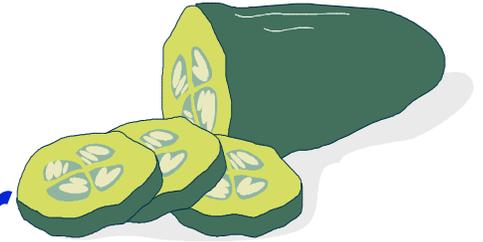
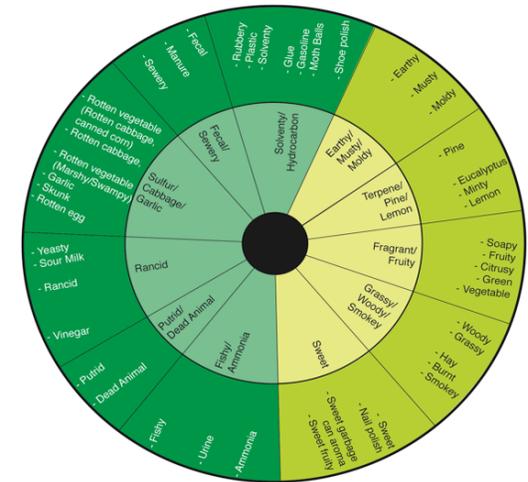
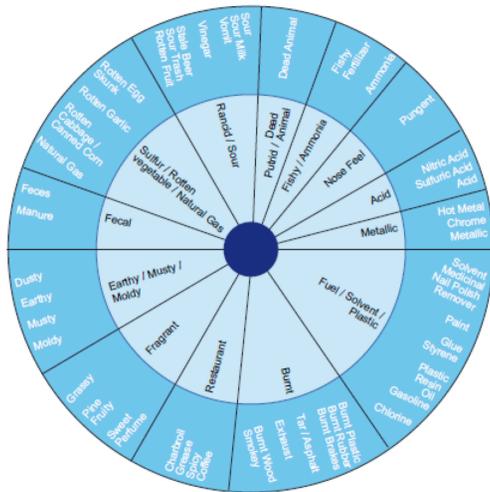


Describing and Characterizing Odor



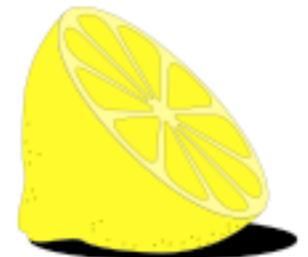
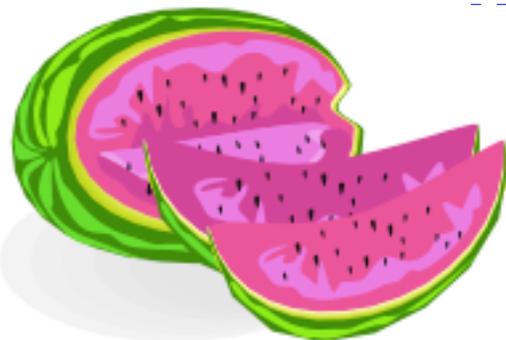
By Odor Wheels



Mel Suffet

Environmental Science & Engineering Program

CLA, School - Public Health
Los Angeles, California

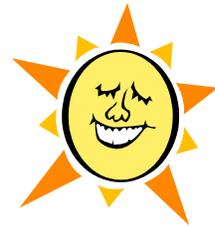




RELEASING ODORANTS INTO AIR



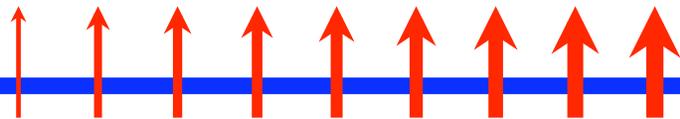
AIR CONTAMINANT DISPERSION



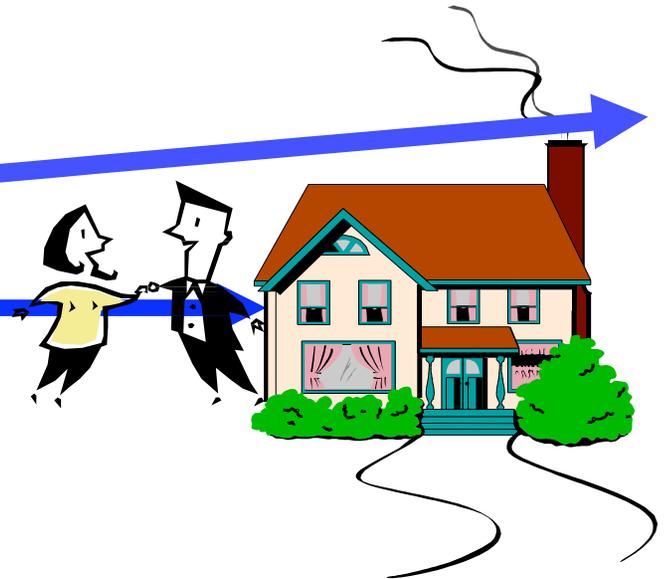
Unstable air

ODOR

Stable air



**WASTE WATER PLANT
or
COMPOST PILE**



ODOR NUISANCE

Odor nuisance can be defined as the

Character of Odor, Intensity, Duration

[Current laws do not account for odor nuisance
in this manner]

However, there is an obligation to limit the
odor nuisance for resident.

Objective of this talk-

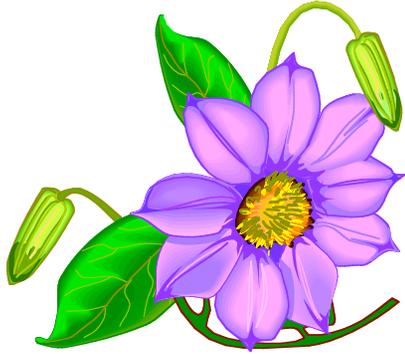
1. Develop a methodology to measure odor nuisance.
2. Show how the methodology can help solve odor nuisance problems.

PROBLEM :

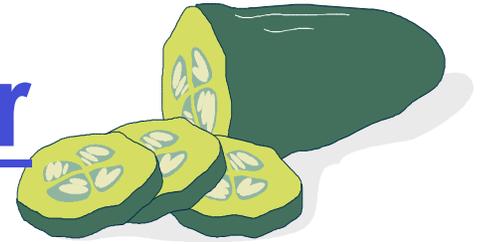
How to define ODOR CHARACTER

We know:

- 1. Each chemical has a unique:**
 - odor threshold concentration (OTC)**
 - a unique dilution rate to threshold**
- 2. Each odor sample has a unique:**
 - mixture of chemicals**
 - mixture of chemical concentration**

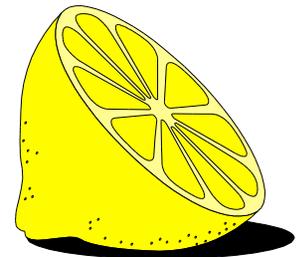
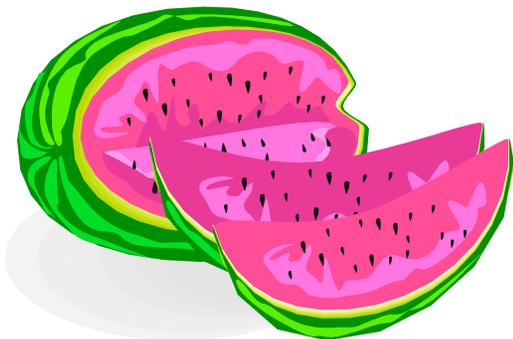


Character of Odor



**Naming the Odor,
so that Everyone
Understands the Problem.**

- Critical to Understanding Odor Nuisance***
- Naming Consensus Between Panelists
and the Public***



Odor Characteristics from Composting

I. INITIAL ODORS OF WASTEWATER SLUDGE

1. Fecal/Sewery

2. Putrid/Dead Animal

3. Solventy/HC

Raw Sludge Odors

Fecal

Sewery/Fecal

Rotten vegetable

Rancid

Ammonia

Rotten fishy

Hay/Manure

Hay

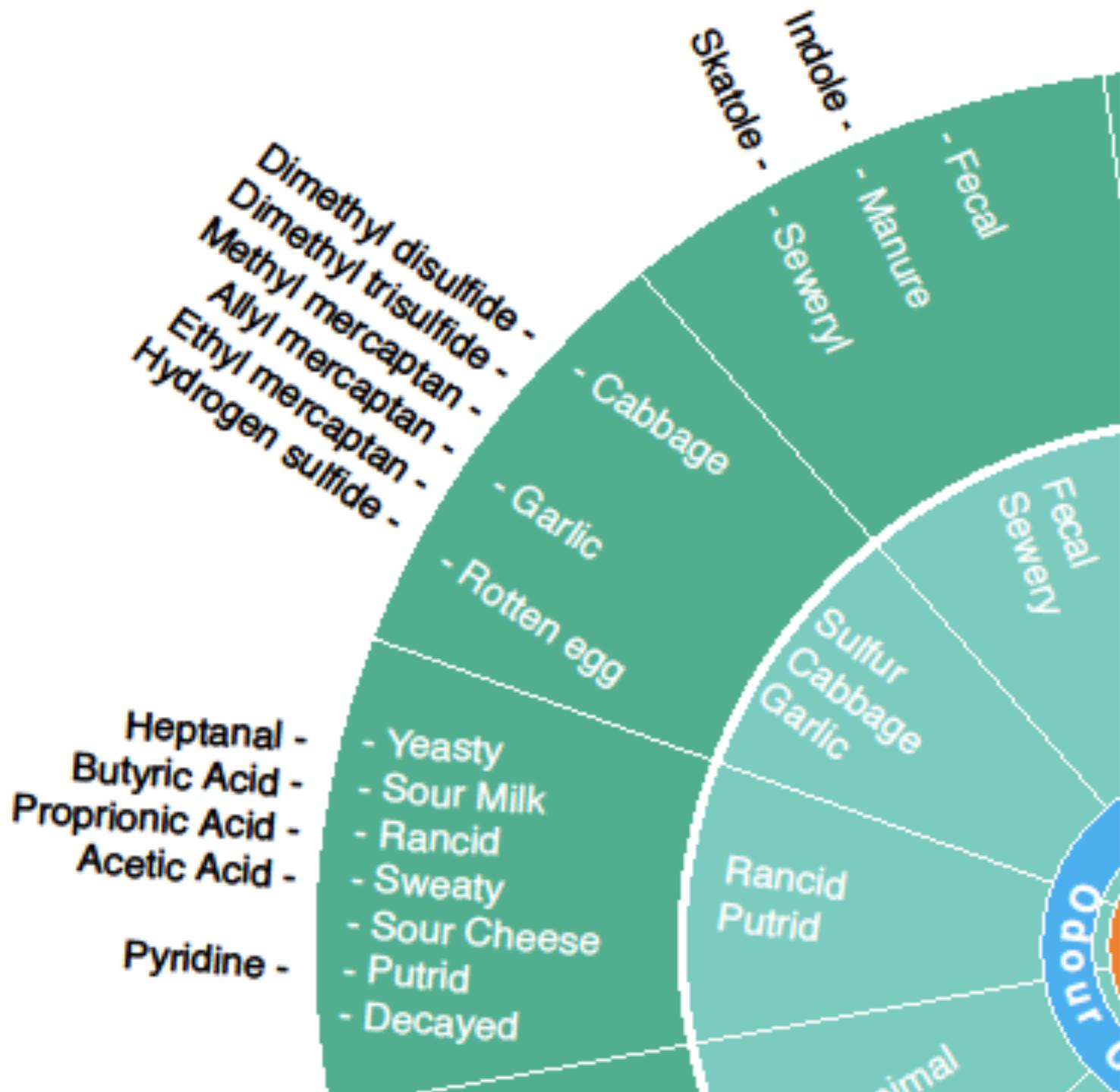
Earthy/Musty

Odor Characteristics from Composting

II. INTERMEDIATES PRODUCTS FROM COMPOSTING

AEROBIC PROCESSES

- 1. Fishy/Ammonia from breakdown of protein type compounds to amines and ammonia***
- 2. Rancid from breakdown of fats and carbohydrates to acids***
- 3. Sweet (Garbage Can) – forming of aldehydes***

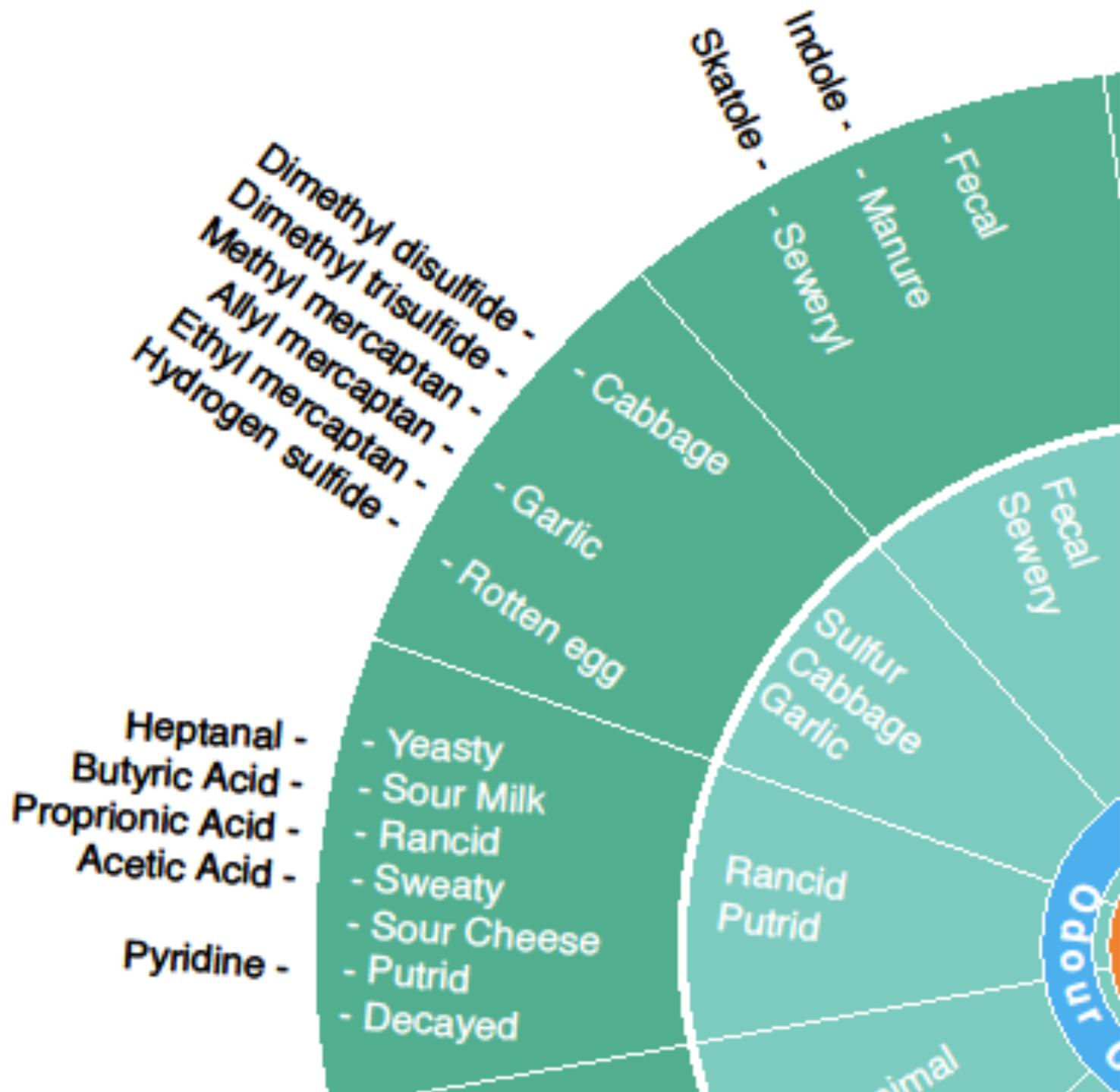


Odor Characteristics from Composting

II. INTERMEDIATES PRODUCTS FROM COMPOSTING

*ANEROBIC ZONES
(NOT SUPPOSE TO BE THERE)*

*1. Sulfur/Cabbage/Garlic breakdown
from Sulfur containing proteins*



Odor Characteristics from Composting

IV. BIOCHEMICAL PRODUCTS OF COMPOSTING

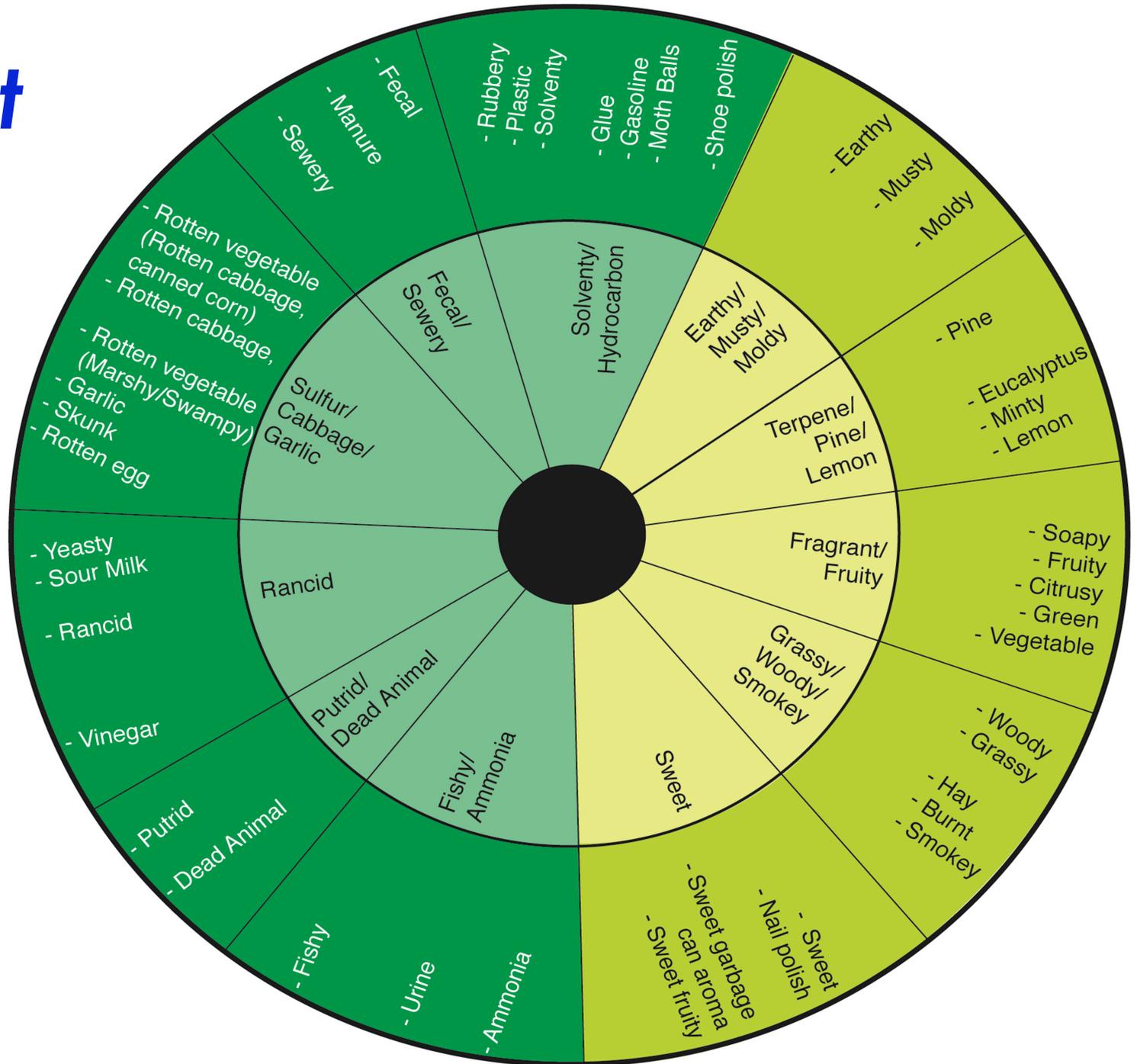
1. Earthy/Musty/Moldy

2. Terpene/Pine/Lemon

3. Fragrant/Fruity

4. Sweet (Nail Polish)

Compost Odor Wheel



Raw Sludge Odors

Fecal

Sewery/Fecal

Rotten vegetable

Rancid

Ammonia

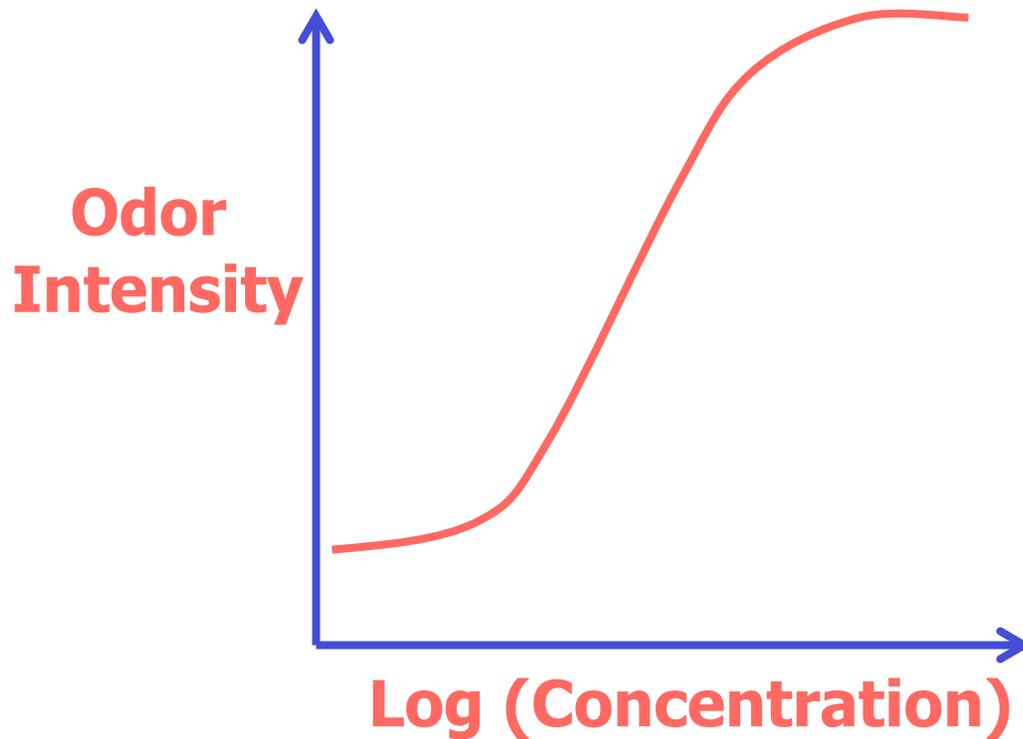
Rotten fishy

Hay/Manure

Hay

Earthy/Musty

EACH Odorant Concentration versus Odor Intensity



$$\text{Odor Intensity} = m \text{ Log [conc.] + b}$$

Weber-Fechner Law

$$\text{Log (Odor Intensity)} = m \text{ Log [conc.] + b}$$

Steven's Power Law

- Semi-logarithmic relationship
- Different chemicals have different curves

Odor Profile Method Intensity Scale

No Odor	0
Threshold)(or 1
Very Weak	2
Weak	4
Weak-Moderate	6
Moderate	8
Moderate-Strong	10
Strong	12

OBJECTIVES



- To identify character of each odor on the wheel and intensity of each odor
- To confirm odor causative agents - identify Chemicals by GC/MS and sensory-GC/MS

Raw Sludge Character and intensity

Sludge A	Avg.	S.D.
Hay/Manure	3.5	3
Sewery/Fecal	2.5	2.2
Ammonia	1.5	0.9
Earthy	1.5	1.7
Rotten vegetable	1.3	1.6
Burnt	note	

Sludge B	Avg.	S.D.
Ammonia	7.5	0.9
Earthy	2	2
Rotten fishy	1.5	1.7
Dead animal	note	
Hay	note	

Sludge C	Avg.	S.D.
Fecal	5.5	0.9
Hay	3	2.2
Rancid	2	2.4
Ammonia	1.3	1.6
Earthy	note	
Rotten vegetable	note	

Odor Profile Method

- Carefully selected panelists
- Extensively trained panelists
- Highly controlled settings
- Blind presentation of samples
- Four panelists: individually
- Panel discussion and consensus on odors if possible

EACH ODORANT POSSESSES A UNIQUE ODOR SIGNATURE

- 1) Odor threshold concentration **W-F Curve****
- 2) Odor character or quality- **Odor Wheel****
- 3) At a chemical concentration, a specific
odor intensity – **OPM Analysis Intensity****
- 4) Odor dilution rate - **W-F Curve****

Odor Characteristics from Composting

I. INITIAL ODORS OF WASTEWATER SLUDGE -

1. Solventy/HC, 2. Fecal/Sewery, 3. Putrid/Dead Animal

II. INTERMEDIATES PRODUCTS FROM WWT

AEROBIC PROCESSES

1. Fishy/Ammonia – N compounds, 2. Rancid – fats and carbohydrates, 3. Sweet (Garbage Can) – aldehydes

III. INTERMEDIATE PRODUCTS FROM WWT

ANEROBIC PROCESSES

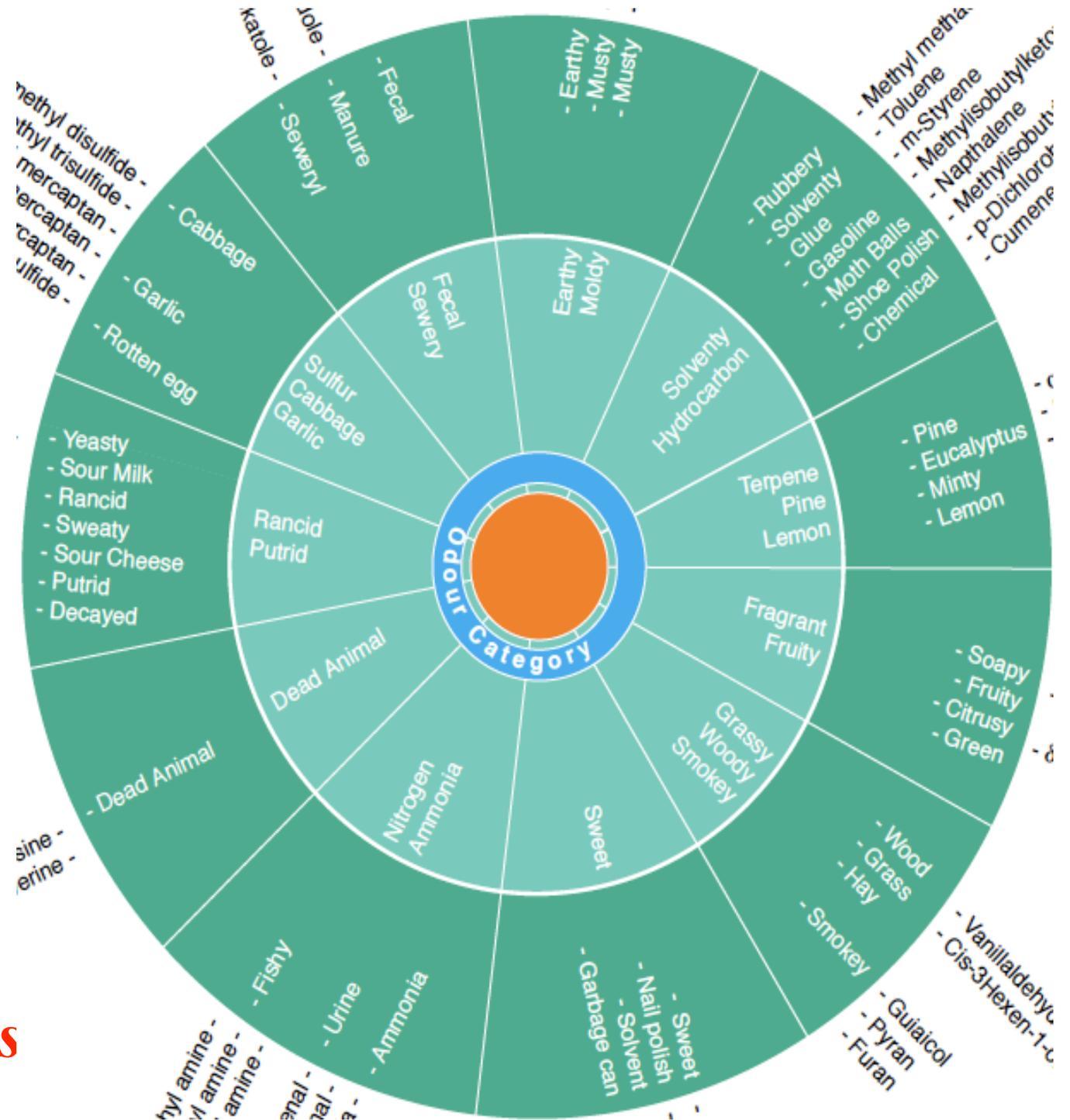
1. Sulfur/Cabbage/Garlic probably from proteins

IV. PRODUCTS OF WWT AND/OR COMPOSTING–

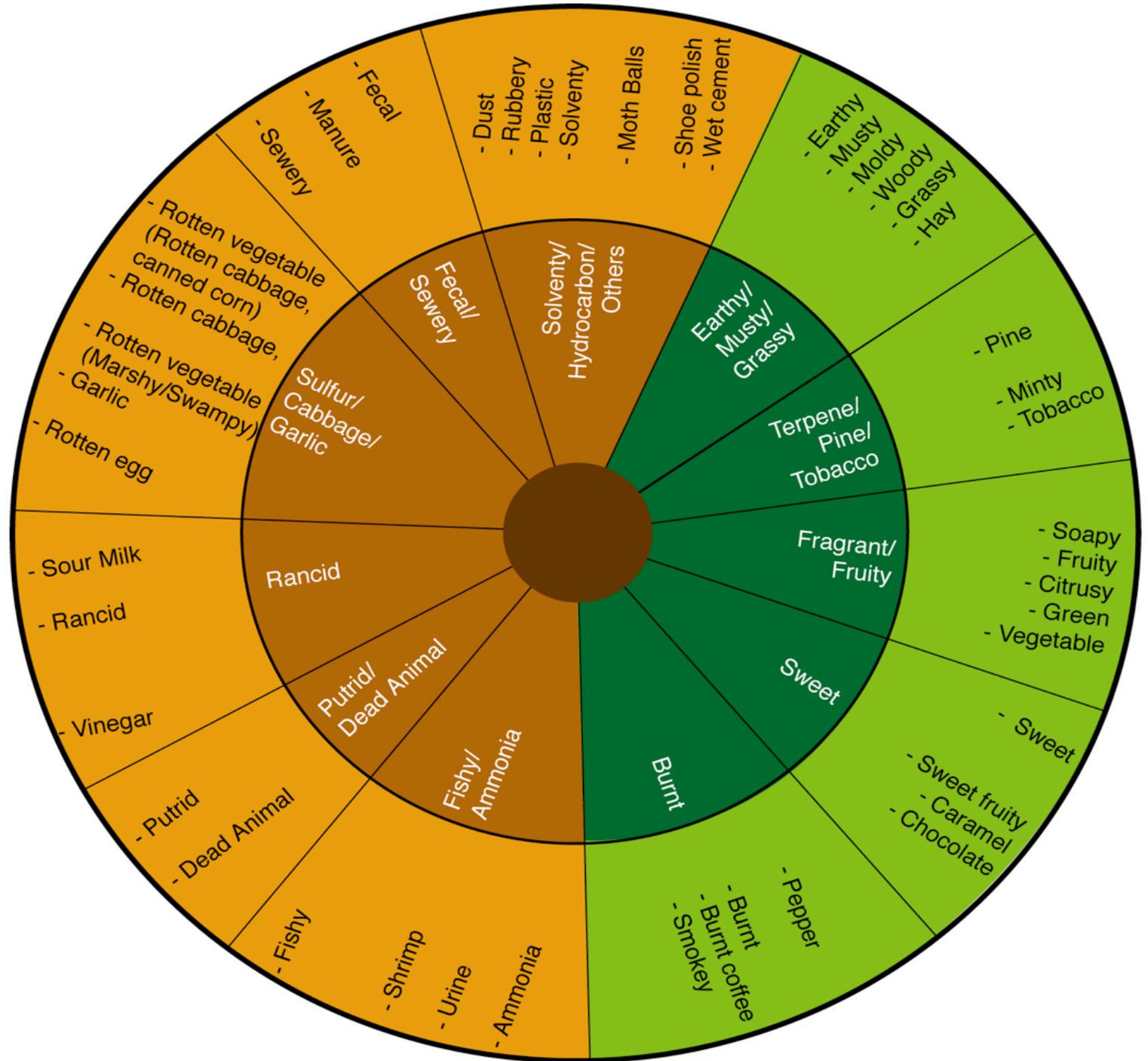
*1. Earthy/Musty/Moldy, 2. Terpene/Pine/Lemon,
3. Fragrant/Fruity, 4. Sweet (Nail Polish)*

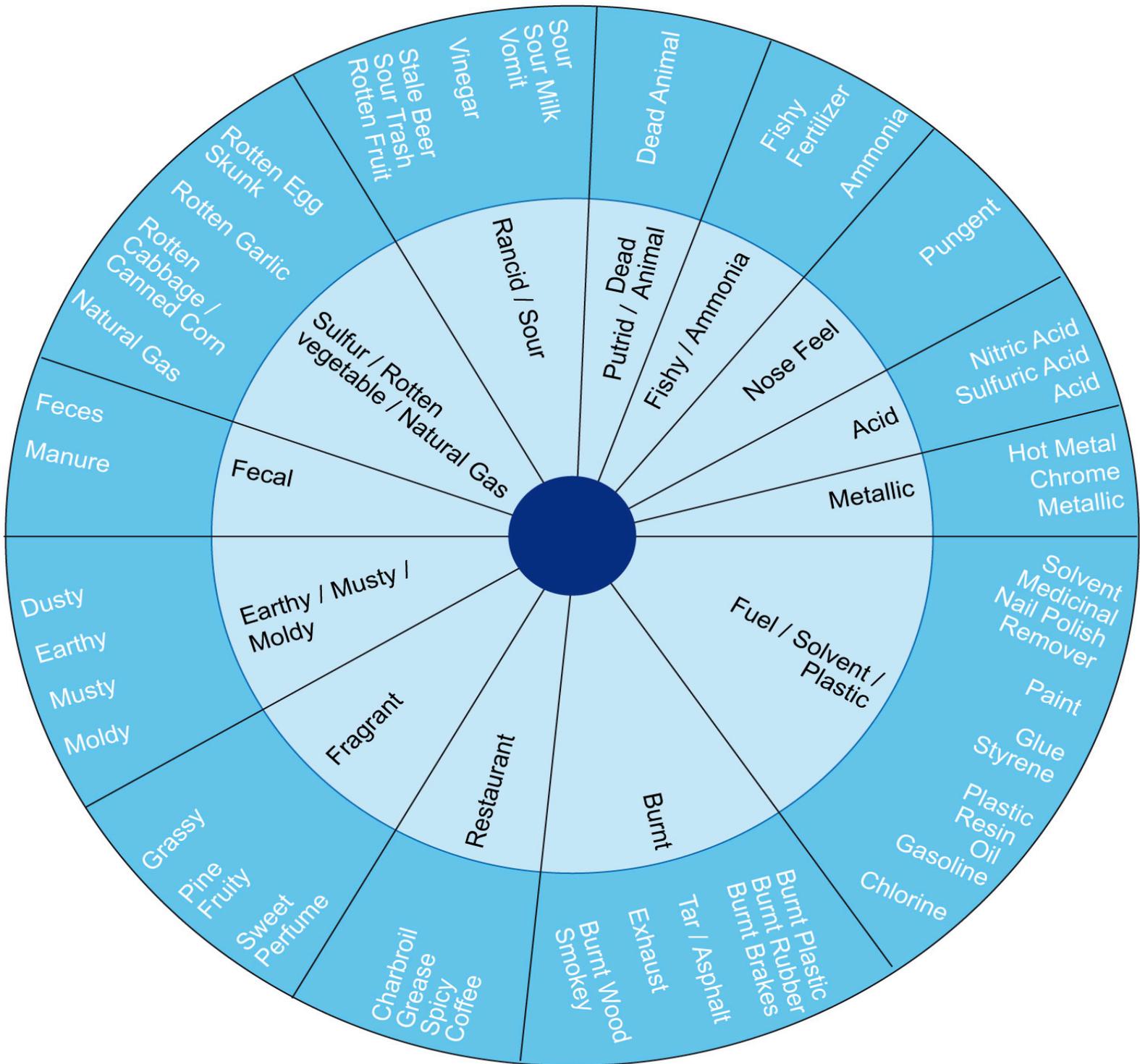
Wastewater Odor Wheel

1. Inside circle: "Categories"
2. Outside circle: "Sub-categories"

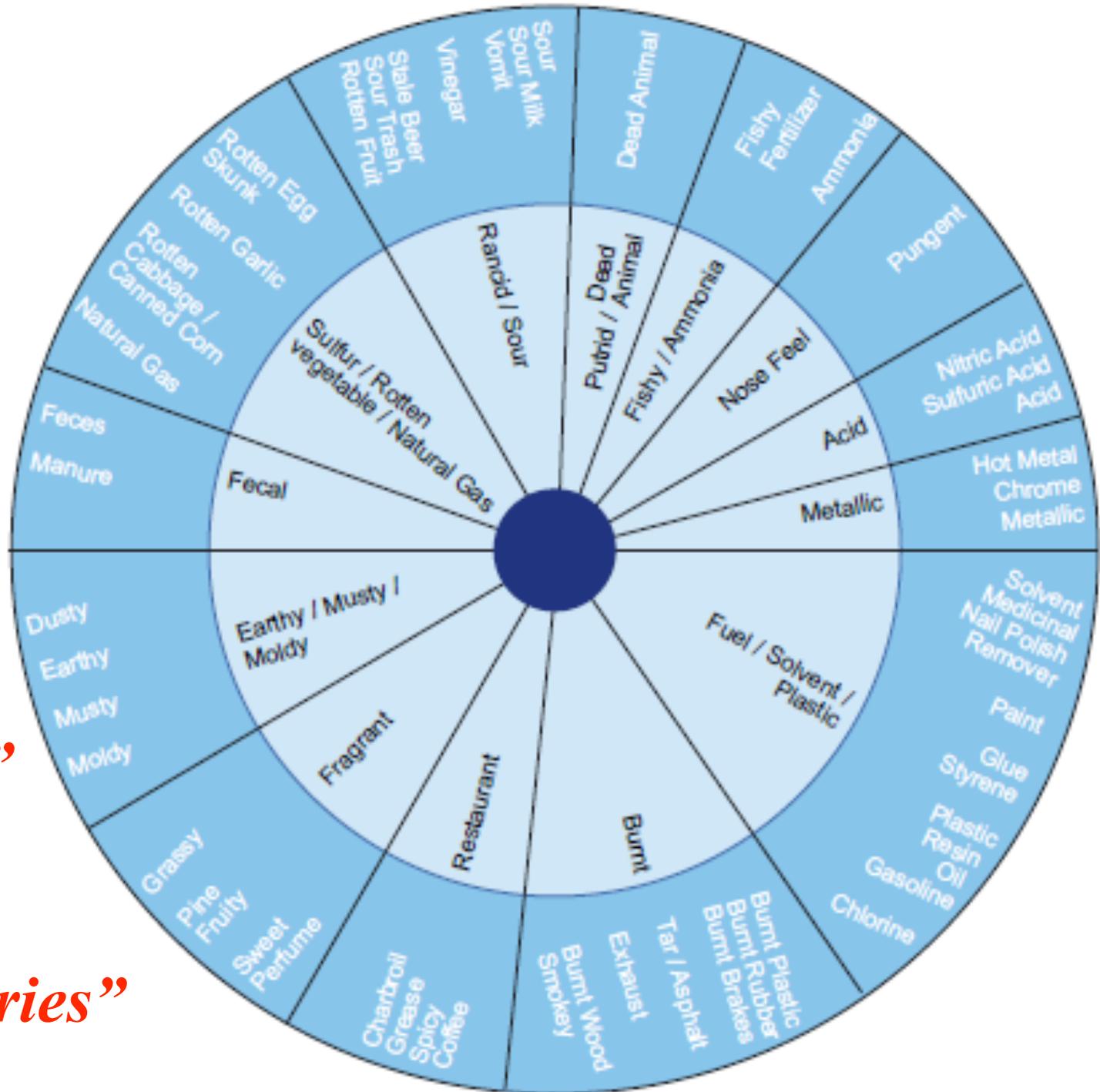


Sludge Drying Odor Wheel





Urban Odor Wheel



1. Inside circle: "Categories"

2. Outside circle: "Sub-categories"

Urban Odor Wheel

3. Outer Ring: Potential Odor Compounds



THANK YOU FOR LISTENING!

• QUESTIONS ?