Sand
- Large particles you can see
- Large spaces between particles
  - Rapid water flow
- Non cohesive
- Small surface area

Sandy Soils
- Low water holding capacity
  - Susceptible to drought
- Small surface area
  - Low CEC
  - Infertile
  - Easily acidified

Sandy soils
- Generally very easy to use equipment on
- Low potential for compaction

Silt
- Small micro sand particles you can’t see
  - Rapid weathering - nutrient release
  - Higher surface area
  - More nutrient retention
- Small spaces between particles
  - Water retention
- Non cohesive - can erode easily

Wind blown and alluvial parent materials
- Generally primarily silt
  - Sand is too heavy
  - Clay is too sticky
- Silt fences
- Sedimentation ponds

Silty soils
- Without vegetative cover
  - ‘can melt like butter’
- Can be excellent agricultural soils
- Fertile
  - Good water retention
  - Nutrient availability
Clay

- Tiny particles, require special microscopes to see
- Very high surface area
  - Very reactive
  - High nutrient / water holding capacity
- Cohesive - can behave like plastic

Clayey soils

- Heavy soils
- Difficult tillage
- Water holding capacity is high
  - Water can be so tightly held to clay particles
  - Not plant available
- Slow drainage

Clay goes up, water goes down

There is a system

- When you classify a soil, texture in the A horizon is major factor

Soil Texture Triangle

25% Clay 50% Sand 25% Silt
How to categorize?
15% Clay 30% Sand 55% Silt

How to categorize?
63% Clay 20% Sand 17% Silt

Aggregation is how soils are held together
- Separates soil from dirt
- "Dirt is soil out of place"

Particle size doesn’t change rapidly (in our lifetime)
- Aggregation is something you can influence
  - Granular
  - Crumb

Aggregates are:
- Small particles or colloids that have been glued together, usually by organic matter

- Organic matter from plants can do this
- Earthworms can do this- casts
- Well maintained soil will have good aggregation
How do you measure aggregation

- Visible appearance
- Feel of the soil
- Quantitative approach

Bulk Density

- Mass per unit volume of dry soil
- How much will the soil weigh
- Lighter the soil - the better the aggregation

We are not weak

How do you calculate

- Known volume of soil
- Dry
- Weigh

- Weight / volume = BULK DENSITY

Particle density

- Known volume of soil
- Dry/ remove pore space
- Weigh
- Weight / adjusted volume = PARTICLE DENSITY

Remember

1m$^3$ of soil is really about half pore space

What do the different components weigh?

- Air is negligible
- Water is 1 Mg m$^3$ but doesn’t count
- Soil solids
  - Inorganic
  - Organic
Inorganic fraction-
Generally 2.6- 2.75 Mg m\(^3\)
2,200 pounds

Organic fraction-
Generally 0.2 Mg m\(^3\)
200 pounds

Bulk density- largely a function of soil structure

What the aggregates consist of

The greater the pore space and organic matter-
The lower the bulk density will be

Bulk densities (g/cm\(^3\))

- Andisol 0.7
- Uncultivated loamy A 1.05
- Cultivated loamy A 1.5
- Dry vertisol 1.8
- Fragipans 1.85
- Concrete 2.45
- Soil I sampled in MO 3.0
Why do you care

- Root growth reduced due to
  - Slow air movement
  - Slow water movement
  - Gas build up
  - Hard to push through
  - Dense soil

Growth is generally limited

- Bulk density greater than
  - $1.45 \text{ Mg m}^{-3}$ in clays
  - $1.85 \text{ Mg m}^{-3}$ in sands

Factors that increase bulk density

- Agricultural practices
  - Tillage
  - Equipment
- Foot traffic

Using conventional ag

- Incorporate more air into soil
  - Break down organic matter
- Plowing can break existing aggregates
  - Decrease number of macro pores
- Can lead to formation of a plow pan
  - Cemented layer as a result of compaction

Moldboard plow - lifts and turns soil

Same soil, from good to bad structure

- Number of Macro pores decreases
- Number of Micro pores increases
Heavy equipment especially under improper conditions

Conservation tillage - Mulchtiller
Only a portion of the soil is disturbed

Conservation tiller

Mark Sheppard wants all the flotation he can get. He works anywhere from 25 to 35,000 acres around Loving, Texas, where much of the soil is sandy and easily disturbed. He needs the kind of low ground contact pressure and high flotation narrow tires can't provide. With Firestone Flotation 23° Center Rib tires up front and Firestone Flotation 23° DTs in back, he's riding high.

Use of organic amendments
- Manures
- Biosolids
- Crop residues
- Composts

Heavy traffic

Use of organic amendments

Heavy traffic
One reason trails exist