1. Rationale

- Today’s education, conservation and research on natural resources are focused on watersheds.
- Soils have necessary and unique functions in watersheds, so soils education is a vital component.
- It is in the soil holes (pores) that we seek understanding of the functions.
- However, soil science teaching still focuses on the solid skeleton of soils, not on soil functions.
- This contribution suggests a change, focusing on the holes where the action is.

2. Unique Functions of Soil Holes in Watersheds

- Provide the diversity of habitat required by the micro and macro soil biota (including roots).
- Decomposition and recycling of organic materials added to soils.
- Storage and release of nutrients from decomposition of organic matter.
- Routing, storage and release of added water.
- Incoming energy routing, storage, and release.

3. A Soil Scientist’s Motto

“The reality of the Building does not consist of roof and walls but in the spaces within to be lived in.”

“Laotse, 6th Century B.P.E.”

The essence of soil consists of the spaces where things happen, not of the skeleton.

4. The Porous Soil System

Pictures of micro and macro holes, and their connections.

5. Definition of Soil

“Soil is…(the) life sustaining, biologically active, porous and structured medium at the Earth’s surface formed by…(inorganic and organic) particles, air and living organisms.” Nieder (2004)

6. Soil Architecture (Structure)

A hierarchal arrangement, from smallest (clay size) to largest (clods), creating stable spaces between.

Table 1. The hierarchical levels of soil structure.

<table>
<thead>
<tr>
<th>Levels of Structure</th>
<th>Solids</th>
<th>Pores</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 µm</td>
<td>Aggregates and peds</td>
<td>1000 µm Transmission</td>
</tr>
<tr>
<td></td>
<td>Inter-ped</td>
<td></td>
</tr>
<tr>
<td>500 µm</td>
<td>Micropeds</td>
<td>100 µm Inter-microped</td>
</tr>
<tr>
<td>50 µm</td>
<td>Conglomerates or clusters</td>
<td>10 µm Storage of plant available water</td>
</tr>
<tr>
<td>1 µm</td>
<td>Domains</td>
<td>0.05 µm Inter-domain Bonding</td>
</tr>
<tr>
<td>0.005 µm</td>
<td>Clay crystals</td>
<td>0.005 µm Inter-grain</td>
</tr>
<tr>
<td>0.002 µm</td>
<td>Clay platelets</td>
<td></td>
</tr>
</tbody>
</table>

7. So How Do We Alter Our Thinking?

- Think about soil functions rather than about the skeleton visible to the eye.
- Think about soils from the inside out, rather than from the shell in.
- Teach soil science at university and school levels on the basis of soil functions.

8. References

Blum, W.E.H. 2002. Soil pore space as communication channel between the geosphere, the atmosphere and the biosphere. 17th Congress of IUSS, Bangkok. CD-ROM, Trans. 2014.


Laotse (L., Erh, 6th century B.P.E.). Seen on a plaque at Taliesin West, Phoenix, AZ, USA.


Acknowledgment

Tracy Mitzel, Department of Crop and Soil Science, Oregon State University prepared the poster.