The Nitrogen Cycle, Composting and Manure Management

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N

Nitrogen

±3,5,4,2

Forms of Nitrogen

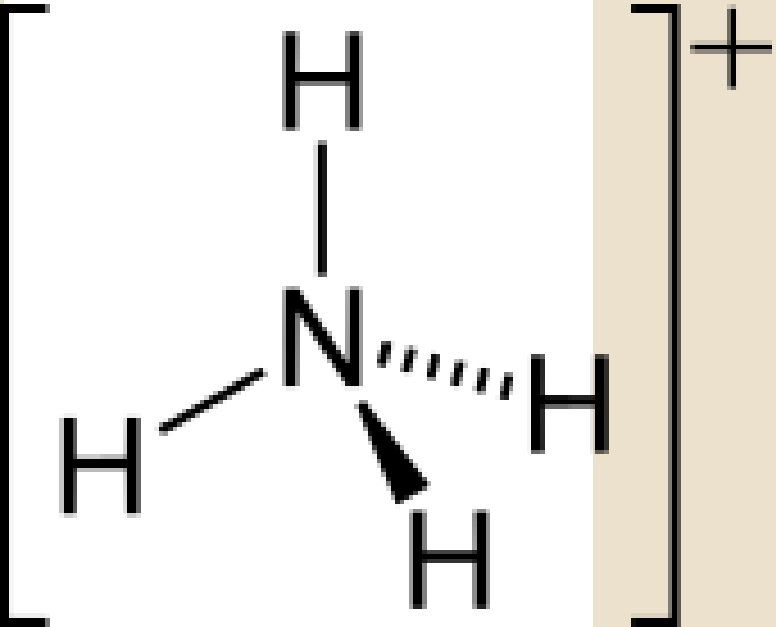
Ammonia/ammonium N

Nitrate-N

Organic N

Total Kjeldahl N

Total N



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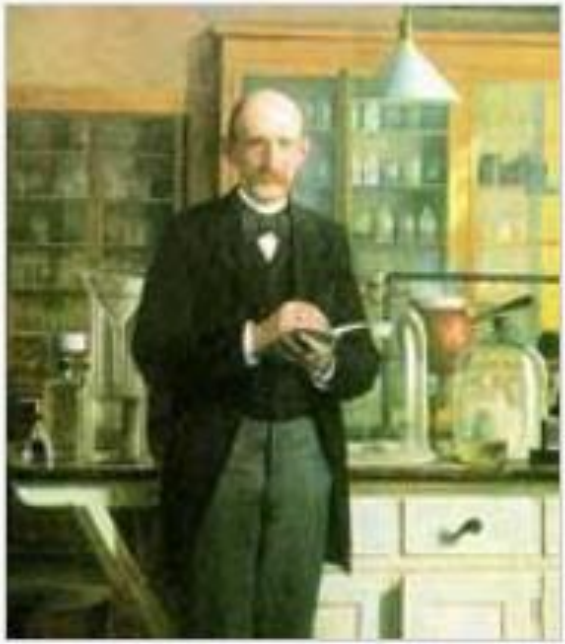

Johan Kjeldahl working at Carlsberg Laboratory in the 1880s. Portrait by Otto Haslund

Carlsberg Brewery Laboratory Copenhagen Denmark Johan Kjeldahl Danish Chemist 1849-1900

Carlsberg Laboratory today

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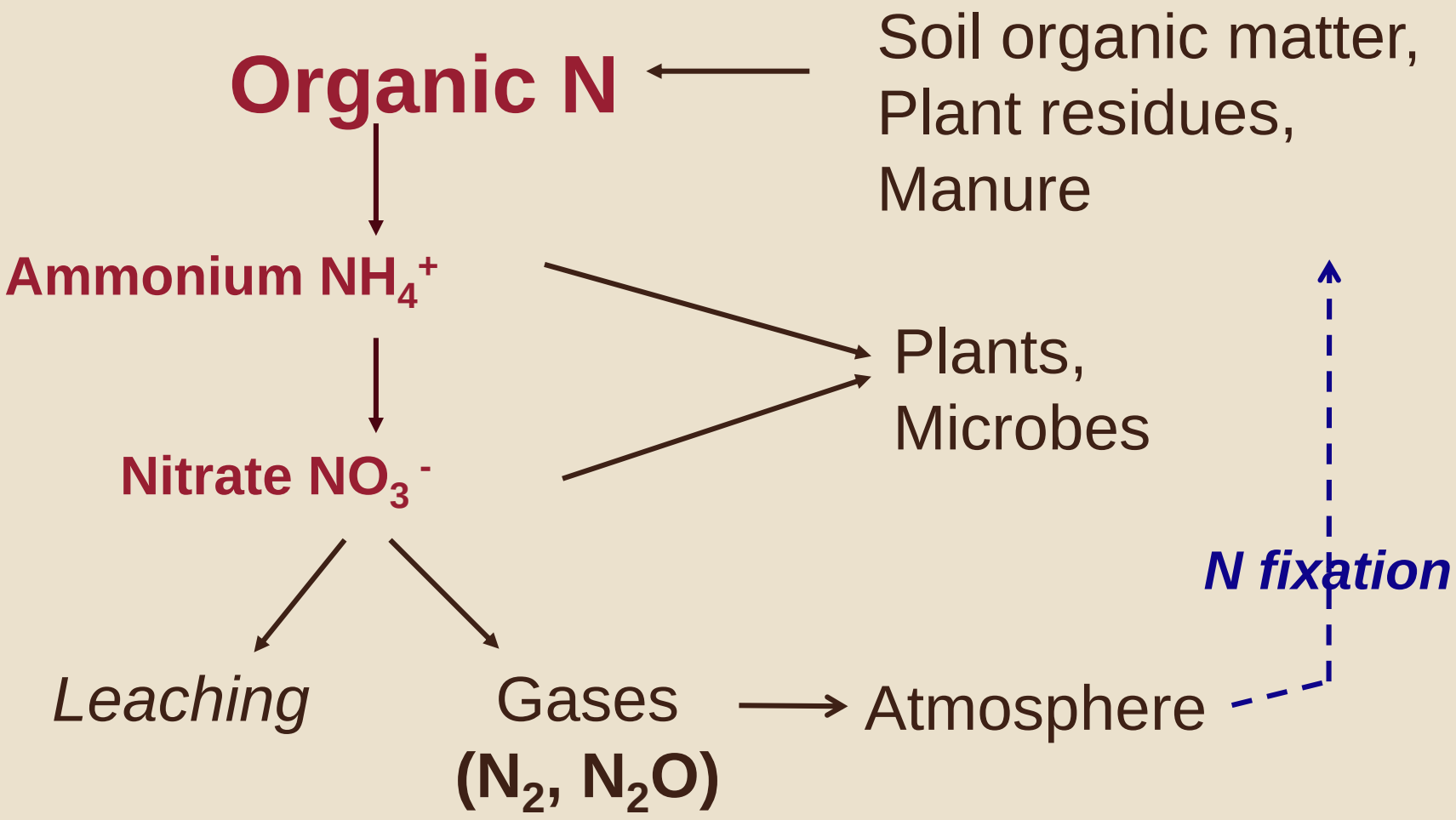
Nitrogen Cycle



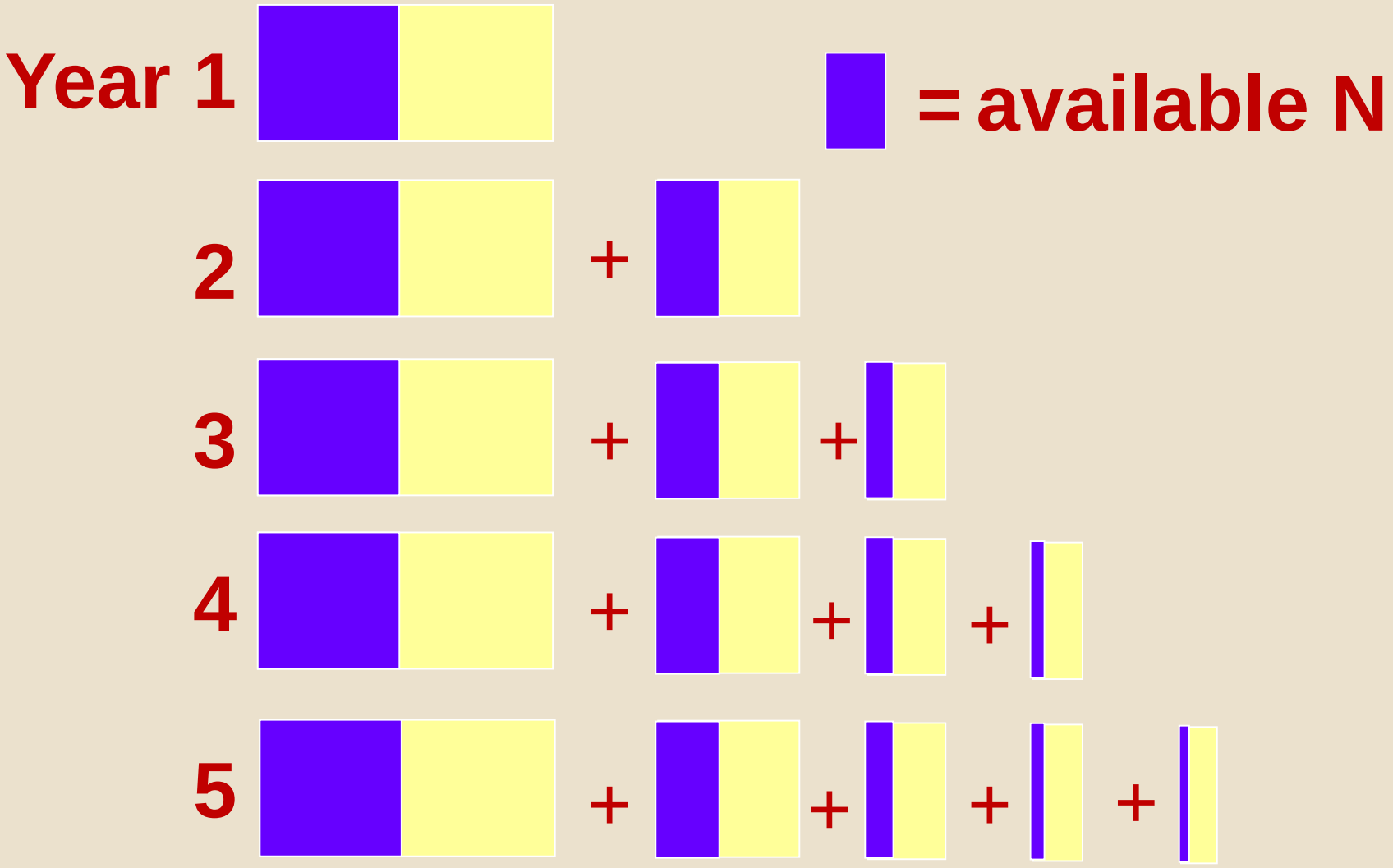
Factors Effecting N Mineralization

- Soil Moisture
- Soil aeration
- Soil Temperature

Organic Matter and Nitrogen Interactions

- Carbon to Nitrogen Ratio,
  C:N always to 1 part N
- >30 nitrogen immobilized (not available for plant growth)
- 20 - 30 neither available or immobilized
- <20 provides N for crop growth

Cumulative available N from an organic source



Biology of Composting

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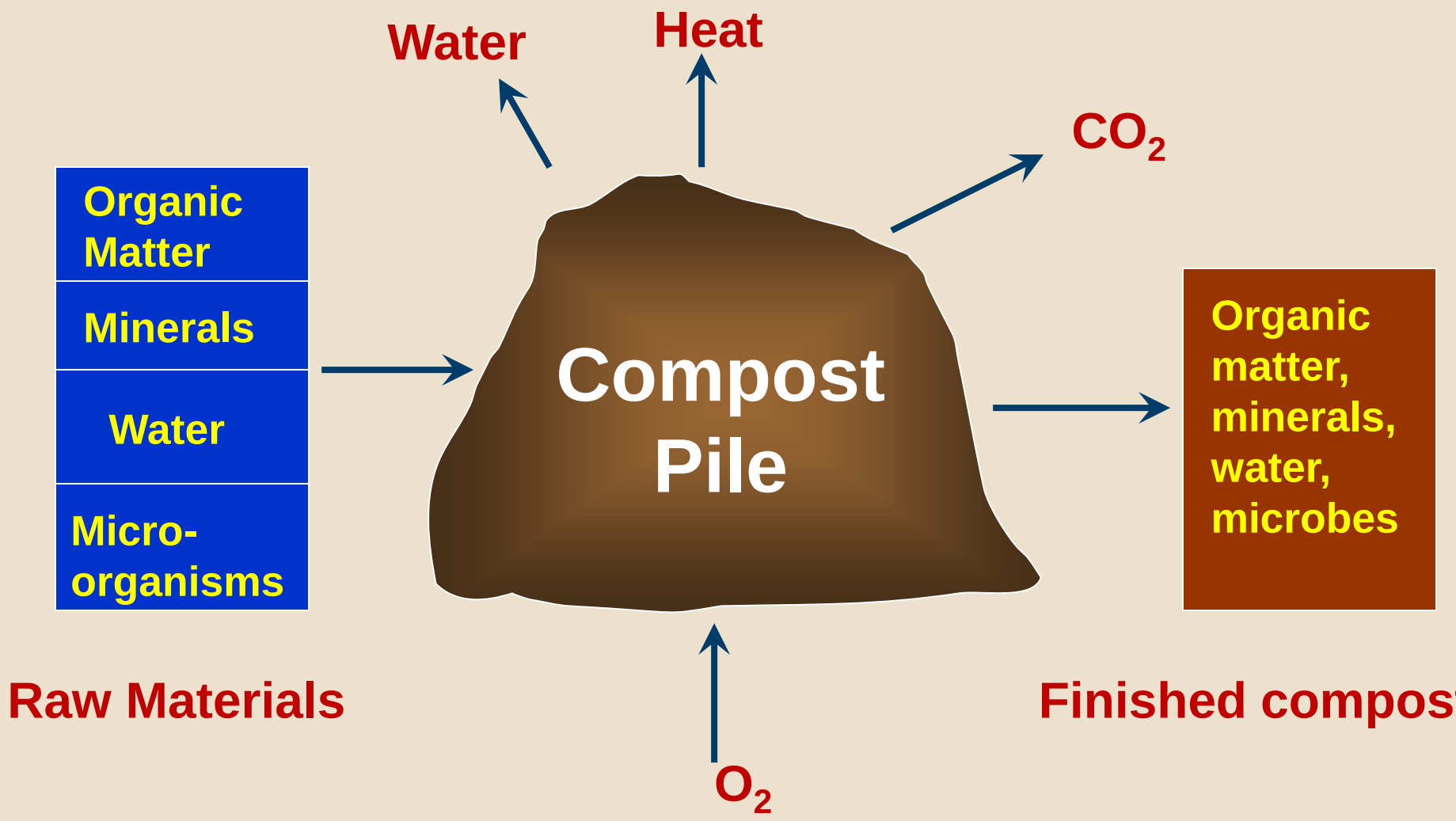
Summary: Requirements for Aerobic, Thermophilic Composting

Parameter	Reasonable Range	Preferred Range
C:N Ratio	20:1-40:1	25:1-30:1
% Moisture	40-65%	50-60%
O_2 Conc.	> 5%	~10%
Particle size	1-3 “	< 1-2 ”
pH	5.5-8.5	6.5-8.0
Temperature	131-170 ^{o}F	131-150 ^{o}F

The Composting Process



Dairy Solids Nitrogen and C:N ratio

Year	N, %	C, %	C:N	Moisture	Bulk Density lb/cu yard
2007	1.49	49	33	81	1342
2008	1.50	53	35	83	1392
2009	0.95	54	57	81	1156
2010	1.16	55	47	79	1061
2011	1.82	57	31	81	1156
2012	0.97	31	32	66	1022
2013	1.41	42	30	73	1018
average	1.33	49	33	78	1156

Oxygen consumption

aerobes (greatest percentage of microbes in compost pile)

- **facultative** (use oxygen, but can switch to other substrates when O_2 becomes limiting)
- **obligate** (cannot survive without O_2)

anaerobes (mostly killed or inhibited on exposure to O_2; some are facultative)

Energy yielding processes include

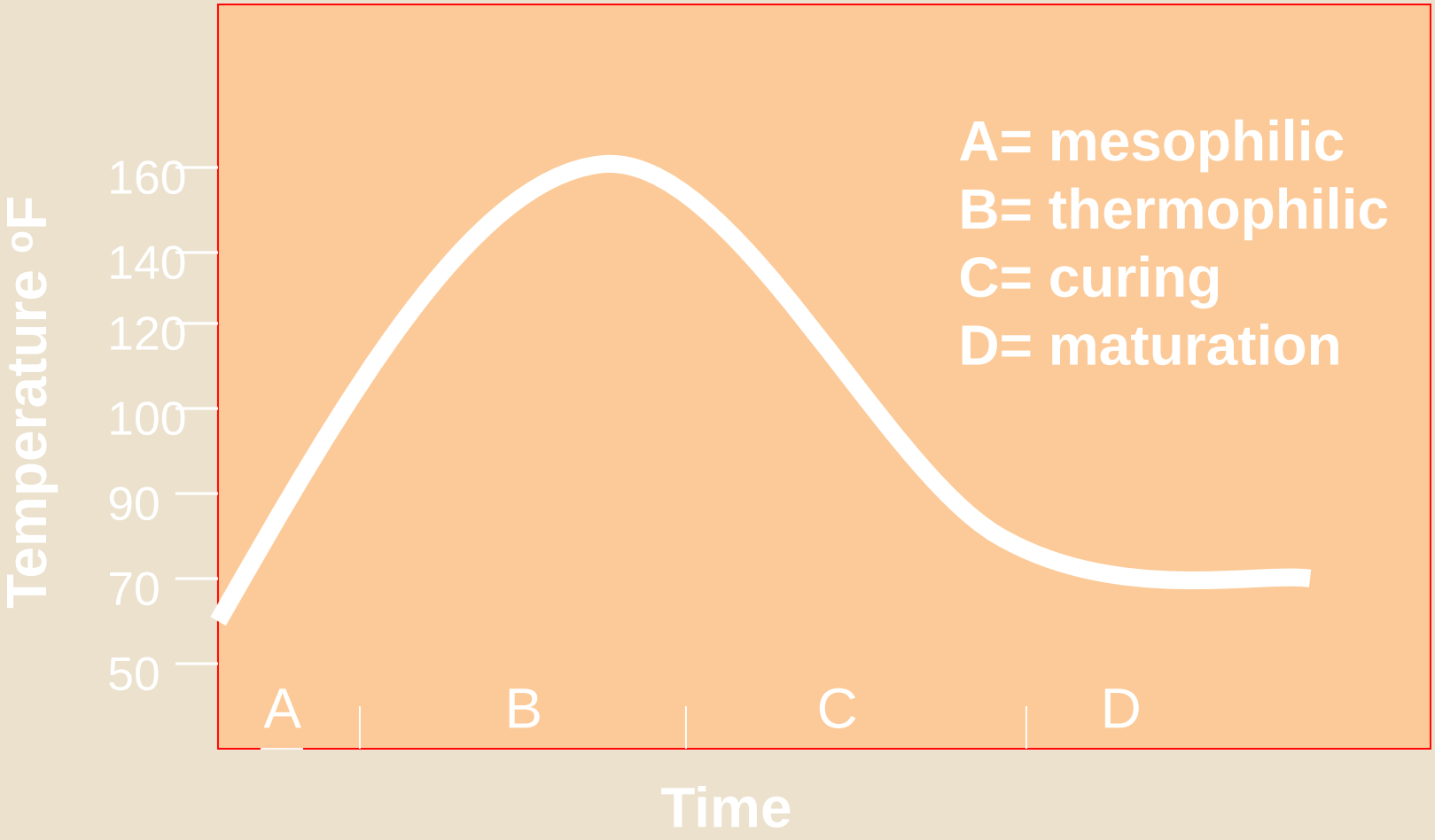
Aerobic respiration: use of O_2 as primary oxidizing agent

Anaerobic respiration: use of inorganic substances other than O_2 as oxidizing agent (e.g., sulfate, nitrate)

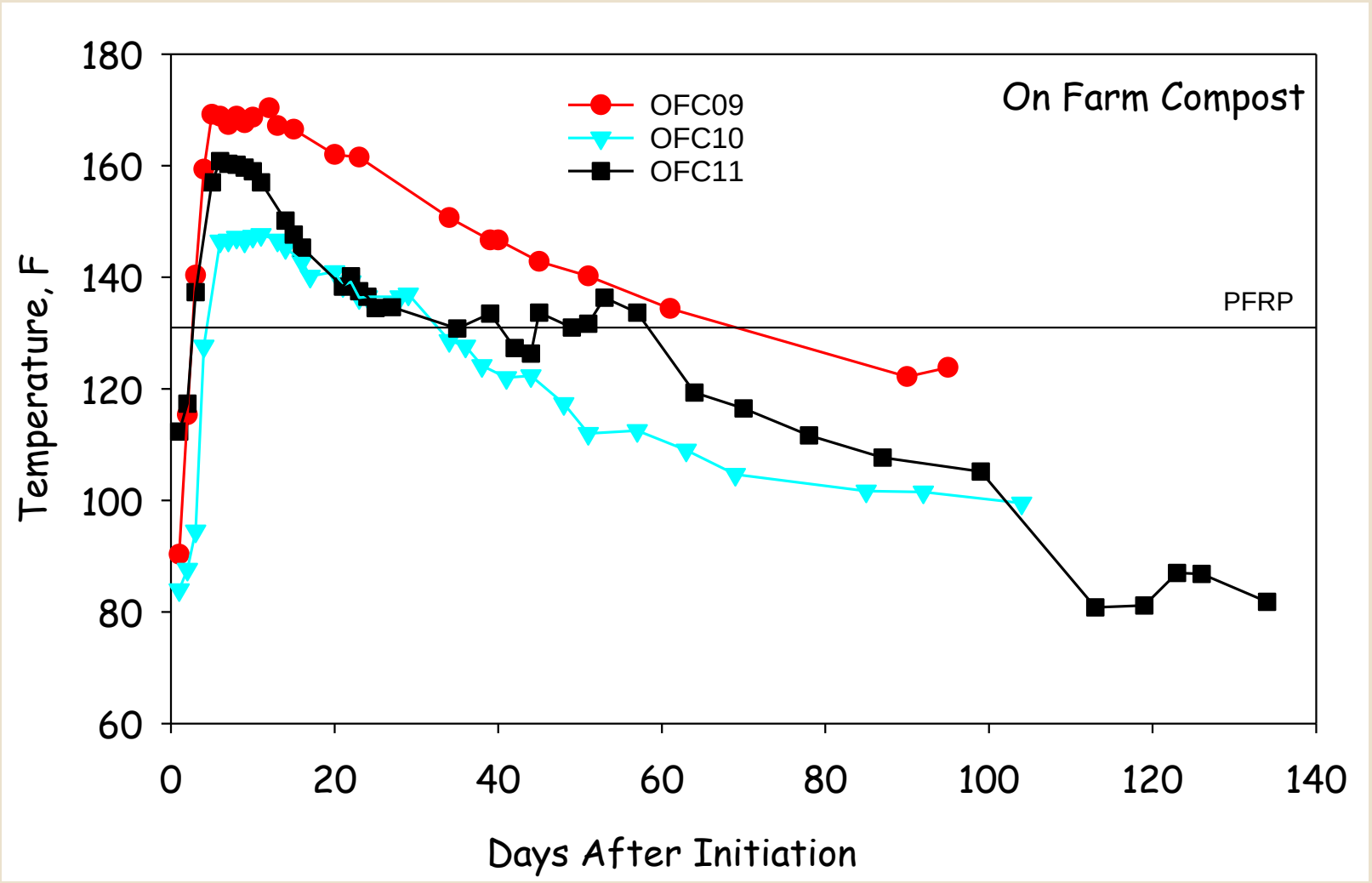
Phases of Aerobic Composting

- Mesophilic active phase: moderate temps., lasts for 24 hrs. to a few days
- Thermophilic active phase: high temps., lasts from a few days to several weeks
- Mesophilic curing and maturation phase: moderate to ambient temps., lasts 1-2 months.

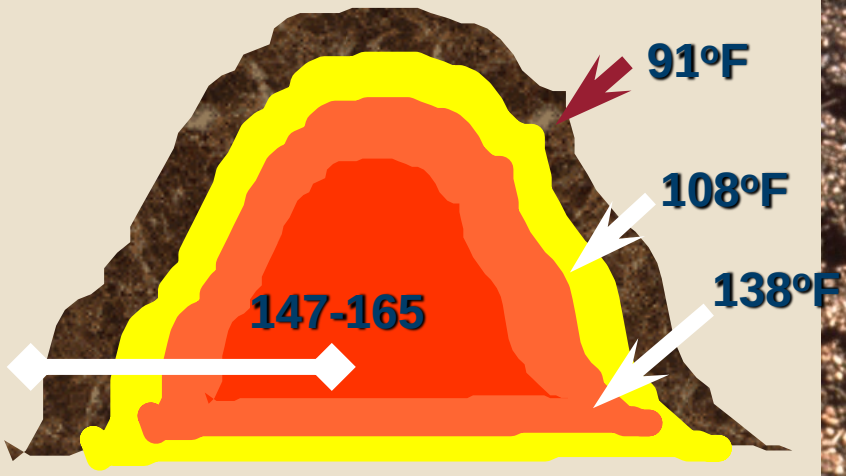
Temperature Changes in an *Average* Compost Pile



Aerated Static Pile Temperatures



Aerated Static Pile Composting



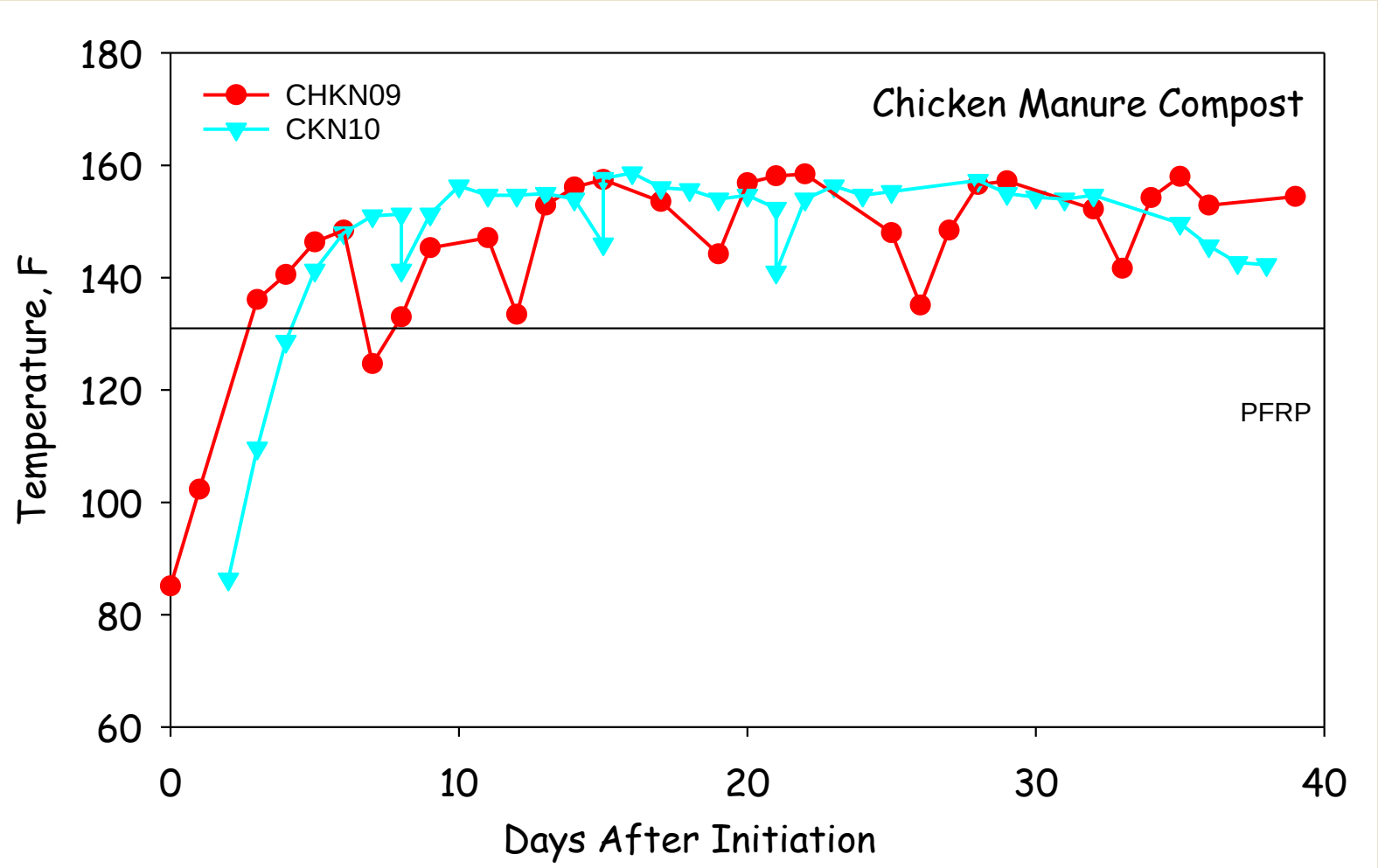
Turned windrow composting

Process to Further Reduce Pathogens PFRP

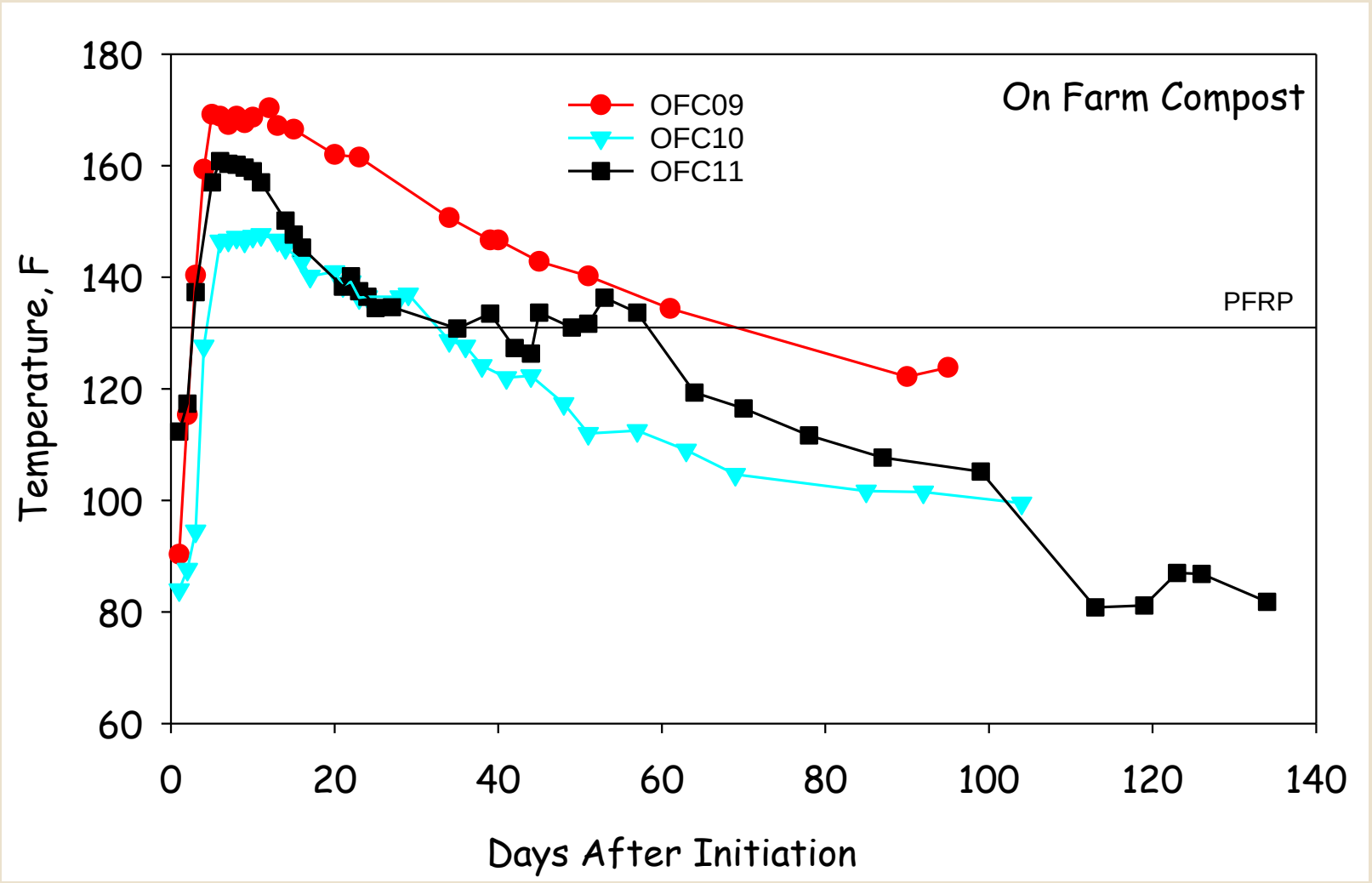
Meet temperature and time criteria

- **For windrow method maintain >131ºF for 15 days with a minimum of 5 turns.**
- **For static aerated systems or in-vessel systems >131ºF for 3 days**

Turned Windrow Temperatures



Aerated Static Pile Temperatures



Thank you
Questions

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