# The Seafood Pot

**Ocean Literacy Principle 5: The ocean supports a diversity of life and ecosystems.**

A. Ocean ecosystems vary widely based on the variety of environmental factors in the community of organisms living there.

A.12. (e.g., shallow brackish water) and in mangroves (lots of decaying organisms) result in highly productive nursery areas for a great many marine organisms.

A.20. Ocean ecosystems are connected to each other via a series of food webs.

Seafood foodways, Species Diversity and the Blue Economy

One of the ways that people are introduced to the diversity of marine organisms is through foodways. Foodways are the traditional ways of collecting, preparing, and sharing food within a culture. These traditions vary throughout the United States and the world. The foods that we eat are components in complicated food webs. The activities the human activities that obtain these marine resources from the natural environment, preserve the environment for future harvest, and move the seafood harvest to the dinner table are all a part of the blue economy. In this exercise, we will use a gumbo recipe as the structure to introduce organismal diversity, trophic relationships, and the blue economy.

**Supplies and Materials**

- A recipe for a seafood gumbo or stew that includes at least one bivalve and one arthropod (optional: add fish fillets for another trophic level)
- Prepare the gumbo for sharing OR
- use Imagery of gumbo or a model using plastic replicas of food

Background

Estuaries are areas where coastal waters meet river systems and are the richest nursery areas for marine organisms. In the southeast United States, wide swaths of *Sporobolus alterniflora* marshes cover the landscape and receive the incoming tide. Within, nutrient rich water bathes the marsh grass and receives additional nutrients from the decomposition of senescing plants. Decaying material from marsh plants moves through the marsh vertically with each tide, falling to the sediment surface where bacteria and fungi colonize each fragment and break it down into smaller particles of detritus. Larger particles break down into smaller particles and after being colonized by microbes, move through the marsh to the creeks. Microbes like bacteria and fungi comprise the largest biomass of any organisms in the ocean despite their small size. In the open ocean they are the most important primary producers creating food for many different types of organisms relying only on dissolved nutrients in the ocean and sunlight. In the saltmarsh, they begin the process of breaking down large pieces of organic matter into smaller ones. Then tides move particulate organic material out and feed multiple levels of estuarine invertebrates and finfish that also move in and out with the tide.

Many of the organisms that are part of a common seafood diet rely heavily upon the diversity of ecosystems within and adjacent to estuaries. For example, marine arthropods like

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the white shrimp (*Litopenaeus setiferus)* and the blue crab (*Callinectes sapidus)* have lifecycles that rely on the estuary and the coastal ocean. Both shrimp and crabs expertly take advantage of the marsh boundaries by season. After successful reproduction offshore, juvenile shrimp move into the estuary on the flood tides and take shelter in the upper areas of the creeks. There they feed on detritus and small invertebrates. As they grow into subadults, they migrate to deeper parts of the estuary. They become omnivorous and use all the marsh provides: polychaete worms, bits of plant material, algae, snails, and more. As adults, they make their way to ocean waters where spawning occurs and resets the cycle.

Blue crabs (also known as the swimming crabs) follow a similar cycle (see Figure 1 created by Louisiana Sea Grant). Mature females move out of the estuary to more saline waters and reluctant adult males move only when they find estuarine areas too cold. The blue crab is an excellent example of an organism that has unique stages to his life cycle. When a newly fertilized blue crab egg begins to develop it goes from the stages of zoea to nauplii to megalopa and juvenile crab- each with physically distinct appearances and needs (Figure 1).

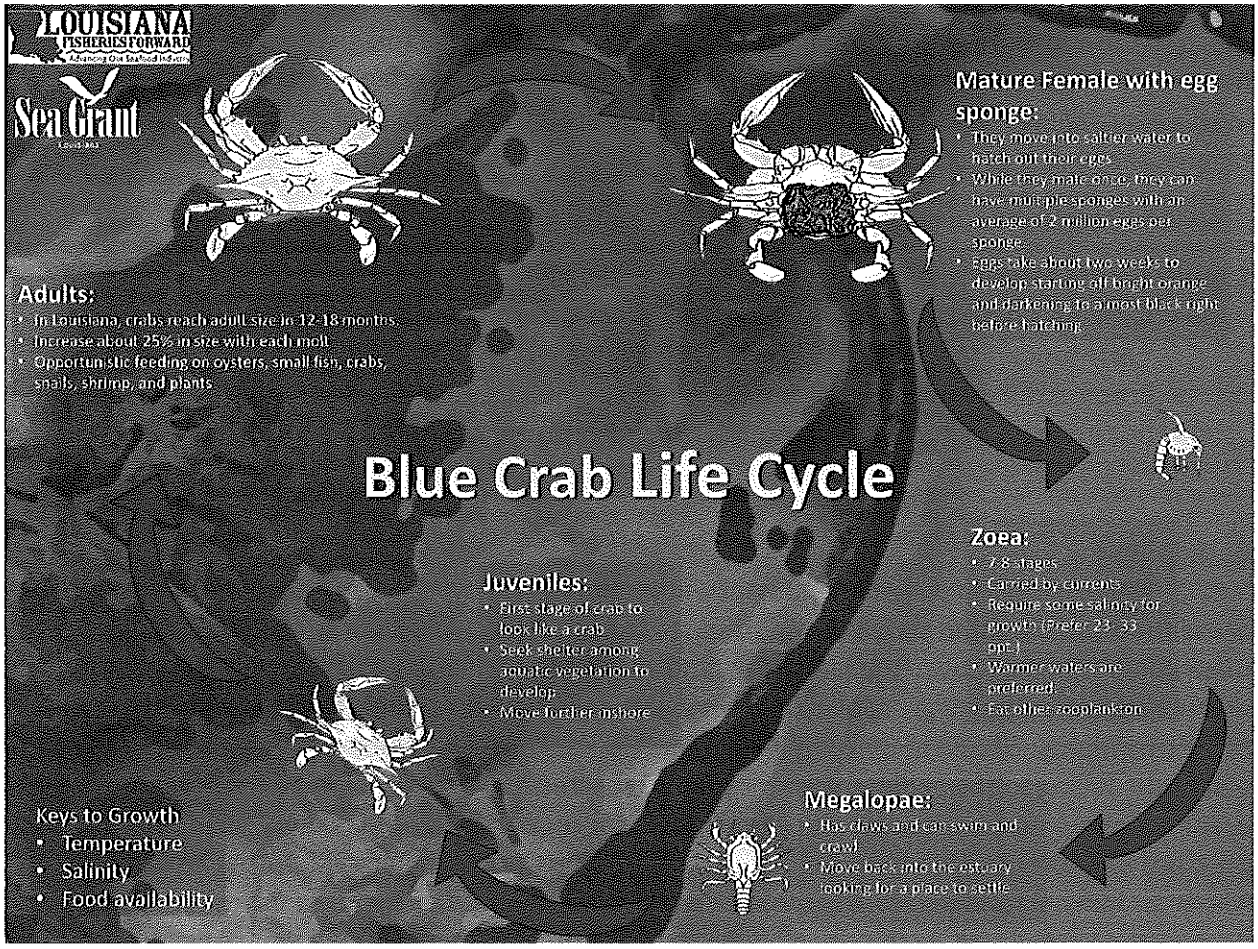


Figure 1. The Blue crab (*Callinectes Sapidus) life cycle.* Source: Louisiana Sea Grant

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Eastern oysters (*Crassostrea virginica)* and hard clams (*Mercenaria mercenaria)* are sessile invertebrates that live on the bottom and rely on food being brought to them by water currents. Both are bivalves (2-shelled) and are members of the 2nd largest of all invertebrate groups, the molluscs (Figure 2). As such they share a common general design, but each has modified one of more aspects that are characteristics to that class. Oysters and clams eat small particles coated with microbes that they filter sifted out of the overlying water. The coincidental ingestion of microscopic planktonic algae make food gathering just that much more rewarding for them. However, consuming whatever gets entrained in the gills makes oysters a risky delicacy if collected from the wrong location- they are whatever they filter, and that could include the bacteria *Escherichia coli* or petroleum-laden particles.

Trophic relationships among these species can be seen as circular. Shrimp will feed on detritus and microbes that grow on oyster reefs. But like blue crabs, they're also scavengers that will feed upon anything on the bottom. Blue crabs will feed directly upon bivalves by cracking them open with their large claws. Yet, oysters and clams can feed upon the decaying particles that come from feces or decomposing shrimp crab carcasses.

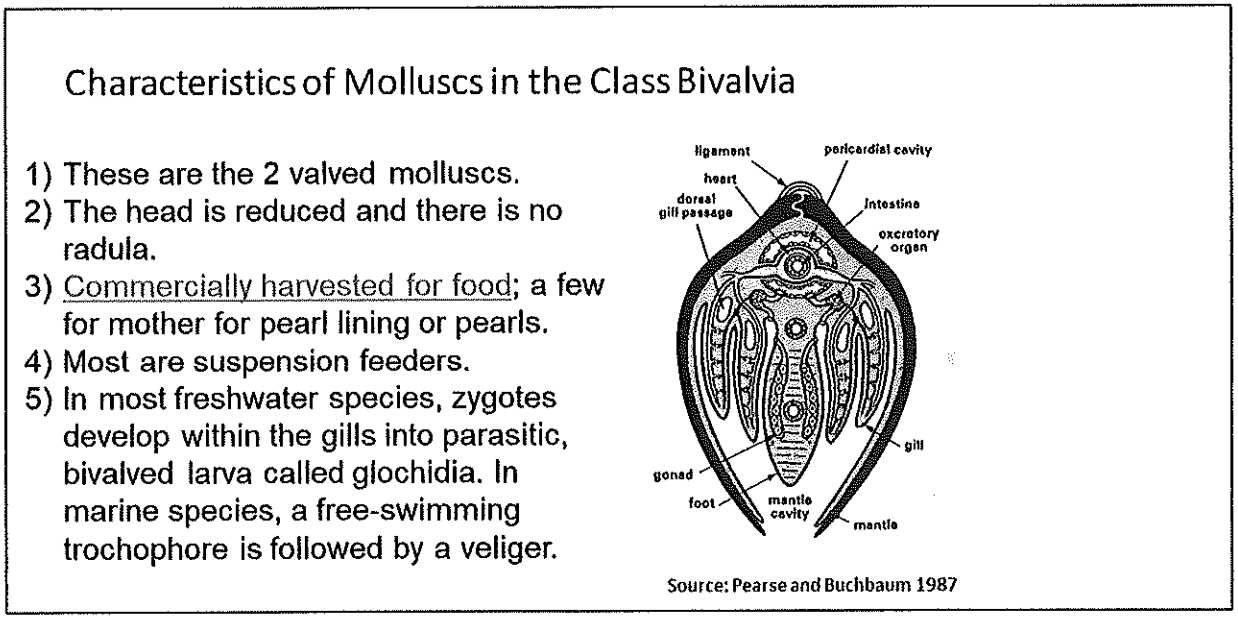


Figure 2. Some Characteristics of the Class Bivalvia (Phylum: Mollusca)

Blue Economy

The Blue Economy is driven by our many connections to the ocean. The term refers to the way that we utilized, preserve, and regenerate the marine environment in a way that allows us to use ocean resources for economic growth and productive livelihoods. A holistic consideration of the blue economy includes all the ways that we rely upon the ocean, including but not limited to seafood production, tourism and recreation, climate, and transportation and

commerce. The National Oceanic and atmospheric administration released a blue economy strategic plan that is available here.

## Instructions

**Part 1**

1. Provide copies of the recipe to the students.
2. Optional: prepare the gumbo for sharing or a symbolic representation of the gumbo
3. Begin by describing marine nursery areas like saltmarshes, swamps, beaches, and mangroves. Give basic contexts on the physical differences between the habitats and how that is important to the marine organisms that live there. Use this background to introduce the marine species in our gumbo: the bottom feeding predators (blue crab and shrimp), the filter feeding benthic molluscs (clams and oysters), and nektonic fish if you choose to add fish (ex. whiting). Here is also the opportunity to describe some of the distinguishing features of the species. This includes describing the swimming leg of the blue crab *Callinectes sapidus*, the powerful abdomen of the shrimp that allows it to thrust and swim so quickly, the digestive system of the clam and oyster that allow them to extract nutrition from very low-quality food in the sediments. Here is also where you can describe that crabs feed upon sessile invertebrates like oysters and that shrimp eat the materials that deposit on oyster reefs but that as scavengers, shrimp and crab will eat anything that is decomposing on the bottom or growing on the oyster reef (algae, bacterial films). And the many fish like whiting will eat the shrimp or crab. The detail that you place on taxonomic differences and trophic relationships will constitute the greatest portion of your lesson.
4. Connect the availability of your recipe ingredients to the factors that drive the Blue Economy. These include the fishermen that catch them, the healthy habitats required for them, and the supply chain that gets them to us. Here is also an opportunity to mention the potential changes to your pot under the conditions that will accompany sea level rise.

**Part 2**

Challenge your students (individually or in groups) to recreate the pot in different regions of the country based on species common to that area. The recipe that you have is it combined Southeast Georgia Louisiana recipe. have students recreate the seafood components of the pot using 3 species from Cape Cod in the northeast United States, Southern Florida and the Gulf of Mexico, California, and Alaska.

1. which ones remain the same and which differ because of availability? On what habitats do the species rely in each region?
2. What physical characteristics does each species have that makes it most suited for the habitat it lives in?
3. What are some of the important microbial organisms in those environments?

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**Part 3**

Have students find two additional seafood Stew, boil, or gumbo recipes from other parts of the country that have at least three different marine organisms in them. Then have them view the video "The American Blue Economy" from the NOAA.gov website.

1. Ask the students to analyze the recipes based on the marine organisms and write down the unique characteristics of those species and their habitat needs.
2. Have the students talk about the blue economy and what kinds of jobs and businesses might be related to the species in their recipes based on what they saw in the video.

Expected Results

1. Students should notice common groups across all regions (ex. Bivalves) with subtle changes in species from east to West (ex. *Crassostrea virginica* versus *Crassostrea gigas*), Atlantic to Gulf and Gulf to Pacific. They will notice some species as being more common than others, like the oyster and that some species are used in recipes interchangeably with any without any reference to the species and just to the general group (ex. white, brown, and pink shrimp).
2. Students are expected to comment on the differences between rocky shores in the northeast and the west coast when compared to saltmarshes on the Atlantic and gulf coasts. References will likely be made to mangroves and hard-bottom dominating Florida, though a few may be aware of saltmarshes in the very northern part of the Florida coast. More advanced students may note the 6 ft tidal range in the South Atlantic compared to the very small tidal range of the Gulf of Mexico (<2 ft).
3. As they address habitat needs students will likely refer to bivalves being intertidal or subtidal. They may refer to clams living in softer sediments that allow them to bury themselves and oysters growing in aggregated reefs and using chemoreception to trigger settling.
4. Comparisons of the morphology between the species described should include the adapted swimming leg of the blue crab, the difference in the body morphology of the shrimp and crab, and the two hinged shell and gills in the bivalves.

Assessment

1. List of species comparable to those in the gumbo recipe.
2. Comparison of 2 additional recipes with the original gumbo recipe that includes the species present, characteristic features of the species, and their habitat requirements.
3. Discussion of the blue economy that connects fisheries and essential habitat to marine careers like fishing and seafood processing to businesses like ice manufacturing or transportation.
4. Optional: A discussion of regional and ethnic foodways

Additional Resources

https://www.noaa.gov/stories/noaa-finalizes-strategy-to-enhance-growth-of-american-blue-economy

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https://louisianadirectseafood.com/seafood-handbook/crab/

Here is a recipe for a Louisiana style seafood gumbo. It is based on Chef Paul Prudhomme's Louisiana seafood gumbo recipe with a few modifications.

**INGREDIENTS**

2 cups chopped onions
1 1/2 cups chopped green bell peppers
1 cup chopped celery
2 bay leaves
2 teaspoons salt
1/2 teaspoon white pepper
1/2 teaspoon cayenne pepper
1/2 teaspoon black pepper
1/2 teaspoon dried thyme
1/2 teaspoon dried oregano
3/4 cup vegetable oil
3/4 cup all-purpose flour (sub rice flour for GF)
1 tablespoon minced or pressed garlic
5 1/2 cups seafood stock
1 pound andouille, cut into 1/2-inch pieces
1 pound peeled medium shrimp
9 ounces medium-large oysters in their liquor (about a dozen)
6 blue crabs, cleaned and halved
2 dozen little neck clams
2 1/2 cups hot cooked rice

## PREPARATION

- Combine onions, bell peppers, and celery in a medium-size bowl and set aside. In a small bowl combine next 7 ingredients for seasoning; mix well and set aside.
- Heat the oil in a large skillet over high heat until it starts to smoke, about 5 minutes.
- Gradually add the flour, whisking constantly with a metal whisk. Continue cooking and whisking until roux is dark red-brown to black, 2-4 minutes.
- Immediately add half the vegetable mirepoix and stir well, switching to a spoon if necessary, 1 minute.
- Add the remaining vegetables, continuing to stir, about 2 minutes. Add the seasoning mix and continue to cook, about 2 minutes.
- Add garlic, stirring well for another minute. Remove from heat.
- Place the stock in a 5 1/2-qt saucepan or Dutch oven and bring to boil. Add roux mixture by spoonful, stirring until dissolved in between each addition. Bring back to boil.
- Add andouille and return to boil again; continue boiling for 15 minutes, stirring occasionally. Reduce heat and simmer 10 minutes.
- Add the shrimp, undrained oysters, and crab meat. Return to boil, stirring occasionally.
- Remove from heat, skim oil from surface, and serve over rice.

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