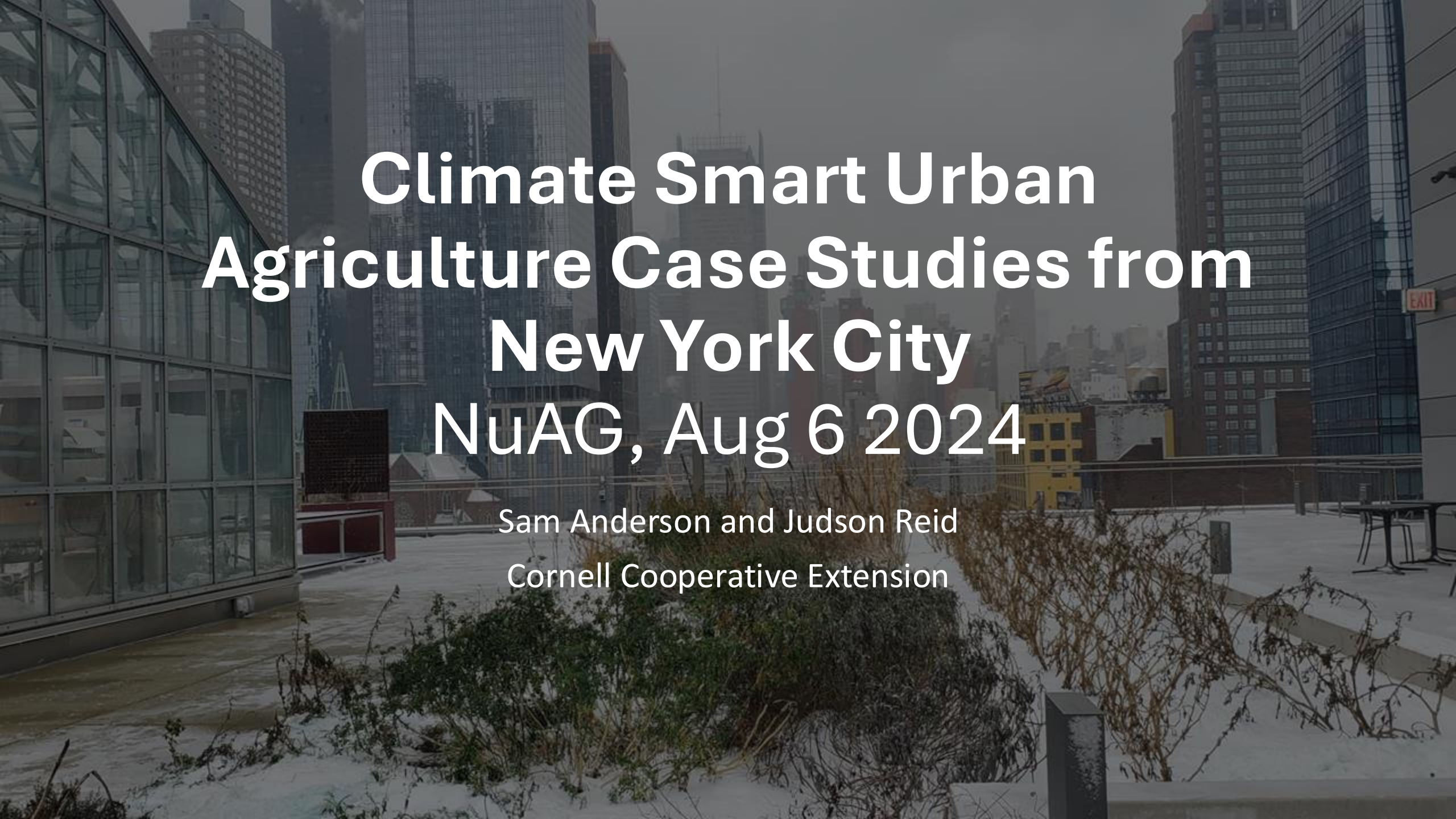


Climate Smart Urban Agriculture Case Studies from New York City

NuAG, Aug 6 2024

Sam Anderson and Judson Reid

Cornell Cooperative Extension

Soils of urban agriculture

Constructed soils

(Often not “native” soils)

- Large amounts of **compost**
- Mineral components: mostly sand
- Underlying: fill (sandy, gravelly, unpredictable)

New raised beds at New Roots Community Farm (Bronx, NY)

Constructed soil considerations

Basics:

- Organic matter
- pH

Physical:

- Water handling
- Depth, “compaction”

Nutrients:

- Imbalances (e.g. N, K, Mn)
- Adjusting soil tests with bulk density

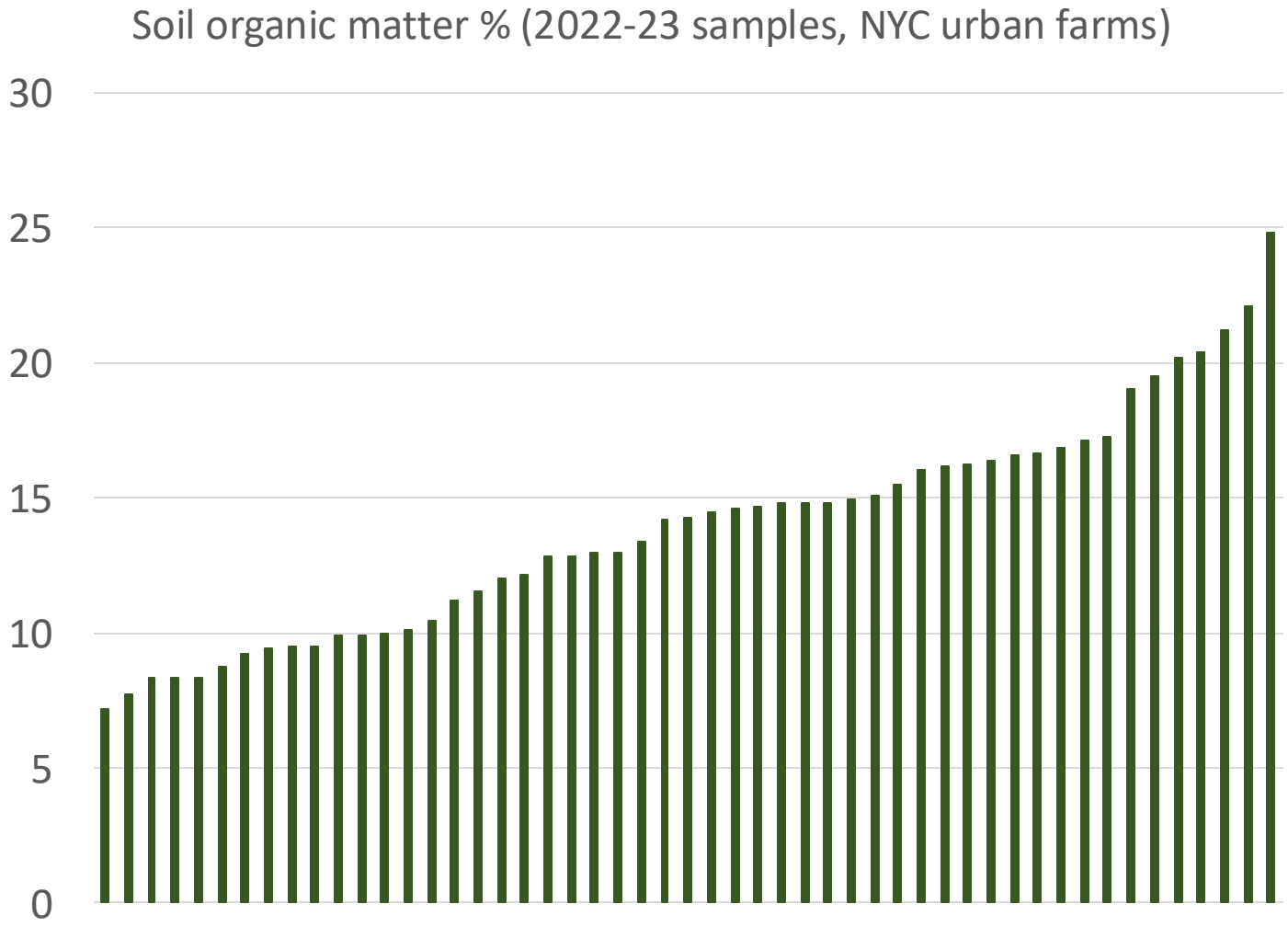
Pink Houses Farm (Brooklyn, NY).

Urban ag soils

High organic matter

Typical: 8 to 16%

Average (2022-23 samples) – 13.8%

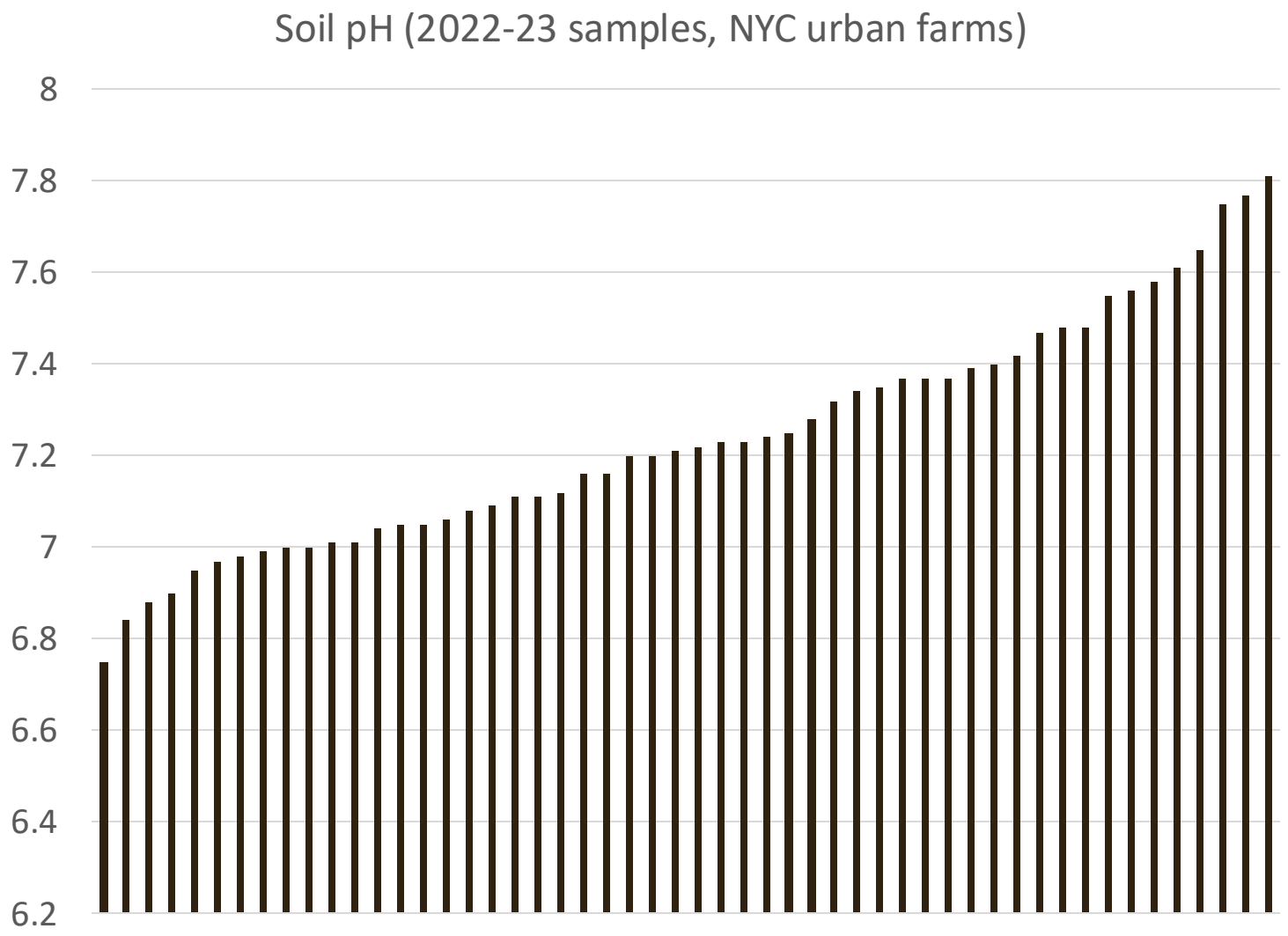


Urban ag soils

High pH

Typical: 7.1 to 7.4

Average (2022-23 samples) – 7.23



Water handling

High OM = porosity, low bulk density

Mostly helpful:

- Good water retention
- Well drained
- Very little compaction

Brooklyn Grange rooftop farm (Brooklyn, NY)

Water handling

Challenges

- Well-drained constructed soils may dry out more quickly than expected
- Can become temporarily hydrophobic

→ Old adages about watering (e.g. water less often, more deeply) don't always make sense

Inset: Blossom end rot on tomato.
Right: Drought-stressed tomatoes with twospotted spider mite damage

Soil depth

Often shallow soils, 1-2 feet

What's beneath?

- More soil?
  - Native soil, construction fill
- Permeable surface?
  - Landscape fabric, green roof membrane
- Impermeable(ish) surface?
  - Asphalt/pavement, container floor

Can mimic **subsurface compaction**

Brooklyn Grange rooftop farm
(Brooklyn, NY)

Water handling approaches

Shallow soils increase the need for excellent water retention

Approaches (urban farms/gardens):

- Organic mulches (wood chips, straw etc.)
- Creative cover cropping
- Reduced soil disturbance

Buckwheat cover crop, mowed and lightly incorporated, Red Hook Farm (Brooklyn, NY)

Nutrient handling

Mostly helpful:

- Slow-release nitrogen (and other nutrients) as OM breaks down
- Plenty of P, Ca, Mg
- Most micronutrient deficiencies uncommon

Collards in shallow raised beds, The Youth Farm (Brooklyn, NY)

Nutrient handling

Challenges:

- Excess nitrogen - **N flush in late spring/early summer**

Excess N problems for some vegetables:

- Increased pest & disease issues
- Fewer flowers & fruits
- Fruit quality issues, blossom end rot

Soil nutrient analysis

(e.g. Modified Morgan)

Standard practice:

ppm x 2 = lbs/acre

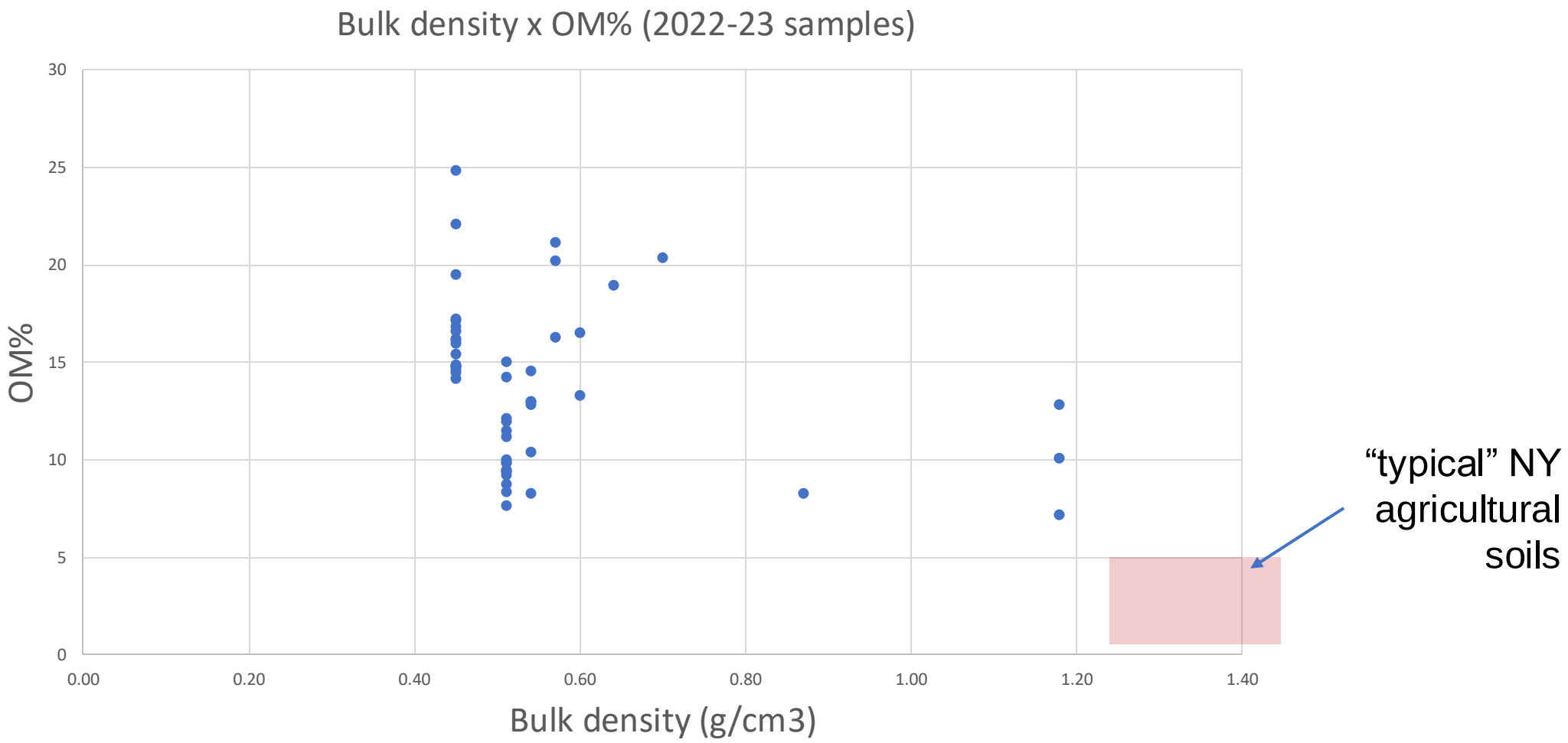
Assumes a “typical” soil bulk density

Element	lbs/acre*	Very Low	Below Optimum	Optimum	Above Optimum	High
Phosphorus (P)	127					
Potassium (K)	630					
Calcium (Ca)	3,484					
Magnesium (Mg)	251					

Element	Value	Element	Value	Element	Value
Soil pH	8.3	Manganese (Mn), lbs/acre	19	Aluminum (Al), lbs/acre	8
Iron (Fe), lbs/acre	1	Zinc (Zn), lbs/acre	2	% OM	2.4

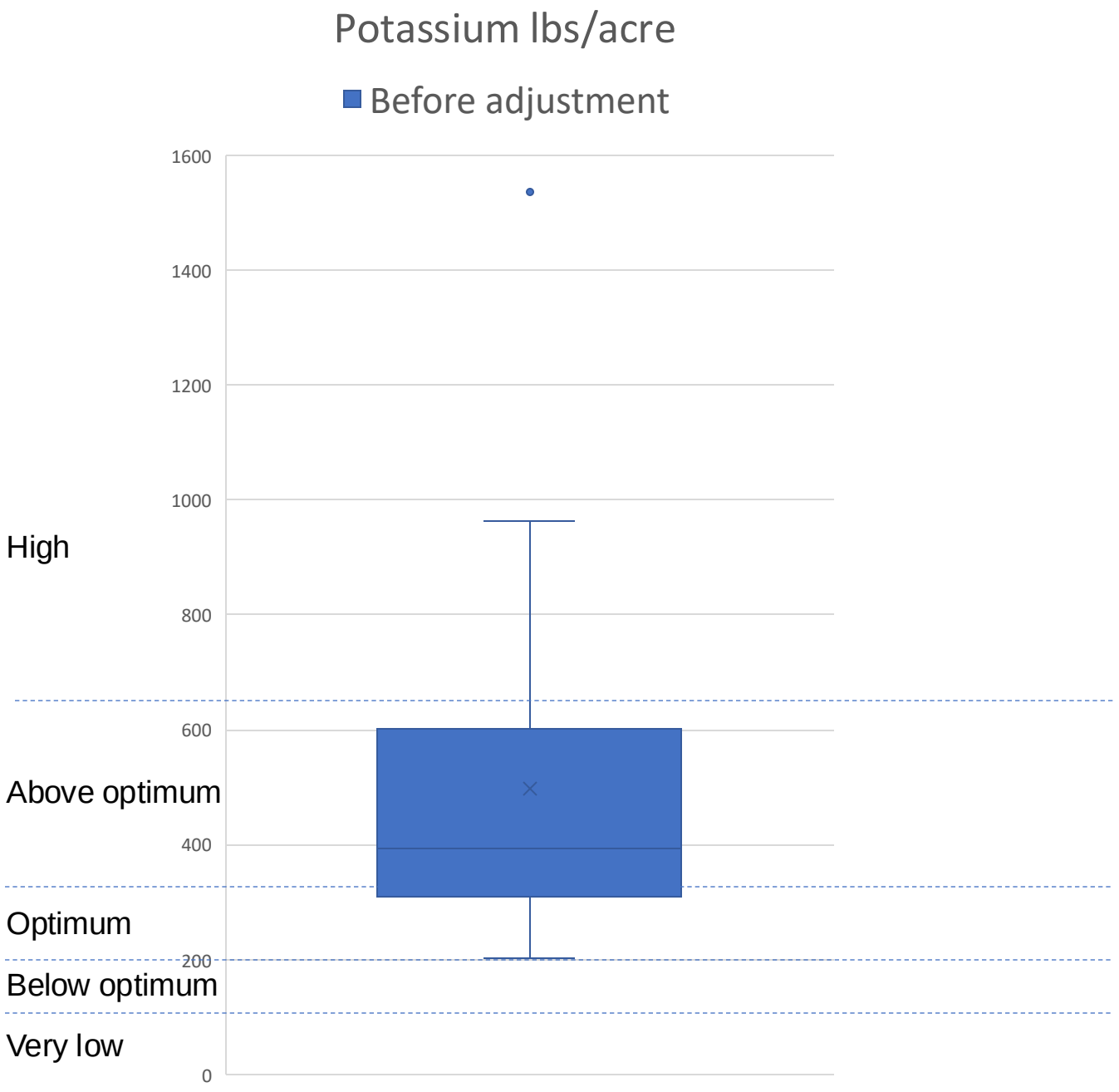
Low bulk density (and high organic matter %)

in urban ag soils of NYC



Adjusting results for bulk density

(2023 results, 21 samples from urban farms in NYC)



Adjusting results for bulk density

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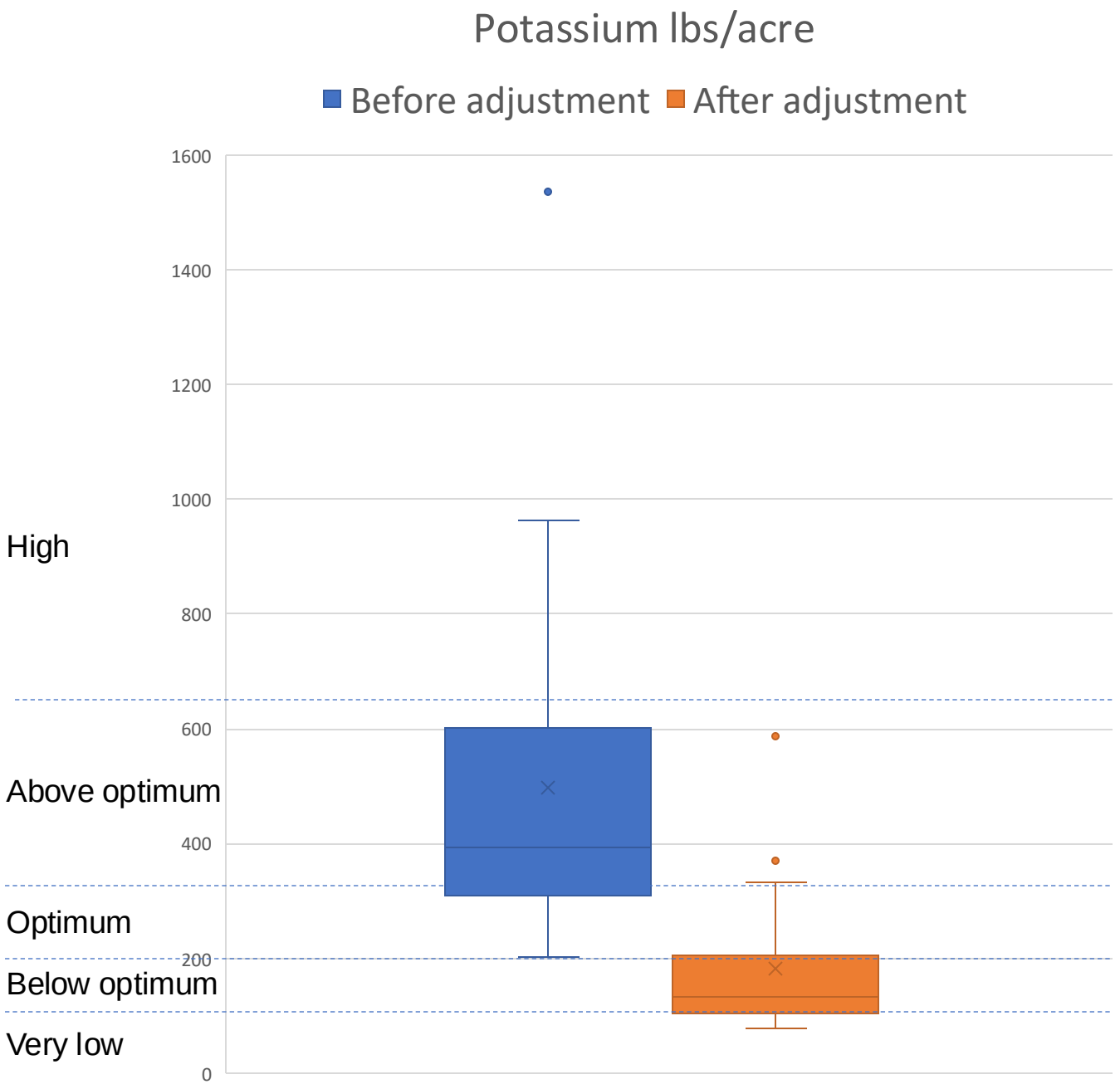
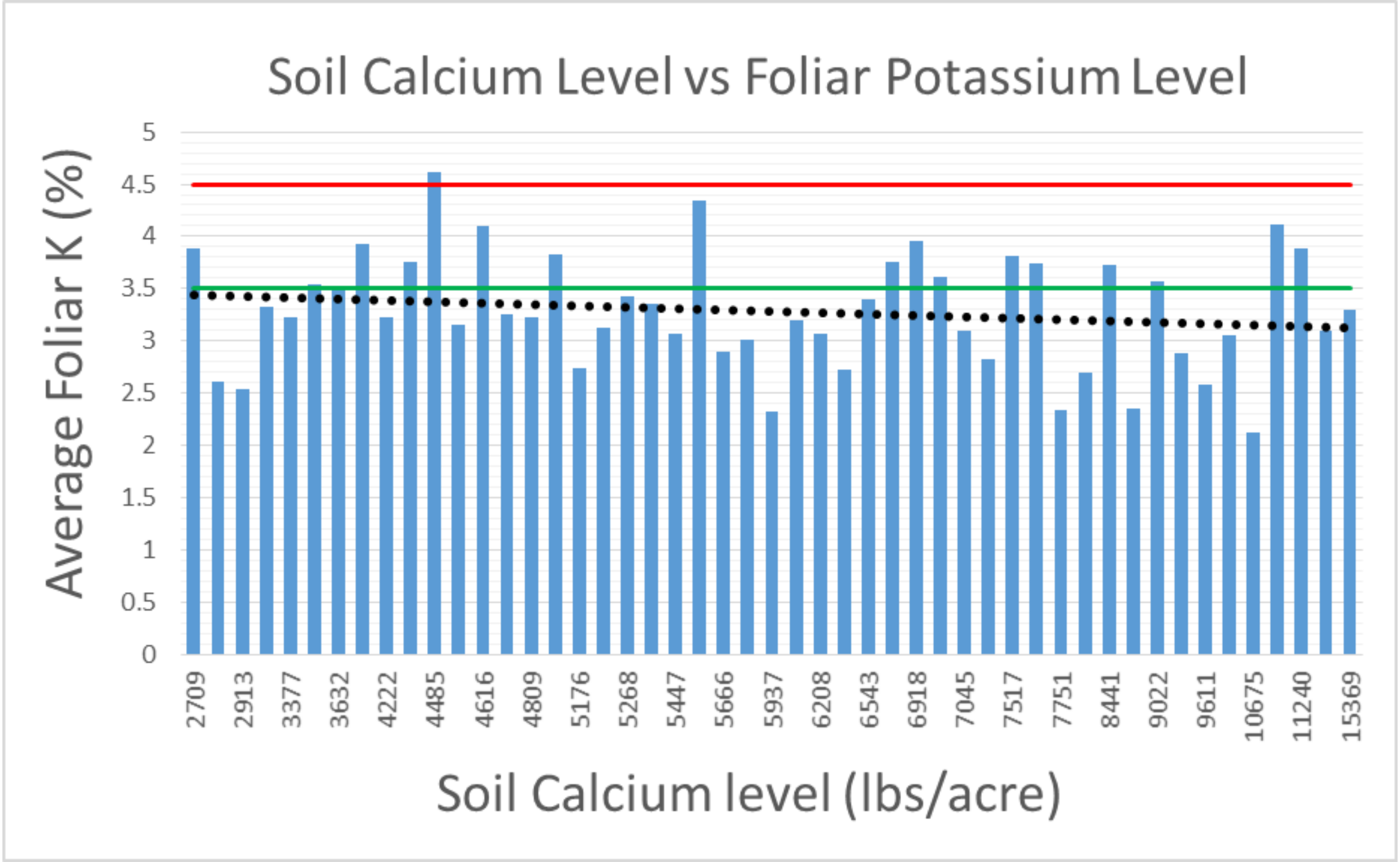
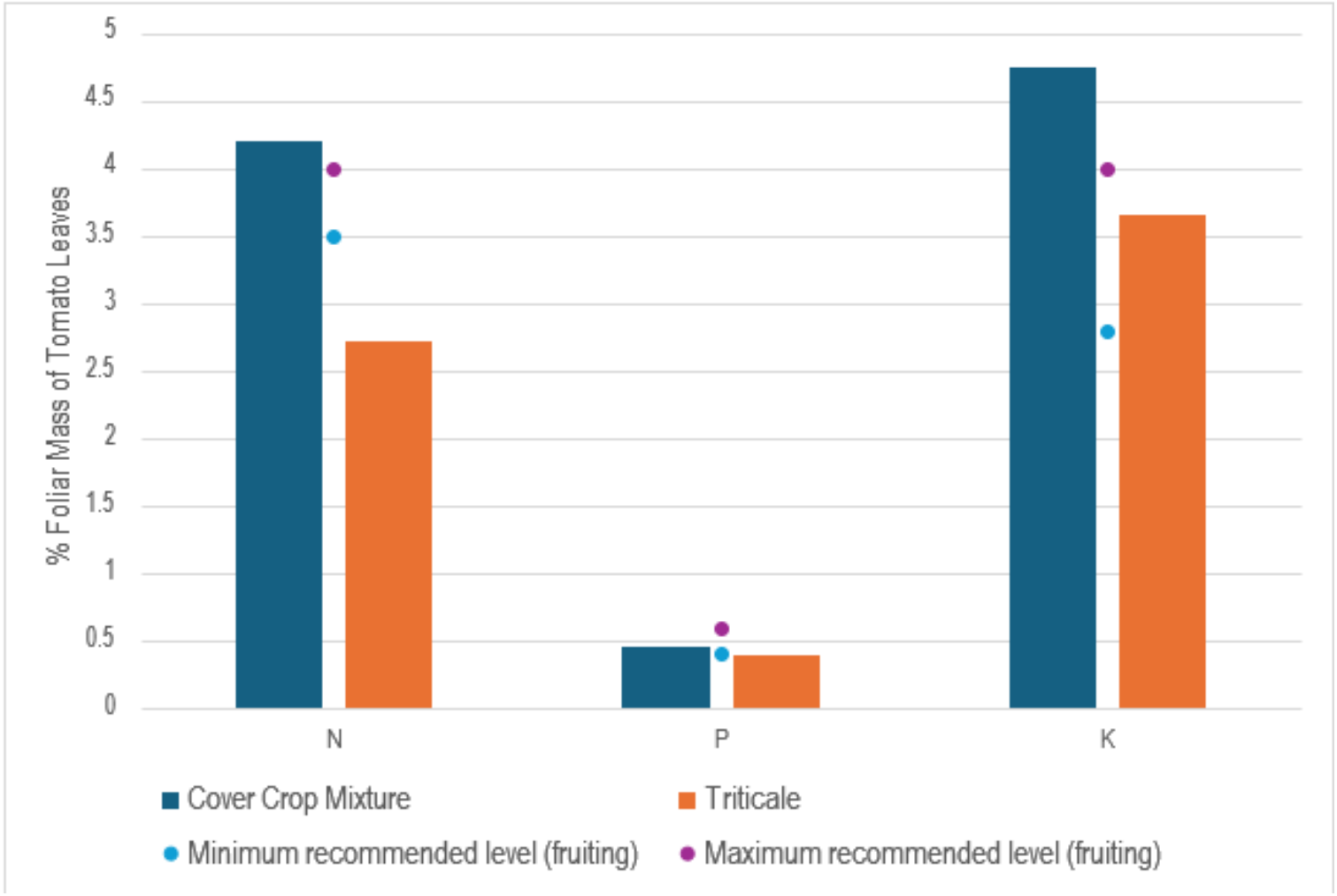



Soil Calcium Level vs Foliar Potassium Level
Average Foliar K (%)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2709
2913
3377
3632
4222
4485
4616
4809
5176
5268
5447
5666
5937
6208
6543
6918
7045
7517
7751
8441
9022
9611
10675
11240
15369
Soil Calcium level (lbs/acre)



Results from USDA CIG Project: multispecies cover crops support nutrient availability in high organic matter soils.

Credit and Thanks:

Sam Anderson, Cornell Cooperative Extension

USDA CIG cooperative agreement NR212C31XXXXG002 “Best Management Strategies for High Organic Matter Soils in Urban and Rural Vegetable production”

Cooperating Urban Farms in Buffalo, Rochester and New York City

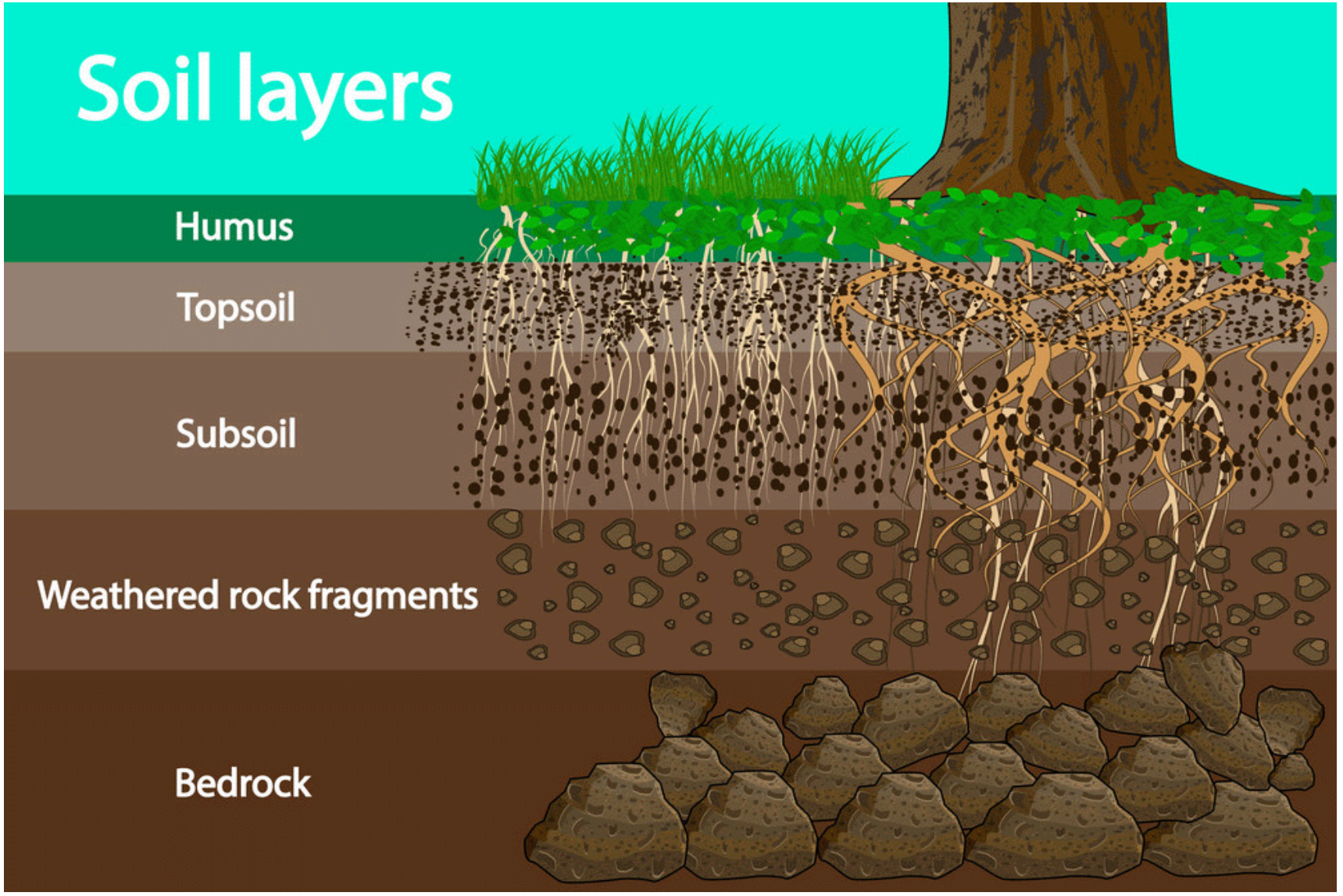
Cornell Cooperative Extension

Rock Dust

Kwesi Joseph| August 6th, 2024

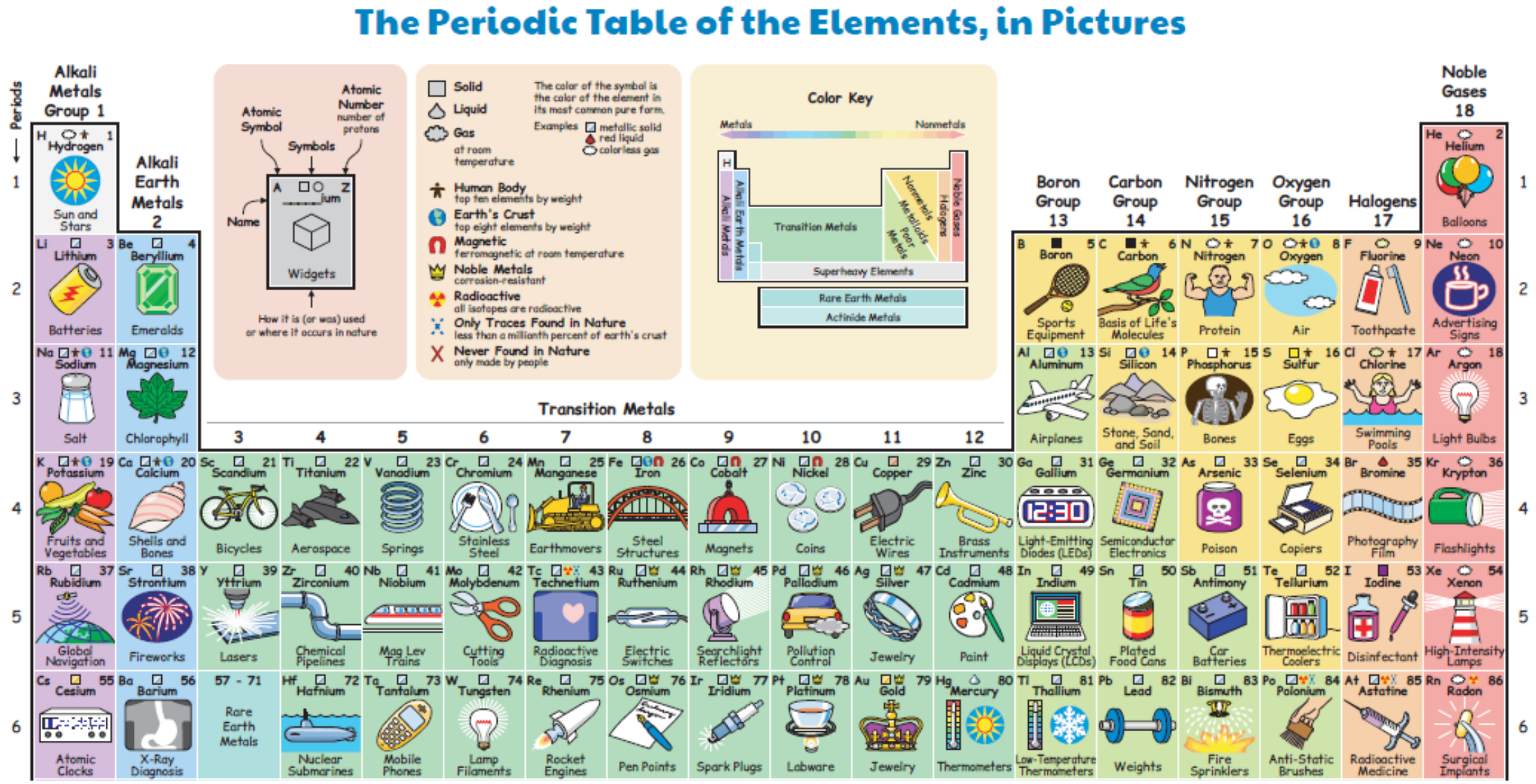
Johnson
Cornell
SC Johnson College of Business

What is soil? Soil is Weathered Rock

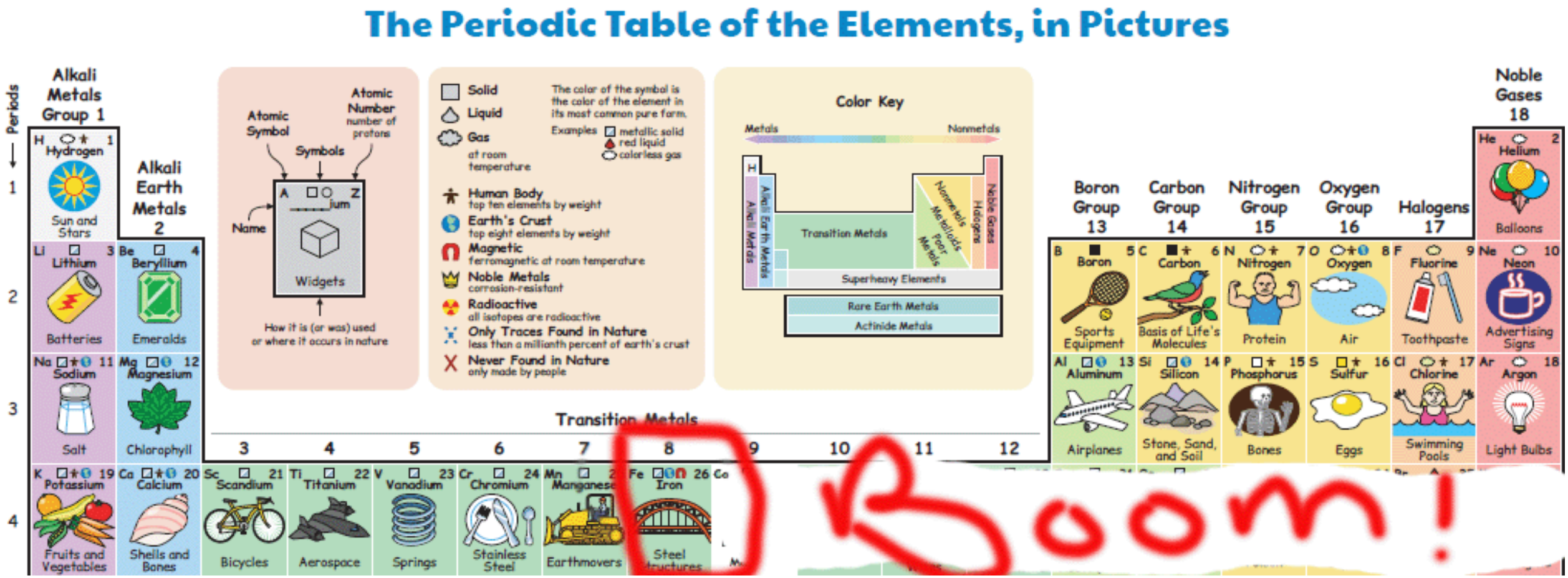


Rocks are an Aggregate of Minerals

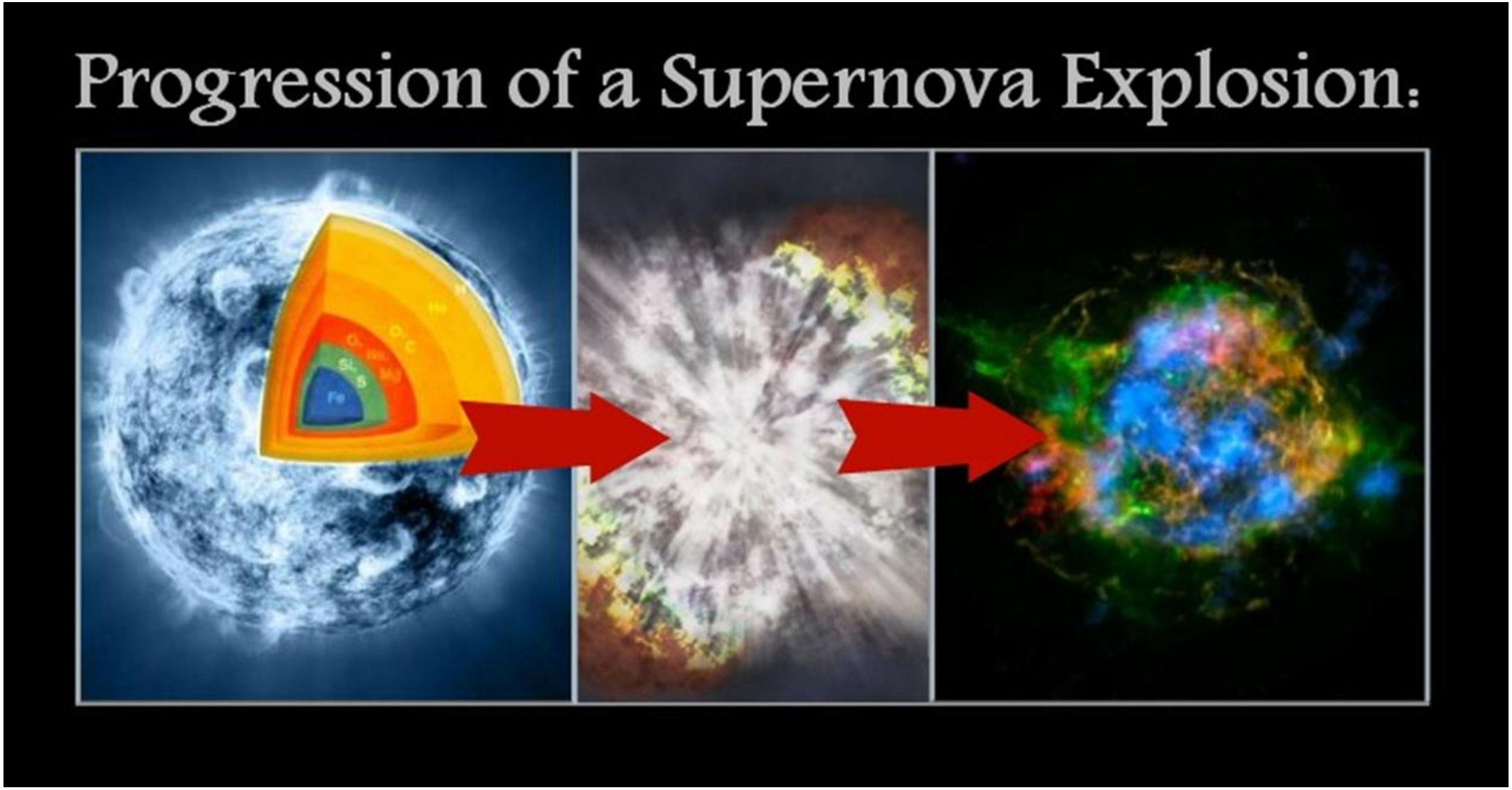
Minerals are Made up of Elements



Elements are Created in Exploding Stars

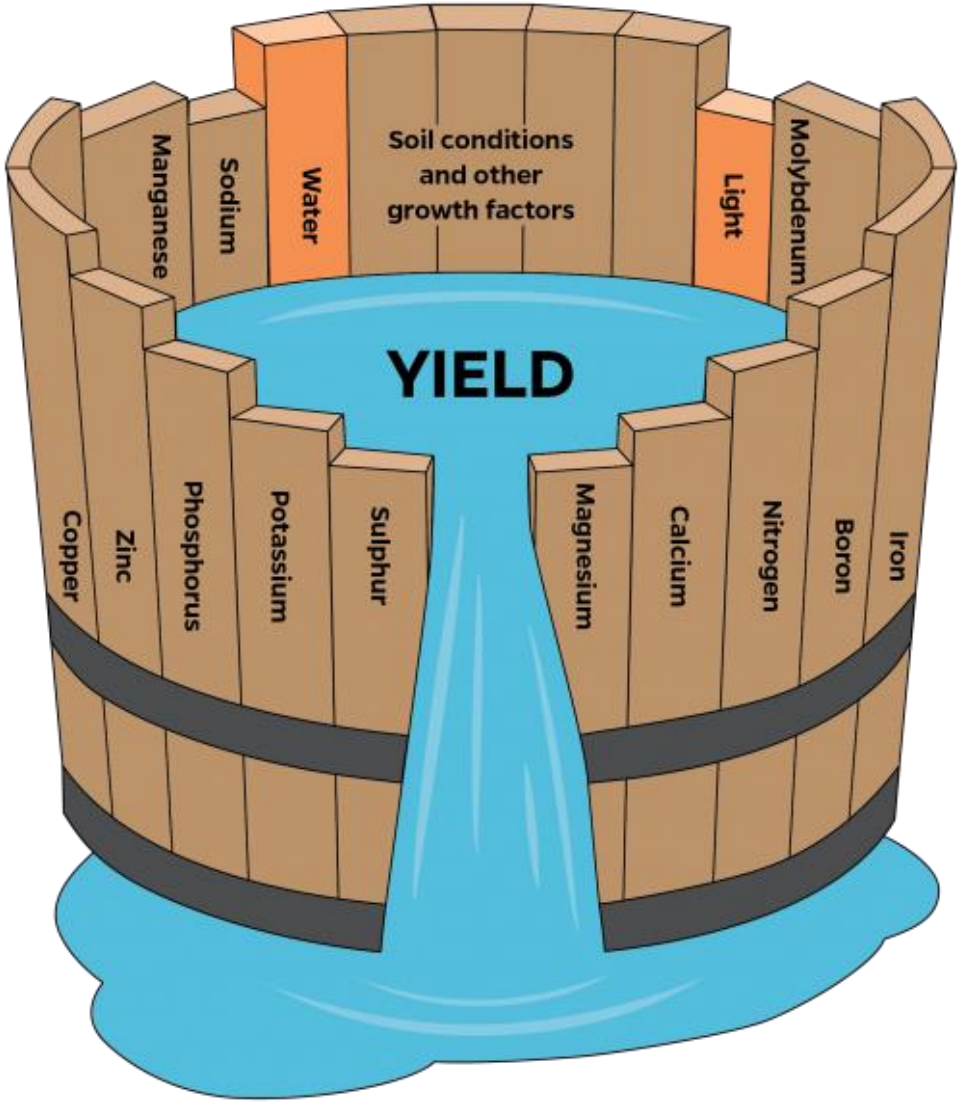


Dr. Neil deGrasse Tyson, “We are all Star Dust.”



Elements Control Chemical Reactions

- Law of the Minimum
  Justus von Liebig 1840
- You're only as strong
  as your weakest link



The 18 Elements Plants Crave

Some of these elements are utilized within the physical plant structure, namely:

- Carbon (C)
- Hydrogen (H)
- Oxygen (O)

Macronutrients
Elements Used in Large Quantities

The primary macronutrients are:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)

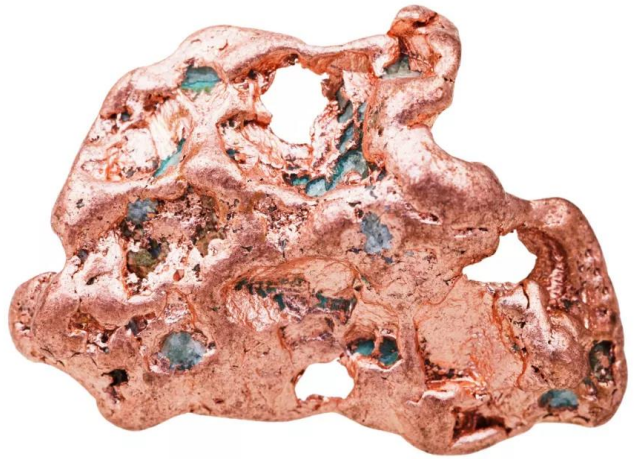
Macronutrients

The secondary nutrients are:

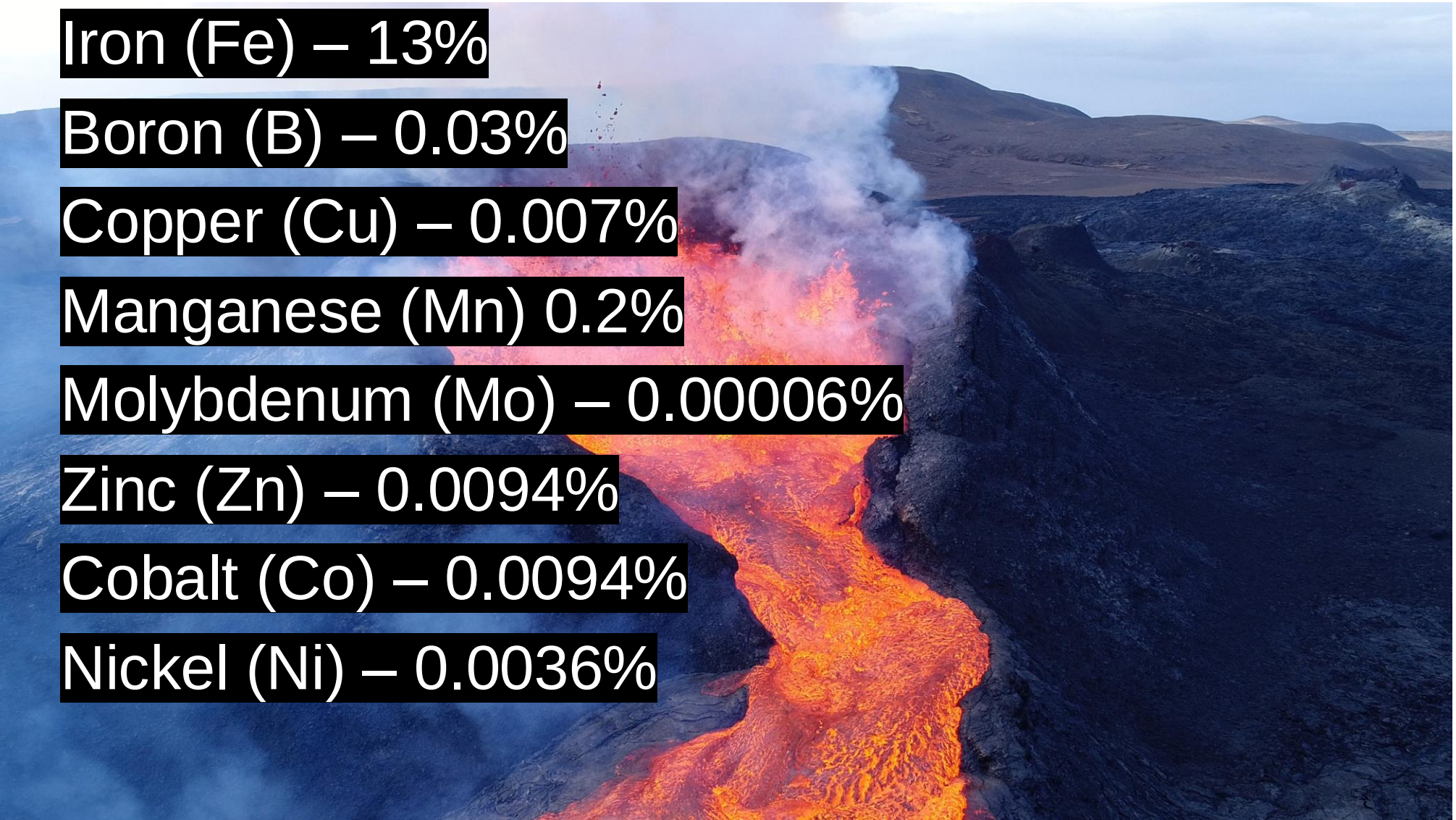
- Calcium (Ca)
- Magnesium (Mg)
- Sulfur (S)

Micronutrients
The Trace Elements from Rocks

These elements are used in small quantities by plants but are critical for plant health



The Micronutrients in Basalt



We Need Some Heavy Metals

Recommended Maximum Soil Trace Element Concentrations for Garden Soils in the Northeast			
Metal	**Concern**	**Soil concentration (ppm)**	**Basalt analysis (ppm)**
Arsenic (As)	Human Toxicity		
Barium (Ba)	Human Toxicity		
Cadmium (Cd)	Human Toxicity		
Chromium (Cr)	Human Toxicity		
Copper (Cu)	Plant Toxicity	75	67
Nickel (Ni)	Plant Toxicity	40	36
Lead (Pb)	Human Toxicity	400	5
Zinc (Zn)	Plant Toxicity	150	94

What Rock Dust Will Do

- Improve soil health (the microbes need the trace elements)
- Increase plant resistant to disease and pest – phytoliths
- Enhance the flavor profile of fruits and vegetable
- Increase plant nutrient density
- Improve human health
- Increase yield

Soil Isn't Just a Growing Medium, it is Alive

- Soil microbes convert elements into a biologically available form for plants to utilize

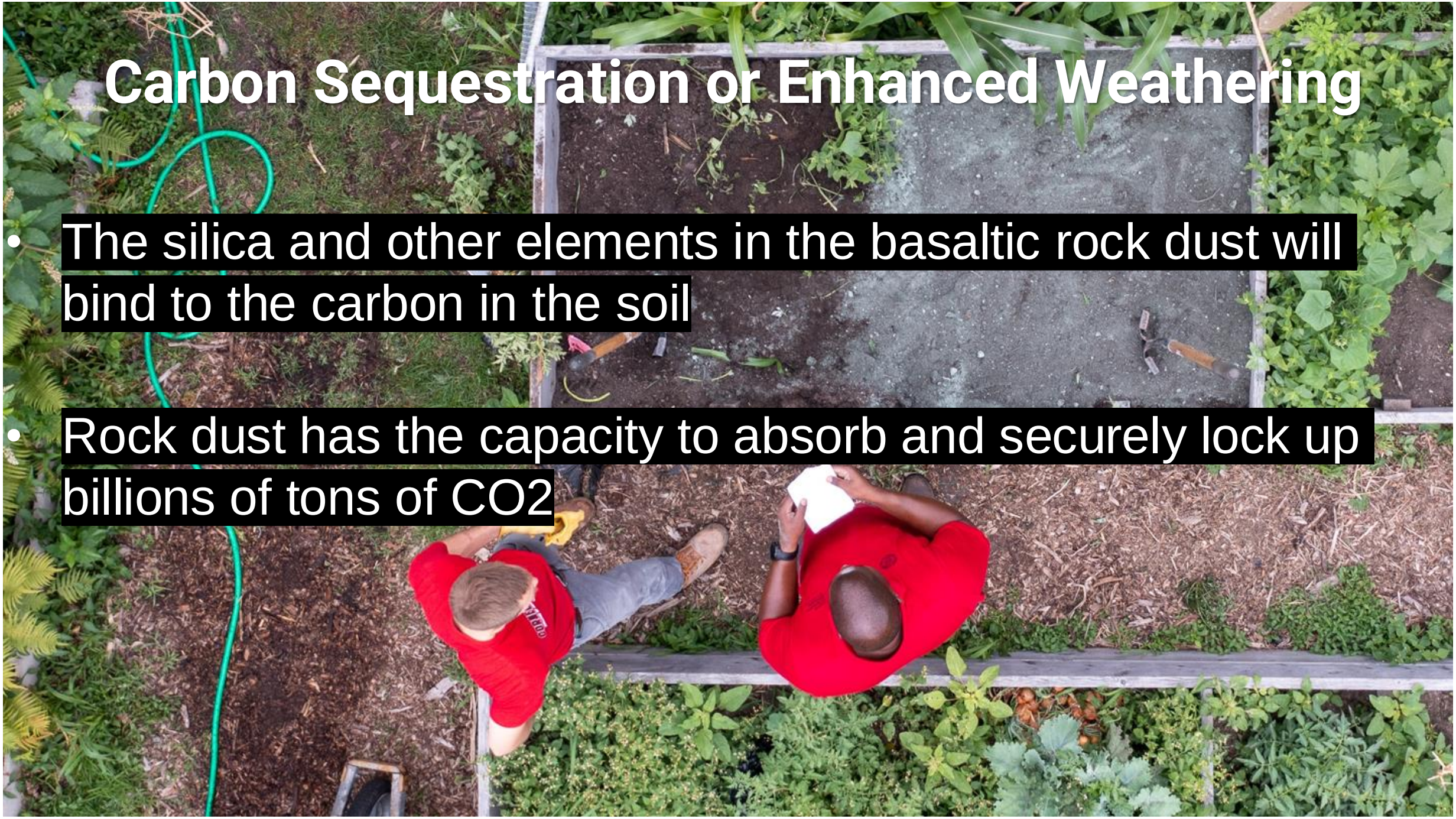


The Rock Dust Equation

Healthy Soils = Healthy Plants = Healthy Humans

Rock Dust Slowly Removes Carbon from the Atmosphere

Carbon Sequestration or Enhanced Weathering



- The silica and other elements in the basaltic rock dust will bind to the carbon in the soil
- Rock dust has the capacity to absorb and securely lock up billions of tons of CO_2


QUESTIONS?

URBAN FARMING, EDUCATION + ENVIRONMENTAL STEWARDSHIP

Oko Farms is an Aquaponics Farm and Education organization in Brooklyn, New York.

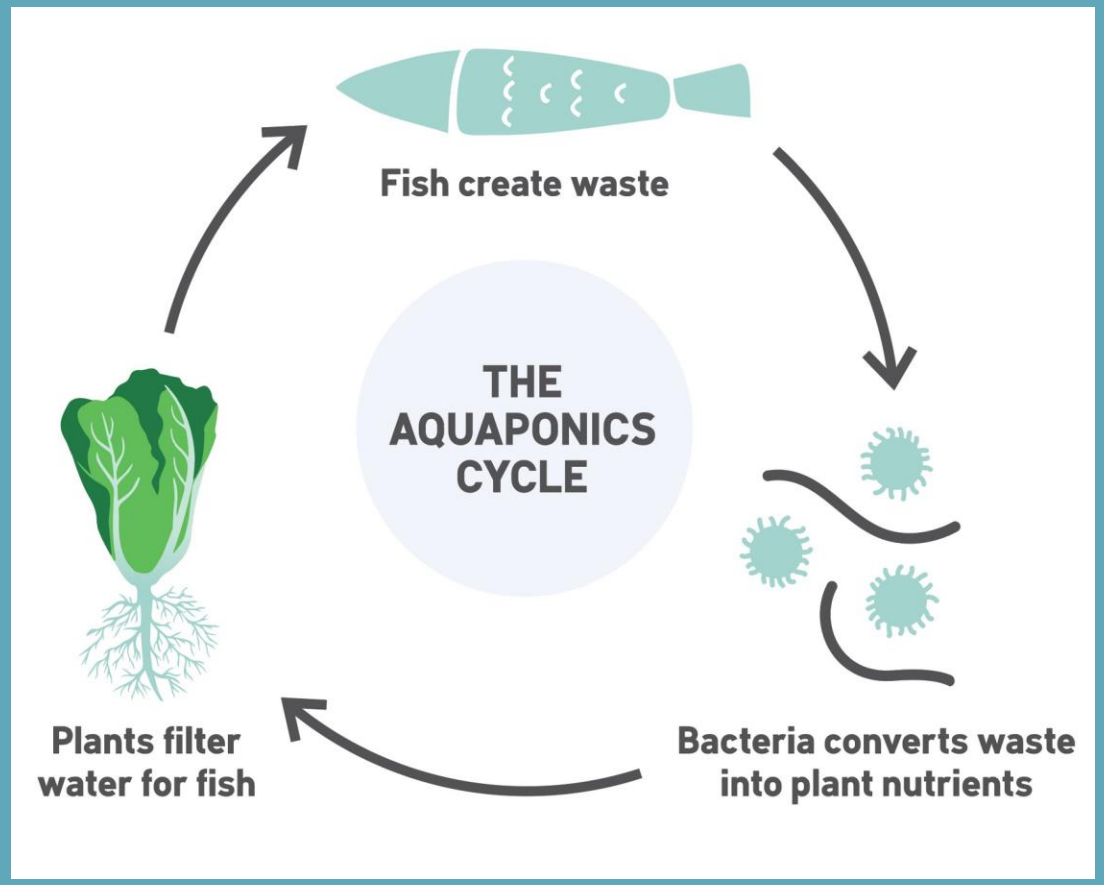
We operate NYC's largest outdoor and only publicly accessible aquaponics farm.

Oko Farms

MISSION

To promote aquaponics as an ecological farming method that mitigates the impact of climate change and increases food security for urban residents while demystifying aquaponics through awareness and education.

WHAT IS AQUAPONICS

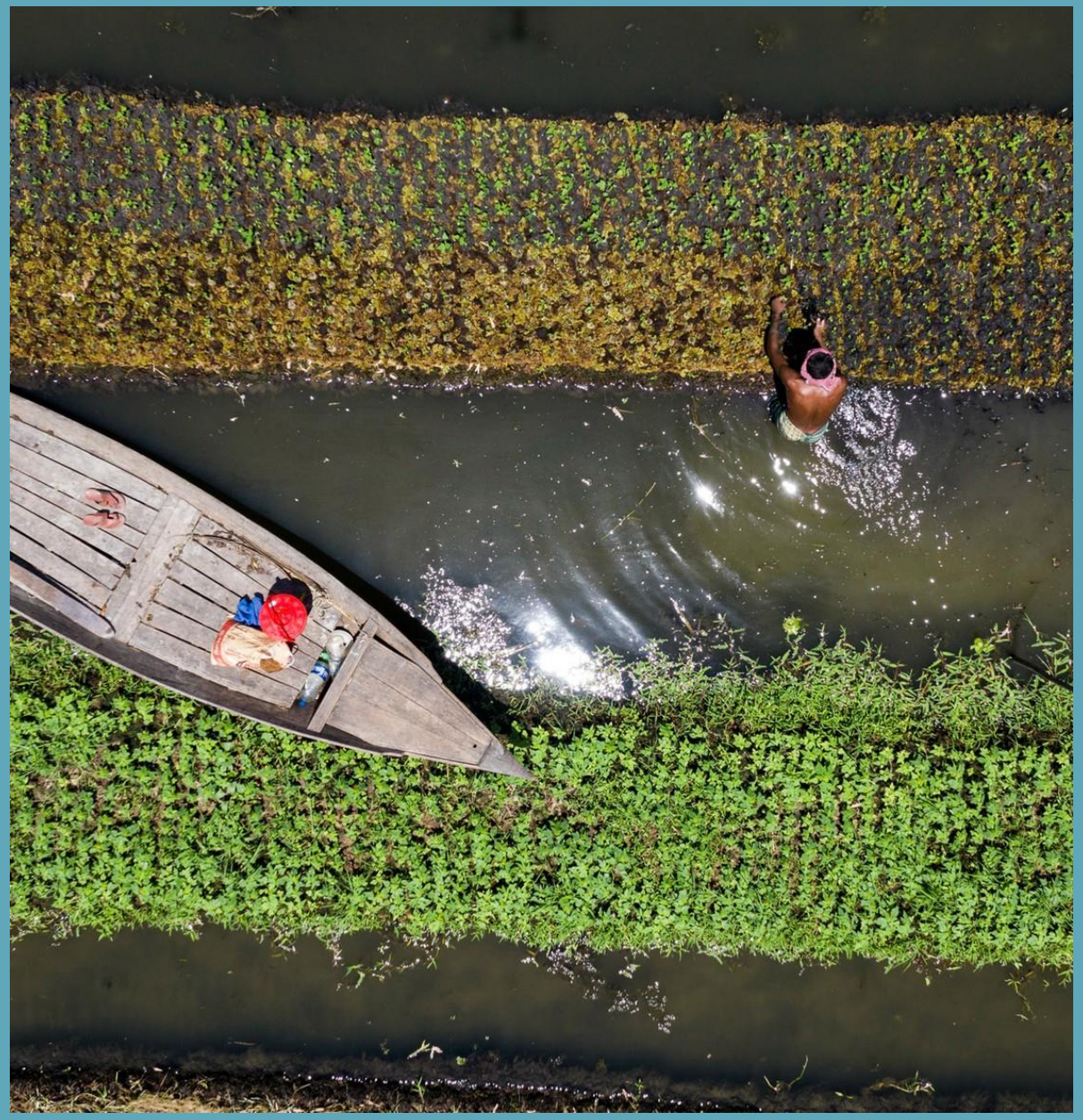


Aquaponics is farming in water.

Cultivation of fish and plants in a symbiotic aquatic environment.

Mimics the closed loop ecosystem that takes place in natural bodies of water.

Recycles water for food production.



WHY AQUAPONICS?

Adaptation:

- Climate extremes
- Environment
- Soil degradation
- Water conservation
- Symbiosis + Biodiversity

GUIDING PRINCIPLES

COMMUNITY CENTERED

SUSTAINABLE ADAPTABLE

INNOVATIVE HANDMADE REPLICABLE

EFFICIENT BIODIVERSE INEXPENSIVE

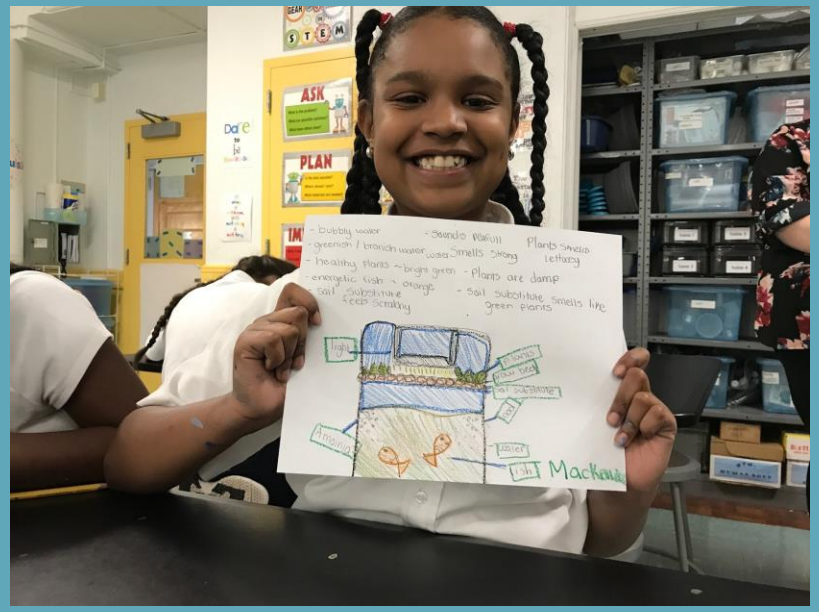
LOCAL TRANSFERABLE ACCESSIBLE

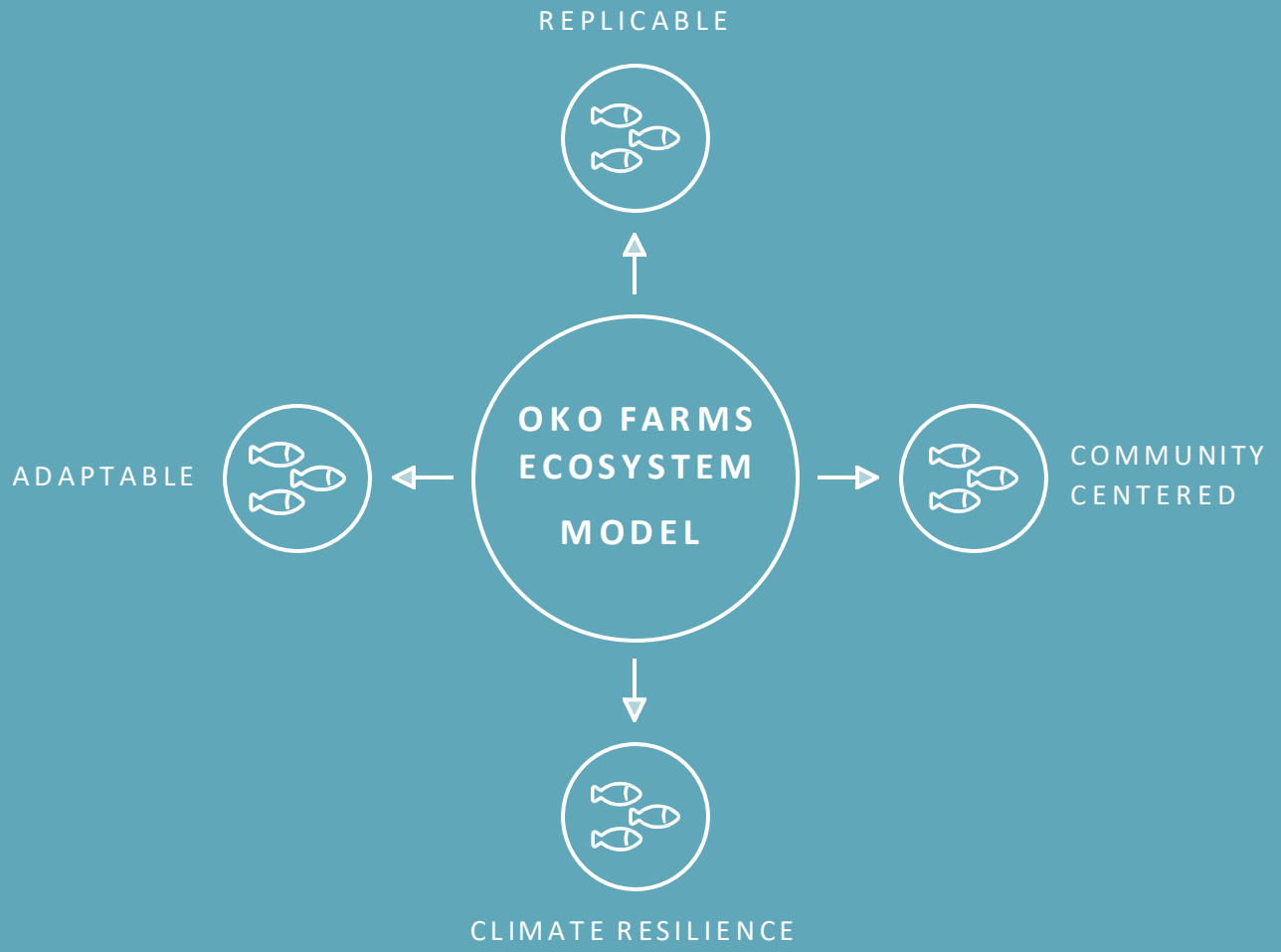
ECOLOGICAL

EQUITABLE FOOD ACCESS | ENV. HEALTH EQUITY

VISION:

SYSTEMIC & STRUCTURAL CHANGE...
WHERE **EVERYONE** PARTICIPATES





PUBLIC PROGRAMS (FARM SITE)

WEEKLY MARKET STAND

AQUAPONICS EDUCATION

YOUTH TRAINING PROGRAM

FOOD DONATIONS

OKO APOTHECARY

COMMUNITY SATURDAY + WELLNESS WEDNESDAY

Oko Farms

PUBLIC PROGRAMS (FARM SITE)

ACADEMIC RESEARCH

CLOTHING RESTORATION PROJECT

FARM TO TABLE EVENTS

PUBLIC PROGRAMS (PARTNER SITES)

AQUAPONICS IN SCHOOLS

FARMS TO COMMUNITIES

PUBLIC SPEAKING

Oko Farms

“I learned what it looks like to *balance environmental protection, financial sustainability*, and community engagement. I am incredibly grateful to have had the opportunity to *interact with the diverse audience that Oko attracts*. I was reminded again and again that there is a *space for everyone in the world of sustainable farming*.”

MIA, 2023 YOUTH INTERN

Website: **www.okofarms.org**

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