EF 152 Engineering Notebook Today's Date: 04/04/2019

Team Info

Team Info		
Name and contact info	**Talents**	**Role / Responsibilities**
1. Sophie Sapp 423-933-4069	:) I can doodle	Materials/Design
2. Lily Parker 865-919-4930	Time management	Organization
3. Bryce Lott 615-767-2652	CAD	Materials
(4.)Landry McHargue 865-332-9383	CAD	Videography

Planned Meeting Dates

Meeting 1: Date_Friday 25_ Time _11:15am_ Goal: _Research and Planning_

Meeting 2: Date_Monday 28_ Time _2:30_ Goal: _Research_

Project Timeline

January 29th - Progress Check grade
February 1st - Project Proposals due
February 6th - View feedback on proposals
February 8th - Revised Proposals due
February 19th - Detail design due
February-March - Build/Test/Redesign Process
March 14th - Project check in lab
April 2nd/4th - project evaluations/testing
April 5th - all deliverables due

Project Identification

Design Challenge: Community Service Design

Research and define a need for something that needs to be designed to help better a given community or set of people. Research and define target audience and scope of project. Deliverable - physical prototype OR a professional detail design.

End Goals: What we will work to produce (without describing HOW to do it or what it is)

- Protect stray animals from harsh weather conditions
- Provide shelter to stray animals
- Keep animals warm in the cold weather
- Make a product cheap enough for the target audience to afford

Indicators of Success: What measures and Indicators will help us know if our design is successful?

- Animals take refuge
- The animal is not cold
- Cost

Constraints: What constraints will we need to manage?

- Cost
- Materials
- Temperature
- Environmental Impact

Research Key Takeaways

- yeti coolers use a vacuum seal and foam insulation to create a strong barrier between the inside and outside
- they also minimize the air flow in and out of the cooler
- these types of design influences have never really been incorporated into an animal shelter, as most current designs of shelter are just a single wall of either wood or plastic
- the internal temperature for a dog is between 101 and 102.5 °F, therefore (because a dog and a human's normal internal temperature are very similar), the internal temperature of the shelter will need to be approximately the same as a house in order to keep the animal comfortable in the winter
- there are two types of insulation that could be used - fiberglass and spray foam
- to maximize the efficiency of the insulation, we need to maximize its coverage, and minimize the presence of air bubbles and spaces between the two walls of the shelter.
- A small dog needs to be kept at a temperature at or above 45℉ or it WILL freeze
- Plastic bins are made of high density polyethylene and have a K value of 0.5 W/m*℃

ID Possible Resources

Animal Shelter Employees

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Select Resource

HSTV

Interview Questions

- Dangers of winter for homeless animals?
- Is there an increase in homeless animals in the winter?

Interview/Field Notes

HSTV employees and volunteers

-decrease in animal intake in the winter but increase in unhealthy animals

-frozen ground can harm younger puppies paws

-illness harder to prevent in winter

-dogs likely to chew and ingest exposed insulation

Brainstorming

We had three main ideas when coming up with our project. One involved a product made completely of wood which we decided instead to use plastic for better insulation, another involved burying the house which would provide amazing insulation but would be a pain to install, our final design was similar to a simple dog house but provided more safety and comfort than a cheap plastic dog house. We go more in depth on our designs in the Design Documents.

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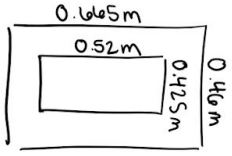
Idea Evaluation

We want the inside to stay at 45°F or 7.2°C. Assuming the temperature outside is 32°F (0°C) we used varying R values to choose the design that retains the most heat. First we found the cross sectional area of the house.



Large bin area = $0.3059\ m^2$
small bin area = $0.221\ m^2$
cross sectional area between = $0.0849\ m^2$

alternatively using 1 bin only allows the resistance of 1 wall so the cross sectional area becomes $0.006714\ m^2$ without.

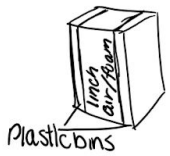
Now that we have the area we can plug it into the equation

$$\frac{\Delta Q}{\Delta T} = -A\left(\frac{T_2 - T_1}{R}\right)$$

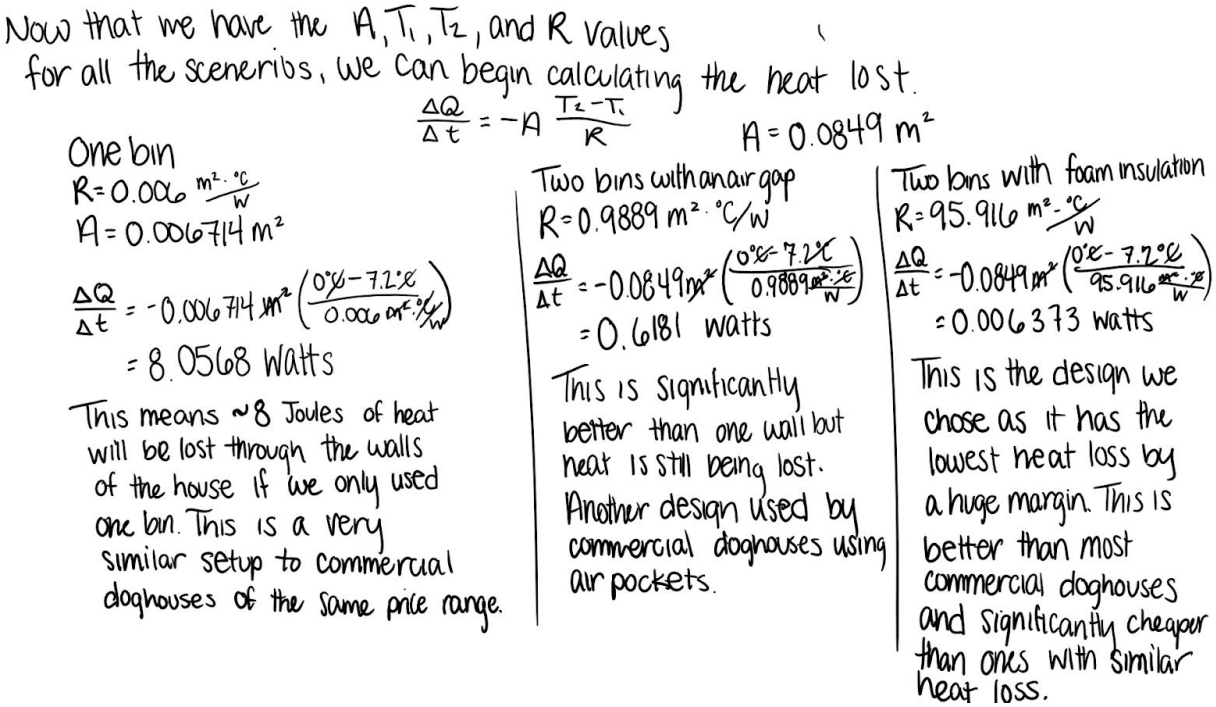
using 0°C as T_2 and 7.2°C as T_1.

Next we have to find the R values of each.

$R = \frac{L}{K}$ A quick google search showed high density polyethylene (what the bin plastic is made of) has a K value of $0.5\ W/m\cdot°C$. The walls were measured as 0.003 m thick giving us the equation $R = \frac{0.003\ m}{0.5\ W/m\cdot°C}$ per wall. So R per wall is $0.006\ m^2\cdot°C/W$. We know from our EF homework air has a K value of $0.026\ W/m\cdot°C$. Our air gap was about 1 inch at the thinest part so we have $R = \frac{0.0254\ m}{0.026\ W/m\cdot°C}$ giving us an R value of $0.977\ m^2\cdot°C/W$. Finally we used the R value on the foam can (3.7 per inch) and did the following: $3.7\ in^2\cdot hr\cdot°F/BTU \cdot 12^2_{in\to ft} = 532.8\ ft^2\cdot hr\cdot°F/BTU \cdot \frac{0.18\ m^2\cdot°C/W}{1\ ft^2\cdot hr\cdot °F/BTU}$ $= 95.904\ m^2\cdot°C/W$. We used all the R values to calculate R for 3 scenarios. (using $R_{total\ in\ series} = R_1 + R_2 + R_3 \ldots$)



one bin = $0.006\ m^2\cdot°C/W$
two bins with air between = $0.006 + 0.977 + 0.006 = 0.989\ \frac{m^2\cdot°C}{W}$
two bins with foam between = $0.006 + 95.904 + 0.006 = 95.916\ \frac{m^2\cdot°C}{W}$



More in the Design Documents.

Project Proposal

We would like to build a shelter for small abandoned animals to protect them from the elements. We plan to use readily available materials to insulate and pad the shelter. The idea of our shelter is that it will be affordable and easy to assemble while providing animals with cozy hideouts during the freezing winter months. The idea of our shelter is that people can use items they would normally just throw away (i.e. clothing with holes, stained blankets, cracked storage containers, etc.) to create a home for a creature that would otherwise be exposed to the harsh elements. We aim to make the design as simple and versatile as possible while still being effective for the animals. The simplicity will allow customers to put their own spin on the design to fit the desired effect based on their geographical location. The idea of reusing items that would otherwise end up in landfill also benefits the customer from an economical as well as environmental standpoint.

Team Name

Planet Home

Team members - Sophia Sapp, Lilian Parker, Bryce Lott, Landry McHargue

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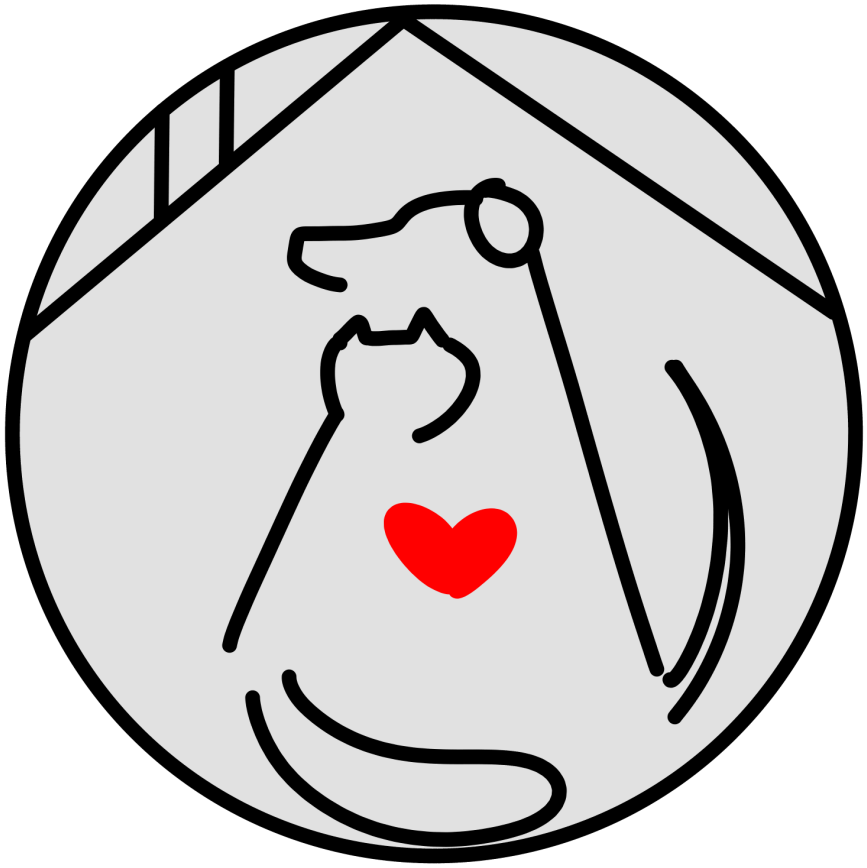

Logo

Prototype Design

Our concept for this project is to create a low-cost shelter that is versatile enough so it can be used with whatever materials are available, simple enough to be modified for the area the product will be placed in, protects stray animals from harsh weather, and keep the animals warm. We will need a product that could keep an animal warm, dry, and safe from the elements. We also revised our design to incorporate stilts to insure that water does not collect inside the shelter in order to prevent growth of mold.

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Describe the concept in two sentences. How does it work?

This product will provide affordable, practical housing for stray pets in the cold months of the year. It can simply be placed and left for animals to take shelter in.

Competing products/designs that exist and the unique value of your product

Simple dog houses, our shelters will be significantly more affordable and will insulate the animals better

Product Name

Shelter for Strays

What do you hope to learn more about through prototyping this idea?

We hope to learn about the safe temperature for living for domesticated cats and dogs.

What needs or opportunities does it address?

This product helps address the issue of homeless pet deaths in the winter.

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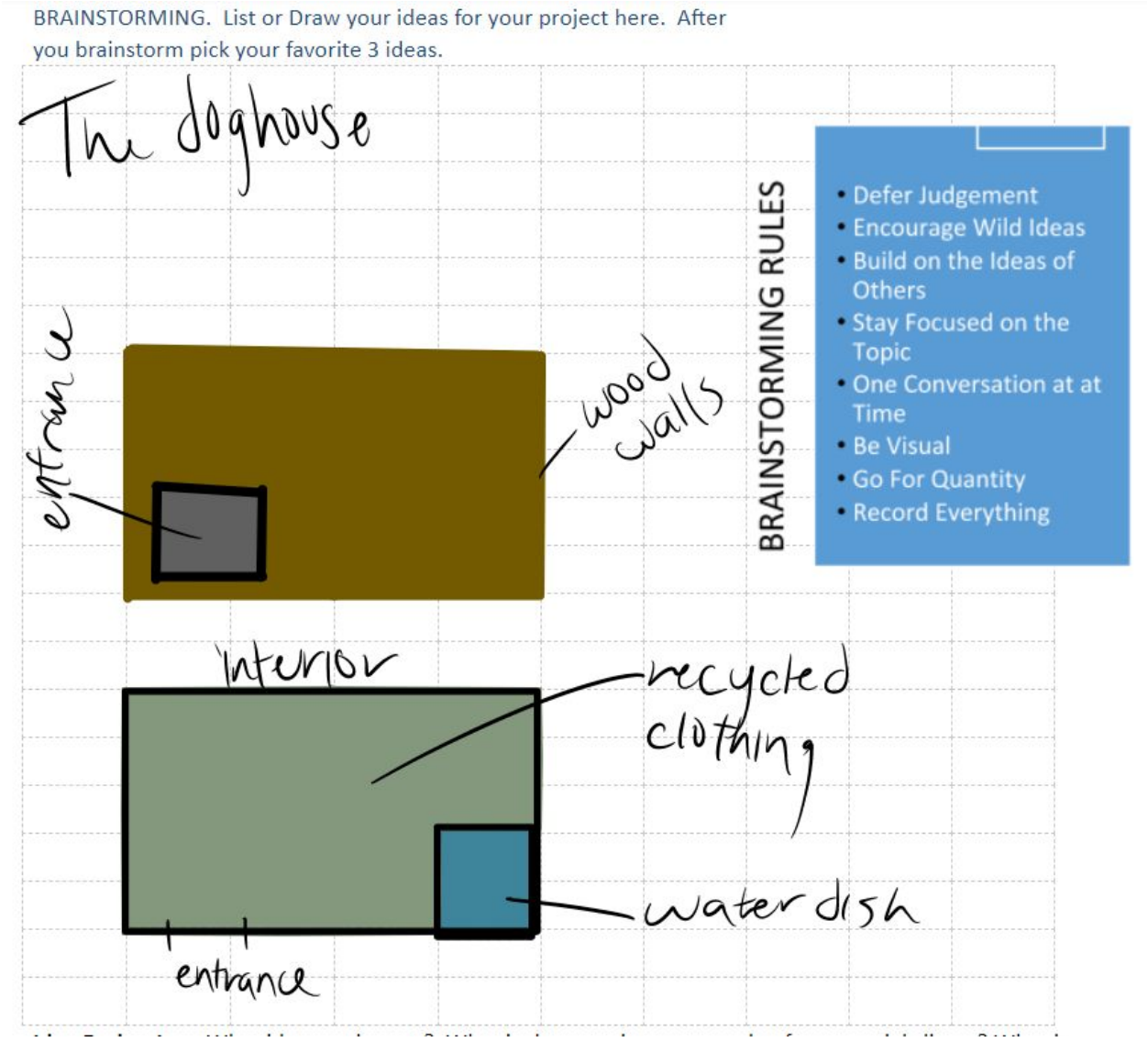
Design Documents

Idea 1:



This idea we chose to scrap because of it's wood walls which would weather and animals and pests may chew through. We also decided to scrap the water dish seeing as it cannot be refilled or cleaned.

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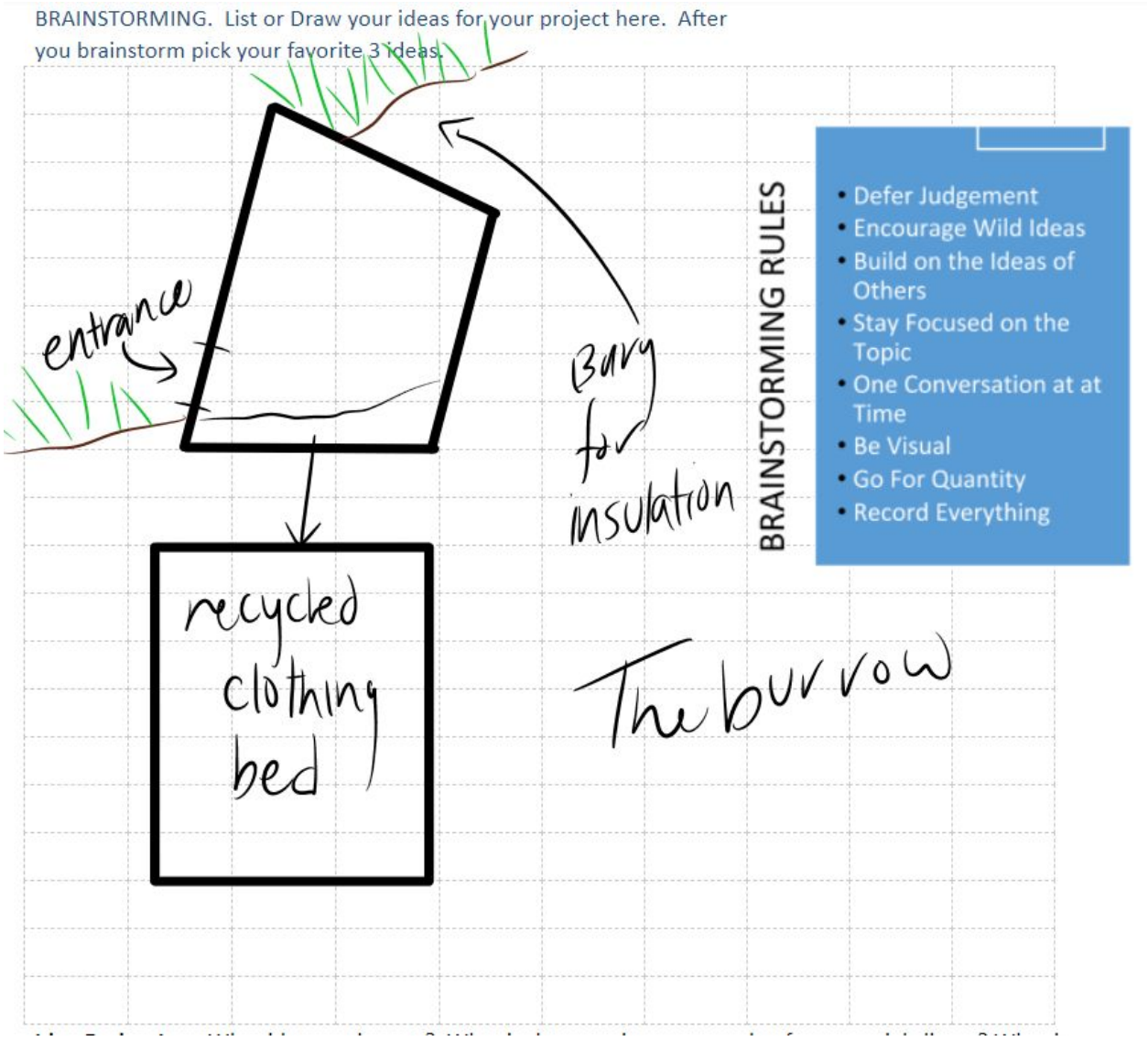
Idea 2:



We decided to scrap this idea because placing the product underground would require the customer to dig a hole and also requires a hill be present. We want this idea to be able to be used anywhere, not just the hilly terrain of Tennessee. We also realized over time the shelter would collapse due to the weight of the dirt.

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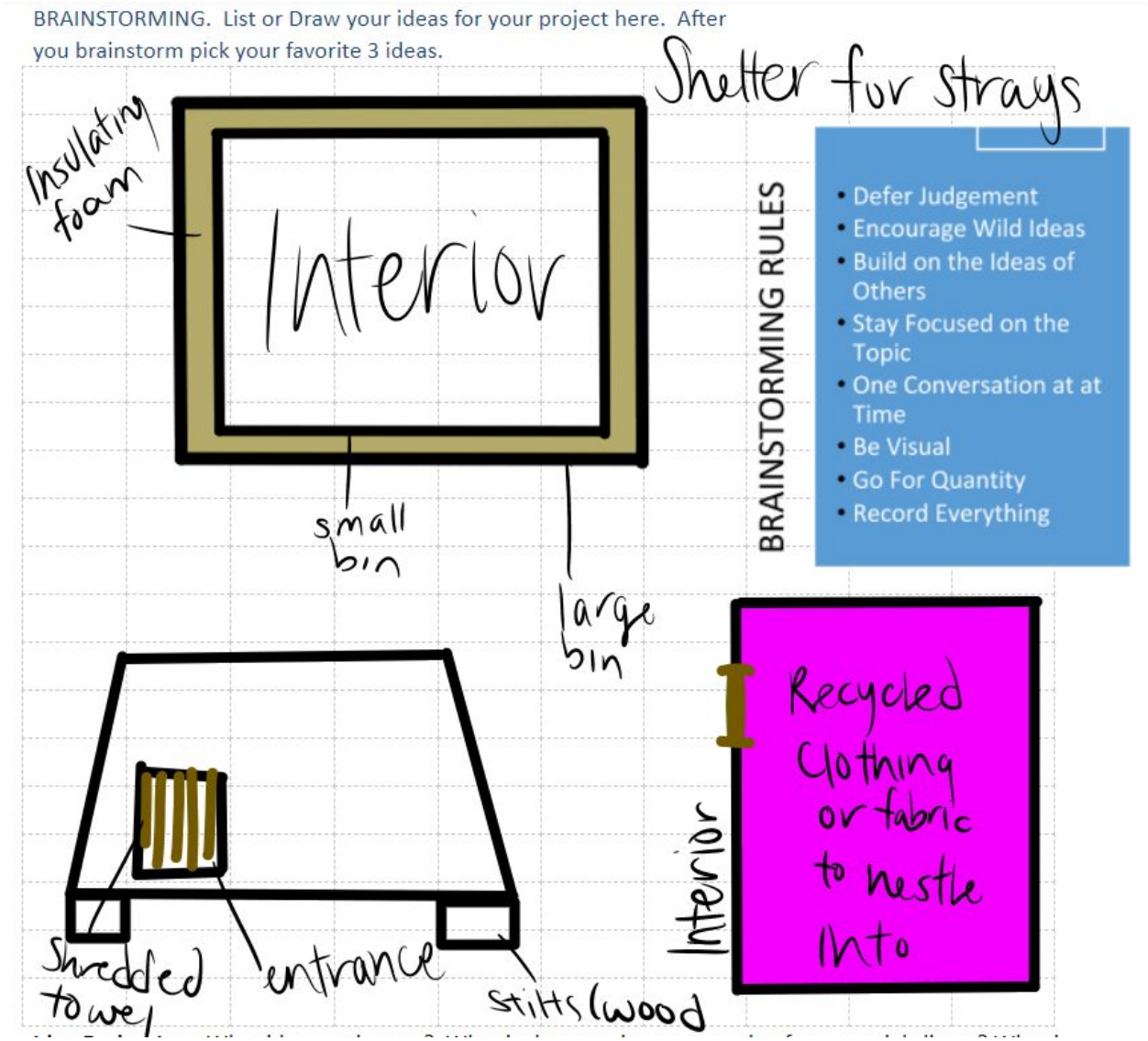
Idea 3:



We chose this idea because it offers a few things the others did not. For one it adds foam insulation to keep the shelter warmer than the doghouse would. We also added shreds of fabric over the entrance for added insulation from the outdoors and decided to put the bins upside down to keep them from blowing away. Finally, we decided to put the product on small wooden stilts to keep it from filling with water and growing mold. Because our design is meant to be as versatile as possible to allow clients to use whatever materials are available, we are only specifying using a large and small bin, though the space between the two should be at least a ½ inch. The stilts should be made of wood and only have to be 4x4 inches and 2 inches tall. The entrance will be 2 inches from the bottom to keep the bedding from spilling out and be a 12x8 inch hole. The strips of fabric covering the entrance will be about 1 inch strips.

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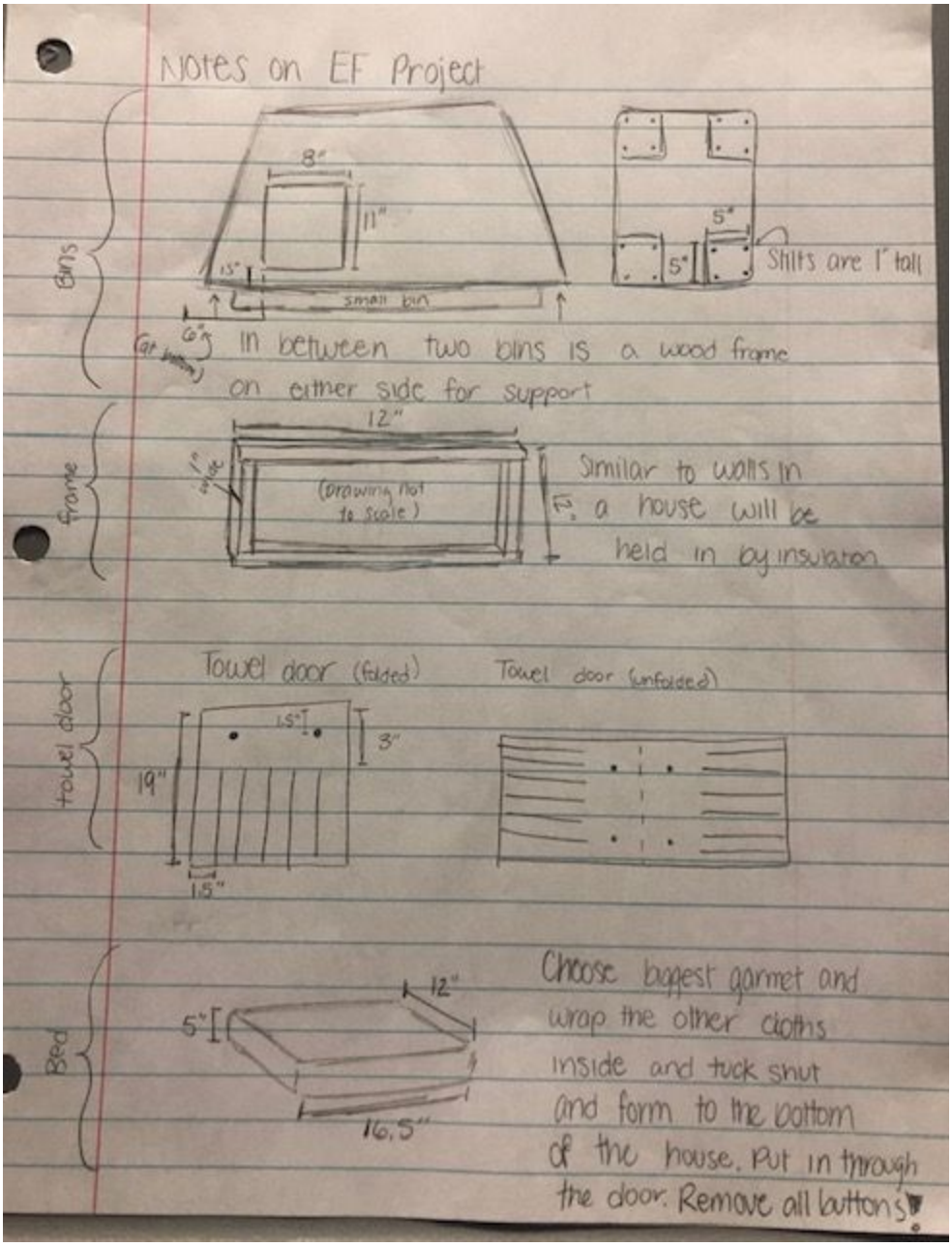

In this one we went a little further in depth with the measurements and basic idea of our project using the measurements of a large and small bin. As we worked on the design some things changed such as the thickness of the bed as it made the door difficult to enter, the door was shortened to keep it from dragging the ground, and the legs were changed as well as adding a center leg for support.

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Schedule

Week	1	2	3	4	5	6
Design						
Build						
Test						
Refine						
Paperwork						
Due Date						April 5th

Client Feedback

HSTV employees and volunteers

-decrease in animal intake in the winter but increase in unhealthy animals

-frozen ground can harm younger puppies paws

-illness harder to prevent in winter

-dogs likely to chew and ingest exposed insulation

Offered the home to Sophie's dog who is larger than our intended animal but she still went in and laid down as well as stood on top to look around. This allowed us to test the durability and see if animals really enjoyed the home. Because every animal is different we also allowed Lily's cat to the home and she stayed in it so long we had to evict her so we could bring the project to present. The two animals we tested enjoyed the home.

Materials

Materials List-
2 plastic bins (one small enough to completely fit inside the other) - less than $10 each
Loctite spray foam insulation - about $5 per 12 oz can
Recycled clothing to make dog bed - No cost
Some recycled wood used from the Perkins Lab.

Required Tools-
Saw to cut the hole for the animal to enter/exit
Drill to make holes in base for the legs

Storage of Materials-
Store at home, because it is too large to store in Perkins

Environmental Impact Statement

Our product makes use of many recycled materials, including recycled fabrics for the bedding inside of the shelter. While our product is made of plastic, it is not disposable. Therefore, it will not have a heavy impact on the disposable plastic waste problem. We will be using a polyurethane foam spray as the insulation for our shelter. Polyurethane sprays have been known to have negative effects on the environment. However, in recent years, polyurethane foam spray manufacturers have been improving their products to reduce their environmental footprint. Overall, our product will have a relatively low impact on the environment.

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Time Logs

Date	People	Hours	Description
January 22nd	**All**	**1.25**	**Brainstorming and deciding on an idea**
January 25th	**All**	**1**	**Research and worked on notebook**
January 29th	**Sophie, Lily, Bryce**	**1.25**	**Research and working on notebook**
February 14th	**Sophie, Lily, Bryce**	**.5**	**Discussing ideas and working on notebook**
February 18th	**Sophie, Lily, Bryce**	**1**	**Notebook finalization, logo design, and diagram of ideas**
February 19th	**All**	**1.5 hrs**	**Detailed design document work and alteration of prototype**
March 15th	**Lily, Sophie, Landry**	**1.5 hrs**	**Building**
March 21st	**Lily**	**1 hr**	**Building**
March 31st	**All**	**3 hrs**	**Presentation work and building**
April 1	**Lily and Sophie**	**1.5 hrs**	**Presentation work**
April 1	**Bryce**	**2 hrs**	**Building**

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Cost Data

We estimated our cost to be around $52 if all the materials are bought brand new. This includes a $10 large plastic bin and a $5 small plastic bin, 2 full sized towels at $5 each, a hand towel at $4, 4 cans of spray insulation at $5 per can, and one 2x4 at $3. When factoring in brand new materials our project becomes costly, but using new materials was not our design plan, we plan to use recycled cloth,wood, and plastic so the only cost would be the insulation and maybe a few small things if we cannot find them recycled.

If we were to make 1000 units we could factor in bulk discounts and get them for around $36,210 with no recycled materials. If we could recycle as we planned we could lower that cost to $20,000 for 1000 units.

We put a total of 45.75 man-hrs Total into this project with 26.25 coming from Design Time and only around 19.5 coming from the actual building process.

Factoring in all of this we would most likely sell this for around $50 per unit. This allocates $30 for materials, $15 for labor, and $5 for profit. Small dog houses of a similar price range usually feature a design similar to one of our tested R values with nearly 8 watts being lost. With our insulation we don't even round up to 1 watt lost. Our design offers a warmer home than the competitors of the same price range and a cheaper price to houses of the same standards.

Final Prototype/Design

This is our final design.

It features two layers of plastic to keep the animal secure and to keep the building sturdy as well as a wood frame inside the walls. It also has five drainage holes in the bottom to allow water to leak out in case it somehow gets inside the shelter. It also features an inch of foam insulation on two of the thinner walls and three inches on the sides. We put the shelter on stilts to keep it from flooding in particularly bad weather. Finally we used a shredded towel to further insulate the home and recycled cloth to make a comfortable bed.

And a Power T for style of course.

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Not entirely sure where this last photo belongs but was told in lab to include it.

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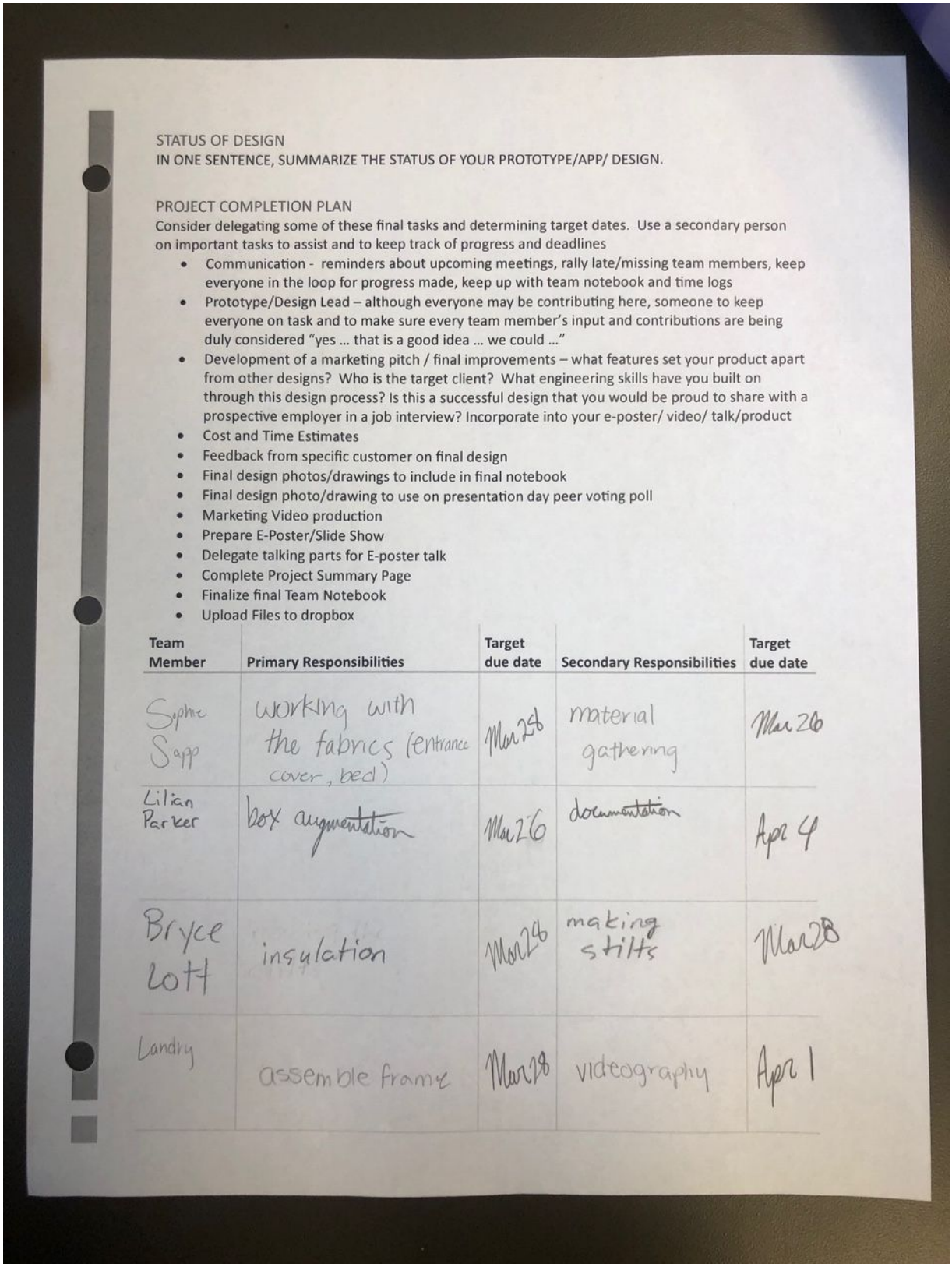

STATUS OF DESIGN

IN ONE SENTENCE, SUMMARIZE THE STATUS OF YOUR PROTOTYPE/APP/ DESIGN.

PROJECT COMPLETION PLAN

Consider delegating some of these final tasks and determining target dates. Use a secondary person on important tasks to assist and to keep track of progress and deadlines

- Communication - reminders about upcoming meetings, rally late/missing team members, keep everyone in the loop for progress made, keep up with team notebook and time logs
- Prototype/Design Lead – although everyone may be contributing here, someone to keep everyone on task and to make sure every team member's input and contributions are being duly considered "yes ... that is a good idea ... we could ..."
- Development of a marketing pitch / final improvements – what features set your product apart from other designs? Who is the target client? What engineering skills have you built on through this design process? Is this a successful design that you would be proud to share with a prospective employer in a job interview? Incorporate into your e-poster/ video/ talk/product
- Cost and Time Estimates
- Feedback from specific customer on final design
- Final design photos/drawings to include in final notebook
- Final design photo/drawing to use on presentation day peer voting poll
- Marketing Video production
- Prepare E-Poster/Slide Show
- Delegate talking parts for E-poster talk
- Complete Project Summary Page
- Finalize final Team Notebook
- Upload Files to dropbox

Team Member	Primary Responsibilities	Target due date	Secondary Responsibilities	Target due date
Sophie Sapp	working with the fabrics (entrance cover, bed)	Mar 25	material gathering	Mar 26
Lilian Parker	box augmentation	Mar 26	documentation	Apr 4
Bryce Lott	insulation	Mar 26	making stilts	Mar 28
Landry	assemble frame	Mar 28	videography	Apr 1