6.7 Beaches on the Move

Lesson Concept
Beaches are dynamic systems where sand is supplied by rivers and moved by waves.

Link
In the previous lesson students learned how rivers deposit sand/sediment along the river and at the ocean. In this lesson, they learn how sand is moved by wave action at the beach. In the next series of three lessons, students visit local areas where evidence of beach sand movement can be observed.

Time
50-75 minutes

Materials
Whole class
Video Beach: A River of Sand available on YouTube at http://www.youtube.com/watch?v=FqT1g2riQ30
R1-3 Before and after Santa Barbara Harbor and Dredging Crane
Individual
H1a,b Video recording sheet
H2a,b Santa Barbara harbor design (optional)
Resources
R1-3 Pictures
R4 Teacher Background on Beach Sand Movement

Advance preparation
1. Access video
2. Duplicate handouts H1 and optional H2
3. Print or display photos

Procedure:
Engage (10 min) Local Beaches (Santa Barbara Harbor) have differences in sand pattern during past and present pictures.

1. Ask students to describe the beach near Santa Barbara Harbor. What do you know about the beach and the pattern of the sand? Chart on KWL.
2. Display Santa Barbara Harbor photos to students and asks students to observe the differences between the past and present pictures. What do you notice about the end of the breakwater? And the beach? What might this piece of equipment (dredge) be used for?

3. Ask students to describe the harbor features of each picture to a partner. Ask partners to discuss the following questions: Why is there sand at the end of the breakwater? Why is West Beach bigger today? Where did the sand come from? Chart responses on appropriate category of KWL.

4. Explain to students that we will watch a video that explains the Santa Barbara Harbor phenomenon. Ask students to watch the video closely and take notes. Use the notes to sketch and summarize understanding of the process.

Explore/Explain (30 minutes) Beach sand moves in predictable patterns. Human impact changes the movement of sand and may have a negative impact on future movement of beach sand.

5. Distribute the H1a,b (Video Recording Sheet) handout to all students and ask students to fill in their responses during the movie.

6. Show students the video “Beach: A River of Sand”. While watching the video, students should be paying close attention to the explanation of what causes the formation of the Santa Barbara harbor sandspit.

7. Stop the video periodically to discuss new concepts and terminology.

8. Ask the students to add to the KWL chart additional information about the Santa Barbara Beach Harbor changes.

Extend/Evaluate (10 minutes) Human impact changes the movement of sand and may require additional human impact to maintain the beach pattern.

9. Have students sketch and summarize the effect of breakwaters on the movement of sand along the coastline on H1a,b (Video Recording Sheet).

10. For extension, students can redesign the Santa Barbara Harbor to minimize the accumulation of sand in the harbor and reduce the need for dredging using H2a,b (Santa Barbara Harbor Design).
Name: _________________________________

**Beach: A River of Sand**

**Video Notes**

1. What are all beaches ultimately made of?

2. What are the two most common rock minerals found in solid rock?

3. What brings rock debris to the ocean?

4. Where do the bigger, heavier chunks of rocks go?

5. Where do the smallest particles go?

6. What happens to sand at the end of summer?

7. What happens to sand at the end of winter?

8. Waves in the summer are smaller so they have ____________energy than winter waves.

9. Why do most waves hit the beach at an angle?

10. What happens when waves hit the beach at an angle?

11. What is the surf zone current called?
12. What does the longshore transport move?

13. In which direction does most sand move most of the time?

14. What does the breakwater do to the sand temporarily?

15. Does sand ever enter the harbor?

16. What would happen if we didn’t dredge the harbor?

17. Where does the river of sand end?

18. What happens when a dam blocks a river?

Sketch and summarize the effect of breakwaters on the movement of sand along the coastline.
The Santa Barbara Harbor was first constructed by a very wealthy resident that needed a place to dock his large yacht. At the time, the harbor was comprised of only a small seawall that still surrounds the harbor today. There were no piers of docks. The sea wall is large piles of rock covered by a concrete walkway. This keeps the ships inside the harbor safe from large ocean swells during winter storms. Each year, the harbor in Santa Barbara is improved with the addition of new docks, piers, weather stations, and emergency services. The Santa Barbara Harbor is now a focal point of tourism, industry, and recreation in the city.

The Problem: Because the seawall of the harbor was built long ago by a private resident, it is not best design for an effective harbor. The seawall keeps the swells away from the boats, but fails to keep the sand out of the harbor. In order to keep the entrance of the harbor free from excess sand, the city of Santa Barbara uses a dredge to suck the sand from the entrance of the harbor and transfer it to the beach east of Stern’s Wharf. The city spends millions of dollars a year to dredge the harbor.

Your Job:
Using the information you have learned today about longshore currents and sand deposition, your job is to engineer a new design for the Santa Barbara Harbor that will enable the city of Santa Barbara to get rid of the dredge. You can either change the map of the harbor on the back of this sheet or create your own map of the new harbor.
6.7 Weathering and Erosion: Beach – A River of Sand

*SCEINEC MATTERS
Santa Barbara Harbor - 1932
Santa Barbara Harbor - present
A dredge in the Santa Barbara Harbor
Teacher Background on Beach Sand Movement in Santa Barbara

Sand is moved along the shore by the direction the waves are traveling, as well as onshore and offshore by changes in wave height (summer winter beach regime). Most waves reach a coastline from either an upcoast or downcoast direction. Rarely do waves come directly straight in (although they may appear to), waves bend as they enter shallow water and break in a more or less parallel direction to the shoreline. Each wave usually breaks starting from either a downcoast or upcoast direction.

The angle of the breaking waves creates a movement of sand along the shoreline; within the surf zone, and in the direction the waves are traveling. This movement of sand parallel to the shoreline due to the angle of the breaking waves is called longshore transport.

Along most of the coastlines of the United States the net longshore transport is from north to south (downcoast). This is due to the fact that the majority of the waves that hit the coastlines of the United States come from the Arctic area. Here in Santa Barbara the longshore transport is downcoast about 80 percent of the year. There are a few tropical storms that create an upcoast longshore transport but these are generally less than 20 percent of the time.

The aerial photographs of the Santa Barbara harbor show the sandspit at the downcoast end of the breakwater. The sandspit forms from the net downcoast longshore transport of sand. The end of the sandspit must be dredged every year to prevent the mouth of the harbor from closing as the sand accumulates.