



### FOCUS

Environmental needs of spawning reef fishes

### GRADE LEVEL

9-12 (Biology)

### FOCUS QUESTION

What environmental conditions are necessary to ensure the success of spawning reef fishes?

### LEARNING OBJECTIVES

Students will understand that the ability of certain reef fishes to have a successful spawning is dependent on numerous environmental conditions.

Students will be able to list some of the factors needed by reef fishes in the South Atlantic Bight to have a successful spawn.

### ADDITIONAL INFORMATION FOR TEACHERS OF DEAF STUDENTS

In addition to the words listed as Key Words, the following words should be part of the vocabulary list.

Evolve  
Reef  
Habitat  
Territorial  
Spawning  
Aggregation  
Conducive  
Survival  
Fertilized  
Larvae  
Hatching  
Estuary

Upwelling  
Spawned  
Solitary  
Abundance

The key words are integral to the unit but will be very difficult to introduce prior to the activity. They are really the material of the lesson. There are no formal signs in American Sign Language for any of these words and many are difficult to lipread. It would be helpful to write the key words on the board prior to the lesson. They can then easily be referred to during the lesson. You may want to give the key words as a handout to your students. If some of the topics in the Background Information section have not already been introduced in your class, you may need to add an additional 20 minutes or so to teach vocabulary and some of the Background Information to the students prior to the activity. Write the rules to the game on the board so that the students can easily follow and access them.

### MATERIALS

- Card stock paper
- Six decks of "Spawn" cards

### TEACHING TIME

One 45-minute class period

### SEATING ARRANGEMENT

Groups of four students

### MAXIMUM NUMBER OF STUDENTS

24 students

### KEY WORDS

Chlorophyll densities  
Current  
Hard bottom habitat  
Phytoplankton  
Spawning aggregation

### BACKGROUND INFORMATION

Like all species, the reef fishes of the South Atlantic Bight, such as the gag grouper and red snapper, are dependent on the environment where they have evolved to live. Groupers and snappers are solitary, territorial fishes that claim a spot on a reef habitat and remain there almost the entire year. Though living alone in a territory provides these fishes with enough food, it does not provide the opportunity for congregating with large numbers of individuals of the same species for reproduction. To address this need, snappers and groupers and other territorial reef fishes will leave their territories at approximately the same time each year to come together into large spawning aggregations. Populations of these fishes will meet at the same site each year to release eggs and milt into the water for external fertilization. These aggregations once numbered hundreds or thousands of fishes because bringing many fishes together, all releasing thousands or even millions of eggs and sperm into the water, ensures the chances of successful fertilizations.

Scientists have noticed that these spawning aggregations only occur in places where certain environmental conditions are conducive to survival of newly-released eggs and sperm, the resulting fertilized eggs, and hatching larvae. Snappers and groupers tend to spawn on

rocky reef habitats that are in a current that will carry the eggs and larval fishes to a nearby area of high food production. In the South Atlantic Bight, these fishes form spawning aggregations around hard bottom habitats usually on the edge of the continental shelf. Though it is not certain why the fishes depend on reef habitats while spawning, one hypothesis is that as currents flow in the vicinity of these reefs, eddies and gyres are sometimes formed that will carry the eggs to areas where the tiny larval and juvenile fishes have a better chance of finding food and shelter.

Most of the reef fishes in the South Atlantic Bight spawn in the Gulf Stream. Some spawn in the gyres and eddies that spin off of the Gulf Stream towards shore. All of these currents lead to areas of high food production, either to inshore estuaries and salt marshes or to the Charleston Gyre. Estuaries and salt marshes have high food production because they are often at the mouths of freshwater rivers that are carrying a high nutrient load from inland sources. Nutrients in these rivers enter the estuaries, thus providing a nutrient-rich environment in which phytoplankton and marsh grasses grow. These plants, producing their own food, can in turn support a large community of animals from tiny herbivores to large predators, including the larval and juvenile offspring of spawning snappers and groupers. By spawning in currents that bring them inshore, these young fishes can find plenty of food and have a better chance of survival.

Young fishes also find plenty of food in the Charleston Gyre, but for different reasons. The Charleston Gyre is a current that spins inshore

off of the Gulf Stream. The Charleston Gyre carries the warm water of the Gulf Stream into the colder waters above the continental shelf. When warm water comes in contact with cold water, upwelling occurs. The colder, denser water sinks below the warm water. When it does, it stirs up the nutrients on the ocean floor that are left behind by decomposed marine organisms. These nutrients are carried to the surface as they are displaced upward by the colder, denser water. Near the surface waters, they are available to phytoplankton, and can support a large population of these microscopic plants. Like the plants in estuaries, the phytoplankton that results from upwelling can support a large community of animals. In the Charleston Gyre, upwelling is constantly occurring, and as a result, it is one of the highest areas of food production in the South Atlantic Bight. The larval reef fishes that are spawned in the Gulf Stream in the South Atlantic Bight are spun into the Charleston Gyre where the abundance of food offers a better chance of survival.

To spawn successfully, reef fish need hard bottom habitats in strong currents that can carry eggs and larvae to areas of high food production. To ensure successful spawning, all of these characteristics have to be available to these fishes. This is important because protecting ecologically and economically important fishes such as snappers and groupers cannot be guaranteed just through setting catch and size limits. As they are dependent on many factors of their environment, entire ecosystems need to be protected if their survival as a species is to be continued.

### LEARNING PROCEDURE

1. Print "Spawn" cards onto card stock and cut out each individual card. Print enough sets that the class can be divided into groups of four and each group can receive a deck of cards.
2. Discuss with the students how organisms adapt to their environment and how they become dependent on certain features of their environment in order to ensure their survival. Explain that the reef fishes of the South Atlantic Bight are an example of this. Explain that fishes, such as snappers and groupers, are solitary and live on reef habitats. When they spawn though, they come together in groups of hundreds or even thousands over reef habitats in currents that can carry eggs to areas that have an abundance of food. Explain that without these conditions, the resulting fertilized eggs and hatching larvae may not be in an environment suitable for survival.
3. Tell the students that they will be playing the card game "Spawn." Divide students into groups of four. Give each student group a deck of the "Spawn" cards and explain the rules. The object of the game is to have a hand that includes a card listing a reef fish, a card listing a rocky reef habitat, a card that lists a current, and a card that lists a nearby habitat with high food production. When all of these cards are in hand, the student has a successful "Spawn" and wins the game. The rules are very similar to those of "Gin." Cards are shuffled and each student is dealt four cards. The rest of the deck is placed face down in the center of the students. The top card is flipped over and laid face-up

next to the deck. The student to the left of the dealer goes first by taking the flipped over card or the card at the top of the deck. A student will finish his/her turn by discarding one card from his/her hand and placing it face up on the flipped over card. Students will keep the cards that make the best hand (those that together provide the conditions necessary for a reef fish to have a successful spawning) and should discard all other cards (such as non-reef fish, non-reef habitats, oceanic conditions without currents and nearby habitats with low food production), as these will not produce a winning hand. When the student has all four cards needed, the student will lay them face down, say “Spawn!” and be declared the winner. If all the cards in the face-down deck have been drawn and no one has successfully “spawned” (i.e., won), shuffle the cards in the face-up deck, place this deck face-down, flip the top card over to make another face-up deck, and continue playing.

4. Have students play a few hands to allow the connection between spawning reef fishes and the environmental conditions they need to successfully spawn.

#### THE BRIDGE CONNECTION

[www.vims.edu/bridge](http://www.vims.edu/bridge)

Choose “Biology,” then “Fishes” for information on life history of reef fishes.

#### THE “ME” CONNECTION

Have students collect menus from local seafood restaurants. How many of the fishes discussed in the activity show up on the menu? Discuss with students how these fishes might not be on

the menu if some of the environmental factors necessary for the successful spawning of snappers and groupers were somehow disturbed.

#### CONNECTIONS TO OTHER SUBJECTS

Social Studies/History

#### EVALUATION

Based on everything they have learned about the environmental needs of spawning reef fishes, have each student write a description of a fisheries management plan that would protect both the fishes and their environmental needs.

#### EXTENSIONS

Social Studies – Mapping. Have students search the Internet to find maps that show currents and chlorophyll densities (food production) and have them map potential places for reef fishes to spawn so that currents will carry their young to a food source.

Language Arts - Have students read the sections of *Song for the Blue Ocean* by Carl Safina on spawning groupers. Have them write a response to these sections, describing what they think about what man has done to grouper populations.

#### RESOURCES

<http://fwie.fw.vt.edu/WWW/macsis/fish.htm>

Detailed information on the life histories of fishes, including many of the reef fish found in the South Atlantic Bight.

[http://206.74.146.33/scaquarium/scaweb/curriculum/ie-xplore/sixth\\_eighth/units/reefs/reefs\\_back.htm](http://206.74.146.33/scaquarium/scaweb/curriculum/ie-xplore/sixth_eighth/units/reefs/reefs_back.htm)

Detailed information on reefs and reef fishes of the South Atlantic Bight.

<http://www.fishbase.org/search.cfm>

Detailed information on the life histories of fishes, including many of the reef fishes found in the South Atlantic Bight.

*Islands in the Stream*, Editor, George Sedberry.

A collection of scientific papers on reef and reef fishes in the South Atlantic Bight.

### **NATIONAL SCIENCE EDUCATION STANDARDS**

#### **Content Standard C: Life Science**

- Interdependence of organisms
- Behavior of organisms

*Activity developed by Kevin Kurtz, South Carolina Aquarium, Charleston, SC*

## Spawn Cards

Reef Fish

### Gray Triggerfish

Reproductive Method:  
Collects seasonally in large groups for spawning. Releases eggs and milt in water for external fertilization.

Reef Fish

### Red Snapper

Reproductive Method:  
Collects seasonally in large groups for spawning. Releases eggs and milt in water for external fertilization.

Reef Fish

### Snowy Grouper

Reproductive Method:  
Collects seasonally in large groups for spawning. Releases eggs and milt in water for external fertilization.

Fish

### Clearence Skate

Reproductive Method:  
Female and male come together for internal fertilization. Larval skates released in egg cases.

Fish

### Oyster Toadfish

Reproductive Method:  
Female and male come together. Female attaches eggs to hard surface and male fertilizes externally and then guards eggs until larvae hatch.

Reef Fish

### Blueline Tilefish

Reproductive Method:  
Collects seasonally in large groups for spawning. Releases eggs and milt in water for external fertilization.

Fish

### Sand Tiger Shark

Reproductive Method:  
Female and male come together for internal fertilization. Embryo stays inside female and is born fully developed.

Fish

### Seahorse

Reproductive Method:  
Female and male come together. Female lays eggs in a pouch on the male's stomach. Male carries and protects eggs until after they hatch.

Habitat

### Hard Bottom Reef

Habitat

**Rocky  
Outcrop  
Reef**

Habitat

**Rocky  
Outcrop  
Reef**

Habitat

**Hard  
Bottom  
Reef**

Habitat

**Muddy  
Bottom**

Habitat

**Sandy  
Bottom**

Habitat

**Saltmarsh  
Tidal  
Creek**

Oceanic Condition

**Gulf  
Stream  
Current**

Oceanic Condition

**Gulf  
Stream  
Current**

Habitat

**Open  
Ocean**

Oceanic Condition

**No  
Current**

Oceanic Condition

**Gyre  
Current  
Off of the  
Gulf  
Stream**

Oceanic Condition

**Eddie  
Current  
Off of the  
Gulf  
Stream**

Oceanic Condition

**No  
Current**

Oceanic Condition

**No  
Current**

Oceanic Condition

**No  
Current**

Productivity of Nearby  
Habitats

**Salt  
Marsh**

Nutrients from freshwater rivers support abundant phytoplankton production and marsh grass production.

Productivity of Nearby  
Habitats

**Charleston  
Gyre**

Upwelling brings nutrients to the surface to support abundant phytoplankton production.

Productivity of Nearby  
Habitats

**Charleston  
Gyre**

Upwelling brings nutrients to the surface to support abundant phytoplankton production.

Productivity of Nearby Habitats

## Charleston Bump

The Charleston Bump is a large reef habitat in the Gulf Stream. The fast moving current of the Gulf Stream does not carry nutrients for phytoplankton production.

Productivity of Nearby Habitats

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The Charleston Bump is a large reef habitat in the Gulf Stream. The fast moving current of the Gulf Stream does not carry nutrients for phytoplankton production.

Productivity of Nearby Habitats

## Salt Marsh

Nutrients from freshwater rivers support abundant phytoplankton production and marsh grass production.

Habitat

## Hard Bottom Reef

Oceanic Condition

## Gulf Stream Current

Productivity of Nearby Habitats

## Charleston Gyre

Upwelling brings nutrients to the surface to support abundant phytoplankton production.

Fish: Reef

## Red Porgy

Reproductive Method:  
Collects seasonally in large groups for spawning. Releases eggs and milt in water for external fertilization.

Productivity of Nearby Habitats

## Open Ocean

The open ocean does not have enough nutrients for abundant phytoplankton production.

Productivity of Nearby Habitats

## Open Ocean

The open ocean does not have enough nutrients for abundant phytoplankton production.

