Living Coast Discovery Center
Field Trip Resource Packet

Crustacean Lab

In this packet you will find lessons and resources related to your Living Coast virtual field trip. The first two activities are intended to bookend your virtual trip, followed by additional resources.

Career Focus: Carcinologist
I perform studies or research that are focused on understanding the biology of crustaceans (such as crabs, lobsters, shrimp and crayfish. I also work on their identification and classification, understanding their evolutionary relationships, ecological relationships, and distribution.

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Living Lab Lesson Plan

Program Title: Crab-o-botics	**Age Range:** 3rd Grade
Date Written: Summer 2015	**Adapted by:** Janani Sivasankaran

Objectives:

1. Students will be able to identify the identifying body parts of a crab.
2. Students will be able to describe some adaptations on a crab that help it to survive.

Next Generation Science Standards

- **3.LS1.1.** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- **LS3.A.** Many characteristics of organisms are inherited from their parents.

Common Core Content Standards

- **SL.3.1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 3 topics and texts, building on other's ideas and expressing their own clearly
- **SL.3.3.** Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
- **SL.3.6.** Speak in complete sentences when appropriate to task and situation in order to provide requested detail or clarification
- **L.3.6.** Acquire and use accurately grade-appropriate conversational, general academic, and domain-specific words and phrases, including those that signal spatial and temporal relationships.

Materials & Prep

Materials in Classroom:

- Paper plates
- Crab templates, or construction paper for students to draw their own
- Pencils/Markers/Crayons
- Projector

3

10 Minutes **Introduction**

Use the images to point out similarities between the features of crabs. Which of these characteristics define a crab?

You can find images of lots of different crab and crustacean species here: http://ladiving.smugmug.com/FieldGuide/Crustaceans/5562746_9Kb6xN/4

[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, 8 jointed walking legs, 2 chelipeds (or pinchers), stalked eyes, antennae, and gills for breathing. Classification helps us understand the world around us.]

Ask students to point out the differences between the true crabs. 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?

35 Minutes **Crab-o-botics**

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.

Give them supplies and let them make their crab creations.

To Make a Paper Plate Crab:

1. Fold a paper plate in half to make the shell body - staple/glue/tape together.
2. Cut out legs and chelipeds from template, or have students draw their own to cut out
3. Fold eyes at the bottom of stalk to attach

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

15 Minutes **Presentations**

Break students into groups, and have them take turns presenting their crabs (focusing on the crabs adaptations) to the group. After all the presentations, ask someone from each group to share the most common adaptation in their group and one unique adaptation from the group (that isn't from their crab).

If you have time, you can lengthen this section and have every student present their crab to the entire class. Poll everyone for the most common adaptation in the class, and take a vote for the most unique adaptation.

Living Lab Lesson Plan

Program Title: Crustacean Life Comic Strip	**Age Range:** 3rd Grade
Date Written: Summer 2015	**Written by:** Janani Sivasankaran

Objectives:

1. Students will be able to describe an event in a crab's life using illustrations and text.

Next Generation Science Standards

- **3.LS1.1.** Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.
- **LS3.A.** Many characteristics of organisms are inherited from their parents

Common Core Content Standards

- **W.3.3.** Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

Materials & Prep

Materials in Classroom:

- Copies of comic strip template
- Pencils/Crayons/Markers
- Reference images of crabs, crayfish and spiny lobsters

Program Outline

10 Minutes Introduction

Bring the class together and discuss what they remember from the field trip program, focusing on what they learned about the crustacean life cycle and growth process.

10 Minutes Comic Strip Introduction

To write the comic strip, students should think about the patterns they learned about on their field trip. They can write about molting, catching food, avoiding predators, etc. Choose a crustacean that they learned about – shore crab, crayfish or spiny lobster. Students can do additional research about their chosen animal (where it lives, what it eats, etc.)

30 Minutes Working on Comic Strips

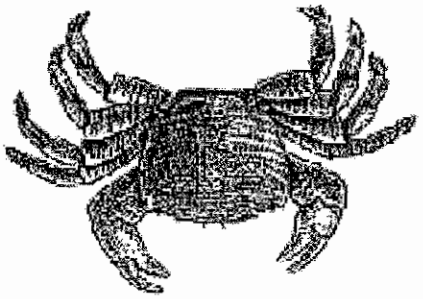
Using the template found on the website, students write a 6-frame comic strip about an event in a crab's life. The first frame should contain the beginning of the event and the 6th frame should be a conclusion to the event. For example, if the student is illustrating molting, they would begin with the crab feeling too tight in its exoskeleton, and they would end with the crab emerging from it hiding spot with a brand new hard exoskeleton! Each frame should include a 1-sentence caption to help the reader understand the comic.

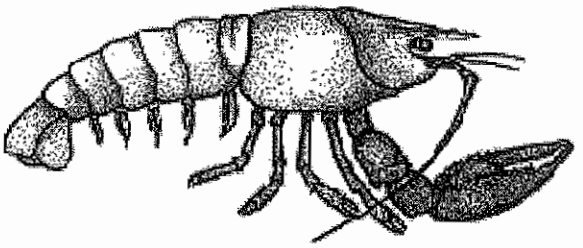
A Day in the Life of a Crustacean Comic Strip

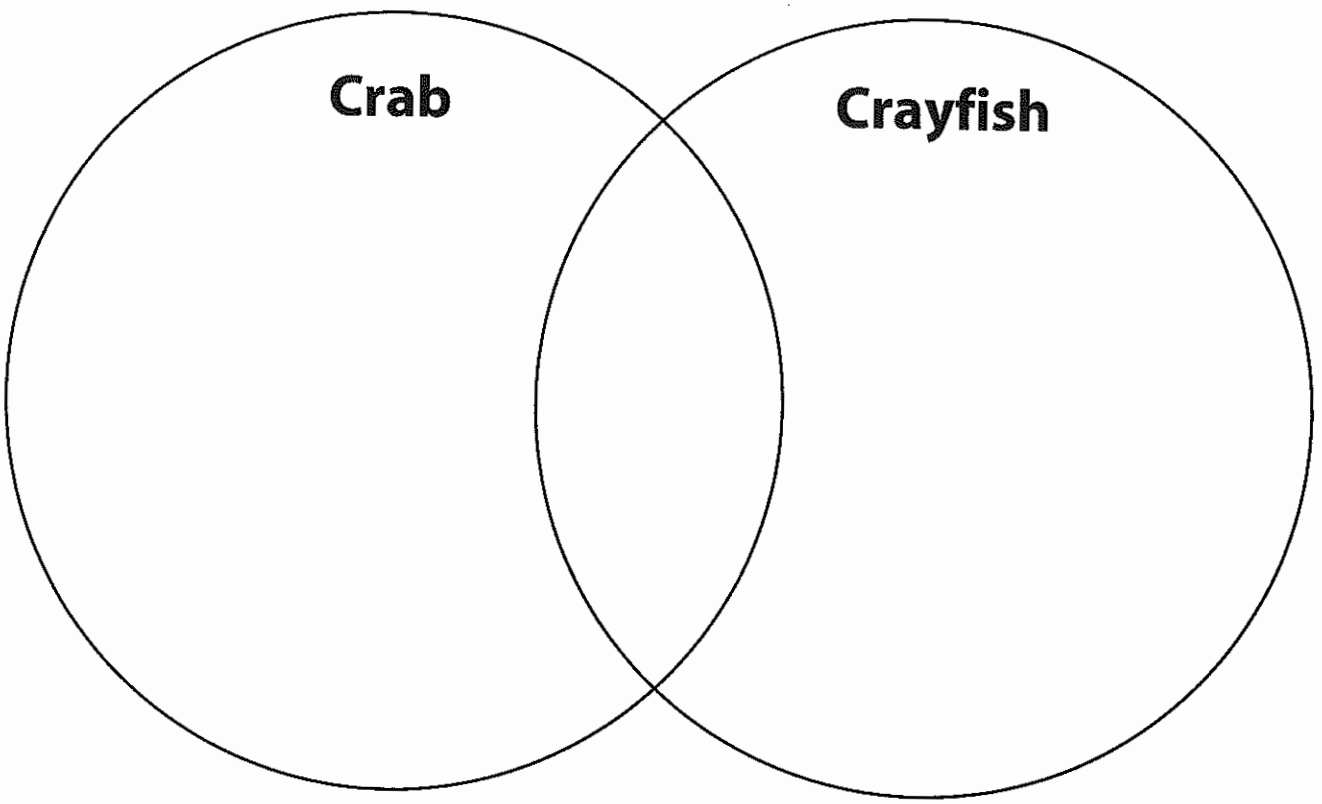
Student Name: _____

	4 (Good)	3	2	1 (Needs Work)	Score
Graphics	Graphics are easy to see, colored neatly, and accurate to the topic	Graphics may have a minor problem with sizing, neatness of coloring, or accuracy to topic	Graphics need some work. Not colored, but fairly accurate to topic	Graphics are insufficient for the assignment. They may not be colored or have major accuracy	
Captions	Captions were used to explain pictures throughout the entire comic strip.	Captions were used to explain pictures thoughout most of the comic strip.	Captions were rarely used to explain the pictures in the comic strip	Captions weren't used to explain pictures in the comic strip.	
Story	Story contains multiple realistic events. All the information provided about crustaceans is	Story contains multiple realistic events. There is some incorrect information provided about	Story contains an unrealistic event. There is some incorrect information provided about	Story contains multiple unrealistic events. There is incorrect information provided about	
Effort and Neatness	Project is attractive and shows effort. Straight lines and effort to make things attractive is evident.	Project has some minor erasures and neatness concerns but still shows effort.	Project is ok, but slightly messy with uneven lines and sloppy coloring.	Project is very sloppy and hard to understand and/or is not colored.	
Use of Class Time	Student used class time well. Never distracted others with talking, noises, other.	Student used most of class time well. Minor distractions - nothing major.	Student used some of the class time well. Only one major distraction	Student did not use class time well and/or distracted others often with talking or noise.	

Name: _____

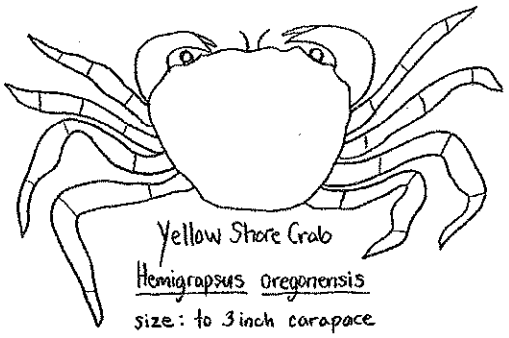


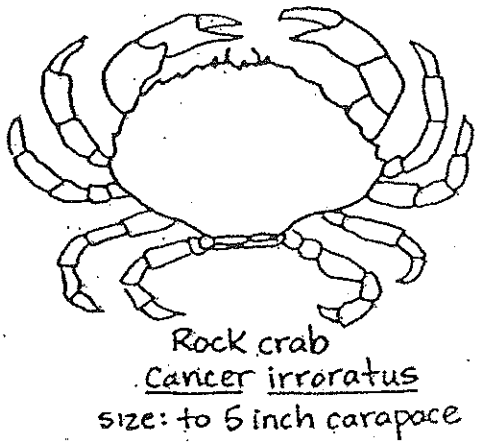




POPULATION

There are almost 5,000 different species of crabs; about 4,500 are true crabs, plus about 500 are hermit crabs (hermit crabs don't have a very hard shell and use other animals' old shells for protection). Most crabs are marine, occurring in all oceans from the edge of the sea down to the greatest depths of the ocean. A few species live in freshwater. The biggest crab is the Japanese Spider crab (*Macrocheira kaempferi*), which lives on the floor of the north Pacific Ocean; it has a 12 ft (3.7 m) leg span. Two of the crabs found often at the Nature Center are the Yellow Shore Crab(Hemigrapsus oregonensis), and the Rock Crab (Cancer irroratus).

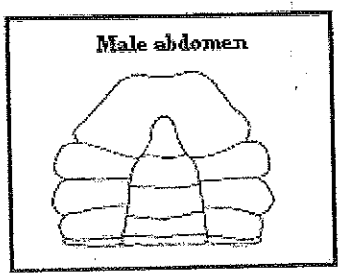


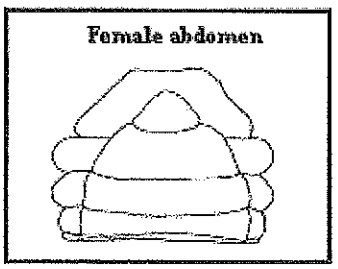


ANATOMY

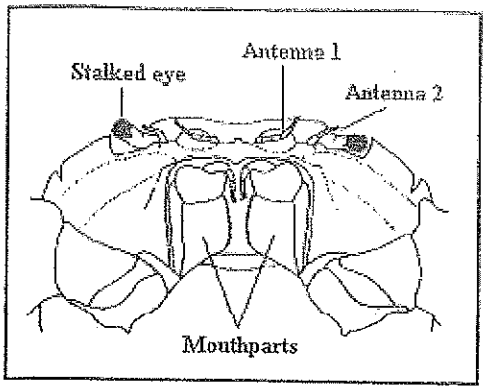
Crabs are **invertebrates**, animals without a backbone. They have an exoskeleton (also called a carapace), an outer shell that both protects them from predators and provides support. These **crustaceans** have ten jointed legs, two of which have large, grasping claws (called pincers or chelipeds). They have a flattened body, two feelers (antennae), and two eyes located at the ends of short stalks. Although crabs come in a variety of shapes and sizes they all have the same general body plan. All crabs have one pair of **chelipeds** and four pairs of **walking legs**. Chelipeds are used for holding and carrying food, digging, cracking open shells and warning off would be attackers. The **carapace** is the hard cover or exoskeleton which protects the internal organs of the head, thorax and gills.

The abdomen is small and tightly held against the underside of the body. Like all crustaceans the sexes are separate and the size of the abdomen distinguishes them: in males it is triangular and inset into the underside. In females it is broad and round and most obvious when the eggs are being carried.





SENSORY ORGANS



Crabs have **eyes** which protrude from the front of the carapace are on the ends of short stalks. Crabs appear to see very well with some species detecting movement 20 or 30 metres away. The mouthparts are a series of pairs of short legs, specialized to manipulate and chew food. Crabs can also **hear** and produce a variety of sounds. In courtship some species attract the females attention by banging their cheliped on the ground or vibrating their walking legs. Crabs have bristles and hairs which act as **touch receptors**. The antennae have "smell detectors" which detect chemicals that stimulate a search for food. Crabs rely on a combination of these sense organs to find food and mates and flee predators.

BREATHING

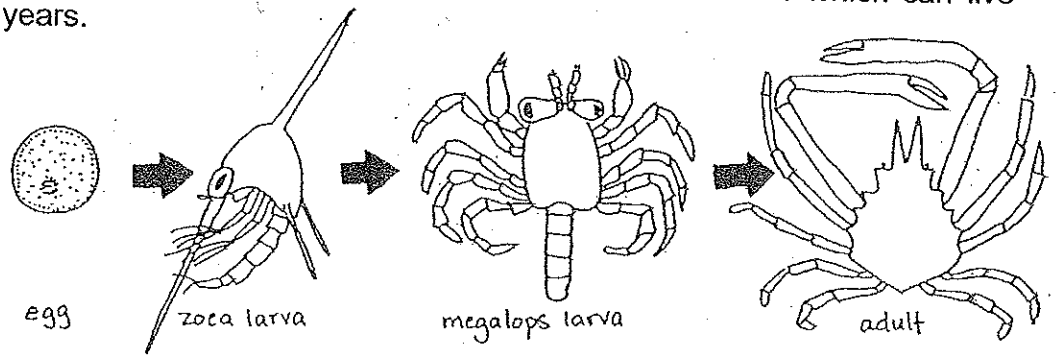
Marine crabs breathe underwater using gills, which are located in a two cavities under the carapace. True land crabs have enlarged, modified cavities that act like lungs so that the land crabs can breathe air.

DIET

Many crabs are omnivores (plant- and meat-eaters), others are carnivores (meat-eaters), and some are herbivores (plant-eaters). Many crabs forage in search of small worms, mollusks, and crustaceans, but are known to be scavengers as well as voracious predators. Crabs can be eaten by gulls herons, fish and other predators.

REPRODUCTION/ LIFE CYCLE

Female crabs usually lay their **eggs** shortly after mating but can also store sperm for many months. The eggs are fertilized as they are laid by passing through the chamber holding the sperm. Eggs are brooded in a mass attached to hair on the female's abdomen. The number of eggs carried can be very large but depends on the size of the crab. Some species may carry tens of thousands of eggs when fully grown. Once developed the egg hatches into a tiny larva called a **zoea**. Release of the zoea is aided by the female wafting her abdomen to and fro. The crab larvae spends its life swimming in the plankton molting several times and gradually metaphorphosing into **megalops larvae** and then into **adults**. Most types of crabs live about 3 years. There are some types which can live much longer, such as the horseshoe crab which can live up to 19 years.

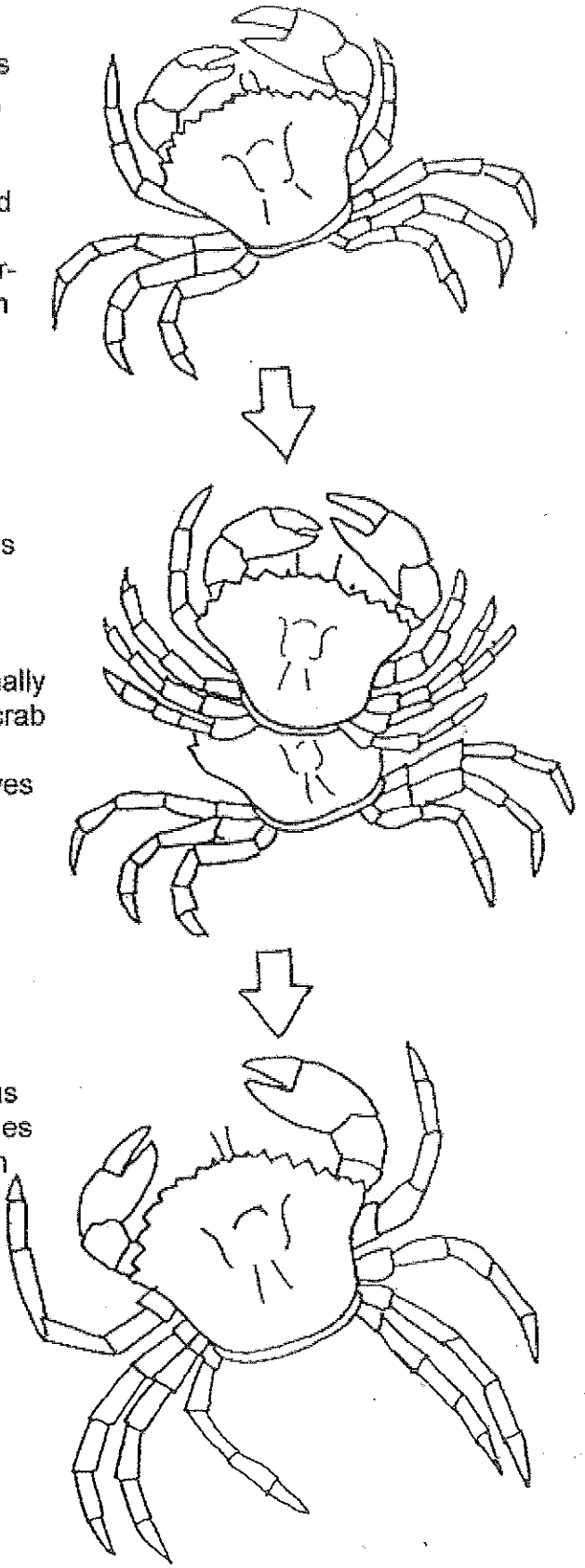


MOLTING

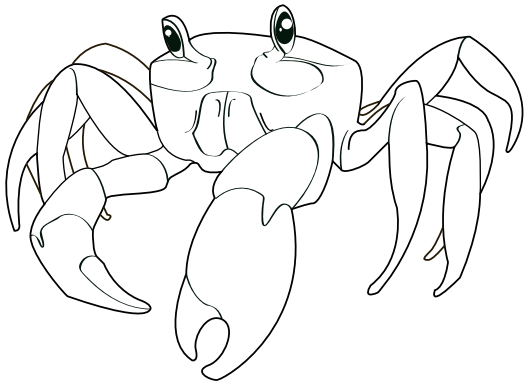
Crabs (and other crustaceans) cannot grow like most animals. Because they have a hard outer shell (the **exoskeleton**) that does not grow, they must shed their shells, a process called molting. Just as we outgrow our clothing, crabs outgrow their shells. Prior to molting, a crab reabsorbs some of the calcium carbonate from the old exoskeleton, then separates the old shell from the underlying skin (or epidermis). Then, the epidermis secretes a new, soft, paper-like shell beneath the old one. This process can take several weeks.

A day before molting, the crab starts to absorb seawater, and begins to swell up like a balloon. This helps to expand the old shell and causes it to come apart at a special seam that runs around the body. The **carapace** then opens up like a lid. The crab extracts itself from its old shell by pushing and compressing all of its appendages repeatedly. First it backs out, then pulls out its hind legs, then its front legs, and finally comes completely out of the old shell. When a crab molts, it removes all its legs, its eyestalks, its antennae, all its mouthparts, and its gills. It leaves behind the old shell, the esophagus, its entire stomach lining, and even the last half inch of its intestine. This process takes about 15 minutes.

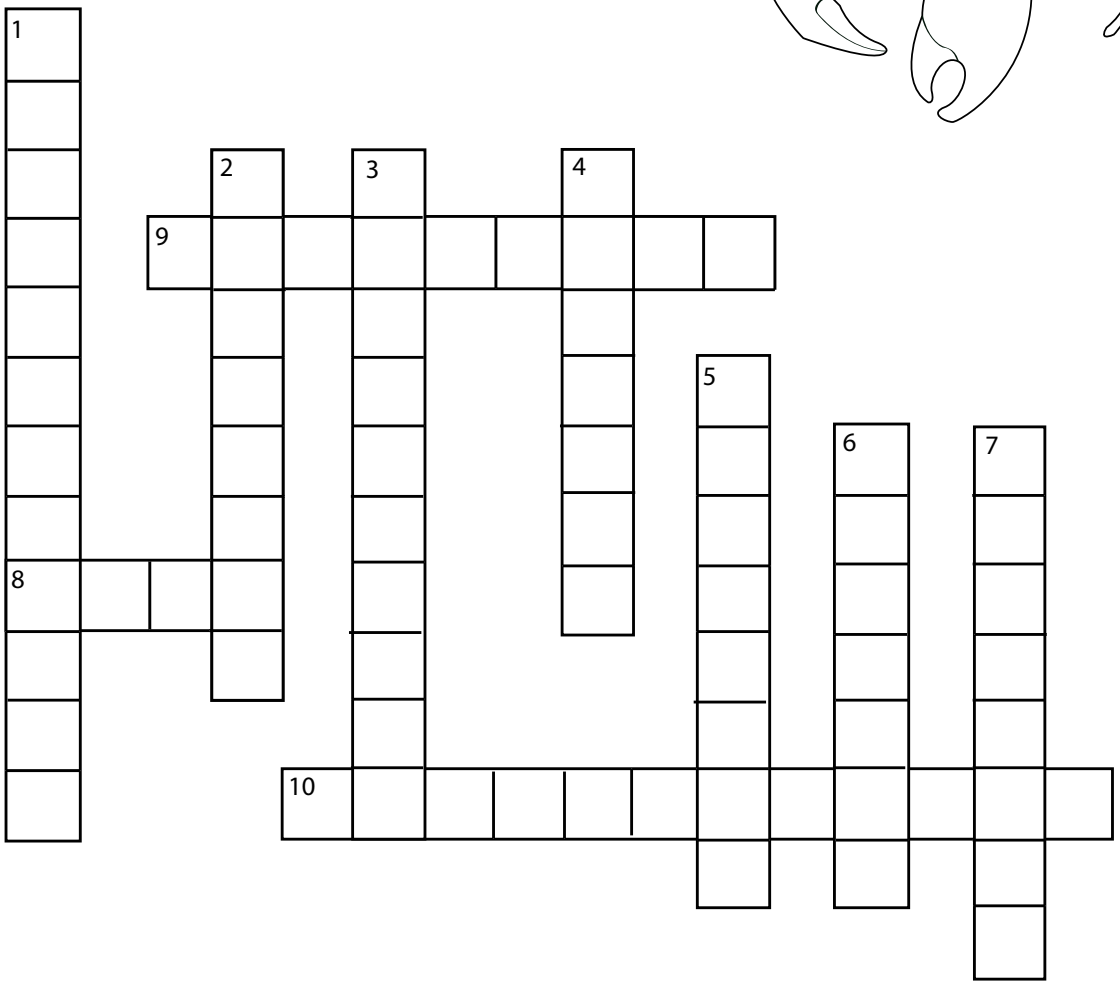
After shedding its old shell, the crab first expands its new shell by pumping water into its body. After that, it takes about 72 hours (three days) for the soft shell to harden. Until the shell is hard again, the crab is very vulnerable and has to hide from predators. Crabs molt about 27 times throughout their lives. They molt very often when young and then less often as they get older.



Coastal Vocabulary Crossword



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



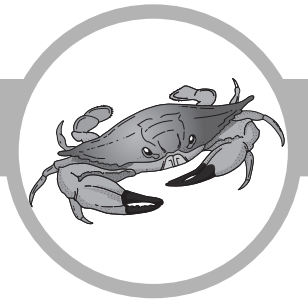
Down

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



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:

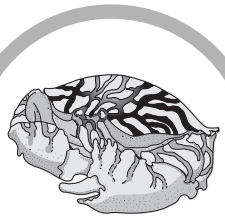
How were living things in Zone B affected by sediment in the water?

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?



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?

Useful Links

I-Spy style activities do do using Monterey Bay Aquarium's live cams
https://www.montereybayaquarium.org/for-educators/curriculum-and-resources/games-and-activities/be-a-sea-searcher

Do-at home Tidepool Curriculum
https://montereybayaquarium.thinkific.com/courses/tidepool-scientist?_ga=2.136602992.1126950030.1588113637-515004903.1587766405

Continue learning about lifecycles from pbs kids
https://ca.pbslearningmedia.org/resource/nat36-int-butterflylifecycle/butterfly-life-cycle/

Crabs come in all shapes and sizes. See scientist studying the horseshoe crab!
https://oceantoday.noaa.gov/horseshoecrabspawning/

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