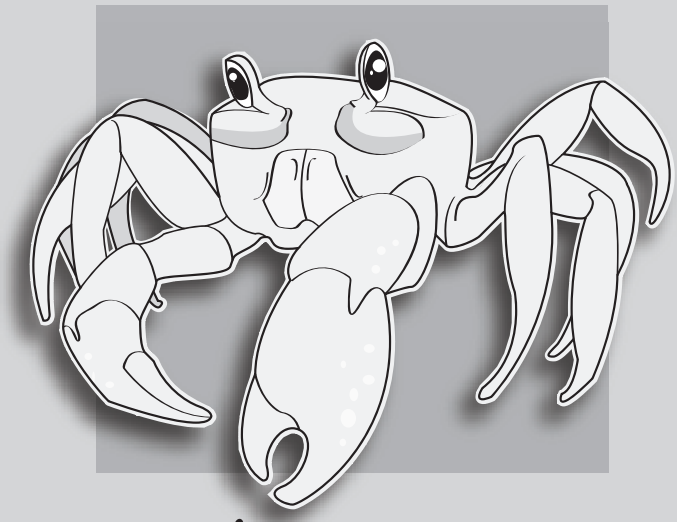
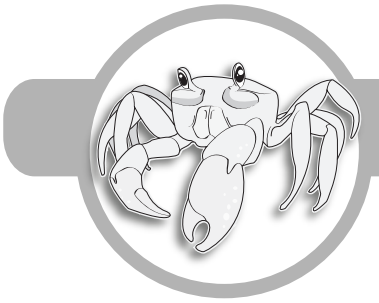


Crab Ecology

Coastal Habitats in the Classroom
Activities and Handouts

MAREX
The University of Georgia Marine Extension Service

www.uga.edu/aquarium



CrabEcology

Dear Teachers,

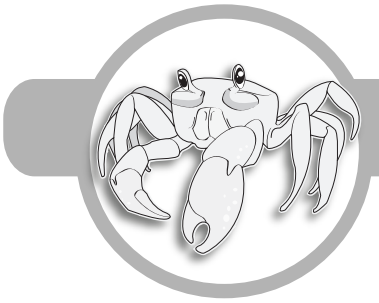
Our coastal environment is truly one of Georgia's treasures. It is a dynamic place where the natural forces that act on our planet can be easily examined. It is home to many unique habitats, and full of creatures that use a wide array of adaptations to survive. It is also a fragile environment where the balance between human interactions and the natural world is a delicate one. Due to their diversity, abundance, and charismatic charm, we believe the study of crabs can help students learn more about Georgia's coastal habitats. We have named this hands-on, feet-in program CrabEcology.

CrabEcology was created through a Coastal Incentive Grant from the Georgia Department of Natural Resources' Coastal Management Program and the National Oceanic and Atmospheric Administration. The activities included here are intended for third grade students, and aligned with their Georgia Performance Standards. They are designed and adapted in order to learn scientific concepts, and at the same time improve writing and language arts skills, practice mathematics, and create visual art.

We hope you will find CrabEcology a useful resources for teaching Georgia's natural habitats. Please refer the the additional resources page at the end of this document to find other materials to compliment your daily classroom lesson plans. We hope that by participating in CrabEcology, your students will be excited by science, and encouraged to explore, appreciate, and protect the coastal habitat that is their back yards for many years to come.

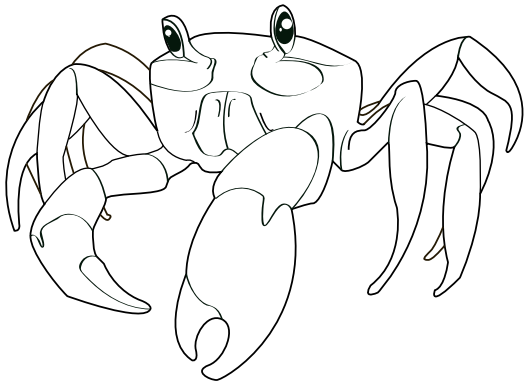
Sincerely,

Rebecca Taylor
Anne Lindsay Frick

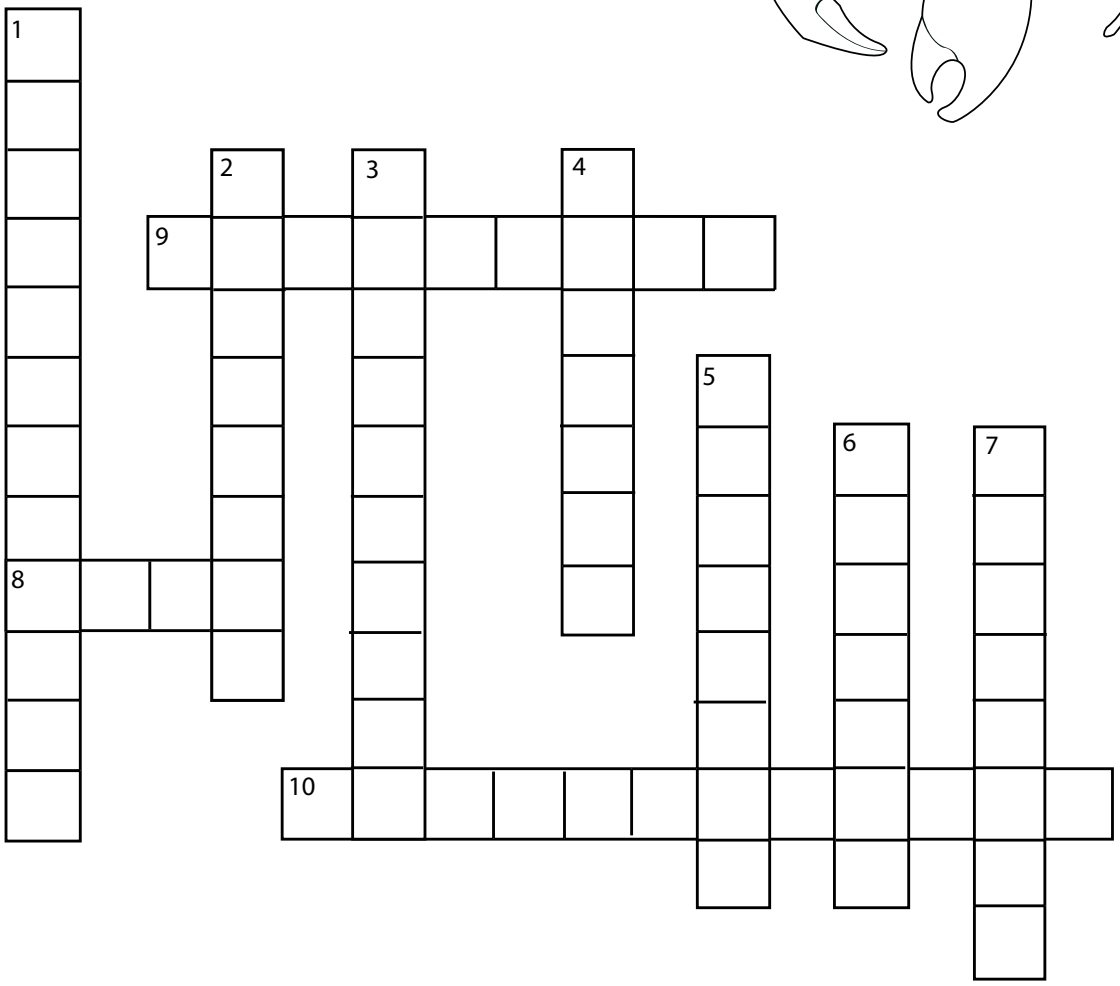


Index of Activities

Coastal Vocabulary Crossword



Match the definitions below to their correct vocabulary word and fill in the answers to the crossword puzzle!



Down

1. Carefully using resources so as not use them all up.
2. A living thing that eats other living things to survive.
3. A characteristic or behavior for survival.
4. A place where plants or animals live.
5. A living thing that makes its own food, like plants.
6. A body of water where a river meets the ocean.
7. Animals or plants that drift freely in the water.

Across

8. The daily rise and fall of the ocean over the land.
9. The path of food energy from one living thing to another.
10. An animal without a backbone.

A. habitat
B. tide
C. plankton
D. food chain
E. conservation
F. adaptation
G. invertebrate
H. producer
I. consumer
J. estuary

CRAB SLAM!

This simple, fast moving card game explores the feeding relationships of animals commonly found in a Georgia estuary. The excitement generated by the game illustrates the dynamic nature of eat or be eaten in the estuary. The first player to collect all the cards wins the game.

Based on SLAMWICH, a card game published by GAMEWRIGHT and created by Ann and Monty Stambler, (website www.gamewright.com), this activity has been simplified and reworked for the marine science classroom.

Objectives:
Students will be able to:
- Illustrate animal life in a Georgia estuary
- Investigate predator-prey relationships using a simulation card game

Georgia Performance Standards
S3L1

Materials:
For each student, or group of 2- 4 players:
card stock, scissors, glue / tape, rubber bands, copies of card templates

Key Terms
estuary, predator, prey, feeding relationship, food chain, adaptation

Time Needed
30 minutes to create card decks. 15 – 30 minutes to play several rounds of the game.

Background

Georgia estuaries and nearshore waters are lively environments where animals eat and are eaten. Feeding relationships create food chains in which energy is transferred from one living organism to another. Loggerhead sea turtles feed on bottom dwelling (benthic) invertebrates including mollusks, crustaceans, and horseshoe crabs. They have heavy jaws with powerful jaw muscles to crush prey items. Red drum also feed along the bottom of tidal rivers and nearshore marine waters on crustaceans, mollusks, and small benthic fish. They have crushing mouth plates that help them process food. Bonnethead sharks feed along the bottom of estuaries and sounds, on crabs, and other benthic invertebrates.

Procedure

Make copies of the card templates provided. Students cut out card pictures and glue / tape them onto appropriately sized pieces of card stock to assemble full playing decks.

Full Deck = 60 cards for 2-4 players and includes.
46 Crab Cards (prey)
4 Scavenger cards (raccoon or ghost crab)
10 Muncher cards (predators – loggerhead seaturtle, red drum, bonnethead shark)

1. To make card decks or let students make decks ahead of time, copy card templates. Glue card templates onto index cards, or card stock. Color animal images if desired.

2. To play the game, use the following rules:
- All players look over cards.
- Pick a dealer who shuffles cards and deals equal number to all players.
- Player to the left of dealer goes first.
- Play continues clockwise.
- Players take turns flipping over their top card

and tossing it in to center.
- Slap the card pile when you spot one of these three things:

Doubler: two identical cards flipped in a row

Sider: two identical cards flipped in sequence before and after a different card

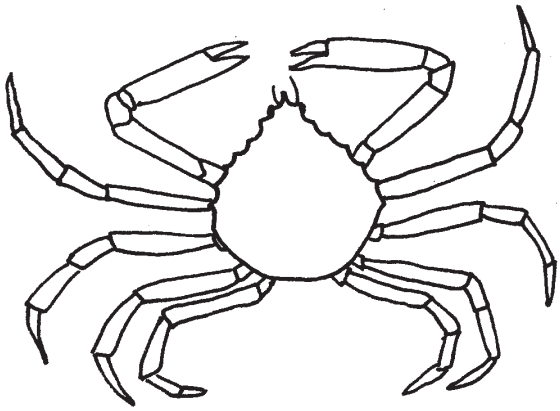
Scavenger: a scavenger animal card is thrown

- First player to slap the pile when a Doubler appears, takes the entire pile.
- When a Scavenger card is flipped, first player to yell CRABSLAM! and slap the pile takes the pile. If he/she forgets to yell CRABSLAM! the first person to do so takes the pile.
- When player wins the pile, add those cards face down and un-shuffled to the bottom of his/her own pile.
- Players who throw a Muncher card, take the pile.

Slip Slaps
If you make a mistake and slap the pile when there is no Doubler, Sider, or Scavenger, you've made a Slip Slap and must lose a card by placing it on the bottom of the center pile.

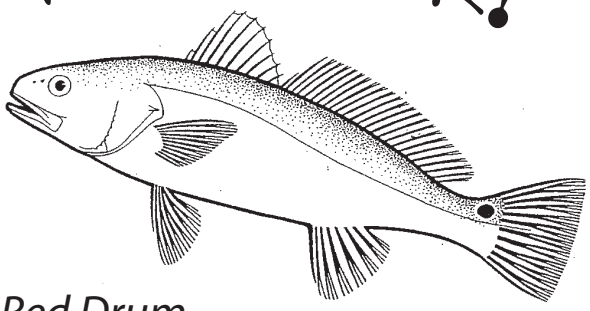
Game End
When players use all their own cards they are out of the game. The first player to collect all the card wins the game.

Crab Slam Cards - make one copy of this sheet per deck.



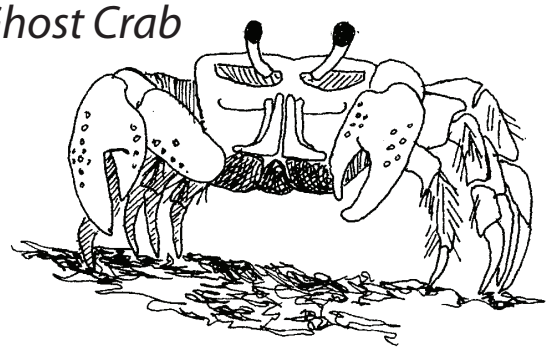
Spider Crab

PREDATOR!



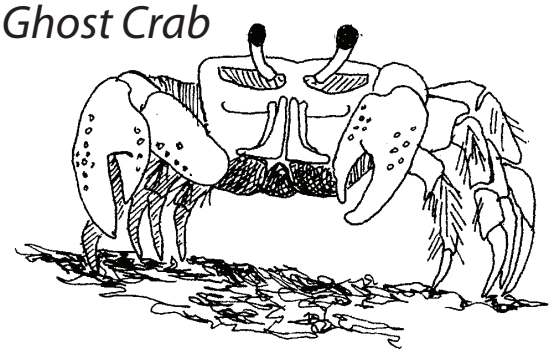
Red Drum

Ghost Crab



SCAVENGER!

Ghost Crab



SCAVENGER!

Raccoon

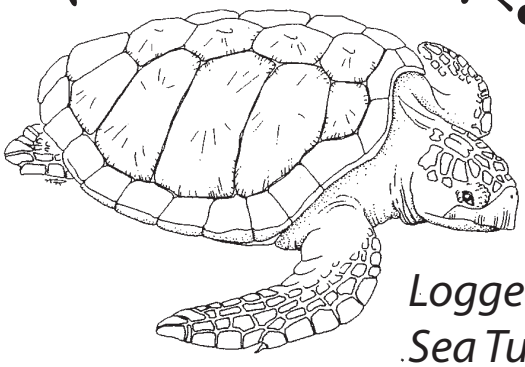
SCAVENGER!

Raccoon

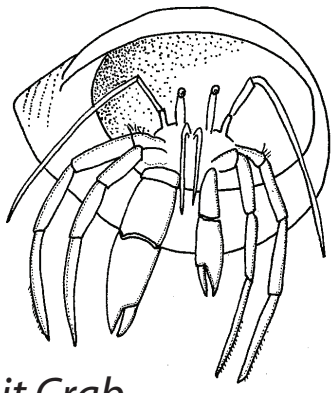
SCAVENGER!

Crab Slam Cards - make three copies of this sheet per deck.

PREDATOR!

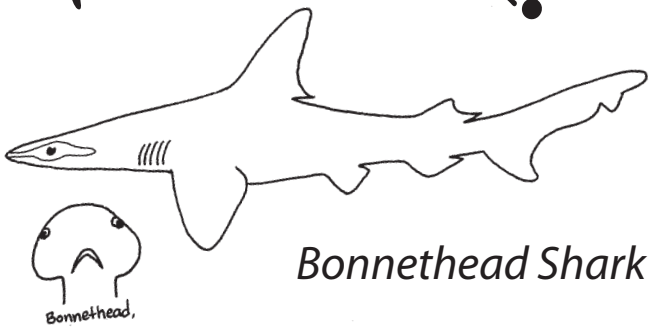


Loggerhead Sea Turtle

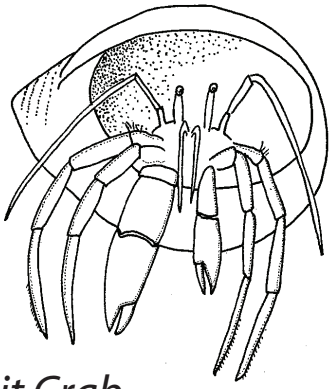


Hermit Crab

PREDATOR!

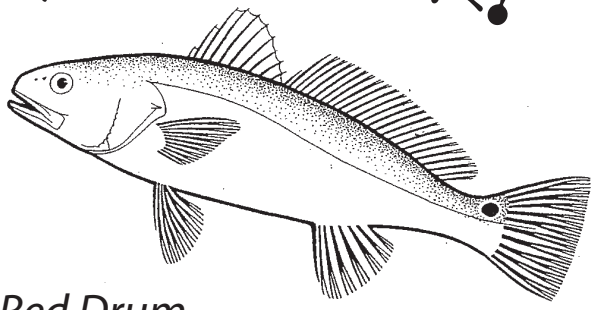


Bonnethead Shark

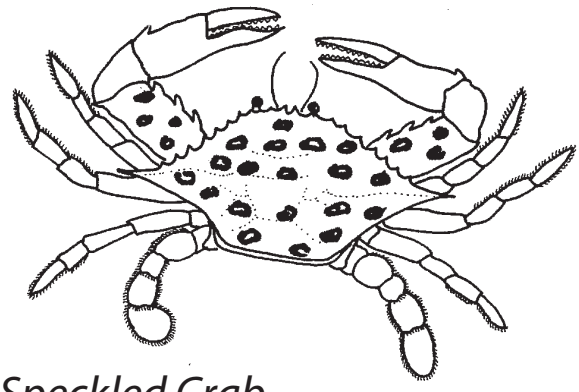


Hermit Crab

PREDATOR!

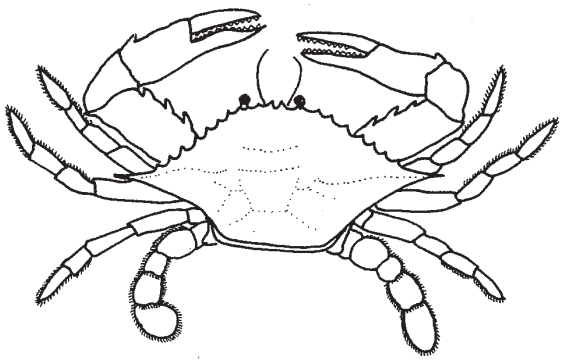


Red Drum

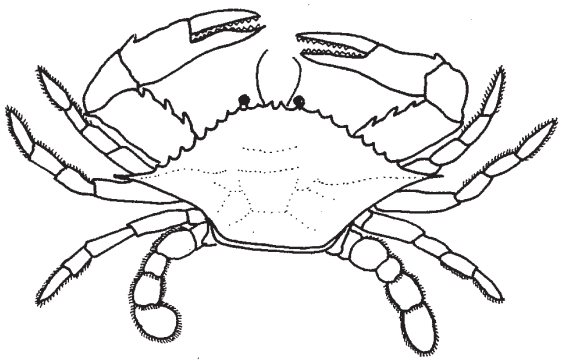


Speckled Crab

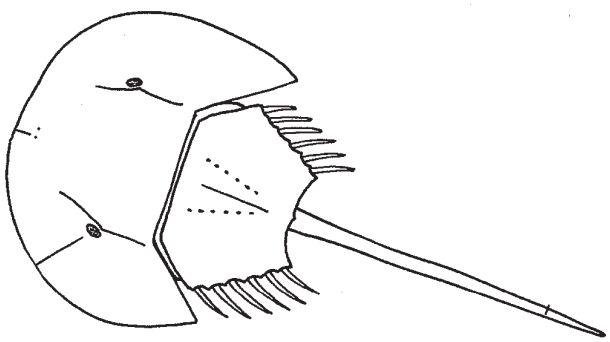
Crab Slam Cards - make six copies of this sheet per deck.



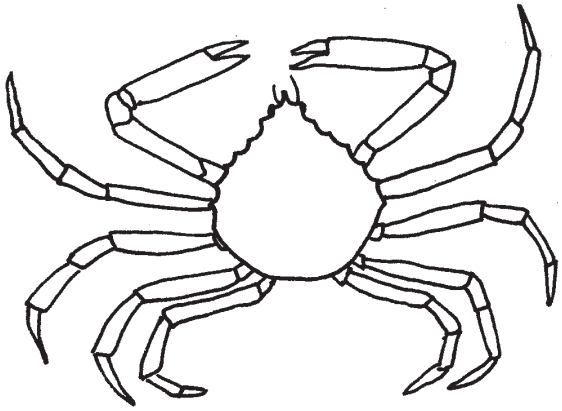
Blue Crab



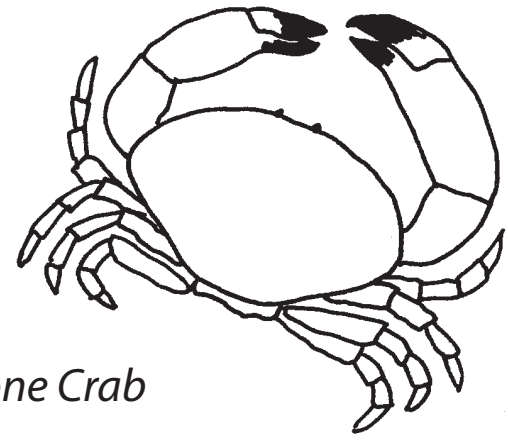
Blue Crab



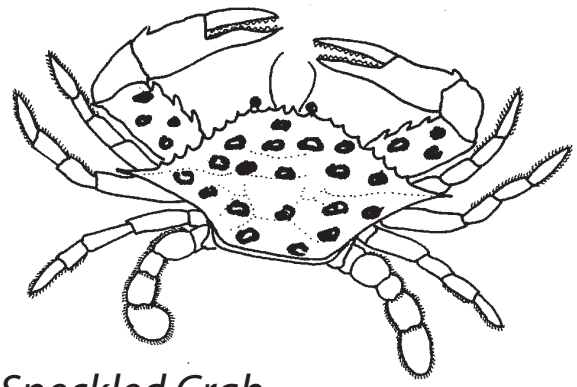
Horseshoe Crab



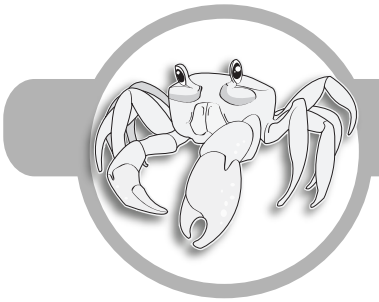
Spider Crab



Stone Crab



Speckled Crab



Walk like a Decapod-ian!

Examine a ghost crab and play a game that introduces how animals are adapted to live in specific habitats.

This activity was adapted from an idea in "How to get your organism into a K-12 Classroom" by Kelly Lewis and Mary Crowe. Find the entire activity at www.animalbehavior.org.

Objectives:
Students will be able to:
- understand that the shape of living things allow them to function and survive in their natural environment
- measure distance in metric units.

Georgia Performance Standards
S3L1, M3M2, M3N4

Materials:
stopwatch or timer (with a second hand) pieces of yarn or string (precut to 15 meters), masking tape, permanent marker, meter stick or tape, CrabEcology Poster

Key Terms
adaptation, meter, decapod, crustacean

Time Needed
One class period

Background

Have you ever wondered why you've seen that crab sneaking stealthily sideways across the sand? By taking a close look at crab anatomy we can gain some insight into crab movement and behavior.

Form follows function in nature. The way an organism is shaped relates to it needs for survival in a particular habitat. Look at a ghost crab and notice how their jointed legs are shaped and hinged. This attachment allows them to easily glide in any plane of movement - not only side to side, but also forwards and backwards. By moving sideways a ghost crab can construct a narrower burrow opening, which leaves less space for a predator to reach inside, and a stronger burrow construction architecturally speaking!

Ghost crabs legs are long and sturdy. Always on the move to dodge predators and scavenge for food, these crabs have been clocked traveling at speeds over one meter per second and covering over 300 meters a night. A ghost crab could be considered an animal Olympian of sorts! Compare and contrast crab and human bodies by studying their locomotion.

Procedure

- Copy pictures of a ghost crab for the class to examine
- If not done as a class activity, cut yarn or string into (9) 15 meter lengths and mark (6) of them at every meter with tape. See procedure step 6.

1. Examine a picture of a crab with the class and generate a list of things students know about crabs. Students may have a lot of different feelings about crabs, so as the list is generated separate facts from opinions.

2. Introduce the idea that there is a reason for the way that living things look and behave in their environment. Crabs are creatures that look completely different from us! Each of their

features (adaptations) has a unique purpose to help them survive in their habitat.

3. Crab legs are shaped for movement. How are our legs shaped for our movements? For example, ghost crabs (*Ocypode quadrata*) could be considered animal Olympians because of their swiftness. Do the students think a human the size of a ghost crab could move faster than a ghost crab? Let's find out!

4. Divide students into 6 teams of 4. Each team should make a measuring yarn to record how far the students will travel in meters. These will also serve as racing lanes. Give teams a precut 15 meter yarn piece, and have them measure and fold masking tape over the yarn at every meter. A marker can be used to write units on the tape.

5. Lay out the six (6) parallel lanes in a teaching area with lots of space (outside is best). An extra unmarked yarn piece can be used to close off the last outer lane edge.

6. Now its' time to test our hypothesis with a race! Ask a student to demonstrate the crab walk, done on all fours with your stomach facing the sky. This race is conducted in four rounds – one team member participates per round, and each round uses a different mode of movement. Assign each team member a different crabwalk for their round – frontward, backward, sideways leading left, or sideways leading right.

7. Line up the frontward crab walkers in the lanes for round one. At the GO signal, students crab walk as far as they can while 10 seconds is timed on a watch. The students freeze at the end of time, and another teammate looks at the yarn to determine how far the crabwalker traveled. Record these distances on group data sheets (attached) or on a class chart.

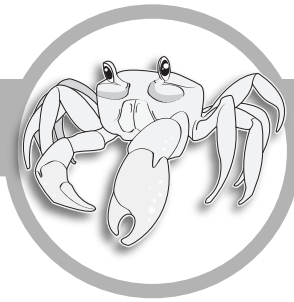
8. Repeat this process for the backwards, sideways leading left, and sideways leading right crab walkers.

9. Analyze the data. The data recorded indicates speed: the number of meters traveled in 10 seconds. Ghost crabs travel over one meter per second. Have students create a division equation to calculate how many meters they traveled per second.

10. Compare data recorded for different racing styles. Were student speeds faster than those of a ghost crab? Why not? Compare human size to that of a crab. Do we move faster just because we are bigger? If we were the same size as a crab, who would move faster? How do our legs bend compared to a crab? Would we be limited in accomplishing daily tasks if we moved like a crab? In which direction was it easiest to move? How does a crab benefit from moving as it does?

Extensions

- Use the data collected to create graphs for visual comparison, or practice math skills by converting meters per second into different units or by computing average speeds for different race methods or racing teams.



Walk like a Decapod-ian!

Do you think you can crab walk faster than a Ghost Crab?
Give the crab walk a try and record the results in the table below.

Crab Walk Movement	Student Name	Meters traveled in 10 seconds
Fontways		
Backwards		
Sideways Left		
Sideways Right		

1. I traveled _____ meters in 10 seconds.

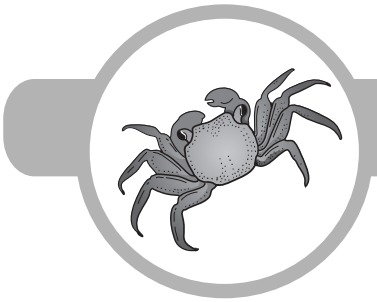
2. I traveled _____ meters in 1 second. *hint: create a division problem*

3. A ghost crab can move up to one meter per second. Was your speed faster than that of the ghost crab?

4. Which racing style was fastest?

5. Think about how much bigger you are compared to a ghost crab. Why was it harder for you to move this way?

6. What are some ways that our bodies are shaped to perform our daily functions?



Salt Water See-Saw

This activity illustrates the way in which plant cells respond to salt water. By extension, adaptations for balancing salt in animals are introduced.

This activity has been modified from "Osmosis in the Wetland" in UGA Marine Extension Service Adopt a Wetland Materials. More Adopt-A-Wetland information may be found at http://www.marex.uga.edu/shellfish.

Objectives:
Students will be able to:
- Investigate how changes in the concentration of salts in water affect the water / salt balance in living cells.
- Investigate what adaptations are necessary for an organism to live in the fluctuating salinity of the estuarine environment.

Georgia Performance Standards
S3L1

Materials:
For each pair or small team of students: Fresh potato (cut into "french fry" type slices), table salt, two cups (glass or paper), tap water, knife, measuring spoons, permanent markers

Key Terms
Adaptation, characteristics, habitat, salinity, solution, osmosis, water balance, estuary, salt marsh

Time Needed
Activity takes one class period for observations. Set up takes 10 minutes.

Background

The water in oceans and estuaries is very salty. Plants and animals that live in salt water must balance salt in their body tissues. Cells make up blood and tissue in animal bodies. Some salt marsh plants secrete or "sweat" extra salt out, while others draw more water into their bodies to balance salt that is already in their cells. Fish excrete super salty and concentrated urine to balance salt in their bodies. Female sea turtles that "cry" during nesting are using special lacrimal glands to secrete extra salt, not because they are sad. Animals that live in an estuary or salt marsh must have characteristics that allow them to adapt to changing salinity levels associated with tides, drought, or excessive rainfall. Vertebrates (including humans) drink extra fresh water, excrete concentrated urine, sweat, and cry to balance salt in our body cells. Think about what you do when you are thirsty. Your cells are working well in advance of your behavior when it comes to balancing salt and water throughout your body. By the time you are thirsty, your cells are already dehydrated to some extent. It's very important for all animals to drink enough water for their bodies to function efficiently.

Procedure

1. Gather materials

2. Divide students into pairs or small teams

3. Peel and slice a fresh potato into french fries

4. Give each team of students two cups and a permanent marker. Label one cup "fresh". Label the other "salt"

5. Fill the fresh cup with tap water

6. Fill the salt cup with tap water and mix in 2 tablespoons of salt

7. Give each team 6 slices of potato. Feel the potatoes and write a sentence to describe how they feel and their appearance.

8. Place 3 in the fresh cup and 3 in the salt cup.

9. Wait 30-40 minutes.

10. Feel the potatoes again and record observations.

11. Discuss results.

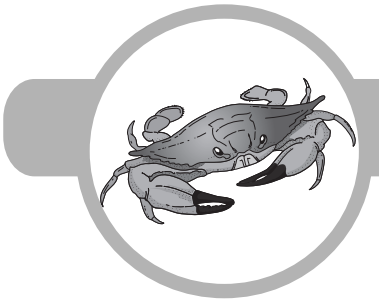
Extension Ideas

What happened to the potatoes?

Potato cells have lots of water and a small amount of salt in them naturally. When potato slices are put into fresh water, more fresh water moves into the cells of the potato to balance the slightly salt water that is already in them. The water and salt solution inside the potato cells want to balance with the water and salt solution outside the cells of the potato. The movement of water from low salinity areas to high salinity areas is called osmosis. The potato slices put into salty water shows that water from the less salty potato wants to move to the more salty water outside the potato in order to balance. Even though two different results are shown, osmosis, or the movement of water from and area of low salinity to and area of high salinity is illustrated.

What would happen if you watered several young bean plants with different solutions of salt and water over two weeks?

What might happen to a saltwater fish that is put into fresh water by mistake? (Please don't actually do this!)



Emergency in the Estuary!

Use the scientific method, experiment to see if dirt can create a dangerous situation for life in the estuary.

This activity is adapted from "Lessons from the Bay – Muddying the Waters",
http://www.doe.virginia.gov/VDOE/watershed/lessonplans/muddy/background.html

Objectives:
Students will be able to:
- understand that water is a resource vital to all living things
- be able to name ways that sediment affects life in the estuary
- learn the steps of conducting a scientific experiment

Georgia Performance Standards
S3CS1, S3CS4, S3CS5, S3CS7, S3CS8, S3E1, S3L2

Materials:
For each group:
glass jars (large; pickle, mayonnaise, etc)
stirring sticks or spoons, potting soil
measuring beakers (in milliliters) or measuring cups, copies of data and question sheets for each group

Key Terms
sediment, estuary, erosion

Time Needed
30 minutes

Background

Soil erosion and runoff caused by human activities like road construction, agriculture, urban development, and dam operations, can dump excess sediment into our waterways. This sediment is then channeled through rivers and streams, eventually ending up in the estuary. Can this dirt be dangerous?

Excess sediment can be detrimental to aquatic animals and plants in a variety of ways. Suspended particles cloud the water, preventing sunlight from filtering down to the aquatic plants and hindering photosynthesis. The cloudy water can also impair the vision of estuarine animals by affecting their ability to hunt and avoid predators. Floating clumps of dirt can clog the gills of fish, and once settled to the bottom of the estuary, can smother the benthic animals, like oysters, that live there. These chains of events can eventually create dead zones within an estuary (a habitat that is one of the most productive on earth). Over time sediments can build up to alter the physical structure of the water body.

Knowing the impact that excess sediment can have, it's important to be conscious of ways to contain the by-products of our construction zones. Keeping a natural vegetation buffer around our waterways can help filter out many pollutants and sediment particles from runoff. Salt marshes are natural buffers for the tidal creeks and rivers that make up a larger estuary. Buffers made from bales of hay or ditches built to catch excess sediment are also ways of limiting the amount of sediment that enters our water sources.

Procedure

This activity works best with students working together in small groups.

1. Talk to students about the importance of quality water as a resource. Who needs water? What does water quality mean? What are types of pollutants that can affect the quality of water?

2. Tell students that they are a part of a research team that will test the effects of sediment on water quality in the estuary. *Dirt Builders Inc.* wants to build an apartment complex right on the edge of a river which would cause a lot of erosion and sediment runoff into the water. *Environmental Agency* is worried that this dirt could be dangerous for wildlife in the estuary, and has hired the students to test if an emergency will be created for the wildlife in the estuary if the construction occurs.

3. Write the steps of conducting a scientific inquiry on the board, and quickly go over the parts of an experiment: Question, Hypothesis (Prediction), Procedure, Results, and Conclusion. The Question: Can sediment create an emergency in the estuary?

4. Hand the following materials to each group of students: a glass jar, stirring stick or spoon and bowl of potting soil.

5. Next students will develop their hypothesis, or prediction of the effect, if any, sediment will have on water quality and wildlife in the estuary. Have them feel the dirt, and think about what will happen when they add it to the water. Share predictions between the groups. Write predications on board.

6. Go over with students the steps of the procedure and how to record their results. Experiment notes should include:

What is the clarity of the water?
Do particles of different sizes settle differently on the bottom?
How would animals that live in each zone be affected by the sediment?

7. Conduct the experiment.

8. After the experiment, students will complete the questions on sheet 2 to determine their results and conclusion. Share the results and conclusion from each group. Discuss variables that may have caused differences in the results gathered by each group. How would the results from this experiment be different from a real life situation? Are there ways to prevent excess sediment from entering the water?

Extensions:

- Have students design an experiment for testing methods for preventing excess sediment from entering the water system

- Purchase a water quality and dissolved oxygen testing kit to test for other indicators of water quality (www. carolinabiological. com). These could be used on water samples from classroom aquaria, a local body of water, or jars of water filled with different contaminants such as vinegar (will show low pH like industrial runoff can), or miracle grow (will show high level of phosphorous that can cause deadly algal blooms).

- Want to explore more in depth? Research how barrier islands on the Georgia coast are built from sediment build up!

- Get involved! There are state wide projects such as Adopt-a-Stream and Adopt-a-Wetland which train community volunteers to monitor the health of their local water supplies.

Emergency in the Estuary - Experiment Sheet

Question: Can sediment negatively affect water quality and create an emergency for wildlife in the estuary?

1. Hypothesis - write a sentence to explain what you think the answer to the question above is:

Experiment Procedure:

1. Obtain a glass jar and cut a narrow paper strip to fit the height of the jar
2. Divide the paper strip into 3 even zones and label A, B, and C - with A being on top . Attach paper to side of jar so it can be read looking through the glass
2. Fill the jar with 500 ml of water
3. Add 50 ml of dirt, and stir
4. After 1 minute, 5 minutes, and 10 minutes, record what you see happening in each zone and sketch a picture to show how cloudy the water is in the correct space below.

	Notes ZONE A	Notes ZONE B	Notes ZONE C	Draw your Jar Here
One Minute				
Five Minutes				
Ten Minutes				

Emergency in the Estuary - Results and Conclusions

1. What were the **Results** of you experiment? *Write a sentence to explain what happened to the sediment in the water over time.*

How were the living things in Zone A affected by the sediment in the water:

How were living things in Zone B affected by sediment in the water?

How were the living things in Zone C affected by sediment in the water?

2. What **conclusions** can you make about sediment and water?

Was your hypothesis (prediction) correct?

How could excess sediment create an emergency for wildlife in the estuary?

Beach Encounters

Human impact on the natural world and the concept of stewardship is the focus of this activity. Students will use critical thinking and creative writing to tell a story about a visit to a sandy beach on the Georgia coast.

Objectives:
Students will be able to:
- name conflicts between humans and nature
- come up with negative and positive ways in which humans impact the environment
- name ways we can enjoy natural areas while being stewards to protect resources for future generations

Georgia Performance Standards
S3L2, ELA3C1, ELA3W1

Materials:
paper and pencils, Story Strips

Key Terms
habitat, conservation, resource, stewardship

Time Needed
one class period

Background

More and more people are moving to the coastal areas of the United States. Some reported statistics show that half of the U.S. population lives within 50 miles of the coast. The coast is a desirable place to be for a variety of reasons. People find relaxation and inspiration exploring coastal habitats. There are many coastal recreational options including fishing, boating, beach combing, and body surfing. Coastal areas support tourism, seafood, and shipping industries.

The coastal environment is also important for wildlife. It hosts many unique habitats for wildlife. It serves as an important resting ground for migratory birds, and as critical nesting habitat for a number of endangered species. Estuaries provide a nursery for shellfish and fin fish species that are the backbone of Georgia's commercial seafood industry. A popular bumper sticker reminds us "No Wetlands. No Seafood". Protection of coastal wetlands is crucial to local and state economics and historic ways of life.

As more and more people move to and visit the coast, resource management conflicts arise between preservation and recreation. This activity explores the different ways that humans and wildlife both need coastal areas, and encourages critical thinking about how to manage an area to allow for both to coexist. The writing portion of this activity encourages students to think about how their choices and small actions have big impacts on living organisms and habitats. It is important for humans to be good stewards who protect these fragile natural resources for the future.

Procedure

Copy and cut Story Strips for each student.

1. Review coastal habitats: salt marsh, estuary, maritime forest, tidal creeks, tidal rivers, sand beaches, sand dunes. Generate a list of ways that humans use and impact the coastal environment.

2. Ask students if they have visited a beach

before. What's it like? What do they like to do at the beach?

3. Give a Story Strip from Sheet A to each student and 5 minutes to write a short story started by the assigned sentence. The story could include the answers to:
What were you doing on the beach?
How will you interact with the organism you have found?
How does that interaction make you (the student) feel?

4. Generate another list for how nonhuman animals use coastal habitats.

5. Give each student the correlating story strip from Sheet B and 5 minutes to write a story again, but from the perspective of the animal on the beach. The story should include the answers to:
Why is the animal on the beach?
What is it doing?
How has its encounter with the human impacted it?

6. Choose a few students to read their complete stories (A and B). Discuss the ways in which our actions can affect wildlife. After thinking about the animal and view would the students change how they wrote their story the first time around? Humans and wildlife many habitats, but we may use habitats in different ways. Review student responses in the first list. Which would have negative effects, positive effects, and no or neutral effects on the habitat and its animals.

Resources are the "things" that living organisms use. Are beaches a resource? Why is it important to think about how we can affect wildlife? Conservation is the act of preserving resources so that everyone and every organism can use them. What would happen if everyone that visits a beach took one live animal home, or left one piece of trash behind? On the flip side, what would happen if each person who visited the beach taught another person about leaving wildlife as they find it or took their personal with them when they left the beach?

Extension Ideas

- Play a game of charades or pictionary where students come up with other ideas about how to be good stewards of habitats

- Design a poster thanking the ocean for something it gives us, and encouraging others to be good stewards of the environment. You can check out the initiative as well as a good short video at www.thankyouocean.org

- Have students use internet and library resources to research a case study of human impacts on coastal environments, and then write an argument for how they would deal with the issue if they were in charge of managing the area. Some issues to look into could be: the over fishing of horseshoe crabs and its effect on red knot populations, coastal development and sea turtle nesting, boat traffic and manatee strikes, piping plover nesting and Cape Hatteras, water quality and red tides.

Story Strips A

1a. I was walking down the beach when through the rippled water I saw the edge of a live sand dollar poking out of the sand! And then ….

What happens? How do you feel? What do you do?

2a. I was walking down the beach with my family at night, when we saw something strange coming out of the water and up the beach. "It's a sea turtle!" I exclaimed, and then ….

What happens? How do you feel? What do you do?

3a. I love the way the wind feels on my face as my family and I zip over the ocean waves on our boat. Suddenly, I think I see the nose of a manatee pop up ahead of our boat, and then…

What happens? How do you feel? What do you do?

4a. I was walking on the oceans edge when I spot the biggest, most beautiful snail shell I have ever seen! I run over to pick it up, but when I flip it over I see the legs of a live hermit crab and then…

What happens? How do you feel? What do you do?

5a. I was walking down the beach, when I see a big flock of resting birds and then…

What happens? How do you feel? What do you do?

Story Strips B

1b. I'm a sand dollar, buried safely under the sand so the waves don't knock me onto the beach. I was feeding on plankton in the water, when I found myself being plucked from the water and then….

What happens? How do feel? What do you do?

2b. I am a female sea turtle ready to lay my eggs. Finally the night has come, and I am ready to start my slow journey up the beach. I was looking for a good spot to lay my eggs in the dunes when a human with a flashlight runs toward me and then….

What happens? How do feel? What do you do?

3b. I am a manatee. All day long I hear the roar of the motor boat engines that use the waters of my home. One day this noise was louder than usual, and as I lifted my head out of the water to breathe I realized a boat was headed straight towards me and then…

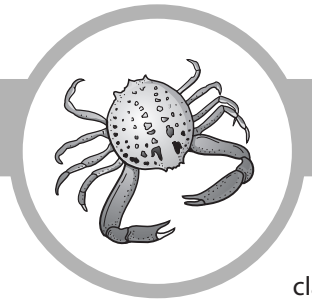
What happens? How do feel? What do you do?

4b. I am a hermit crab that lives in a tidepool on the beach . I had just molted and moved into the only empty snail shell that was just my size, when a human scoops me up off the beach and then….

What happens? How do feel? What do you do?

5b. I am a shore bird that just flew in from Argentina! What a journey! It's not over yet. I was resting on the beach (because it's important I save my energy to fly to my next destination) when a human being with a barking dog ran towards me and then…

What happens? How do feel? What do you do?



Crabby Constructions

Create a paper plate crab and explore adaptations that help living things survive in their habitats! Learn general anatomy of crabs and characteristics used for crab classification.

Objectives:
Students will be able to
- recognize the diversity of life and the use of classification to understand the world around us
- recognize that animals have forms which fit their survival needs
- name characteristics that are unique to true crabs

Georgia Performance Standards
S3L1, ELA3R3

Materials:
paper plates, colored construction paper, scissors, staples and/or glue sticks, markers or crayons, CrabEcology Poster

Key Terms
invertebrate, adaptation, classification, characteristics, survival, appendage, exoskeleton, jointed, diversity

Time Needed
One class period

Background

Scientists classify things into groups by looking for (1) characteristics that living things share or for (2) characteristics that differ from all other organisms. The characteristics that all true crabs share are exoskeletons, 10 jointed limbs (8 of which are used for locomotion and 2 of which are pincers for feeding), stalked eyes, antennae, gills for respiration, and short "tails" folded against the underside of their bodies. Classification helps us understand the world around us.

Not all crabs look alike. Within the true crab order there are many differences between individual species (diversity). These varying characteristics are the adaptations that allow crabs to survive in their preferred habitat. Variation creates diversity. Diversity make the earth a vibrant, healthy system.

Procedure

- Make an example of the paper plate crab to show students.

1. Use the CrabEcology poster to point out similarities between the features of crabs. Note which of these characteristics define a crab.

2. Ask students to point out the differences between the true crabs. Think about the Great Crab Grab activity from the CrabEcology program. Was it better to be able to eat many different things or specialized for feeding on just one food item? Would it be harder to survive if they were all using the same food source?

3. Tell the students they have been hired by a bioengineering firm, Crab-o-botics, to create a true crab. This crab can be completely imaginary, but must have all the typical crab body parts.

4. Show students the example of a paper plate crab. Give them supplies and 20 minutes to make their crab creations.

5. After students complete their crab, have them write up a short summary that includes where the crab lives and how it survives there.

6. Have students give their crab a common name, and two descriptive scientific names (*Genus, species*) by combining Latin and Greek roots words. For example, blue crabs are known scientifically as *Callinectes sapidus* (meaning beautiful swimmer). Scientific names allow scientists and teachers to talk about a single species of animal even if they speak completely different languages.

7. Take turns presenting crabs to the class and discussing the adaptations the students designed.

Extensions

- Have students research a Georgia habitat and outline features of that habitat that could provide water, food, shelter, and space. Then make a crab to live in that specific habitat.

To Make a Paper Plate Crab:

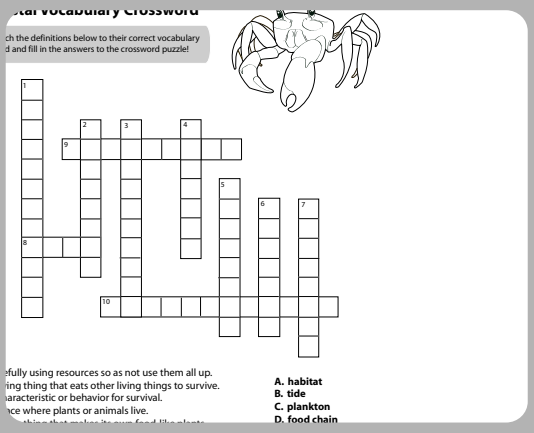
1. fold a paper plate in half to make the shell body - staple/glue/tape together

2. cut 8 legs for movement out of contruction paper and attach to sides of paper plate

3. cut two claws from contruction paper and attach to front portion of paper plate

4. create stalked eyes with creased construction paper cutouts

5. use craft supplies to decorate and camoflage!



Egg Float

Different solid objects have different densities in fresh and salt water. In this activity, students will experiment with a floating egg and water to investigate how objects float.

Objectives:
Students will be able to:
- compare the buoyancy of solid objects in waters of differing densities
- relate salinity to densityTo investigate the density of fresh and salt water and how objects float

Georgia Performance Standards
S3CS1, S3CS3, S3CS7, S3CS8

Materials:
For each team of students:
wide mouth glass jar (eg., pickle, mayo, canning, fresh egg, table salt, water, teaspoon

Key Terms
Investigation, prediction, sink, float, dissolve, buoyancy

Time Needed
One class period

Procedure

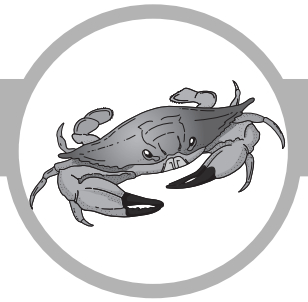
This activity is suggested as a pair competition. Before dividing into teams of 2 students, explain the materials to be used and the principles involved in the teacher demonstration.

Demonstration:
1. Fill jar with tap water and put and egg beside the jar.
2. Ask the class to predict whether the egg will sink or float.
3. Place the egg in the water (it should sink).
4. Ask the group what will happen if salt is added to the water.
5. Slowly add one teaspoon of salt at a time to the water, stirring gently. The egg will eventually float off the bottom. The salt water is heavier (or denser) now and can float (or buoy) heavier objects than the lighter fresh water.

Team Competition:
1. Choose one member of the team to measure and add salt and another to record.
2. Repeat the demonstration steps.
3. How many teaspoons of salt did it take to float the egg?
4. What is the difference in the tap water in which the egg sank and the salt water in which the egg floated.
5. In which water could a person float best? Why do huge animals like whales live in the ocean instead of on land?

Repeat the Experiment:
1. Repeat the egg float in salt water.
2. Does it take the same amount of salt to float the egg the second time? If not, what might account for the difference?

Extensions
- Research the Dead Sea or the Great Salt Lake in the media center.
- What earth and water cycle processes cause these rare areas of high salinity to form? What kinds of organisms live in these areas?
- Think about how animals adapt in super salty bodies of water.
- Try "Easy Estuary" as an extension activity.



Easy Estuary

This activity explores the difference between salt and fresh and simulates the mixing that occurs between these water sources in an estuary.

This activity has been modified for grade 3 from the original "Salt Wedge Estuary", by Dr. Leslie Sautter (Department of Geology, College of Charleston and included in the COASTEAM PROGRAM: Marine Science for Teachers). For the complete curriculum, log on to: http://oceanica.cofc.edu/coasteam

Objectives:
Students will be able to:
- Define fresh, salt, and brackish water sources on the coast
- Illustrate differences in density of salt and fresh water
- Investigate the mixing of salt and fresh to create brackish water
- Understand that tides play a large role in estuary mixing
- Perform experiment twice and compare results

Georgia Performance Standards
S3CS1, S3CS2, S3CS3, S3CS4, S3CS5, S3CS7, S3C38

Materials:
For each pair or small team of students:
2 clear, clean baby food jars with lids fresh water in a large jar, liquid measuring cups (one with a pouring lip) or paper cups, table salt, blue and red food coloring, 2 index cards, basin to catch spills (tub, or baking dish), plastic teaspoons, eye droppers

Key Terms
Experiment, method, hypothesis, estuary, salt water, fresh water, brackish, salinity, density, tides

Time Needed
One class period

Back ground

Ocean water is very salty. Salt water is heavier (and more dense) than fresh water. Fresh water on the coast of Georgia comes from rain, groundwater sources, and rivers that originate in the upper half of the state and flow towards the coast. Georgia's five big freshwater rivers that flow to the coast are the Savannah, Ogeechee, Altamaha, Satilla, and St. Mary's. The famous Chattahoochee River actually flows to the Gulf of Mexico. Fresh water flowing into the estuary from a river is less heavy (dense) than the salt water entering the estuary from the ocean. In some estuaries a wedge of heavier salt water is created as the lighter fresh water flows over it. Brackish water is a mixture of salty water and fresh water and is typically less salty (has lower salinity) than ocean water. Ocean water defines the marine ecosystem. Brackish water may be found in salt marshes, estuaries, sounds, tidal rivers, and tidal creeks. Tides, currents, and waves mix water in the estuary. Georgia's coast has two full tidal cycles a day (high, low, high, low) Because tidal range (the vertical difference in water level difference between high and low tides) in Georgia is 6-8 feet, and a lot of water moves in and out twice a day, we do not often see a true salt wedge in our estuaries. There are areas in estuaries and in the ocean where heavier salt water lies underneath layers of less salty water.

Procedure

Set up basins and gather all materials before starting activities. Do all work in basin, tub, or baking dish to minimize wet mess.

Practice:

1. Fill two jars with fresh water add 2 drops blue color to one jar.
2. Add 2 drops red color to the other jar.
3. Over fill both jars with several drops of water.
4. Cover mouth of blue jar with index card.
5. Turn the jar upside down while holding the card in place, and place it over the mouth of the second jar.
6. Be sure to line up jar mouths.
7. Remove card between the two jars carefully.
8. Discuss what happens. Write a sentence to describe what happened.

Now try it again with salt and fresh water. Here's how:

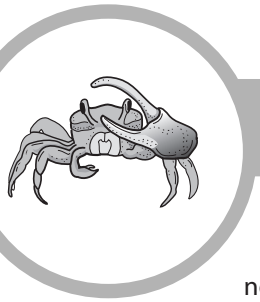
1. Fill both jars with tap water.
2. To one jar add 2 teaspoons salt and 2 drops red food coloring. Stir.
3. To the other add 2 drops blue food coloring.
4. Add a few more drops of fresh water to each jar, so each jar is over filled.
5. Place index card over the mouth of blue (fresh) water jar.
6. Carefully turn the jar upside down while holding the card in place, and place the blue jar's mouth on top of the mouth of the red (salty) water jar. Be sure to line up the jar mouths!
7. Predict what will happen when the card is removed.
8. Remove card and observe.
9. Discuss what happens with research team. Write a sentence to describe what happened.

Now expand:

Holding the jars together and over the basin, slowly rotate the jars 45 degrees while watching the interaction between the salt and the fresh water. A "purple wedge" will form with a mixed region of salt and fresh. This mixture is brackish water! Why does this wedge happen?

Now repeat salt – fresh water experiment and compare results.

Extension Ideas
Team this activity with "Egg Float".



Marsh Mosaics

Explore the dynamics of a salt marsh habitat through literature and art. This activity reinforces the concept of habitat, and encourages students to think about how nonliving things (temperature, water, sediment type, ect) influences the animals and plants you find there.

Objectives:
Students will be able to:
- differentiate a wetland habitat from other habitats of Georgia
- name organisms that are unique to a salt marsh
- understand how nonliving factors such as water, sunlight, temperature, and salt determine what organisms live in a habitat
- name how animals in a wetland habitat respond to their environment

Georgia Performance Standards
S3L1, ELA3LSV1

Materials:
story of "Clawson the Fiddler Crab", paper pieces of various textures and colors, scissors, glue

Key Terms
Habitat, estuary, brackish, plankton, mollusk, bivalves

Time Needed
One class period

Background

Organisms of a tidal salt marsh have many different ways of responding to changing environmental conditions. Fiddler crabs dig burrows that offer protection from predation as well as a safe place to wait out the high tide. Bivalve mollusks, like oysters and ribbed mussels that filter feed in the water, become easy targets for predators once the tide retreats. Bivalves close their hard shells for protection from predators and from drying out in the hot sun. Living in a salty environment is challenging. All organisms in nature must maintain a balance between the water and salt levels in their bodies. *Spartina alterniflora*, the common salt marsh grass, is one of the few plants that can inhabit areas that are flooded twice daily by salt water. It has special glands that rids the plant's body of extra salt. You can actually see the salt encrusted on its leaves! Other animals in the salt marsh are just visitors, moving freely in and out of areas in the salt marsh, when conditions are favorable.

Procedure

- Gather large pieces of butcher paper, large pieces of construction paper, or poster boards on which for students can make their collages
- Copy the pictures of salt marsh animals provided for students to use as reference or cut outs in this activity.

1. Review the concept of habitat. Review the components of a habitat – food, water, shelter, and space in the right arrangement. Salt marsh is a type of wetland habitat. What do students know about wetland habitats? What are other types of wetland habitats? Do they think wetland habitats are hard places to live? Why?
2. Show students on the Coastal Georgia map provided where salt marshes are found. What makes a salt marsh different from other wetland habitats? Review the concept of tides (see fact sheet file on CrabEcology CD). Georgia's estuaries are the transition areas between the Atlantic ocean and fresh water river systems. The tide

goes in or out about every 6 hours and 12 minutes.

3. Pass out a sentence of the story of "Clawson the Fiddler Crab" to each student. Read the story aloud as a class; each student reads an assigned sentence in turn.

4. After reading, list with the students some things that changed in the salt marsh habitat and how animals responded. Break students into four groups according the assigned sentences:
Low Tide 1 – Sentences 1-6
High Tide 1 – Sentences 12-17
High Tide 2 – Sentences 15-21
Low Tide 2 – Sentences 22-29

5. Two groups will create a marsh mosaic at high tide, and two will create a marsh mosaic at low tide. Each group should show water level in their depiction of the salt marsh, and what the animals are doing under water or above water.

Note: Creating these mosaics can be as simple as using torn paper to represent the elements of the marsh - a long brown strip for the mud, a large blue piece for the water or sky, and rectangular green strips for the marsh grass. Circle punches could be used for plankton, or larger pieces for snails, etc. Be creative and have fun!

6. Assemble the mosaics side by side in a low-high-low-high tidal cycle to represent a 24 hour period in the salt marsh.

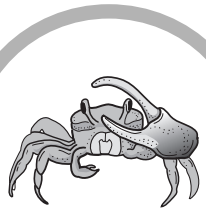
Extension Ideas

- Collaborate on this activity with your art teacher, and study the style of paper collage works of Henri Matisse!

- Write a poem about the salt marsh habitat created or about the changes that the tidal cycle brings to organisms that live there.

- Research a fresh water wetland and write a postcard to a salt marsh animal, telling about his animal friends and his life there.

- Pull animals from the mosaics and write their names on the board, and then have students construct food chains and food webs within the habitat.



A Salt Marsh Story

Cut these sentences into strips and hand one to each student. Each student reads there sentence aloud in order to complete the reading as a class.

1. Somewhere down in coastal Georgia, Clawson the fiddler crab lives in a salt marsh with a million of his relatives and best buddies.

2. Crawling around outside of their burrows, the fiddler crabs scoop up the deep dark marsh mud and eat the nutrients within.

3. The crabs have to stay close by their burrows however, as the water has been gone for awhile now.

4. Hungry egrets and raccoons are on the lookout for a fiddler crab that can't move fast enough to retreat into the safety of its burrow.

5. The herons and egrets quietly stalk, their long toes spread to help them walk on top of the soft marsh mud.

6. The birds long slender bills are well suited for spearing small animals like fiddler crabs up off the ground.

7. All is well and good, until slowly and surely the water starts creeping in.

8. The periwinkle snails that were feeding on the marsh grass slither and slime their way to the top to get out of the waters way.

9. Clawson and his friend go deep into their burrows, plugging the entrance with sand, to hang out in an air bubble in the deep dark marsh mud until it is low tide again.

10. The birds take flight to roost in the trees.

11. The raccoon slinks off into the hammock of trees.

12. By noon it is high tide and everything is under water.

13. But the marsh is not empty.

14. Changes are taking place.

15. The ribbed mussel, who has been silent, wedged in the deep dark marsh mud, slowly opens his shell for the water!

16. He begins to filter the water and feed on the microscopic plants and animals, called plankton, that drifted freely by.

17. The oysters too open their shells, and filter the water for food.

18. A blue crab who has been buried in the sand at then bottom of the estuary begins to swim, chasing the fish that now dart in and out of the marsh grass.

19. Bigger fish chase the smaller fish hoping to fill their bellies with something delicious.

20. A marsh terrapin, the beautiful polka dotted turtle, stalks and crunches on the periwinkles that don't climb high enough out of its reach.

21. But life in the salt marsh goes on, and in six hours and a few minutes the water has drained from the surface of the marsh and the underwater excitement is over.

22. The water is almost all gone.

23. The oysters and mussels close their shells, and the fish and blue crabs and turtles swim with the outgoing water back into the estuary.

24. The sun shines, it is hot, and the water on the ground dries up leaving behind a salty crust.

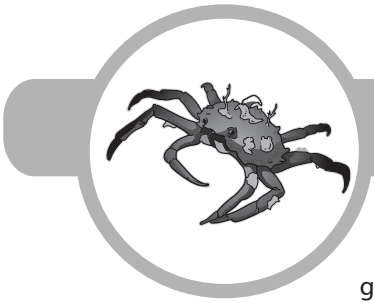
25. But something on the ground is stirring.

26. The periwinkles stretch their muscles, coming out of their shell no longer worrying about not having gills to breathe with under water.

27. A little pile of dirt shifts.

28. Out crawls Clawson, and one by one he is followed by all of his relatives and friends.

29. Keeping one eye open for the birds, they happily started to feed on their favorite food, the deep dark mud of the marsh.



The Watershed Puzzle

Given money and valuable riverfront property, students make land use decisions and determine the impact their decisions have on their neighbors property and greater watershed health. They create a large paper river by putting together their individual pieces of property.

This activity is adapted from a Project Wet activity entitled Sum of the Parts. "Project Wet: Water Education for Teachers is K-12" water focused curriculum. To participate in a Project Wet workshop for the extensive curriculum, teaching ideas, and materials, http://www.gaprojectwet.org.

Objectives:
Students will be able to:
- List land uses for riverfront property
- Define the term watershed and understand it's significance
- Understand that individual decisions about land impact the greater human community and natural world
- Create a local watershed map
- Identify their local watershed

Georgia Performance Standards
S3CS4, S3E1, S3L2

Materials:
copies of property map pages for each student, drawing pens/pencils/crayons/markers, large floor area to create watershed puzzle

Key Terms
Watershed, river, river corridor, sediment, pollution, water quality, land use, erosion, stewardship, habitat

Time Needed
One class period

Background

A watershed is the area of land that drains into a creek or river. Land use in many watersheds around Georgia includes riverfront homes, publicly used marinas, agricultural and industrial uses, and conservation areas where no land use is permitted. When we change the land that lies along a creek or river's edge, we change the water that runs through it. We impact everything downstream, including water quality, animal and plant populations and habitats, and other human activities. Rivers flow downhill. Coastal rivers originate in upper reaches of the state and therefore have huge watersheds. Your school lies within a local and regional watershed. Everything humans do impact the land and water in the area and downstream. Another way to think about it is that your neighbors upstream changes the river that flows past your property and downstream.

Procedure

1. Ask students if they have been to a river lately. Which river? Which river is closest to our school? What did you do along the river? What are some other ways that people use the land along rivers. List these on the board.

2. Anyone know what a watershed is? Define the term

3. Tell students that you are giving them each two acres of riverfront property along the imagi-

nary Coastal River. This is freshwater river that begins in the upper parts of our state and flows through an estuary and empties finally into the Atlantic Ocean. Along with two acres of water front property, each student will receive one million dollars and a map of their land.

4. Hand out one property map to each student. Point out land and water on the map. Tell students they can use their money anyway they like to support their ideas for land use on their property. They have 15 minutes to complete the map of their property in a way that shows other property owners in the watershed how they will use their land. Students use pencils, crayons, and markers to illustrate the land use decisions they make.

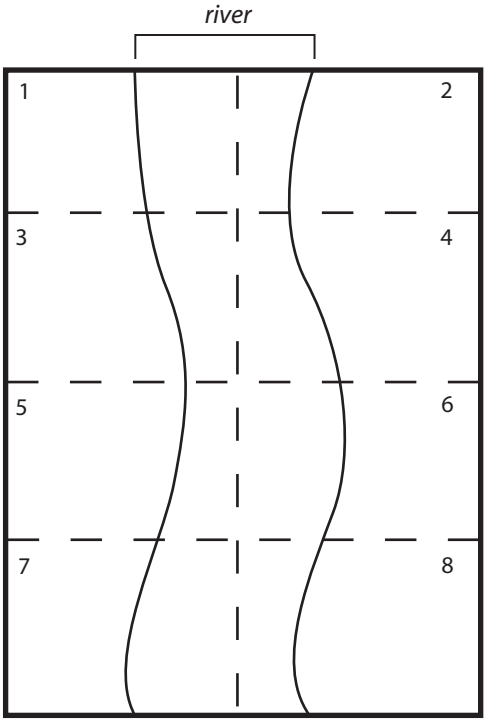
5. When 15 minutes is up, ask students to put their property maps together to form a stretch of the Coastal River corridor. This works best on the floor with everyone gathered around. Using property pieces that lie across form one another (Acre # 1 across from Acre #2). Place "river" next to "river". Add all property maps until one along piece of the river has been created. This will take facilitation by you and or group discussion, juggling, and puzzle skills.

6. Once the river corridor map has been completed, take a look at the land use decisions neighbors have made. Discuss any conflicts that might arise. How will land use choices made impact water quality? Do any create pollution, increase sedimentation, or alter habitat along the river? Do any take water out of the river? Once you have had a general discussion about the land uses your students have chosen, ask them if they would make different choices as a result of the activity. Discuss issues like sewage, septic systems, water quality, and impermeable surface pavement.

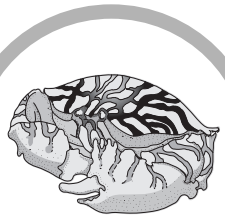
Extensions

- Find out what watershed you live in and locate your school within it! Research land uses within your watershed. Log on to EPA's website, http://cfpub.epa.gov/surf/locate/index.cfm

- Get involved in "River of Words" writing and art activities through Georgia Project Wet. www.gaprojectwet.org



To create the property map, draw a river down the center of a large piece of butcher paper. Then cut so that each group has one piece to work on . Number each peice for easier reassembly.



Spoonful of Sand!

Learn the complex story by looking at just a small spoonful of sand in new and different ways.

Objectives:
Students will be able to:
- locate the Appalachian mountains on a map
- name two causes of erosion
- identify ways to study sand such as color, texture, shape, and size

Georgia Performance Standards
SS3G1, S3P2, S3E1, S3CS5, S3CS1

Materials:
For each student:
sand samplesm magnifying lens, small magnets, maps of Georgia and North America,
Sand Inspection Sheets

Key Terms
Sediment, Erosion

Time Needed
One class period

Background

What is sand? Sand is a composition of small pieces of sediment, specifically between 2mm and .06 mm in size. Sand pieces or grains are the product of the chemical and mechanical weathering of rocks. Sifting through a small handful of Georgia coastal sand, you might also find plant materials, sea shells, broken bits of fossils, and even the shells of microscopic animals! We can learn a lot through the observation of sand. Color is an indicator of the source material of the sand. Shape and texture and size point to "how" and "how long" the sand has been transported. These clues begin to weave together a story, which shows how wind and water change our coastal landscape over time.

Although sand is found abundantly on beaches and in deserts, it is also found as an element of many different soils around the world. Different sands are found in different places. On some of the world's beaches you'll find sands that contain tiny pieces of garnet, diamonds, and tin. On some of the Japanese islands, you can find star shaped sand made of the skeletons of foraminiferans, single celled microscopic animals that live in oceans. The sand on our coast are mostly uniform pieces of quartz that have been smoothed and broken over time as they traveled down the rivers to the coast from the Appalachian mountains. So in a way you are actually standing on mountain tops when you visit a Georgia beach!

Procedure

1. Hand out a Sand Inspection Sheet and sand sample, and hand lens provided by CrabEcology, to each student.

2. Have students follow the instructions on the Sand Inspection Sheet on their own, in pairs, or as a teacher led class activity. The teaching companion below provides you with background information for guiding students through the activity as they unravel the secrets of their spoonful of sand!

Sand Lab Teaching Companion

Looking at sand under magnification will bring its size into perspective and make it interesting. Hand lenses work well for individual students, but if you have a microscope, you can really make sand look amazing. Also, a quick internet search can bring up sands under the microscope from around the world. A few sites are listed in extension ideas for this activity.

Nearly any kind of object can be broken down into sand. Encourage students to think about how these objects ended up in their sand sample. Do they see tiny pieces of human garbage like glass and plastic? Where could the broken down pieces of rock come from? Do they think the plant matter is from a nearby source or could it have floated in from another state or even country in the ocean? Bits of seashells and corals can be broken down by other animals, like the parrot fish that munches on corals and in the process makes small pieces that become a part of the sand.

Magnetite is a material that can be found in sand and, as its name suggests, has magnetic qualities. This can be something fun to test for and separate from the sand sample.

Color can be an indication of source material.:
- clear or frosty white (quartz), peach or tan (feld spar), and gold, silver, brown (mica) fragments usually are transported from mountains
- shiny black (basalt or magnetite) and green (oliv ne) usually originates from volcanic areas
- white or pink (seashells and corals) come from the skeletons of ocean animals

Sand is transported by water, wind, animals and people. New sand broken off from the parent material will be rough and jagged around the edges. It takes time being rolled in the water against other rocks and grains to wear down the edges to produce a smooth sand grain. Students can probably relate to the smoothness of river rocks. Smooth sand grains are probably much older.

Looking at the sizing chart students can estimate the particle size of their sand. Grains larger than 2mm are categorized as gravel rather than sand, and smaller than 0.06 mm are considered silt. Large sand size usually comes from high energy beaches with strong winds and powerful waves. Small grain sizes are usually from a beach with little wave action, or could indicate sand sampled from an area where wind was the main transport such as the top of a dune.

Extensions
- *Write a story about where the sand came from and what happened to it along the way, a great activity using this idea can be found in the Sand Travels Unit with the Surfrider Foundation. http://www.surfrider.org/whatwedo3a_beachology.asp*
- *Have students bring in sands from their travels or from around their homes and compare them to beach sand*
- *Did you know that some sands sing? Check it out at: http://www.pbs.org/wgbh/nova/sciencenow/3204/04-recipe.html*
- *Take a field trip to a sandy beach or river bed beach*

Resources
- *Surfrider Foundation, Studies in Sand and Sand Travels Units. http://www.surfrider.org/whatwedo3a_beachology.asp*
- *New Jersey Marine Sciences Consortium – The Science of Sand http://www.njmsc.org/_vti_bin/shtml.dll/Education/Lesson_Plans/LessonPlansRequest.html*
- *Sapelo Island, Georgia's Coastal Treasure Curriculum Guide, How to Classify Your Sand.*
- *World wide sand photo gallery http://www.chariho.k12.ri.us/curriculum/MISmart/ocean/pixindex.html*

Sand Inspection Sheet

Alright CrabEcologists, it's time to put your detective skills to use again. Every grain of sand has a story - let's use your observational skills to discover that story today!

Name:

My Sand Sample's Source:

1. Spread a small bit of sand out on a piece of paper and look at the sample under a hand lens. What shapes and textures do you see? **List** them here:

2. **Draw** a really big picture of the sand grains in the circle. Show how rough or smooth the edges are!

3. Sand can composed of different materials. Examine your sand sample under a magnifying glass and use a toothpick to sort out groups of materials. **Circle** the items you find in your sample of sand:

Small rocks and minerals Sea shells Plastic

Plant matter Glass Other: _____

4. With a small magnet, **test** if anything is attracted to it in your sand sample! Pass the magnet just above another little bit of spread out sand. Does anything stick to the magnet?

What is that magnetic material called? _____

5. Look closely at your sand sample and **write** down what colors you see, this can tell us the source of your sand sample.

What do the colors tell you about where your sand came from?

6. Size, shape, and texture will tell us about sand transportation. **Name** 3 ways that sand gets transported from one place to another?

_____ _____ ___ _____

7. Look at your sand grains again. **Circle** the words that describe their general shape.

rough and edgy a little rounded really rounded

It takes a long time for sand to become smooth and round. Do you think your sand is young or old?

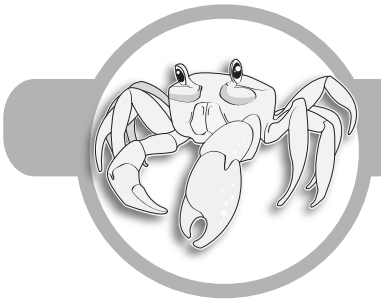
8. Good work CrabEcologists! Let's summarize what we learned from our spoonful of sand:

Where did your sand come from?

How did travel from where it came from to the beach?

What happened to it over time?

What does it look like today?



Additional Resources

Books

Good Books For Students

The Crab That Played with the Sea
by Rudyard Kipling

Lobsters, Crabs, and Other crustaceans
by David Gilpin

Crabs (True Books)
by Mary Jo Rhodes

The Crab Man
by Patricia E Van West

Does Anyone Know Where A Hermit Crab Goes
by Michael Glaer

Is this A House for Hermit Crab?
by Megan McDonald

A House for Hermit Crab
by Eric Carle

Crab, Welcome Books
by Lloyd G. Douglas

Harry Horseshoecrab.
by Suzanne Tate

Leroy the Lobster
by Katherine Orr

Clumsy Crab
by Ruth Galloway

Grasper, A Young Crab
by Paul Owen Lewis

In One Tidepool: Crabs, Snails and Salty Tails
by Anthony Frederich

Dancing on the Sand. The Story of an Atlantic Blue Crab,
by Kathleen Hollenbeck and Joanie Popeo

Why the Crab Has No Head
by Retold by Barbara Knutson

Crab Moon.
by Ruth Horowitz

Extraordinary Horseshoe Crabs
by Julie Dunlap

Pagoo
by Holling Clancy Holling

Crabby and Nabby
by Suzanne Tate

Good Books For Teachers

Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida
by Austin B. Williams

Beautiful Swimmers
by Robert Warner

Georgia's Amazing Coast
by David Bryant, Georgia Sea Grant

Seashore Animals of the Southeast
by Edward E. Ruppert and Richard S. Fox

Peterson Field Guide Southeastern and Caribbean Seashores
by Eugene H. Kapla

Helpful Websites

Check out the following websites that we have visited and feel appropriately supplement the CrabEcology program!

www.Crabstreetjournal.com/kidzone
www.eric-carle.com
www.ala.org
www.mbayaq.org
www.oceansalive.org
www.christmas.net.au/parks/crabs/intro.html
www.vims.edu/adv/ed/crabs
www.vims.edu/chessie/lessons/html
www.earthwindow.com/crabs.html
www.fiddlercrab.info/
http://pelotes.jea.com/fidcrab.htm
www.kidsconnect.com
www.vims.edu/~jeff/ghost.htm
www.museum.vic.gov.au/crust/crabbiol.htm
www.stemnet.nf.ca/CITE/oceancrabs.htm#Blue
www.scseagrant.org/se-cosee?
www.dnr.sc.gov/marine/sertc
www.graysreef.gov
www.georgiacoastaleducationgroup.org
www.marex.uga.edu

Field Trip Ideas

Feild experience in the outdoor classroom is the best hands on learning opportunity available. Contact the following providers for coastal field experiences today!

Crooked River State Park
912.882.8531
www.gastateparks.org

Cumberland Island National Seashore
912.882.4336
www.nps.gov/cuis

Fort Frederica National Monument
912.638.3639
www.nps.gov/fofr

Georgia DNR – Coastal Resources Division
912.264.7218
www.gadnr.org click "coastal resources"
www.knowtheconnection.com

Georgia Sea Turtle Center
912.635.4076
www.georgiaseaturtlecenter.org

Gray's Reef National Marine Sanctuary
912.598.2345
http://graysreef.noaa.gov

Oatland Island Wildlife Center of Savannah
912.898.3980
www.oatlandisland.org

Okefenokee National Wildlife Refuge (NWR),
U.S. Fish and Wildlife Service
912.496.7836
www.fws.gov/okefenokee

Sapelo Island National Estuarine Research Reserve
912.485.2251
www.sapelonerr.org
www.sapeloislandnerr-ctp.org

Skidaway Island State Park
912.598.2300
www.gastateparks/.org/info/skidaway

Tidelands Nature Center
912.635.5032
www.tidelands4h.org

Tybee Island Marine Science Center
912.786.5917
www.tybeemarinescience.org

UGA Burton 4H Center
912.786.5534
www.burton4h.org

UGA Jekyll Island 4-H Center
912.635.4115
www.jekyll4h.org

UGA Marine Education Center and Aquarium
912.598.2364
www.uga.edu/aquarium