A STUDENT'S VIEW OF THE SOUTHEASTERN COAST FROM SPACE

-Lessons-

BACKGROUND:

Coastal Zone: The word coast is used to designate the entire region of the land next to the ocean. It usually takes many shapes and forms including bays, tidal flats, marshes, and beaches. The rise and fall of the tides affect this area. Many marine organisms spend a majority of their lives in the coastal zone. The organisms that inhabit this zone are benthic, neritic or even planktonic in nature. Usually coastal zones are well developed and are often over crowded especially during the summer months. The coastal zone is greatly affected by pollution and municipal dumping.

Beaches. A beach is a deposit of wave-washed sediment along the coast between the landward limit of wave action and the outermost breakers. The intertidal zone or littoral zone is the area between high and low tide along the shoreline. Sand, which is commonly the sediment size that comprises most beaches, is usually not consolidated or cemented together. The sediment or sand-sized material is transported or moved by waves or breakers and longshore currents along the beach. Some beaches are made of cobble while others are made of silt and clay. The beaches on the southern and central coast of Florida are primarily composed of carbonates. In Hawaii, a few of the beaches have black sand-sized sediment, which is a result of the erosion of lava, which is rich in ferro-magnesium minerals which was extruded from volcanoes.

Although humans know this area as a great place to lie out in the sun or play in the ocean, beaches are very dynamic areas. They constantly undergo deposition and erosion of material by ocean currents and by the wind. Humans also have a strong impact on the structure of a beach. Erosion from both natural and human causes has prompted extensive efforts to preserve their beauty and cleanliness.

The beach is a dynamic feature that is constantly changing its overall shape and form. One way in which the change can occur is a result of sand movement along the coastline. As waves approach the beach at an angle, they form a longshore current. The current transports sediment parallel to the coastline. Sand is being removed from one area of the beach and deposited on another. If sediment is not returned to the beach by incoming waves, the beach is eventually eroded. Longshore currents can cause repeated erosion along one area only to have an adjacent area built up over time.

Sand movement generally differs from summer to winter. Summer waves are often long slow waves and carry sand on to the beach. In winter, there are strong off shore storms that cause the waves to be short and higher. These tend to carry sand from the shore in to the ocean. Thus the beach tends to build up in the summer and decrease in the winter.

An undertow is the current that takes the water and returns it seaward after the wave breaks on the beach. Rip currents are the funneling of the seawater in isolated areas that form when there is convergence of currents in opposing directions back out to sea. A break in the waves can sometimes be seen. If caught in a rip current it is suggested that one swim parallel to the beach until you are free of it then swim to shore. Thus the islands are always changing due to the movements of sediment along the shore.
**Barrier Islands:** Natural projections of sediment sometimes form spits that eventually form barrier islands over a period of time. Barrier islands are long low islands that lie parallel to the coastal mainland. Barrier islands can be seen along the eastern coast of the United States. These islands act as a barrier or buffer that protects the mainland from offshore storms. Barrier islands are separated from the mainland by lagoons, and are cut by one or more tidal inlets. The coasts of South Carolina and Georgia contain a series of barrier islands and are known for the diversity of the wildlife that inhabits this environment. Barrier islands are also popular vacation and recreation areas, with many developments and towns blanketing the coastline.

Estuaries, lagoons, marshes, and mangrove swamps are common to coastal areas. In these areas, the seawater is often diluted by fresh water resulting in brackish water. Estuaries that are bays that form at the mouth of a river by subsidence of land or a rise in sea level are one of the most complex parts of the ocean. The water in this area undergoes very drastic changes in temperature and salinity due to infiltration and mixing of fresh water. The effect of man on these areas is also great and can be quite disastrous. Some of the better known estuaries along the United States are: Chesapeake Bay areas, Hudson River, Delaware Bay, Puget Sound, and Galveston Bay. This can cause the blocking of estuaries that leads to the formation of additional marsh land. In shipping areas, the rivers are constantly being dredged to keep channels open to navigation.

The East Coast has many estuarine environments and shifting barrier beaches. On the Gulf Coast there is an estuarine area greatly affected by the Mississippi River. The Mississippi delta shifts sediment from Louisiana to the Texas coast. The Mississippi Delta is quite massive in size. Barrier Islands accrue around Padre Island, Texas.

**Coastal Problems:** Erosion is a major problem along the coastal zone. The erosion rates vary from high rate areas along the Atlantic and Louisiana coasts to lower rate areas along Alaska and the Great Lakes coasts. Factors such as wave action, currents, sediment supply, coast shape, tidal range, and intensity of storms have affected erosion rates. However, the greatest effect on coastal areas has been human activity. Eighty-five percent of the United States coastline is privately owned and vicariously managed.

Beach erosion is affected by three basic man-made ways:
- Dredging, filling, and/or damming of rivers.
- Construction of jetties, sea walls, or other structures.
- Changes in coastal dune area.

Estuaries, salt marshes, and mangrove swamps have felt the impact of man. The development of harbors, homes, and factories along the coast has impacted the marsh areas. Almost half of the original area found here when America was settled has been filled in for development. The importance of marshes as nurseries, filters, and sources for food cannot be over estimated.

Increasing green house gases in the atmosphere may have continued to cause the oceans to rise due to polar melting. The effected of this may be greatly felt in delta regions during storm periods.

Use of the Coastal Zone: There is considerable debate over the use of coastal zones. For example:
- The development of offshore oil terminals versus recreational use of the environment – leaving it in its natural state.
- The development of waterfront homes versus the preservation of the area for aesthetic value.
Marine Life: The coastal areas often contain marshes or mangrove swamps that are the nurseries of the ocean. These productive areas provide a large source of food that support a diverse marine population that includes birds, fish, shellfish, and plants. Marshes also protect the land behind them from storms. The Kiel of organic flow is further aided by the nutrients supplied by rivers flowing through the marshlands sending the rich organic water on to the ocean. Most marshes have a small number of species of plants but they are in great abundance. The organic matter in a marsh is about 5 – 10 times greater that in wheat field and 20 times greater than in the open ocean.

Some of the plants found in the marsh are Zostera (Eel Grass), Spartina (Cord Grass), Salicornia (Spike Grass) and Distichlis (Salt Hay)
Lesson One:
A Changing Perspective of Charleston, South Carolina from A Satellite Image to a Flat Map

Time required – One class period

Materials - One set of materials will be needed for each cooperative group:
• image of Charleston area -
• markers
• overhead transparencies
• Goodes Atlases
• Rand McNally Atlases
• magnifying lenses or glasses
• political maps of Charleston and South Carolina
• relief maps of Charleston and South Carolina

Suggested grouping patterns- cooperative groups of either 2 or 4 students depending on materials. It is best to have smaller groups since this would permit the students to be more involved in the learning process.

Objectives:
1. Students will identify island features, processes and formation.
2. Students will access the Internet to investigate island images in the EarthKAM data system.
3. Students will design and conduct island explorations during a shuttle flight.

Exploration of South Carolina Image: These are suitable as an introduction as they will allow the students to become familiar with the geographic location of the area.
• Discuss possible locations of photo site – brain storm as initial activity
• Confirm it is 33 degrees North Latitude and 80 degrees West Longitude
• Have students locate the position of this image on a USGS map, road map and/or quadrangle map of the Charleston area.

• Students will mark or annotate the following geographic locations that appear on a political map. It might be suitable to duplicate a world map and have the students make their own copy as well.
• Continent (North America)
  • Body of water (Atlantic Ocean)
  • Country (USA), state (South Carolina)
  • County (Charleston)
  • Ashley River, Cooper River and Wando River
  • Charleston Harbor
• Location of beaches- Correlate a USGS map of Charleston with the satellite image so that the students will be able to correctly identify each beach by its name
Questions:
1. Is the amount of sediment load the same in all the rivers? (No, the rivers with heavy sediment load will look lighter in color in the image.)
2. Are these rivers mature or new rivers? (These are mature rivers due to the meandering of the rivers and sediment build-up.)
3. Describe the seeming pattern on the bottom of the ocean near the shore. (You can see ripples and ridges.)
4. Can you find evidence of erosion and accretion? (Yes, the lighter color in the water indicates a build up of sediments?)

Ground Truthing:
Ground truthing is the use of filed measurements to validate remotely sensed data. In this activity, students will be able to use a variety of maps to practice the skills of ground truthing.

Political Map Identification: Direct students to examine the South Carolina political map and identify the following places:

<table>
<thead>
<tr>
<th>Place</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charleston</td>
<td>Cooper River</td>
</tr>
<tr>
<td>Ashley River</td>
<td>Edisto River</td>
</tr>
<tr>
<td>Bull's Bay</td>
<td>Lake Moultrie</td>
</tr>
<tr>
<td>Isle of Palms</td>
<td>Sullivan’s Island</td>
</tr>
<tr>
<td>Folly Beach</td>
<td>Atlantic Ocean</td>
</tr>
<tr>
<td>Charleston Harbor</td>
<td>Interstate 26</td>
</tr>
</tbody>
</table>

Students will answer the following questions in complete sentences:
5. What is the population of the largest city in the coastal zone of South Carolina?
6. What is the name of the largest Barrier Island in the coastal zone of South Carolina?
7. On the map, locate wetlands found in the coastal zone. Using the shuttle photo, mark with a (w) all of the wetlands found on the map. Can you distinguish between fresh water and saltwater wetlands?
8. Which areas have the greatest development? (Charleston) What are you are using to determine population density?

Relief Map Identification: Direct students to examine the South Carolina relief map to determine the following:
9. What is the elevation of Charleston? (Sea Level)
10. What is the highest point in South Carolina? (Sassafras Mountain)
11. What are the major river systems which flow through the coastal zone? (Pee Dee, Santee, Edisto, Ashley, Cooper, Savannah)
Lesson Two: **Barrier Islands**

**Time required** – One class period

**Materials** - One set of materials will be needed for each cooperative group:

- Shuttle image of Charleston area 
- markers
- overhead transparencies
- Goodes Atlases
- Rand McNally Atlases
- magnifying lenses or glasses
- political maps of Charleston and South Carolina
- relief maps of Charleston and South Carolina
- Charleston Shuttle image and maps.
- journals or notebook paper to record their work

**Suggested grouping patterns**- Cooperative groups of either 2 or 4 students depending on materials. It is best to have smaller groups since this would permit the students to be more involved in the learning process.

The coastal area in this photo is called the **South Carolina Low country** and includes regions known as the **Sea Islands** (a chain of barrier islands).

1. Examine the Charleston Shuttle image. Identify and label the following on the image:
   - Barrier islands  
   - Lakes  
   - Atlantic Ocean  
   - Sand bars  
   - Urban development  
   - Drainage patterns  
   - Coastal area  
   - Water sheds  
   - Salt marsh  
   - Clouds  
   - Rivers  
   - Peninsula  
   - Bays  
   - Charleston harbor  
   - Beach

2. **Exploration of the City of Charleston.**
   a. Is there any evidence of people living in this area? (Yes) What types of evidence do you look for to prove that an area is inhabited?
   b. Circle those areas that look the most populated? (Those that are light gray in color, on and around the peninsula)
   c. Why do you think that people would want to move or live in this particular city on the East Coast? (river and harbor access, recreation, commercial development of the port)
   d. What influence do you think the river system has played in the development of this particular area? (for example, trade and transportation)
   e. Is there any evidence of agriculture? Us there any characteristic of vegetation that would help you identify and distinguish trees from low-lying vegetation? Is there
evidence in the image of farms or of plantations? (Yes, one example is in the lower right quadrant where is evidence of fields)

3. Using a map of major world current, students will identify the current moving along the South Carolina coast. (The Gulf Stream)
   a. Where does this current come from? (The Equatorial Current which flows across the Atlantic Ocean from Africa)
   b. Is it a warm or cold current? (Warm)
   c. What is its general direction of flow? (It flows from the south to the north of the United States)
   d. What happens to the Gulf Stream when it reaches the northern portion of the United States? (It is forced to turn and it moves across the ocean toward Europe)

4. Use the Savannah, Georgia and Charleston, South Carolina image to explore barrier island structure and formation.
   a. What is the primary function of Barrier Island? (They serve as a barrier to the main land from the ocean.)
   b. How are they formed? (sediment deposit)
   c. What separates the island from the main land? (rivers, lagoons, and salt marsh creeks)
   d. What importance might these islands serve? (buffer for storm systems, habitat for marine organisms)
   e. Do they appear to be stable islands? (No, there is shifting of the sediments from one island to another.)
   f. Locate evidence of change on the islands? (The coastline is narrow at the south end and wider at the north end.)
   g. Can you find evidence of erosion (washing away of land) or accretion (building up land)? (One end of each island appears to be adding sand and the other end is losing sand. This is evident at the inlets where one side has more sand built up.)

5. Use the Savannah, Georgia/Charleston, South Carolina images, to determine the types of plants and animals found in each distinctive habitat (marsh, beach, rivers, forest, lakes, oceans, etc.)
   a. What are some ways that plants and animals could adapt to these environment? (Research plants and animals of coastal South Carolina)
   b. List plants and animals found on barrier islands.

6. Do you see any evidence of man’s attempt to alter the course of nature by the introduction of jetties or seawalls on either image?
7. Which city appears to be more heavily populated? What types of evidence do you look for to determine population density?
8. Would measure off the same size area on each image allows you to make a better or more reliable comparison of population density by eliminating one variable?
9. What is the source of the sediment that is carried down the river in the Savannah image? What happens to this sediment when the river reaches the Atlantic Ocean?
10. What evidence is present in the image(s) that shows where the sediment is being deposited?
11. How is it possible to tell the direction of the longshore current by examining the development of beaches and spits along the coast?
Lesson Three:

Marine Organism Identification

Time required – One class period

Materials - One set of materials will be needed for each cooperative group:
- reference book on marine organisms including deep sea animals
- markers, crayons or colored pencils
- charts or posters which illustrate marine organisms and which environment they inhabit
- copies of magazines— Ocean, National Geographic, Scuba Diver

Suggested grouping patterns- cooperative groups of either 2 or 4 students depending on materials. It is best to have smaller groups since this would permit the students to be more involved in the learning process.

The student will be able to identify marine organisms that inhabit the Atlantic coastal zone and describe their adaptations their unique environments.

1. List and describe the major regions of the ocean. (Tidal zone, neritic zone, open sea, bathyal zone and abyssal zone).
2. Brainstorm and list adaptation of ocean organisms (don’t forget about the plants).
3. Have students list possible organisms found in the open ocean or off shore zone. Characterize those organisms as floaters (plankton), swimmers (nektonic or pelagic), crawlers (benthic) or sedentary.
4. Draw a class mural of the offshore region of the Atlantic coastal zone and its inhabitants.
5. Construct a food web for the off shore region.
6. Have students choose an animal that inhabits the ocean environment
7. Have students explore the tidal zone and beach region of a barrier island.
8. What causes the tides? What is the length of tidal period for South Carolina coastal zone? (6 hours 12 minutes)
9. List and describe the major parts of the coastal tidal zone. (above high tide line, inter-tidal zone and sub-tidal zone).
10. Brainstorm and list adaptation of sandy beach inter-tidal organisms (do not forget the plants). Characterize those organisms as to how they avoid the stress of being stranded on the beach for up to 6 hours? (ability to walk or swim to the ocean, hide in holes or close up.)

Discussion Questions:

1. Discuss with students the definition of salt marsh? What are the uses of a salt marsh and why is it know as natures’ nursery? List and describe the major parts of the salt marsh. Discuss with students the definition of an estuary and tidal creek? What are the uses of an estuary and why is it considered a major feeding ground for marine organisms especially birds?
2. Why are salt marshes considered tidal? How do tides determine what lives within the marsh?

3. Students should make a list of organisms found in the salt marsh or estuary environments. Characterize those organisms as to how they avoid the stress of a changing tide. Investigate the life cycle of each organism.

4. Brainstorm and list adaptations of salt marsh organisms (both plants and animals). Identify how plants and animals adapt to the changing conditions of the salt marsh.