

Topic/Lesson:	Beating Extinction: Atlantic Sturgeon
Subject:	Relating extinction of species to mismatch of adaptation and the changing environment
Author:	Kate Sundquist
Time Duration:	Five days
Overview:	Students will learn how a species can be become extinct if a mismatch exists between its adaptations and its environment. Students will learn this through explicit instruction, reading, and the use of a board game. They will use the Atlantic sturgeon as a case study and will relate its adaptations to the changing environment in which it lives. Students will learn about the various ways in which the sturgeon has been well adapted to its environment, and the various threats to its existence. Learning will be reinforced through a board game that the students design together in small groups. The board game should reinforce their knowledge of six specific adaptations that make Atlantic sturgeon well-suited to their environment, three specific threats to the environment, and the phases of the sturgeon life cycle. To assess their knowledge, students will write a paragraph describing why Atlantic sturgeon are currently listed under the Endangered Species Act (ESA).
Objectives:	<p>Students will be able to:</p> <ul style="list-style-type: none"> • Name specific environmental and physical threats to Atlantic sturgeon and explain how these factors put sturgeon at risk of extinction. • Relate the mismatch of adaptation and environment to the extinction of a species. • List basic adaptations and life cycle stages of sturgeon.
Background Knowledge:	<ul style="list-style-type: none"> • Students should understand that an organism’s habitat provides for its basic needs, including nutrients and shelter. • Students should be able to give examples of how adaptations to changes in the environment enable organisms to survive, e.g. shape of beak or feet, placement of eyes on head, length of neck, shape of teeth, color, etc.
Materials:	<ul style="list-style-type: none"> • Poster board for displaying anchor charts and student work, and possibly for creating game boards as well. • Atlantic and Shortnose Sturgeon Information Packet (“Historical & Current Spawning Grounds” PowerPoint presentation located in the Sturgeon Information section of the binder and in the Sturgeon

	<p>Information folder on the cd)</p> <ul style="list-style-type: none"> • Information Packet Worksheet • Sturgeon Illustration Assignment and Rubric • Poster boards or large construction paper, and drawing materials (markers, crayons, colored pencils, etc.) for sturgeon illustration assignment. • Atlantic Sturgeon Life Cycle Worksheet • Board Game Assignment and Scoring Rubric • Board Game Supplies: Teacher may source independently or see resource websites listed with this lesson to locate printable game boards, spinners, number cubes, etc. • Atlantic Sturgeon Threats to Environment Writing Prompt • Writing Prompt Scoring Rubric • Self-assessment
<p>Vocabulary:</p>	<p>Organism: An individual animal, plant, or single-celled life form.</p> <p>Environment: The circumstances, objects, or conditions surrounding an organism.</p> <p>Habitat: The area where an organism normally lives or occurs.</p> <p>Species: One of the basic units of biological classification, a group of organisms capable of interbreeding and producing offspring.</p> <p>Adaptation: A physical or behavioral characteristic that has developed to allow an organism to better survive in its environment.</p> <p>Extinction: The end of a species normally occurs when a species cannot adapt to changes in its environment or compete effectively with other organisms.</p> <p>Endangered: A species that is at high risk of becoming extinct.</p>
<p>Procedures:</p>	<p>Day One</p> <p>The teacher breaks the students into groups and presents each group with a set of “Blank Vocabulary Cards.” The groups are asked to develop their own definition for each word without using a dictionary. They are also asked to come up with an example of each vocabulary word. After 10 minutes, the teacher asks for volunteers to share their definitions and helps to correct any misperceptions. The class develops an anchor chart to display the relevant vocabulary.</p> <p>Students are told that this week they will be studying how a species becomes extinct. The teacher asks if anyone has any ideas about how this might happen. If students do not talk about adaptation to environment, the teacher should</p>

bring it up. Ask students to think about ways in which various species are well adapted to their environments. In partners, students come up with an example of a species that has adapted to its environment, e.g. a giraffe's long neck, a lobster's claws, a pelican's beak, etc. Students share these examples with the class and for each one, the teacher poses the question: *How would this organism be affected if it did not have this adaptation? How would this organism be affected if its environment suddenly changed?* The teacher should try to come up with specific examples of hypothetical environmental threats to each species volunteered by students.

Day One Homework

Students are told that to study extinction this week, they will be learning about the Atlantic sturgeon, which are protected under the Endangered Species Act (ESA). For homework, students read (or re-read, if they have already read the packet in another subject area) an Atlantic and shortnose sturgeon information packet called "Historical & Current Spawning Grounds." They will then answer questions on the "Information Packet Worksheet."

Day Two

Students begin class by reviewing their homework and correcting it together. The teacher then breaks the students into small groups and asks each group to create a poster of the Atlantic sturgeon. The poster should show an Atlantic sturgeon in one of its natural environments. The students must label the various adaptations on the sturgeon's body, and must identify in the natural environment illustrated at least three threats to the sturgeon. Students receive "Sturgeon Illustration Assignment" and rubric. After half an hour, students share their group's work. The teacher uses the sharing time to create an anchor chart showing sturgeon adaptations and threats to the sturgeon's environment. For each threat, the teacher poses the question: *Could the Atlantic sturgeon adapt to this threat? How? Do you think it will? Why or why not?*

Day Two Homework

Students read the "Atlantic Sturgeon Life Cycle Worksheet" to prepare for the board game that they will create during Day Three. Students will use the illustrations from the Sturgeon Information Packet to create their own sturgeon life cycle.

Days Three and Four

Students are broken into groups to create board games using the "Atlantic Sturgeon Board Game Assignment and Rubric" sheet. In order to inspire the students, the Adaptation game that is included in the SCUTES kits may be played beforehand. Groups are given supplies for creating board games.

Note: This assignment can be adjusted to have each group focus on a single issue (i.e. overfishing, dams, etc.) involving sturgeon, and they can develop a

	<p>game to easily explain the issue to other students.</p> <p>To make this lesson shorter, students can suggest other questions or changes to the already made Adaptation game that is included in the SCUTES kit.</p> <p>Day Five</p> <p>Students set up their board games and rotate through games to play one another's games.</p> <p>Final Homework</p> <p>Students complete the "Atlantic Sturgeon Threats to the Environment" writing prompt which can also be used as a final assessment.</p>
Conclusions:	<p>Students share their "Atlantic Sturgeon Threats to the Environment" writing prompt homework with a partner, and they score each other's work using the Writing Prompt Scoring Rubric. Students complete a self-assessment.</p>
Massachusetts State Education Standards:	<p>Life Science (Biology) Grades 6-8:</p> <p><u>Evolution and Biodiversity</u></p> <p>12. Relate the extinction of species to a mismatch of adaptation and the environment.</p>
Resources:	<p>http://www.greateratlantic.fisheries.noaa.gov/protected/scutes/teachers/science/adaptation.pdf</p> <p>http://www.gov.mb.ca/conservation/sustain/adapt.html</p> <p>Sources for printable board game materials:</p> <p>http://jc-schools.net/tutorials/gameboard.htm</p> <p>http://people.uncw.edu/ertzbergerj/word_games.html</p> <p>http://donnayoung.org/homeschooling/games/game-boards.htm</p> <p>http://donnayoung.org/homeschooling/games/game-cards.htm</p> <p>http://www.webeans.net/hutt/gamespinners.htm</p> <p>http://printables.atozteacherstuff.com/435/cube-pattern/</p>

Organism

Definition:

Environment

Definition:

Habitat

Definition:

Species

Definition:

Adaptation

Definition:

Extinction

Definition:

Endangered

Definition:

Organism

Definition: An individual animal, plant or single-celled life form.

Environment

Definition: The circumstances, objects, or conditions surrounding an organism.

Habitat

Definition: The area where an organism normally lives or occurs.

Species

Definition: One of the basic units of biological classification, a group of organisms capable of interbreeding and producing offspring.

Adaptation

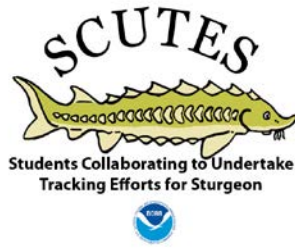
Definition: A physical or behavioral characteristic that has developed to allow an organism to better survive in its environment.

Extinction

Definition: The end of a species, normally occurs when a species cannot adapt to changes in its environment or compete effectively with other organisms.

Endangered

Definition: A species that is at high risk of becoming extinct.



Name: _____

Date: _____

Sturgeon Information Packet Worksheet

1. Why are sturgeon sometimes referred to as a “living fossil”?

2. What is an *anadromous* fish? Where do they live during different parts of their lives?

3. When does an Atlantic sturgeon reach sexual maturity?

4. Now, think about other species we have studied or with which you are familiar. Do these species take longer or shorter to reach sexual maturity? How does the length of the Atlantic sturgeon life cycle affect their survival as a species?

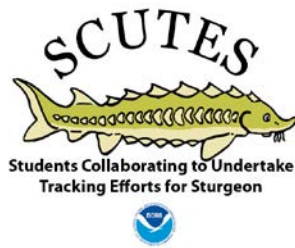
5. What is homing fidelity?

6. Name two current threats to sturgeon populations and describe how they affect these populations.

7. In how many rivers are Atlantic sturgeon currently spawning? How does this compare with historical spawning grounds?

8. The chart below lists some adaptations that sturgeon have that help them to survive. For each adaptation, write why it might be advantageous.

Adaptation	Purpose of Adaptation
Mouth is <i>ventral</i> , meaning on the bottom of the head.	
Mouth is sucker-shaped and protrusible.	
4 barbels between mouth and snout	
Small eyes	
Bony <i>scutes</i> along length of body	
Flat-bellied	
Young sturgeon have speckled coloration.	
Adult sturgeon are dark on top and light on their bellies.	



Name: _____

Date: _____

Sturgeon Information Packet Worksheet Answer Key

1. Why are sturgeon sometimes referred to as a “living fossil”?

Sturgeon are sometimes referred to as “living fossils,” because they date back to the Cretaceous period, 120 million years ago, and it is believed that their ancestors lived with the dinosaurs.

2. What is an *anadromous* fish? Where do they live during different parts of their lives?

An anadromous fish spends part of their life cycle in salt water and part in freshwater. Sturgeon are born in fresh water, spend most of the lives in the ocean, and return to fresh water to spawn.

3. When does an Atlantic sturgeon reach sexual maturity?

An Atlantic Sturgeon reaches sexual maturity around 20 years old.

4. Now, think about other species we have studied or with which you are familiar. Do these species take longer or shorter to reach sexual maturity? How does the length of the Atlantic sturgeon life cycle affect their survival as a species?

Most species reach sexual maturity at a much younger age. Because Atlantic sturgeon do not reach sexual maturity until 20 years old, they are more likely to die before being able to reproduce. This makes the population of Atlantic sturgeon vulnerable because fewer fish are able to reproduce.

5. What is homing fidelity?

Homing fidelity means that these fish live in marine waters and will return to the rivers in which they hatched to spawn.

6. Name two current threats to sturgeon populations and describe how they affect these populations.

Answers will vary. Some might include:

Dams, locks, and hydroelectric power plants have all created barriers to migration.

Habitats are being destroyed.

Pollution.

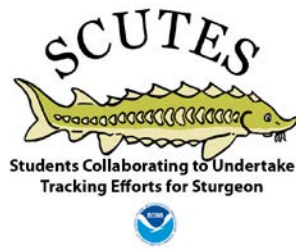
Incidental catch in commercial gill nets.

7. In how many rivers are Atlantic sturgeon currently spawning? How does this compare with historical spawning grounds?

Atlantic sturgeon are currently spawning in 33 rivers. They used to be present in approximately 38 rivers.

8. The chart below lists some adaptations that sturgeon have that help them to survive. For each adaptation, write why it might be advantageous.

Adaptation	Purpose of Adaptation
Mouth is <i>ventral</i> , meaning on the bottom of the head.	<i>Ventral mouths allow a fish to feed efficiently off the bottom.</i>
Mouth is sucker-shaped and protrusible.	<i>Sucker-shaped protrusible mouths allow a fish to feed efficiently off the bottom.</i>
4 barbels between mouth and snout	<i>Barbels help a fish to feel for or sense food.</i>
Small eyes	<i>Small eyes make a fish less visible to others and are possible when a fish has barbels to help with detecting food.</i>
Bony <i>scutes</i> along length of body	<i>Scutes act as armor to protect sturgeon.</i>
Flat-bellied	<i>Flat bellies allow sturgeon to sit close to the bottom and makes them less conspicuous to predators.</i>
Young sturgeon have speckled coloration.	<i>Speckled coloration allows young sturgeon to camouflage in estuaries.</i>
Adult sturgeon are dark on top and light on their bellies.	<i>Dark tops make sturgeon less visible to predators above them, and light bellies make them less visible to predators below them.</i>



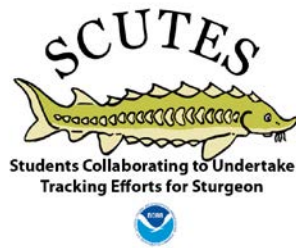
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Date: _____

Atlantic Sturgeon Illustration Assignment

Directions: In your group, you are going to create a poster to illustrate the adaptations of an Atlantic sturgeon to its environment, and some current threats to the sturgeon population. Using the attached rubric to guide your thinking, you will design a poster that shows an Atlantic sturgeon in one of its natural habitats. You will label physical adaptations on its body, and threats to its environment around it. Use your homework from last night. To begin your work, make a rough draft in the space below. Once your group has agreed on a design, you may gather your materials from the teacher.

Rough Draft Sketch:

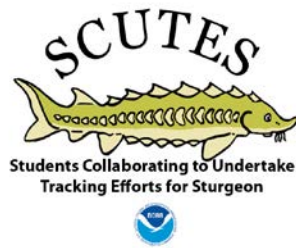


Name: _____

Date: _____

Sturgeon Illustration Rubric

SCORE	DESCRIPTION
4	The illustration demonstrates a thorough understanding of the physical adaptations and threats to the environment of an Atlantic sturgeon. It clearly and accurately illustrates and identifies at least six adaptations and at least three threats to the environment. The illustration includes a neat and relevant title and the names of all group members.
3	The illustration demonstrates a general understanding of the physical adaptations and threats to the environment of an Atlantic sturgeon. It clearly and accurately illustrates and identifies at least five adaptations and at least two threats to the environment. The illustration includes a neat and relevant title and the names of all group members.
2	The illustration demonstrates a limited understanding of the physical adaptations and threats to the environment of an Atlantic sturgeon. It illustrates and identifies at least three adaptations and at least one threat to the environment. The illustration includes a title and the names of all group members.
1	The illustration demonstrates a minimal understanding of the physical adaptations and threats to the environment of an Atlantic sturgeon. It illustrates and identifies at least one adaptation. The illustration includes a title and the names of all group members.
0	The response is incorrect or contains some work that is irrelevant to the skills or concept being measured.



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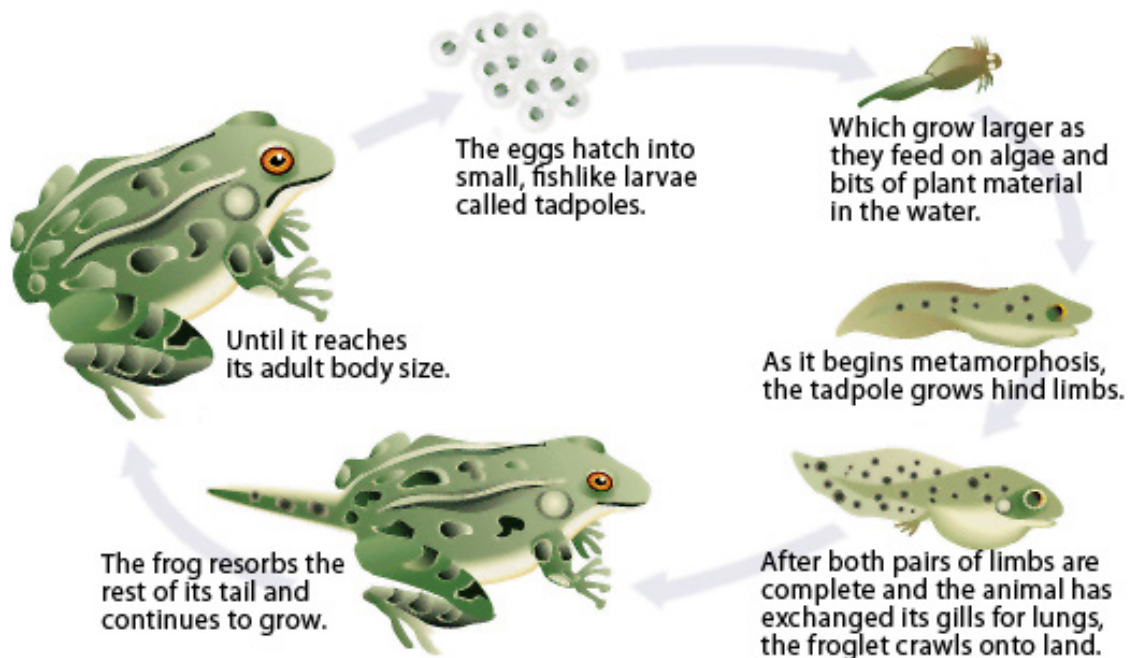
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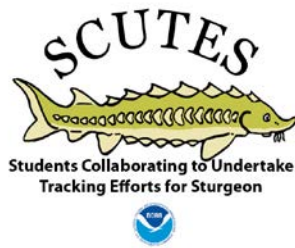
Atlantic Sturgeon Life Cycle Worksheet

Directions: Tomorrow, you will design a board game to teach about the life cycle of Atlantic sturgeon and its current race against extinction. As you have already learned, Atlantic sturgeon can take 20 years to reach sexual maturity, and the many threats on their environment can sometimes make it difficult for sturgeon to reach this phase in their lives. Without sexually mature adults, the species will not be able to reproduce and will die. Before you challenge yourself to race against the extinction of Atlantic sturgeon, you'll need to make sure you know about the life cycle of a sturgeon.

Please read the Life Cycle section of the Sturgeon Information Packet you previously received. Once you have learned all of the phases of a sturgeon's life cycle, cut out the sturgeon life cycle illustrations from the information packet. You will use them to illustrate the complete life cycle of a sturgeon. You should paste them in order on the back of this page. For each illustration, label it with the name of the phase it illustrates and write a brief description of this phase.

Below is an example of a frog's life cycle. Your illustration of a sturgeon's life cycle should be similar.





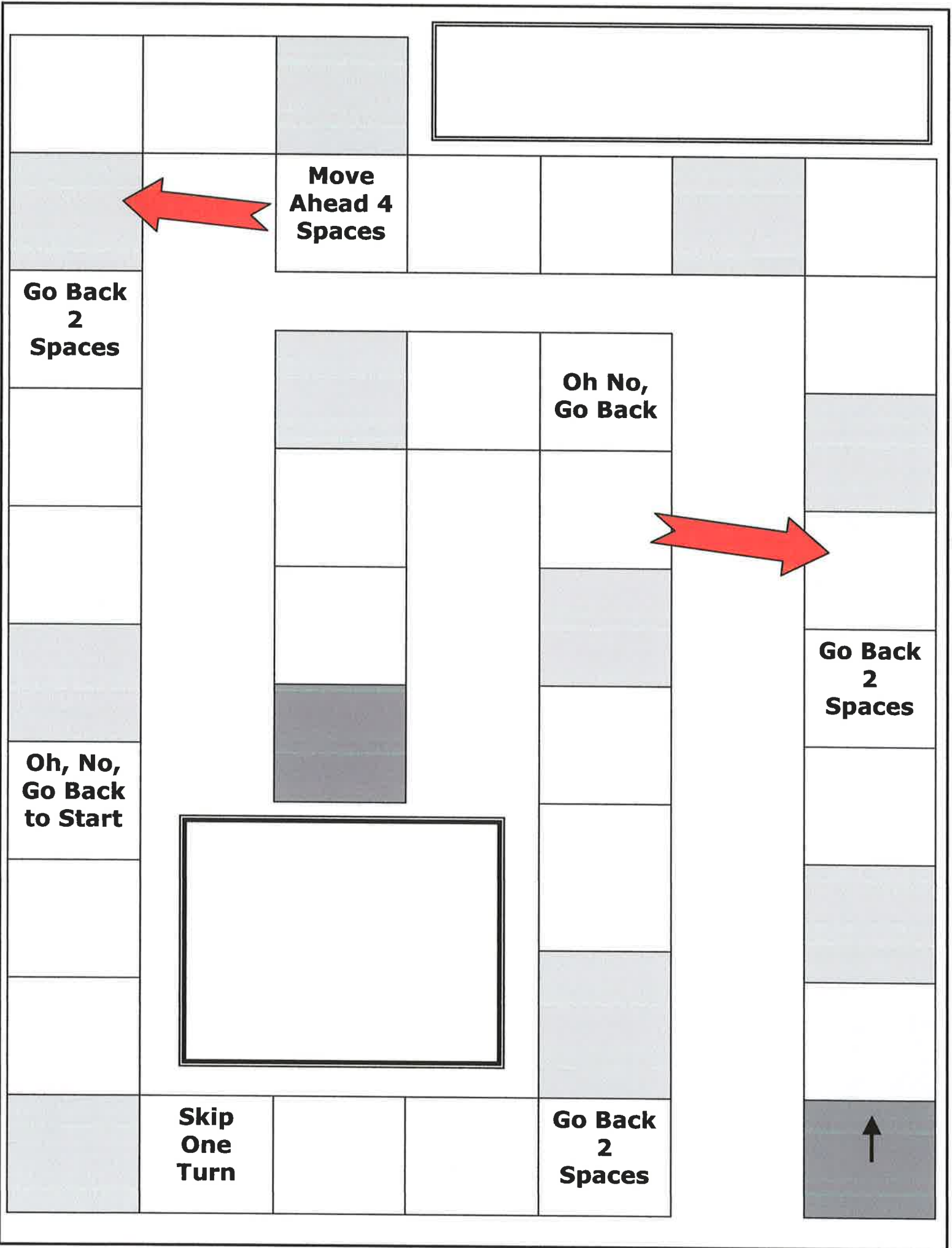
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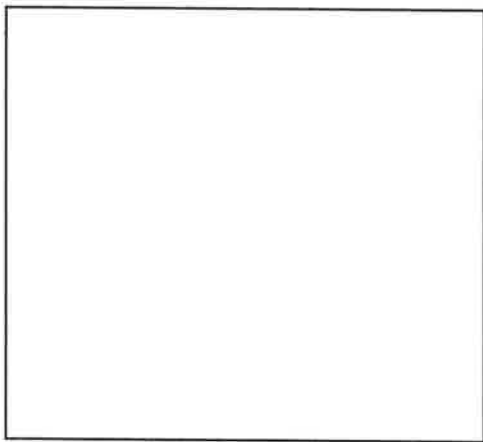
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Atlantic Sturgeon Board Game Assignment

Directions: During this class period, you will work with your group to create a board game about Atlantic sturgeon and their fight against extinction. You will be provided with several game board templates, spinners, and game pieces to use. Please use the rubric below to help guide your thinking.

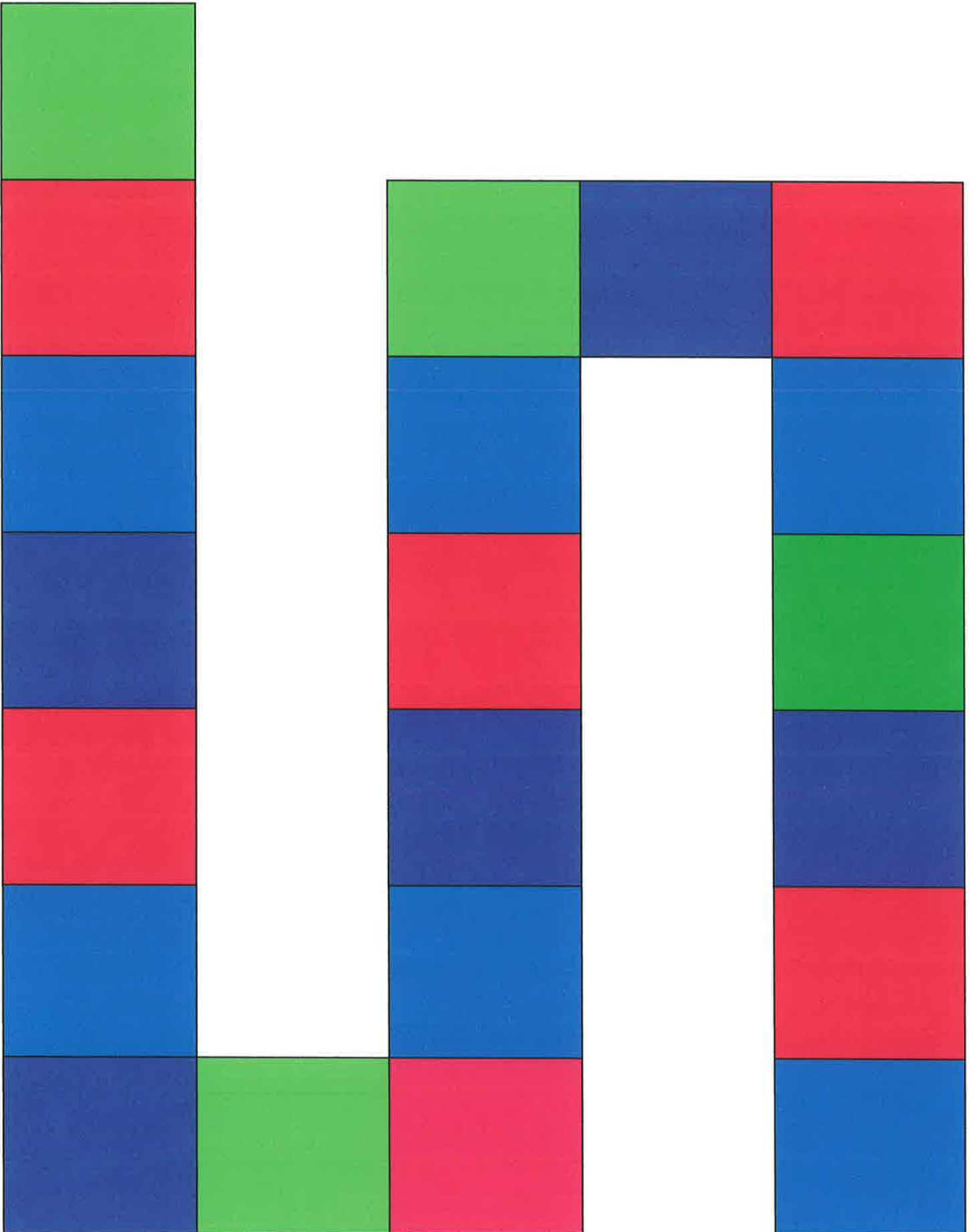
	4	3	2	1
CONTENT	The board game reinforces at least six specific adaptations of Atlantic sturgeon that make them well-suited to their environment, and at least three specific threats to these environments. The board game also includes each of the six phases in an Atlantic sturgeon's life cycle.	The board game reinforces at least four specific adaptations of Atlantic sturgeon that make them well-suited to their environment, and at least two specific threats to these environments. The board game also includes each of the six phases in an Atlantic sturgeon's life cycle.	The board game reinforces at least three specific adaptations of Atlantic sturgeon that make them well-suited to their environment, and at least one specific threat to these environments. The board game also includes some of the phases in an Atlantic sturgeon's life cycle.	The board game does not reinforce at least three specific adaptations of Atlantic sturgeon that make them well-suited to their environment, nor at least one specific threat to these environments. The board game also does not include the phases in an Atlantic sturgeon's life cycle.
FORMAT	The board game has clear directions and is easy for players to understand. It has a clear title and clear objectives.	The board game has directions and is relatively easy for players to understand. It has a clear title and relatively clear objectives.	The board game has vague directions and may not be easy for players to understand. It has a clear title and but its objective may be somewhat unclear.	The board game is missing key elements such as directions, title, or clear objectives.
CREATIVITY	The board game is designed with unique creativity and special care is given to its aesthetic appeal.	The board game is designed with some creativity and care is given to its aesthetic appeal.	The board game is designed with minimal creativity and little care is given to its aesthetic appeal.	The board game is not designed with creativity or care for aesthetic appeal.





Rules Box





START

Go ahead 2 spaces

Take the Shortcut Pass

Take an extra turn

Go back 2 spaces

Miss one turn

Go ahead 2 spaces

Go back 2 spaces

Go ahead 2 spaces

Go back 2 spaces

Go back 2 spaces

END

Go back 2 spaces

Miss one turn

Go back 2 spaces

Go ahead 2 spaces

Take the Shortcut Pass

Take an extra turn

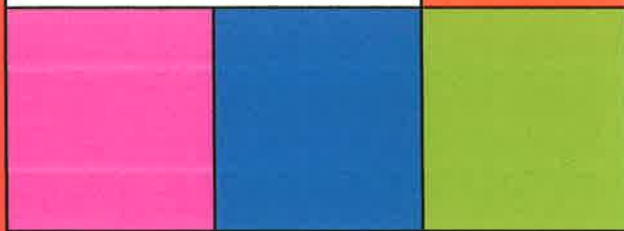
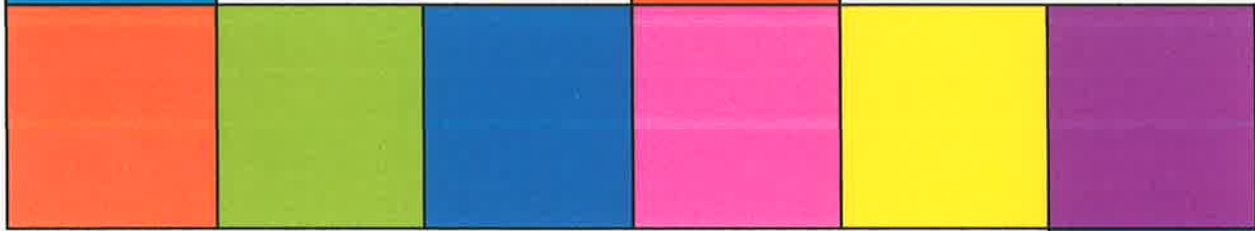
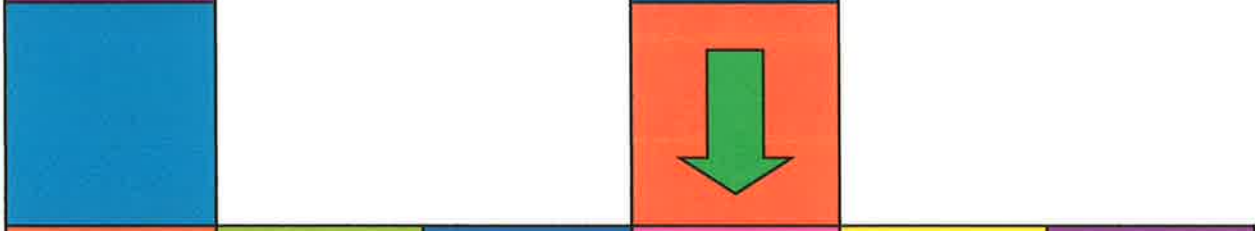
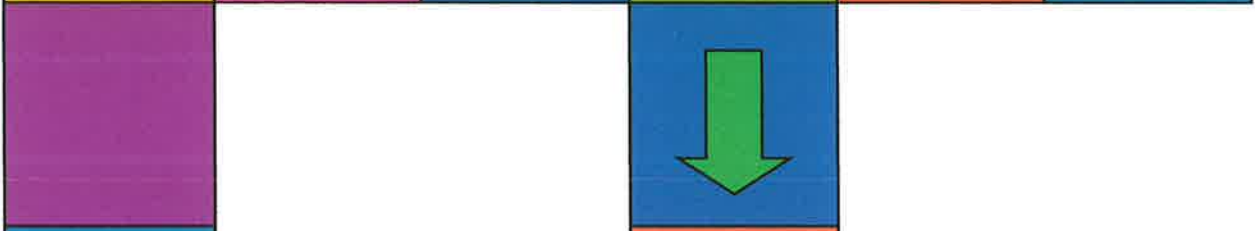
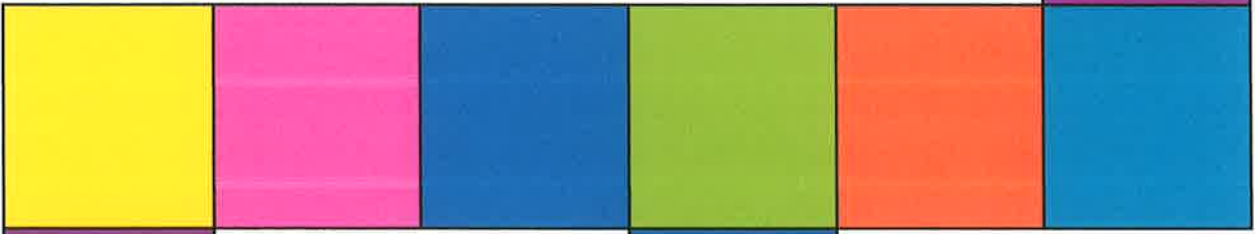
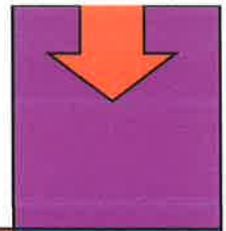
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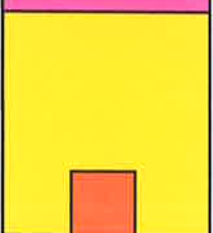
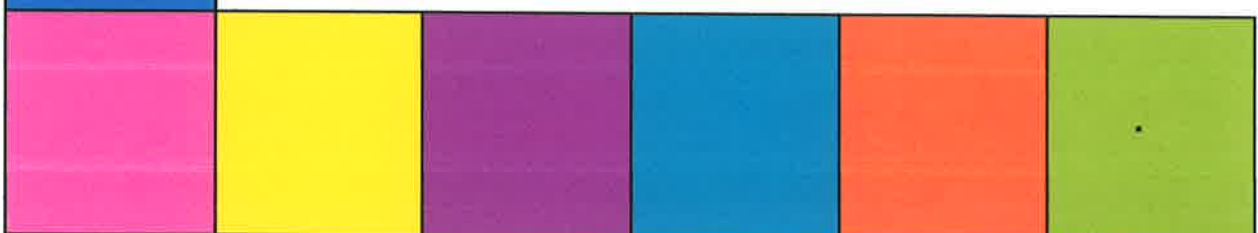
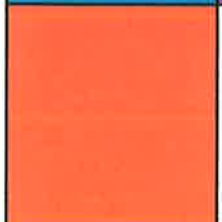
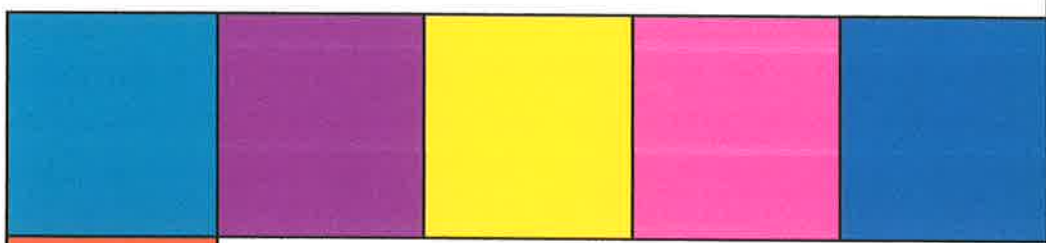
Take an extra turn

Take an extra turn

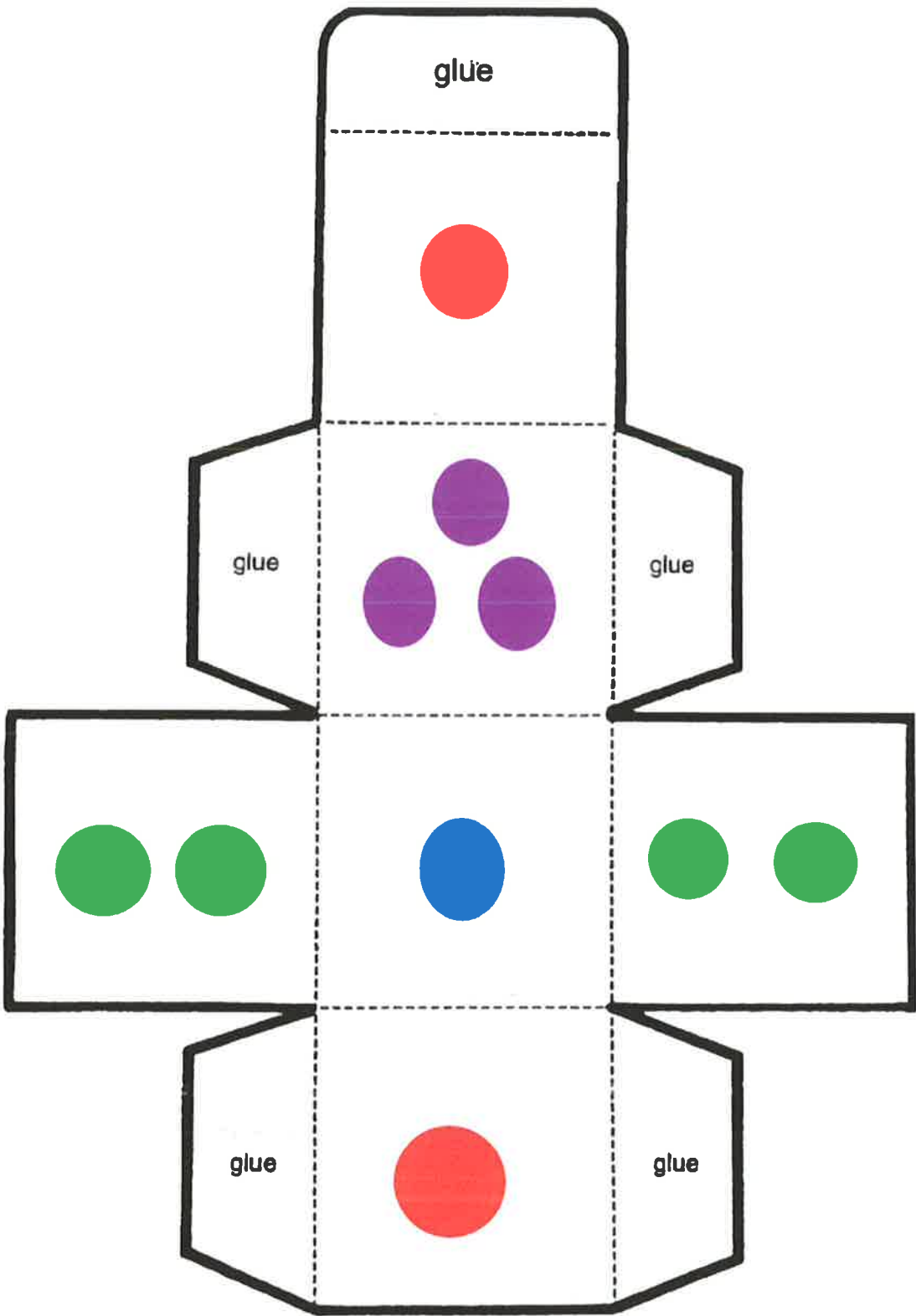
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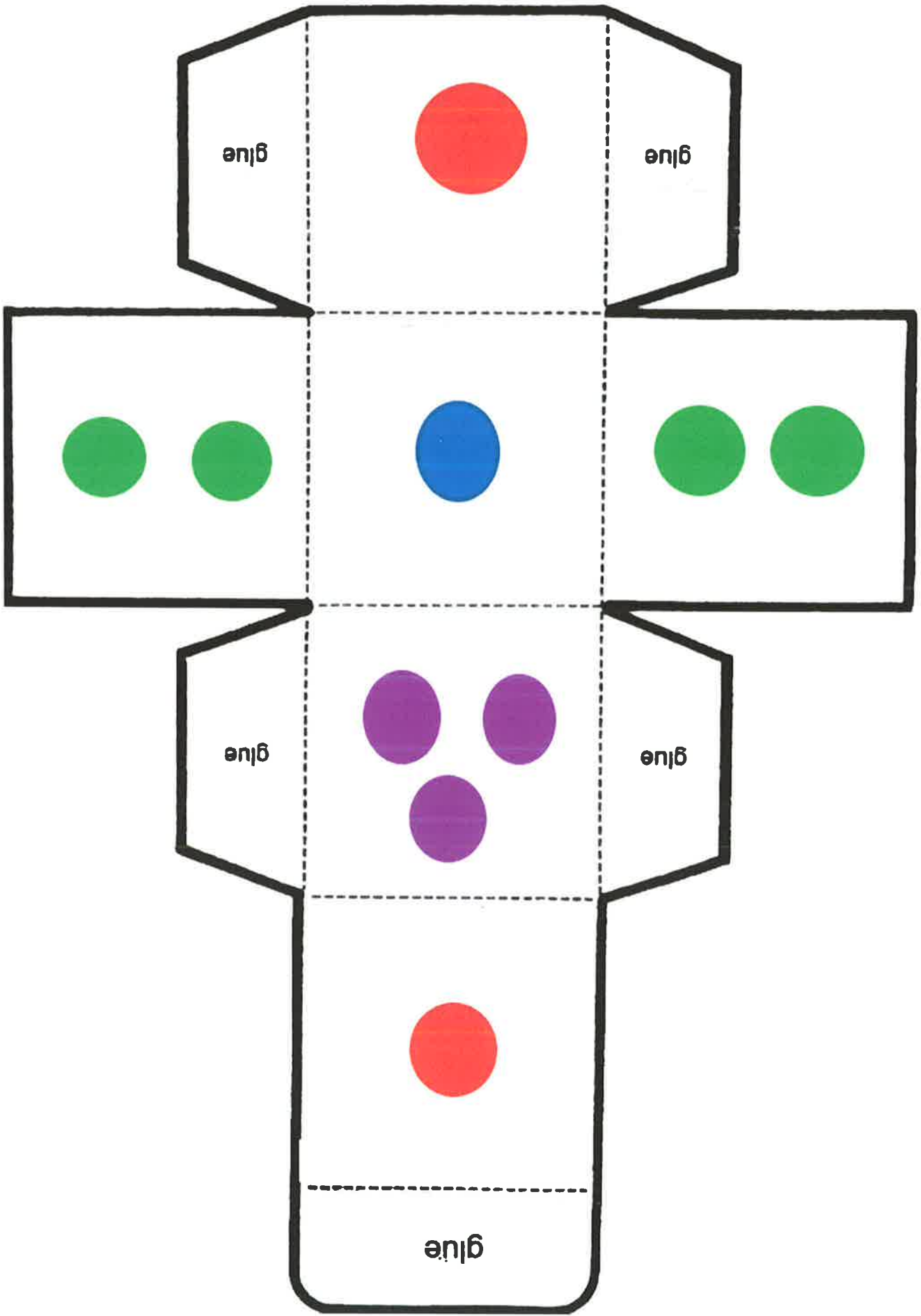


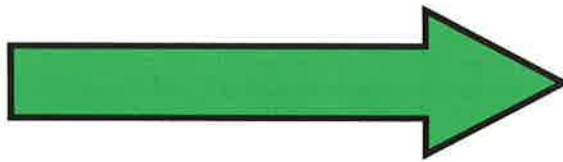
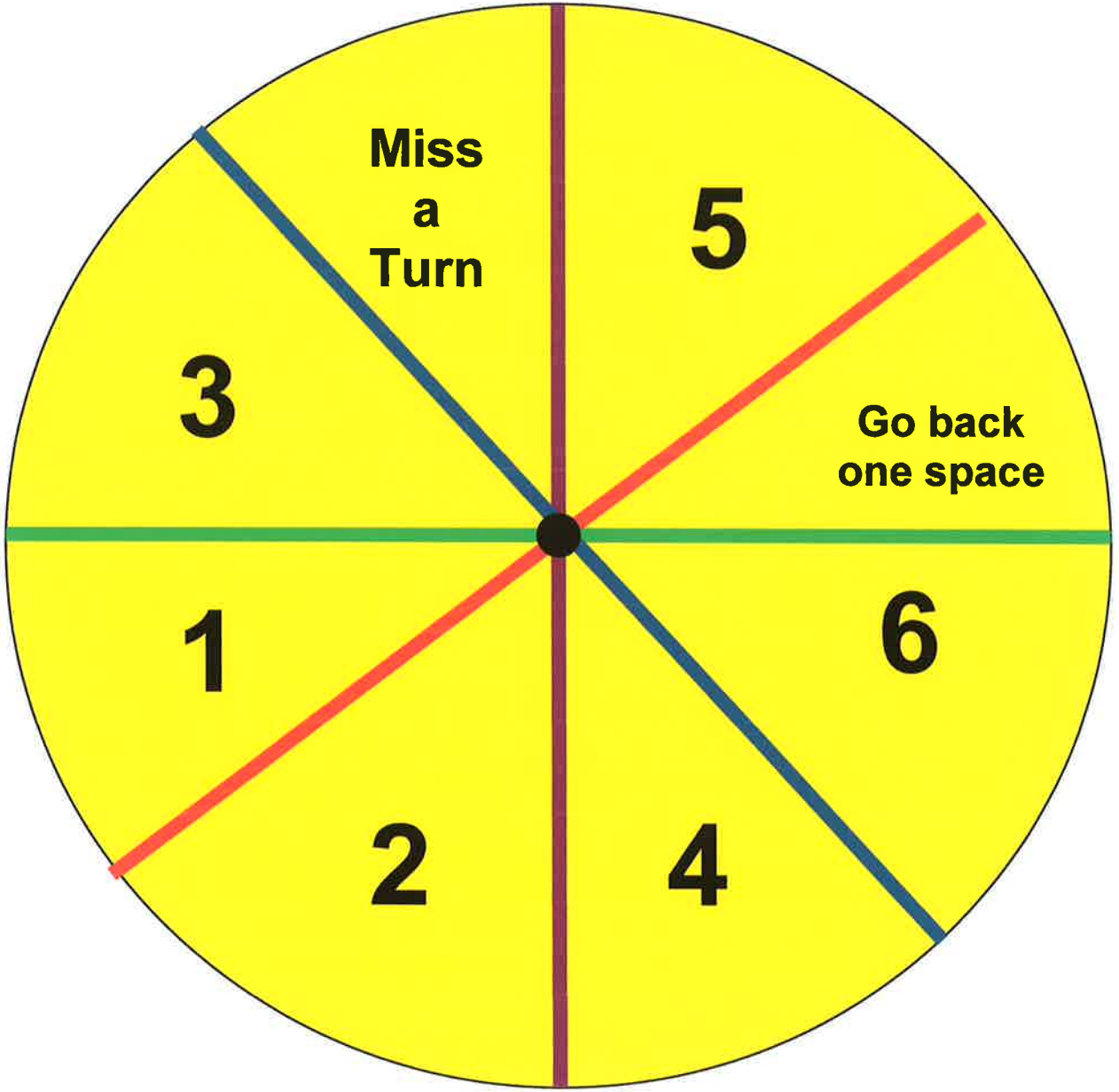


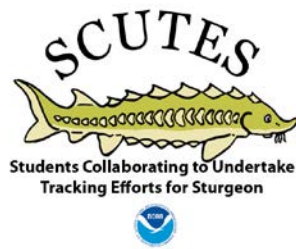


**Game
Cards**









Name: _____

Date: _____

Rubric for Threats to the Environment Writing Prompt

SCORE	DESCRIPTION
4	The response demonstrates a thorough understanding of the Atlantic sturgeon's adaptations to the environment, specific threats to this environment, and the relationship between extinction and a mismatch between adaptation and the environment.
3	The response demonstrates a general understanding of the Atlantic sturgeon's adaptations to the environment, specific threats to this environment, and the relationship between extinction and a mismatch between adaptation and the environment.
2	The response demonstrates a limited understanding of the Atlantic sturgeon's adaptations to the environment, specific threats to this environment, and the relationship between extinction and a mismatch between adaptation and the environment.
1	The response demonstrates a minimal understanding of the Atlantic sturgeon's adaptations to the environment, specific threats to this environment, and the relationship between extinction and a mismatch between adaptation and the environment.
0	The response is incorrect or contains some work that is irrelevant to the skills or concept being measured.