Bruce Museum Seaside Saturday:
Let's Look at Sand!

A guided exploration for use around the Long Island Sound
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**Note: This is part of a series of educational pamphlets and activities released as part of the Bruce Museum's Seaside Center's Digital 2020 Season. For access to all our content, please visit: http://www.storagetwo.com/seaside-center*

Introduction

Sand: For those of you who spend time at the beach, it can be a great source of fun or the ultimate annoyance. But what *is* sand?

By many definitions, sand is any loose substrate made up of partially eroded rocks and minerals. These are **inorganic** particles, materials that do not come from living things. These particles can be diverse, but ***silicon dioxide***, in the form of **quartz**, often makes up a large proportion of typical sands.

Technically, sand is just one ingredient in what we call *soil*, the layer of accumulated material that covers the surface of the earth. Soils can contain or be nothing but sand, but sand cannot contain soil. Unlike other parts of soil, sand is very coarse and grainy. It is composed of relatively large particles, and does not hold water: liquid runs through it instead of being soaked in. As water flows between the particles, it carries with it smaller bits of matter. This is one reason why sand seems so lifeless: given frequent exposure to water, all the material accumulating between the particles tends to be washed away. This is often what happens to the nutrients organisms need to live, so many plants have trouble growing in sand. The movement of water also shifts the sand around, preventing the buildup of much **organic** (living or once living) matter.

Not all sand is the same, however. At a certain point, when particles are big enough to look like small stones (> 2 mm) we no longer call it sand: it's now *gravel.* When the particles are small enough (< 0.03 mm) we call the "sand" *silt.* Between these extremes, a wide variety of sands can exist. At the beach, the type of sand you see is not random; it's a product of the history and conditions of that location. Since conditions can vary across a single beach, differences in sand can occur on very small scales -- but those

differences tell us a lot! In this activity we'll learn to *read* the sand, in hopes of better understanding the dynamics that shape our coastline.

Before continuing with this activity, consider watching the Seaside Center educational video on "Soft-Sediment Shorelines." In the first part of this video. "*Ecosystem*," I describe some of the factors that shape beaches and mudflats – sand is carried in the waves and tide, and where it ends up is not random. Understanding this movement is important when looking at the differences between sands, especially on small scales.

That video is available here: https://www.youtube.com/watch?v=5DqmDKl1W8A

Let's Look at Sand!

When we crouch down to look at the sand, or let it run through our fingers, what characteristics should we take note of? Try answering a few of these questions.

- Size
    - *How big are the largest particles?*
    - *How small are the smallest?*
    - *Is there an average?*
- Variation
    - *Are most particles the same size?*
    - *Are no two particles the same size?*
    - *How big is the difference between the largest and smallest particles?*
- Color
    - *Is the sand light, dark, or clear and glassy?*
    - *Is there much variation? (see above)*
- Texture / Consistency
    - *Is the sand coarse or fine?*

Let's put these questions in context by looking at sand from different areas of the beach. I collected some sand samples from a beach in Milford, CT that has four distinct habitats in close proximity: dunes, marsh, high sandbar, and tidal flat. I then took these samples home and looked at them under a microscope. Such close examination is not necessary, but it will illustrate a few points -- most of the differences can be seen with the naked eye alone!

Below, all images through the microscope are taken at 20x magnification.

Sand Sample #1: Dunes

Sample site: Sample:

What are some things to notice here?

The sand is varied in color and size, and on average the particles are very small. Some particles are clear and crystalline, others are dark like small stones. The texture is quite fine, with particles mostly rounded. Most particles are < 1 mm across.

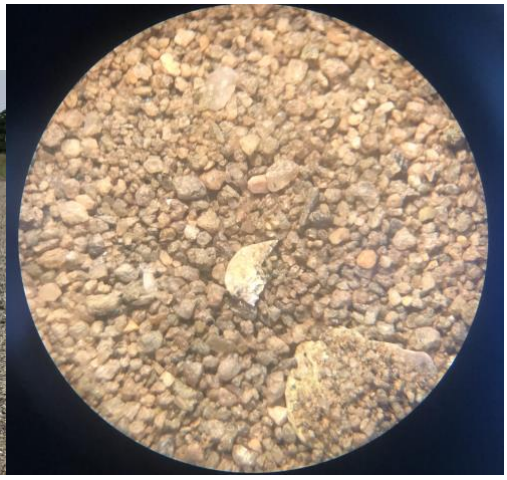
What does this tell us?

Small particles are easily carried by the wind, waves, etc. When subjected to these forces, sand often goes through a “sorting” process -- the smaller particles are carried away, and the large ones stay put. Dune sand is often very fine, as it’s made up of small sand particles blown back from the beach by onshore winds (winds blowing off the water). The grass and shrubs of the dunes catch these windblown particles and keep them from continuing inland. Over time, small sand particles accumulate at the plants’ base and create dunes. We can observe the results of that wind sorting in this sample. The particles here are also rounded, as round particles are more easily carried in the wind.

Sand Sample #2: Marsh

Sample Site:

Sample:



What are some things to notice here?

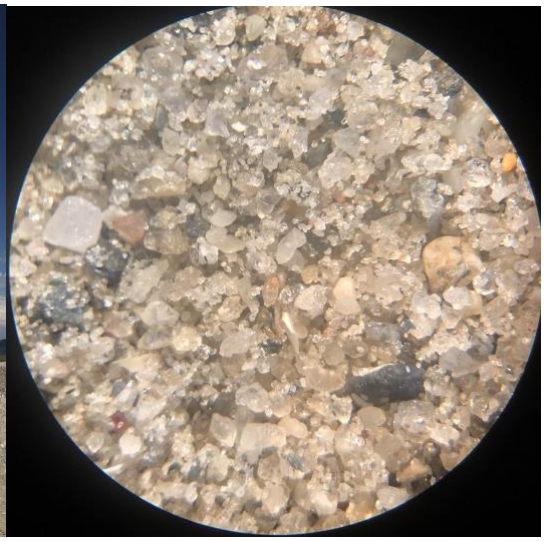
There is less variation in size and color among this sand than in sand from the dunes. On average, the particles seem a bit larger (~1 mm) and are coarser, with the edges less rounded.

What does this tell us?

I collected this sample on the backside of the marsh, and while the area is covered at high tide, it is submerged only briefly. The tide must flow through much of the marsh to reach this spot. During this process, the saltmarsh cordgrass slows the water and catches many of the larger particles drifting with it. Only smaller particles can get carried to the other side. Once there, these particles are subjected to further sifting by the winds at low tide. Many of the very small particles are likely blown up into the dunes, as we saw in Sample 1. This sand has been subjected to two types of sorting, and contains little variation as a result. The brown color is likely a result of staining from mud and sediment, which is abundant in the waters of the marsh.

Sand Sample #3: Sandbar

Sample site: Sample:



What are some things to notice here?

The sand is, on average, larger and very coarse (remember, all these images are at the same magnification). There's a good diversity of shapes and colors.
The largest particles are > 1 mm. Smaller particles are dispersed throughout.

What does this tell us?

On a sandbar, waves push large particles to the top of the bar (the highest points) and pull small particles back down the slope. This sample was taken from the upper band of the bar (visible in the photo) where some of these larger particles accumulate.

On Long Island Sound, wave action is generally minimal and low-energy (unlike beaches on the open Atlantic Ocean). As a result, sandbars here are not as steep, nor as well sorted. There is a diversity of particle shapes and sizes in this sample, and many of the particles are larger than in the marsh or dunes. Along the beach, some amount of sand is generally produced by broken shells, too. These get washed ashore in the waves and likely account for some of the diversity in color we see here.

Sand Sample #4: Tidal Flat

Sample site: Sample:

What are some things to notice here?

The sand particles from the flat are very small, very fine, rounded and clumpy. There is little to no variation, and there are no particles larger than 1 mm. The sand here looks completely different from the three other samples.

What does this tell us?

Most of the time this sand is submerged, and even during very low tides it does not dry out completely (water remains between the particles). The wet sand is heavy and sticks together, so individual particles are less likely to get moved around. The frequent movement of water over this sand weathers it faster than sand in the open air, rounding it and reducing its size.

This flat is adjacent to the sandbar from Sample 3. While the low-energy waves push large particles up the beach the waves then quickly lose energy, and only small particles are dragged back down to the tidal flat. Under this repeated influence, and the general movement of the tides, the flat is smoothed out and made **homogenous** (the same).

Conclusion

Across these four examples you can see the diversity of sand that might exist on a single local beach. Hopefully, after examining the differences between each sample, you have a sense of how sand can provide clues to the natural history and conditions of a specific area. While this exploration has touched on many of the factors that shape and move sand, no two beaches are alike, so always expect the unexpected.

Next time you're out on the beach, spend some time looking at the sand instead of just lying or playing in it! I hope this guided exploration helps make those observations educational and rewarding.

Cheers!

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