

## Dune Movement

## Teacher's Guide

**Subject:** Integrated Science (Life; Earth-Space; Physical)

**Topics:** Longitudinal Sand Dune Study: Accretion and Erosion, Wind

**Summary:** Students will examine the dunes and measure the movement of sand dunes along a portion of the boardwalk trail. Students will discover the importance of preserving the dune vegetation, by realizing that the vegetation provides an obstacle for the sand and “holds” the sand in place.

After completing the field lab, students will be able to:

**Objective(s):**

1. Explain the environmental causes of dune formation
2. Define erosion and accretion
3. Pinpoint dune movement via comparative data and measurement

**Ecosystem(s):** Coastal, Beaches/Dunes

### Equipment:

- 3 extendable metric measuring rods
- Compass
- Digital camera
- GPS Units

### Background:

- **Vocabulary:** accretion, erosion, parallel, perpendicular, compaction, windward, leeward
- **Reference Material:** *The Beaches are Moving* (Video), Science Voyages (Green Glencoe) Chapters on Ocean Shoreline (354-358); Ocean Waves (379-381); and Dunes (323-325); Creating Sand Dunes: [http://www.eduref.org/Virtual/Lessons/Science/Earth\\_Science/EAR0007.html](http://www.eduref.org/Virtual/Lessons/Science/Earth_Science/EAR0007.html) Barrier Island Ecology (How stuff Works): <http://www.howstuffworks.com/barrier-island2.htm> (Post-Activity) Students create a graph with the data from Lab #3 (Dune Movement) and compare it to previously recorded data (when available).
- **Equipment Training:** Using/reading a metric measuring rod

### Procedure (Engage; Explore; Explain)

1. What forces in the environment move sand? (namely, wind and water)
2. Begin activity as one group at the head of the boardwalk. Explain that barrier islands are dynamic places. Their size, shape and location are constantly changing. Define **erosion** as the removal of material and **accretion** as the addition of material. Explain that sand movement is not always in the same direction, but in general there is a net movement in one direction over time. Changes are most noticeable on the gulf side where sand blown from the beach forms dune ridges, lines of dunes perpendicular to the prevailing wind. Using a compass, compare wind direction to the orientation of the first set of dunes.
3. Review with students the “recipe” for dune formation.
  - Abundant supply of **sand**. Where does the sand that makes up our barrier islands come from? The river carries huge amounts of sediments that are the result of erosion of mountains to the north (quartz sand comes from the breakdown of granite). Sand travels across the bay and into the Gulf to create offshore sandbars. Waves deposit sand onshore during calm weather and wind moves the sand landward forming dunes. During storms, sand erodes from the dunes and is moved back offshore. This means dunes serve as sand reservoirs for the barrier island system.

- **Wind** energy. Sand can only be moved by fairly strong winds (>15mph) and is only lifted a few feet off the ground. How then can dunes form that are over 30 feet high? As sand carried by the wind drops, it bumps into other grains. This “leapfrog” effect pushes sand up the dune front and eventually over the top. On the back of the dune many inclined layers of sand form called cross-beds. This rolling over action explains how dunes migrate down wind.
  - **Obstacles.** Objects reduce wind speed causing sand to accumulate. Ask students to list objects they observe (plants, shells, man-made items such as sand fencing, boardwalks, etc). Other than objects, what else might impede sand movement? (Compaction, moisture, large grain size)
4. Divide the group into three teams. Assign each a section of boardwalk where they will take a series of 10 measurements. One student positions the rod so that it barely touches the top of the dune while another determines the distance to surface of the walkway. Do not disturb the dune by moving or pressing down on the measuring rod. Other team members record the measurements. After all teams have completed their measurements the group shares their data.
  5. Take a picture of the group standing on the first section of boardwalk showing the dune below.

### **Sunshine State Standards:**

**Science:** SC.B.1.3.1; SC.B.2.3.1; SC.D.1.3.1; SC.D.1.3.4; SC.D.2.3.2; SC.G.2.3.2; SC.H.1.3.4; SC.H.2.3.1

**Language Arts:** LA.A.1.3.3; LA.B.2.3.1; LA.C.1.3.1

**Mathematics:** MA.B.2.3.1; MA.B.3.3.1; MA.E.3.3.1

**Social Studies:** SS.A.6.3.2; SS.B.2.3.6;

**Dune Movement****Student Data Sheet****General Information**

|                   |  |            |  |
|-------------------|--|------------|--|
| Full Name:        |  | Date:      |  |
| School (teacher): |  | Time:      |  |
| Latitude:         |  | Longitude: |  |

**Student Hypothesis and Rationale**

If the wind is the main force in dune movement, than I hypothesize that most of the measurements at the posts will show (choose one: erosion/ accretion) because...\_\_\_\_\_

\_\_\_\_\_.

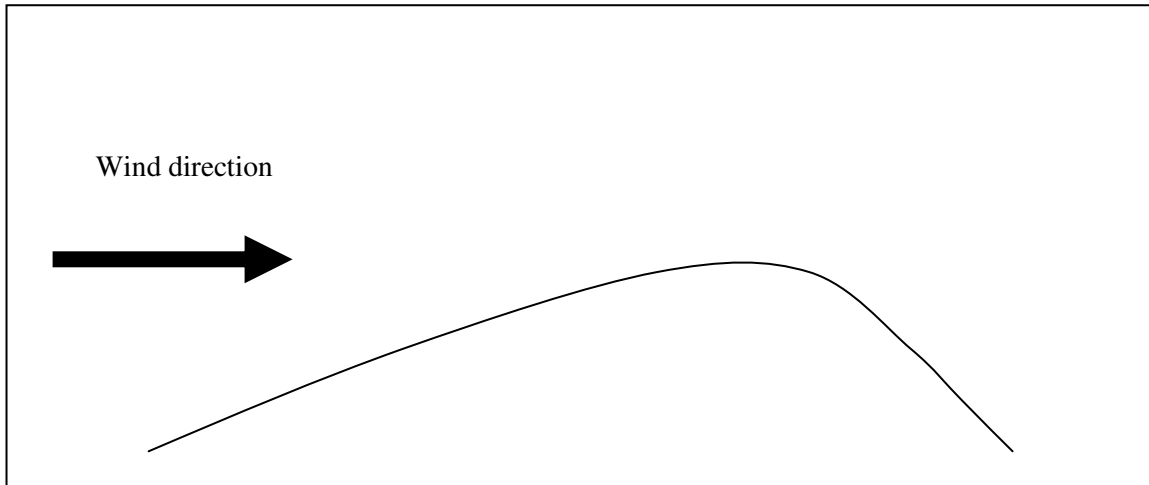
**Field Observations/Measurements/Data**

| P<br>O<br>S<br>T<br># | 1 <sup>st</sup> Year's<br>Data<br>(2004) | Current<br>Measurement<br>space beneath<br>boardwalk (cm)<br>* indicates sand<br>over boardwalk | Change<br>difference in<br>measurements<br>(cm) | <u>Erosion (E)</u><br>space increased<br>so sand lost or<br><u>Accretion (A)</u><br>space decreased<br>so sand added | P<br>O<br>S<br>T<br># | 1 <sup>st</sup> Year's<br>Data<br>(2004) | Current<br>Measurement<br>space beneath<br>boardwalk (cm)<br>* indicates sand<br>over boardwalk | Change<br>difference in<br>measurements<br>(cm) | <u>Erosion (E)</u><br>space increased<br>so sand lost or<br><u>Accretion (A)</u><br>space decreased<br>so sand added |
|-----------------------|--|---|---|--|-----------------------|--|---|---|--|
|                       |  |   |   |  |                       |  |   |   |  |
| 1                     | 78cm                                     |   |   |  | 16                    | 107cm                                    |   |   |  |
| 2                     | 81cm                                     |   |   |  | 17                    | 95cm                                     |   |   |  |
| 3                     | 107cm                                    |   |   |  | 18                    | 105cm                                    |   |   |  |
| 4                     | 107cm                                    |   |   |  | 19                    | 105cm                                    |   |   |  |
| 5                     | 105cm                                    |   |   |  | 20                    | 123cm                                    |   |   |  |
| 6                     | 113cm                                    |   |   |  | 21                    | 105cm                                    |   |   |  |
| 7                     | 120cm                                    |   |   |  | 22                    | 104cm                                    |   |   |  |
| 8                     | 114cm                                    |   |   |  | 23                    | 132cm                                    |   |   |  |
| 9                     | 119cm                                    |   |   |  | 24                    | 142cm                                    |   |   |  |
| 10                    | 95cm                                     |   |   |  | 25                    | 146cm                                    |   |   |  |
| 11                    | 87cm                                     |   |   |  | 26                    | 166cm                                    |   |   |  |
| 12                    | 76cm                                     |   |   |  | 27                    | 151cm                                    |   |   |  |
| 13                    | 57cm                                     |   |   |  | 28                    | 145cm                                    |   |   |  |
| 14                    | 90cm                                     |   |   |  | 29                    | 134cm                                    |   |   |  |
| 15                    | 89cm                                     |   |   |  | 30                    | 153cm                                    |   |   |  |

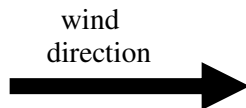
## Dune Movement

## Assessment

1. In the drawing below, label the windward and the leeward sides of the dune. Also show the direction of sand movement and the formation of cross-beds.



2. What are the three key “ingredients” necessary for dune formation?
3. List three obstacles that could slow down the movement of sand?  
What other factors could impede the sand movement?
4. Below, show the alignment of a dune ridge as either **parallel** or **perpendicular** to the prevailing wind direction?



5. What are 2 important functions of sand dunes?

### Portfolio Journal Prompt

The wind erosion can shape and move landscapes, like the sand dunes explored during the lab. Before you begin writing think about how the wind moves around the earth, and the factors that cause the air to move. Describe the process that causes the air to move. Explain how energy and heat are a part of this process.