PROJECT PLAN
IPRO 325
Designing Affordable Water, Energy, and Shelter Solutions for the World's Rural Poor

Friday, September 19, 2008

IPRO 325

1.0 Abstract

An estimated 2.7 million people die prematurely each year due to smoke and toxic emissions from wood burning. Around 3.1 million people died in 2002 as a result of diarrhea related diseases which are contracted from polluted water; 90% of whom were children. Out of 792 million people suffering from malnutrition, 5 million children die each year. 4 out of 5 of these 792 million people do not have access to needed fruits and vegetables.

For the past four semesters, IPRO 325 has focused on helping solve problems of the world's rural poor. This semester, the team is focused on improving last semester's designs and developing better field manuals. Our team implemented our past projects in Sincape, Peru last semester, and we also intend to go back to look at them after a semester and implement more of our projects.

2.0 Background

In fall 2006, IPRO 325 identified the three most severe problems of the world's rural poor: water, energy, and shelter. The next two semester's team focused on designing better energy, water and shelter solutions and improving awareness of global poverty on IIT's campus. In fall 2007, the team completed designs and positive tests for an improvement for turbid water using the SODIS UV water cleaning method, and adobe/sand evaporative cooling system improving on the two-pot system used in Africa, and an improvement to the rocket stove design. In January 2008, the team was able to being to test their designs in Peru and Nicaragua using local people and local materials. Finally, the spring 2008 team further improved their project designs and made field manuals. They also implemented their projects in Sincape, Peru.

This semester, the team is focused on improving last semester's design, developing better field manuals, and creating a better test record. The fall 2008 IPRO 325 is divided into three subgroups again: water-two-bucket system, energy-barrel-rocket stove and shelter-evaporative cooling systems.

3.0 Objective

Design, build and test energy, water or shelter solutions costing $5 or less that can be implemented and maintained by local people using locally available materials.

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Water – Two-Bucket System Subgroup

1.0 Abstract

3 billion people live on less than $2 per day. This leaves nearly half the world's population without access to basic amenities. 5 Million People die each year from illnesses caused by unsafe drinking water. Around 3.1 million people died in 2002 as a result of diarrhea related diseases and malaria, which were contracted from polluted water, 90% of whom were children.

Our objective is to increase the availability of portable water in the world by making the SODIS system applicable to areas with turbid water. We will be testing the efficiency of the 2 Bucket system prototype, an affordable solution build using locally available materials costing $5 or less to clear the turbidity of the water.

We will also be developing workshops and field manuals, mainly visual, to educate the people about the need for the system and how to construct and maintain it.

2.0 Background

Water-borne diseases are a world-wide pandemic. Every year more than five million human beings die from illnesses acquired from unsafe drinking water. In essence, by eliminating common bacterial diseases that stem from unsafe drinking water would make the quality of life for the world's rural poor much better. Therefore, the goal of this semester's IPRO 325's water subteam is to further develop a technique for purifying water that was developed in the fall of 2007. This technique should cost less than $5 to implement and should be able to be assembled on site in the local community using locally available materials. Last semester the water subteam developed and built composting toilets, which now has been changed to water purification because the composting toilets was not a big success when Spring-08's IPRO 325 went down to Sincape, Peru. Also, currently, the water subteam has grant money pending from National Collegiate Inventors and Innovators Alliance (NCIIA) to further test and build on the water turbidity purification process and make it available to regions in the world having turbid dirty water.

The techniques that were studied and developed in the fall of 2007 were a three bucket filtration system followed by a 2 bucket system that would be used in place of sedimentation within a process known as SODIS, which has been implemented in many third world countries. This system works by exposing water to sunlight. Then the UV radiation neutralizes microbes in the water. Basically, SODIS, Solar Water Disinfection is a simple method to improve the quality of drinking water by using sunlight to inactivate pathogens causing diarrhea. Consequently, contaminated water is filled into transparent plastic bottles and exposed to full sunlight for six hours. During the exposure, the UV-A radiation of the sunlight destroys the pathogens. A synergy of UV-A and temperature occurs, only if the temperature rises to about 45 degree Celsius. Fundamentally, this system is ideal in areas where there is lots of sunlight. However, there are always barriers when searching for solutions and the limitations of the SODIS system include: SODIS not changing the chemical water quality, does not increase the water quantity or reduce water shortages, requires relatively clear water, not useful to treat large volumes of water, and requires suitable climates and weather conditions. The SODIS group recommends slow sand filtration requiring the filtered water to be stored for significant periods in open areas, which often leads to recontamination. The sedimentation allows the suspended particles to settle in a reservoir for 24 hours. This method is slow and does not reduce turbidity appreciably. As a result, the IPRO 325 class from the fall of 2007 developed a three bucket and then two bucket filtration system to replace the sedimentation step in the SODIS system.

In the three bucket system, the bottom bucket is connected to the system through a lid with a four inch diameter hole. Above the lid sits the middle bucket, which is perforated with a knife to allow water to drain though. A piece of fabric is placed on the bottom of the middle bucket and is covered with three inches of selected filter material. Directly above the filter material is the top bucket that is also perforated at the bottom to allow water to drain through to the middle bucket. Now, the two bucket system is the same concept except a bucket is taken away and in between the top and bottom bucket there are sticks holding the buckets in place. This design refinement was made in order to eliminate the backpressure of the middle bucket on to the top bucket and to use fewer materials, thus making the apparatus cheaper. The first bucket includes turbid water, 1-2 inches of gravel, the filter media, and a one inch by one inch scrap cloth. Then on top of the bottom bucket there are branched sticks that hold the top bucket in place. The bottom bucket just includes clean water that been filtered through the holes of the top bucket. Testing for the filtration system was completed by the fall 2007 IPRO 325 class. On October 30, 2007, a large sample of turbid water was prepared by mixing soil with tap water. This yielded 6 gallons of turbid water for testing. Several filtration Medias were tested by filtering out the water. The 2.5 gallon filter apparatus was loaded with each filter media to a depth of 3 inches and 2.35 L of turbid water was filtered during each test. The five different filter medias used were: 1:4 charcoal: sand, with a cloth liner, 1:8 charcoal: sand, with a cloth liner, 1:16 ash: sand, with a cloth liner, 1:8 ash: sand, with a cloth liner, and 1:16 ash: sand, with a cloth liner. Another test was accomplished on optical absorbance measurements. Basically, in this experiment four different filter materials were tested, namely sand, crushed volcanic rock, a ratio of 1:2 coarse charcoal to sand, and 1:2 fine charcoal to sand. The amount of water that filtered through each material on the first, third, and fifth passing was recorded. Unfortunately, filtering out the turbidity using the bucket system only reduces the dirt from the water. It has not been determined if it effects the bacterial content or toxicity of the water. Then the water will go through the SODIS system to kill the bacterial organisms present in it and make it safe for drinking. The outcome is that the IPRO 325 team from fall 2007 addressed the problem of unsafe drinking water, researched it and accomplished a lot in one semester; however, this semester's team is going to take it couple steps further and add to their findings.

3.0 Objective

The IPRO 325's Water Sub-team will continue the development of previous semester work of a water filtration system that would help the world's rural poor to have potable water, and to sustain a simple, low cost and affordable method of doing so.

4.0 Methodology

Similar to the IPRO 325's of the past, this year's water subgroup will be focusing on four majors issues with regards to our main objective:

- Designing a system made of components that are affordable, and available to the people who will be using them.
- Making our design flexible, so that it can be adopted outside the limits of one single village.
- Designing a solution that will be accepted by the people who we are aiming to help.
- Keeping construction simple enough, and directions as intuitive as possible in order to make sure that the system will stay in use.

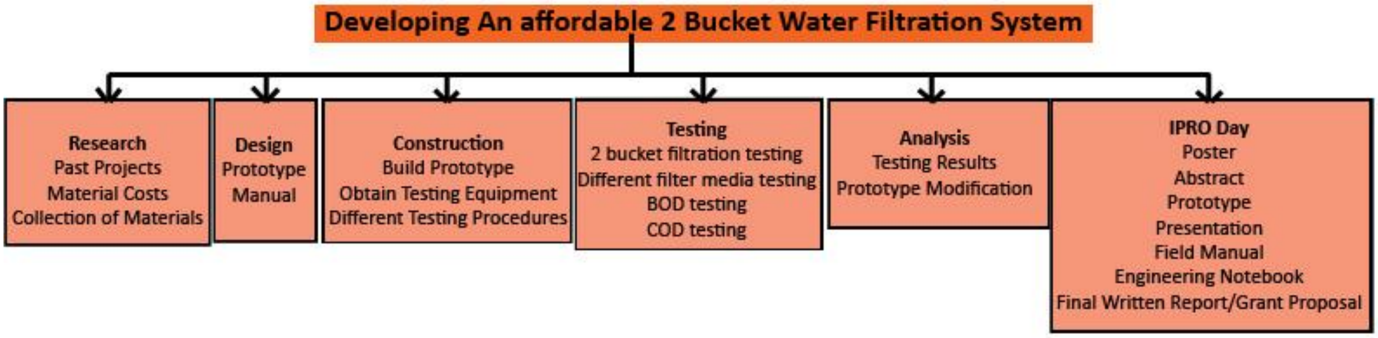
There are a good amount of resources available to us on the iGroups website. IPRO 325 water subgroups of the past have been researching and designing solutions to these problems. We intend to take full advantage of these resources in order to help aim our focus, and build off of work done in previous semesters.

After researching past semester's results, it seems that they have narrowed down the types of materials that should be used. They have also tested different filter materials and the ratios of those materials in an attempt to discover the best way to filter turbid water. Though results have been posted, some of them are difficult to understand, and seemingly contradictory. We hope to retest some materials and ratio's in order to clear up these misunderstandings.

The foundations for this project have been laid by students of the past. We hope to build on those ideas by:

- Clarifying the type of filter material that should be used by briefly retesting ratios of sand to charcoal.
- Test how the amount of filter material affects the results.
- Test if these materials filter out chemical compounds such as pesticides.
- Attempt not only to design a filtration system that reduces turbidity, but test systems that kill bacteria and other biological matter as well. In addition to the SODIS method that has been used in the past. We'd also like to look into the COD and BOD methods as well, and assess their plausibility.

The results of our tests will be recorded and uploaded to the iGroups website. We will make it a priority to clearly label our findings so that future IPRO groups, as well as our teammates, will be able to easily access and understand our findings.



[Turbidity & Disinfection][1]

- Turbidity(using Optical Absorbance Measurement(283nm))
  The previous result indicates that filtrated water has about 0.15 when the input water's absorbance is about 2.15.
  For this semester, enhancing the design and material, we will be able to get the data below 0.15 when we use source, the absorbance is about 2.15.

- Disinfection
  We cannot measure how well the disinfection works.
  We need various researches for the disinfection.

[DO & COD][1]

: We have no previous result of this.

- DO(Dissolved Oxygen)
  We can measure the amount of DO by experiment.
  Clean water's DO is about 7~14 ppm.
  The result of DO depends on source, so we can't estimate it.

- COD(Chemical Oxygen Demand)
  We can measure the level of COD.
  We should focus on not the level of COD but the efficiency of filtration reducing COD.
  We cannot estimate the level of COD.

[1] See igroups.iit.edu from Fall 208

5.0 Project Budget

TOTAL BUDGET = $378

Prototype Materials	Cost	Amount	Total
5 gallon Buckets	$5	8	$40
Sand(50lb bag)	$5	4	$20
Charcoal (20lb bag)	$20	1	$20
Gravel (20lb bag)	$20	1	$20
Scrap Cloth	$5/shirt	5	$25
Branched Sticks	0	As needed	0
Turbid Water	0	0	0
Screws/Nails	$3/box	1	$3
Education Materials-Manuals	$10	5	$50

TOTAL= $178

Testing Materials	Cost
UV-vis Spectrometer	0
BOD Test Kit	$50
COD Test Materials	$50

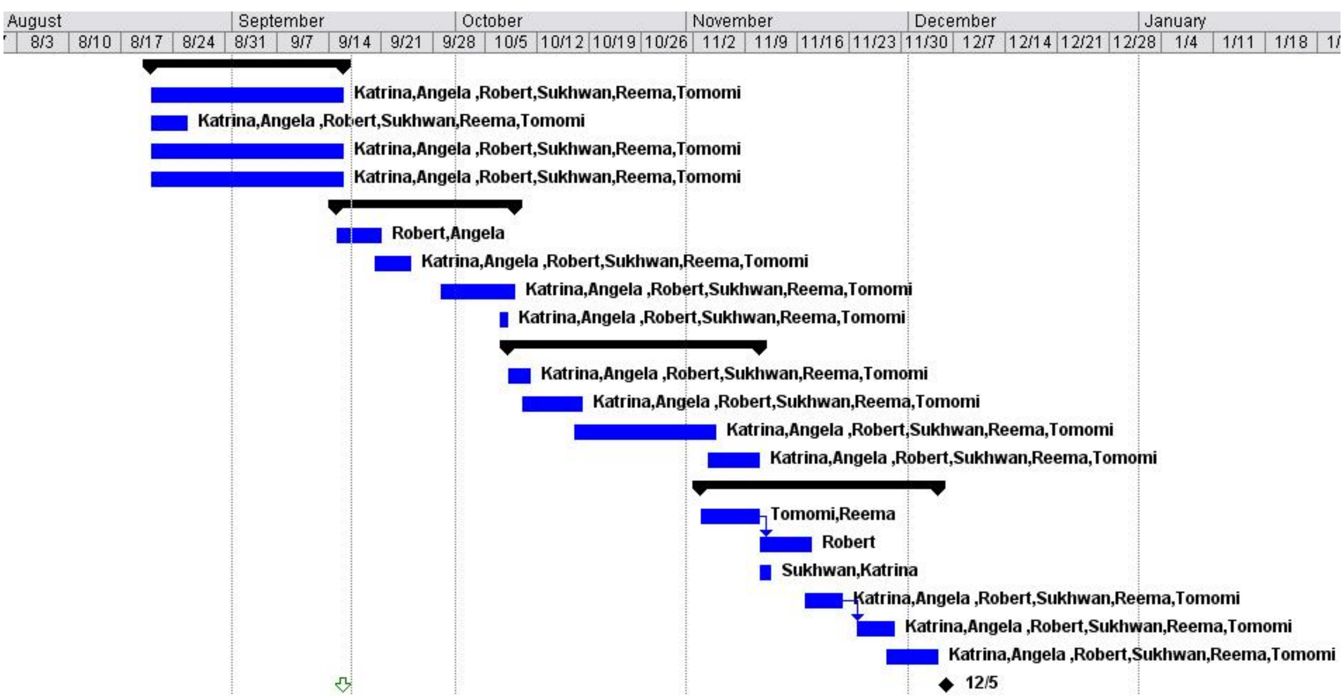
TOTAL=$100

Miscellaneous	Cost
Transportation	$100

TOTAL=$100

6.0 Project Milestones

- Phase 1: Research	**18 days**	**Thu 8/21/08**	**Mon 9/15/08**	
Current Example	18 days	Thu 8/21/08	Mon 9/15/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Material Costs	3 days	Thu 8/21/08	Mon 8/25/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Location Information	18 days	Thu 8/21/08	Mon 9/15/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Benchmark Selection	18 days	Thu 8/21/08	Mon 9/15/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
- Phase 2: Design & Build	**19 days**	**Mon 9/15/08**	**Wed 10/8/08**	
Material Collection	6 days	Mon 9/15/08	Sat 9/20/08	Robert,Angela
Past Design Construction	4 days	Sat 9/20/08	Wed 9/24/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
New Design Construction	8 days	Mon 9/29/08	Wed 10/8/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
MIDTERM REPORT	1 day	Tue 10/7/08	Tue 10/7/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
- Phase 3: Testing & Analysis	**24 days**	**Wed 10/8/08**	**Mon 11/10/08**	
Obtain Testing Equipment	3 days	Wed 10/8/08	Fri 10/10/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Testing Procedures	6 days	Fri 10/10/08	Fri 10/17/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Modification Construction	13 days	Fri 10/17/08	Tue 11/4/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Testing and Analysis Recording	5 days	Tue 11/4/08	Mon 11/10/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
- Phase 4: Conclusion	**24 days?**	**Mon 11/3/08**	**Thu 12/4/08**	
Manuals	6 days?	Mon 11/3/08	Mon 11/10/08	Tomomi,Reema
Abstract	5 days	Tue 11/11/08	Mon 11/17/08	Robert
Poster	1.5 days	Tue 11/11/08	Wed 11/12/08	Sukhwan,Katrina
Presentation Practice	5 days	Mon 11/17/08	Fri 11/21/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Question and Answer Practice	5 days	Mon 11/24/08	Fri 11/28/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
Final Written Report / Grant Proposal	5 days	Fri 11/28/08	Thu 12/4/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi
IPRO DAY	1 day?	Fri 12/5/08	Fri 12/5/08	Katrina,Angela ,Robert,Sukhwan,Reema,Tomomi



7.0 Team Structure and Assignments

Name	Major	Skills	Experience	Responsibility
Christo, Robert	Architecture, 4th year	AutoCAD 2000-2008,Adobe Photoshop, 3D Studio Max, Revit 08-09, Microsoft Office, Modeling	Construction, Drafting	Subgroup Minute Taker
Gandhi, Angela	Psychology, 4th year	Microsoft Office, SPSS, PeopleSoft, Business Objects, Kenexa Recruiter	Customer Service	Cultural Liason
Ongchangco, Katrina	Architecture, 4th year	AutoCAD 2000-2008, Microsoft Office, Adobe Photoshop, 3D Studio Max, Modeling	Customer Service, Drafting	Minute Taker
Paranthan, Reema	Architecture, 5th year	AutoCAD 2006-2008, Autodesk Viz 2008, Adobe Photoshop CS2, 3ds max 7, Adobe Illustrator, Microsoft Office, Modeling	Customer Service	Subgroup Leader
Tsukioka, Tomomi	Architecture, 5th year	AutoCAD, Autodesk Viz, Adobe Illustrator, Adobe Photoshop, 3ds max, Microsoft Office, Modeling, Ability to use workshop tools	Customer Service, Drafting	Team Leader
Yun, Suk Hwan	Chemical Engineering, 4th year	Microsoft Office, Foreign Language: Korean and some Chinese	Customer Service	Engineering Notebook

Energy – Barrel-Rocket Stove Subgroup

1.0 Abstract

Throughout the world, millions of poor people in developing countries use inefficient cooking methods or stoves – but mostly open fires – that cause a variety of problems – health issues and premature death due to smoke inhalation and environmental harm due to deforestation. To address these problems, the energy subteam of the fall 2008 IPRO 325 will improve and test a new design of the barrel-rocket stove, which was designed and tested (and proven very effective for reducing smoke and wood used) by the energy subteam of previous semesters of this IPRO. Our team will be focused on addressing the flaws that were uncovered during the testing of the previous designs and also on adapting the new design to match the needs of the people we are trying to help.

2.0 Background

In developing countries, the most significant source of indoor air pollution is toxic emissions released from inefficient stoves or open fires. According to the World Health Organization, indoor air pollution is one of the most severe global environmental risks, and is estimated to cause 1.6 million premature deaths each year. There is now strong evidence to support the correlation between indoor air pollution and health, particularly respiratory diseases. Indoor air pollution is strongly linked to poverty, as it is the rural poor who rely on free and/or lower-grade fuels and inefficient stoves (or open fires) for cooking. These unhealthy practices are also linked to deforestation and global warming; they also force people to spend a significant portion of their time gathering fuel. Improving cooking methods will certainly offer the opportunity for better health and improved living conditions.

In response to these global health and environmental problems, organizations such as the Aprovecho Research Center strive to improve cooking-stove technologies. Hoping to make a contribution into this development, IPRO 325 is collaborating with a few institutions in Nicaragua and Peru to further develop affordable solutions that can be implemented by the local populace in rural areas. High-efficiency cooking stoves that burn less charcoal and other biomass provide tremendous socioeconomic, environmental, and health benefits to the users and their communities. Our improved stoves will be fuel-efficient, safe to operate, and will minimize the amount of smoke that escapes into the users' home. The use of these stoves will also help reduce deforestation by reducing the consumption of charcoal and wood.

The energy subgroups of previous semesters have looked into a few types of cooking stoves: solar cookers, the rocket stove, and the institutional barrel stove. Our predecessors have done extensive research on these alternatives and tested them successfully, but were not completely satisfied with the results. Solar cookers use only the sun's energy as fuel and release no toxic smoke, thus completely eliminating that issue. However, it is very time consuming and impractical because it is useless if the sun is not cooperating. The rocket stove is very efficient – it uses less wood, thus saving people time from collecting large amounts of firewood. However, this rocket stove is only ideal for outdoor use. Though it generates less smoke, the users are still exposed to the toxic emissions if it is used indoors. The institutional barrel stove implements the design of the rocket stove and uses an extra barrel that surrounds the inner. barrel in order to trap the smoke. An exhaust pipe is added to provide a pathway for smoke to escape to the exterior of the users' home. This solves the smoke problem, but it is only good for a certain size of pot[2].

With the problem of the toxic emission in mind, the spring 2008 energy subgroup did further

[2] See our engineering notebook from spring 2008 (located on iGroups) for a complete explanation of how it works

research and was able to come up with a new design that minimized the smoke from escaping into the users' home. The new design is a hybrid of the rocket stove and the industrial barrel stove. Since the outermost container of the barrel-rocket stove does not have direct contact to the fire, it can be constructed with the same materials as the outer container of the rocket stove or with different material(s). The smoke released by the fire is prevented from leaving the outside barrel because it is virtually closed. This forces the smoke to travel between the two barrels of the barrel-rocket and into the exhaust pipe built into the outside barrel.

With the completion of the testing, two members of the energy subgroup participated in a field-test and implementation in Sincape, Peru in the summer of 2008. The locals were excited about the idea of using less wood and not breathing in the smoke, but were hesitant to adapt to the idea because of a design flaw. The prototype was only good for cooking with one pot at a time. Additionally, the team received conflicting information about what materials are available over there – metals are actually scarce and/or expensive. With their suggestions, they were able to come up with a new design which allowed for cooking with two pots. They used the same concept, but different materials – ceramic bricks instead of a barrel. Unfortunately, it was their time to leave when the construction of the newly designed stove was completed. They were not able to test it. However, thy still kept in touch with one of the local people. About three weeks later, they were informed that the stove was no longer in use – the combustion chamber could not withstand the heat and the stove broke down.

3.0 Objective

The purpose of the IPRO 325 energy subgroup is to design, build, and test a very affordable and durable cooking stove for the world's rural poor using locally available materials.

4.0 Methodology

This semester, we will work to improve the design from the previous semester based on recommendations from those who went on the field test in Sincape, Peru. The energy subgroup will be divided into four phrases: design, research, construction, and testing.

To improve the design, we will:
- Carefully analyze the flaw(s) of the previous design
- Create a few new designs based on recommendations of the locals and available materials

To validate the new design(s), we need to spend more time doing research to back up our ideas. When conducting research, we must:
- Use only trustworthy sources
- Distribute the work as evenly as possible
- Help each other out when needed

Before constructing our prototype, we need to:
- Put together a shopping list
- Minimize the budget by window shopping

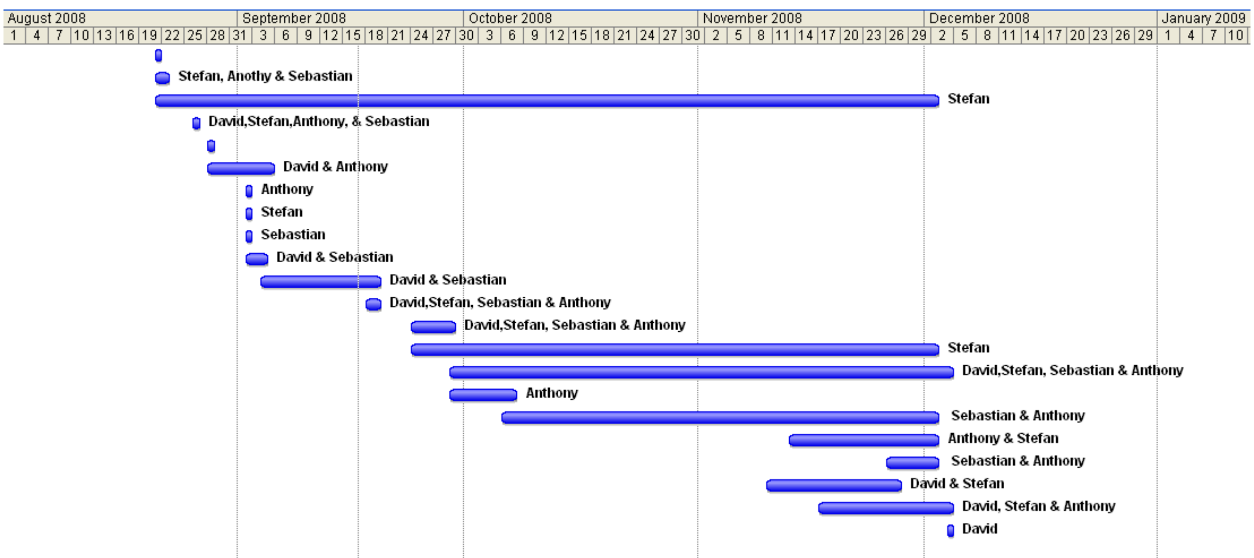
During the construction, we should:
- Stick with the designs
- Capitalize on those team members who have construction experience
- Build it in a environmentally sound and practical way

Testing will be performed at least one hour per day for five days a week. Members will take turns in groups of two to test the prototype. To prepare and have a successful experiment, we must:
- Communicate frequently and clearly
- Manage our time wisely
- Record the data accurately
- Keep the data organized
- Exam the prototype for any visible damage before and after each test

All materials will be listed on the iGroups website, allowing future teams to analyze our work. An engineering notebook will also be created by members of the group in order to provide an accessible way to observe what has been conducted during this IPRO. To successfully document all materials in an organized fashion we need to:
- Provide a clear explanation throughout each entire experiment
- Have an organized manner of combining all documents

IPRO deliverable reports will summarize the entirety of the project and the semester as a whole. For each IPRO deliverable, members are expected to complete the assignment within two weeks. Preparation is critical and constant feedback and updated results can help complete tasks appropriately.
- Time management will keep the members focused
- Making Power Point slides of results and key points can keep ideas focused

		Task Name	Duration	Start	Finish	Resource Names
1		Form an energy subgroup	1 day	Thu 8/21/08	Thu 8/21/08	
2		Read previous semester's work	2 days	Thu 8/21/08	Fri 8/22/08	Stefan, Anothy & Sebastian
3		Meeting minutes	74 days	Thu 8/21/08	Tue 12/2/08	Stefan
4		Present the goal of previous & this semester	1 day	Tue 8/26/08	Tue 8/26/08	David,Stefan,Anthony, & Sebastian
5		Welcome new members	1 day	Thu 8/28/08	Thu 8/28/08	
6		Look for a construction and test site	7 days?	Thu 8/28/08	Fri 9/5/08	David & Anthony
7		Research on adobe bricks	1 day?	Tue 9/2/08	Tue 9/2/08	Anthony
8		Research on ceramic tiles	1 day?	Tue 9/2/08	Tue 9/2/08	Stefan
9		Research on how to make a concrete	1 day?	Tue 9/2/08	Tue 9/2/08	Sebastian
10		Research on prices of materials	3 days	Tue 9/2/08	Thu 9/4/08	David & Sebastian
11		Work on the project plan	12 days	Thu 9/4/08	Fri 9/19/08	David & Sebastian
12		Shop for materials	2 days?	Thu 9/18/08	Fri 9/19/08	David,Stefan, Sebastian & Anthony
13		Construct the stoves	4 days?	Wed 9/24/08	Mon 9/29/08	David,Stefan, Sebastian & Anthony
14		Engineering notebook	50 days	Wed 9/24/08	Tue 12/2/08	Stefan
15		Test the prototypes	49 days?	Mon 9/29/08	Thu 12/4/08	David,Stefan, Sebastian & Anthony
16		Midterm presentation	7 days	Mon 9/29/08	Tue 10/7/08	Anthony
17		Field Manual	42 days	Mon 10/6/08	Tue 12/2/08	Sebastian & Anthony
18		Abstract/brochure	14 days	Thu 11/13/08	Tue 12/2/08	Anthony & Stefan
19		Posters	5 days	Wed 11/26/08	Tue 12/2/08	Sebastian & Anthony
20		Final presentation	14 days	Mon 11/10/08	Thu 11/27/08	David & Stefan
21		Final report	14 days	Mon 11/17/08	Thu 12/4/08	David, Stefan & Anthony
22		IPRO Deliverables CD	1 day?	Thu 12/4/08	Thu 12/4/08	David

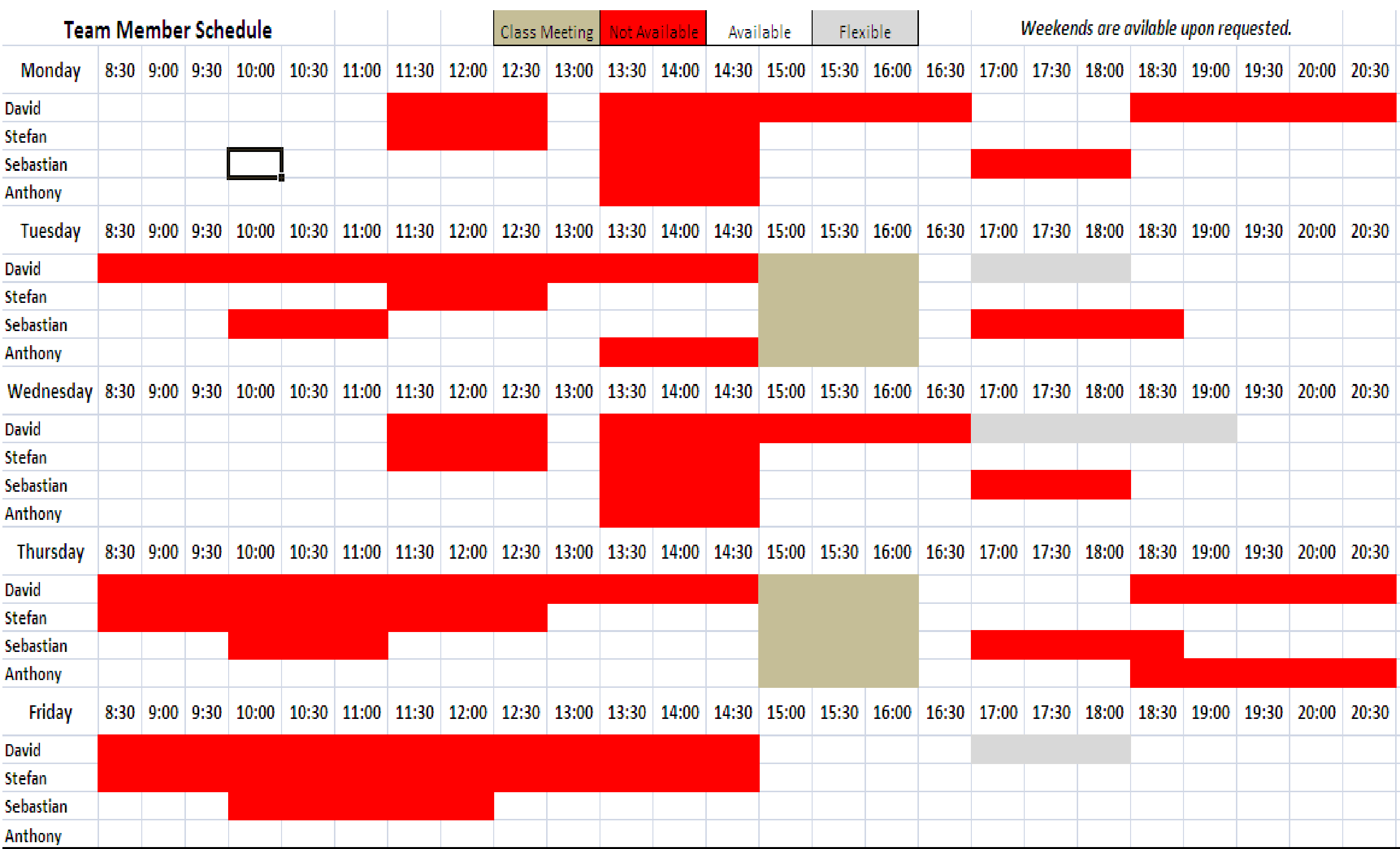


5.0 Project Budget

Materials	Quantity	Description	Price	TOTAL
Ceramic Tile	20	12in x 12in	$0.99 each	$19.8
Ceramic Brick	80	Concrete brick	$0.69 each	$55.2
Adobe Brick	80	Not buyable	-	-
Cement	1 bag	70lbs Portland Cement	$7.74	$7.74
Sand	1	Sheetrock Easy Sand	$6.47	$6.47
Bucket	1		-	-
Metal Sheet	1	15in x 35in	$19.99	$19.99
Ash	10 gallons		-	-
Tent	1	13' x 10' 72" center height	$48.97	$48.97
Shovel	1		-	-
Fire Wood	¼ chord		-	-
Rebar	1	100'	$6.99	$6.99
Scrap Board	2		-	-
Line Level	1		-	-
Mortar	1	50lbs Custom blend thin set	$5.19	$5.19
Trowel	1		-	-
Protective Clothing	4		-	-
Mask	4		-	-
Goggles	4		-	-
Pot	1		-	-
Transportation	-		$50	$50
TOTAL				$220.35

6.0 Individual Team Member Assignments

Name	Major, Year	Skills	Experience	Responsibility
Khem, David	Computer Engineering, Senior	MS Office, Java, C++, PSpice, GIMP	Customer service, project management for community events	Subgroup Leader
Matei, Stefan	Computer Science, Junior	MS Office, Java, C++, SQL, Unix	Customer service, programming,	Minute taker, timekeeper
Tarchala, Sebastian	Aerospace Engineering, Senior	MS Office, construction work	Leadership with the US Army, operating hydraulic equipment	Engineering Notebook
Mihovilovic, Anthony	Chemistry, Senior	MS Office, construction work	Customer service	Cultural Liason



Shelter – Evaporative Cooling Subgroup

1.0 Abstract

792 million people worldwide are malnourished and 5 million children die each year due to malnourishment, and therefore IPRO 325 shelter subgroup plans on designing a cooling system that will help deal with this problem.

2.0 Background

According to research done at Stanford University, although the world's supply of basic food has roughly doubled over the last half century this fluctuation causes an increase in consumer demand severely hurting the world's rural poor who already spend a majority of their income on food. Couple this with the fact that they must often times travel many miles in order to acquire any food supply, often with the lack of a decent means of travel, because of living in rural areas. It is no surprise they try and stock up with as much as they can, having to travel so far for food, but often the case is that most of the food they stock pile will spoil before they have the chance to eat it. With this in mind finding the means to store this food for prolonged periods of time become essential to their survival.

In response to this rapidly growing problem, we are attempting to develop an affordable, sustainable, and energy efficient solutions that can be implemented by the local populace. To accomplish this, we must understand the cultural and economic differences involved, and not force our ways of life onto them, but rather develop a solution that they can easily adapt to and improve their lives.

Sustainable and energy efficient evaporative cooling devices provide tremendous economic, environmental, and health benefits to the users and their communities. The cooling devices will utilize the already sunny environment to evaporate the water in the device in order to keep food cold and give them the ability to store that food for prolonged periods of time. Needless to say this would greatly reduce the amount energy that would be needed to keep the food in storage. Evaporative cooling uses a combination of strategies to both cool and store food. These include converting the heat of the sun in order to evaporate water from the medium of the device, and utilizing the insulative properties of the adobe and clay to keep the food cool. If the poor had access to these technologies, they could effectively store their food for prolonged periods of time and improve their overall way of life.

There are currently locations all over the world that are using food cooling and storing technologies, and they are achieving positive results. However, there is still much more that can be done.

3.0 Objective

The objective of the IPRO 325 evaporative cooling subgroup (formerly known as the shelter subgroup) is to develop and help implement a more effective and efficient way for the world's rural poor to store food. Over the semester, the primary objective of this group will be to plan, design, and create a working prototype of an evaporative cooling refrigeration system that will successfully store food for extended periods of time. The team will be focusing on the zeer pot cooling system along with certain modifications to it, and will be comparing it to the original tests done in previous years. The teams primary focus will be on utilizing local materials from a targeted region to develop the more effective cooling/storage method, and will ensure that the design remains relatively cheap, efficient, and above all self-sustainable.

IPRO 325 shelter subgroup also plans to design and create a manual that will not only encompass the benefits of the developed food storage method, but also provide directions for using and assembling the system as well. The team's manual will be comprehensible regardless of the language and level of literacy of the targeted region. In the end, the shelter team hopes to pave the way for IPRO 325 to conduct in-depth research and development at sites chosen in South America for on-site field testing and implementation.

4.0 Methodology:

1. The primary problems:

- Design a lasting and functional yet inexpensive evaporative cooling system for rural poor to store food.
- Design a straightforward and comprehensible evaporative cooling system manual for utilization and assembling of the desired system.

2. We will research the accomplishments and drawbacks of semesters passed to prevent repeating unnecessary work. We have decided that the pot in pot system is the most viable design, ensuring that it meets all the criteria that are created by constrictions of the targeted region. The traditional pot in pot system, which is also known as a Zeer pot has many advantages over the other adobe brick systems that were tested, including: portability, ease of cleaning, minimal cost of construction. We will be testing the pot in pot prototype against variations of it to test for improvements in lid design, and whether burying the system will aid in cooling the system. We will also gather results from these tests of cooling method proposals, and create a manual that illustrates and instructs how to assemble the evaporative cooling design.

3. Our proposals for solutions include:

- The testing the pot in pot system that the IPRO has been developing for several semesters against new variables.
- Burying the entire pot in pot system until the top rim of the pot is flush with the ground.
- Burying just a single pot in the ground without the use of sand of another pot to contain the system.
- Burying just a pot in the ground with sand to facilitate the evaporative process. With this system however, we would eliminate the external pot used to enclose the system.
- The testing of the above ground pot in pot system while testing for different lid materials. The materials that we propose are: cardboard, terracotta, and plastic.
- The development of a manual that effectively communicates the construction process of our final solution.

4. We have chosen two locations for testing our proposals. The first location is an outdoor location on the Southeast corner of campus. We will use this to simultaneously test the in ground systems against a traditional above ground Zeer pot system. We will also select an indoor location to test the traditional zeer pot system with different lid prototypes.

   The shelter group's intention is that a "Field Team," or on-site group of volunteers, will be able to fully implement our system in the targeted region during the field testing phase of the IPRO in the summer. There is the intent to send a small number of students to rural regions of South America to meet with the communities that are in dire need of food storage methods. This field testing will provide extremely valuable information regarding the specific needs of targeted rural poor communities and will assist future IPROs in fine-tuning our design for greater efficiency and effectiveness.

5. Once our initial tests on the in-ground systems are complete, we can begin analyzing the results. These initial tests will be meant to prove whether or not burying the evaporative cooling system into the ground helps the cooling, defeats the evaporative cooling process making it ineffective, or yields improved results based on cooling without the use of evaporative cooling. Due to weather constraints within the Chicago area, we will not be able to run more tests throughout the semester due to freezing outside. Therefore, if improved results are recorded by burying the system, we will suggest further testing be done when whether is permitting.

   After initial testing is complete, we plan to move to testing pot-in-pot systems in two ways in a controlled environment. First, we will set up a traditional pot-in-pot system and place fruit similar to that found in our target region inside. This system will be set aside to measure the amount of time that the system stores food as compared to food left out in the open. While these tests are running, we will be going through different lid design tests in order to determine what kind of material and design works to best keep the inside of the pot cool.

6. By adding and comparing the results that we obtain from testing this semester along with results from other semesters, we will be able to recommend a design that would seem most effective based on the data collected. The design will be a modification of past designs incorporating our suggestion for a lid as well as our recommendation as to whether the system should be buried under the ground. We will then make detailed drawings of the final design for future semesters to use and modify as they see necessary.

   Once this "maximum efficiency" design is selected, we can start work on our manual. The design of the manual will be very crucial to how effective it is in allowing our system to be implemented. If it does not clearly explain how our system is constructed as well as why it works and the benefits of using it, then all our work throughout the semester will be useless.

7. While work is being done to design and perfect our manual, we will also be working on creating a comprehensible and appealing set of deliverables for IPRO Day. Our goal is to use our skills of design in order to attract interest from people at IPRO Day in order to provide ourselves with the opportunity to explain and gain support for our project. By having deliverables that are appealing, comprehensive, and easily understood, we feel our message will be most effectively delivered.

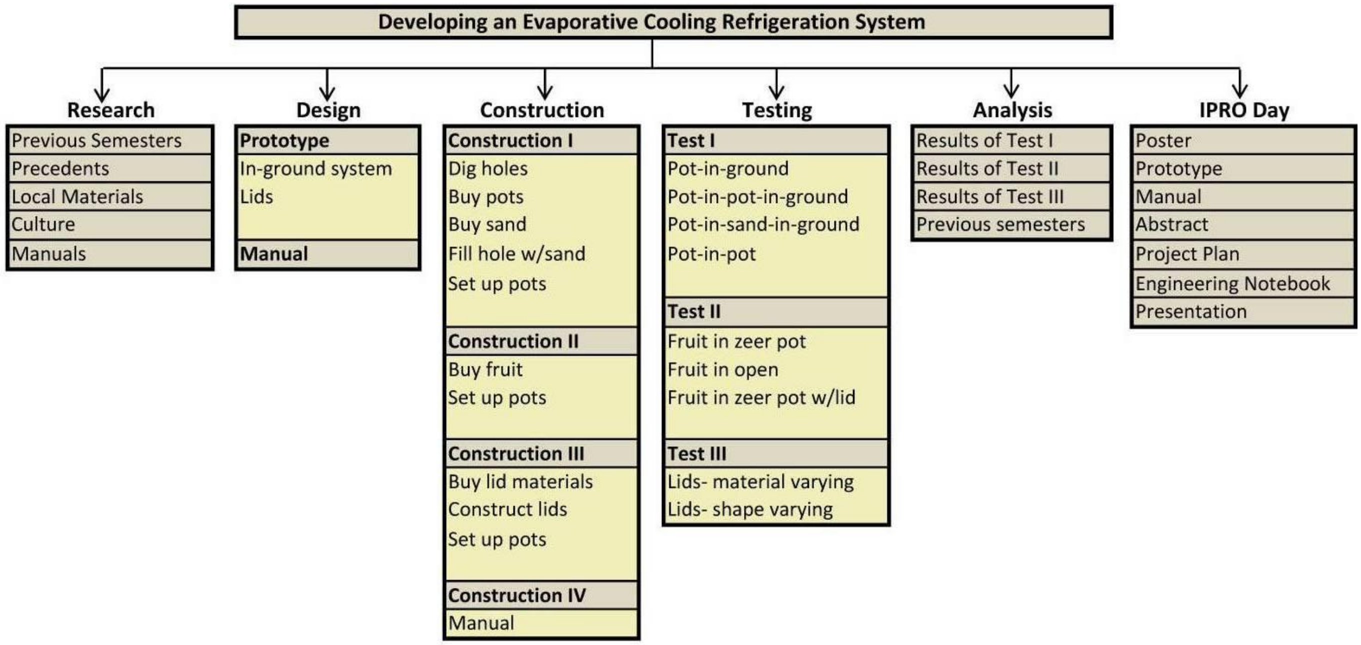
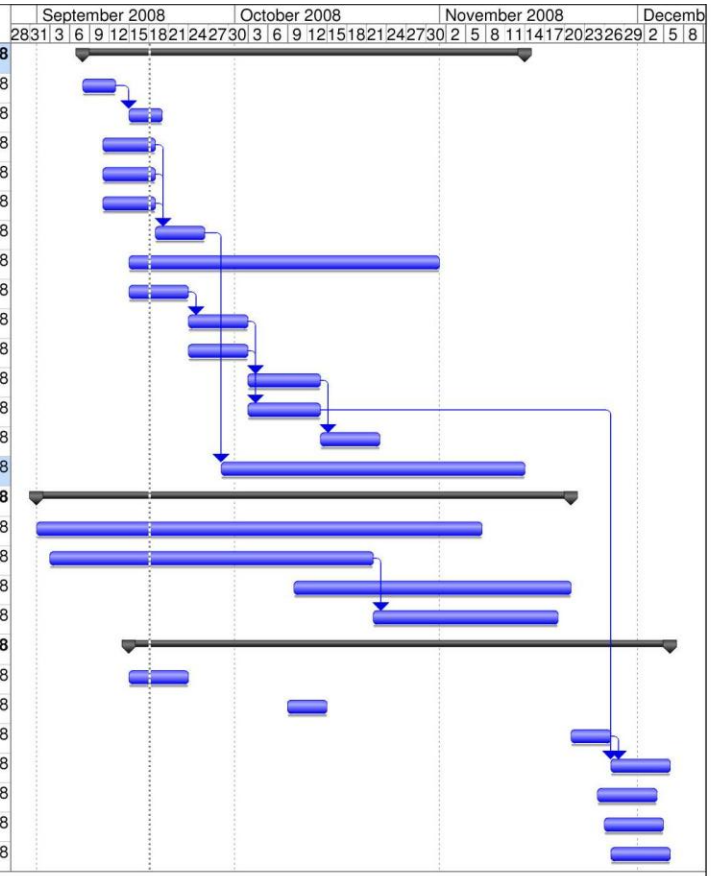


Figure 1: WBS of developing an Evaporative Cooling Refrigeration System

ID		Task Name	Duration	Start	Finish
1		**Testing**	**49 days?**	**Mon 9/8/08**	**Thu 11/13/08**
2		Find Test Site	5 days	Mon 9/8/08	Fri 9/12/08
3		Determine What Will be Tested	5 days	Mon 9/15/08	Fri 9/19/08
4		Determine Testing Supplies Needed for Pot in	6 days?	Thu 9/11/08	Thu 9/18/08
5		Determine Testing Supplies needed for Lid Tes	6 days?	Thu 9/11/08	Thu 9/18/08
6		Determine Testing Supplies needed for Food T	6 days?	Thu 9/11/08	Thu 9/18/08
7		Price Supplies	5.5 days?	Fri 9/19/08	Fri 9/26/08
8		Cultural Research: Nutritioon	35 days?	Mon 9/15/08	Fri 10/31/08
9		Check if Previous Model Exists	7 days?	Mon 9/15/08	Tue 9/23/08
10		Design Pot in Ground System	7 days?	Wed 9/24/08	Thu 10/2/08
11		Design Lids	7 days	Wed 9/24/08	Thu 10/2/08
12		Construct Lids	7 days	Fri 10/3/08	Mon 10/13/08
13		Test Pot in Ground System	7 days	Fri 10/3/08	Mon 10/13/08
14		Test Lids	7 days	Tue 10/14/08	Wed 10/22/08
15		Test Various Foods	34 days?	Mon 9/29/08	Thu 11/13/08
16		**Create Manual**	**59 days?**	**Mon 9/1/08**	**Thu 11/20/08**
17		Research for Manual	49.5 days	Mon 9/1/08	Fri 11/7/08
18		Determine Contents of Manual	35 days?	Wed 9/3/08	Tue 10/21/08
19		Graphics for Manual	30 days	Fri 10/10/08	Thu 11/20/08
20		Write Manual	20 days	Wed 10/22/08	Tue 11/18/08
21		**IPRO Deliverables**	**60 days?**	**Mon 9/15/08**	**Fri 12/5/08**
22		Project Plan	7 days	Mon 9/15/08	Tue 9/23/08
23		Midterm Review Presentation Slides	4 days	Thu 10/9/08	Tue 10/14/08
24		Abstract/Brochure	4 days	Fri 11/21/08	Wed 11/26/08
25		Poster	7 days?	Thu 11/27/08	Fri 12/5/08
26		Final Presentation	7 days	Tue 11/25/08	Wed 12/3/08
27		Final Reports	7 days?	Wed 11/26/08	Thu 12/4/08
28		IPRO Delliverables CD	7 days?	Thu 11/27/08	Fri 12/5/08



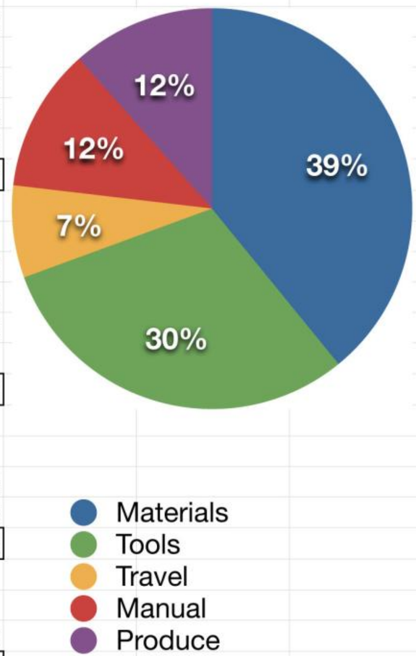
Project: Project1.mpp
Date: Thu 9/18/08

Task | Milestone | External Tasks
Split | Summary | External Milestone
Progress | Project Summary | Deadline

Figure 2: Gannt Chart by IPRO-325: Evaporative Cooling Subgroup

5.0 Project Budget

SHELTER/EVAPORATIVE COOLING BUDGET				
Materials				
	Pots	Qty	Unit Cost	Subtotal
	12"	5	$10.00	$50.00
	8"	6	$5.00	$30.00
	Sand			
	50 lb bags	4	$5.00	$20.00
	Lids			
	Terracotta	3	$6.00	$18.00
	Cloth	3	$5.00	$15.00
	Plastic	3	$4.00	$12.00
	Wood	3	$5.00	$15.00
	Cardboard	3	$3.00	$9.00
				$169.00
Tools				
	Hand Trowel	1	$6.00	$6.00
	Shovel	2	$0.00	$0.00
	Thermometer/ Hygrometer	1	$125.00	$125.00
				$131.00
Travel		Miles	Mileage Rate	
	Home Depot	5	$0.59	$2.93
	Future Trips	50	$0.59	$29.25
				$32.18
Manual				
	Printing	5	$10.00	$50.00
				$50.00
Produce				
	Fruits		$25.00	$25.00
	Vegetables		$25.00	$25.00
				$50.00
			TOTAL	$432.18



6.0 Team Structure and Assignments

Name	Major, Year	Skills/Strengths	Experience/Interest	Responsibilities
Heinz, Amber	Architecture 5th year	Leadership Project Management Design Spanish	Architect Intern Interest in sustainability Subgroup leader in previous semester	Subgroup leader
Sylvain, August	Biology 4th year	Construction and maintenance Organization and finalization	6+ ys. Construction Green Construction Health and Medicine	Engineering Notebook
Banda, Justine	Architecture 4th year	Design, CAD, organization	Architectural Intern, interest in sustainability, interest in affordable construction	Minute Taker
Chiu, Mark	Architecture 4th year	Design Graphics CAD	Detailing Sustainability Low cost design	Construction Manager
Ekstrand, Carl	Civil Engineering 4th year	Construction Cultural awareness Innovation	Inhabitant of a third-world rainforest Construction/maintenance	Materials & Testing Coordinator
Franklin, Casey	Architecture 5th year	MS Office Graphic Design CAD Spanish-Fluent Planning and Organization Communication Secretarial	Architectural Intern Low cost housing Urban design and planning Graphic design	Cultural Liason