Topic/Lesson:	**Migration**
Objectives:	Students will be able to: • Explain what migration is. • Demonstrate their knowledge of Atlantic sturgeon migration patterns as well as their motivation to do so. • Understand and compare some human movement with Atlantic sturgeon movement. • Explain potential risk factors that historical Atlantic sturgeon faced during migration. • Determine reasons Atlantic sturgeon were once unable to successfully migrate and spawn. • Create a comic book detailing the journey of an Atlantic sturgeon migrating to the Merrimack River to spawn in an historical scenario (Atlantic sturgeon do not presently spawn in the Merrimack River, but historically once did). Students will choose whether or not the sturgeon will successfully migrate and spawn. • Appropriately use dialogue to tell a story in their comic book.
Materials:	• Composition paper • Pencils, erasers • Google map • Colored pencils, crayons, markers • Construction paper • Fish Migration paper • Migration Pitfalls paper • Stapler, staples, tape, string, hole puncher • Computers with internet – if possible • Comic books – to view as examples for modeling
Vocabulary:	• Migration/migrate • Spawn • Merrimack River • Estuaries • Anadromous • Natal homing • Dialogue • Historical • Scenario

	• Foraging • Rearing • Pollution • Dredging • Animals • Fishing; hunters • Fish-ways • Algal blooms • Dissolved oxygen
Procedures:	1) Begin class by posting the following question on the board; "Why might your parents decide to have your family move to another location or migrate?" 2) Give students a few minutes to brainstorm their ideas on paper. 3) Have students turn and tell some of their ideas to a partner at their table. 4) Have a class discussion, and list reasons students came up with on the board. 5) Next ask "Why might fish like the Atlantic sturgeon migrate?" 6) Continue with class discussion and brainstorming ideas. 7) Activate background knowledge of the "fish" classification group and their reproduction characteristics. 8) View Google map together. Trace the hypothetical path from the Atlantic Ocean to Haverhill (Merrimack River). 9) Have the students brainstorm potential reasons that Atlantic sturgeon may be unsuccessful in their spawning migration. 10) Distribute "Fish Migration" and "Migration Pitfalls" papers. Read them with the class. Distribute Comic Book Guidelines and discuss. Review a few examples of actual comic books and leave up front for students to view and refer to. 11) If working in partners, assign partners; if working independently, go over materials and supplies needed and the rubric for the assignment. 12) Allow students to work on their comic books. If the class has access to the internet, it may be helpful to allow students to utilize this as a resource. 13) Teacher circulates and assesses by walking around. Perform small conferences with students, or pairs.

	14) Students must edit and revise their comic books before publishing and creating their final copy. 15) Students may present their finished copies to the class. Note: For students with special accommodations, you can shorten the length requirement, and not grade spelling and grammar. **Other ways to have the students do this assignment:** 1) Have the students create one "Telephone" comic book. Have one student complete the first page or scene, and then have them pass it on to the next student who will do the second page/scene and so on. 2) As a class, create a "Choose Your Own Adventure" Comic book. Assign the students different pages and scenarios to work on. 3) You can give the students a word bank (you can use the Vocabulary section (above) as an example) and require the students to use a certain number of those words in the comic book.
Accommodations/ Modifications:	• Preferential seating • Peer partnering/cooperative learning • Multiple step instructions • Teacher modeling – providing real life examples • Step-by-step written instructions • Rubric • Project based learning

SCUTES
Students Collaborating to Undertake Tracking Efforts for Sturgeon

Fish Migration

For reproduction, some fish migrate to certain areas for spawning. Fish that migrate from freshwater to saltwater and vice versa are called **diadromous**. Migrations that leave from the freshwater rivers and lakes, and head down to estuaries, seas, and oceans for spawning, are called **catadromous** migrations. American eels have catadromous migrations. This means they spend parts of their life-cycle in rivers and lakes, but migrate and travel through estuaries to the ocean for spawning. Migrations that leave from oceans, seas, and estuaries, and head up rivers and into lakes for spawning, are called **anadromous** migrations. Species such as the Atlantic salmon, river herring, and Atlantic sturgeon have anadromous migrations. This means they spend parts of their life-cycle in the ocean, but migrate and travel through estuaries to rivers and lakes for spawning. Some anadromous fish, like the Atlantic salmon, soon die after only making the migration and spawning once in their short life. Atlantic sturgeon, however, are able to migrate and spawn several times during their lifetime. Generally, fish begin their migration together, congregating in groups that grow until the temperature and time for spawning is right. Thus some fish will enter the mouth of a river together over a short period of time; this is when a fish starts its 'run'. Before migration, the fish have lived in smaller schools dispersed around their feeding areas in the marine environment.

Atlantic Sturgeon

Atlantic sturgeon spend their winters in deep coastal waters. When winter ends they begin migrating up and down the coast to foraging and spawning grounds in the coastal estuaries and rivers. Atlantic sturgeon use estuaries for foraging grounds and also rearing grounds for juveniles. For spawning, they usually travel to their natal river which is a process is called natal homing. A natal river is the river where they were originally hatched. Spawning grounds are found above the salt wedge in rivers, and are usually places with flowing water and a bottom consisting of gravel, pebbles, and cobble. When they arrive at the spawning grounds, females release eggs which are very sticky and attach to the pebbles and gravel. Males then swim over the eggs spreading milt which fertilizes the eggs and creates embryos.

The embryos will hatch into larvae within 3-6 days. At first, larvae have the yolk sac from the egg still attached to them that provides food and nourishment. This stage is called the yolk sac larval stage and lasts about 8-12 days. When the larvae or fry are finished with the yolk sac and are more mobile, they begin migrating downstream to the rearing grounds in the estuary, and use rocks and aquatic plants for hiding. As the fry continue to grow they are called fingerlings and continue to become more mobile. They feed on zooplankton, aquatic plants, and insect larvae. When they become juveniles, they move further downstream to the estuaries and brackish waters which are a mixture of salt and fresh water. Juveniles then stay in the estuaries for months or even years. They are considered to be sub-adults by the time they leave the estuary and begin migrations. Sub-adults look the same as adults, but have not yet reached reproductive maturity. Adults and sub-adults migrate along the coast to their wintering habitats and then begin the whole migration all over again in the spring.

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Migration Pitfalls

Fishermen/Hunters – Atlantic sturgeon were targeted by hunters or fishermen for their meat, skin, and roe (eggs).

Bycatch/Nets - Atlantic sturgeon are sometimes caught as bycatch in some fisheries. Atlantic sturgeon are particularly vulnerable to fisheries that fish with gill nets. The fishery practices commonly used with gill netting involves setting and leaving nets for long periods of time, anywhere from several hours to days. Atlantic sturgeon swim into these nets and can get stuck. If their gills get closed shut by the nets, they can suffocate and die. Another threat posed by nets is what happens when nets are lost. Due to weather, storms, and rough waters, nets can break free and get lost. These are called "ghost nets" and can float around the ocean and rivers entangling sturgeon as well as other marine fish, mammals and sea turtles.

Dams - Dams on rivers pose another threat to Atlantic sturgeon. Dams were constructed on many rivers along the east coast. They were made for many reasons including the production of electricity through hydropower and for diversion of water for agriculture. Dams can be harmful to Atlantic sturgeon by blocking the way to their spawning grounds. If they are unable to reach their spawning grounds, they may choose to not spawn at all, or may end up spawning in an area that is not suitable for the development of embryos. Many dams have special fish ladders or fish ways that are designed to allow for the passage of fish upstream of the dam. Sturgeon, however, do not use the fish ways to pass the dam, and even if they did, there have not yet been suitable methods designed for passage downstream.

Pollution – Pollution can be harmful to an Atlantic sturgeon's ability to migrate, spawn, and survive. Pollution can be caused by many different actions, and can include run-off from agricultural sites, roadways, construction sites, and pesticide applications. All of these things can affect water quality. A couple factors that affect water quality are dissolved oxygen and temperature. Run-off from agricultural sites can include fertilizer which can cause harmful algal blooms. When algae blooms, it can take oxygen out of the water which can kill fish and other aquatic life. Temperature is another factor that can affect the migration spawning cues for sturgeon. The spawning migration is tied-in with the rise in temperature in the spring. Hatching time and egg development are also dependent on temperature.

Name: _____

Comic Book Guidelines

1) Your comic book must be at least 8 pages long.

2) Your main character must be a historical Atlantic sturgeon that was born in a specific river on the East coast of the U.S.

3) The comic book must contain dialogue, using quotations.

4) The story must begin with your main character in the Atlantic Ocean, attempting to migrate to their natal river.

5) The story must end with your main character in their natal river; either having successfully or unsuccessfully spawned.

6) Your finished product must be error free; no spelling mistakes. It must be neat and well organized.

7) The comic book must be illustrated. The pictures must be accurate.

8) Your comic book must detail the sturgeon's migration from the ocean to the river. You must convey in your comic book, the historical scenario of why the Atlantic Sturgeon migrates from the Atlantic Ocean to their natal river, the process of migrating, as well as the outcome; spawning or reproduction - the species lives on. If your sturgeon does not spawn, you must give the specific reason why your Atlantic sturgeon was unable to migrate from the Atlantic Ocean to the spawning grounds, and present the topic of how not successfully migrating, and therefore not successfully spawning, will affect the entire Atlantic sturgeon species.

9) The comic book must have a story to it. It should include supporting characters, and possible, realistic experiences that the sturgeon may encounter.

10) You must create a cover for your comic book, with a title.

Comic Book Rubric

Guideline Number	Possible Points	Points Earned
# 1	10	
# 2	10	
# 3	10	
# 4	10	
# 5	10	
# 6	10	
# 7	5	
# 8	20	
# 9	10	
# 10	5	