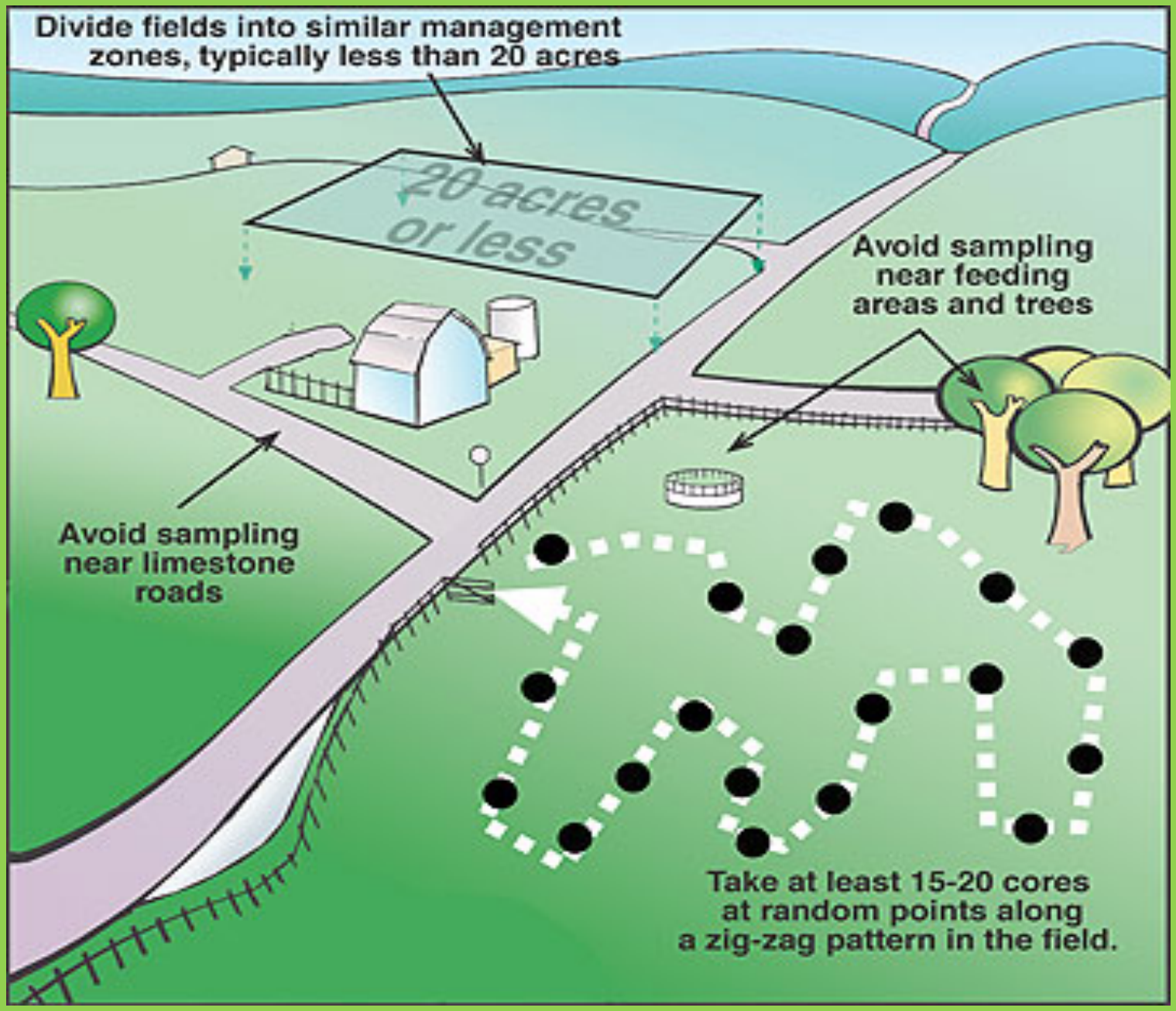
Soil Sampling:
Methods & Analyses

Objectives

- To group soils into classes
- To predict the probability of getting a profitable response to the application of plant nutrients
- To help evaluate soil productivity and for the purpose of suggesting fertilizer and lime practices
- To determine specific soil conditions that may be improved by addition of soil amendments or cultural practices
- To answer research questions and follow trends resulting from land management practices
- To investigate problems such as contamination, toxicity, or deficiency of substances in the soil

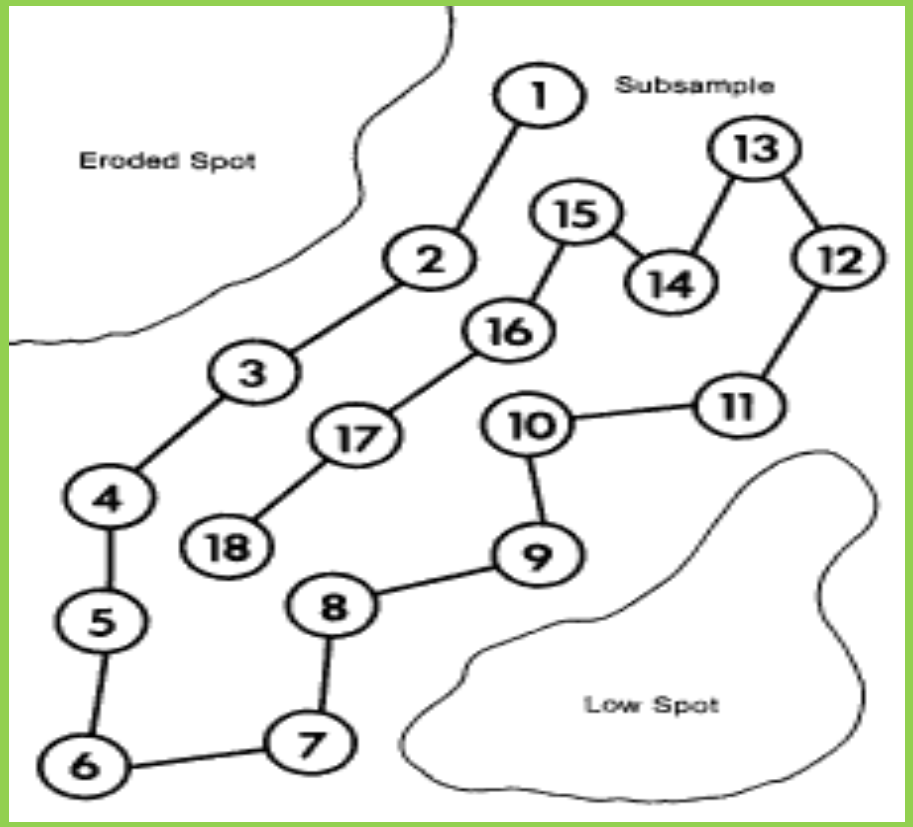
General Steps to Follow:

- Determine objective
- Create sampling design: includes depth, randomness, compositing, number of samples, type of analyses which will be done, etc.
- Make sure you have all needed supplies
- Gather samples, make sure they are kept at appropriate temperatures and use clean sampling equipment
- Record field conditions and other pertinent observations
- Analyze samples which are time sensitive in the first couple of days after sampling
- If sending to a lab, make sure you know the protocols and requirements they use



http://extension.missouri.edu/explore/images/g09215art01.jpg

Composite soil sampling plan for glacial landscapes



Advantages:

Relatively inexpensive

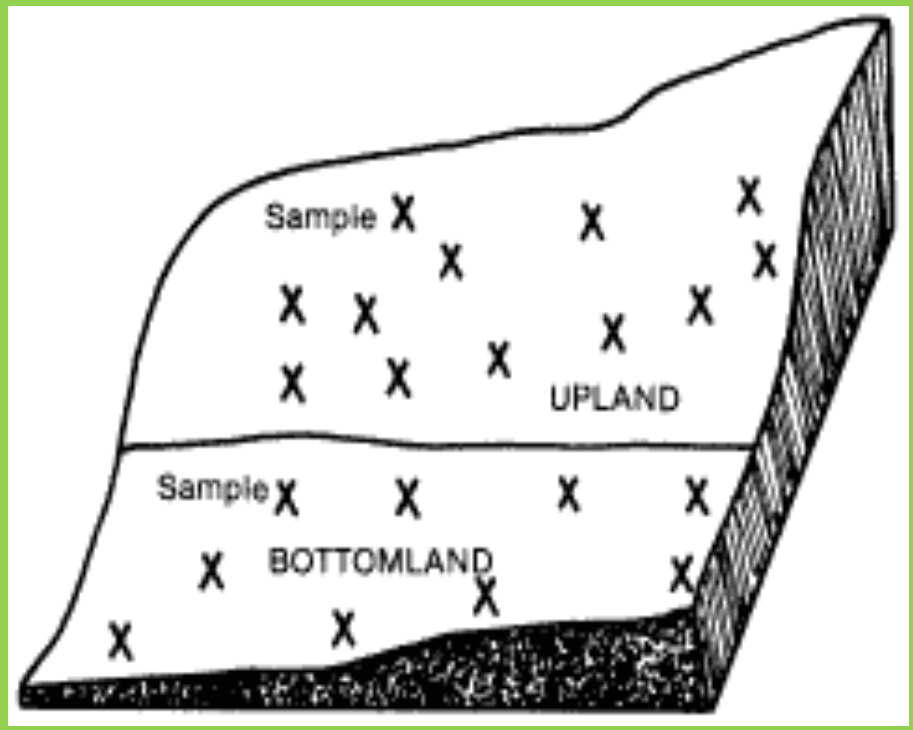
Relatively quick, only 20 to 30 cores are needed to represent a field, and only one analysis is required for each field

Results are mostly reproducible

Results can easily be tracked from year to year

http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf-990-3.htm

Composite soil sampling plan for rolling landscapes



Disadvantages:

"Unusual areas" not sampled may comprise significant acreage in a field…Sometimes it is difficult to distinguish which locations are unusual

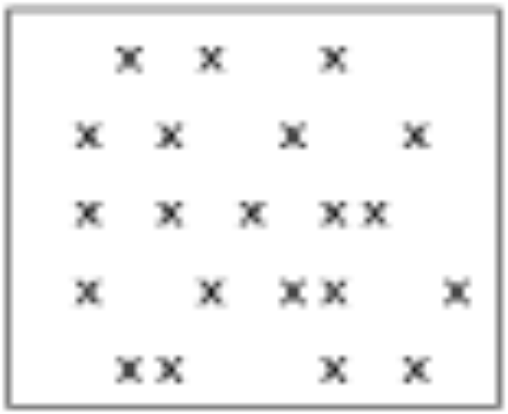
Large portions of the field may be over- or under-fertilized

Low level of confidence that high soil test values represent most of the field

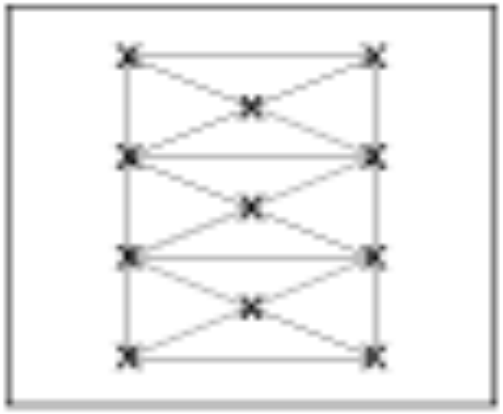
Grid Sampling

regular
systematic grid

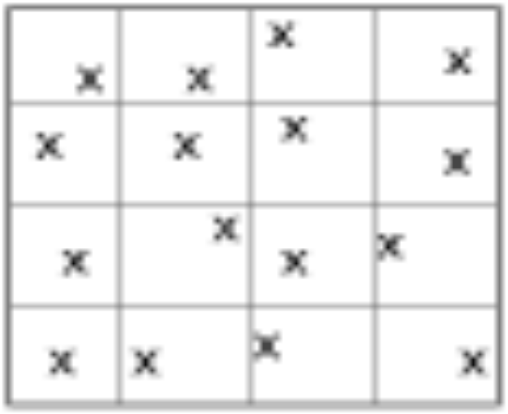
staggered start
regular grid



random



diamond triangle
hexagon systematic



systematic
unaligned grid

http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf-990-3.htm

Recommended Sampling Depths

Soil Surface	Soil Properties	Crops
0-6 inch	pH, P,K, OM, Cl, S, Ca, Mg, CEC, Zn, $NH4^{+}$-N, Fe, Mn, Cu, soluble salts, NA	Alfalfa, clovers (analyze only 0-6 inch depth, nitrate analysis at deeper depths not necessary).
6-24 inch	Soluble salts, NO_3-N, S, Cl (in addition to 0-6 inch depth)	Wheat, barley, oats, durum, corn, soybean, dry bean, potato, canola, crambe, mustard, sunflower, grass hay, pasture, millet, canary seed, flax, safflower, buckwheat, lentil, field pea, sorghum, sudangrass. (Separate 0-24 inch depth into a 0-6 inch and 6-24 inch depth.)
24-48 inch	NO_3-N, in addition to the 0-6 inch and 6-24 inch depths	Sugarbeet, malting barley. (Sunflower if greater than 30 lb N/acre are anticipated at the 24-48 inch depth.) (Separate cores into 0-6 inch, 6-24 inch and 24-48 inch depths.)

http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf-990-3.htm

52,200 ft squared
= 1.20 acres per block

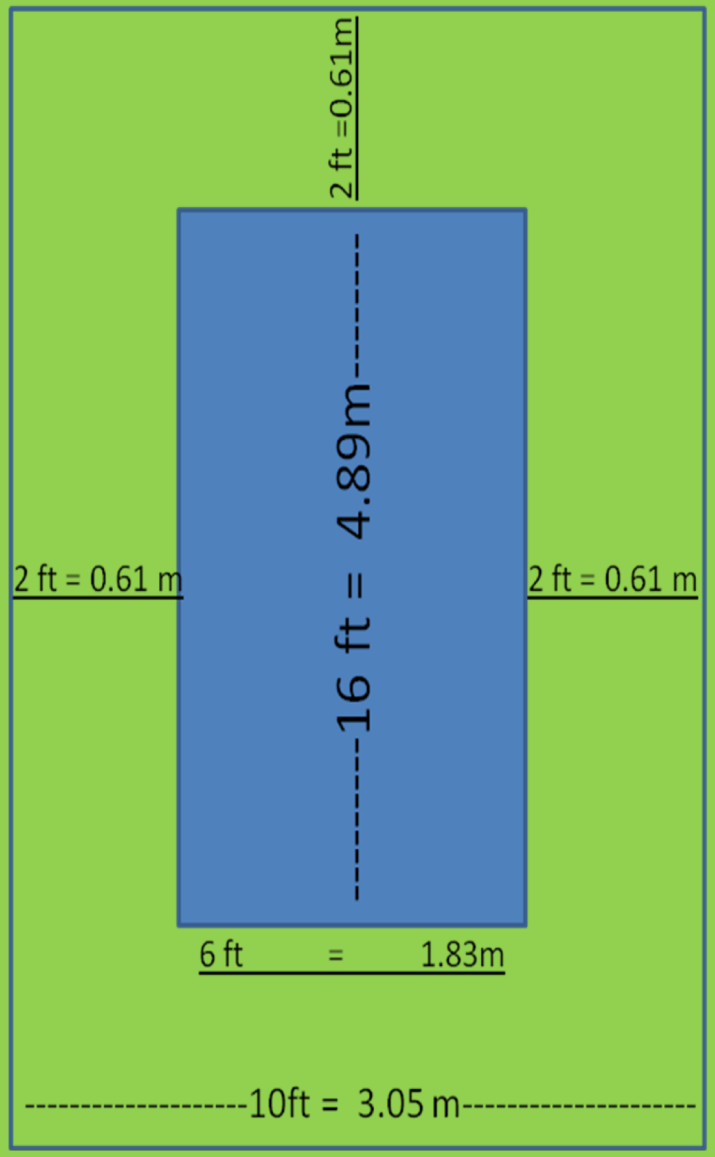
Randomized Complete Block Design

n = 36

180 ft = 54.86m

290 ft = 88.39m

	Rep 1	Rep 2	Rep 3	Rep 4
(B)	Wood Chips: Rate 1	(C)	(D)	(G)
(H)	Grass Hay: Rate 1	(A)	(E)	(C)
(G)	Straw: Rate 2	(B)	(I)	(D)
(F)	Straw: Rate 1	(I)	(C)	(H)
(E)	Wood Chips Rate 2 with Compost	(D)	(A)	(F)
(A)	Control	(H)	(G)	(E)
(C)	Wood Chips: Rate 2	(F)	(B)	(I)
(I)	Grass Hay: Rate 2	(G)	(H)	(A)
(D)	Wood Chips Rate 1 with Compost	(E)	(F)	(B)



Research Study Design

- **Eight subsamples will be collected from each plot, at 20 cm depth for one composite sample per plot**

- **Two well pads will have 40 plots each, for a total N of 80**

Three field samples will be collected from each plot for

1) **bulk density**
2) **wet analyses**
3) **and dry analyses**

width of plot = 10 ft = 3.05 m; 6ft = 1.83m width for sampling area
length of plot =20 ft = 6.10 m; 16ft = 4.89m length for sampling area
additional buffer of 20 ft = 6.10 m between all plots on each side of plot
total block area = 52,200 ft2 = 1.20 acres for total site area

Data Collection/ Analysis

- *Initial treatment application/ incorporation and soil sampling in late October 2010*
- *Soil sample lab analysis*:

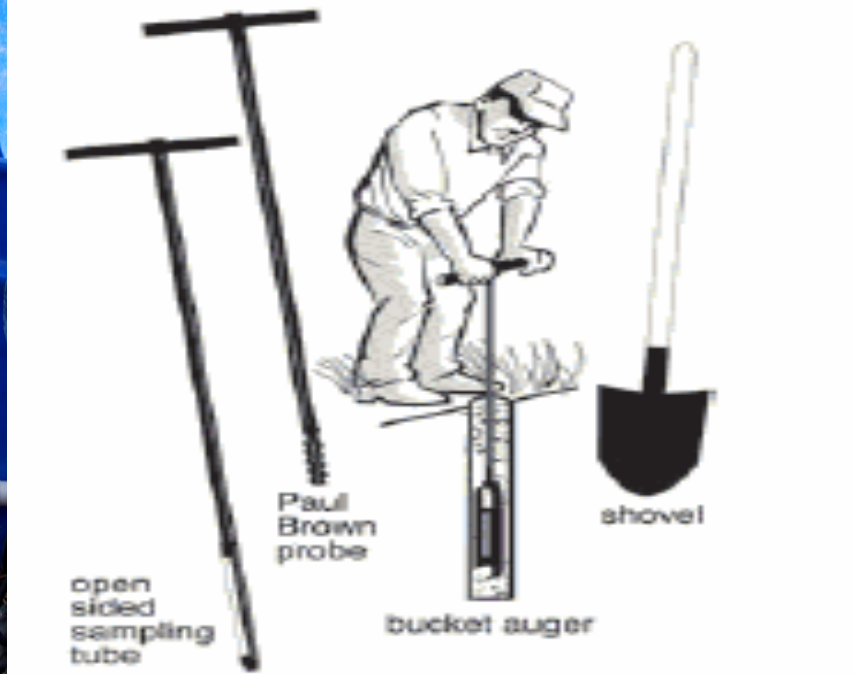
From field moist samples: To Extractions- Dissolved Organic C and N and mineral N; gravimetric moisture; microbial biomass carbon and nitrogen (fumigations); mineralizeable C and N (incubations); PLFA (pending additional funding)

From field air-dried samples: pH; EC; bulk density, total C and N; OM fractionation; inorganic C

- ***Vegetation sampling(will design detailed sampling/analysis methods this spring)*** *and 2nd soil sampling at peak growth summer 2011*
- *Final soil sampling during late Oct. 2011*

Treatment Application

Tools of the Trade



http://www.google.com/imgres?hl=en&q=image+of+soil+sampling+tools&um=1&ie=UTF8&source=univ&sa=X&ei=CROaTZr4LMzciAKLlZSdCQ&ved=0CCUQsAQ

Soil Sample Handling

Samples intended for NO_3-N sampling should be stored in ice chests during transport. Moist samples subjected to heat will increase N mineralization and test values will increase during transport/storage.

Another procedure is to transport the samples immediately to a soil testing laboratory in a cold ice chest. Usually, the soil laboratory attaches a drying charge for wet soil samples. Rubber gloves should be used to handle samples intended for chloride analysis to prevent contamination from chloride in perspiration.

Soil samples intended for Zn analysis should not come into contact with any galvanized surface, including the soil sampling tool, bucket, drying container or grinder

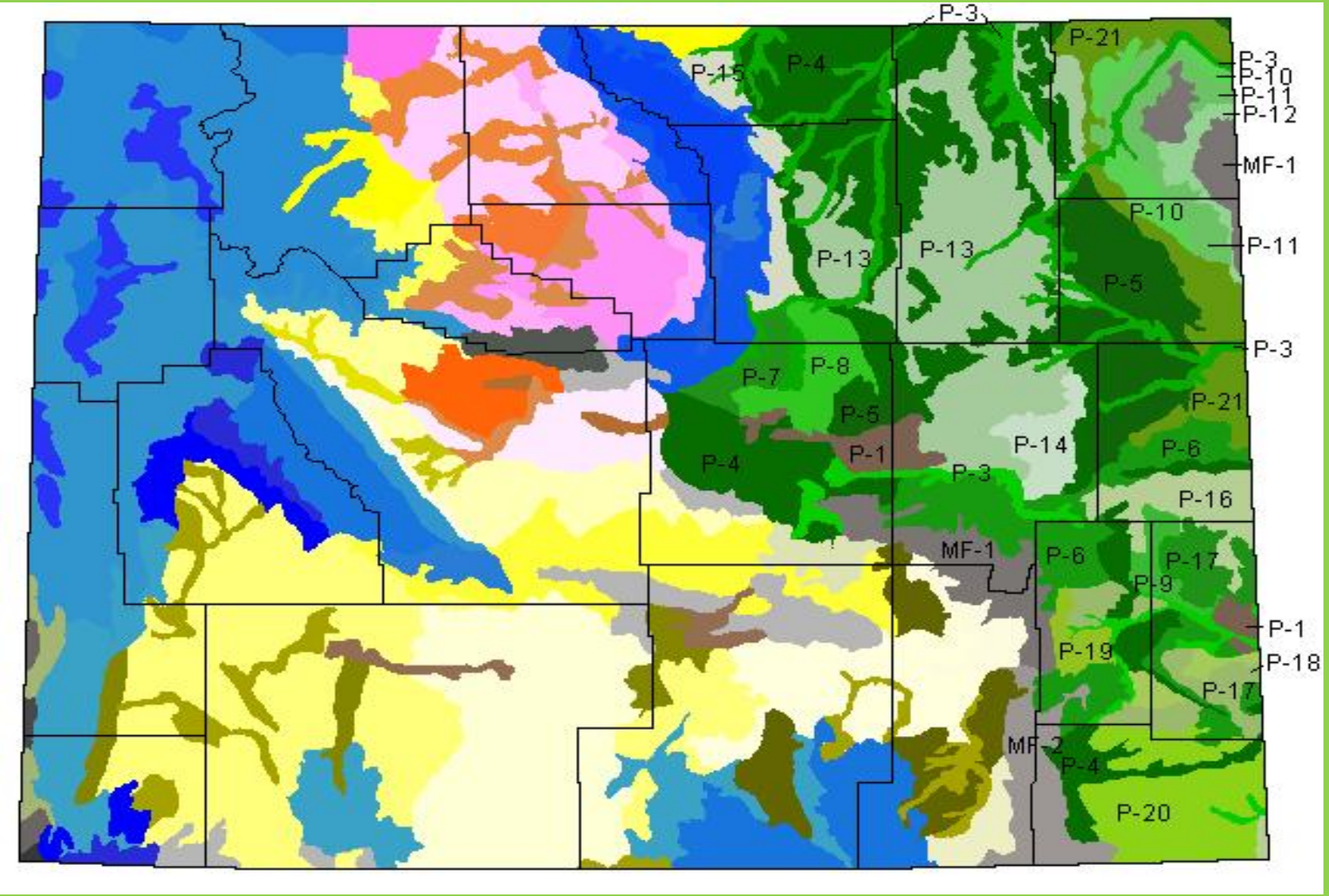
Quality Control

http://www.chemtrack.net/images/projects375/insitu.jpg

http://www.oiltankservice.com/sitebuilder
content/sitebuilderpictures/soilMediumWebview.jpg

www.miljostatus.no/…/Contaminated-soil/

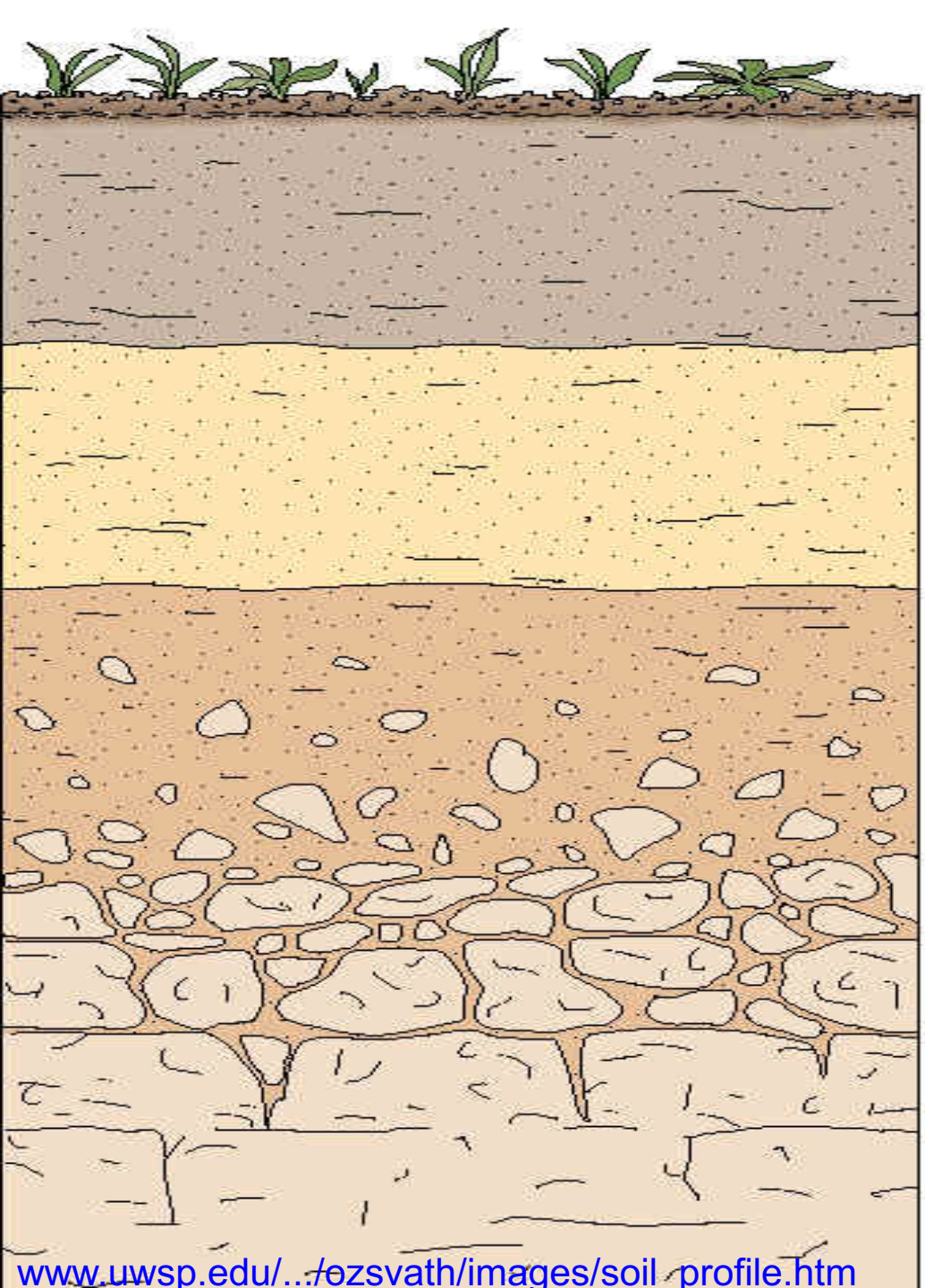
Pit and Profile Analysis for Classification, Characterization, & Mapping



http://www.uwyo.edu/grasshoppersupport/html_pages/ecomap5.htm

Classification Information Accompanying Previous Map

New Figure. Detailed soil association map of Wyoming replaces Figures 6 & 7 in Chapter III. The eastern plains soil associations are all shades of green, with the exception of P-1 (which is brown- for the sandhill soils), and are labeled with a P-#: P-1 = Torripsamments; P-2 & P-3 =Torrifluvents-Haplargids & Torrifluvents-Haplargids-Torriorthents (River valleys); P-4 = Torriorthents, shallow; P-5 = Torriorthents-Haplargids; P-6 = Torriorthents-Torriorthents, shallow; P-7 = Torriorthents-Torriorthents, shallow-Rock Outcrop; P-8 = Torriorthents; P-9 = Argisustolls; P-10 = Torriorthents, fine, acid; P-11 = Torriorthents-Argisustolls; P-12 = Torriorthents-Argisustolls-Haplustolls; P-13 = Haplargigs-Paleargids-Torriorthents; P-14 = Haplargigs-Torriorthents; P-15 = Torriorthents-Haplargigs-Camborthids; P-16 = Argisustolls-Haplustolls; P-17 = Haplustolls-Argisustolls-Torripsamments; P-18 = Haplustolls-Argisustolls-Torriorthents; P-19 = Haplargigs; P-20 = Argisustolls-Haplustolls-Torrifluvents; P-21 = Torriorthents, fine-Torrifluvents.



Soil horizons

O Humus

A Zone of leaching of soluble salts (topsoil)

B Zone of accumulation of salts (subsoil)

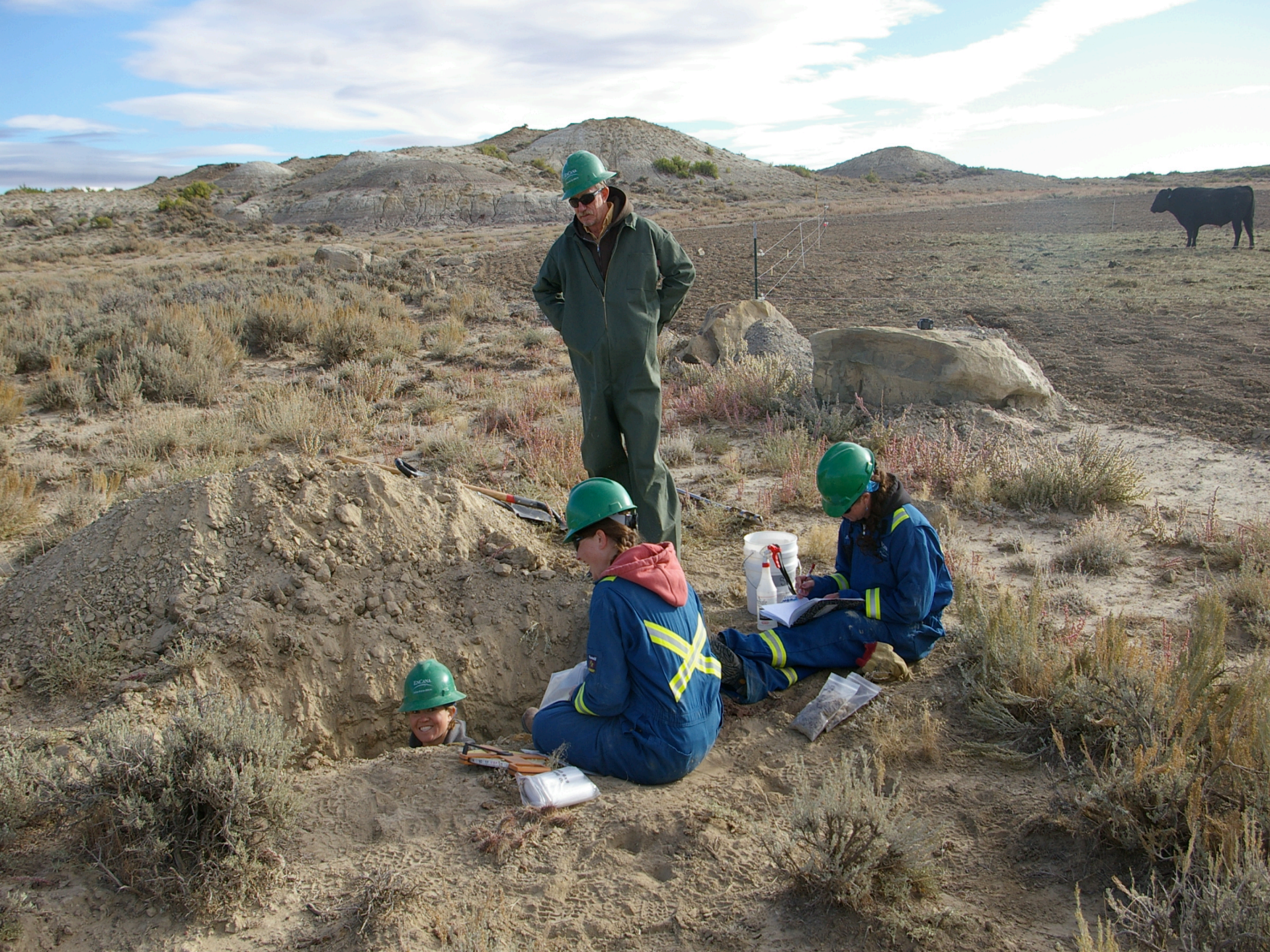
C Weathered parent material (bedrock)

Gradational contact

Fresh parent material (bedrock)

www.uwsp.edu/.../ozsvath/images/soil_profile.htm

web.utk.edu/~zli/speleothems.htm




JEFF
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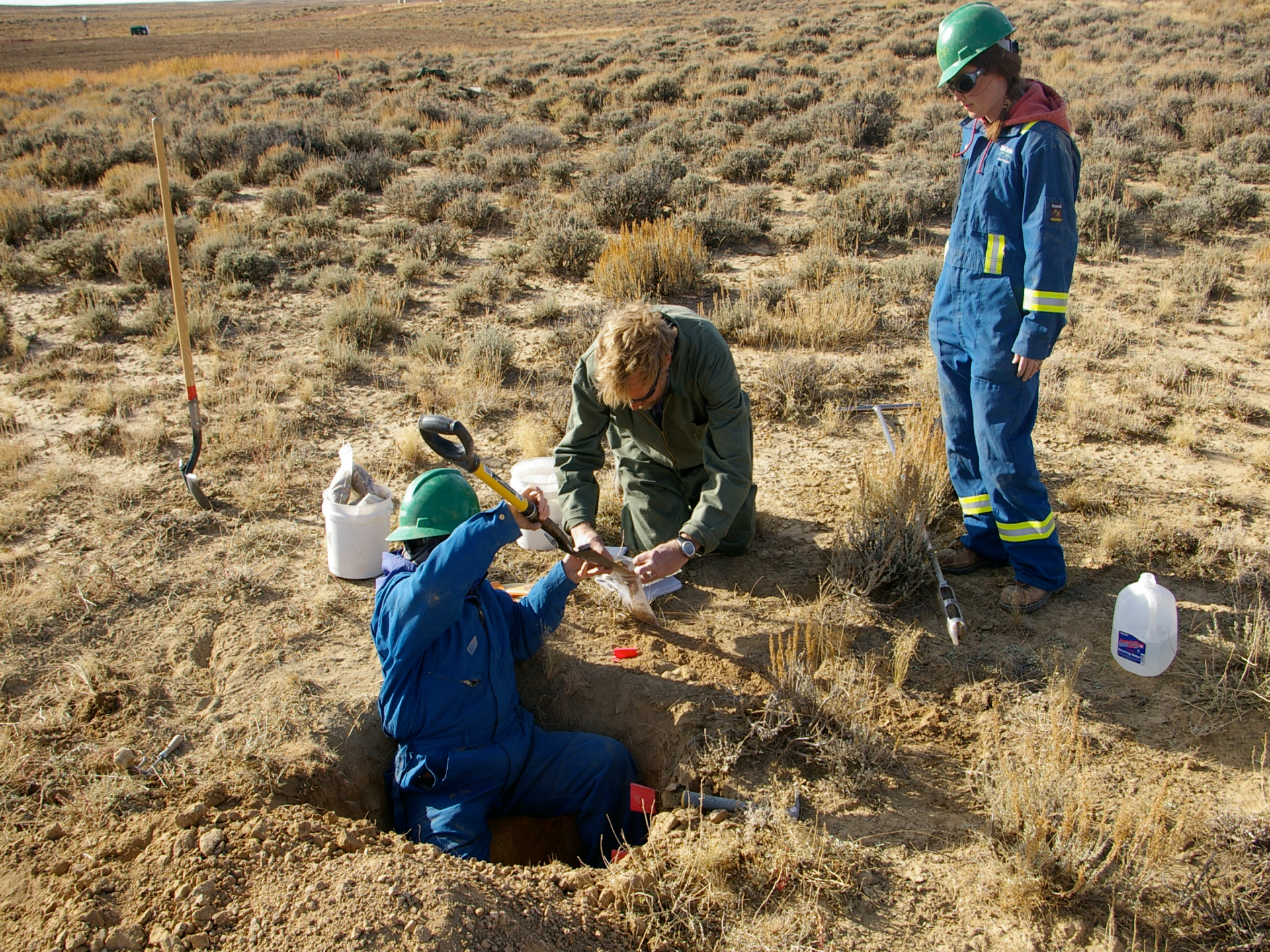
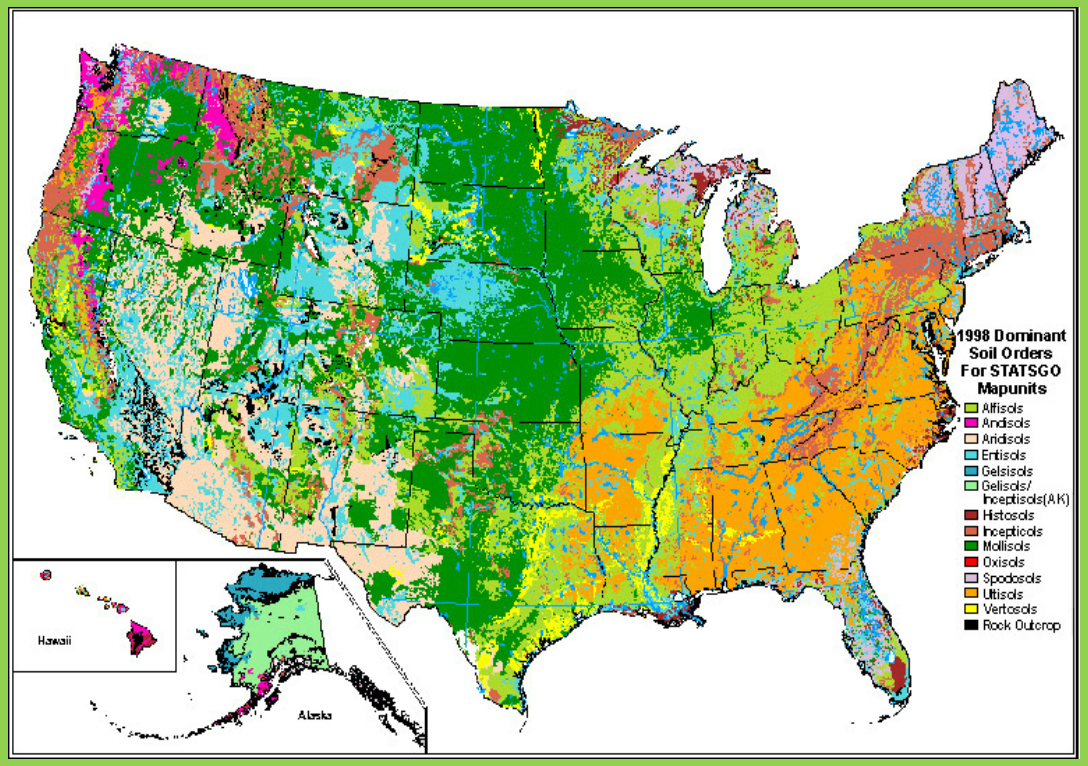
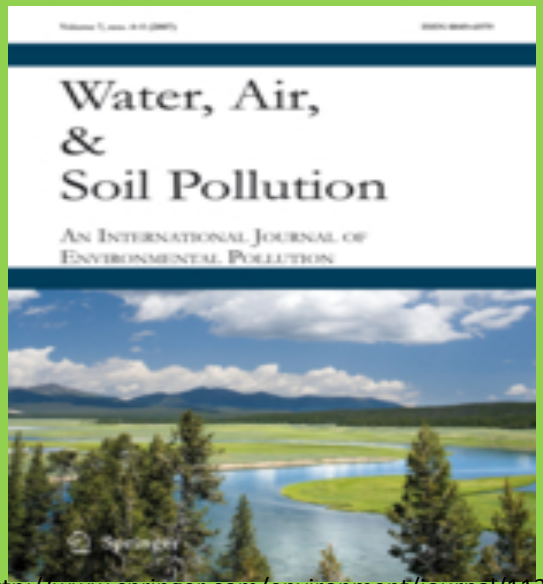
VISITOR



http://soils.usda.gov/gallery/photos/profiles/dough.html





http://www.springer.com/environment/journal/11270

http://www.gilroydispatch.com/content/img/f241930/4.28fertilizer3c.jpg

Compost:
From Garbage to Garden

SOIL 2010

Spring 2011

http://compost.css.cornell.edu

The Science of Compost

- Advantages
  - Soil conditioning (WHC, nutrients, buffer, etc.)
  - Value-added product
  - Improved manure handling and land application
  - Pathogen destruction
  - May reduce soil-borne plant pathogens

The Science of Compost

- Disadvantages
  - Time, money, education involved
  - Risk of odors, leachate contamination
  - Weather issues
  - Loss of N
  - Slow release of nutrients

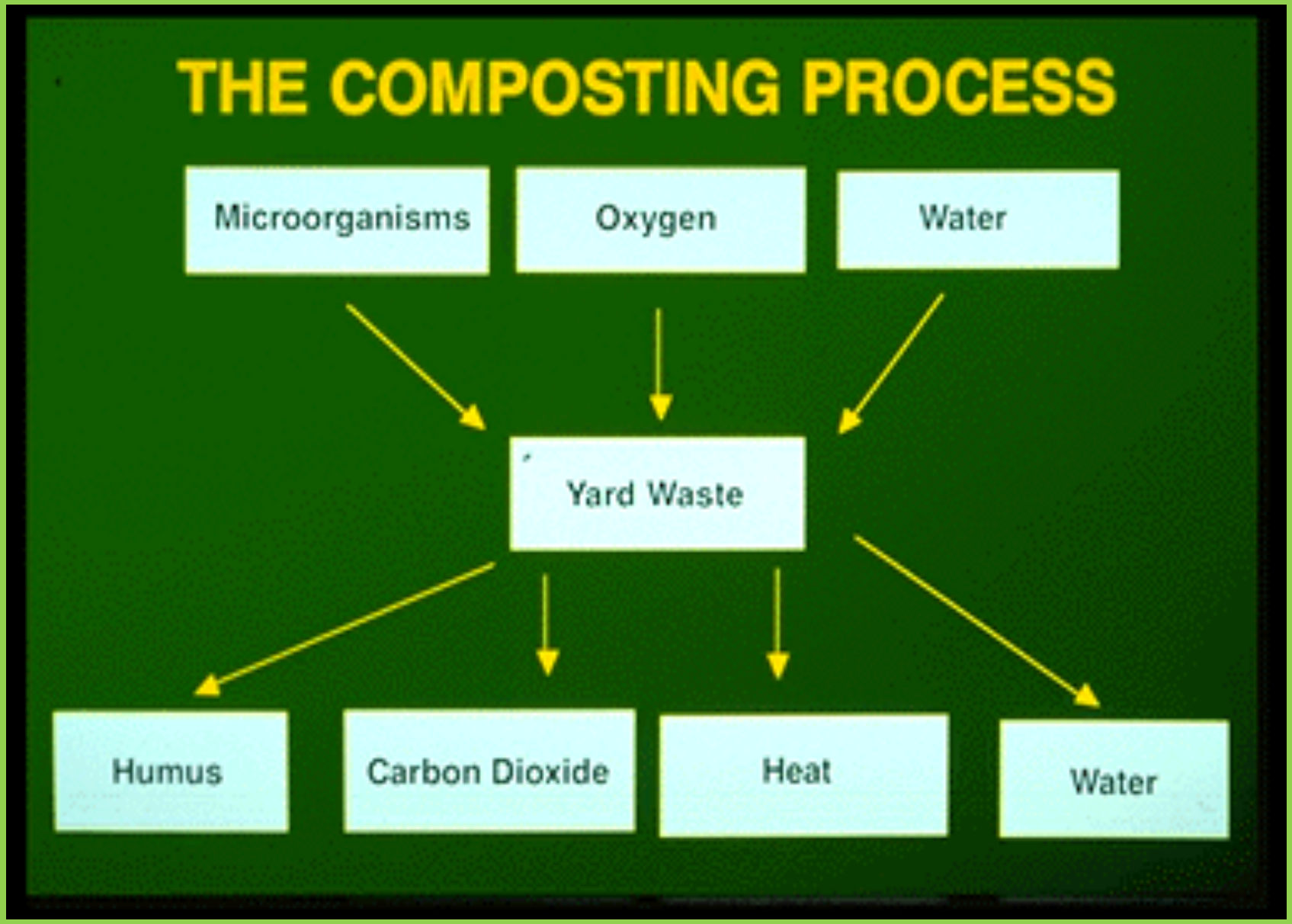
How does compost happen?

- Microbial action breaks down materials
- Mixing or turning enhances aeration (prevents anaerobic conditions)
- Temperature increases
- Humification

Ideal Composting Conditions

	Acceptable Conditions*	Preferred Conditions
C:N Ratio	20:1-40:1	25:1-30:1
Moisture	40-65%	50-60%
pH	5.5-9.0	6.5-8.0
Temperature (˚F)	110-150	130-140
Particle size (diameter, in.)	1/8-1/2	Varies
O_2 concentration	>5%	>>5%

**Conditions required for rapid composting*


THE COMPOSTING PROCESS
Microorganisms
Oxygen
Water
Yard Waste
Humus
Carbon Dioxide
Heat
Water

The Heat is On

- Indicator of…
  - MICROBIAL ACTIVITY!
  - Rate of breakdown in the compost pile
- Turning maintains aeration (aerobic decomposition)
  - Piles (passive)
  - Windrows (active)
- DESTROYS PATHOGENS and WEED SEEDS!

To Compost or Not to Compost?

YES!

- Vegetables and fruits
- Egg shells
- Yard waste (pesticides?)
- Manure
- Field residue, cotton,
- Hair, fur, dryer lint
- Coffee grounds/filters, tea bags
- Papers/cardboard

NO!

- Dairy products
- Meat products
- Bones
- Human/pet waste
- Fats, grease, lard
- Diseased plants
- Coal/charcoal
- Chemically treated wood products