Bonefish Genetics

What does it take to protect a species?

Grade Level: 9th – 12th

Lesson Summary:

Recent research has shown that bonefish (*Albula vulpes*) found all around the Florida Keys, The Bahamas, and many other places across the Caribbean are genetically related. In this lesson, students will learn about what it means to be "genetically related," how genetics are determined, and how this could change how we manage bonefish populations locally and internationally. They will work together in to create an international fisheries management plan that protects bonefish across the Atlantic, Gulf, and Caribbean.

Standards:

SC.912.L.17.3 – Discuss how various oceanic and freshwater processes, such as currents, tides, and waves, affect the abundance of aquatic organisms.

SC.912.L.17.5 – Analyze how population size is determined by births, deaths, immigration, emigration, and limiting factors (biotic and abiotic) that determine carrying capacity.

SC.912.L.17.8 – Recognize the consequences of the losses of biodiversity due to catastrophic events, climate change, human activity, and the introduction of invasive, non-native species.

SC.912.L.17.12 – Discuss the political, social, and environmental consequences of sustainable use of land.

SC.912.L.17.13 – Discuss the need for adequate waste management strategies.

SC.912.L.17.20 – Predict the impact of individuals on environmental systems and examine how human lifestyles affect sustainability.

Project Activity Assessment

Conservation usually requires some sort of law or policy in order to be effective. In the case of bonefish, many different countries must cooperate in order to help the population grow. In this activity, students will experience just how difficult this type of cooperation can be. Using the bonefish as a model, they will consider the different habitats and the migration routes this species are likely to use, and come up with a cooperative conservation plan.

The major goals of this activity are:

1. to clarify the bonefish life cycle and emphasize the role of different habitats in the growth and development of the species;
2. to think critically about the different factors involved in environmental policy, and how each decision will have costs and benefits;
3. and to consider how science can influence policy.

Procedure:

- Students should read the "Bonefish Genetics" document prior to class, taking notes and referring to the vocabulary listed at the bottom of the reading.

- For this exercise, students break into 8 groups, where each group will represent one of the countries where bonefish DNA was collected: The United States, The Bahamas, Mexico, Cuba, Honduras, Nicaragua, the Cayman Islands, and Puerto Rico (a U.S. territory).

- Each group will represent each of the nations in an international fisheries management meeting. Together, they must develop a master, multi-national management plan for *Albula vulpes* that includes fisheries conservation, habitat protections, and water-quality protections.

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Standards Continued:

LAFS.910.RST.1.1 – Cite specific textual evidence to support analysis of science and technical tests, attending to the precise details of explanations or descriptions.

Resources:

BTT's Bonefish Genetics project:
https://www.bonefishtarpontrust.org/conservation/research/projects/btt-bonefish-genetics-program/
https://www.bonefishtarpontrust.org/blog/2018-11-28-btts-bonefish-genetics-study-reveals-connectivity-across-caribbean/

The Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement that prevents trade of endangered species.
https://www.cites.org/

Procedure continued:

- Ask the students to recognize that funding is extremely limited, especially in the poorer countries, and identify funding sources for enforcement, habitat restoration, and water-quality improvements.

- Give the groups 30 minutes to do some quick research on their countries and figure out what their positions will be. There is guidance for this on the "Preparation Tips" sheet.

- After this, answer any questions that may have come up and reiterate the structure of the meeting. You will be acting as the moderator for the meeting, but the students will be in charge of their negotiations. This part is done best in a large room, where students can move around and talk to each other, and it has the potential to be loud as students discuss in many groups.

- Walk around and listen to the negotiations. Students should be discussing habitat and water quality protections and fishing regulations, so gently guide them to these concepts if they are getting off topic.

- Near the end of the activity, bring the class back together and ask them what rulings they discussed. Write each ruling on the board.

- For each major ruling, hold a vote. Each country has one vote. If any countries do not vote and there is time, ask them why. Celebrate when rulings are voted into action!

Expansion:

- To expand this activity into multiple sessions, allow students time to research their countries in their groups (session 1) prior to the international meeting (session 2).

International Fishery Management Activity Rubric

AREA	1 Does Not Meet Expectations	2 Partially Meets Expectations	3 Meets Expectations	4 Exceeds Expectations
Science Content	NONE. Student does not exhibit or express the concepts of bonefish genetics with clear and defined examples.	SOME. Student exhibits a basic understanding of bonefish genetics but does not convey its importance or uses	MOST. Student grasps the concepts of bonefish genetics but lacks mastery of the subject.	ALL. Student grasps the principles and needs for bonefish genetics. Student can draw comparisons and need for citizen science.
Use of Scientific Vocabulary	NONE. Student does not use any introduced concept or use scientific vocabulary to form thoughts and narrative.	SOME. Student attempts to use scientific jargon, but fails to use it properly or in context. Shows some mastery of science language, but fails to use effectively.	MOST. Student uses significant scientific jargon, but fails to identify all principles and concepts. Student exhibits some mastery of scientific concepts and vocabulary.	ALL. Student effectively communicates using scientific jargon and vocabulary to convey narrative. Student has achieved mastery of vocabulary and concepts.
Participation	Student did not participate in the discussion or indicate any form of engagement.	Student participated in the discussion, but only briefly, and only answered direct questions that did not involve critical thinking (i.e., only regurgitated information).	Student participated in the discussion, and though maybe briefly, the student was able to offer a thoughtful idea or opinion that indicated that they were engaged, OR student actively participated but did not listen to other students.	Student actively participated in the discussion and consistently offered thoughtful ideas or opinions, AND student listened carefully to other students.
Conventions	Student did not consider large-scale consequences of their conservation plans during the activity, did not cooperate well with other groups, and did not attempt to mitigate negative impacts.	Student attempted to cooperate with other groups, but did not consider the large-scale consequences of the conservation plans being proposed or did not attempt to mitigate the negative impacts.	Student cooperated with other groups and reached agreements, but did not consider the large-scale consequences as completely as they should have, or missed an important concept.	Student cooperated with other groups and reached agreements, fully considered all the large-scale consequences of their plans to conserve bonefish, and attempted to mitigate negative impacts.