

# CLASSROOM ACTIVITY

## Larger Than Life: Magnification of Sand

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**Grade Level:** Grades 5-8 and 9-12

**NM Science Standards:** See Appendix

**Objectives:** Students will:

- Explore samples of sand from different localities without magnification, and then examine the same sands at several magnification scales.
- Make and record observations describing what the enhanced details of the magnified images reveal about the composition, texture, and ultimately, the source of the materials.

### **Background:**

Sand is defined as granular material with grains that are smaller than gravel (2 mm) but larger than silt (0.0625 mm). Sand is created by the disintegration of rocks or minerals through weathering processes such as chemical reactions, freezing and thawing, and abrasion by wind or water. Sand particles can be transported away from their source rocks by wind or water, which continues to wear the particles into characteristic rounded shapes. Immature sand is one that is freshly weathered and has not been transported far, so the grains retain much of the original mineral shapes, typically have sharp, angular edges and have larger average sizes. Mature sands are typically of uniform size, finer grained, and spherical (this is because spheres represent a geometry of minimum surface area).

Wind transported deposits: A sand particle that has been windblown for a considerable distance will tend to have a higher degree of roundedness than one transported by water, and may have a frosted appearance on its surface (think of sandblasting). They will also be smaller. Also, a windblown sand deposit typically will be well-sorted, containing mostly the same size particles. This is because the heavier, larger grains tend to remain in place while the lighter ones are carried away by the wind.

Water transported deposits: Water transported sands can also have a high degree of roundedness that is indicative of the distance the grains have traveled. Water deposited sands will often have a wide range of particle sizes within the deposit, which is described as a poorly sorted deposit. Particle sizes of water-deposited sands commonly reflect specific conditions of transport and deposition (think energy)—from well sorted sand in migrating ripples in a stream to poorly sorted sand in a turbulent flood deposit. Beach sands tend to be well sorted, but the sizes of grains may change as conditions change from gentle lapping of small summer-time waves (small grains) to roaring surf from winter-time storms (large grains).

Examining sands from a variety of deposits can be useful in comparing the source (called provenance) and transport history of the different materials. These sands may appear

similar without magnification. However, viewing the sands with a hand lens, digital scanner, or microscope will reveal clues about their origin, and in many cases, the journey from their source to the location where the sand particles were found.

**Method overview:** Samples of various sand grain materials will be viewed first with the unaided eye, then at different levels of magnification starting with a hand lens, which typically magnifies the image about 10 times, or 10X. For greater magnification, next a flatbed document scanner or digital microscope is used. The digital images can be projected for students to view and study.

**Materials:**

- 1) **Sand samples**--Gather samples from as many different sources and locations as possible, such as sand from beaches, rivers, lakes, anthills, deserts, gravel pits and dunes (even play sand or blasting sand sold at home improvement stores). Be creative about finding interesting samples to magnify. Document the location and environment of the sand deposit, along with the date when it was collected.
- 2) Hand Lens
- 3) Either a **digital microscope** or a **flatbed document scanner** with a high resolution along with a computer to process the scanned images
- 4) **Template for scale** to be scanned with the sand sample (see appendix for download)
- 5) **Chart** for making observations (see appendix)
- 6) **White paper** for displaying samples for unmagnified and low magnification observation

**Method:**

On the observation chart, record the sample names before beginning.

**Unmagnified and low magnification observations:**

For each of the following observations, look for these characteristics: color, size, shape, markings on the grains, how uniform the size and shape of the grains are, and other features.

- 1) Prepare each sample by spreading a small amount on a white piece of paper.
- 2) Using your unaided eye, view and make observations about each sample. Record your observations on the chart.
- 3) Using your hand lens, view and make observations about each sample. Record your observations on the chart.

**Digital scanner or microscope magnification observations:**

**Using a digital scanner**--Place an acetate scale template, if using, on the flatbed scanner glass. Carefully place the sample grains on the template to cover a 2cm<sup>2</sup> area so that grains are close to the scale marks on the template. Cover the samples with a piece of clear acetate and close scanner lid. Select a high resolution setting and scan the sample.

**Using a digital microscope**--Place a sand grain sample on the scale template, if using, and collect images at a high magnification setting.

Save the scanner or microscope images in a gallery and explore image processing options, such as further magnification or image enhancement. Compare the digital images

of each sample. Make observations and record on your chart. Consider the following questions:

**Questions:**

1. How would you describe the grains in this sample?
2. What are the average sizes of the grains (remember your magnification!)
3. Are the grains well sorted (mostly the same size, typical of wind deposited sands) or poorly sorted (various sizes, more typical of water laid deposits)?
4. How can you tell if the sand grains are shaped by wind or water action?
5. Can you assume that the sand found at a particular location was formed locally? Why?
6. Can you see any crystal structure evident in the grains
7. How many different minerals do you think are present in the sample?
8. If grains are sharp and angular, what does this angularity tell you about the minerals contained in the grains?
9. Are you an Arenophile? (Someone who collects sand)

**Expanded Inquiry**

What other substances or materials can you think of to explore through magnification? Examples of different materials to examine might include soils, fossils, diatomaceous earth, chalk, table salt, and dust. Other ideas: Sugar vs. salt, rocks, leaves, sliced fruit, your hand, hair, feathers, etc. You can also check for the presence of magnetite by running a magnet under the paper containing the sand sample. Magnetite will collect against the paper.

**Appendix**

**1) Chart for observations**

**2) Template for scale to be printed out on acetate**

**3) NM Science Standards—Strands and Benchmarks:**

**Strand 1: Scientific Thinking and Practices**

**Standard 1:** Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

**Grade 5-8 Benchmark I:** Use scientific methods to develop questions, design and conduct experiments using appropriate technologies, analyze and evaluate results, make predictions, and communicate findings.

**Grade 9-12 Benchmark I:** Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.

**(source: August 2003 Public Education Department Science Content Standards, Benchmarks, and Performance Standards)**

**Other resources:**

Colorful and artistic collection of magnified sand grains

<http://www.sandgrains.com/Sand-Grains-Gallery.html>

Sample lessons on sand from the U.S. Forest

Service:<http://www.fs.fed.us/outdoors/nrce/iye/unique/chdunes.pdf>

Sample lessons on comparing minerals and soils under magnification using the **ProScope Digital USB Microscope:**

Lesson using mineral samples

[http://www2.vernier.com/sample\\_labs/BD-PS-mineral\\_matters\\_es.pdf](http://www2.vernier.com/sample_labs/BD-PS-mineral_matters_es.pdf)

Lesson using soil samples

[http://www2.vernier.com/sample\\_labs/BD-PS-analyzing\\_soil.pdf](http://www2.vernier.com/sample_labs/BD-PS-analyzing_soil.pdf)

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