

Focus on Inquiry

Students will:

- Name the stages of the shrimp life cycle
- List the various jobs provided by the shrimping industry
- Discuss the effects of naturally driven and human-caused disturbances on the shrimp cycle and shrimp business success
- Learn the term “sustainable” as it applies to shrimp resources and businesses

Lesson Content Overview

In this lesson, students will examine the life cycle of shrimp to determine how they develop. Students will then analyze how the shrimp fits into the ecosystem and the food web throughout the distinct stages of its life.

When people eat shrimp at a shrimp boil party or a restaurant, they often do not think about the various stages of the shrimp life cycle in Louisiana waters or the various places that the shrimp traveled to after being caught. The shrimp life cycle alone has six stages. Shrimp then have a whole other life once they are caught and brought to the docks. Shrimp are handled by several different people in various locations before they make it to the dinner plate. Along the way, both naturally driven and human-caused disturbances can affect the shrimp supply and seafood-dependent businesses.

The purpose of this interactive game is to help students understand the term “sustainable” by first learning system linkages between the stages of shrimp growth in the Gulf of Mexico and shrimp-dependent businesses that move shrimp from boats to dinner plates. Then, students will consider how external factors affect the growth of shrimp populations and the sustainability of shrimp-dependent businesses. This lesson is designed to take place during two different class periods, with the first lesson focused on offshore aspects and the second lesson focused on onshore aspects.

Duration: One to two 90 minute classes (or three to four 45 minute classes)

Setting: Classroom

Grouping: Various grouping throughout the lesson

Grade Level: Middle School (Grades 6-8)

Louisiana Social Studies Standards – Middle School

Standard	Description
6.6.1	Explain the impact of job specialization in the development of civilizations.

7.5.1	Analyze the physical and political features of the United States.
8.10.3	Describe historical features including the economic growth, interdependence, and development of Louisiana.

Louisiana Science Standards -- Middle School

Standard	Description
6-MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
7-MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
8-MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Louisiana English Language Arts Standards -- Middle School

Standard	Description
Writing 6.1, 7.1, 8.1	Write arguments to support claims with clear reasons and relevant evidence.
Speaking and Listening 6.1, 7.1, 8.1	Engage effectively in a range of collaborative discussions with diverse partners on grade-level topics, texts, and issues, building on other's ideas and expressing their own clearly.

Prior Knowledge Needed by Students

- Stages of shrimp life cycle
- Types of shrimp
- Interdependence in an ecosystem
- Map Reading
- Engineering Process (science standards)

Background Information for Teachers

The two most common shrimp species found off the Louisiana coast are brown shrimp (*Penaeus aztecus*) and white shrimp (*Penaeus setiferus*). Both species begin their life cycle as tiny shrimp eggs deep in the water off the coast of our coast. Spawning occurs at various times, depending on the species. Peak spawning times for brown shrimp are April to May and September through November. Brown shrimp usually enter the estuaries during late winter and feed and grow until early summer. As brown shrimp move back to the Gulf to spawn, they are available for harvest, usually during summer. White shrimp spawn two to three times from April to September (when stimulated by temperature increases) but typically enter the estuaries in early summer and grow

and feed until mid-fall. Every year, environmental parameters such as temperature and freshwater input drive the shrimp growth cycle and determine which species are available for harvest at certain times of the year. Therefore, we have shrimp seasons.

In general, both brown and white shrimp follow the same stages of the life cycle.

Egg. A single female shrimp may produce anywhere from 500,000 to 1,000,000 eggs, but less than 2% will survive to adulthood.

Larvae. Fertilized shrimp eggs go through three larval stages over several weeks, during which time the larvae grow and molt several times. Small fish and filter feeders swimming through the water might consume shrimp eggs and small shrimp larvae as incidental nutrition. As shrimp enter the third larval stage, they are large enough to be seen and actively hunted by juvenile fishes.

Post-larvae. In the post-larval stage, flood tides and wind-driven currents carry the shrimp from the Gulf into the estuaries. Over the next four to six weeks, the post-larvae shrimp grow legs, acquire mobility, and start to look like shrimp.

Juvenile. For the next one to two months, shrimp are in the juvenile stage and are found in upper estuaries where saltwater still reaches. The shrimp continue to forage on algae and small organisms and grow larger into subadults.

Subadult. During the subadult stage, colder temperatures and freshwater input into the estuaries push the shrimp down to the barrier islands and estuary passes. At this stage, shrimp prefer warmer, saltier waters so that any weather changes will carry the shrimp back to the Gulf of Mexico. Many subadult shrimp are harvested as the population concentrates on the barrier islands.

Adult. Shrimp that reenter the Gulf of Mexico continues to grow into adult shrimp. Adult shrimp have three fates: to be caught by shrimp harvesters, to be eaten by predators, or to spawn new shrimp eggs to begin the cycle all over again.

The whole life cycle, from shrimp egg to adult shrimp, takes about one year. Some adult shrimp may live longer than one year, but this is rare.

During the open shrimping season, shrimp captains fish inshore waters at the bottom of estuaries or offshore waters off the coast of Louisiana. They take their boats for weeks at a time and drag trawl nets through the water to catch as many shrimp as they can. When their boats are full of shrimp, the captains come back to the dock. At this point, the shrimp can go to many places. Individual customers might purchase large fresh shrimp directly from the boat captains at the docks. Shrimp processors might buy massive quantities of all sizes of shrimp to take to their processing plant. The smallest shrimp might get sold to a shrimp drying plant owner, who will dry the shrimp, package them, and ship them to locations all over the country. At the processing plant, the shrimp go through several stages of cleaning, peeling, size grading (i.e., 21/25-count shrimp [21-25 shrimp per pound] vs. 12/14-count shrimp [12-14 shrimp per pound]), packaging, and blast freezing to be ready for shipments both in and out of Louisiana. Refrigerated trucks pick up the loads of shrimp and deliver them to grocery stores and restaurants all over the country.

The shrimp have been through a lot once they reach grocery store shelves, restaurant kitchens, or shrimp boil pots. These are the places where the average shrimp consumer meets shrimp, without

really thinking about everywhere that shrimp have been and how many people were required to get the shrimp to that location.

Materials

- EdPuzzle Video (<https://edpuzzle.com/media/61291b2f886af241bb11a5e0>)
- Brown and white sheet images (provided)
- White paper for opening exercise (a piece for each student)
- Tape
- Shrimp diagram (provided)
- Reader clues (provided)
- Poster Board for each stage of the game:
 - Blue for the life cycle
 - Green for predators
 - Yellow for businesses
 - Brown for the consumers
- Wall mounting supplies (i.e., removable mounting putty, Velcro fasteners)
- Role cards (Teacher note: cards included for 24 students. A minimum of 24 students is required for each student to have a role card. For classes smaller than 24, students can be assigned multiple roles. For classes larger than 24, role cards can be printed in multiples.) (in teacher documents)
 - Six life cycle stage cards mounted on blue paper
 - Four predator cards mounted on green paper
 - Five business cards mounted on yellow paper
 - Four consumer cards mounted on orange paper
 - Four disturbance cards mounted on red paper
- 20 Velcro fasteners for role cards
- Hole puncher
- Colored yarn:
 - 6x1'-2' lengths of green yarn
 - 1x1'x2' lengths of yellow yarn
 - 6x1'x2' lengths of brown yarn (shrimp consumers)
- Scissors
- 20 red foam "x's to symbolize connections broken by disturbances
- Disturbance labels (5 Weather, 5 Marine Pollution, 5 Hurricanes, 5 Foreign Imports, included separately)
- The Life of Shrimp Student and Teacher worksheet (provided)
- Video Resource of Game (provided) (<https://youtu.be/FimEarE1ZSY>)

Prepare in advance:

- Print large version of shrimp diagram #1 or #2 and cover body parts (provided)
- Print Reader Clues (provided)
- Format pieces of poster board with stage labels and numbered squares for role cards (Note: Poster setup should match the Teacher Visualization Diagram, included separately)
- Laminate poster boards to preserve them for several uses
- Hang poster boards on the board in the front of the classroom, using removable wall mounting supplies
- Print, Cut, Mount, and Laminate Role Cards (provided):

- Life Cycle cards on blue paper
- Predator cards on green paper
- Business cards on yellow paper
- Consumer cards on orange paper
- Disturbance cards on red paper
- Match Velcro fasteners to the backs of the role cards and the numbered squares on the poster boards. Have the DOCK card already on the poster board before the game begins.
- Punch holes in role cards (location of holes indicated on Teacher Visual, included later in lesson plan)
- Cut lengths of yarn (Suggested colors and lengths are on the materials list)
- Cut disturbance labels and tape them to red foam “X”s
- Assign roles to students:
 - Reader: 1-2 students
 - Life Cycle Stages: 6 students
 - Predators: 4 students
 - Shrimp Businesses: 5 students
 - Shrimp Consumers: 4 students
 - Disturbances: 4 students (Suggestion: Assign the Disturbance roles to the more creative and outgoing students. Students will exercise some independence and creativity in their roles.)

Engage

Ask: *What do shrimp look like?*

Classroom Discussions

1) Ask students if they have ever seen a live shrimp. Give every student a half-sheet of white paper and ask them to draw a shrimp and write their favorite way to eat shrimp. Collect the pieces of paper and tape them to the chalkboard in the front of the room. Ask the students to think about where the shrimp come from.

2) Put a shrimp diagram (provided) on the board and ask the students to name any body parts. The teacher will lead a class discussion about the various parts of the shrimp’s body and what students believe to be their function.

3) The teacher should then ask students if there are different types of shrimp. The teacher should lead students towards the understanding that there is a variety of shrimp in the water. Louisiana seafood consists mainly of two distinct types of shrimp—white and brown shrimp. The teacher will show the image of the two kinds of shrimp (provided), and students will compare the two shrimp. This should be done by implementing a think-pair-share. Students will think about the differences and share their findings with their shoulder partner when the teacher gives the correct signal. After a few minutes have passed, the teacher will call the students back to the whole group, and students will share their findings in the whole class or a scientist’s circle.

4) The teacher will remind the students about the many parts of the shrimp and ask them to think about how the shrimp can grow from a tiny egg to an organism with all those parts. What changes occur? Where in the water do these changes occur? The teacher will ask students their thoughts about the life cycle of a shrimp. After the discussion, the

teacher will show an Ed Puzzle video (<https://edpuzzle.com/media/61291b2f886af241bb11a5e0>) about the life cycle of the shrimp and have students answer the questions. The teacher can display this video to the whole class or have students perform the task independently.

Explore and Explain

Teacher's Notes for Activity 1:

Purpose: To establish knowledge by discussing the life cycle of shrimp

Goal: At the end of this activity, students will understand the growth stages of shrimp and the factors that influence the size of the shrimp population

- Objective 1: Students will learn the six stages of the shrimp life cycle
- Objective 2: Students will learn the types of predators for juvenile, subadult, and adult shrimp
- Objective 3: Students will identify and discuss the effects of weather and marine pollution on the sustainability of the shrimp life cycle

The teacher will explain to students that they will play a Question & Answer game to learn how shrimp grow in Louisiana waters and the dangers that shrimp face while growing. Every student will eventually have a role in the game, but since the lesson plan is split over two days, not every student will play their part on Day 1. Students will need to listen attentively when their role is described.

The teacher will set up materials for Activity 1:

- Distribute Life Cycle cards (blue cards) to 6 students
- Distribute Predator cards (green cards) to 4 students
- Distribute Weather and Marine Pollution cards (red cards) to 2 students
- Put six lengths of green yarn and ten red foam “X”s (5 weather, five marine pollutions) on a desk at the front of the classroom

Procedure:

1) A student will read the clues (provided) that describe each stage of the shrimp life cycle. When students hear a description that matches their assigned role, they will walk to the front of the classroom and match their role card with the correct square on the blue poster board. *(Notes for teachers: Numbered squares on the Teacher Visual (provided) indicate where the role cards should go. For greater student engagement, another option is to assign each student a clue and have the entire class figure out together which role cards match the given clues)*

2) When the six shrimp life cycle stages are in place, the student reader will read questions about predators for the last three growth stages of shrimp. Students with predator cards need to listen attentively when their prey is the question. (For example, what kind of predators does a juvenile shrimp have? The student’s role card has a list of predators for juvenile shrimp.) Students with predator roles will read the back of their role cards aloud to the class and match them with the correct square on the green poster boards. *(Note for teachers: The bolded names on the back of the predator cards correspond to the images on the front of the predator cards.)*

3) After students match the predator cards on the poster board, the teacher will prompt students to make connections between predators and the shrimp life cycle by tying green yarn through the holes of the role cards. (For example, after the predator card for juvenile shrimp is in place, another student can tie a length of green yarn on the hole of the “predatory fish” card and the hole of the “juvenile shrimp” card.) (*Notes for teachers: Circles on the numbered squares of the Teacher Visual indicate where the yarn will be tied.*)

4) The last clue that the student reader will read is for the Shrimp Captain. This will be the last role card placed on the green poster board for Activity 1. After this point, the total green yarn connections should include:

- Predatory Fish Card 1 to Juvenile Shrimp
- Predators Card 2 to Subadult Shrimp
- Predatory Fish Card 3 to Adult Shrimp
- Shrimp Captain to Subadult Shrimp
- Shrimp Captain to Adult Shrimp

5) The teacher will highlight that we have just gone through the offshore component of how a shrimp grows and develops off the Louisiana coast. Of course, there are external inputs that might affect the growth of shrimp. The teacher will ask the student with the naturally driven disturbance (weather) to read the back of their information card and make choices of which connections they will influence (symbolized by placing red foam “X” s with the weather label at the chosen links).

6) When the student is at their chosen link, the teacher will ask students to discuss how the weather might impact them. (*Note for teachers: The text that the students have on the information cards are included below. Also, there are questions for the teachers to ask and ideas for discussion.*)

7) Repeat steps 5-6 with the student for the human-caused disturbance (marine pollution).

Student Disturbance Cards and Teacher Questions to Stimulate Discussion:

How Do Naturally Driven and Human-Caused Disturbances Influence Shrimp Growth?

WEATHER: Cold weather can have an impact on the movement of subadult shrimp. Cold fronts and heavy rainfall push subadult shrimp towards barrier islands and open water in the Gulf of Mexico. Shrimp will gather behind barrier islands until they get harvested or until a strong tide carries them out to open water. Similarly, warm weather brings currents and salty water from the Gulf of Mexico and carries post larval shrimp into the estuaries.

STUDENT POSSIBILITIES: If the student chooses to represent cold weather, they might move the subadult shrimp actor next to the adult shrimp actor and link the subadult shrimp with the shrimp captain (symbolized by placing a red foam X on the yarn between the subadult and the shrimper).

If the student chooses to represent warm weather, they might move the post-larvae shrimp actor closer to the juvenile shrimp actor (symbolized by placing a red foam X in between the two

cards). The student might also verbally explain the influence of the warm weather on later stages of shrimp growth by indicating more juveniles, subadults, and adults.

(Note for teacher: Remind the students that weather influences the growth of shrimp but does not deplete the resource. Shrimp will still grow, despite warmer or colder weather. The important take-home message is that the shrimp population size is variable from year to year because of the influence of the weather.)

TEACHER QUESTIONS TO STIMULATE DISCUSSION:

Cold Weather:

1) Why might cold temperatures and fresh rainfall cause shrimp to move to the bottom of the estuary and near the barrier islands? In post larval growth stages, shrimp prefer warmer, saltier waters. When a cold front moves through the estuary, it brings cold temperatures and rainfall. The fresh rainfall lowers the salinity of estuarine waters. *Subadult shrimp will notice the change in temperature and salinity and move down through the estuary to get closer to warmer, saltier waters. The subadult shrimp will spend time together in the barrier islands to be protected from heavy winds.*

2) If there is a cold front, where would captains take their boats to catch shrimp? *If they are looking to harvest subadult shrimp, shrimp captains will take their boats to the estuary passes and barrier islands to harvest shrimp.*

3) If the shrimp captain catches substantial amounts of subadult shrimp, how will that affect businesses on land? *Subadult shrimp are smaller than adult shrimp, so the overall count of the shrimp harvest will be higher (for example, 35/40 count shrimp vs. 16/18 count shrimp). A harvest with higher count shrimp may result in more business for drying plants, grocery stores, and restaurants.*

Warm Weather:

1) How does warm weather from the Gulf of Mexico carry post-larvae shrimp into estuaries? *Warm weather brings currents and saltwater towards the shore. Since post-larvae shrimp move from off the coast into the estuaries, additional warm water currents will help move the post-larvae shrimp into the estuaries.*

2) How might this warm weather influence the growth of shrimp? *Shrimp like to grow in estuaries where they have access to plants and animal detritus on the muddy bottoms of the marsh edges. When warm weather brings shrimp into the estuaries, the shrimp spend more time eating food and growing into nice, healthy shrimp.*

MARINE POLLUTION: Marine pollution includes oil spills, toxic chemical spills, water pollution, and marine debris. Every year, this human-driven pollution causes marine environments to be unhealthy and causes marine species to die.

STUDENT POSSIBILITIES: The student might choose to place a red foam X anywhere on the shrimp stages of growth. The teacher should point out that the breakages represent a decreased (as opposed to depleted) shrimp supply.

TEACHER QUESTIONS TO STIMULATE DISCUSSION:

Marine Pollution:

1) How might oil spills and toxic chemical spills affect the shrimp life cycle?

If there are hazardous materials in the water, they might affect the maturation of shrimp eggs into larvae. If shrimp eggs and shrimp larvae are reduced, the shrimp supply later in the chain will be smaller.

2) If severe pollution, such as an oil or chemical spill, the Department of Wildlife and Fisheries might close certain coastal areas to shrimping activity. How might a shrimping closure affect shrimp-dependent businesses?

If an area of the coast is closed to shrimping, then shrimpers will not be allowed to enter those areas with their boats. Such an action immediately shuts down the shrimp supply. Businesses onshore will not have fresh shrimp to sell or to export to other states.

3) What can humans do to reduce marine pollution?

Do not litter. Recycle as much as possible. Participate in beach and bayou cleanups to reduce the amount of trash that enters the water. Educate others about the harmful effects of marine debris on marine animals.

Expand

Teacher Notes for Activity 2:

Purpose: To establish knowledge by discussing the shrimp business chain and its consumers. At the end of this activity, students will understand the interconnectedness between shrimp supply and shrimp-dependent businesses.

- Objective 1: Students will learn various jobs provided through the shrimping industry.
- Objective 2: Students will identify and discuss the effects of hurricanes
- Objective 3: Students will discuss the impact of foreign-imported seafood on the sustainability of shrimp-dependent businesses.

The teacher will explain to students that they will build on the previous day by playing a Question & Answer game to learn how shrimp move through the business chain and eventually reach consumers. Students will need to listen attentively when their role is described.

The teacher will set up materials for Activity 2:

- Have the completed game up to this point mounted on the wall in the classroom
- Have the DOCK card already in place on the yellow poster board
- Distribute Business cards (yellow cards) to 5 students
- Distribute Consumer cards (orange cards) to 4 students
- Distribute Hurricanes and Foreign Imports cards (red cards) to 2 students
- Have one length of yellow yarn available
- Put six lengths of brown yarn and ten red foam “X” s (5 hurricanes, five foreign imports) on a desk at the front of the classroom

Procedure:

1) The teacher will prompt students with questions about how the shrimp reach the shore, thereby recapping the previous day’s lesson with the Shrimp Captain being the endpoint. The teacher will tie the length of yellow yarn from the Shrimp Captain card to the Dock

card to help students start thinking about the onshore component of shrimp life.

2) A student will read the script that describes each stage of the shrimp business chain. When students hear a description that matches their assigned role, they will walk to the front of the classroom and match their role card with the correct square on the yellow poster board. (*Note for teacher: Numbered squares on the Teacher Visual [provided] indicate where the role cards should go.*)

3) When the business cards are in place, the reader will read descriptions of several types of consumers. Students with consumer roles will match their role cards with the correct square on the brown poster boards.

4) After students match the consumer cards on the brown poster board, the teacher will prompt students to connect consumers and the shrimp business chain by tying brown yarn through the holes of the role cards. (For example, after the consumer card for Shrimp Boil Party Host is in place, another student can tie a length of brown yarn on the hole of the “Dock” or “Grocery Store” card and the hole of the “Shrimp Boil Party Host” card.) (*Note for teacher: Circles on the numbered squares of the Teacher Visual (provided) indicate where the yarn will be tied.*)

5) When all the role cards are matched up on the poster boards, the total brown yarn connections should include:

- Shrimp Boil Party Host to Dock
- Shrimp Boil Party Host to Grocery Store
- Shopper to Dock
- Shopper to Grocery Store
- Chef to Dock
- Restaurant Diner to Restaurant

6) The teacher will highlight that we have just gone through the onshore component of how a shrimp travels from the boat to the dinner plate. Of course, there are external inputs that might affect the travel of shrimp. The teacher will ask the student with the naturally driven disturbance (hurricanes) to read the back of their information card and make choices of which connections they will influence (symbolized by placing red foam “X”s with the hurricane’s label at the chosen links).

7) When the student is at their chosen link, the teacher will ask students to discuss how hurricanes might impact. (*Note for teacher: The text that the students have on the information cards is included below. Also, there are questions for the teachers to ask and ideas for discussion.*)

8) Repeat steps 6-7 with the student with the human-caused disturbance (foreign imports).

Student Disturbance Cards and Teacher Ideas to Stimulate Discussion:

How Do Naturally Driven and Human-Caused Disturbances Influence Shrimp Business?

HURRICANES: Hurricanes cause a lot of damage to coastal infrastructure. Storm damage can affect shrimp boats, docks, processing plants, grocery stores, and restaurants.

STUDENT POSSIBILITIES: The student might choose to place a red foam X on any of the following connections: adult shrimp – shrimp captain; shrimp captain – dock; dock – drying plant; dock – processing plant; dock – people, etc. By breaking one connection, the students should see how the rest of the chain is affected and deprived of shrimp supply.

TEACHER QUESTIONS TO STIMULATE DISCUSSION:

Hurricanes:

1) How might hurricanes affect shrimping activity?

Severe weather associated with hurricanes will prevent shrimp captains from taking their boats out during the late summer and early fall months. Large and strong hurricanes (i.e., Katrina, Rita, Gustav, Ike, Isaac, Laura, Ida) with powerful winds cause damage to boats and docks. After the hurricanes of 2005, boats were ripped out of their slips and carried far away from the docks.

2) How far up the chain might hurricanes affect shrimp-dependent businesses?

Hurricanes may not have any real effect on the actual shrimp population in the estuaries and the Gulf. Hurricanes may move shrimp around, but the shrimp will not die. But if hurricanes damage shrimp boats and docks, it will be difficult for shrimpers to get out on the water to harvest shrimp. Therefore, processing plants, grocery stores, and restaurants will receive less shrimp, which might reduce business in the weeks and months after a severe hurricane.

FOREIGN IMPORTED SEAFOOD: Between 60 and 65 percent of seafood bought and consumed in the United States comes from countries outside the United States (e.g., China, Thailand). Shrimp imported from other countries are sold in grocery stores and restaurants at a much cheaper price than fresh shrimp from the Gulf of Mexico.

STUDENT POSSIBILITIES: The student might choose to place a red foam X on connections between grocery stores and restaurants (i.e., processing plant – grocery stores; drying plant – grocery stores; refrigerated truck – grocery stores; refrigerated truck – restaurants). The teacher should point out that bringing foreign shrimp into the business chain reduces the profit that local shrimpers and local businesses make from shrimping off the coast of Louisiana.

TEACHER QUESTIONS TO STIMULATE DISCUSSION:

Foreign Imported Seafood:

1) How can imported shrimp from foreign countries be sold at a cheaper price than local shrimp coming from Louisiana?

The cost of shrimp laborers in foreign countries is much cheaper than here in the United States. Since the cost of work is so much lower, the shrimp can be sold for cheaper in the U.S. The United States also has more regulations to ensure that the shrimp caught meet health regulations than other countries.

2) If foreign shrimp are cheaper, how might that affect the sale of Louisiana shrimp.

Shrimp consumers might be more interested in cheaper shrimp so they can get the

“biggest bang for their buck” – more shrimp for a cheaper price.

3) Why are Louisiana shrimp more expensive?

Louisiana shrimpers have to cover their costs for laborers, vessel safety training, shrimping licenses, boat maintenance, boat gas, and ice to chill the shrimp when they are caught. Louisiana shrimp might be more expensive, but consumers will know that the quality of the shrimp is exceptionally good and they were more sustainably harvested.

4) How can a shrimp consumer in Louisiana support the local shrimp economy?

Purchase shrimp that was caught in Louisiana waters by Louisiana shrimpers. Be sure to eat locally-caught seafood (including shrimp) at restaurants. In 2019, Governor John Bel Edwards passed a law that now requires restaurants that serve foreign shrimp or crawfish to post notices about the food’s origins. These posts should be placed on menus or on a sign at the main restaurant entrance. If a restaurant fails to display the shrimp or crawfish origins, the establishment will be in violation of the state’s sanitary code. Go ahead and ask the server where the shrimp on the menu come from.

Evaluate

The teacher will ask the following questions at the end of Activity 1 to double-check that the students are meeting the objectives of the activity:

- 1) What are the first three stages of the shrimp life cycle?
Egg, larvae, Postlarvae
- 2) What are the last three stages of the shrimp life cycle?
Juvenile, Subadult, Adult
- 3) How do shrimp get from the Gulf of Mexico to the dock?
Shrimp Captain

The teacher will ask the following question at the end of Activity 2 to double-check that the students are meeting the objectives of the activity:

- 1) What are three jobs provided by the shrimp industry?
Shrimp Captain, Drying Plant Employee, Processing Plant Employee, Refrigerated Truck Driver, Grocery Store Manager, Restaurant Chef

The teacher will read the definition of “sustainable” to the class. In a discussion setting, the teacher will ask the following questions at the end of Activity 2:

Sustainable describes something that is related to using a resource in such a manner that the resource is not depleted or permanently damaged.

- 1) In Louisiana, the Department of Wildlife and Fisheries regulates shrimp seasons and sets limits on the size of the shrimp harvest. How does this help to sustain the shrimp resource in Louisiana waters?
 - *Shrimp Seasons: Each year, the Department of Wildlife and Fisheries schedules shrimping seasons for different areas of the state’s coast to ensure that the shrimp population remains sustainable. There are different rules for inshore waters vs. offshore waters. The time frame of the seasons is a little different every year, depending on environmental variables that affect shrimp growth.*

- *Limit on Size of Harvest: Similarly, the Department of Wildlife and Fisheries sets rules to limit how many pounds of shrimp can be caught at various times of year in inshore and offshore waters.*

2) What are some ways that humans can control marine pollution and foreign imported seafood? How can we contribute to the sustainability of the Louisiana shrimp industry?

- *Buy local! Support local seafood businesses*
- *Improve water quality and prevent marine pollution (how might we do this?)*
 - *Regulations to improve water quality*
 - *Regulate waste disposal*
- *Eat more shrimp!*

Other questions to ask students or assign as homework:

- 1) Define “water column” and explain how certain environmental variables (i.e., light, temperature, organisms) might change as shrimp eggs move from the bottom of the water column to the top.

The water column is a conceptual description of the water that begins at the surface of a body of water and continues down to the surface of the bottom sediments. Shrimp eggs move from the bottom of the water column to the top before maturing into larvae. At the bottom of the water column, there is no light, and the temperature is colder. Organisms on the bottom are adapted to living in dark environments and are described as bottom feeders. Temperature increases and light increases as organisms move up the water column and reach the surface of the water. Also, more fishes and larger marine animals are found in the upper parts of the water column.

- 2) What species of shrimp grow off the coast of Louisiana, and when do they grow?

*The two most common shrimp species that grow off the Louisiana coast are brown shrimp (*Penaeus aztecus*) and white shrimp (*Penaeus setiferus*). Brown shrimp usually feed and grow from late winter to early summer and are harvested during the summer months. White shrimp usually feed and grow from early summer to mid-fall and are harvested during the fall months.*

- 3) Find pictures of the three different larval stages (nauplius, protozoa, Mysis) for shrimp. Explain how the larval stages are different.

(Pictures of shrimp larval stages can be found on Google Images). Shrimp larvae grown and molt through three larval stages over a two- or three-week period. Nauplius larvae and protozoa larvae are hardly visible and have little control over what they eat. They also cannot control their movements. These two types of larvae are filter feeders as they move through the water column and feed on zooplankton, phytoplankton, and small detritus. Mysis larvae are carried towards shore by flood tides and wind-driven currents. They still feed on zoo- and phytoplankton, but they start to get large enough to be seen and hunted by juvenile fish. Even though they don't have swimming or walking legs yet, Mysis larvae move slightly down the water column to escape light and predators at the surface of the water during the day.

- 4) How do flood tides and wind-driven currents are active on the surface of the water?

Flood tides and wind-driven currents are active on the surface of the water. Since shrimp

larvae don't have swimming or walking legs, the movement of water generated by tides and currents carries the larvae closer to the shore and the estuaries.

- 5) What are the names of some estuaries in Louisiana where you might find post-larvae shrimp?
Black Bay, Barataria Bay, Chandeleur Sound, Breton Sound, Timbalier Bay, Terrebonne Bay, Caillou Bay, Atchafalaya Bay, Vermilion Bay
- 6) Define the term “turbidity” and explain how shrimp activity on the muddy bottom causes turbidity of estuarine waters to increase.
Turbidity describes muddiness or cloudiness in water generated by stirring up and suspension of muddy sediment particles. When shrimp forage on the estuary bottom for food, their activity stirs up soft sediments and suspends them into the water. Increased sediment particles in the water means increased turbidity.
- 7) Research one of the following species of predators for juvenile shrimp (Southern Flounder, Spotted Seatrout, Red Drum, or Atlantic Croaker).
Find the scientific name, range, and habitat, two facts about the fish biology, and whether or not you can eat it. For this question, students can find the information on www.seagrantfish.lsu.edu/biological/index.html.
- 8) Where might you expect to find predators that feed on subadult shrimp? Research one of the following species (Sheepshead, Red Drum, Black Drum, Atlantic Croaker, Sand Seatrout, Sea Catfish, Gafftopsail Catfish, Southern Kingfisher, Southern Flounder, or Spotted Seatrout).
Find the scientific name, range, and habitat, two facts about the fish biology, and whether or not you can eat it. For this question, students can find the information on www.seagrantfish.lsu.edu/biological/index.html.
- 9) Where might you expect to find predators that feed on adult shrimp? Research one of the following species (Spotted Seatrout, Lady Fish, Crevalle Jack, Bluefish, Florida Pompano, Spanish Mackerel, Silver Seatrout, Black Tip Shark, Atlantic Sharpnose Shark, Gulf Kingfish, Red Snapper, Sand Seatrout, or Redfish).
Find the scientific name, range, and habitat, two facts about the fish biology, and whether or not you can eat it. For this question, students can find the information on www.seagrantfish.lsu.edu/biological/index.html.
- 10) Define the word “bycatch” in terms of fisheries. In addition to shrimp, what other types of marine life might shrimpers catch in their trawl nets? Fisheries bycatch describes unwanted (or non-target) marine life might shrimpers catch in the trawl nets?
Fisheries bycatch describes unwanted (or non-target) marine species caught in nets while fishing for other species. Examples of different types of marine life caught in trawl nets include sea turtles and dolphins.
- 11) Find a picture of a shrimp boat. What are trawl nets?

(Shrimp boat pictures can be found on Google Images.) A trawl net is a large, strong fishing net shaped like a cone that gets towed behind a boat and dragged along the water bottom.

Extension

Assign these questions to individual students (or a group of students) for a project to be completed over a longer time frame.

- 1) Research the history of shrimp drying plants in Louisiana and find examples that still operate.
- 2) Research the history of shrimp processing in Louisiana to find how processing plants have changed over time. Specifically, are there machines at processing plants that do jobs that humans used to do? Describe what a shrimp experiences as it moves through a processing plant.
- 3) Research Louisiana Direct Seafood (<http://louisianadirectseafood.com/>) and explain how the program helps shrimpers stay in business. Look for news articles online about Louisiana Direct Seafood.
- 4) Research shrimp seasons and catch limits to explain how these management strategies contribute to the sustainability of shrimp resources. Start by looking at the webpage for the Louisiana Department of Wildlife and Fisheries (www.wlf.louisiana.gov).
- 5) Research how Hurricane Katrina affected the shrimping industry in 2005. (Additional research resources provided).
- 6) Research what happens to waste generated by shrimp processing (i.e., what happens to heads and shells?). New research is being done on how to use shrimp waste for bait.

References

Shrimp Life Cycle

“The Life Cycle of a Shrimp.” www.seagrantfish.lsu.edu/pdfs/shrimpcycle_info.pdf

“Life History.” www.dnr.sc.gov/marine/pub/seascience/shrimp.html

“Shrimp Facts.” PDF by Elizabeth Baron-Mounce, Walter Keithly, Kenneth J. Roberts

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“100-Year-Old Business Has Kept Some Traditions Intact”

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Seafood Processing

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“Shrimp Processing Equipment” <youtu.be/XeFWOgYrM3E>

“Shrimp Catching, Peeling & Processing Video” www.youtube.com/watch?v=BhKo5yNgcII

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External Disturbances

“Hurricanes and Seafood Safety” www.lsu.edu/seagrantfish/resources/chenier/2005/11-05.htm

“Long-term effects of Gulf oil spill on shrimp, other species is still unknown” gulfresearchinitiative.org/long-term-effects-of-gulf-oil-spill-on-shrimp-other-species-is-still-unknown-2/

“New Orleans Shrimpers Struggle to Make Comeback” www.npr.org/templates/story/story.php?storyId=87865582

Other

Types of Fish www.seagrantfish.lsu.edu/biological/index.html

Louisiana Direct Seafood www.louisianadirectseafood.com

Louisiana Wildlife and Fisheries www.wlf.louisiana.gov

Parts of a Shrimp www.naturenoon.com

Photo Image Credits for Role Cards

Shrimp Egg

Single Shrimp Egg (Louisiana Sea Grant Shrimp Life Cycle Poster)

Brine Shrimp Eggs (www.brineshrimpdirect.com/brine-shrimp-eggs/)

Shrimp Larvae

Cleaner Shrimp larvae (www.norbertwu.com/nwp/storycode/ppk-web/large-65.html)

Crustacean larvae (en.wikipedia.org/wiki/Crustacean_larvae)

Fairy Shrimp larvae (es.wikipedia.org/wiki/Archivo:Fairy_shrimp_larvae.jpg)

Stage 1 and Stage 2 larvae (www.ucl.ac.uk/~rtb6933/shrimp/macro.html)

Postlarvae Shrimp

Stage V: post-larvae (www.fao.org/3/ac232e/ac232e04.htm)

Marine Shrimp Post-larvae (www.ag.auburn.edu/fish/image_gallery/details.php?image_id=378)

Post larval Shrimp from Texas (www.flickr.com/photos/terrymct/139432405/)

Postlarvae from Central America (acuamaya.com/?page_id=190)

Juvenile Shrimp

Juvenile (www.dnr.sc.gov/marine/pub/seascience/shrimpcycle.html)

Juvenile Shrimp from Pacific (library.enaca.org/Health/FieldGuide/html/cv005ihh.htm)

Juvenile Shrimp from Florida (www.fisheries.noaa.gov/species/white-shrimp)

Subadult Shrimp

Subadult Northern Brown Shrimp

(www.vims.edu/research/departments/fisheries/programs/mrg_oldwebsite/species_data/brown_shrimp/index.php)

Sub-adult Shrimp (www.dnr.sc.gov/marine/pub/seascience/shrimpcycle.html)

Adult Shrimp

4 Single Adult Shrimp (Louisiana Sea Grant Flickr)

(www.flickr.com/photos/88158121@N00/8283620195/in/set-72157632277635838)

Pile of Adult Shrimp (Louisiana Sea Grant Flickr)

(www.flickr.com/photos/88158121@N00/8283619301/in/set-72157632277635838)

Predators

Southern Flounder (tpwd.texas.gov/huntwild/wild/species/flounder/)

Spotted Seatrout (tpwd.texas.gov/huntwild/wild/species/seatrout/)

Atlantic Croaker (www.dnr.sc.gov/marine/species/atlanticcroaker.html)

Red Drum (portal.ncdenr.org/web/mf/drum_red)

Pinfish (floridasportfishing.com/magazine/baitfish-profiles/pinfish.html)

Sheepshead (www.landbigfish.com/fish/fish.cfm?ID=26)

Gafftopsail Catfish (www.electricbluefishing.com/fish/Gafftopsail_catfish.htm)

Southern Kingfisher (ebird.org/species/silkin)

Crevalle Jack (www.costa-rica-fishing.info/fish-identification/crevalle.html)

Florida Pompano

(seasquaredcharters.com/florida-keys-fishing-fishidentification/floridapompano/)

Atlantic Sharpnose Shark (floridasharkbait.blogspot.com/2010/05/atlantic-sharpnose-shark.html)

Red Snapper (www.fisheries.noaa.gov/species/red-snapper)

Shrimp Captain

Miss Bonnie Shrimp Boat (Louisiana Sea Grant Flickr)

(www.flickr.com/photos/88158121@N00/4907392173/in/set-72157624635976951/)

Working Shrimp Boat (pontoonopedia.com/how-do-shrimp-boats-work/)

Forrest Gump

(www.fanpop.com/clubs/forrest-gump/images/15591133/title/shrimp-captain-forrest-gumpphoto)

Dock

Dock Workers in Louisiana (www.alamy.com/stock-photo/dock-workers-black-and-white.html)

Boats at the Dock in Louisiana

(www.flickr.com/photos/88158121@N00/4907962464/in/set72157624635976951/)

Buying Shrimp at the Dock

(www.louisianaseafoodnews.com/wpcontent/uploads/2010/05/LaSEA_Seafood_05_10_355m.jpg)

Delcambre Direct Seafood (louisianadirectseafood.com/delcambre-direct-seafood/)

Shrimp Drying Plant

Louisiana Dried Shrimp (simplycajun.com/)

Drying Plant in Manila Village, LA

(archives.datapages.com/data/gcags/data/040/040001/0147.htm)

Shrimp Processing Plant

Lafitte Frozen Seafood Processing Plant (lafittefrozenfoods.com/wordpress/about-us.html)

Motivatit Seafood

(www.louisianaseafoodnews.com/2011/05/11/louisiana-seafood-businessesface-more-challenges/)

Refrigerated Truck

Dragos Fleet (www.dragosyachts.com/dragos_fleet.aspx)

Lafitte Frozen Foods Truck

(www.louisianaseafoodnews.com/2010/11/09/with-inventory-downone-processor-struggles-to-catch-up/truck-departs/)

Grocery Store

Wild Gulf Shrimp for sale (sea2table.com/products/gulf-shrimp)

Walmart (www.walmart.com/browse/food/shrimp/976759_9569500_1001442_5098461)

Rouse's (www.rouses.com/our-food/seafood-market/)

Restaurant

Magnolia Café (www.themagnoliacafe.net/)

Shrimp Pasta (www.evilshenanigans.com/2009/04/garlic-butter-shrimp-pasta/)

Shrimp Po'boy (Louisiana Sea Grant Flickr) –

(www.flickr.com/photos/88158121@N00/7550859652/in/set-72157630531066550)

Shrimp Boil Party Host

Boiled Shrimp (www.bonappetit.com/recipes/2011/06/shrimp-boil)

Family Shrimp Boil (www.delcambredirectseafood.com)

Shrimp Boil Pot (www.cookingclassy.com/shrimp-boil/)

Shopper

Shopping for Seafood

(www.123rf.com/photo_3203656_woman-shopping-for-fish-and-seafoodat-a-grocery-store.html)

Seafood Counter (www.seafoodbusiness.com/articledetail.aspx?id=9429)

Restaurant Diner

Louisiana Restaurant Association

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Eating Sushi (www.tripsavvy.com/how-to-eat-sushi-1458298)

Shrimp Cocktail (www.tripsavvy.com/how-to-eat-sushi-1458298)

Chef

Louisiana Seafood Festival (www.louisianatravel.com/articles/louisiana-seafood-festivals)

Great American Seafood Cookoff (www.louisianaseafood.com/great-american-seafood-cook)

Weather (kids.nationalgeographic.com/nature/article/predict-the-weather)

Hurricanes (www.nhc.noaa.gov/outreach/history/)

Foreign Imported Seafood

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Marine Pollution

Dead Bird Carcass

(www.dailykos.com/story/2011/03/06/953372/-DK4-Groups-Video-Response-Team)

Wastewater Effluent (www.epa.gov/eg)

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