NPS Photo by Rick Wood

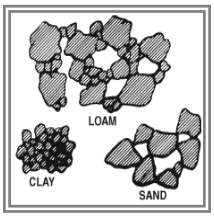
Porosity Mini-Lab

Student Copy

MINI-LAB: POROSITY

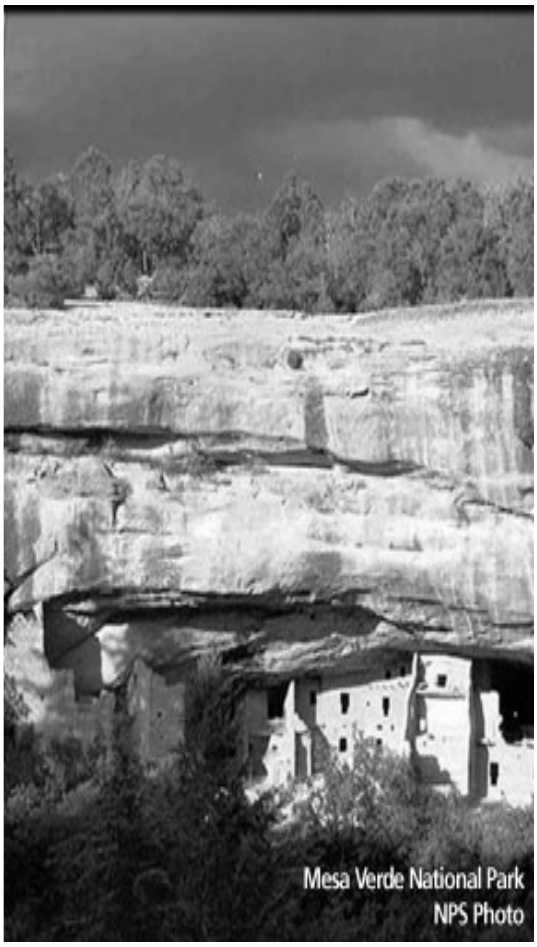
How can you measure pore space?

Background:



What we perceive as solid rock is often not so solid. Rock formations made from sedimentary rocks, like sandstone, have spaces between the sediments. These spaces, or pores, are the result of irregular shaped particles not fitting together. (The picture on the left illustrates 3 classifications of soil textures and their relative pore spaces.) Spaces may be formed between soil particles due to the movement of roots, worms, and insects; expanding gases trapped within these spaces by groundwater; and/or the dissolution of the rock.

Sandstone caves can form through weathering processes where sandstone and shale meet. Water readily percolates down through sandstone but is trapped and cannot pass through shale beds because their pore spaces are so small. The groundwater is forced to move laterally along the contact between the two rock units until it seeps out on the face of the canyon wall or at the back of an alcove, creating a spring or seep. The prolonged flow of water along these spring and seep zones ultimately dissolves the calcium carbonate cement and loosens individual sand particles and blocks of sandstone, thus forming a void that enlarges with time. These voids can develop into caves similar to the ones early people used at Mesa Verde National Park (see photo on the right).


Mesa Verde National Park
NPS Photo

Why is this important?

Aquifer: a porous rock formation that transports underground water resources.

There are many reasons why it is important to study and understand pore spaces and how they affect the soil environment. The first reason is that underground aquifers hold the groundwater we drink within the pore spaces of rock formations. Approximately 40% of the U.S. population relies upon karst aquifers for drinking water. It is very important to protect these underground water resources. You see this by looking at the flow through the Mammoth Cave Karst aquifer. Approximately 1000 to 10,000 feet of water per day flow through this aquifer. Contaminants entering the karst aquifer can thus be rapidly transported and spread.

Another important aspect of soil concerns our transportation: 50% of U.S. citizens obtain part or all of the oil and gas found within pore spaces.[i] Crude oil is the "raw" source from which we manufacture gasoline, and there have been many conflicts, even wars, waged over this natural resource. A final reason to study the porosity of soils is because of the oxygen found within these pore spaces. All plants need oxygen for respiration, so a well-aerated soil is desired by the farmers that produce the crops we eat.

IN SUMMARY... SOMETHING AS SIMPLE AS THE SPACES BETWEEN PARTICLES OF SOIL CAN AFFECT THE WATER WE DRINK, THE FOOD WE EAT, AND THE WAY WE GET FROM PLACE TO PLACE!

Questions:

1.) What are 3 factors that may result in the formation of pore spaces between soil particles?

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2.) Explain the difference between the movement of water through sandstone and through shale.

3.) What is an aquifer?

4.) List 3 ways pore spaces can affect the human population:

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Mini-Lab Procedure:

1. Put 100ml of sand in one beaker and 100ml of gravel in another beaker.
2. Fill a graduated cylinder with 100 ml of water.
3. Pour the water slowly into the gravel and stop when the water just covers the top of the gravel.
4. Record the amount of water used in the table to the right.
5. Repeat step 3 with the sand.
6. Record the amount of water used in the table to the right.
7. Answer the following questions:

Particle Type	Volume of Water Used (ml)
Sand	
Gravel	

Which substance has more pore space: gravel or sand?

How did you make this decision?

[i] *Soils in our Environment*, 7th Edition by Miller and Donahue. Copyright 1995 by Prentice-Hall Inc.