Repurposing the Greenhouse Display Gardens into an Environmental Education Exhibit and Orientation Center

Alison Kopsco, MCRP ‘19
Lisa Avichal, MCRP ‘19
Emily Maciejak, MCRP ‘19

Avonnét Bell, JD/MCRP ‘19
Mike Kwan, MCRP ‘19
Anna Quan, MCRP ‘19

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Rutgers University Faculty & Staff

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Planning Studio Classmates

Content Overview

- Goals & Objectives
- Methodology
- Existing Conditions
- Innovative Examples
- Recommendations
- Future Research

Goals & Objectives

Greenhouse Project Principles and Objectives

- Reduce carbon emissions & energy usage, educate about carbon sequestration
- Focus on native species
- Hands-on learning
- Accessible and comfortable spaces for school trips

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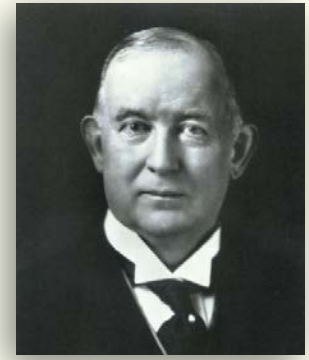


Image Source: Wikipedia

James B. Duke purchases and begins to assemble land that now comprises Duke Farms.

1917

Greenhouse complex is completed.

1964

Greenhouse complex opens to the public as “Gardens of the World.”

2008

Greenhouse complex closes to the public because Duke Farms has shifted its mission from displaying plants to modeling environmental stewardship.

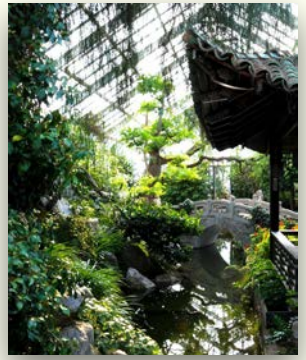


Image Source: Wikipedia

Methodology

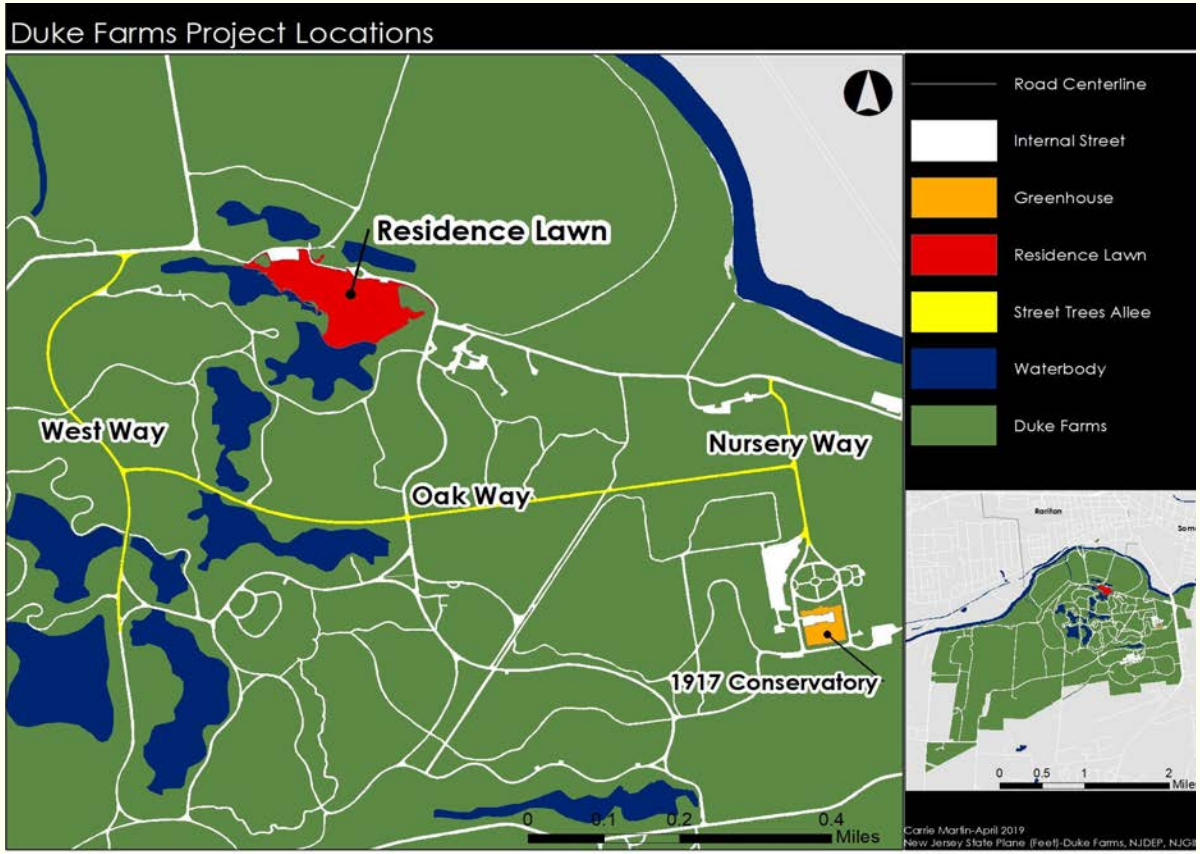
The Process of Re-purposing the Greenhouses

- Site visits
- Interviews with Duke Farms executive team
- Documents
- Consultations with design, education, and greenhouse professionals

Greenhouse Methodology

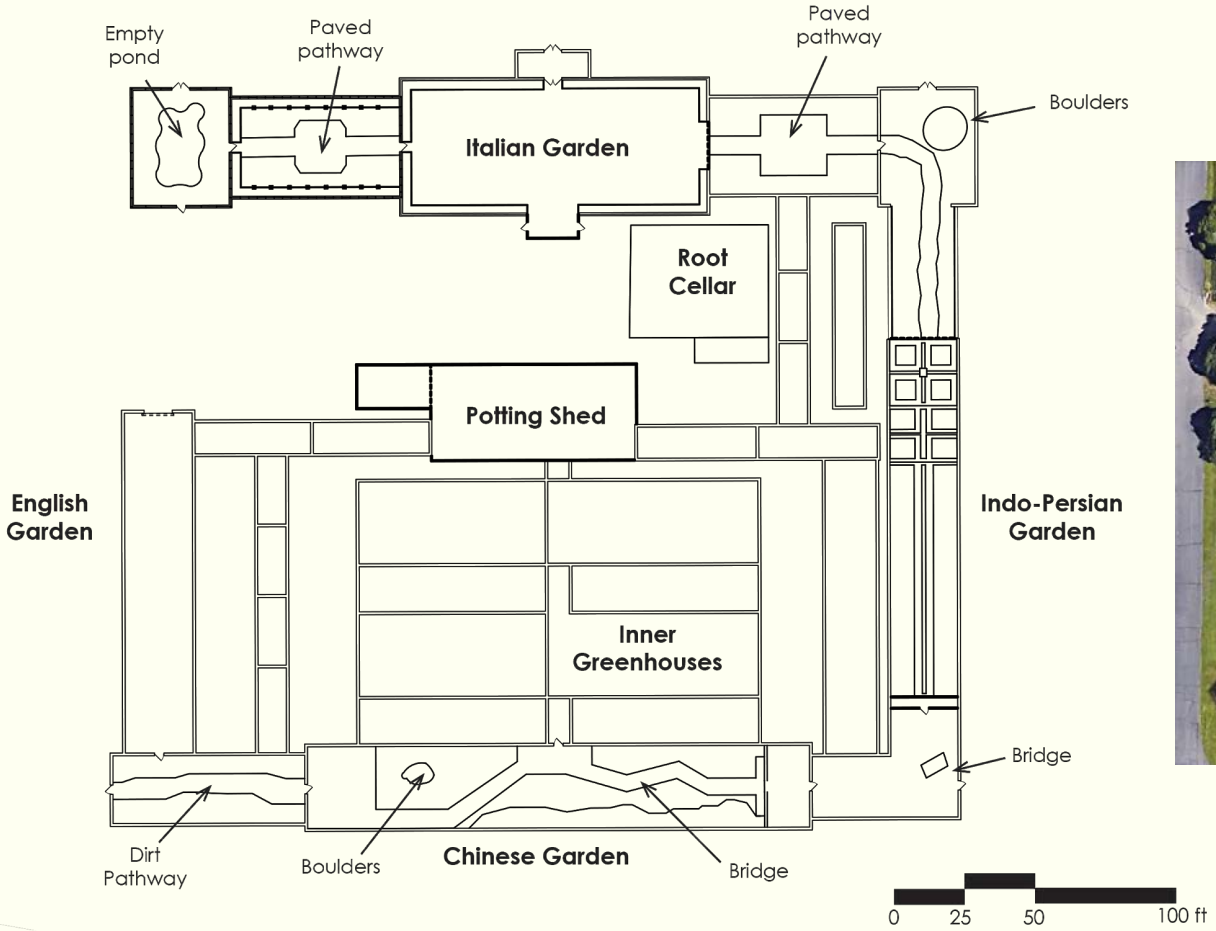
- Existing Conditions
  - Site Location
  - Key Geographic Features
  - Structure & Maintenance

Existing Conditions

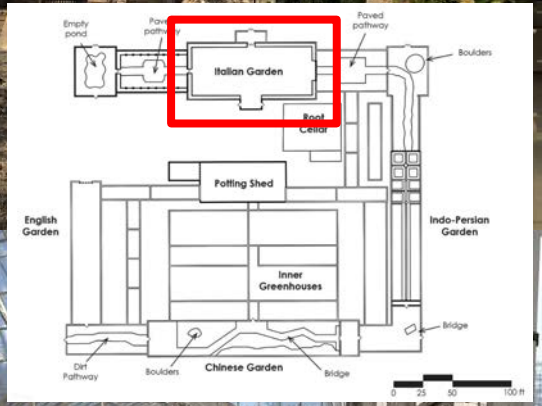


Site Location

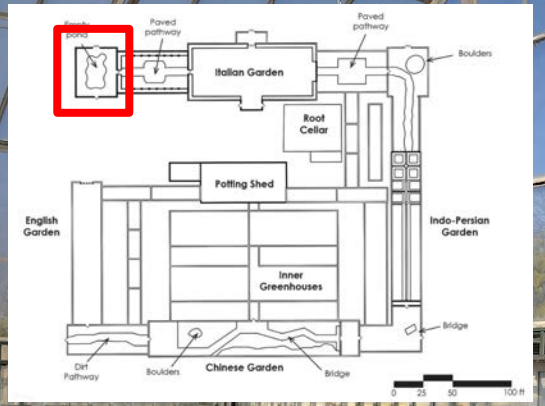
Existing Interior Layout



Italian Garden

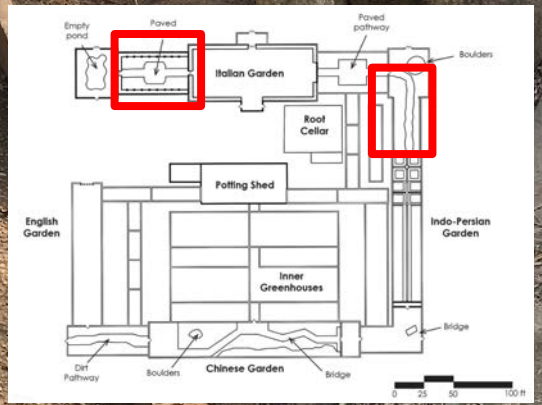


Edwardian Garden



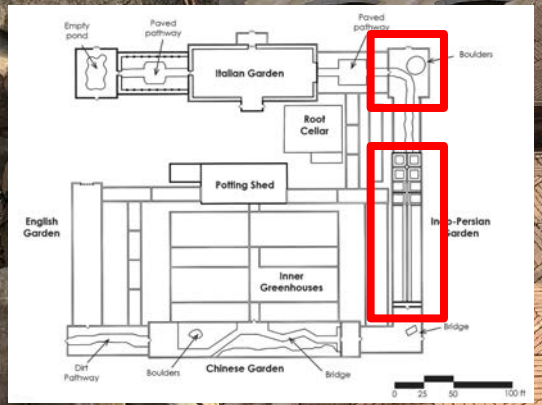
Colonial American Garden

Tropical Garden

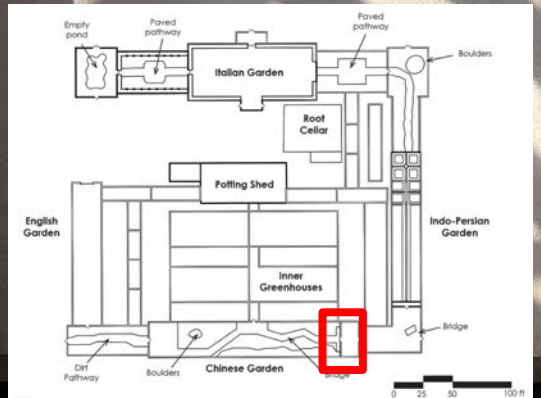


Tropical Garden

Indo-Persian Garden

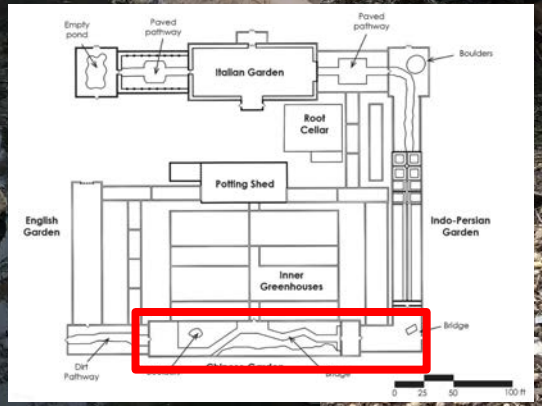


Entrance to Chinese Garden

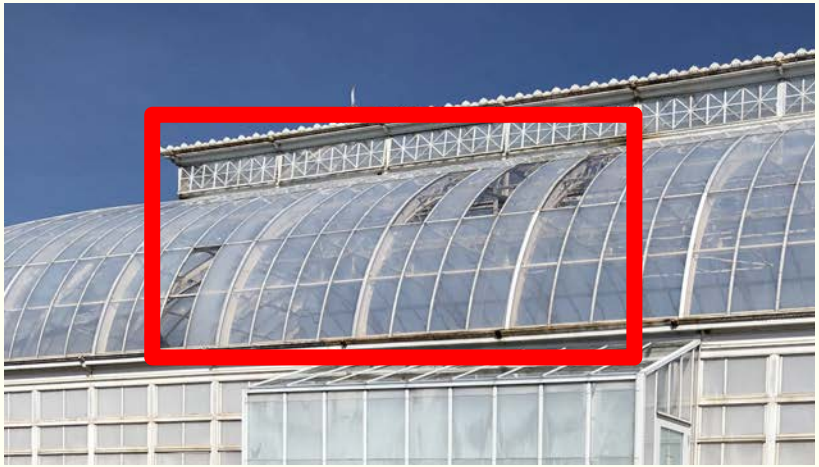


Chinese Garden

Japanese Garden

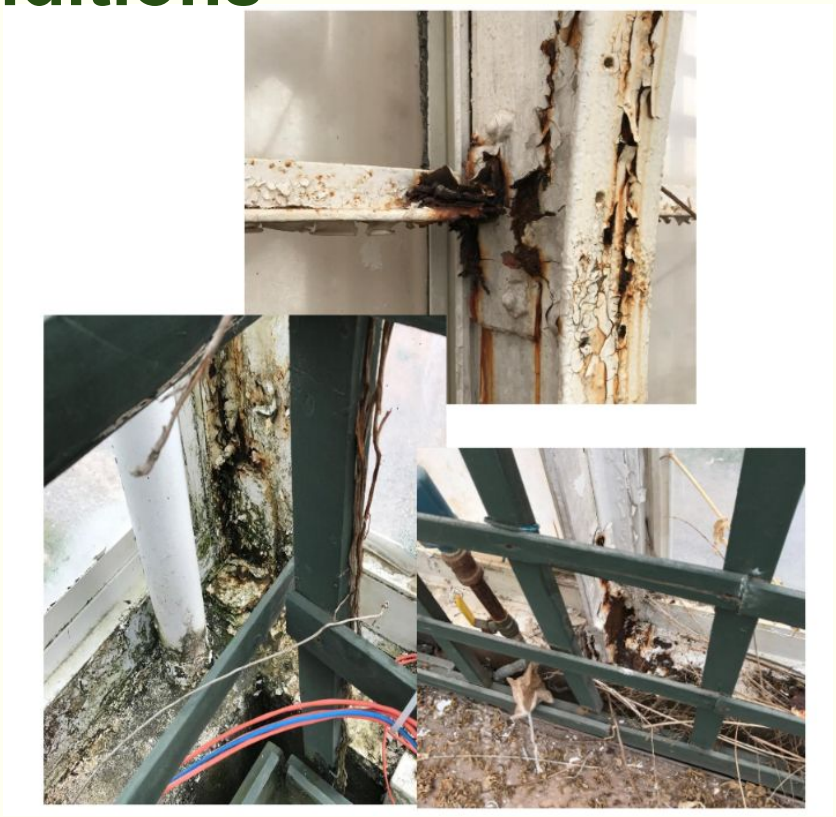


General Conditions



Summary of Existing Conditions

- Currently: no significant energy needs or uses in the conservatory region
- Only needs: few lights and fans in potting shed, basement and seedling greenhouses
- Significant rust in many rooms, specifically in Edwardian
- All existing drainage lines need to be inspected/cleaned



Source: 2017 Duke Farms Renovation Assessment Estimate

Innovative Examples

Reducing carbon emissions and energy

Duke Farms Orchid Conservatory

- LEED-Platinum certified
- Radiant floor heating
- Condensing boilers
- Rainwater captured and reused to water plants and used in misting system
- Double-pane insulated glass

Reducing carbon emissions and energy

Phipps Conservatory

- Historical greenhouse behind new welcome center
- Use LEDs for lighting
- Fixed water pipes
- Whitewash windows in summer

Source: Phipps Conservatory, Pittsburgh

Focus on native species

Flat Rock Brook Native Habitat Gardens

- Different native plants attract wildlife
- Seventeen micro-ecosystems
- Signs encourage visitors to transform their gardens to attract wildlife

Source: Flat Rock Brook Nature Center, Englewood, NJ

Hands-on learning

New York Botanical Garden, Everett Children's Adventure Garden

- 12-acre garden
- Indoor Discovery Center
- Exploration of nature intersects with science activities

Source: New York Botanical Garden

Hands-on learning

The Schuylkill Center, Philadelphia, PA

- Leader in environmental art
- Using art to encourage the public to engage in environmental stewardship
- Art displays are both indoors and outdoors

Source: Rain Yard by Stacy Levy. Permanent installation that demonstrates importance of soil and plants in water cycle

Accessible and comfortable spaces

Source: Kirsch Environmental Center, De Anza College, CA

Source: Potawatomi Conservatories, South Bend, Indiana

Recommendations

PHASE 1

- Demolition
- New Entrance
- Bathrooms
- Seating & Gathering

Rooms 1, 2, 5, 6, 7, 8, 9A, 10A*, 11, 11A, 12*, 12A, 16, 17, 17A, 18, 19, 20, 21

PHASE 2

- Welcome Center
- Hands-on Learning
- Zen Garden

Rooms 23, 24, 25, & 26

PHASE 3

- Climate Change Demonstration
- Life Cycle Demonstration

Rooms 14, 15, 22

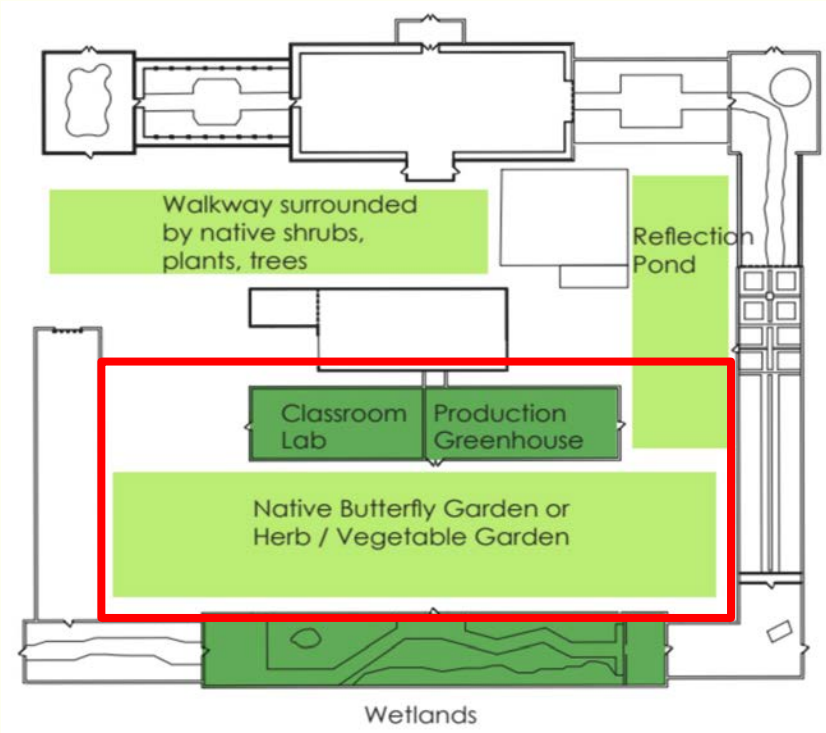
PHASE 4

- Wetlands
- Courtyards
- Classrooms
- Labs

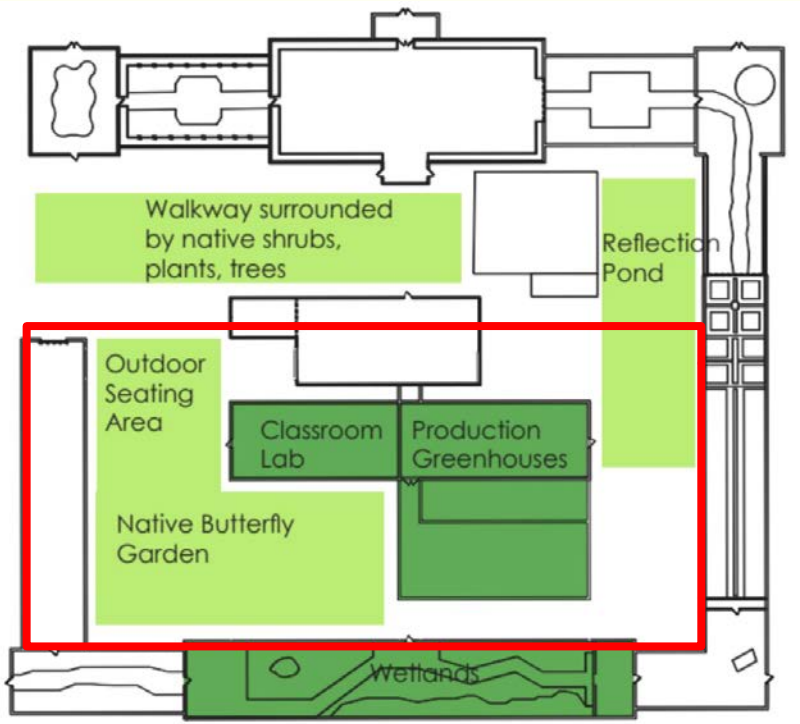
Rooms 4, 9, 10, 10A, 13

Layout Options

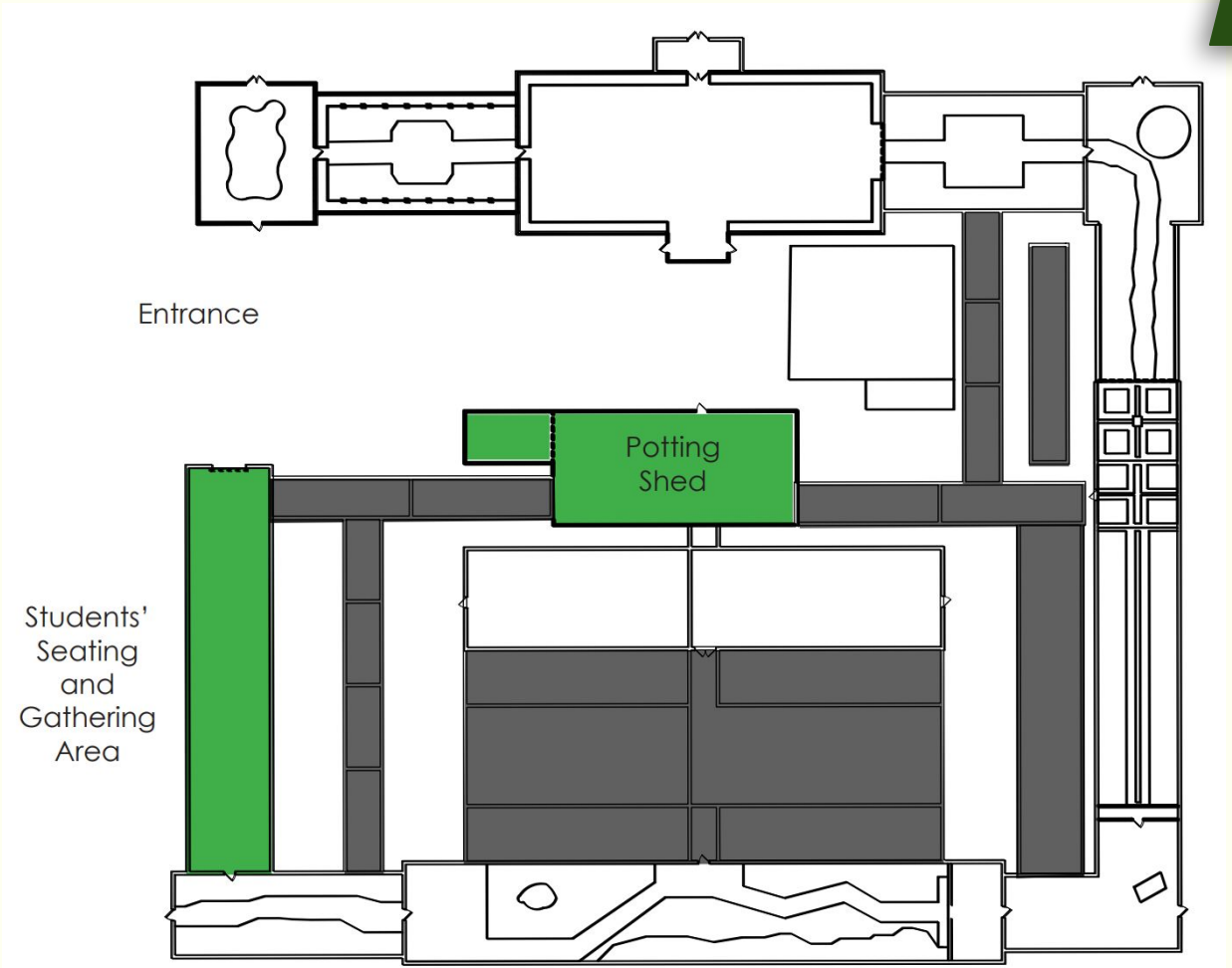
Option A: More courtyard, less classrooms



Option B: More classrooms, less courtyard

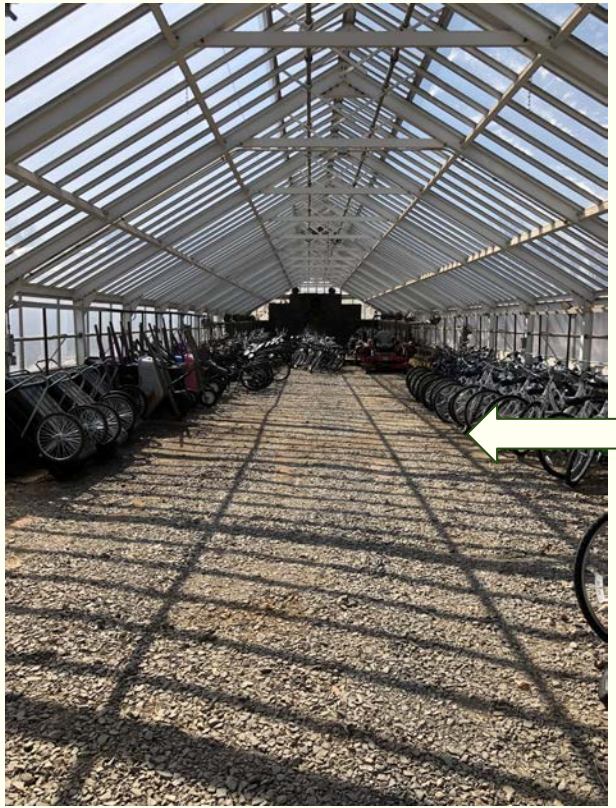


PHASE 1



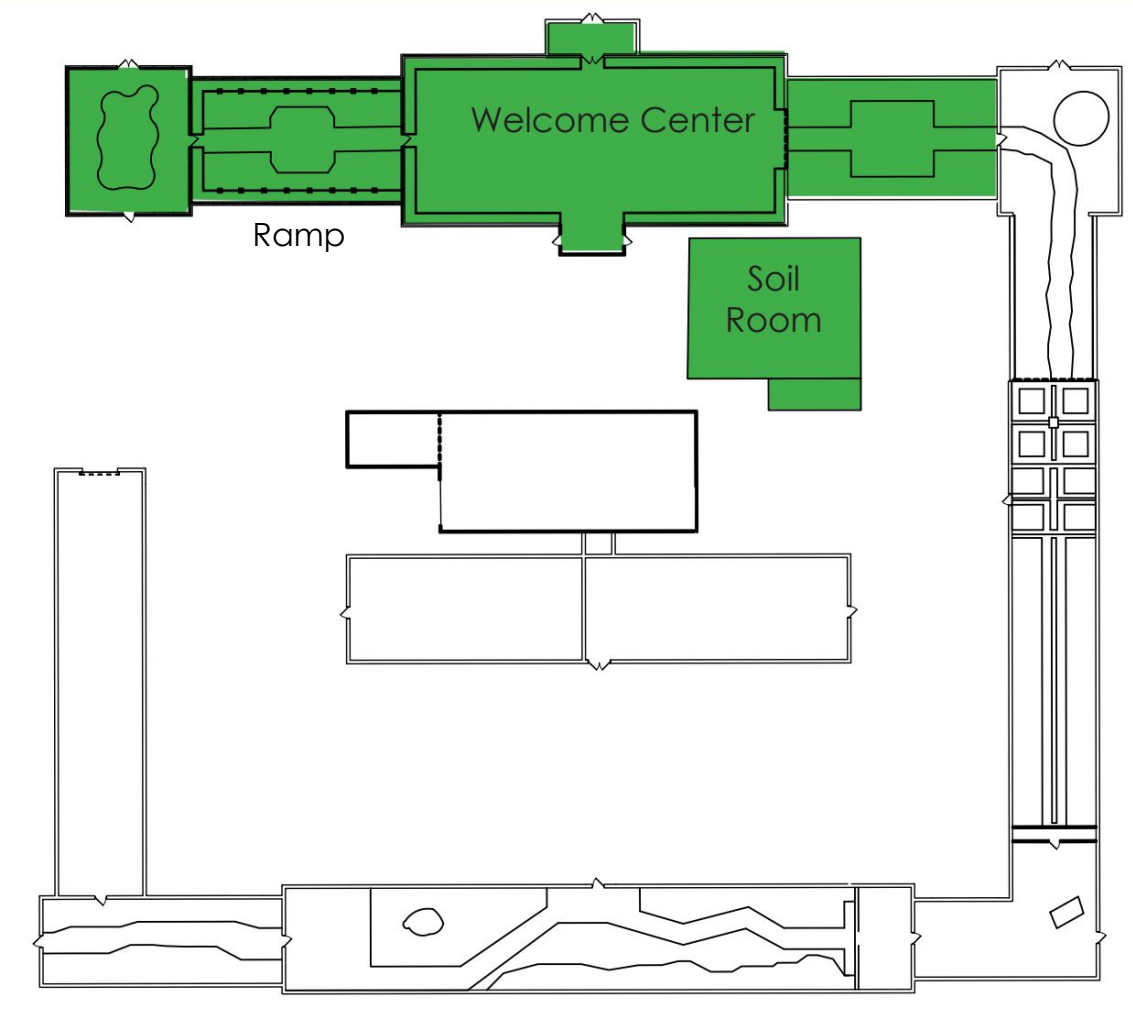
- Remove inner greenhouses
- Add bathrooms
- Seating area

Student Seating and Gathering Area



- Passive learning opportunity
- Use eco-friendly materials (Bamboo!)
- Signage that reveals the eco-friendly characteristics of the room

PHASE 2



- Work on Rooms 23-26
- Build ramp for ADA compliance
- Cellar → Soil Exhibit

Welcome Center

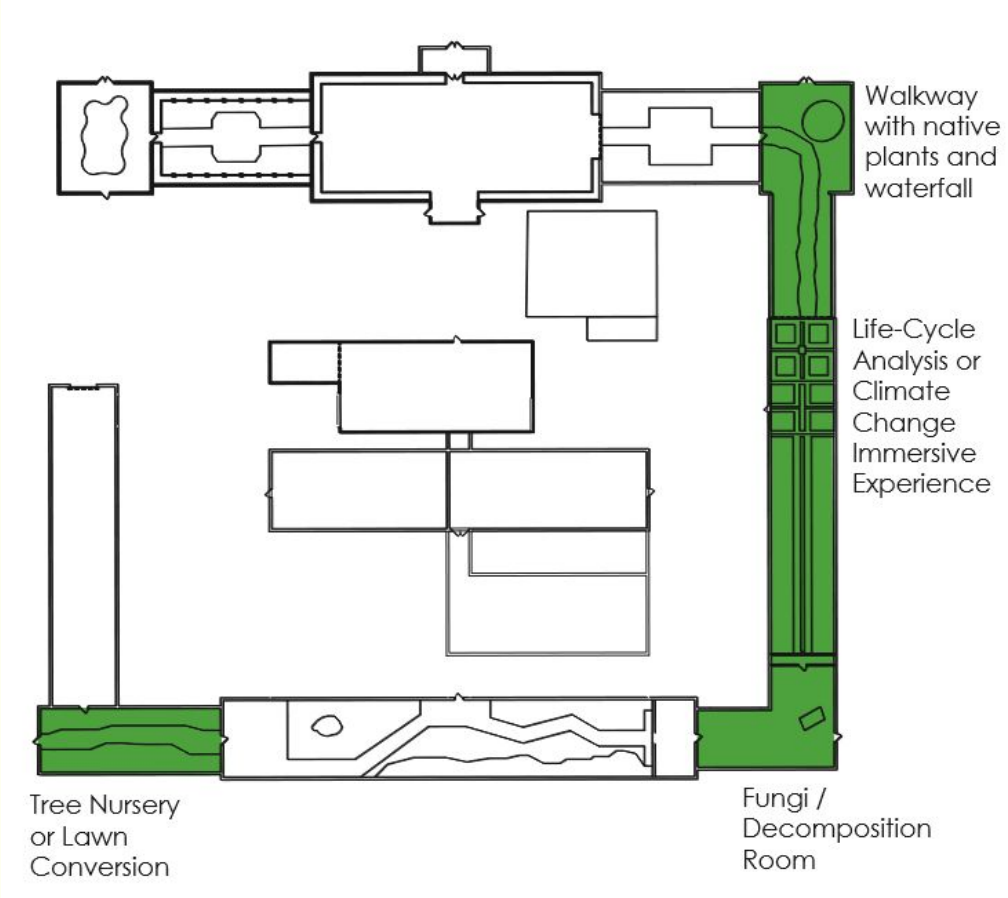
Welcome Center

Source: San Francisco Conservatory of Flowers

- Check-in desk
- Seating
- Colorful, playful central display
- Ramp

PHASE 3

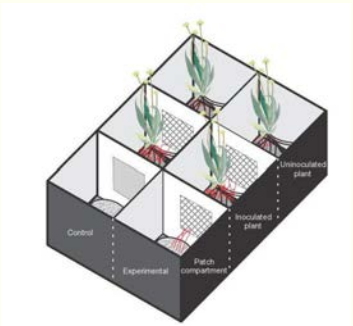
- Work on Rooms 4, 4, 14, 15, 22
- Room 22 natural progression of Room 23
- Immersive climate change experience
- Fungi / Decomposition Room
- Connection to other parts of Duke Farms and daily lives



Decomposition Room: Fungi in Action

PHASE 3

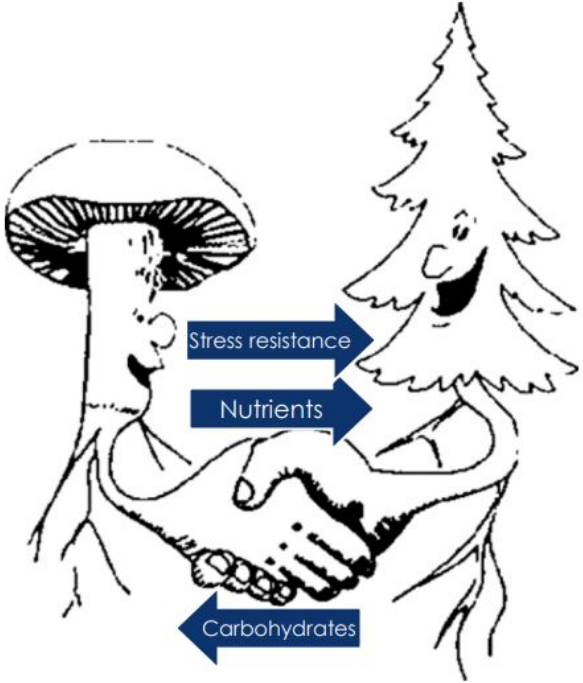
- Role of fungi & organisms with decomposition & sequestration
- EM mycorrhizal fungi (in trees) have 70% more carbon vs AM
- Test and compare different levels and types of fungi species, mycorrhizal & organisms in demonstration soil plots of decaying matter, grasses, meadows, shrubs.
- Mycorrhizal products & fertilizers stimulate soil fungi.
- How can we apply research to maximize soil conditions throughout Duke Farms & beyond?



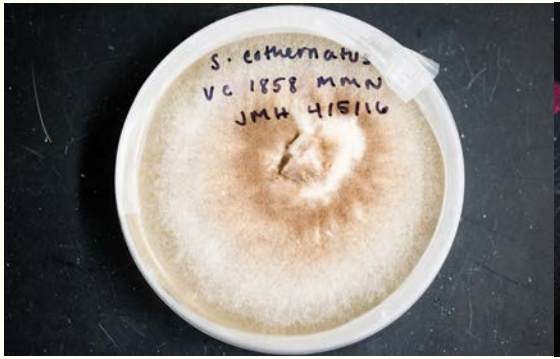
Sources:
(Counter clockwise from top-left) 1) storiented.blogspot.com
(2,3) Pennington.com "Why and How to Improve Grass Roots with Mycorrhizal Fungi"
(4) Nature.com "An arbuscular mycorrhizal fungus accelerates decomposition and acquires nitrogen directly from organic material"

Decomposition Room: Fungi in Action

PHASE 3



Souce: modified Egli, Brunner 2002 from South Dakota State University PowerPoint Arbuscular mycorrhizal fungi – Implications for management and conservation planning



Suillus fungi makes enzymes that **decompose organic matter** -> increases carbon stored. Associated with pine

Golden jelly fungus

EEM fungi like the Amanita mushroom help soils store more carbon

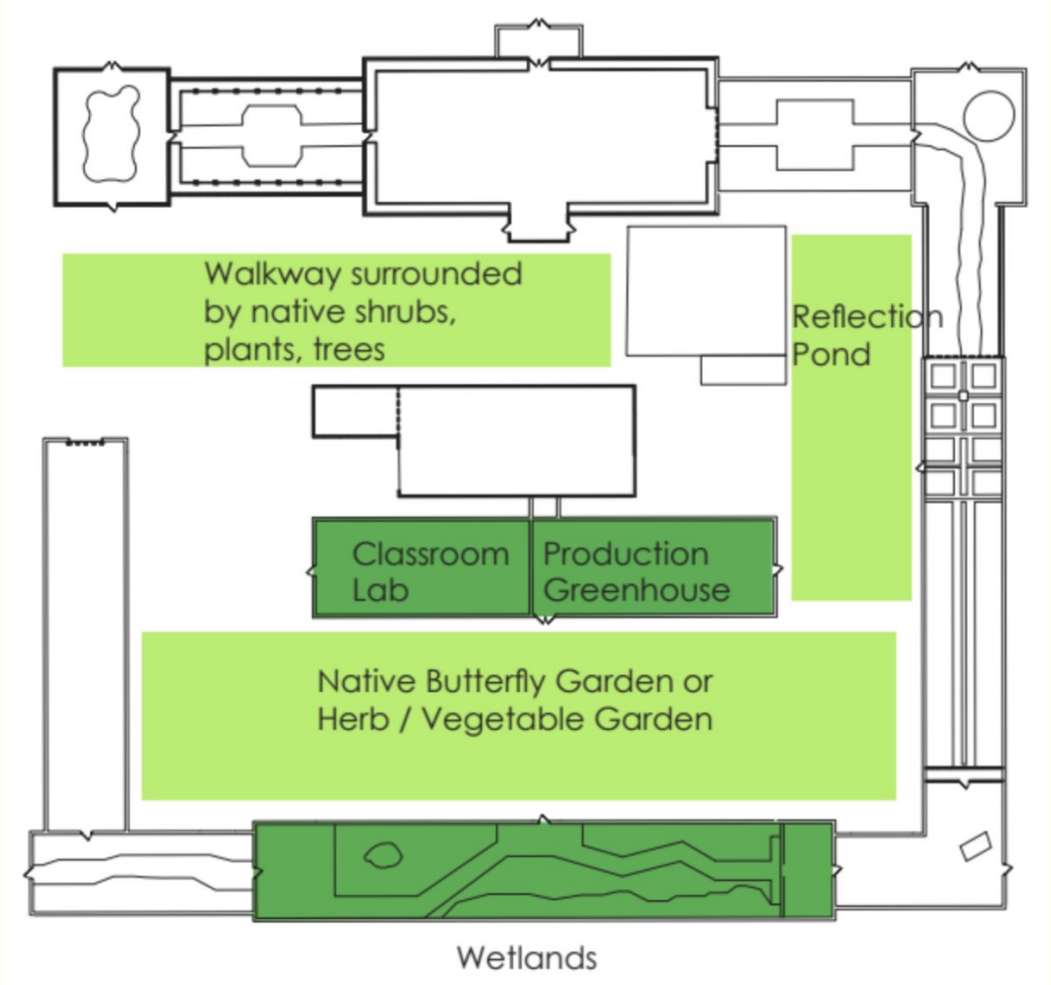
Images bottom-left: credit: Colin Averill

Honey fungus

Images top-left, top-right, bottom-right: bu.edu, “Why Fungi Rule the World”

PHASE 4

- Outdoor landscaping & courtyards
- Wetlands
- Classrooms/Labs

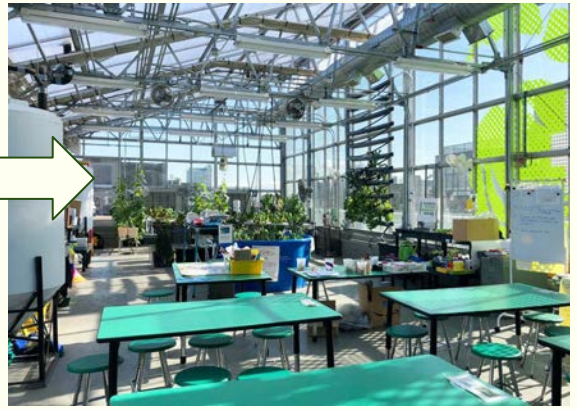


Wetlands

PHASE 4

- This room will introduce visitors to indoor wetlands display
- Educational Landscape
- Housing native plant species
- Part of this exhibit will show how wetlands improve water quality and absorb pollutants

Classrooms/Labs



Energy Strategies and Considerations

- Natural ventilation
- Passive cooling / heating
- Energy: biomass from the community & Duke Farms
- Lighting: limited use for indoor plants, may need mood/aesthetic lighting
- Water: water storage tank, recycle through irrigation and condensation, rainwater capture, req. high maintenance

Image sources (left to right): unitedgreenhouse.com, theviewfrombagend.blogspot.com, Omafra.gov.on.ca

Future Research

- Using data from this project for other DF projects & beyond
- Costs
- ADA Compliance
- Historic Preservation

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Thank you!

Questions & Feedback