

MR. SAND
TEACHER'S MANUAL

INTRODUCTION:

Although Mr. Sand is a cartoon presentation that is attractive to children (of all ages), the material is technically accurate and quite significant to our understanding of the basic processes that drive the formation and function of the barrier islands of the north-central Gulf of Mexico. Our intention is to help you identify the useful science and resource-use items that are intrinsic to the story of "Mr. Sand". This key to the panels follows the order they are presented on the walk south of the Sea Lab.

PAGE 3. Key words:

* granite -igneous(volcanic) rock containing lots of silicon dioxide (SiO_2), which is the mineral name for sand

* Appalachian Mountains -the mountain range in the Eastern U.S. which terminates in north-central Alabama

* erosion -the act of wearing away the surface of the earth, in this case, by moving wind or water

Key idea: Sea level was 300 feet lower 20,000 years ago and has been rising ever since the last ice age. The rate of rise slowed about 6,000 years ago and allowed the barrier islands to form, more or less, where they are now. **But** sea level is still rising and the islands are still migrating slowly, usually parallel to the shore.

Questions:

1. Where does sand come from?
2. What is sand made of?
3. What is a beach?
4. Where do you think the sand under the sign could have been 20 years ago?

PAGE 4. Key words:

* wave -energy moving through the water. Wind is created by solar energy and moves across the ocean surface. This causes a ridge, which moves on the surface of the water. Waves move in periodic impulses.

* current - continuous onward movement of water caused by gravity , the turning of the earth, tides

Key ideas: There is a lot of sand held in suspension by waves and currents in the Gulf of Mexico. Sand is transported **onto** the beach by moving water.

- Questions:**
1. How does sand move?
 2. Where is sand often deposited?
 3. Observe the waves in the Gulf. Are they bringing sand onto the beach?

PAGE 5 Key words:

* texture -the structure of the surface of something. You can feel texture, usually

Key ideas: The fine white sand of our beautiful beaches is a consequence of the sand grains being rolled along the bottom and being worn down.

- Questions:**
1. What is the texture of our sand on these beaches?
 2. Why is the sand like that?
 3. Pick up a small amount of sand in your hand. Are all the sand grains the same size? Why?

PAGE 6. Key words:

* offshore bars -hills or banks of sand underwater off the beach

* island -a piece of land surrounded by water

Key ideas: The gradual accumulation of sand, at some point, can lead to the emergence/development of an island, defined by geography and currents.

- Questions:**
1. Where do barrier islands come from?
 2. How is a barrier island like an offshore sandbar?
 3. Can barrier islands move? How?

PAGE 7. Key words:

* leeward -protected, away from the wind

* Aeolus -Greek god of the winds

* obstacle -an obstruction, preventing forward movement

Key ideas: Dry sand can be moved by the wind. If windblown sand hits an obstacle, such as a sand fence, or a plant, or if the wind is slowed, the sand will drop to the nearest surface. Aeolus was the Greek god of the winds, and so the technical term for movement by the wind is "aeolian transport". This accumulation of sand on the leeward (protected) side of an obstacle is why vegetation or sand fences work to trap sand and allow sand dunes to form!

- Questions:**
1. Where can sand collect when wind blows it?
 2. Why does the sand collect there?
 3. Look around you. Can you see where sand has been blown, dropped, and accumulated against obstacles?

PAGE 8. Key words:

* stabilize -to prevent from changing

Key ideas: Unless a sand dune is stabilized, held in place, it could be blown away and lost. Even large sand dunes can be blown away grain-by-grain and moved, if not destroyed.

- Questions:**
1. What can move a dune?
 2. Where will sand go when it is blown from a dune?
 3. Can you see Aeolian Transport going on right now?

PAGE 9. Key words:

* dynamic -active, forceful, energetic, changing

* pioneer plant -a hardy plant that helps to establish, settle, a dune

* adapt -to survive with changed circumstances

Key ideas: Grasses and other plants adapted to the dynamic "life style" of a beach or sand dune can survive and put down roots to stabilize the sand. As the plants grow up into the air, they slow down wind-blown sand, and it accumulates around the base of the plant. Sometimes the plant is entirely buried by the sand! .Sea oats are the major pioneer plant for our sand dunes.

- Questions:**
1. What good are dune plants?
 2. What is the major dune grass for our area?
 3. Can you see any Sea oats on our beach?

PAGE 10. Key words:

* soil -the top few inches of the earth's surface-sand, silt, clay, sand that has organic (plant or animal) matter mixed with it

* moisture -water

* primary dune -first line of sand dunes, nearest the water

* secondary dunes -second line of dunes. Old enough to have small shrubs on them, as well as grasses

* tertiary dunes -third line of dunes. Usually taller than any other dunes and old enough to have small trees on them

Key ideas: When the soil is physically stabilized by the grasses on a dune, more organic matter can accumulate on the dune, allowing larger, slower growing, woody plants to survive. These larger plants, in turn, provide shade and additional stabilizing effects to the dune.

Questions:

1. Why can other plants follow grasses on a dune?
2. Which plants grow where it is wet?
3. What is the difference between sand and topsoil?
4. Which type of sand dunes can you see on our beach?

PAGE 11. Key words:

* community -a group of animals and plants sharing the same environment

* diverse -different, unlike

Key ideas: The development of a diverse plant community on a sand dune or beach attracts all kinds of animals that use the plants for food, shelter or protection. These animals add to the organic matter collecting on the dune. This added organic matter increases the nutrients available to the plants.

Questions:

1. Who comes after the plants?
2. Why do they come?
3. Can you find evidence of any animals on our beach or dunes?

PAGE 12. Key words:

* unstable -subject to change

* topsoil -dirt which contains nutrients and is found on the surface

Key ideas: The bigger a sand dune gets, the more it is exposed to wind and water that can erode it. The sandy soil of a dune is always relatively unstable, compared to mud (wet dirt), topsoil, rocks, and etc. Sand dunes can be easily eroded away. The sand in a dune can be piled very high by the wind and plants that formed it, and it tends to roll downhill very easily when attacked by wind and water during a storm. This is because of gravity. During a storm, offshore bars are often formed underwater. Much of the sand that forms these offshore bars has been taken from the beach!

These underwater bars actually protect the remaining beaches and dunes from further storm impact. During times of no storms, this process is reversed (at a slower rate) and the sand is restored to the system of beaches and dunes.

- Questions:**
1. Does erosion destroy the dunes forever?
 2. Can you see a cycle to sand dune life?
 3. What is the difference between a sand bar and a sand dune?
 4. Can you see a sand bar from this beach?

PAGE 13. Key words:

- * seasonal -during certain months or seasons
- *cuttings -pieces of grasses that have been torn apart by a storm
- * recedes -goes down

Key ideas: Seasonal cycles are common and predictable in the formation and erosion of sand dunes and sand bars. After a storm, beach grasses such as sea oats can reproduce readily from the tattered "cuttings" produced by beach erosion and left behind when the water level recedes after a storm.

- Questions:**
1. What time of year do dunes build up?
 2. What time of the year are dunes torn down?
 3. What causes these seasonal cycles?

PAGE 14. Key words:

- * onshore breeze -wind coming from the water onto the shore
- * migrate -move slowly

Key ideas: Heat rising over land tends to draw (pull) air to it, creating winds from the Gulf that blow toward the land: thus we have the "onshore" breeze or winds characteristic of the warmer months of the year. These onshore breezes move a lot of sand around on the dunes at Dauphin Island. The sand dunes used to regularly migrate to and cover the playground of the elementary school here. National Guard engineer units were called in every few years to push the sand dunes back toward the Gulf of Mexico.

- Questions:**
1. What is an offshore breeze?
 2. Which way do sand dunes tend to move?
 3. Can you find a place where sand has covered an object?

PAGE 15. Key words:

* stabilizing vegetation -sea oats and other dune plants

* natural processes -the building and migrating of sand dunes and sand bars on and along a beach

Key ideas: The massive sand dunes that used to bury the school playground have almost completely disappeared, and the school hasn't been threatened in many years. The loss of these dunes is directly due to people walking and driving on the island and on the dunes, interfering with the natural processes, and causing the old sand dunes to erode and blow away. The problem with this is that the island needs those dunes and that sand to protect itself from hurricanes and to keep our beaches here. The mainland needs the island to protect it from the storms. The damage is a result of the physical destruction of the stabilizing vegetation. Boardwalks built over the dunes can minimize the destructive human impact on our dunes.

Questions:

1. How are dune plants destroyed?
2. What is one way to help prevent the destruction of the dunes?
3. Can you see where humans have helped destroy dunes?

PAGE 16. Key words:

* conservation -the act of keeping or protecting from loss or injury

* fragile -easily broken or damaged

* abuse - to misuse

Key ideas: We can use both natural vegetation and man-made material to stabilize sand dunes. We can enjoy the beaches and dunes, but they are fragile. We can easily destroy them by abusing them!

Questions:

1. How can we help restore the dune lands?
2. What did you learn from Mr. Sand?