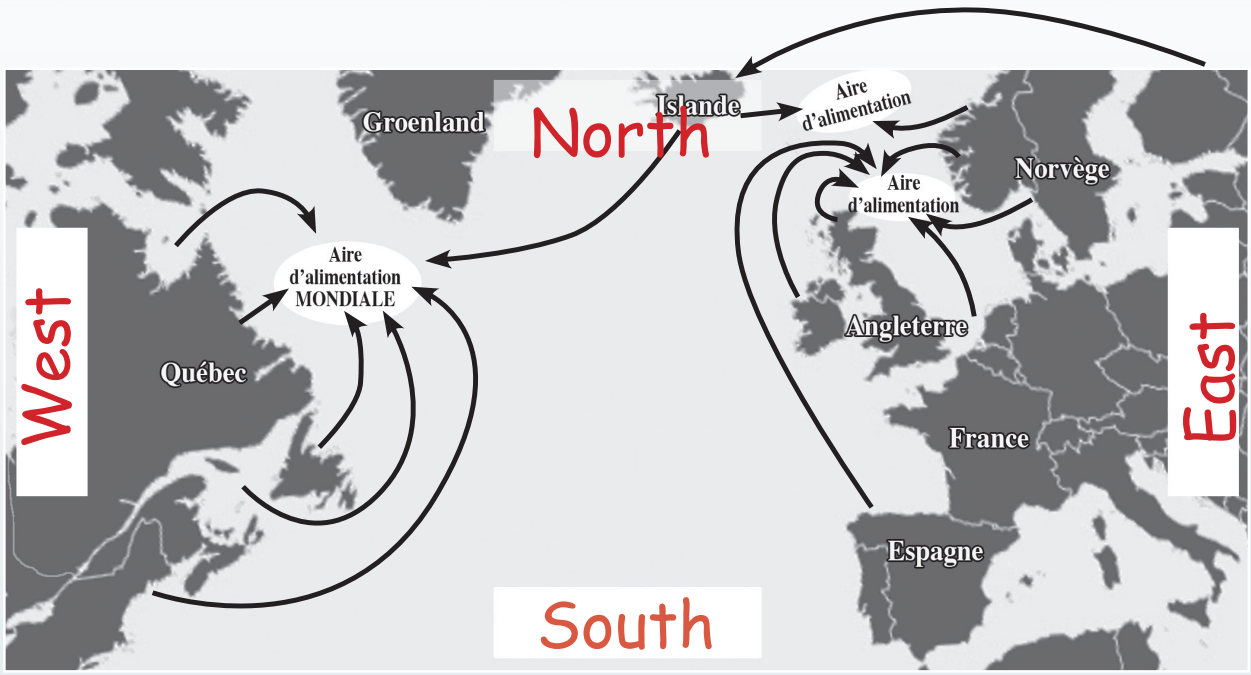
1. Greenland
2. Norway
3. England
4. Quebec
5. France
6. Spain

Write down the four cardinal points of the compass, which are north, south, east, and west, in the correct place on the map.

Write down the four cardinal points of the compass, which are north, south, east, and west, in the correct place on the map. All North American Atlantic salmon are found in the same part of the Atlantic Ocean where they feed before returning to their native rivers to spawn. Can you mark this location on the map? You can search the Internet or at the library!

Atlantic salmon from all countries in the world also migrate to this part of the North Atlantic !





8.14 Return of the salmon, from the ocean back to the river

After spending 1 to 3 years in the ocean, adult salmon return to their native river to reproduce. They typically return between June and September, in an event that we refer to as the salmon run. Be aware of the meaning of the word anadromous, a term used to describe migrating salmon..

Scientists believe that salmon can find their way home by using the memory of their native river's smell. Indeed, each river has its own unique smell emanating from the surface on which it flows. Also, the feces produced by their fellow creatures contribute to give a particular odor to each river. It is believed that salmon use the Earth's magnetic fields to orient themselves

as if they had an internal compass! Salmon returning to the river do not feed. They can go up to about 9 months without feeding, during which time they will live off the reserves made at sea.

You may wonder why salmon do get fooled by a fisherman's fly when they have completely stopped feeding and are now only in the river for spawning purposes. Part of it will always be a mystery, but some say that the fly triggers an innate reaction in salmon or that it awakens instinctive feeding behavior.

Salmon can jump up to 3.5 meters high! This is like jumping over a whole school bus! Also, when they are running, they can travel between 10 and 20 km per day if not more! Scientists are able to measure this distance by tagging some of the returning salmon with transmitters and then closely monitoring their migration.

Salmon re-entering the river have the same silvery appearance as they did when they first set out for the ocean. They adapt into this color, which allows them to blend in the marine environment and be more protected against certain predators. The same thing happens when salmon re-enter the river, as they change colors once again to blend in with their new environment.

Indeed, salmon lose their shiny chrome aspect after a certain time upon their return to the river. Especially

during the spawning season, females will display colors ranging between brown, green and gray, while males will turn green, sometimes yellowish, and have red spots. The most impressive feature we notice in the changing males' body is the kype (hook) developing on its lower jaw, which will disappear after spawning. These are only a few characteristics that allow us to differentiate males between females.

After spawning, salmon take on a much darker color, hence the name "black salmon". They lose their vivid colors and become dull and dark because they have used up a large amount of their resources (fat, protein, etc.). They are exhausted after the spawn, as they have not eaten for almost 6 months and have put a lot of effort into getting to the spawning grounds (and in the actual breeding process itself). Black salmon are those, too tired to return at sea, that spend the winter in the river and then return to the ocean early in the following spring. A little less than 10% of them may return to spawn more than once.

We understand that the majority of salmon usually do not go on to spawn more than once, which explains why there are few multi-sea-winter salmon. The grilse stage is not a stage that should be considered as intermediate and leading to that of a large salmon (multi-sea-winter). Black salmon are very weak and become more easily preyed upon by predators or are often victims of adverse conditions at sea.

8.15 Answer sheet: Male or female

Their silvery-gray color makes all salmon look alike in the ocean. When they come back to the river to reproduce, however, they take on their most beautiful colors. This is when males and females begin to stand out more, in the hopes of finding a partner.

1) Why do salmon have a silver color when they are in the ocean?
   They take on this color to blend in the environment. It serves as camouflage, protecting them from predators.

2) What are the main differences between males and females while in the river?
   The male has bright colors, ranging from green to yellow through orange, along with red spots. What stands out the most in them is the hook that develops on their lower jaw, called a kype.
   The female also takes on her breeding colors, varying from green to brown, gray, and sometimes still slightly silver.

To learn more about all parts of my body and my internal organs, do the anatomy board activity! Once you've filled out the sheet, you can fold it and keep it in your workbook, so you won't forget what you've learned.

Extra activity: the Salmo anatomical board!

You will learn about the different parts and organs of salmon.

8.16 Answer sheet: The life of Salmo

Using the word bank below, complete the gap sentences on the following pages. Words marked with (2) can be used twice.

UPSTREAM

This is where spawning areas are typically found: these are shallow areas where the riverbed is mainly composed of GRAVEL and PEBBLES. It is here that the FEMALES will deposit their EGGS and that the males will come to FERTILIZE them.

Life cycle stage: EGG

Females can lay between 1 500 et 1 600 per kg of weight. These ORANGE or amber-colored eggs are laid in the head-waters, more commonly known as the SPAWNING GROUNDS. The eggs will begin to develop over the WINTER and INCUBATE for a period varying from 70 to 160 days. Salmon deposit their eggs in the FALL (season).

Life cycle stage: ALEVIN

These little 2 cm long fish live under the gravel, patiently feeding on the YOLK SAC, that is still attached to their BODY. They will stay in this form for about 5-6 weeks. This phase occurs in the SPRING (season).

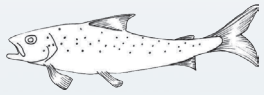
Life cycle stage: FRY

These small fish emerge from the GRAVEL; ltheir yolk sac is now RESORBED. They can feed for themselves on MICRO-ORGANISMS on the surface of rocks, and soon in-sects.

Life cycle stage: PARR

Salmon remain in this life stage for 1 to 3 years until they have grown to about 12 cm in size. They spend winter under large ROCKS. In the summer, they are found in faster flowing water and in other smaller neighboring streams, where food is abundant. This is the time when we can easily confuse them with BROOK TROUT (also called speckled trout).

Life cycle stage: SMOLT

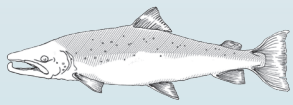


At this point, they are now ready to begin their DOWNSTREAM MIGRATION out into the ocean. We can easily recognize them due to their SILVER color. This stage happens in the SPRING (season).

Life cycle stage: ADULT

This stage, which takes place in the OCEAN, allows the salmon to grow enormously and to stock up on FAT. When they have spent only 1 year at sea, we call them 1-sea-winter fish or GRILSE. Salmon spending more than one winter at sea are called LARGE SALMON (smulti-sea-winter).

DOWNSTREAM



After a year or more at sea, we begin to see salmon RETURN to the rivers, in an event we refer to as the SALMON RUN. Each salmon finds its NATIVE RIVER using its OLFACTORY. senses and the Earth's magnetic field. Salmon do not FEED during this time.

9. Scales That Tell

The scales of a salmon allow us to learn a lot about its life. We can determine their age, the number of years they have been at sea, the number of times they have spawned, etc. When we look closely at scales under the microscope, they appear as the tree rings in a sawn trunk. The circular lines correspond to growth rings, the difference being that trees have one ring per year and salmon can have several rings. Rings that are grouped together represent seasonal growth: wider spaces between the rings are the result of the rapid growth that occurs in summer, while slower growth in winter is reflected in more closely spaced rings.

Otoliths, which are small bones located in the inner ear of fish, can also be interpreted in the same way. The otoliths develop as the fish grows and form growth rings as well.

Suggestions for the activity: We suggest that you show students a photo of the inside of a tree trunk or a photo of an enlarged salmon scale and/or otolith.

You can invite students to speak on the similarities between some of these pictures.

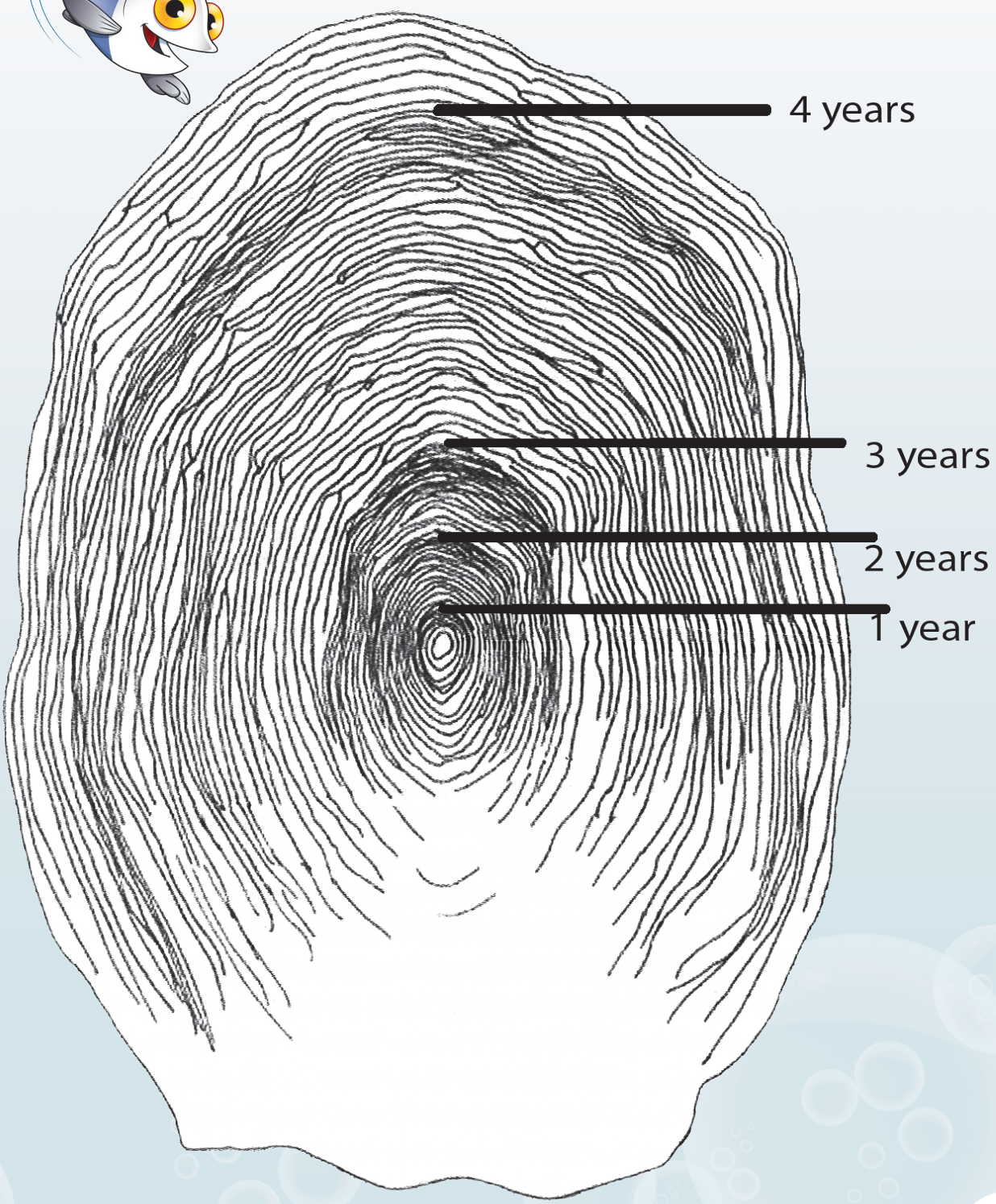
You can also ask students what may affect the spacing between each growth ring (temperature, abundance or lack of food, disease, etc.).

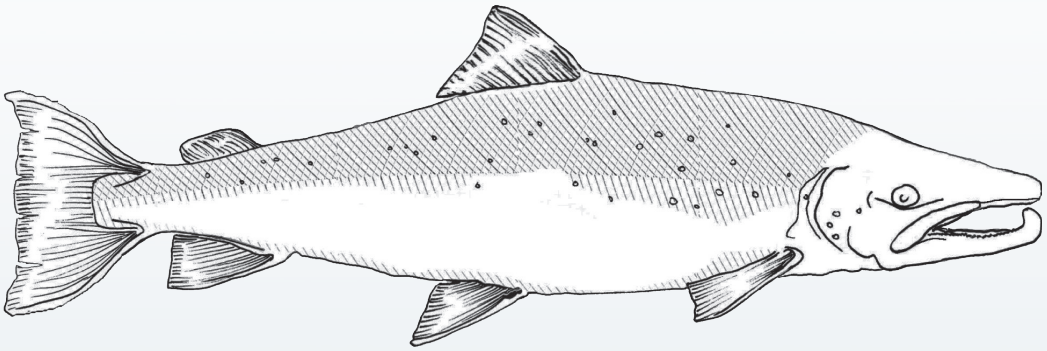
9.1 Answer sheet: The tales of my scales

Much like the growth rings of a tree, we can look at the life of a salmon through its scales and learn more about its age and maturity. We can also determine such information from the otoliths, or the tiny bones in the fish's inner ear!

Match the sentences below to the correct stage of the salmon's life on the scale shown on the next page.

1. I am a little over 4 years old
   With each year, we can see alternating rings that are more spaced (summer) and some that are closer together (winter).
2. Water becomes very cold and food becomes scarce in winter. I don't grow much during this season.
   The cold of winter numbs the fish and reduces its appetite, which makes the growth rings appear closer together.
3. I am at sea. I feed abundantly and grow rapidly, which is why my growth rings are further apart from each other, especially in the summer.
   This salmon spent 3 years in the river since birth and a full year feeding abundantly at sea. The scale was taken in the spring since the outer rings are spaced apart.
4. My first growth rings will begin to show from the beginning of my life, but I am growing slower than at sea.


4 years
3 years
2 years
1 year



Using the salmon's scales and the descriptions in the previous pages, indicate how many different environments this salmon has lived in.

2

Nomme ces milieux :

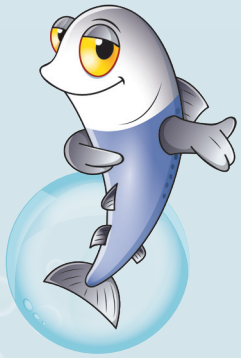
River and sea

How long did the salmon stay in the river?

3 years

How much time did he spend at sea?

1,5 year



10. Salmo's survival

We cannot assume that all the eggs produced by salmon will eventually become adults, or even smolts. The survival rate is what tells us how many of them will grow into the next stage. The survival rate indicates how many individuals will survive beyond the next life stage out of 100.

From the offspring of two adult salmon (male and female), meaning 8000 fertilized eggs, and taking into account natural mortality and predation both in the river and at sea; only 4 adult salmon will return to their native river!

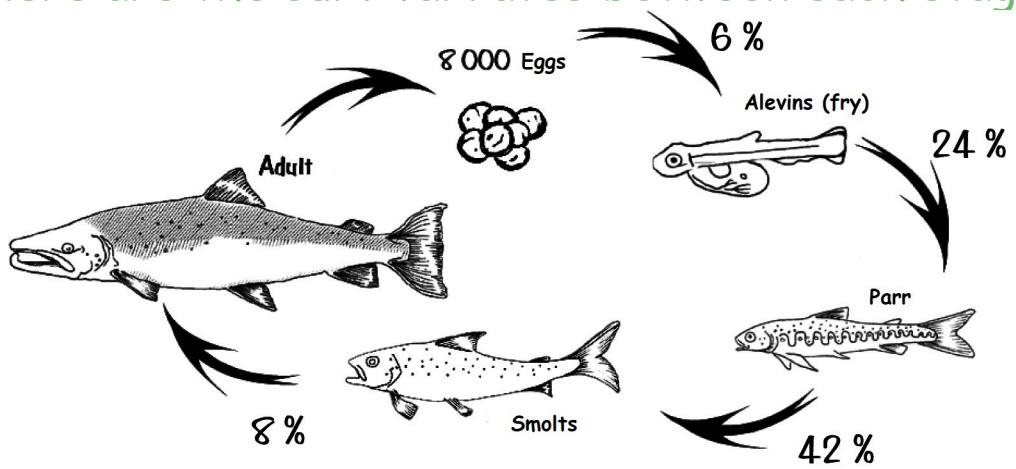
However, these numbers vary depending on environmental conditions. Currently, the return rate of adult salmon is not exactly 4, but rather 3 salmon. According to scientists, this is probably due to adverse conditions at sea.

The survival rate from egg to fry is only 6%. For a fry to become a parr, having already spent 1 year in the river, the survival rate is 24%. Survival rate from parr to the next stage, the smolt, is 42%. Finally, from smolt to the adult stage, the survival rate is 8%.

10.1 Answer sheet: Salmo's survival

To begin, suppose there are 8000 eggs. Of these eggs, 6% become fry. Of these alevins, 24% will become parr. Of these parr, 42% will become smolts and of these smolts, 8% will become returning adult salmon.

Here are the survival rates between each stage:



1) Write the values corresponding to the percentages in the table below in the form of fractions and in decimals:

	Pourcentage	Fraction	Nombre à virgule
	6%	6/100	0,06
	24%	24/100	0,24
	42%	42/100	0,42
	8%	8/100	0,08

2) In your own words, can you explain the meaning of SURVIVAL RATE??
It is the number of salmon that survive between each stage of their life cycle.

3) What are some of the factors (environmental, biological, human, predation, etc.) that could affect the survival rate of salmon during its life cycle? Provide an explanation.
Several correct answers: predators (mergansers, kingfishers, otters, cod, tuna, seals, gannets), springtime flooding, poor conditions in rivers and at sea (e.g., lack of food sources), pollution, human-made obstacles (e.g., dams), fishing, etc.

4) Based on the percentages in the table on the previous page, find the number of individuals at each stage. Write your answers in the spaces below, describing how you went about doing your calculations.

There are 8000 eggs.

How many will go on to become fry?
Here's an example of how to do the first calclation:
If the survival rate from egg to fry is 6%, then you have to figure out what 6% of 8,000 is:

8 000 X 6 = 48 000
48 000 / 100 = 480
There will be 480 fry.

How many eggs did not make it?
8,000 x 480 = 7,520 eggs did not survive.
Your turn !

a) How many parr will there be?
480 X 24 ÷ 100 = 115 fry

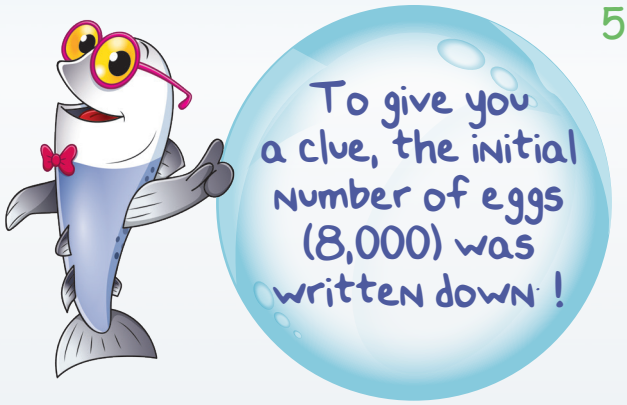
b) How many fry have died?
480 – 115 = 365 dead fry

c) How many smolts will there be?
115 X 42 ÷ 100 = 48 smolts

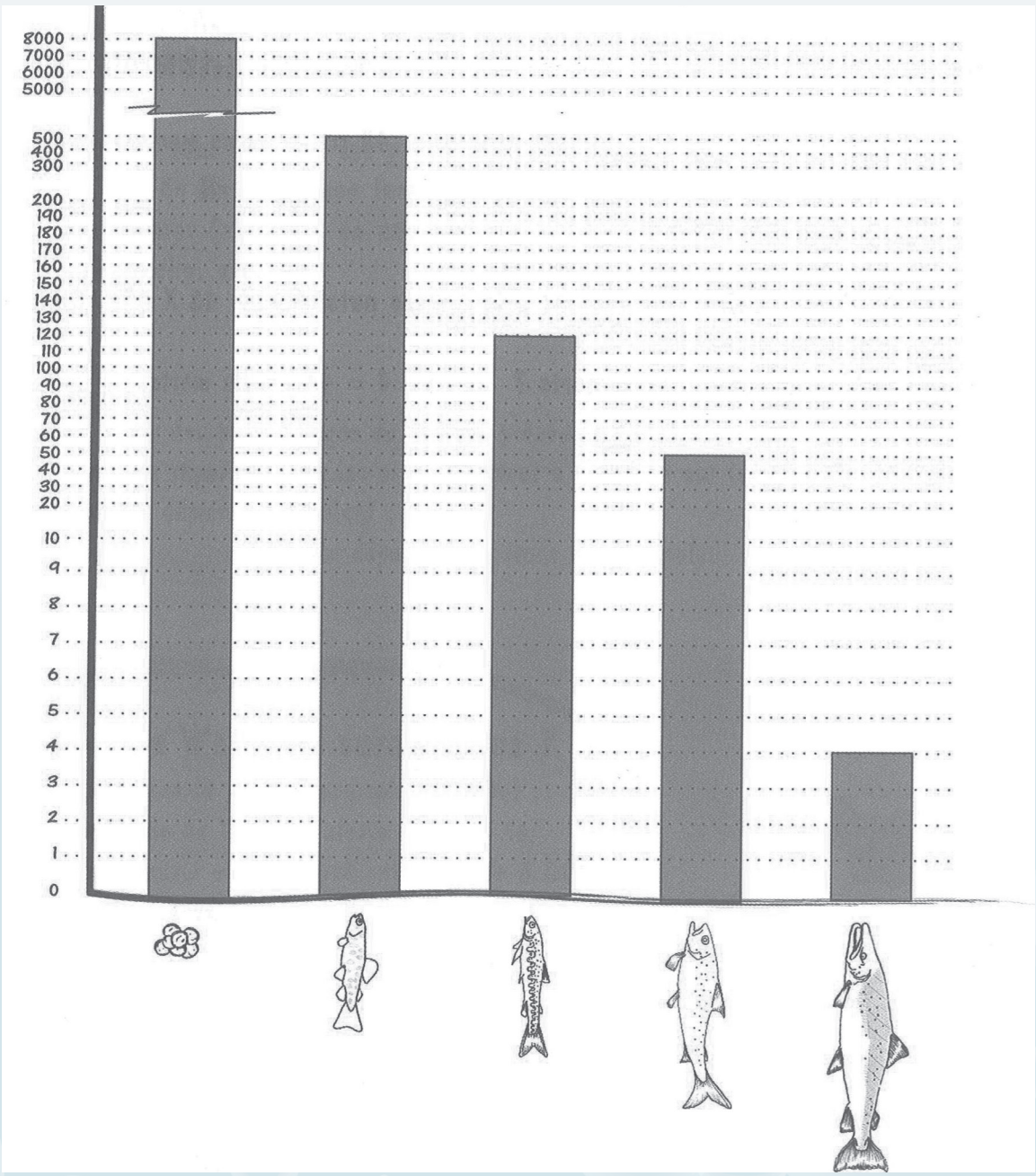
d) How many parr died?
115 – 48 = 67 dead parr

e) How many adults will return to their home river?
48 X 8 ÷ 100 = 4 adults

f) How many smolts died?
48 – 4 = 44 dead smolts



5) For this exercise, base yourself on the calculations made previously. Using the number of individuals at each stage of the salmon's life cycle, complete the following bar graph by drawing the columns corresponding to each number of individuals.



10.2 Answer sheet: A bit of history!

Historically, Atlantic salmon could be found all the way to the Great Lakes. Today, they only inhabit 118 rivers in Quebec, mostly in the eastern part of the province, in the Gaspé Peninsula, and on the North Shore. The westernmost river where Atlantic salmon are still found in Quebec is the Jacques-Cartier River, in the Nation's Capital area. Salar has been in our rivers since long before colonization! In fact, it was an important food source for First Nations. Indigenous people have always had great respect for this resource, and many Native communities still fish for their own livelihood.

The first French settlers came across this resource after the founding of Quebec City in 1608 and established the first fishing stations in the area. Fishing and hunting have always been an important part of the settlers' diet wherever they would go or establish.

In the late 1600s, business-men began to develop the salmon fishery more seriously and began trade with France and the Natives. Following the British conquest of Nouvelle-France in 1760, commercial fisheries expanded greatly, reaching their height in the mid 19th century.

Salmon harvests began to decline around 1850 and people began to worry. Fishing, logging, the building and use of riverside sawmills were all important factors in the decline of salmon.

In 1855, the government enacted legislation to regulate the salmon fishery. A government department was also created to manage the resource, and for the first ti me, commercial and sport fishing became two separate entities

While commercial fishing kept going after the Confederation in 1867, salmon harvests were still in decline. As a result, the governments of Quebec and Canada decided to phase out commercial fisheries from 1972 to 1992.

Meanwhile, sport fishing went on and became even more popular, as its practice was done with respect for nature and allowed anglers to feed for themselves. Several associations, such as the Fédération québécoise pour le saumon atlantique, are working with the government to better manage the resource so that sport fishing can continue while we protect the species.

Wild Atlantic salmon populations are vulnerable, which is why we need to care for them. Today, most anglers practice catch-and-release, which means that instead of eating what they catch, they release the fish back into the river so they can live another day. Anglers and wardens both try to protect the rivers from poaching. We should all do our part in protecting Atlantic salmon populations from human impact such as pollution and climate change.

By working together, we can combine economic development with conservation of the species! Learn more about the environmental conflict through the suggested activity on the next page.

Did you understand the reading? Let's see!

1) In what year did the government create the first law on salmon fishing?

   1855

2) Which is the western-most river where Atlantic salmon are still found in Quebec?

   Rivière Jacques-Cartier

3) What are some of the main causes of the decline in salmon populations by 1850?

   Fishing, logging, the building and use of riverside sawmills.

11. Environmental issues and the salmon resource

In the fictional community of Salmonar, a hydroelectric developer from the HydroWatt Company is seeking approval from city council to build a dam. The dam would be located on the Wild River.

This is a river that attracts many salmon anglers every year. The fishery provides work for many people and is an important contributor of economic benefits for the community at large. However, many people in the community, and Indigenous people especially, for whom salmon fishing is part of their traditional livelihood, are concerned that this kind of human intervention could jeopardize the salmon resource.

City council now has to assemble and hear the voices of those who will be affected by this project. On the basis of what they've gathered, the council will have to make a decision whether to accept or refuse this project.

This activity is a role-playing game in which you will be asked to discuss the situation. Together with the students in your class, you must form teams that will represent the different actors involved. Depending on the group you represent, you will be able to list the pros and cons of building the HydroWatt dam on the Wild River. Then, each group will speak to the city council to decide whether the construction of the dam should be authorized..

This kind of approach is known as an issue table!

Inspired by real-life issues, this activity allows students to develop their critical thinking skills and their ability to express themselves in a group. Students must adopt a position regarding the situation, and together as a group, find arguments to justify their choice. We suggest you take on the role of the city council, to whom each group must present its arguments...

APPROACH:

1. Introduction

Suggest that students read on the issue in their workbook. This activity proposes a role-playing game based on an environmental issue and the conservation of wild Atlantic salmon. You could summarize the situation for them to make sure they understand it.

2. Assign roles

Once the class has understood the role of each group, it is time to form teams. You may allow students to make their own teams, assign roles to them, or simply choose at random.

3. Prepare the discussion

Each team has to divide the tasks among group members (researching information, preparing arguments, taking notes, etc.).

Next, students will decide whether they are for or against the hydro dam project, and why. For example, anglers could be against it because they may not be able to fish anymore, and so on.

The class should also consider under what conditions they would be willing to agree to the dam project. For example, guides, anglers, and biologists might be willing to accept the dam if HydroWatt were to take measures in order to protect

salmon, such as building a fishway. This would allow migrating fish to return to the river even after the dam is completed. Indigenous people could also agree if HydroWatt promised well-paying jobs for the community and made plans to benefit the resource, such as the enhancement of the spawning grounds.

4. Deliver argument to city council

Each team must state their position (for or against) and present their arguments to the class and city council. Once this is done, they can bring forward any matters on which they are willing to negotiate (conditions for HydroWatt). You can encourage the students to dress up for this activity!

5. Making a decision

With the help of the whole class, try to summarize all the pros and cons that you can come up with. Then, proceed to vote on whether the construction of the dam should be allowed, and if so, under what conditions.

ACTORS INVOLVED

HYDROWATT

The HydroWatt developer is an entrepreneur seeking to meet the energy needs of the population by developing hydroelectric projects. His primary concerns are the profitability of his company and the region's economic development.

He describes the dam project as a socio-economic enterprise. The river's location and its characteristics (ideal height of waterfall, road access, local labor, and available machinery) are conducive to the development of a small hydroelectric power plant that would provide income for the municipality. In addition, this project would lead to the creation of both temporary and permanent jobs. The construction of an 8-megawatt dam requires 200 employees during construction

(2 years) and 4 permanent employees thereafter. If the developer commits to the community, part of the revenues could be reinvested in development projects, biological monitoring, stocking efforts, etc.

CITY COUNCIL

The city council is made up of elected officials who are entrusted with the management of the municipality's public affairs. Members of the council try to serve the interests of as many citizens as possible. They would like to find a solution that is respectful of the environment while enabling economic growth in the region.

The council aims to fulfill the needs of each and every citizen. They would like to see sustainable development happen, which is why they want to minimize the environmental impact of the dam in order to protect the river and preserve the salmon resource. At the same time, the council wants to see growth in the community, and to provide more electricity for the town's increasing demand.

THE BIOLOGIST

biologist is a scientist who studies the relationships between living beings and their environment. Their role is to provide objective and accurate information about salmon, their behavior, their life cycle, and their needs in relation to their habitat (the river). Biologists are concerned about the effects of changes in the environment that may affect the survival of salmon.

The dam's construction could lead to a significant decline in the number of returning salmon. However, there are ways to ensure the survival of the species, such as the transportation of the salmon by road, or by installing a fishway. But smolt outmigration would be disrupted by a dam since these facilities do not always ensure the safety of smolts, who can die shredded in the turbines; unless special safety

devices were put in place that prevented them from passing through. Nevertheless, this might still disrupt their life cycle and have a negative impact on overall outmigration. In addition, the decrease in water flow below the dam greatly affects the salmon fishing conditions. The changes in water flow and temperature can also have serious consequences on the species.

Spawning grounds and other important sites for fry and parr could be developed as a compensation initiative. The HydroWatt company could also be asked to conduct studies to monitor the salmon population, and or, to carry out stocking efforts. However, the dam will undoubtedly have a negative impact on salmon. Biologists may demand that the dam be built on a different river in the area, and not on a salmon river.

THE CITIZENS

Citizens represent all members of the community, both young and old. They simply want a better quality of life. Citizens want both, jobs, and a sustainable environment.

Citizens can be for or against the dam project based on their own personal interests, whether it has to do with leisure or their livelihood. The demand for electricity and other services in the community is clear, but people also want to live in a healthy environment. They are concerned about the project and are there to ask questions to the other teams.

INDIGENOUS PEOPLE

For Indigenous people, salmon has always been an important food source and part of their way of life. Members of the local community have an inherent right to fish and have priority over recreational anglers (Aboriginal right to fish). They therefore see the construction of the dam as a threat to their traditional livelihood. They are concerned about the conservation of Atlantic salmon and perceive the alteration

of the salmon's habitat as a possible impediment to their ancestral rights. However, they are just like all other citizens; they want both jobs and a healthy environment, where they can carry on tradition.

Indigenous people view the dam's construction as a threat to their Aboriginal rights, including the right to fish for their livelihood, for which they are already allocated a quota. Like the biologists, they are deeply concerned about the resource. They are against the dam project and are very reluctant to negotiate. No compensation (financial or any kind) could ever justify abandoning their traditional way of life. They want jobs and economic benefits for the community, programs to preserve their culture, and funding to protect salmon and the land.

GUIDES AND ANGLERS

The main concern for guides and anglers is the conservation of the species and the development of the sport. They perceive any alteration in the salmon environment as a threat to the sustainability of the fishery. For fishing guides, the decline of this sport means that they could lose their jobs.

The construction of the dam would become a permanent obstacle to the salmon's migration. Currently, the river has a beautiful natural waterfall and offers many great pools for salmon fishing, but the dam would destroy all fishing areas located upstream of the construction. The pools located downstream will also likely pay the price in terms of the quality of fishing. Besides, the landscape will be permanently altered. Guides, wildlife officers, and many others could directly lose their jobs. Indirect job losses might also occur, such as in restaurants, hotels, and sporting goods stores.

12. Answer sheet: Crossword puzzle

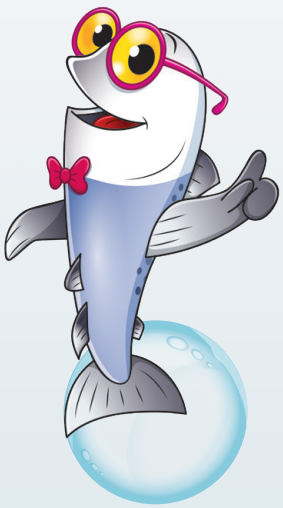
Complete the crossword puzzle on the next page using your answers to these questions.

HORIZONTAL

1) I produce energy using the flow of the river and I often have a fishway. HYDROPLANT
2) The term used to describe fish that are born and reproduce in fresh water and live in salt water. ANADROMOUS
3) Where the salmon rest when they are «running» (when they return to the river). POOL
4) I am a fish that lives in the ocean who feeds on salmon, among other things. SHARK
5) I look a lot like a parr, but I am NOT a salmon. BROOK TROUT

VERTICAL

6) They call me the «leaper». SALMON
7) I am unique to each river and I am the reason that salmon can find their native river. ODOR
8) The time when smolts leave their rivers to go out in the ocean. OUTMIGRATION
9) A shallow part of the river with clear, cool, and well-oxygenated water. SPAWNING GROUNDS
10) The salmon's first habitat. RIVER
11) The term used to describe an animal that preys on other animals. PREDATOR
12) I am the one who digs the nest. FEMALE



11 ↓ P R E D A T O R

12 ↓ F E M A L E

6 ↓ S A L M O N

10 ↓ D R I V E R

9 ↓ S P A W N I N G

2 → A N A D R O M O U S

8 ↓ O U T M I G R A T I O N

1 → H Y D R O P L A N T

3 → P O O L

4 → S H A R K

7 ↓ B R O O K T R O U T

5 → D O O R

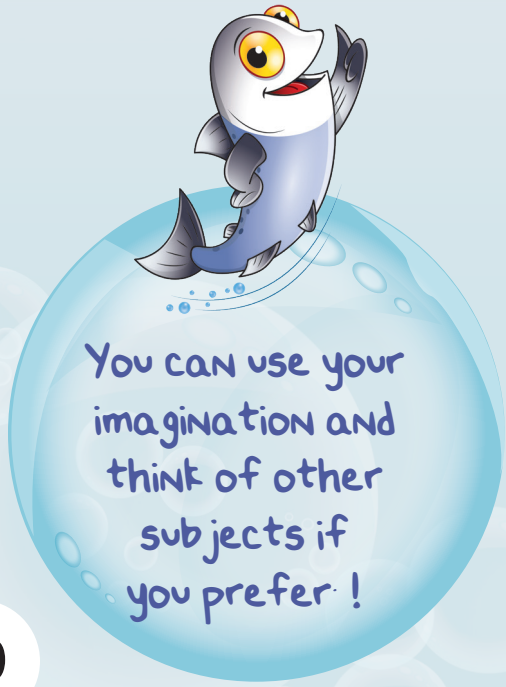
13. A few ideas for extra thought-provoking activities

Students can make a presentation or write a paper on a topic that interests them about salmon as part of the next activity:

Would you like to learn more about some of the topics surrounding the life of Salar? What are some of the things that you were most impressed by? Let's do one more activity!

First, choose the topic that interests you the most. Next, look up more information on the subject online, at the library, or at a local environmental organization in your area. You can also talk and ask questions to a fisherman or a specialist, etc. There are many different useful sources of information out there and you are free to look wherever you please.

Now it's time to write a short text on the topic you've explored, and to share what you learned with the rest of the class!



Here are a few topic examples

- The scales of the salmon
- Salmon otoliths
- Spawning
- The life of salmon in the river or at sea
- Salmon migration
- Hydroelectric power plants
- Aquaculture
- Climate change
- Sport fishing/fly fishing
- Fishways
- How salmon find their way home

13.1 Suggested books

• Atlantic Salmon: An Illustrated Natural History. Dr. Malcolm Greenhalgh, illustrations by R. Sutter by. Chanteuges, Salmon Foundation, 2005.

• Le saumon, 400 ans d'histoire et de passion au Québec. Collective work under the direction of Bernard Beaudin and Yvon Côté. Saumon Illimité, 2008. (Only available in French)

14. Important facts for the program

In preparation for the season:

- Confirm your registration for the program by December 1st
- Place your order for all educational material and rearing equipment upon registering in the program.
  Note: Certain components of the filtration system (carbon) must be changed every year. Also, the equipment should be thoroughly cleaned when doing so
- Pick up a few rocks from the river, rinse them with water and clean them properly without using soap. Put them inside the incubator and provide shelter for the fry - it doesn't cost much!

One to two weeks before delivery of the eggs:

- Before you start using the system, let the water sit in the aquarium for at least 72 hours to allow time for the chlorine to evaporate.

- Turn on the system to make sure that it is functional, and gradually lower the temperature (1 °C per day).

On the day the eggs are delivered:

- The water temperature must be between 4 and 6 °C.

From the delivery of the eggs to the stocking of fry:

- Once every two weeks, rinse the foam filter and replace a small part of the incubator water (about one third) with dechlorinated water.
  - Note: Allow the water to dechlorinate in a separate container (such as a bucket) for 72 hours. Refrigerate the water to cool it down as close to aquarium temperature as possible before pouring it inside.
- Remove dead eggs (white and dull-looking ones) using a baster to prevent the spread of fungus.
- Once the fry begin to swim and their yolk sac is gone, begin feeding them in small amounts (one small pinch per day).
  - Note: it is important not to overfeed them. If there is food left in the aquarium, it means they are being given too much. Keep a close eye on students if they are given the task of feeding the fry because they sometimes tend to overfeed. This can lead to the

development of fungi and bacteria, which can kill the fry.

Two weeks before the stocking of fry in the river, gradually increase the temperature of the incubator (1 °C per day) to meet the river's temperature:

- Prepare and plan the stocking of fry a few weeks in advance: transportation, location, material, etc. You can refer to the stocking protocol available on the FQSA website, www.saumonquebec.ca.

The stocking of fry:

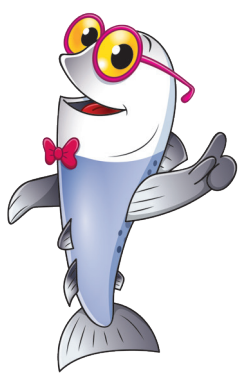
- Fry must be kept in fresh water at all times, in a bag or in a clean container.
- Stocking of the fry must be carried out in an authorized location according to the permit issued by the Ministry of Forests, Wildlife and Parks.
- Fill out your request for the stocking process and send it to the FQSA by email at secretariat@fqsa.ca.

After the stocking of fry:

- Clean the incubator components with running water or 10% bleach (1 part bleach to 9 parts water), rinse well and allow components to dry. Do not rinse the filter components (foam filter, carbon, ammonia neutralizer or Biomax) with bleach.
- Store components in a clean and dry place where they won't freeze.
- Store fry feed in the freezer or away from light and moisture.

We hope that the program has fulfilled your expectations and those of your students, and that it has helped raise awareness on the importance of our beautiful rivers how we should be respectful of the environment.

Thank you to all the students, teachers, and volunteers who continue to support us throughout Quebec for over 20 years !



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