

Recipes for Success in teaching Soil Chemistry

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Students are hungry
for knowledge

(or maybe just hungry?)

class is taught at 11:30 – 12:20

*“just a spoonful of sugar makes the
medicine go down...”*

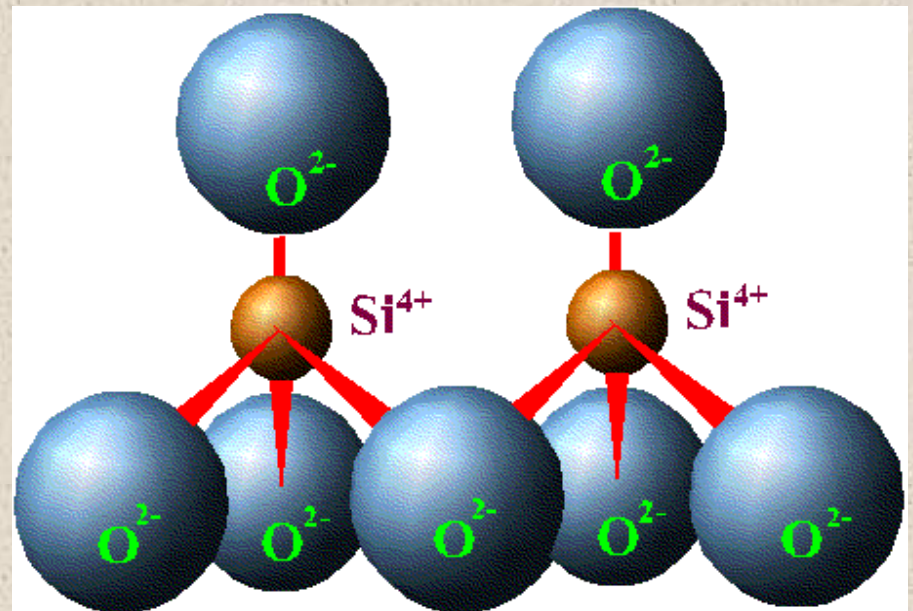
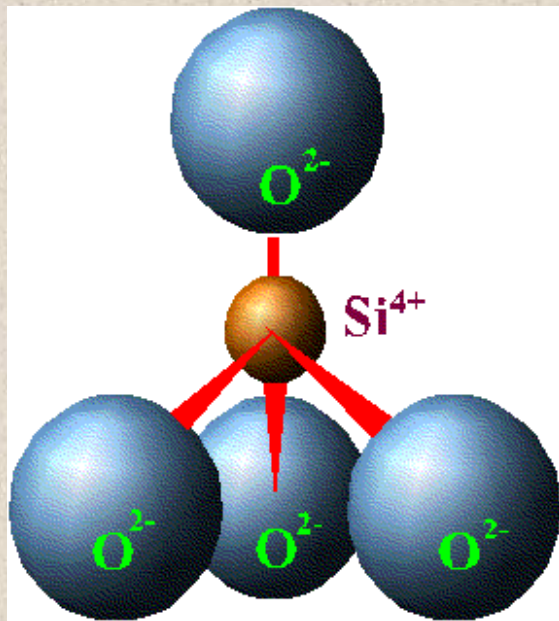
Mary Poppins

Soil Chemistry includes:

- Components of soil
 - Inorganic (soil minerals, salts,...)
 - Organic (aggregates, humus, plant residues)
 - Solution
 - Gases
- Processes important to plant growth and environmental applications
 - Ion exchange capacity
 - Sorption/Complexation

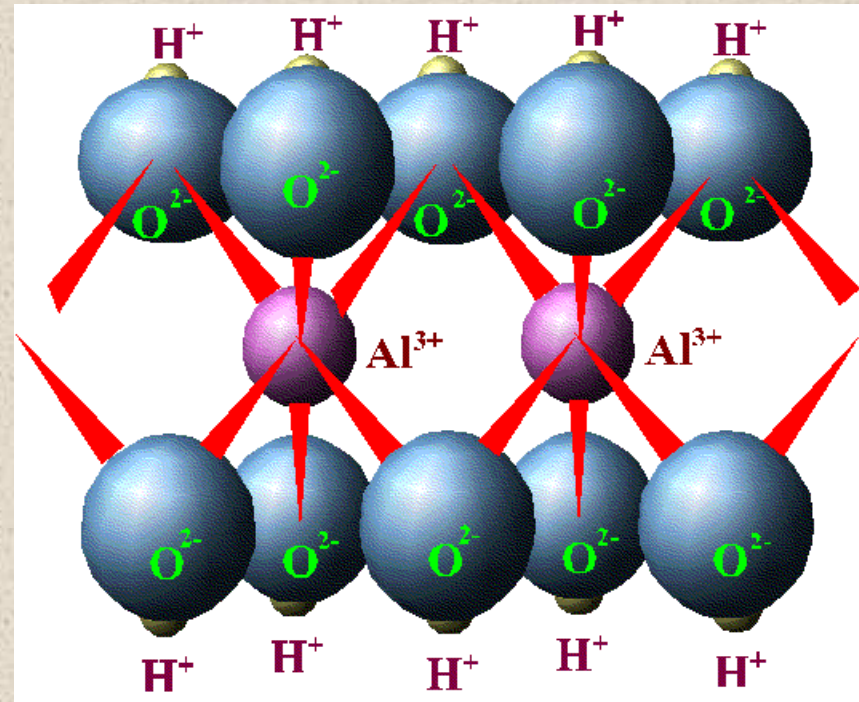
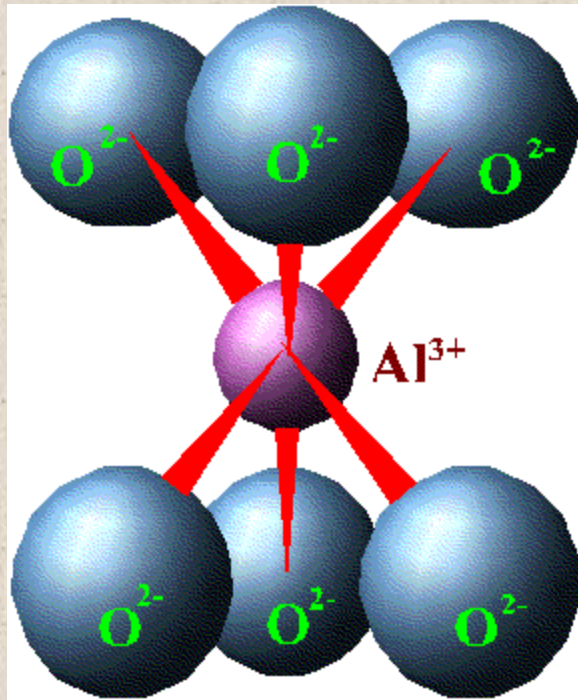
Soil clay minerals

Silica Tetrahedrons – *one building block of soil minerals*

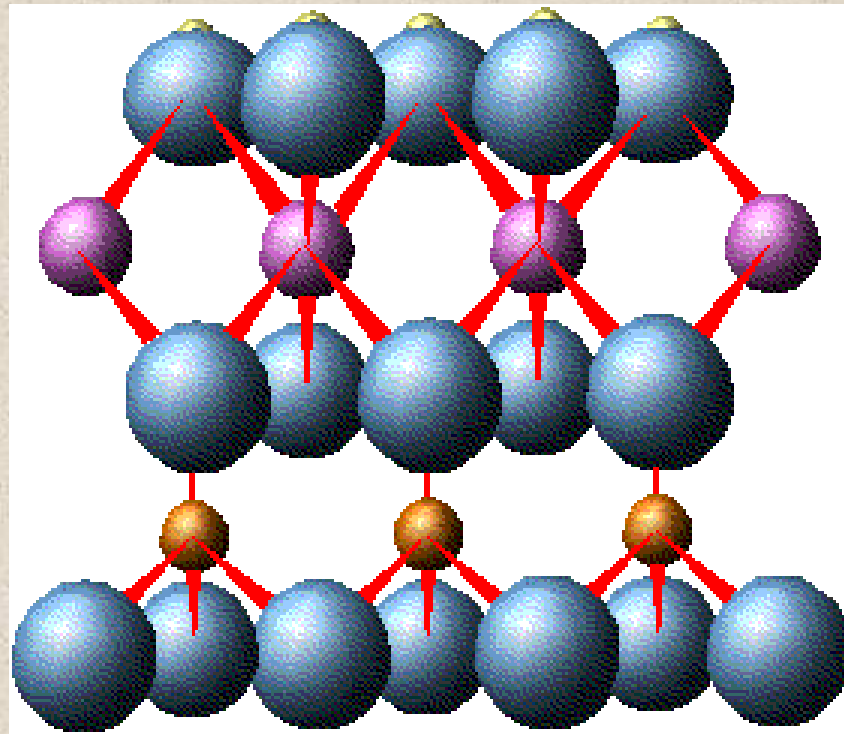


Crystal pictures are from Bob Harter at Univ. of New Hampshire
<http://pubpages.unh.edu/~harter/crystal.htm#2:1%20MINERALS>

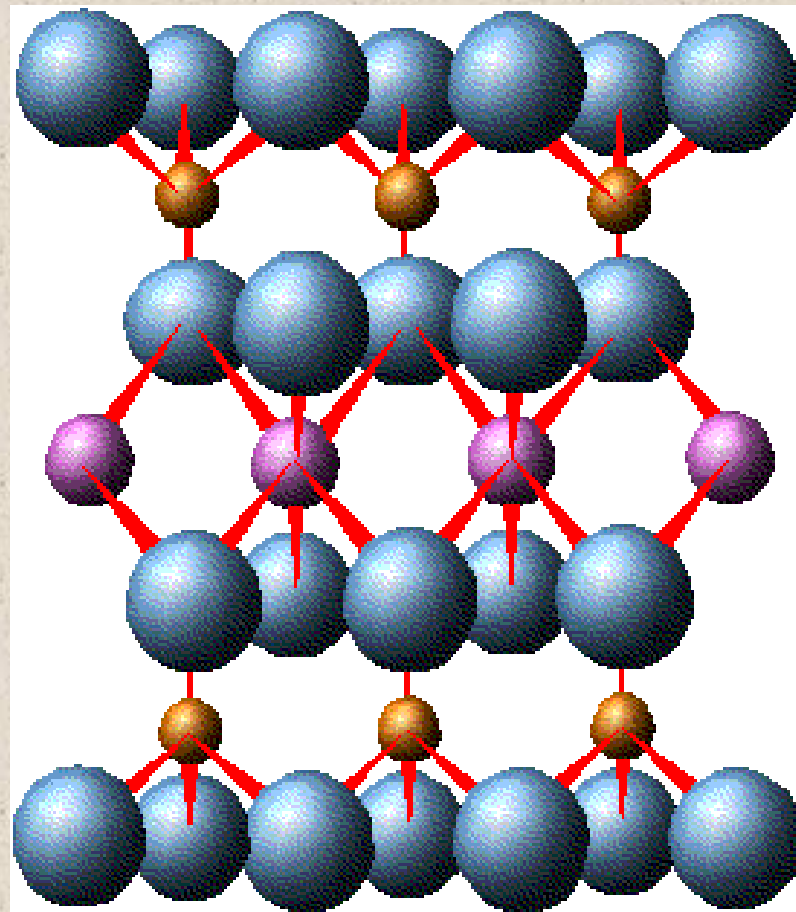
Aluminum Octahedrons – another building block or *layer* in minerals



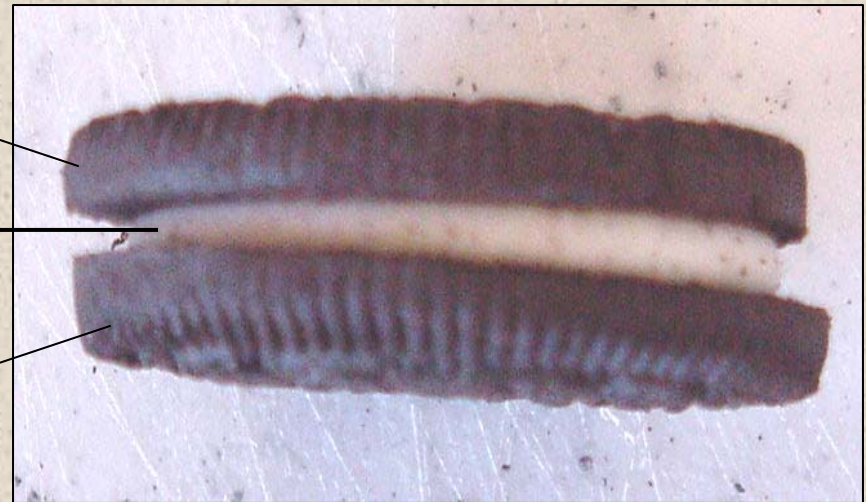
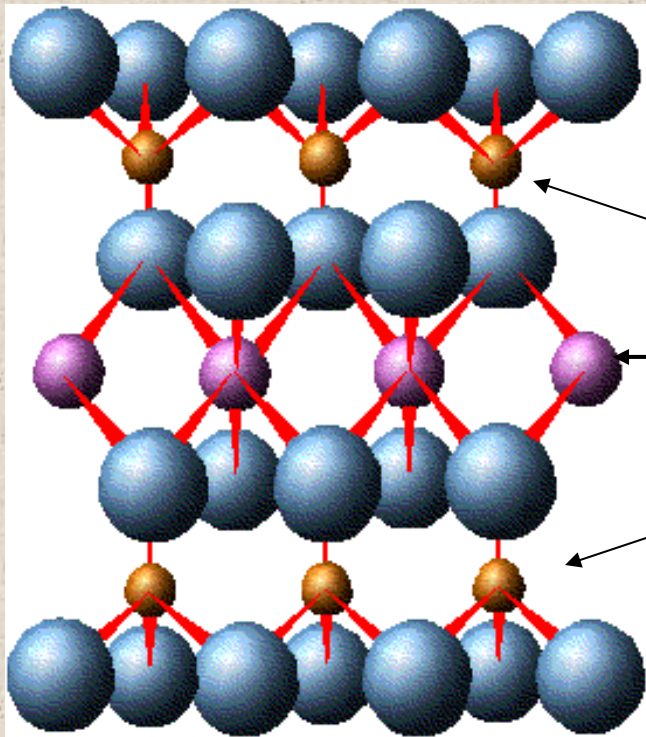
1:1 mineral formed when the silica tetrahedron bonds with an aluminum octahedron



2:1 minerals are formed when 2 tetrahedrons bond with 1 octahedron



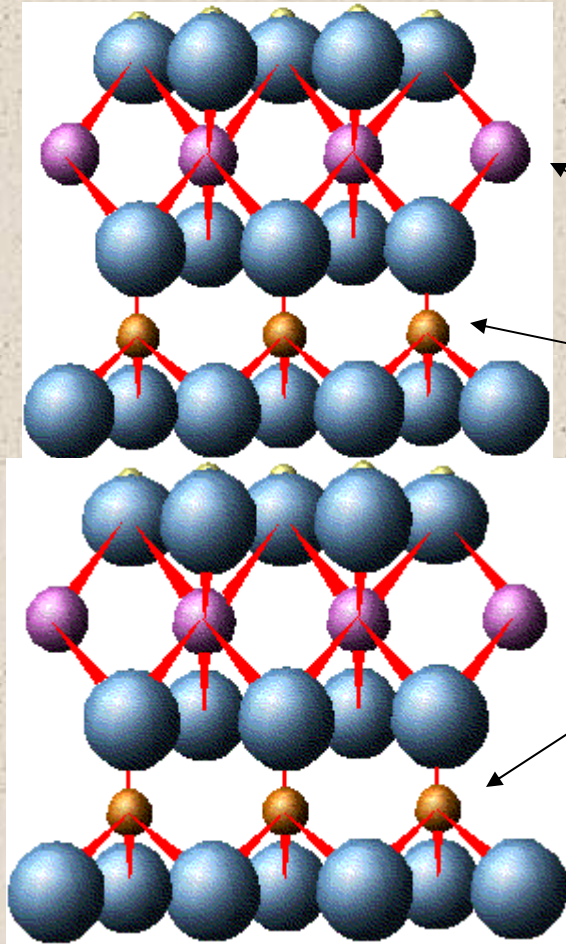
Oreo cookies serve as models for layer minerals (phyllosilicates)



One Oreo can be a mica or smectite-type mineral

First proposed by Jerry Irvin at UCR

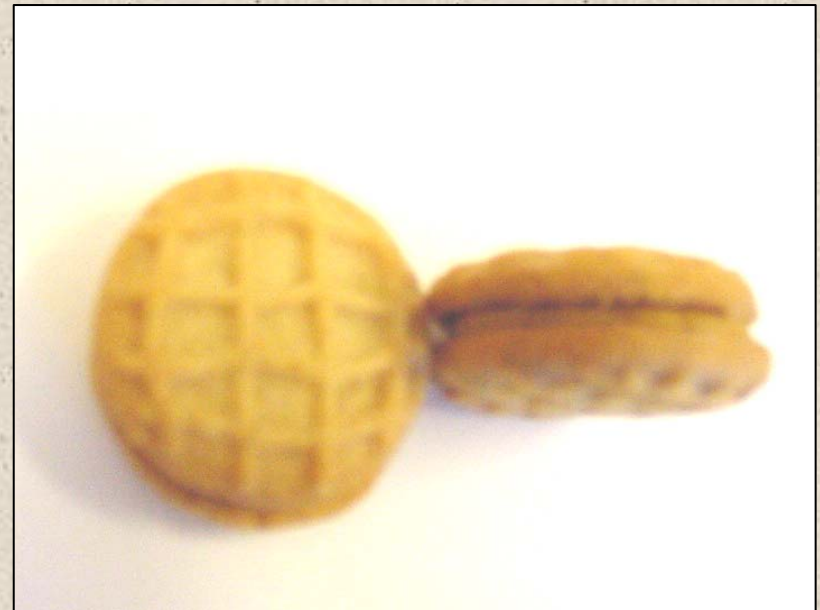
Kaolinite



Two Oreo cookies can be split and reconstructed to form a 1:1 mineral

Other mineralogical models:

- **Layer cookies** dipped in chocolate
 - Soil minerals usually have organic matter or iron and aluminum **coatings**.
- **Sugar wafers**
 - Same basic idea as Oreos, but “**corrugated**” surface better mimics the oxygen plane.



Soil Aggregate Models

- Organic matter binds various soil particles together to form stable peds, crumbs, or aggregates.
- Organic matter can be short- or long-term (easily decomposed or more stable)
 - Chocolate coconut haystacks contain nuts that mimic sand grains held together by coconut (fresh residues) and coated with chocolate (stable humus coatings).

Soil Aggregate models



Candy or chocolate haystack



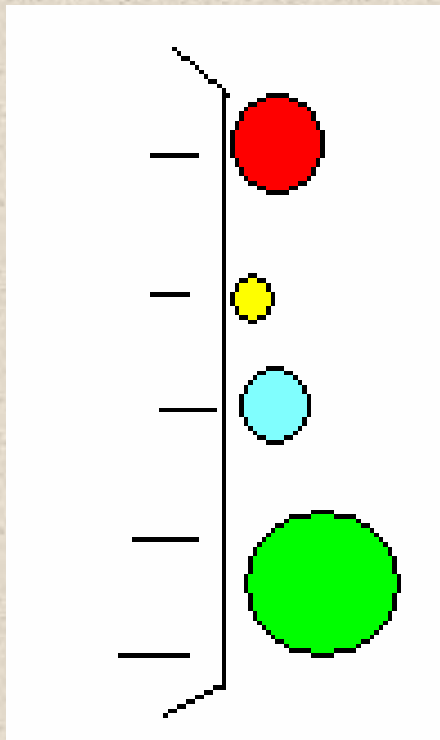
Computer-generated picture

Other models that demonstrate soil organic matter effects

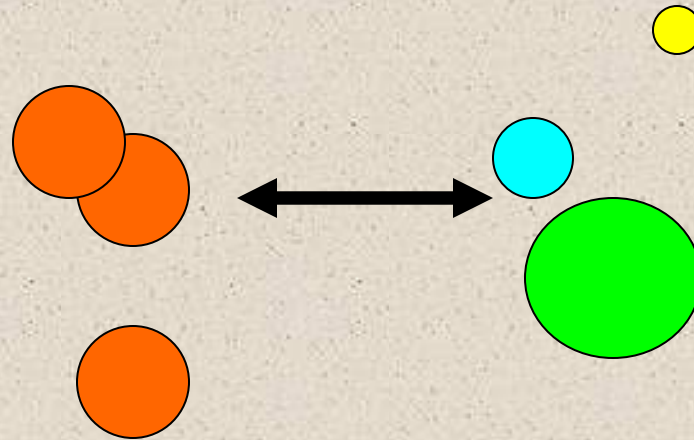
- Trail mix bars or any cookie that has a mixture of different size ingredients *and preferably coated*.
 - The cohesive nature of these desserts shows how soil can form stable peds.



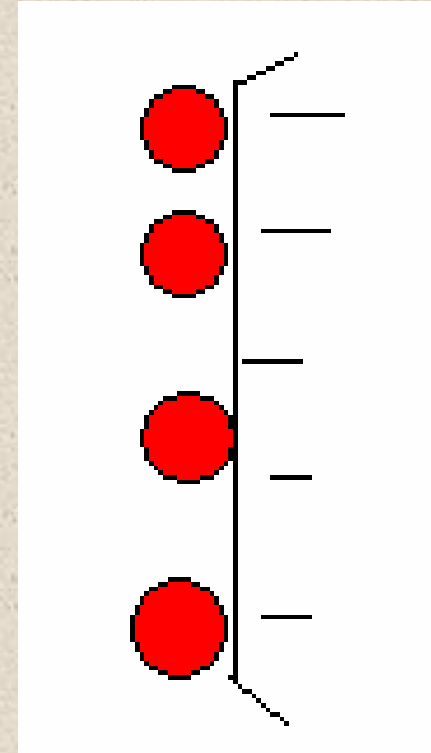
Ion Exchange Process



Mixed cations adsorbed onto charged surface

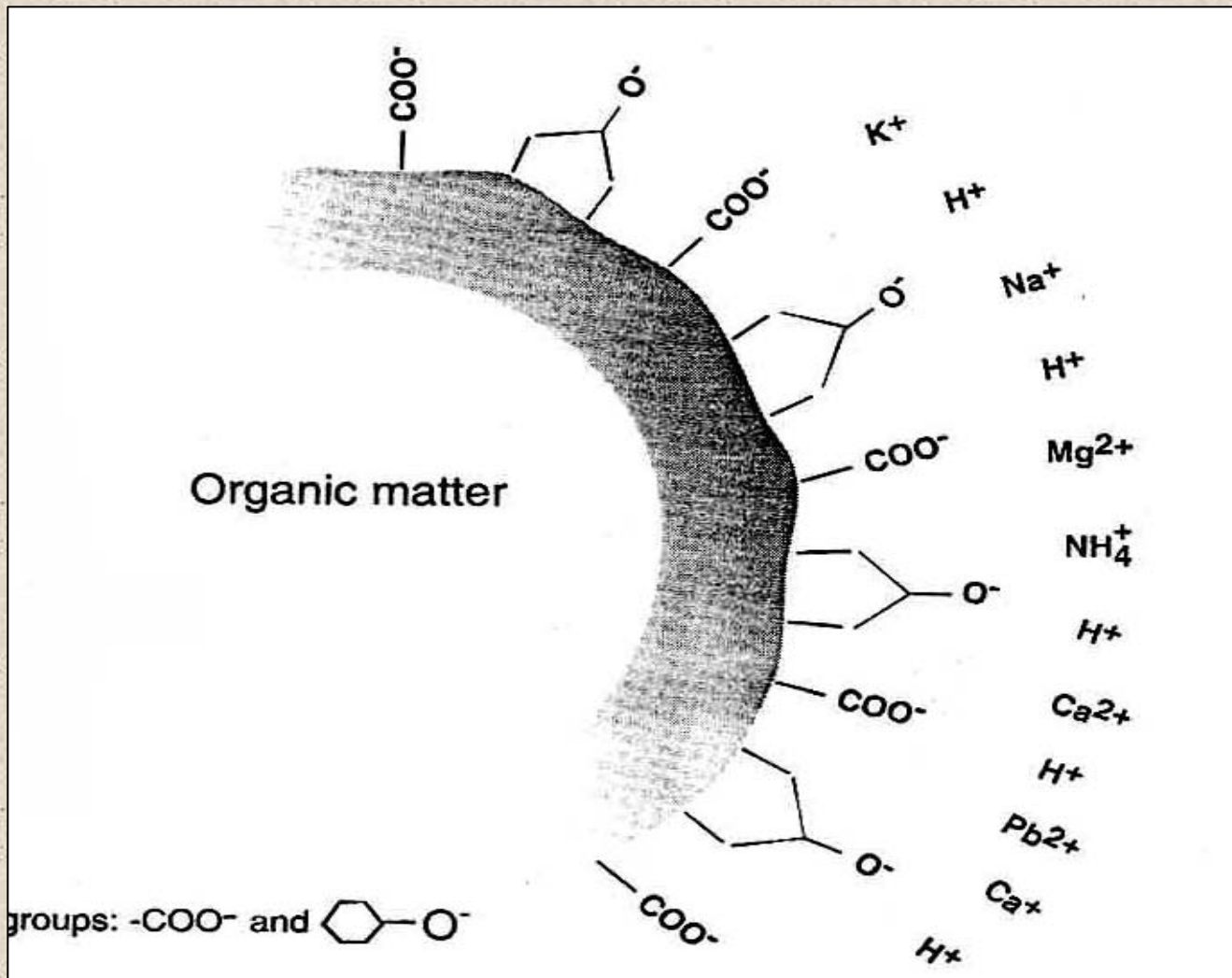


Ions in solution



Single cation type adsorbed onto charged surface

Picture of CEC



Edible models of Ion Exchange Capacity



**Mixed ion
saturation**



**Single ion
saturation**

Conclusions

- Food is interesting to almost everyone
- The solid phase of soils can be modeled using lots of different materials, but food is the most fun.
- Spark the students' imagination and get them involved both for learning and for camaraderie.
- In 8 years, one "*complaint*" about cookies, many more complements.