COASTAL HAZARDS

PART 1: Coastline Features

A. How coasts form

Watch this video and answer the following questions:
https://www.youtube.com/watch?v=pxmHHoTPSK1

1. Which mineral comprises the sand on most beaches?
2. Where does sand come from?
3. How is the sediment that becomes sand transported to the coast?
4. Why are most beaches made of sand and not large pebbles? (Hint: think energy of transportation!)
5. Why are silt and clay deposited off-shore and not on the beach?
6. When rock is weathered and becomes sediment it is called (Circle one):
   EROSION or DEPOSITION
7. When that sediment settles out (ex. on the beach) it is called (Circle one):
   EROSION or DEPOSITION
8. Are ALL beaches made of the mineral Quartz?
9. If not, what are some examples of where sand on other beaches comes from?
10. Look at mineral sample #s 3, 7, and 25. Which do you think is Quartz, and WHY?
11. Look at the three containers of sediment. Below, name which container number belongs to which sediment type, SAND, SILT/CLAY, or PEBBLES:
   a. 
   b. 
   c.
12. Below, name where you think each container would settle out, RIVER, BEACH, or DEEP OCEAN and WHY (Hint, think again about energy!):
   a. 
   b. 
   c.
Watch these videos and answer the following questions:
https://www.youtube.com/watch?v=U9EhVa4MmEs
https://www.youtube.com/watch?v=rCpZYlPqn6E

13. Do waves approach the beach parallel to the beach?
14. How does the angle of approach of waves move sand along a beach?
15. What is longshore drift?

B. Common features of coasts
16. What are the main features of a barrier island system? Use Figure 14.15 on p.354 of your manual to describe the following:
   a. Barrier Island-
   b. Spit-
   c. Marsh-

17. Looking at Figure 14.15, what do you conclude an inlet is?

18. In the Coastal Images folder, find the sheet labeled washover fans:
   a. Washover fans consist of beach sand, but you can see they are found towards the marsh side of a barrier island. How do you think a washover fan forms?
   b. What do you think the existence of a washover fan(s) indicates about that particular barrier island?
   c. What do you think happens to a barrier island if washover fans occur frequently on an already eroding barrier island?

19. The process you described above is called barrier island rollover. Washover fans are often the result of typical storms. Therefore, hurricanes can have an even more drastic effect. You can see rollover happen as a result of Katrina in this clip:
   http://www.nasa.gov/vision/earth/lookingatearth/katrina_poststorm.html
   In which direction did the island rollover towards? ________________________

20. Watch this video and answer the following: https://www.youtube.com/watch?v=5W3_y5_3w9A
   a. How do dunes form?
   
   b. How does vegetation help form dunes?
   
   c. Dunes are the first line of defense in the event of a storm. What do humans commonly do to interrupt this process?

PART 2: Coastal Issues
1. So why learn to identify the features and characteristics of coastal environments? Use the following two websites to answer the questions below:
   http://oceanservice.noaa.gov/facts/population.html
   a. According to the 2010 census how many people live in counties directly on the shoreline?
   
   b. What percentage of the nation’s population is that?
c. How much is this figure expected to increase by 2020?

d. Beaches help generate how much money per year for the national economy?

e. How much money do beaches contribute per year to tax revenue?

2. In the Coastal Images folder, find the sheet labeled “Erosion.” Answer the following:
   a. On the South end of Folly Beach, are there any areas labeled as “Low” for coastal erosion (BVI=Beachfront Vulnerability Index, determined by NOAA)?

   b. Are there areas labeled high? If so where?

   c. Comparing the Folly erosion map to the erosion map of the entire US, is the erosion on Folly unusual?

   d. Which areas in the country have higher rates of coastal erosion than the Charleston area?

3. Using p.262-3, what are the two major factors that your manual outlines as coastal threats (and therefore agents of coastal erosion)?

4. Go to the NOAA Tides and Currents, Sea Levels Online site at: http://tidesandcurrents.noaa.gov/sltrends/sltrends.shtml. Zoom in to South Carolina and click on the data for Charleston (yellow arrow). What is the mean sea level trend for Charleston? ________________

5. Scientists interpret this mean sea level trend to be equivalent to ______ feet over 100 years.

6. In the same data box used for the question above, look under ‘Choose plot’ and select ‘Linear trend’. What does the data show in terms of sea level rise?

   *Note: The annual peaks and troughs are reflecting the average high and average low tide for that year, as monthly mean sea level incorporates the tides.

7. Using the mean sea level trend for Charleston, calculate the increase in sea level in 20 years and 100 years. Convert each prediction to inches. Show your work!

   20 years predicted sea level = ________________

   100 years predicted sea level = ________________

8. Based on the number above, how much will sea level rise by 2100? ________________________m

   Show your WORK:

9. Within your calculations you are making an assumption regarding the rate of sea level rise – what is it?

10. Most models predict a faster rise in sea level than the linear rate indicated on the NOAA site (Q#4). According to a recent report by SC Department of Natural Resources, water levels in the Charleston Harbor and neighboring estuaries have risen approximately 1 foot in the last 100 years, and more importantly, over 4 inches in the last 30 years. What is the annual rate of sea
level rise, in inches/yr, based on these data?

Annual rate based on a rise of 1’ in 100 years: ________________________ inches/yr
Annual rate based on a rise of 4” in 30 years: _________________________ inches/yr

11. You lab manual states that by 2100 moderate estimates are that sea-level will rise another 6.5’ (2m). In the Coastal Images folder, locate the image titled “Sea Level Risks-Louisiana.” What is the fate of the New Orleans area for this 2100 prediction?

12. Go to this site: https://coast.noaa.gov/slr/ and zoom in on downtown Charleston until the scale in the lower left is 500m, or 2000ft. use the slider bar on the upper left to change the amount of sea-level rise (be sure the Sea-Level Rise icon is selected above the slider bar). What would happen in the following areas if the 6ft sea-level rise (as stated in your manual) happens? (You may need to look at a Charleston map online for help with locations).
   a. The Battery:
   b. The College of Charleston:
   c. MUSC and Roper Hospitals (near where the connector comes into Charleston):

13. Winds from a hurricane are hazardous but the more hazardous aspect of a hurricane is called a storm surge. What is it? (Hint, look on page 363 of your manual about half way down).

14. What was the estimated storm surge of Hurricane Katrina in New Orleans?

PART 3: Combating beach erosion

As we explore what is being done to combat shifting beaches, keep the following in mind:
- Coastal environments are dynamic, constantly in flux.
- Seasonal changes occur due to late summer/fall hurricanes and winter storms. These storm events often have devastating results as barrier islands buffer our main coastlines from the storm energy and therefore receive the brunt of the storm.
- Hurricanes can have even more drastic affects as winds can reach high velocities and storm surges can push ocean water over the entire island.
- On the other hand, change can be gradual and almost unnoticeable. As global climate change pervades, sea level rise increases.

1. Also keep in mind that tides have a great influence on shaping our coasts. Use page 339 in your manual and the video below to answer the following: http://oceanservice.noaa.gov/education/tutorial_tides/tides01_intro.html
   a. What causes tides?
   b. How many low tides per day do most coastal areas (including SC) have? ______
   c. How many high tides per day do most coastal areas (including SC) have? ______

What is being done to combat beach erosion? We will now explore 4 different methods commonly seen on the east coast to preserve beaches.

Hard Stabilization:

2. Using page 360 in your manual and the simulation titled “Stabilization” on OAKS, answer the following:
a. What are groins?

b. Are groins PARALLEL or PERPENDICULAR to shore? (Circle one)

c. Do they stabilize INLETS or BEACHES? (Circle one)

3. Using the simulation titled “Stabilization” on OAKS, answer the following:
   a. What are jetties?

   b. Are jetties PARALLEL or PERPENDICULAR to shore? (Circle one)

   c. Do they stabilize INLETS or BEACHES? (Circle one)

4. Using page 358 in your manual and the simulation titled “Stabilization” on OAKS, answer the following: (Note: a breakwater in the simulation is similar to a seawall, but a seawall is ON the beach, commonly built directly in front of property).
   a. What is a seawall?

   b. Are seawalls PARALLEL or PERPENDICULAR to shore? (Circle one)

   c. What is the purpose of a seawall?

   d. What happens to the beach on either side of a seawall?

Soft Stabilization:

5. Using page 359 in your book and your knowledge from your prelab, answer the following:
   a. What is beach renourishment?

   b. Where does the sand for this commonly come from?

   c. What is a problem with breach renourishment?

Go to the sandbox with your team and complete the following exercises and questions:
(Note: “Downdrift” is the direction longshore drift is moving; Updrift is where it is coming from)

6. Use your hands to shape the sand into two barrier islands that are approximately 12” long. Include an inlet between the two islands. Draw your islands below and label the inlet, ocean, and beaches.
7. Using your fingertips, simulate longshore drift (you pick the direction). Note the direction of longshore drift with arrows on your drawing above.

8. Based on your simulation of longshore drift, label areas where you think there would be accretion on each island, and where you think there would be erosion (using symbols A and E) in your drawing in #6.

9. Based on your simulation of longshore drift do you think inlets stay in the same place over time? If not, how do they migrate?

10. Using the two short rulers/sticks provided, “construct” two groins in the sandbox, dividing the beach of one barrier island into three equal sections. Add the groins to your drawing above (Q#6). See the diagram below for an example of groin placement relative to the beach.

   Example of groin placement:

   beach
   groin   |   groin

11. Using your fingertips, simulate the effect of the groins on sand deposition on the beach. Label areas of accretion and erosion (A and E) on each side of the groin in your diagram in Q#6.

12. If sand is accreting on one side of the first groin, where does the sand come from to accrete onto the downdrift groin?

13. In the sandbox, use the rulers to construct two jetties at the mouth of the inlet between the two barrier islands. Simulate the longshore drift again with your fingertips. On your diagram from Q#6, draw in the jetties and label areas of erosion and accretion (A and E).

14. Based on your simulation, what do you think would happen to the sand supply of the next barrier island in the downdrift direction?
PART 4: Folly Beach Case Study

1. In the Coastal Images folder, locate the satellite images of Folly Beach and the Charleston area. Sketch the Folly beach system below (birds-eye view) and label the following: Barrier islands, marsh inlet, beach, mainland.

The South (west) end of Folly

- The images for the following questions can be found in the Coastal Images folder

2. Locate the photo labeled “S end 2013.”
   a. What is the difference between the 1989 and 2013 vegetation line?
   b. What signs/features of erosion do you see?

3. Locate the photo labeled “S end 1989-2014.”
   a. In which year was the beach farthest seaward?
   b. In what year was the beach farthest landward?
   c. Is there any year when the beach accreted (accumulation of sand)?

4. Locate the photo labeled “S end 2014.” In late spring of 2013, a terminal groin was constructed at the very southern end of Folly Beach, on the County Park beach.
   a. What is the direction of longshore drift at this location? __________
   b. Therefore, what is the purpose of this groin?
   c. From the 2014 photo is the groin working? WHY or WHY NOT?
The South end of Folly in Google Earth

- You can download google earth or use the smart board for this exercise. If you download it and use your computer, you need to download the CCPRC_Folly_term_groin and the Coastal Lab –Folly KMZ files on OAKS. Once you have the file open in Google Earth, zoomed to Folly Beach, under View, click on Historical Imagery. A timeline will appear in the upper left corner so that you can view various historical images for the location. Answer the following:

5. Zoom in to the south (west) end of Folly Beach. You should see two irregular shapes, one yellow and one green, in the Stono Inlet. The yellow outline is a small island called Bird Key and the green outline is Skimmer Flats. These two small islands have been extremely important biologically and support nesting seabirds (http://www.dnr.sc.gov/birdsanctuaries/birdkeystono.html).
   a. What happens to Bird Key between 1989 and 1995?
   b. What happens to Skimmer Flats between 1989 and 1995?
   c. What impact do you think the impact of the South end groin at the county park will be on Skimmer Flats, which is a very important nesting site for birds?

PART 5: Folly Beach Field Trip

It is imperative that you know the details about next week’s field trip to Folly Beach. It is YOUR responsibility to leave today’s lab knowing all details. Ask your instructor if you are confused at all about any information, or have questions. Answer the following:

1. What time are you meeting your lab class? _______________
2. Where are you meeting them? ______________________________________________________________
3. What happens in the event of bad weather?
4. With whom are you riding (who is the driver?)? ________________________________________________
5. If you are a passenger and not a driver then it is YOUR job to contact the driver about any change in picking you up. What is their cell #? ______________________________
6. You have a paper due at the START of the field trip lab. You are also giving a presentation on a specific area/feature of Folly. What is your stop # for your project and presentation?
7. What should you bring to the field trip?
8. How much money do you need for the field trip? $____________