

Master Composting Program

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Overview of Section I

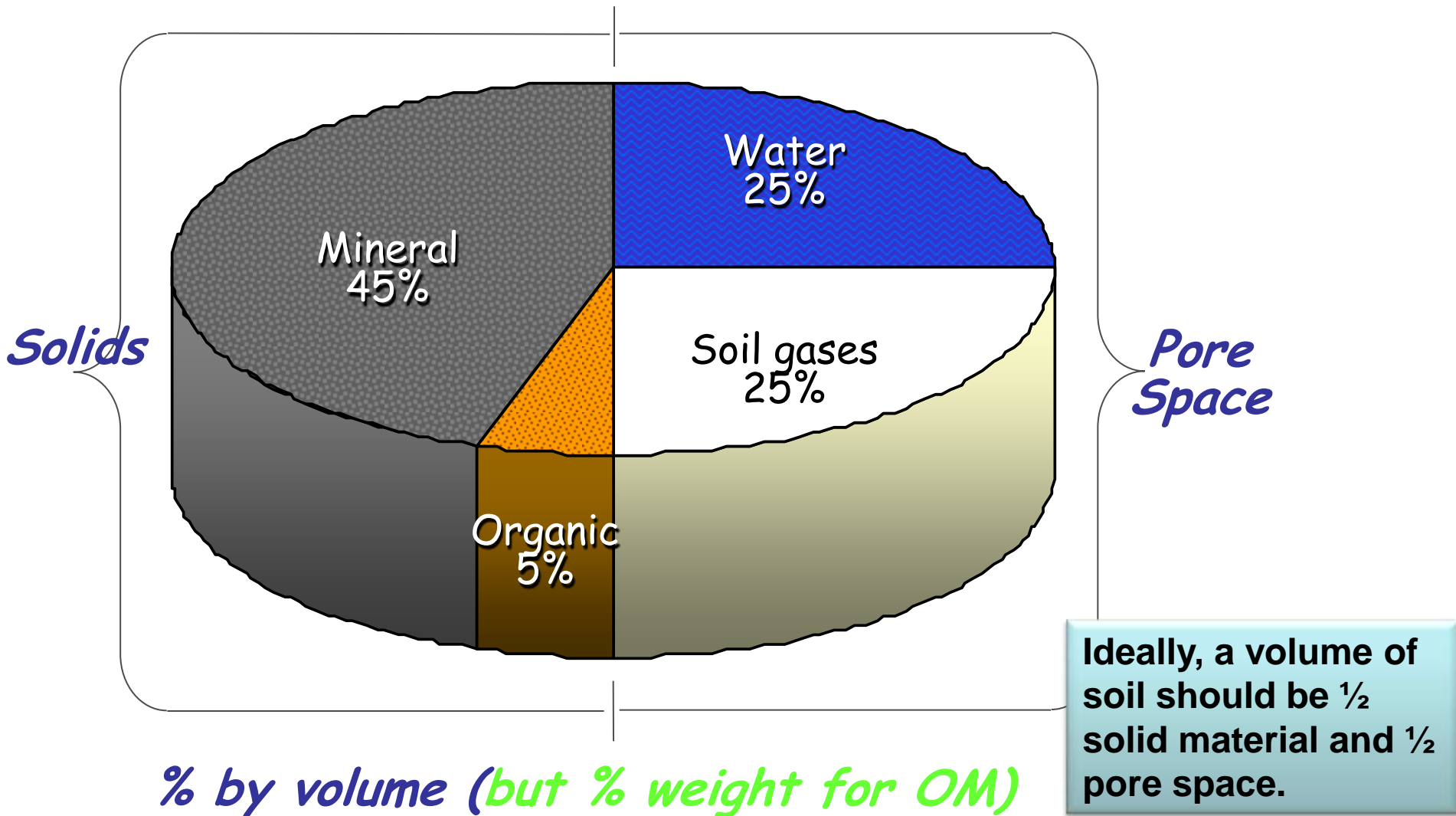
- Introduction to soils
- What is CEC
- The role of organic matter in plant nutrition
- What is composting
- Why compost
- What to compost
- The C:N ratio



Soils Defined

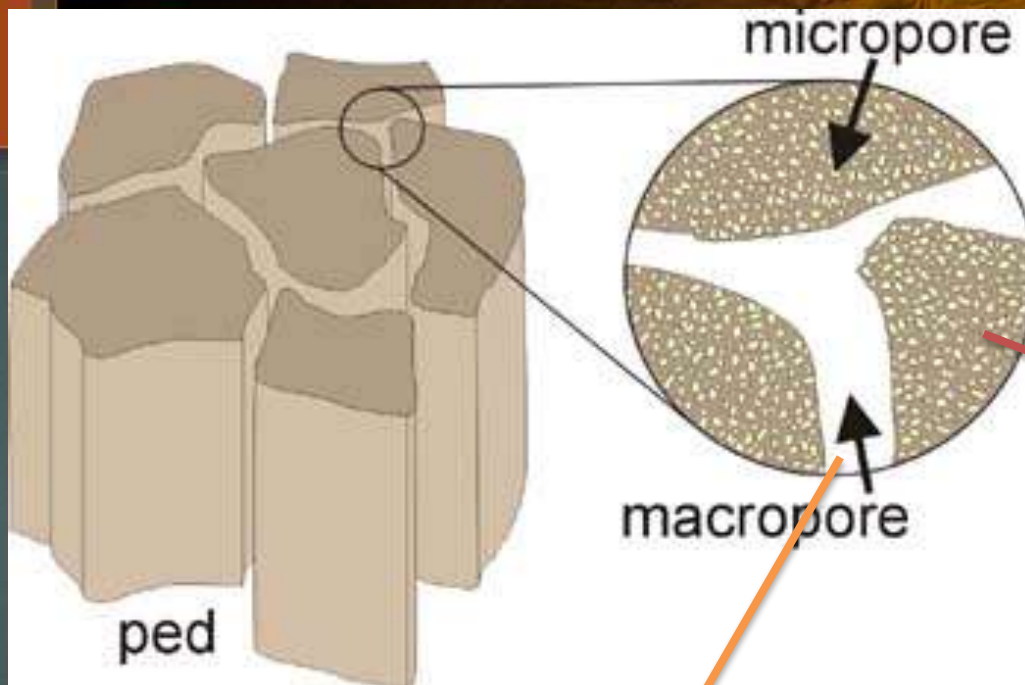
- An ecological system consisting of inorganic minerals, organic matter, living organisms, water & air and plant roots; and it is not = dirt
- Ideal ratio by volume:
 - $\frac{1}{2}$ Soil particles (5% OM by weight)
 - $\frac{1}{2}$ Pore spaces ($\frac{1}{2}$ water, $\frac{1}{2}$ air)

Soil Composition



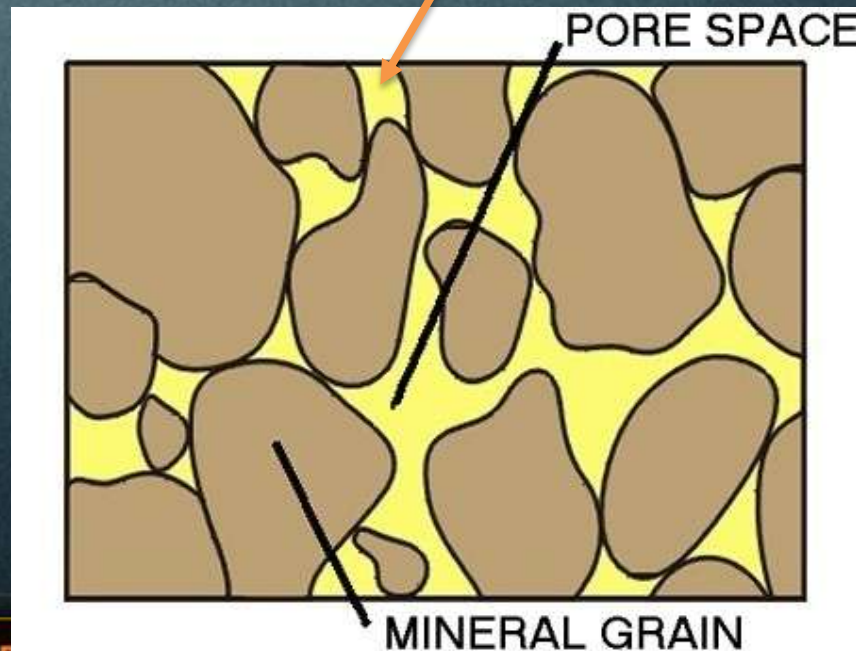
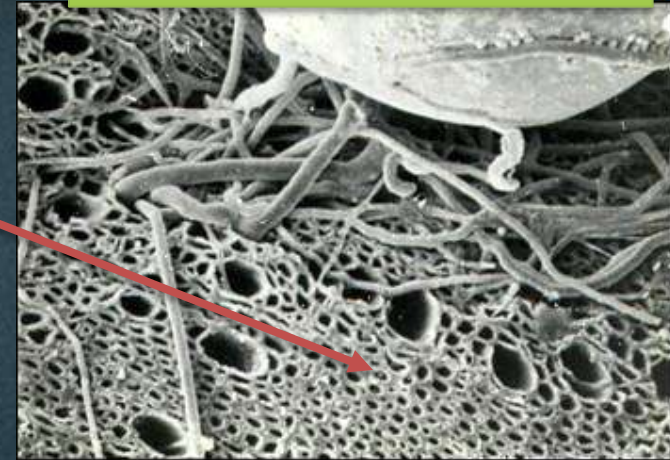
Pore Space & Particle Space - Magnified





Micropores

Filter & detoxify pollutants



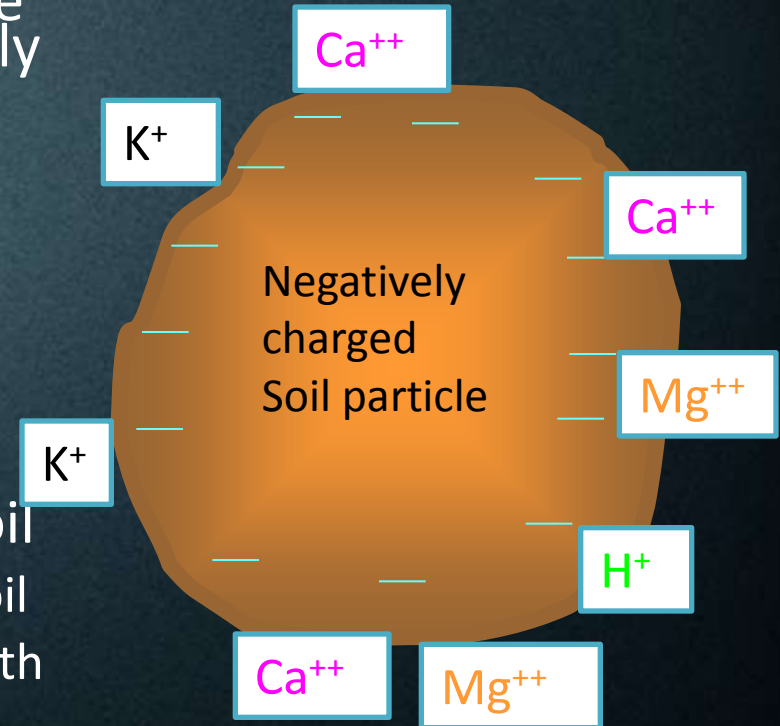
- Macropores = earthworms & root channels (drainage)
- Micropores = water holding capacity, minerals

Plant Nutrients

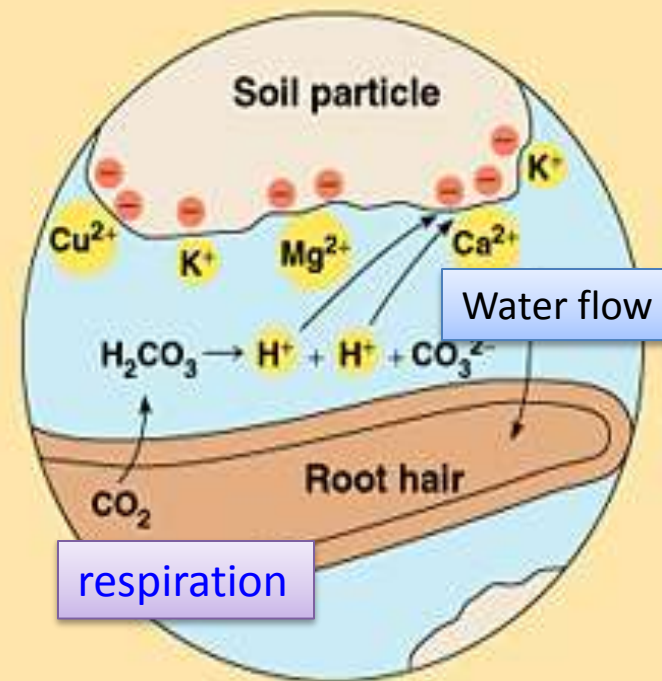
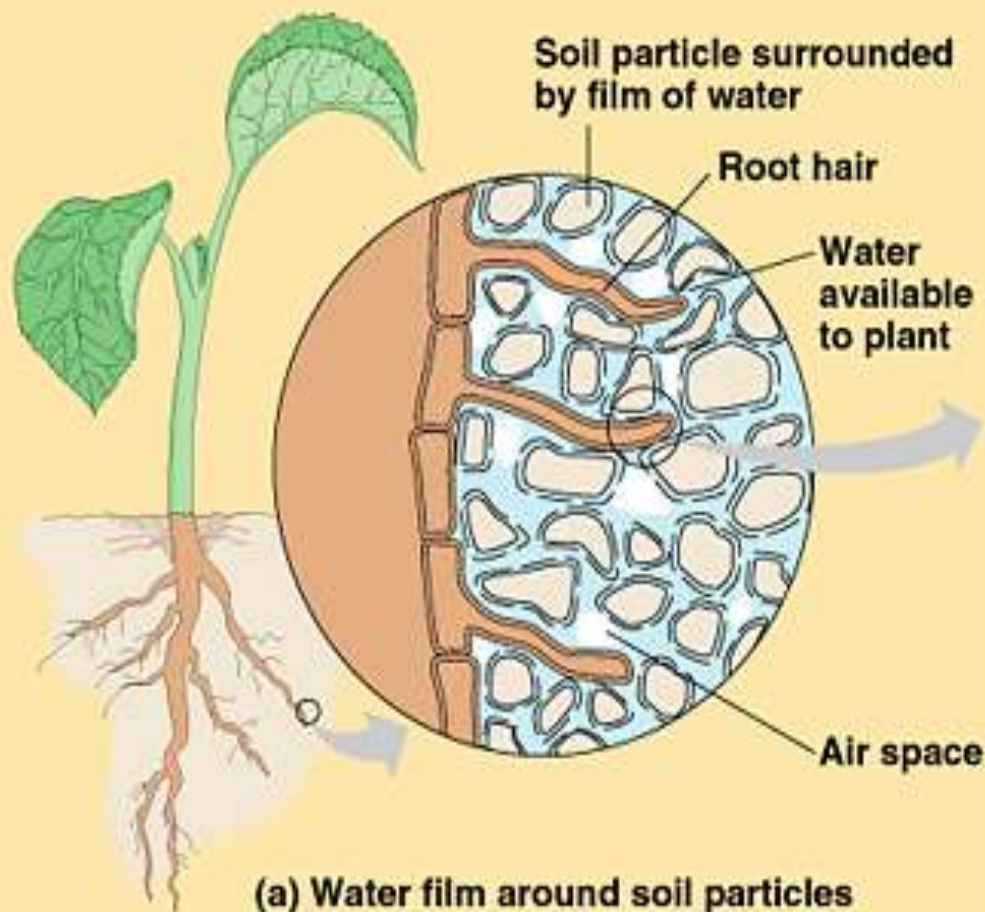
- Soil nutrients are in form of +vely charged ions (cations) and & –vely charged ions (anions)
 - Cations e.g. NH^+ , Mg^{2+} , Ca^{2+} , = +ve
 - Anions e.g. Cl^- , H_2PO_4^- and HPO_4^{-2} = -ve
- Clay & OM particles are –negatively charged
- So cations are adsorbed to these particles
- A soil's capacity to hold these cations is the Cation Exchange Capacity or CEC

Cation Exchange Capacity

- Soil particles and organic matter are negatively charged, attract positively charged ions (cations)
- CEC measure of the number of adsorption sites in a soil to adsorb and release cations
- A soil with a CEC of one (1) has 600,000,000,000,000,000,000 adsorption sites in 100 grams of soil
 - = About 25 tps or 8 tablespoons of soil
 - These adsorption sites can be filled with 1mg of H^+ ions
- Low CEC soils leach & store less nutrients



Uptake of Minerals by Plants



OM Importance

- First, the organic matter coats soil particles, physically separating clay particles and aggregates from each other
- Second, and more important, microorganisms that degrade organic matter produce a by-product called **glomalin** that bind individual clay particles together into stable **aggregates**

After adding water...

**LOW
O.M.**

**HIGH
O.M.**

photo by Ray Weil

Gruver, 2005

Composting



Its Recycling...



Fast - Naturally

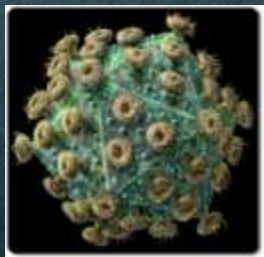
Compost – What is it?

- Resultant material from aerobic breakdown by microorganisms of organic plant & animal materials

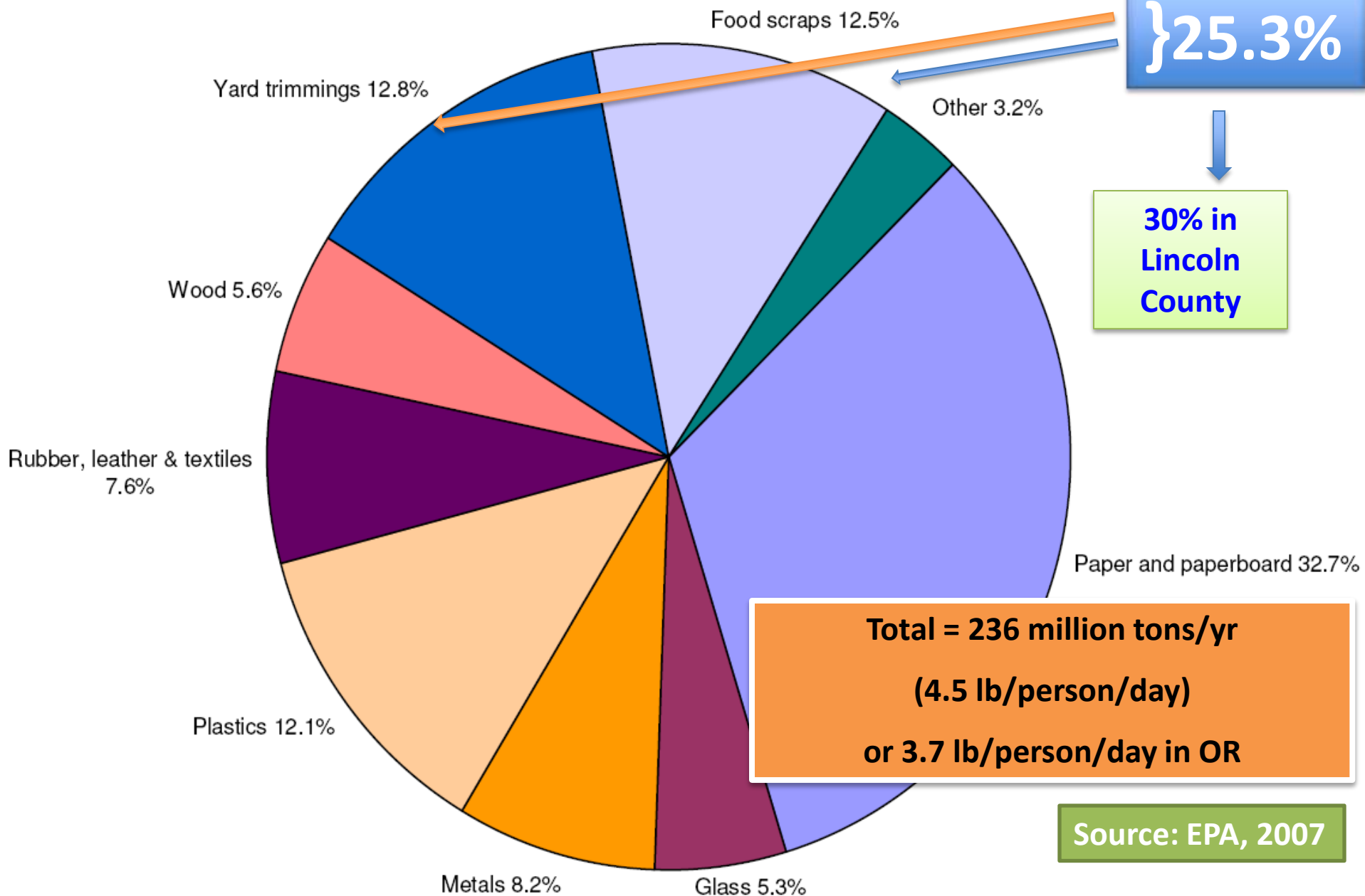


Why compost?

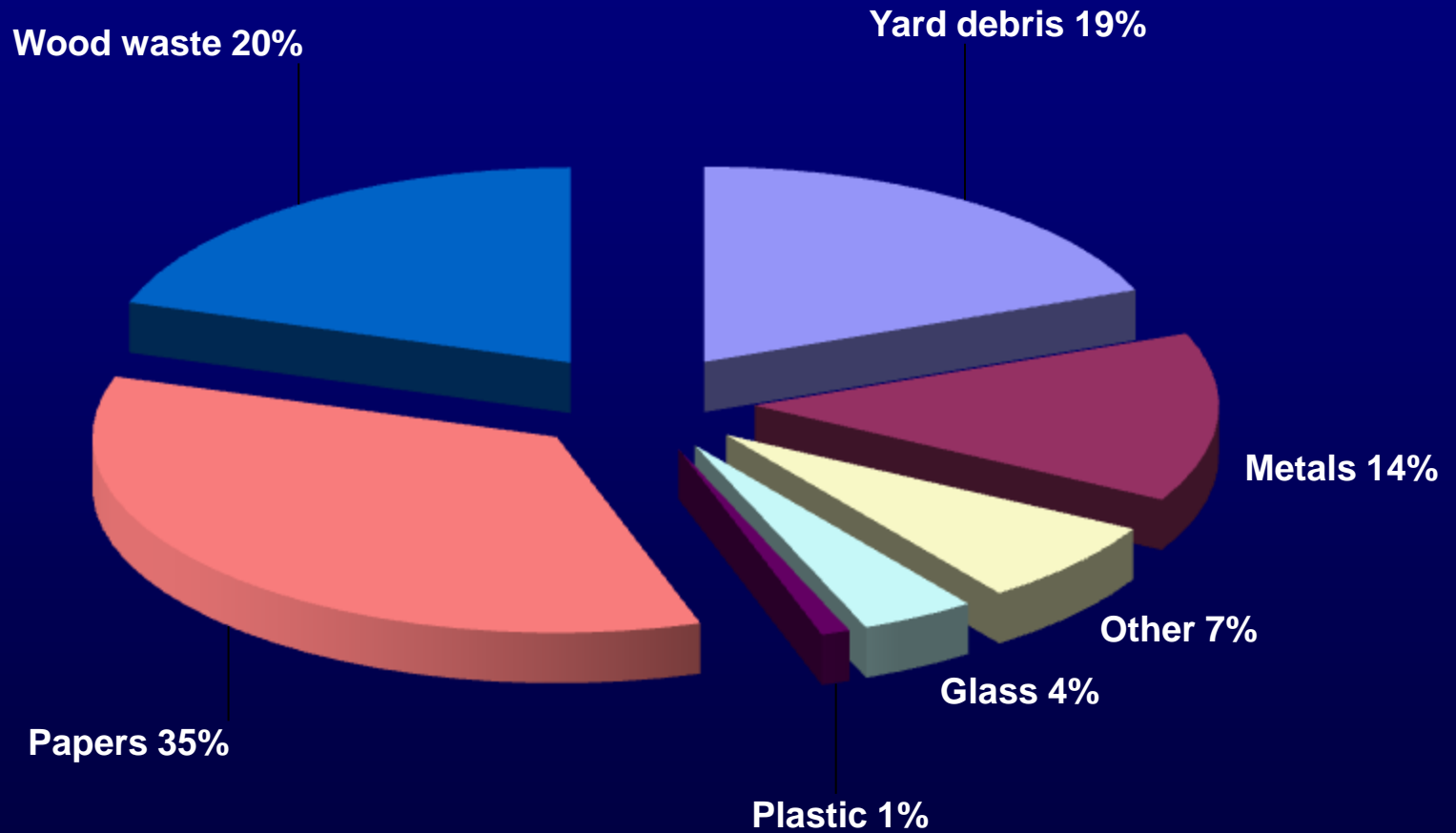
- Long term soil fertility – optimum yields
- Soil structure that makes better use of water and nutrients and easier to till
- Desirable microorganisms thrive in compost soils reducing incidents of pests and diseases



Municipal Solid Waste Production in the U.S. 2007



Materials Recovered in Oregon



What do You Need to Make Compost?



- Decomposers – Your composting work crew. These are the microbes (mainly bacteria and fungi) that do all the work for you (Bugs)
- Food for the decomposers
The organic materials to be composted
- The right amount of air, water, and warmth to keep the work crew happy

Conditions Good for Composting

- Proper conditions for composting
 - Adequate O_2 you need free air space of 55-65% by volume.
 - Moisture content 40-65%
 - Particle size 1/8- 2 inches
 - C:N ratio of 25:1 to 40:1

Composting Methods

(to be covered in week 2)

- Passive Pile Method
 - *not approved for certified organic production*
- Windrow Method
- Aerated Static Pile Method
- Aerated static and windrow methods should have:
 - temperature of 120 to 140° F
 - moisture content of 50 to 60 percent.
 - pH of 6.5 to 8.5
 - bulk density of less than 1,100 pounds per cubic yard (40 lb per cubic foot)

Where do the Decomposers Come From?

**If you build it,
they will come...**

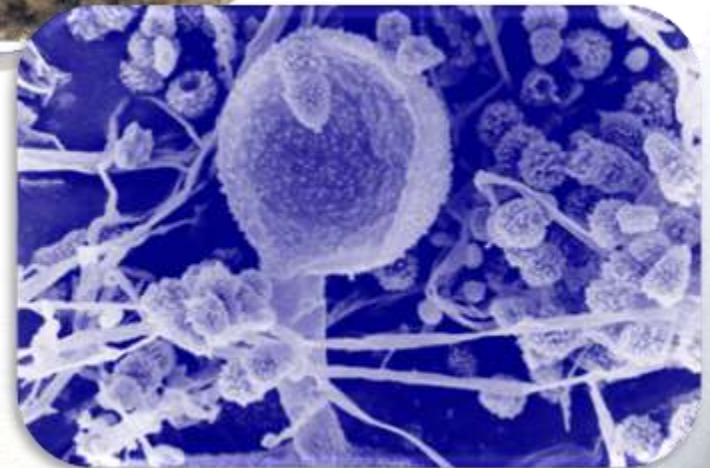
- Soil
- Leaves
- Food scraps
- Manure, and
- Finished compost

**Each of these will add
microorganisms
to the compost pile**



One teaspoon (4g) of good garden soil to which compost has been added contains

- 100 million bacteria**
- 800 feet of fungal threads**



What is the Best Food for your Decomposers?

All organic materials will compost, but not all should be added to a backyard compost pile

Organic wastes that should be composted include:



Garden trimmings



Grass clippings



Leaves



Kitchen scraps

Also

- Used potting soil
- Manure
- Sawdust
- Hair

Food for Decomposers

Wood Waste



Sawdust



Ashes

Others:

- Dryer and vacuum lint (no plastic)
- Napkins & paper towels
- Shredder newspaper and cardboard
- Coffee grounds
- Sea weed



Wood Chips

Materials to Avoid...

Avoid organic materials that could cause problems during or after composting

- **Oil, fat, grease, meat, fish or dairy products, unwashed egg shells (tend to attract pests, vermin)**
- **Hard to kill weeds (bindweed, quackgrass) and weeds that have gone to seed (could infest garden area when compost is used).**

Materials to Avoid...

**Manure: Pig manure, and Cat or dog waste (parasites survive a long time)
(attracts pests, could spread disease)**



**Diseased or insect ridden plants
(could infect or attack garden
plants when compost is used)**

Materials to Avoid...

- **Lime** (increases compost pH and promotes ammonia odor problems = losing N)
- **If large quantities of acid materials such as pine needles, spruce needles, or fruit wastes are composted, additional lime may be necessary.**
- **Wood ash - add sparingly to the pile - add no more than 1/2 cup per five gallon bucket**



Is Shredding Necessary?

**Smaller particles decompose faster:
about 18 days**



**Greater surface area
per unit volume**

**Allows microbes to
get at more of the
food (particle size =
1/8 to 1/2 inches
diameter)**

**Chipping or
shredding coarse
materials (twigs,
stems) will speed
up the rate at which
they decompose**

More about Food for your Decomposers

Provide a balanced “diet”

- Feed them a mix of carbon rich and nitrogen rich materials.
- Carbon rich organic wastes are known as “**BROWNS**”(>30:1)= bulking agents
- Nitrogen rich organic wastes are known as “**GREENS**”(<25:1)=energy materials
- Balanced Materials: Have right C:N ratio for direct composting [C:N ratio of 25-40:1]

C:N Ratio

- The proportion of carbon to nitrogen in an organic material.
- High lignin based organic compounds have a high carbon ratio to nitrogen
- If this ratio is 365:78 then 78 is used as a denominator to 365 to get corresponding C:1N ratio
- In this case the C:N ratio will be 4.7:1

Why is C:N Ratio Important

- This ratio is an important factor determining how easily bacteria are able to decompose an organic material
- The microorganisms in compost use carbon for energy and nitrogen for protein synthesis, just as we use carbohydrates for energy and protein to build and repair our bodies
- The optimal proportion of these two elements used by the bacteria averages about 30 parts carbon to 1 part nitrogen
- Given a steady diet at this 30:1 ratio, they can decompose organic materials very quickly.
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Figure 5.8 — COMPOSTABLE FOOD SCRAPS

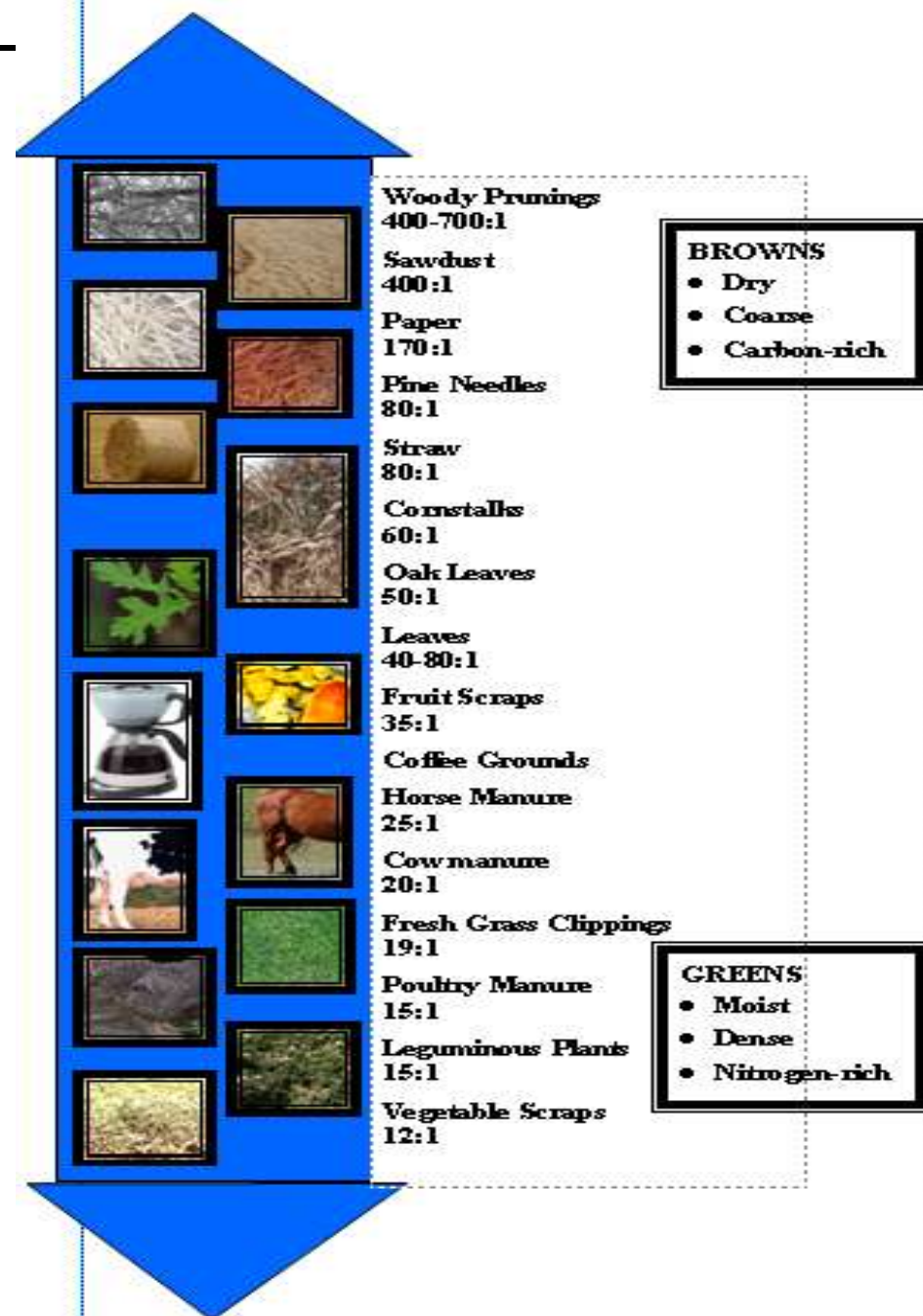
Can Be Used

Apples
 Apple peels
 Cabbage
 Carrots
 Celery
 Coffee grounds/filters
 Egg shells
 Grapefruit
 Lettuce
 Onion peel
 Orange peel
 Pears
 Pineapple
 Potatoes
 Pumpkin shell
 Squash
 Tea leaves and bags
 Tomatoes
 Turnip leaves

Cannot Be Used

Butter
 Bones
 Cheese
 Chicken
 Fish scraps
 Lard
 Mayonnaise
 Meat scraps
 Milk
 Peanut butter
 Sour cream
 Vegetable oil
 Yogurt

Figure 5.9-AVERAGE CARBON-NITROGEN RATIOS



Material	C:N ratio
Wood chips	641:1
Corrugated cardboard	563:1
Sawdust	500:1
Rotted sawdust	208:1
Newspaper	170:1
Wheat straw	128:1
Dried leaves	70:1
Corn stalks	60:1
Horse manure with litter	60:1
Pine needles	60:1 to 110:1
Peat Moss	58:1
Timothy hay	58:1
Oat straw	48:1
Fresh leaves	40:1
Hay	40:1
Horse manure	30:1
Red clover	28:1
Oak leaves	26:1
Coffee grounds	20:1
Alfalfa pellets	20:1
Cattle manure	19:1
Vegetable produce	19:1
Alfalfa hay	18:1
Composted dry chicken manure	15:1
Fresh grass clippings	17:1
Cottonseed meal	7:1
Soybean meal	6:1
Blood meal	4:1
Urine	0.6:1



Browns

High carbon materials such as

Leaves (30-80:1)

Straw (40-100:1)

Paper (150-200:1)

Sawdust (100-500:1)

Animal bedding
mixed with manure
(30-80:1)



Greens

High nitrogen materials such as

Vegetable scraps (12-20:1)

Coffee grounds (20:1)

Grass clippings (12-25:1)



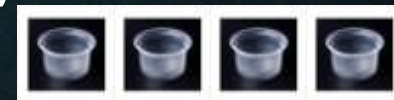
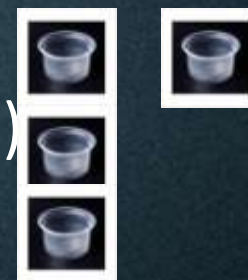
Calculating the C:N Ratio

- To calculate the C:N Ratio in a compost recipe, multiply the C:N value of the material by the parts used of that material.
- Total the combined C:N of all the parts and divide that amount by the number of parts in each recipe.



Calculating the C:N Ratio

- For example: let us say you are using
 - 2 part of grass clippings (C:N = 15)
 - One part of chicken manure (C:N = 15)
 - One part of dry leaves (C:N = 70)
- Now calculate
 - 2 parts of grass clippings x 15 = 30
 - plus (1 part chicken manure x 15 = 15)
 - plus (1 part dry leaf x 70 = 70)
- Add $30 + 15 + 70 = 115$; divide by four (4) parts (i.e., $115 \div 4 = 28.75$ cumulative overall C:N recipe in your container





Klickitat County

[Solid Waste Home Page](#) > [Compost](#) > [Compost Mix Calculator Introduction](#) > Compost Mix Calculator

Compost Mix Calculator

Choose a material. Enter a cubic foot measurement. Press TAB. The Total C:N ratio for your recipe will appear.

Aim for a TOTAL C:N RATIO of 30. (25-30 is good. 20-40 is OK.)

Material	CuFt	LbWet	%H2O	available %C	%N	available Lb C	Lb N	available C:N
Leaves Fresh 37:1	1	11.11	65	48.32	1.3	1.88	0.05	37.17
Food Waste 15:1	1	55.56	69	37.1	2.5	6.39	0.43	14.84
Grass (loose) 15:1	1	11.11	82	52.31	3.4	1.05	0.07	15.38
Wood Chips Softwood 226:1	5	74.07	40	20.38	0.09	9.06	0.04	226.41
TOTALS:						18.37	0.59	31.18

For a total C:N Ratio of 31:1 mix
1 part(s) Leaves Fresh
1 part(s) Food Waste
1 part(s) Grass (loose)
5 part(s) Wood Chips Softwood

[About this Compost Mix Calculator](#)

[Top of Page](#)

Solve & C:N ratio -Online

- <http://www.klickitatcounty.org/solidwaste/file.shtml/organics/compostcalc.htm>














Approximate ratio: $\frac{2}{3}$ browns to $\frac{1}{3}$ greens








PLEASE TURN TO PAGES 60-64 IN THE NOTEBOOKS FOR C:N RATIOS OF COMMON COMPOSTING MATERIALS

**The one page handout summarizes
most common composting
ingredient's C:N ratios**

Table 1. Characteristics of Compost Feedstocks ¹

Material	% N (dry wt) ^{2,3}	C:N (wt/wt) ⁴	Moisture % (wet wt)	Bulk Density (lb/cu yd, wet wt)
Plant Residues				
Apple filter cake	1.2	13	60	1,197
Apple pomace	1.1	48	88	1,559
Corn stalks	0.6 - 0.8	60-73	 12	32
Cottonseed meal	7.7	7	-	-
Cull potatoes	-	18	 78	1,540
Fruit wastes	0.9-2.6	20-49	 62-88	-
Potato processing sludge	-	28	75	1,570
Rice hulls	0.3	121	14	202
Soybean meal	7.4	4-6	-	-
Vegetable produce	2.7		87	1,585

Material	% N (dry wt) ^{2,3}	C:N (wt/wt) ⁴	Moisture % (wet wt)	Bulk Density (lb/cu yd) (wet wt)
Municipal Wastes				
Food waste	1.9-2.9	14-16 	69	
Paper	0.2-0.25	127-178 	18-20	
Refuse (mixed)	0.6-1.3	34-80	-	
Sludge	2.0-6.9	5-16	72-84	1,075
Straw, Hay, Silage				
Corn silage	1.2-1.4	38-43	65-68	
Hay (legume)	1.8-3.6	15-19 	-	
Hay (non-legume)	0.7-2.5	32 	-	
Straw (wheat)	0.3-0.5	100-150 	-	
Wood and Paper				
Bark (hardwood)	0.1-0.4	116-436 	59	4
Bark (softwood)	0.04-0.39	131-1,285 	40-50	225

Material	% N (dry wt) ^{2,3}	C:N (wt/wt) ⁴	Moisture % (wet wt)	Bulk Density (lb/cu yd, wet wt)	
Bark (hardwood)	0.1-0.4	116-436	59	471	
Bark (softwood)	0.04-0.39	131-1,285	40-50	225-370	
Corrugated cardboard	0.1	563	-	259	
Newsprint	0.06-0.14	398-852	-	195-242	
Sawdust	0.06-0.8	200-750	-	350-450	
Wood chips/shavings (hardwood)	0.06-0.11	451-819		-	445-620
Wood chips/shavings (softwood)	0.04-0.23	212-1,313		-	445-620
Yard Wastes					
Grass clippings	2.0-6.0	9-25		82	300-400
Leaves	0.5-1.3	40-80		38	100-300
Seaweed	1.2-3.0	5-27		53	-
Shrub trimmings	1	53		15	429
Tree trimmings	3.1	16		70	1,300

1. Source: *On-Farm Composting Handbook*, NRAES 54

2. Where a range is not given, data indicate an average value.

3. A dash indicates that information is not available.

4. All ratios are expressed relative to 1; e.g., the C:N of apple filter cake is 13:1

**Be proud: Made Locally in Oregon
Using Local Ingredients and Local
“Bugs” by**



End of Week One