

LAKOTA Design Review

Fall 2017

December 8, 2017

Outline

- Community Partner Introduction
- Greenhouse
- Bee Box

SOUTH DAKOTA

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SCHOOL OF MINES
& TECHNOLOGY



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Community Partner Information

Pine Ridge Reservation

- Population: Estimated 20,000
- Food desert
- Lowest per capita income in US
- 70% Unemployment
- 50% of those over 40 years old have diabetes

Poverty by design



South Dakota's Indian Reservations



Community Partner Information



Community Partners





Greenhouse Project

Introduction to the Team

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- *Samuel Rickman*
- *Shashwati Shradha*



- *Lashell Bagola*
- *Akaya (Amanda) Ruiz*
- *Rick Gerlach*

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- *Aimee Atakere - Civil 2021*
- *Pheobe Appel - ChE 2020*
- *Jonathan Damon - ME 2021*
- *Shamya Dey - ME 2021*
- *Jacob Lundgren - IE 2021*
- *Taihai He - CompE 2019*
- *Brendan Proudfoot - ME 2021*

Basic Information

- Location on OLC campus
- Will serve as a learning and community center.
- Changes in project direction:
 - “porch-able” greenhouse
 - exterior of a larger scale greenhouse
 - overall design of a large scale greenhouse
- Have received permission and blessings from the OLC Tribal College President and He Sapa Center Director

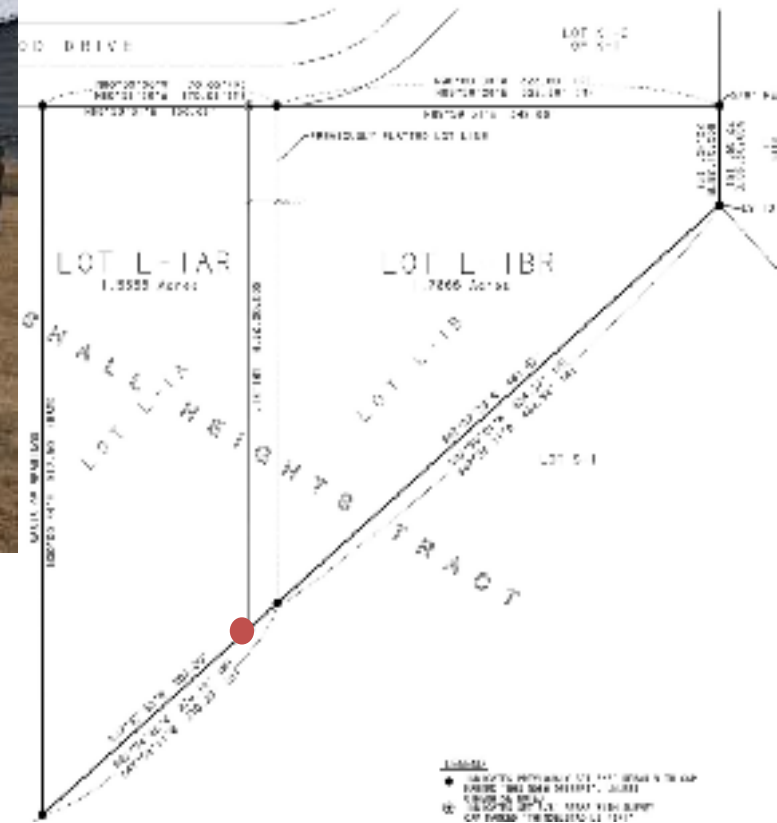


OLC Campus Rapid City

User Needs

- Create Greenhouse Design for OLC's campus
 - Cost effective
 - Durable
 - Size - 40 ft x40 ft
 - Educational area should occupy a large portion of the interior area.
 - Meant to serve as a learning and community center as well as a location for food production.
 - Possibly grow tomatoes, lettuce, shrubs, local medicinal herbs, and other local plants

Disputed Land

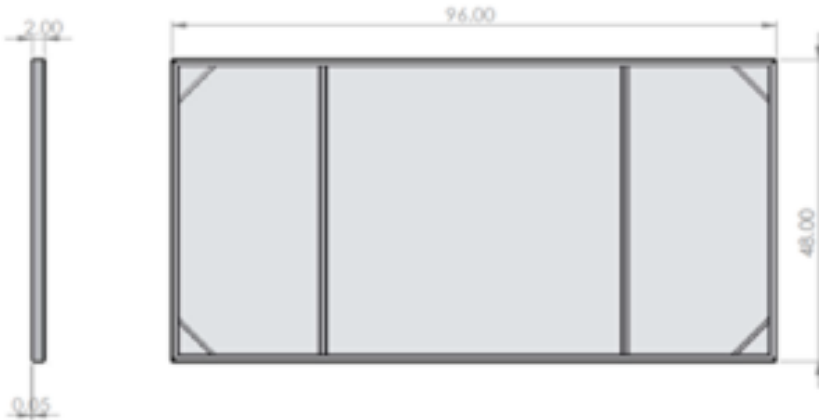


Survey of Students

- 26 students at the He Sapa campus
- Additional focus: learning center

RANK	ANSWER	RESPONSES
1.	See plants	11
2.	Learn about plants that they can then grow on their own	10
3.	Get homework done, relax and read	4
4.	Learn about the Lakota tradition and native plants	3
5.	Clean air, fresh fruits	3
	TOTAL	31

Donated Panels



Quantity	Item
5	12' 2" x 1" steel tube
2	15' 2" x 1" steel tube
2	24' 2" x 1" steel tube
2	4' x 8' plexiglass/mesh panel
2	4' x 8' sheet metal panel
6	4' x 8' sheet metal/plexiglass panel
4	8' x 8' plexiglass/mesh panel
4	8' x 8' sheet metal panel
4	8' x 8' sheet metal/plexiglass panel
1	6' x 8' sheet metal door panel
-	Miscellaneous wood beams and boards

Brainstorming Pictures



Pictures of Team from Trip



Cultural experience

Significance of Greenhouse

Not solely meant for food production but as a learning centre where the elders pass on their knowledge to the young. Active learning area is an *essential part* of the structure.

South Dakota Trip (Geothermal Greenhouse)



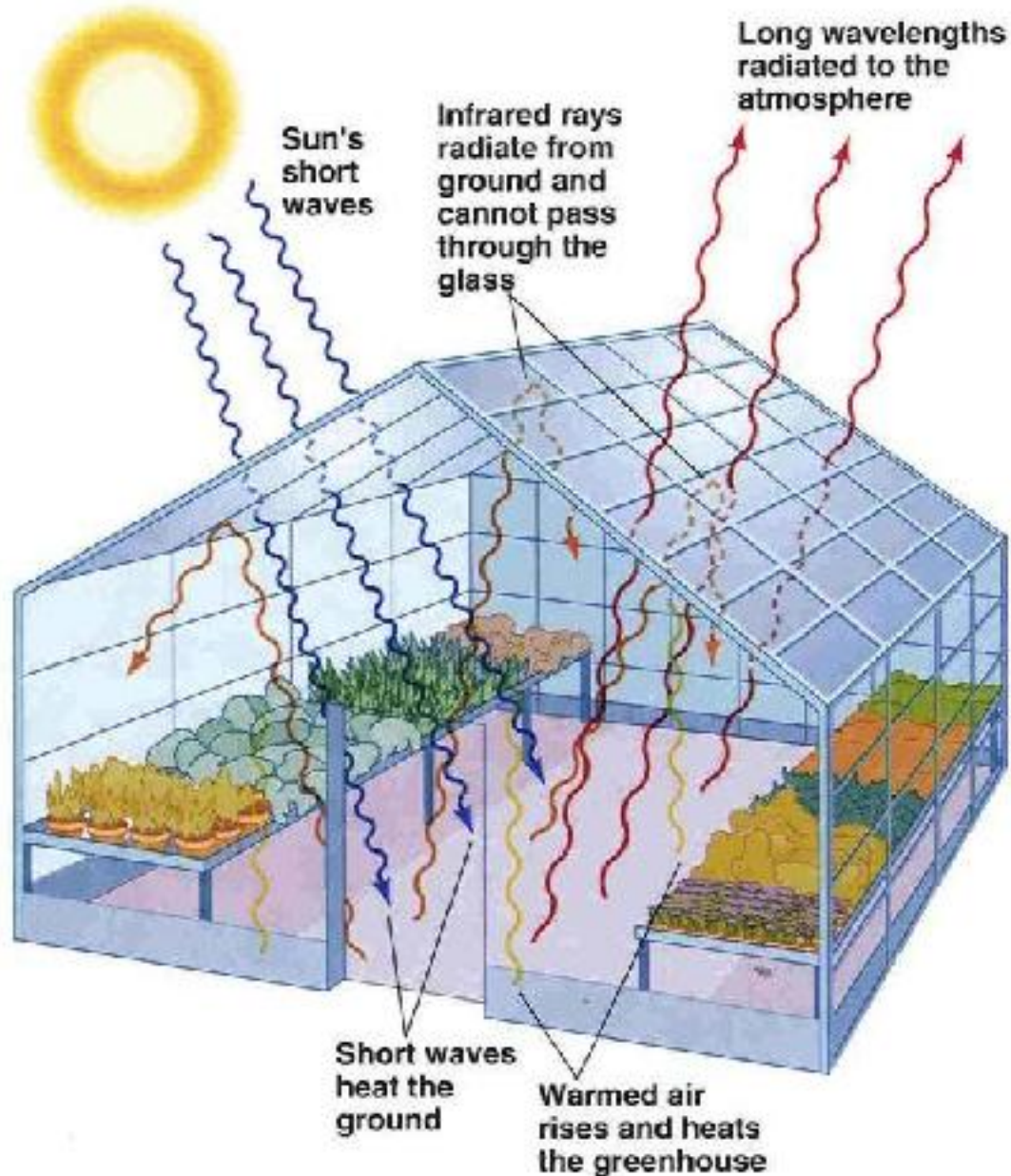
- Survived **hail** and **70 mph winds** that didn't damage structure
- Based on Russ Finch Greenhouse in the snow.
- **Polycarbonate sheeting** covers the top of the greenhouse
- Not operational

South Dakota Trip (Geothermal Greenhouse)

- Cooling system inside greenhouse.
- Fan in second picture blows air into main section.
- **Corrugated tubes** help cool the system with a fan
- **16 tubes 8ft** in the ground pull heat from the ground into the greenhouse

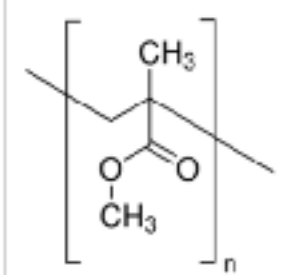


Greenhouse Technology

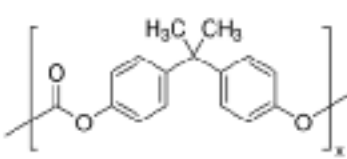


Differences in Potential Materials

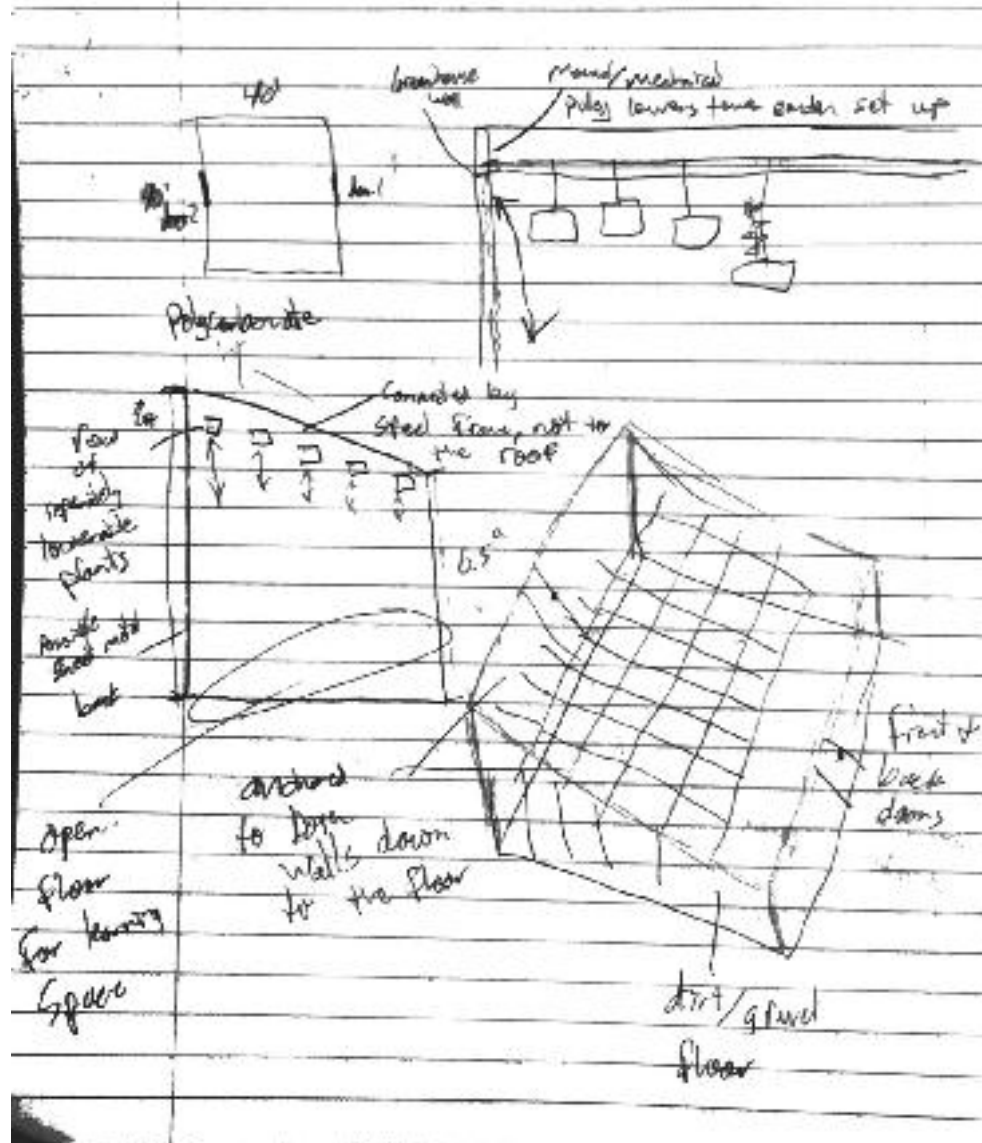
Plexiglas → Poly(methyl methacrylate)¹

Molecular Formula	Structure ²	Bending Strength	Compressive Strength	Impact Strength	Refractive Index	Glass Temperature
$(C_5O_2H_8)_n$		120-148 MPa	83 - 124 MPa	0.16-0.27J/cm	1.49 (at 20 °C)	105°C

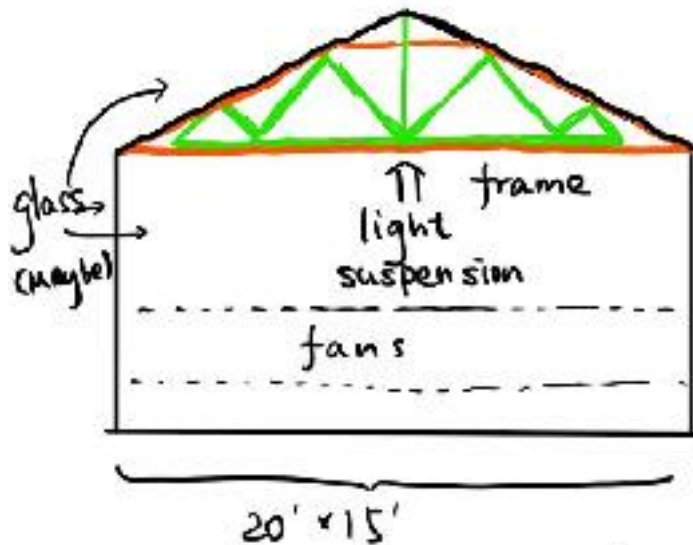
Polycarbonate¹

Molecular Formula	Structure ²	Bending Strength	Compressive Strength	Impact Strength	Refractive Index	Glass Temperature
$(C_{15}O_2H_8)_n$		141-145 MPa	117 MPa	0.8-1.28J/cm	1.58 (at 20 °C)	150°C

Low Resolution Prototypes

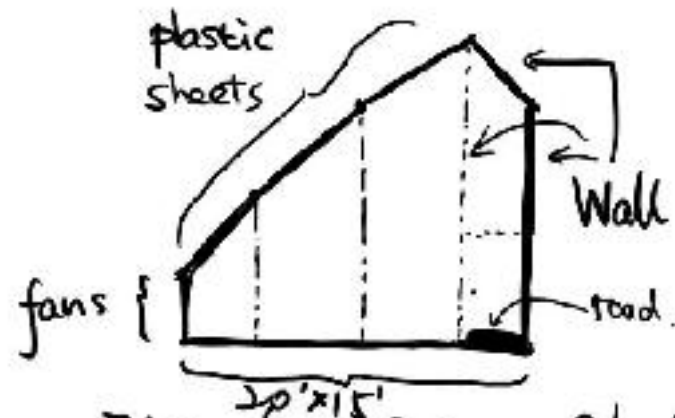


Low Resolution Prototypes



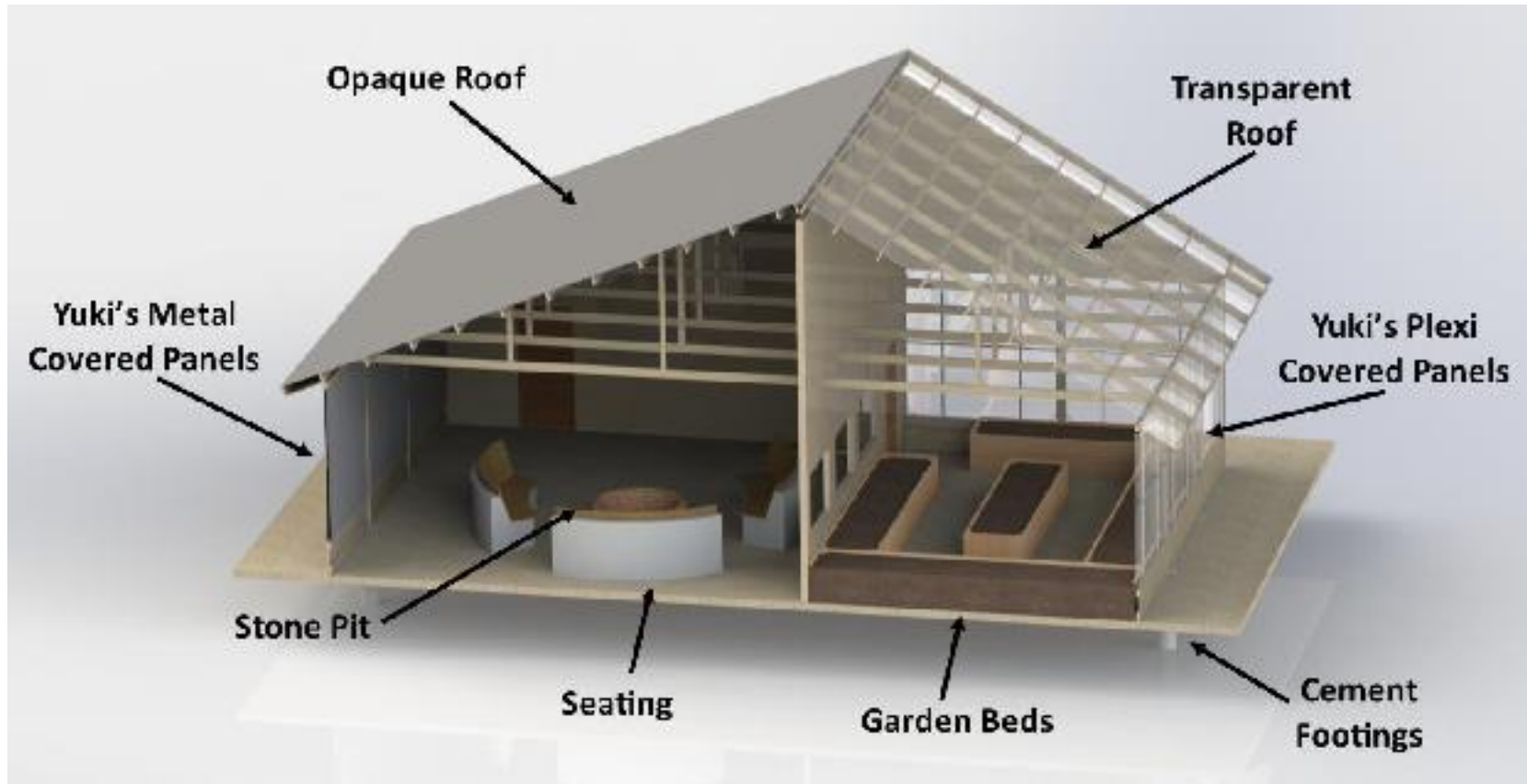
Idea from purdue's greenhouses
pots are used to plant productions,
tables with wheels are used to
carry pots.
Material need to be carefully considered
But should be easy to (re)build.

solar greenhouse

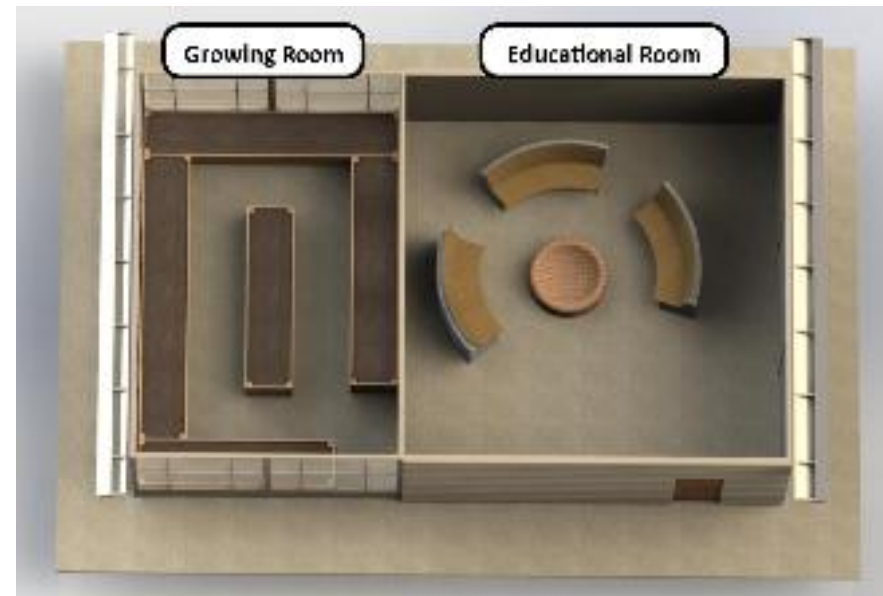


Idea from Interpet & local example
Soil inside need to be used to
plant anything one wants.
Should be cheaper,
with brick walls support,
should be solid and
cheaper.

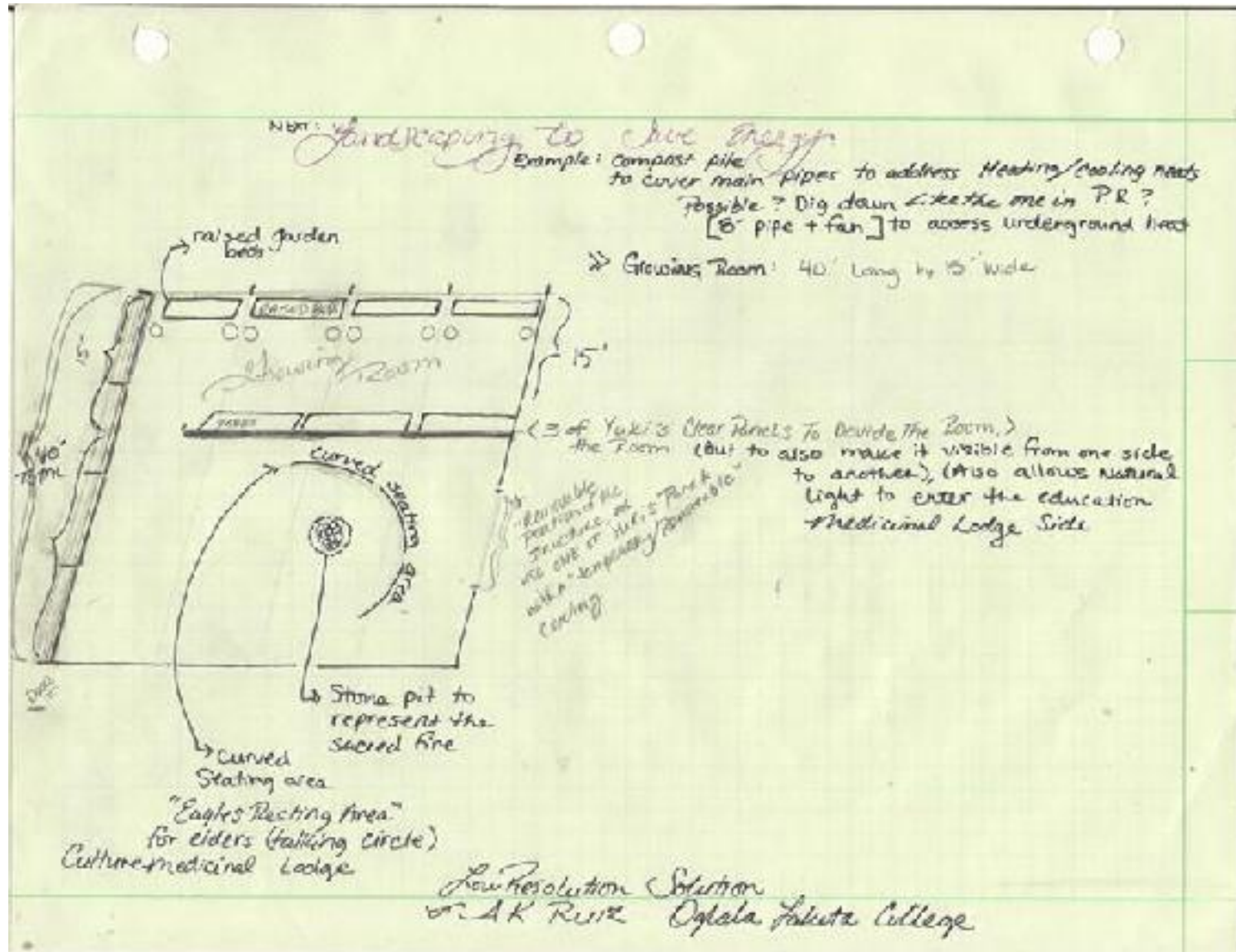
Description of work completed this semester



Description of work completed this semester



Description of work completed this semester



Anticipated Achievements

- Finalizing brainstorming process
- Final design for the greenhouse
- List of specifications and materials.



Questions?



Bee Project

Introduction to the Team

SOUTH DAKOTA



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- Bo Paulsen
Mechanical Engineering, 2018
- Averyonna Kimery
Metallurgical Engineering, 2019

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- Caleb King
*Aeronautical and Astronautical
Engineering 2021*
- Kendall Kyle
Civil Engineering 2019
- Graham Oberweiser
Electrical Engineering 2021

Overview

Design a bee box that can withstand South Dakota elements and can be mass produced.

Purdue- Interior

SDSMT- Exterior



Overview

Help Thunder Valley CDC to become a large scale honey producer

Instruction Manual

Demonstration Video

Manufacturing Templates



Project Specifications

Maximize Honey Production

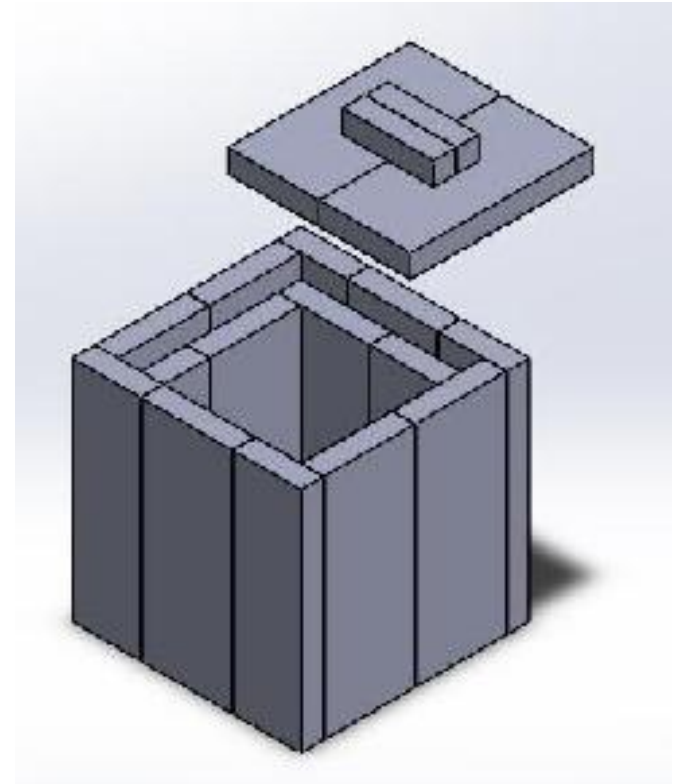
Produce locally and easily

Able to withstand elements

Develop instructions to build and maintain

Exterior Progress

- Designed prototypes
- Testing Cedar and Douglas Fir
 - Most common woods used in bee hives
 - Cedar is culturally significant
- Testing latex and acrylic paint, linseed oil, and tung oil
 - Low cost options
 - Organic options



Interior Progress

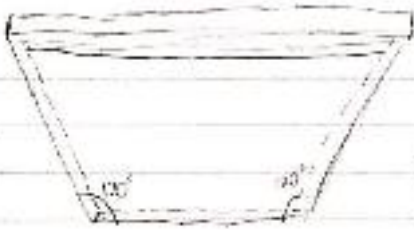
- Brainstorm
 - Multiple ideas
- Detailed Design
 - Created a detailed design for prototyping
- Prototype
 - Frame
 - Instruction Manual



Interior Progress

Brainstormed Ideas

Square box



to keep original shape of honeycomb box bees

Prism form

top bar w/ slots

w/ seat frame

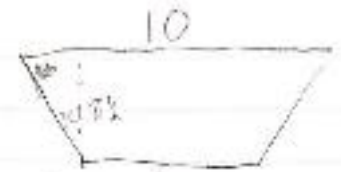
height as top bar honey structure

Heavy extruder - don't design comb

Variable slots for bees in sizes? Keep bees safe



top bar
then add
angled sides
in the square box

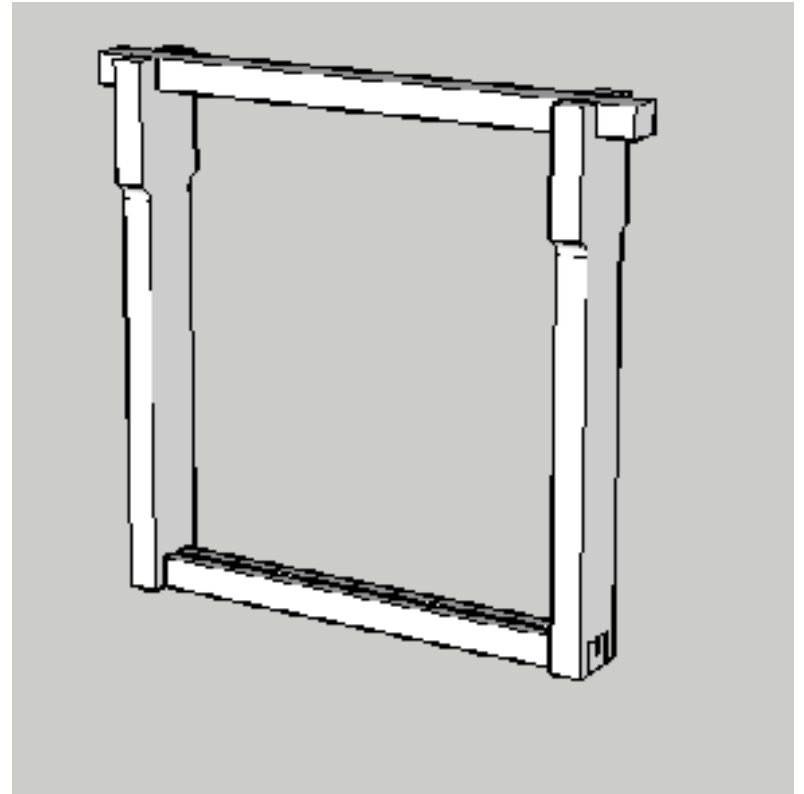
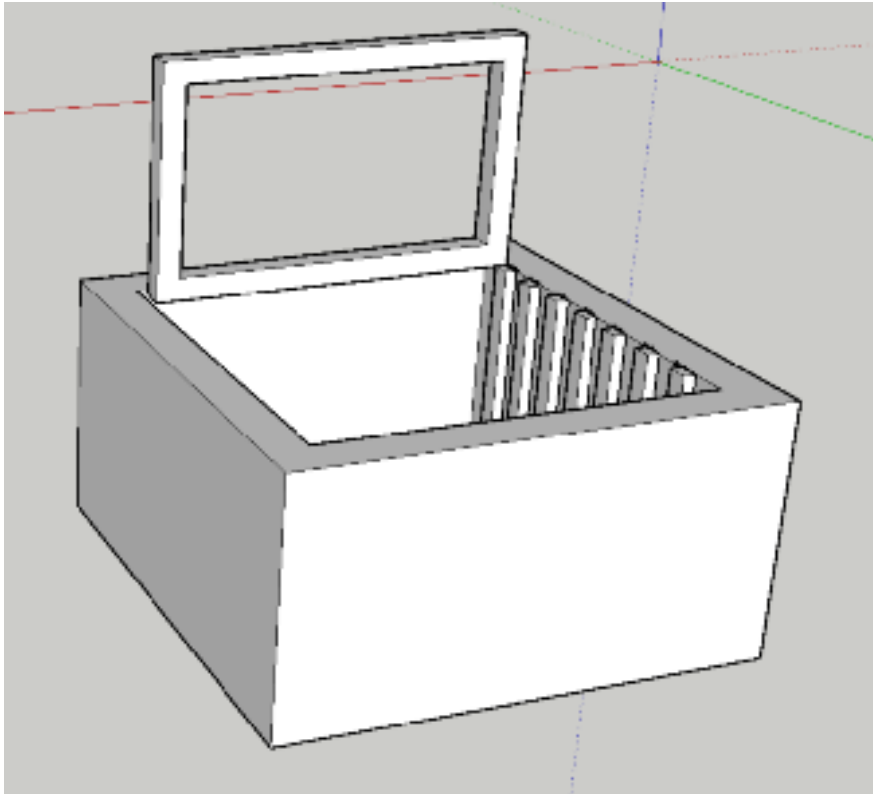


$$\text{top bar} = \frac{9}{8\frac{1}{2}}$$

4.91

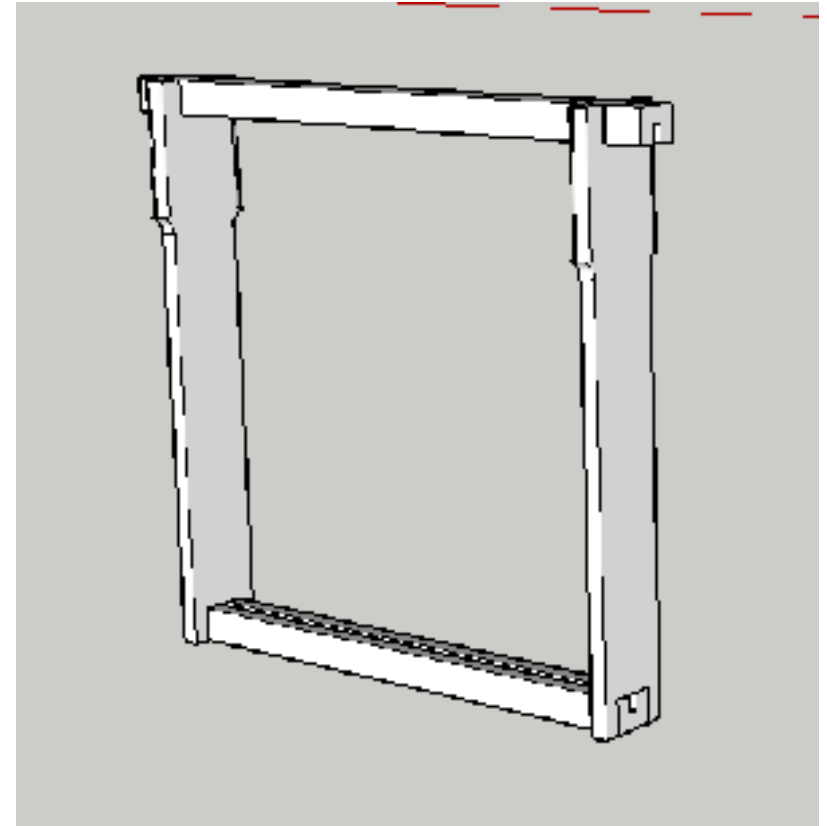
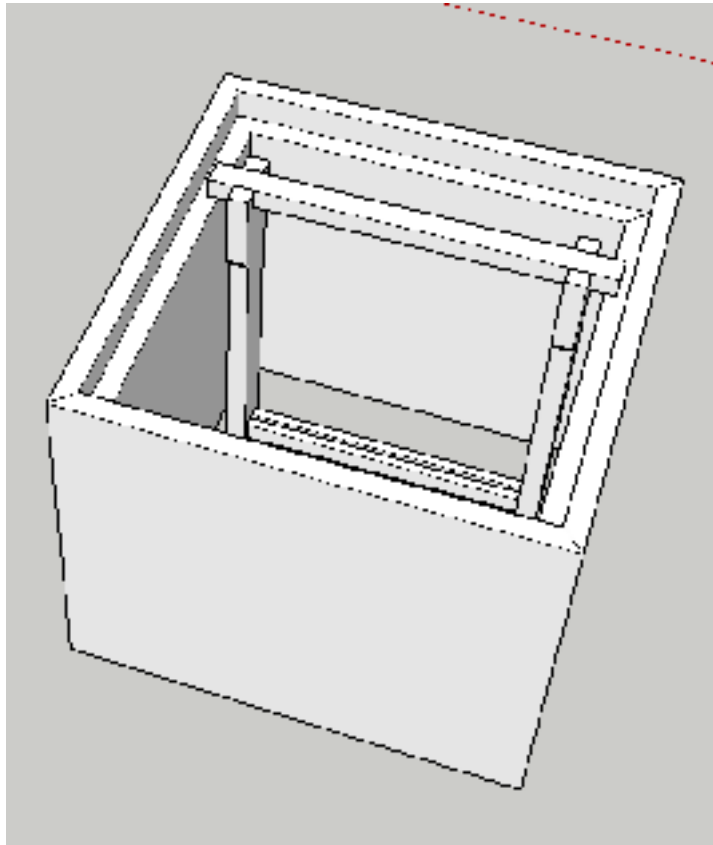
Interior Progress

Brainstormed Ideas



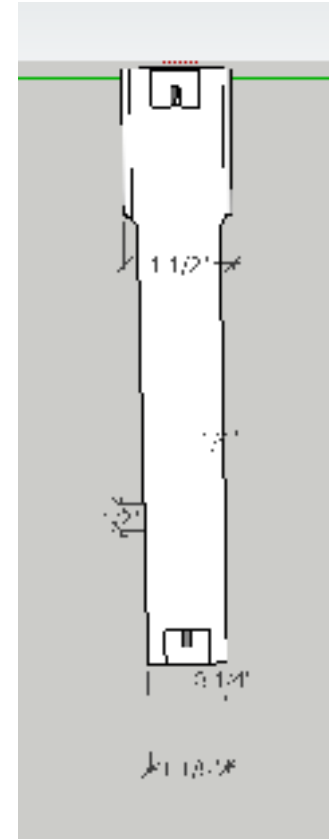
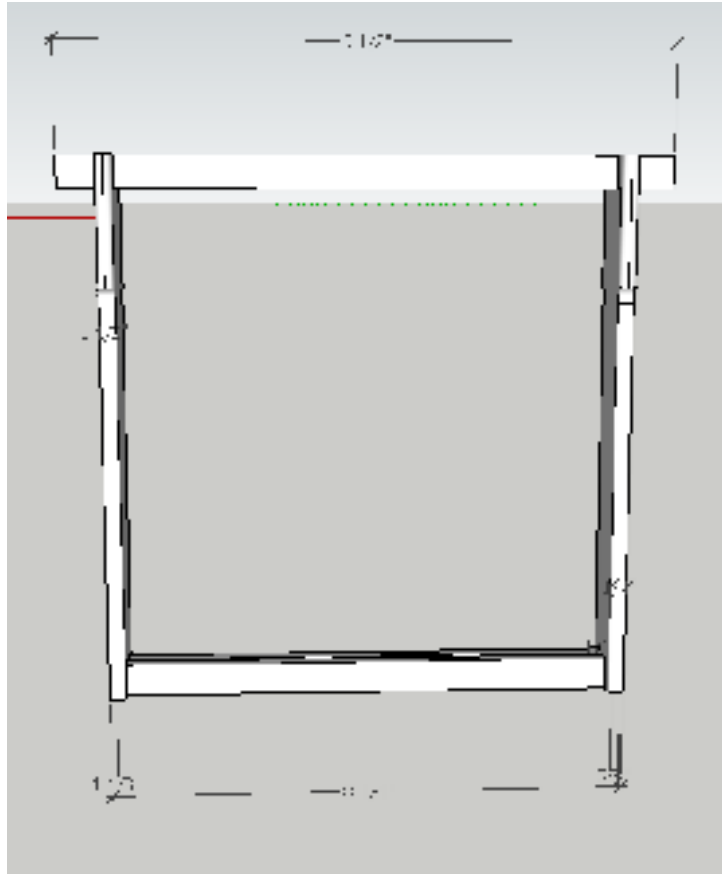
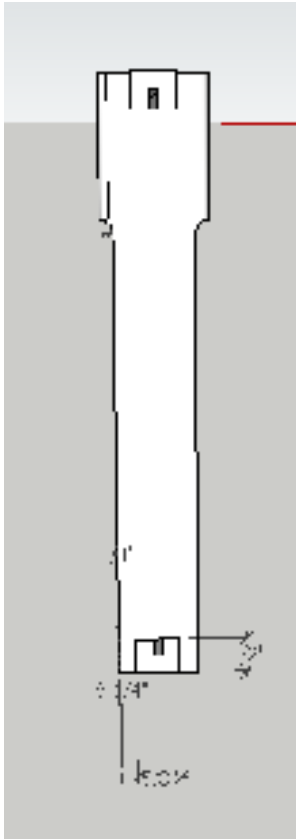
Interior Progress

Detailed Design



Interior Progress

Detailed Design



Interior Progress

Prototype



Interior Progress

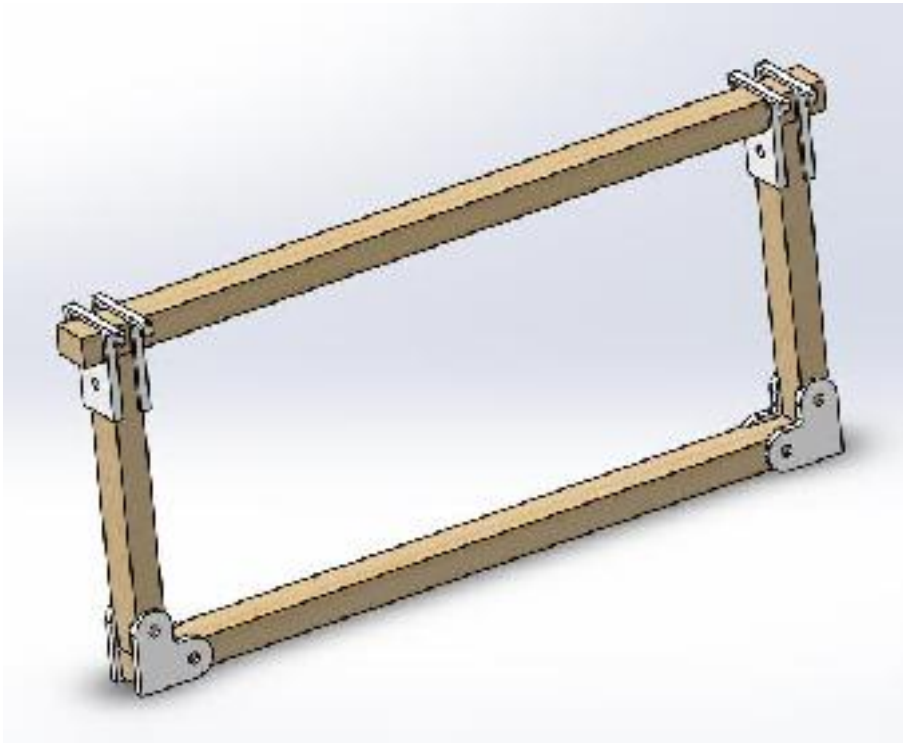
- Honeycomb
 - 2 popular theories of beekeeping
 - No Foundation (natural beekeeping)
 - Only the frames are provided to the bees, they build their own honeycomb on the frame
 - Foundation (most common)
 - A foundation made of plastic or wire coated in wax is provided for bees to use as base for their honeycomb

Interior Progress

- Brackets help increase tolerance
- Metal not ideal
 - Temperature
 - Moisture
- Plastic not ideal
 - Less life than wood
 - Does not harm bees in small amounts

Interior Progress

- Designed brackets multiple times after finding issues with them
- 3D printed brackets and built one frame to test



Budget

Item	Quantity	Price	Total Price
Bee Box from Dadant.com	3	\$67+Shipping	\$250
Timelapse Cameras	1	\$90	\$90
Interior Wood	-	\$50	\$50
Exterior wood	-	\$80	\$80
Coatings	-	\$40	\$40
Total Cost			\$510

Anticipated Achievements

- Completed transition document for next semester:
 - Partnership
 - Cultural importance
 - Suggestions
- Spring Semester goals
 - Finalize interior and exterior
 - Interior exterior integration
 - Create manufacturing aids
 - Produce video

Questions?