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

PROJECT PLAN

IPRO 325, over the past three semesters, has focused on helping solve problems that plague the world's rural poor population. In fall 2006, the team identified the three most severe problems in which the following semesters should choose to focus. These problems fell into the general categories of water, energy and shelter.

Last spring, the team divided into two main subgroups to focus on creating water and energy solutions. In addition to engineering potential solutions, both the fall and spring teams aimed at improving awareness of poverty and its effects on campus. From the success and setbacks of the prototypes and awareness campaigns of the previous semesters, the team has doubled in size this fall.

This semester, the team has divided into three subgroups, one for each of the three major problem categories: water, energy and shelter. Due to the various projects amongst the subgroups and the complexity of each, three project plans have been drafted. However, in the spirit of the team, we have presented it as a collective whole.

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Project Plan Report: Energy Subgroup

1.0 Objective

IPRO 325 energy subgroup's objective is to develop and to provide a low-cost solution addressing the problem of cooking stove efficiency for the world's rural poor. We seek to do this; firstly, by familiarizing ourselves with the common means of cooking and current stoves options in certain impoverished regions of the world, identifying the technical and economical deficits associated with, and selecting designs that we think have the greatest potential for enhancement. Second, we will be studying current designs of one or two chosen (commercially available) stoves, conducting tests to gain a better understanding of their working process, and reverse engineering them to implement our designs. And, finally, we will be delivering a prototype of an improved stove that can be easily fabricated by our target population with a fairly low cost. Through this research, we hope to learn from similar projects done in the past, and at the meantime find other schools and organizations that are currently endeavoring in relevant projects for possible partnerships.

2.0 Background

The most significant source of indoor air pollution in poor countries is smoke from the burning of low cost biomass fuels in inefficient stoves or open fires. There is now strong evidence to support a link between indoor air pollution and health, particularly respiratory diseases; increasing evidence suggests links with cataracts, TB, asthma, and possibly low birth weight and heart diseases. Indoor air pollution is strongly linked to poverty as it is the poor who rely on lower-grade fuels and have least access to clean technologies for cooking and lighting.

In response to these global health and environmental problems, improved stove technologies have been developed. Improved, high-efficiency cook stoves that burn less charcoal and other biomass provide tremendous socioeconomic, environmental, and health benefits to stove users and their communities. Our improved stoves will be incredibly fuel-efficient, helping families save on energy costs. The use of these stoves will also slow the rate of deforestation by reducing the consumption of charcoal and wood.

There are currently places in India, China, and South America that are using improved stove technologies. These new technologies have been found to be more fuel-efficient and release fewer harmful pollutants. However, much work is still needed to determine their effectiveness under the tough environments often found in developing countries.

3.0 Expected Results

The goal of the energy subgroup of IPRO 325 is to improve the health of the local populace and facilitate the economic growth of the impoverished of the world by improving efficiencies in their cooking methods. The focus will be on helping the poor move away from burning biomass and towards burning liquid and gaseous fuels, as well as, utilizing solar energy.

The results that our team hopes to achieve are implementing a more efficient conventional stove, as well as, improving on the solar oven prototype from last semester. The major constraint is keeping the cost as low as possible, preferably within the $5 parameter.

The project will involve both research and development phases. In the research phase, we expect to ascertain which fuels and stoves are most promising, while accounting for socioeconomic constraints. From here, we will attempt to improve on the designs that we have selected. In the development phase, we will design, build, and test two different stoves. One will burn liquid or gaseous fossil fuel, and one will use solar energy as fuel. Both will be tested against commercially available models. In these tests, the data will include fuel consumption, heating time, and temperature achieved.

The results of these tests will determine the viability of our prototypes. Optimally, our prototypes will perform as well as the commercially available models, yet only cost a fraction of the price. This would create a flexible approach to cooking where free fuel (solar) could be used when available, and an efficient stove could be used otherwise.

Achieving these results would reduce the amount of time that the rural poor must spend gathering fuel, reduce health risks, and create more opportunities to rise above the cycle of poverty.

4.0 Methodology

The problem faced is that much of the world's population lives in rural and underdeveloped areas lacking adequate living conditions—largely clean water, efficient cooking methods, and sufficient shelter.

To combat this problem the Energy Subgroup will focus on the efficiency of stoves and the methods to implement more efficient stoves in rural areas of Ghana and the Deserts of China. The subgroup will research current stoves both used by people in rural areas as well as stoves that are commercially available in order to develop a method of creating a stove that is as, if not more, efficient using local building materials. Several models will be built and tested against the commercially available models to judge success.

To accomplish this we must:

- Define a region of which to focus our time on within Latin and/or South America
- Select stove designs to improve
    - Stoves based on fuels and resources available in given locations
- Find results or buy commercial stoves to test
- Design, build, and test IIT stoves against standards
- Produce final report on findings

Potential solutions to the problem of efficient cooking will be based on several criteria. The stoves should provide an easily distinguishable increase in benefits form what is currently used.

To accomplish this we must:

- Reverse engineer current stoves to discover where the problems lie
- Design new stove based on research to increase efficiency
- Test new design to see if efficiency can surpass commercial/local stoves
- Based on tests and time, improvements may be made to improve stoves
- Possibility of actual field test in rural area

The research and data collected will be documented and archived in two locations. One of those being iGroups/iKnow, which will present the material to anyone who wishes to see the work that has been done. Another place the information will be available will be the engineering notebook, which should be electronically published. These two methods provide easy access to all of the work done so that future IPRO groups do not waste time doing work that has already been completed.

To accomplish this we must:

- Organize our tests into easily readable charts

- Post research and testing results on iGroups

Analysis of the test will simply be to compare the testing results to the results of commercial and locational stoves. If the IIT stove works more efficiently and can be made of local materials, the project will be successful.

To accomplish this we must:

- compare both qualitative and qualitative testing results
- create a report summarizing our findings.

The final product will consist of an organized report which summarizes and details all of the findings during this project. The report will consists of all work done including research, design, and testing.

To accomplish this we must:

- Create and organize intro, conclusion and final proposition pages
- Compile and submit all research in on report with the possibility of prototypes

5.0 Budget

Item	Description	Qty.	Price
Benchmark Prototype	Stove technology already in existence for educational purposes of group		$100.00
Building Materials	Materials needed to build prototype. May include, but not limited to: Wood, metal, concrete, liquid fuels, sealant, etc.		$200
Testing Materials	Sunlamp, Thermal , Light meter, Carbon Monoxide Detector, Pots		$75
Educational Materials	Materials to aid in educating the local populace. May include, but not limited to: laminated handouts, puppets, video, etc.		$25
	TOTAL		**$400**

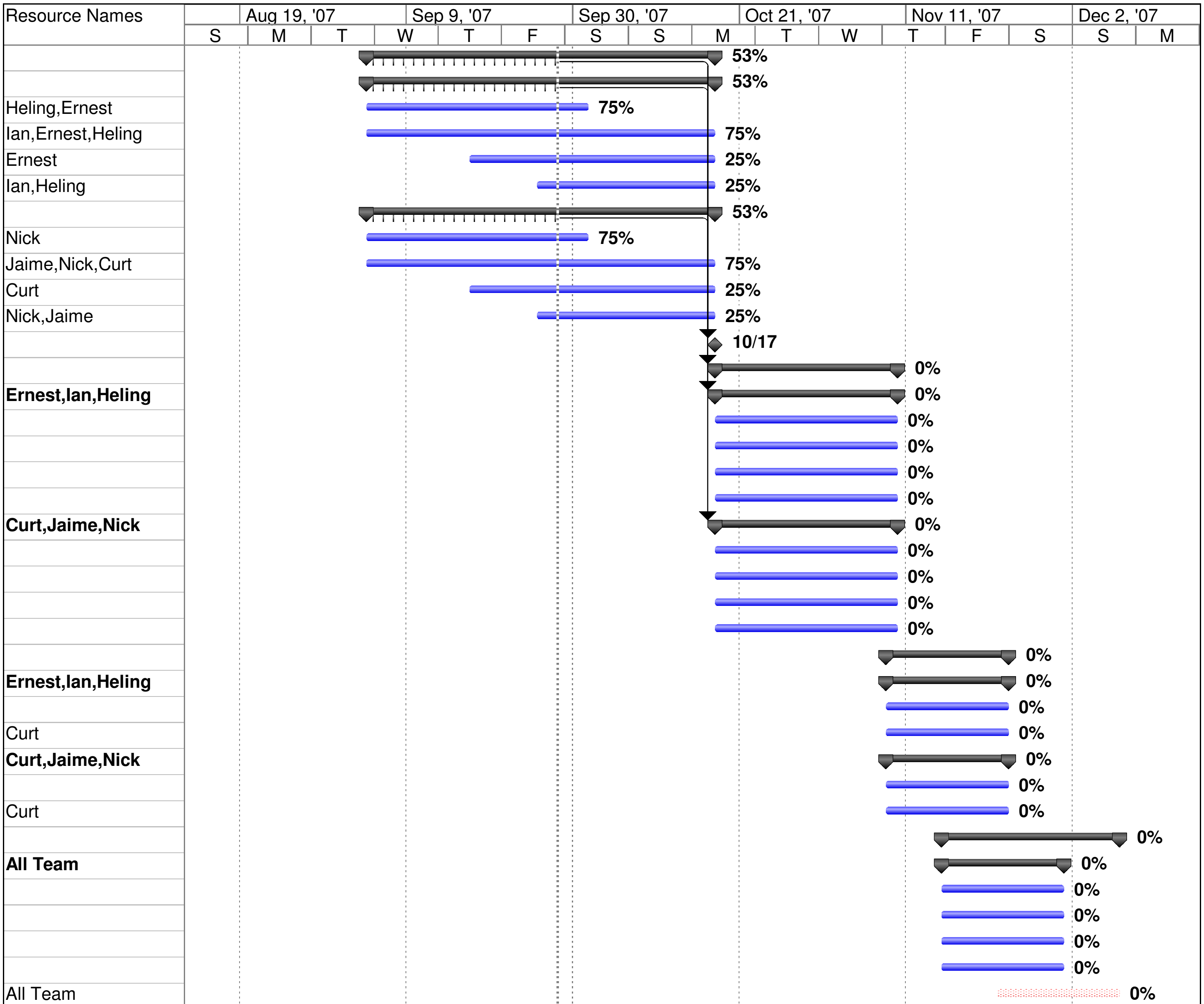
6.0 Project Milestones

Please refer to attached Gantt chart.

ID		Task Name	Duration	Start	Finish
1		**Phase 1: Research**	**29 days**	**Tue 9/4/07**	**Wed 10/17/07**
2		**Solar Cooker**	**29 days**	**Tue 9/4/07**	**Wed 10/17/07**
3		Location Information	18 days	Tue 9/4/07	Mon 10/1/07
4		Current Solutions	29 days	Tue 9/4/07	Wed 10/17/07
5		Testing Parameters & Standards	21 days	Mon 9/17/07	Wed 10/17/07
6		Benchmark Selection and Defintion	15 days	Tue 9/25/07	Wed 10/17/07
7		**Conventional Cooker**	**29 days**	**Tue 9/4/07**	**Wed 10/17/07**
8		Location Information	18 days	Tue 9/4/07	Mon 10/1/07
9		Current Solutions	29 days	Tue 9/4/07	Wed 10/17/07
10		Testing Parameters and Standards	21 days	Mon 9/17/07	Wed 10/17/07
11		Benchmark Selection and Defintion	15 days	Tue 9/25/07	Wed 10/17/07
12		Midterm Report	0 days	Wed 10/17/07	Wed 10/17/07
13		**Phase 2: Design & Build**	**15 days**	**Thu 10/18/07**	**Fri 11/9/07**
14		**Solar Cooker**	**15 days**	**Thu 10/18/07**	**Fri 11/9/07**
15		Analysis of Benchmark	15 days	Thu 10/18/07	Fri 11/9/07
16		Analysis of New Prototype	15 days	Thu 10/18/07	Fri 11/9/07
17		Collection of Materials for Design Modifciations	15 days	Thu 10/18/07	Fri 11/9/07
18		Prototype Modification	15 days	Thu 10/18/07	Fri 11/9/07
19		**Conventional Cooker**	**15 days**	**Thu 10/18/07**	**Fri 11/9/07**
20		Analysis of Benchmarks	15 days	Thu 10/18/07	Fri 11/9/07
21		Design of New Prototype	15 days	Thu 10/18/07	Fri 11/9/07
22		Collection of Materials for Build	15 days	Thu 10/18/07	Fri 11/9/07
23		Prototype construction	15 days	Thu 10/18/07	Fri 11/9/07
24		**Phase 3: Testing and Analysis**	**10 days**	**Thu 11/8/07**	**Fri 11/23/07**
25		**Solar Cooker**	**10 days**	**Thu 11/8/07**	**Fri 11/23/07**
26		Obtain testing equipment	10 days	Thu 11/8/07	Fri 11/23/07
27		Testing Procedures	10 days	Thu 11/8/07	Fri 11/23/07
28		**Conventional Cooker**	**10 days**	**Thu 11/8/07**	**Fri 11/23/07**
29		Obtain testing equipment	10 days	Thu 11/8/07	Fri 11/23/07
30		Testing Procedures	10 days	Thu 11/8/07	Fri 11/23/07
31		**Phase 4: Conclusion**	**14.5 days**	**Thu 11/15/07**	**Fri 12/7/07**
32		**IPRO Presentation**	**10 days**	**Thu 11/15/07**	**Fri 11/30/07**
33		Abstract	10 days	Thu 11/15/07	Fri 11/30/07
34		Poster	10 days	Thu 11/15/07	Fri 11/30/07
35		Presentation Practice	10 days	Thu 11/15/07	Fri 11/30/07
36		Question and Answer Practice	10 days	Thu 11/15/07	Fri 11/30/07
37		Final Written Report	10 days	Thu 11/22/07	Fri 12/7/07

Project: EnergyProjectPlan
Date: Fri 9/28/07

Critical	Baseline Milestone
Critical Split	Milestone
Critical Progress	Summary Progress
Task	Summary
Split	Project Summary
Task Progress	External Tasks
Baseline	External Milestone
Baseline Split	Deadline



Project: EnergyProjectPlan
Date: Fri 9/28/07

Critical	Baseline Milestone
Critical Split	Milestone
Critical Progress	Summary Progress
Task	Summary
Split	Project Summary
Task Progress	External Tasks
Baseline	External Milestone
Baseline Split	Deadline

7.0 Task Assignments

Team Members

Name	Major	Skills	Interests
Aubry, Curtis	Architectural	HVAC Analysis, AutoCAD, Photoshop, MS Office	Alternative materials for construction and sustainable energy
Dogbe, Ernest	Electrical		Affordable renewable energy for use in developing countries.
McClain, Jaime	Architecture	Microsoft Office, AutoCAD, 3D Max, Photoshop, Illustrator	Creating affordable solutions for use in developing courtiers. Micro-enterprising and micro-loans.
Przybysz, Nicholas	Mechanical	Microsoft Office, AutoCAD, Pro Engineer, Matlab, some programming.	Creating the most efficient energy for the least amount of fuel
Seagren, Ian	Electrical	MATLAB, RET screen, MS Office, Pspice, Java, Assembly	Power electronics, sustainable energy & development, communications & economy
Shi, Heling	Mechanical	SolidWorks, Microsoft Office, Photoshop, iWork, iLife, basic	Mechanical and thermal design of energy infrastructures and/or appliances

Team Responsibilities:

1. Identify cooking problems in rural impoverished areas of the world
2. Conduct extensive research into existing solutions, programs, and outreach
3. Identify target area and local populace
4. Develop a prototype that addresses a specific issue
5. Propose future IPROs

Individual Member Responsibilities:

Name	Role	Task Group	Tasks
Aubry, Curtis	iGroup Organizer Engineering Notebook	Conventional Oven	Testing Procedures Prototype building
Dogbe, Ernest	Ethics Organizer	Solar Oven Code of Ethics Location	Research Current Ovens Testing
McClain, Jaime	Team Leader	Conventional Oven	Contact w/ P.Land Oven Research

Przybysz, Nicholas	Team Member	Conventional Oven Project Management	Testing Facilities; contact w/ Mast Location Specific Research
Seagren, Ian	Meeting Minute taker	Solar Oven	Testing Procedures, prototype building
Shi, Heling	Engineering Notebook Organizer	Solar Oven Location	Location research, prototype building

Project Plan Report: Cooling Subgroup

1.0 Objective

IPRO 325 cooling subgroup's objective is to develop and implement a more effective and efficient way for the world's poor to store food. Our primary objective is to create a working prototype of an evaporative cooling refrigeration system that can successfully store food for a longer period of time using all local materials from the region which we are targeting. Our secondary objective is to design a manual explaining the benefits of our system as well as how to use and assemble it. This manual must be understandable to people of any language or level of literacy.

2.0 Background

840 million people around the world suffer from malnourishment because they lack the technology for modern refrigeration. Crops such as tomatoes, mangoes, and pears, which provide necessary nutrients not found in the more common cereal crops, rot before they can be eaten or sold on the market. Third world rural cultures and communities do not have electricity delivered to their villages and cannot afford to generate their own electricity due to high initial costs. In Nicaragua over 52% of the population has no access to electricity. However, there are ways to increase the quality of life without the use of electricity and the modern products that we take for granted. Evaporative cooling is an easy and inexpensive system that can be implemented into many different projects.

Refrigeration systems exist that work on the base idea of evaporative cooling. Evaporative cooling is a physical phenomenon in which evaporation of a liquid, typically into surrounding air, cools an object or a liquid in contact with it. Latent heat describes the amount of heat that is needed to evaporate the liquid; this heat comes from the liquid itself and the surrounding gas and surfaces. A simple example would be precipitation or sweat that the body secretes in order to cool down the body temperature. Whenever dry air passes over water, some of the water will be absorbed by the air. That's why evaporative cooling naturally occurs near waterfalls, at rivers, lakes and oceans. The hotter and drier the air is, the more water can be absorbed. This happens because the temperature and the vapor pressure of the water and the air attempt to equalize. Liquid water molecules become gas in the dry air, a process that uses energy to change the physical state. Heat moves from the higher temperature of the air to the lower temperature of the water. As a result, the air is cooler. Eventually the air becomes saturated, unable to hold more water, and evaporation ceases.

In India they are using evaporative cooling systems in "air conditioners" in which a fan blows cool air into a room. In Nigeria, the Zeer Pot is being implemented. It's simply a pot inside another pot with sand in the gap between them. Water is poured into the sand and as it evaporates, it cools whatever is inside it. Studies show that evaporative cooling systems can keep certain foods up to 14 days longer than just leaving them in the sun. Other designs that are currently being used in poor countries are the Bamboo Cooler, the Almirah Cooler, Charcoal Cooler, and the Naya Cellar Storage. All projects are similar in the fact that they use evaporative cooling to the keep the contents inside fresh for long periods of time.

The biggest constraint of using evaporative cooling as a means for "refrigeration" is the location and climate. The preferred climate is dry, with little humidity, hot, and low elevation. If the surrounding climate is too humid or too cold, the water will not evaporate. In some areas it is possible to use the same system on a larger scale, which is the aim of our project. We will be making a larger, fixed refrigerator using two layers of adobe bricks with wet sand in the gap. This is primarily based off the work done by the Indian Agricultural Research Institute. They have developed the Static Cooling Chamber that can be made in any part of India from local materials.

Although these refrigeration systems are already used in different areas around the world, they have not been implemented in all the places where they could help the local population. For our project, we are focusing on Nicaragua and Northwest China, both areas with a hot, dry climate for at least part of the year. The crops in these areas are mostly cereals which don't need refrigeration, but also do not provide enough nutrition. Other crops, which could be used to supplement the cereals, are planted in small quantities because of their short shelf life. With added refrigeration, these crops could become an important part in eliminating malnutrition in these areas.

3.0 Expected Results

A large portion of the world's poor are without access to the proper means to store food for a sufficient amount of time due to lack of electricity, financial restrictions, or other such problems. Our group intends to ameliorate this situation by creating a zero-energy refrigeration system using the process of evaporative cooling. By using all local materials, this system should be very low cost, if not free to the people using it.

Our groups expected results are:

- Successfully simulate building conditions and materials based on our chosen region of concentration, especially in the creation of adobe bricks.
- Have a working prototype that performs according to our group's goals and guidelines.
- Present a project that is an improvement on similar systems that are existing.

Create a manual that is proven to be comprehensible.

4.0 Methodology

We have decided that the best way to achieve our objectives is to divide up our tasks as follows:

	Adobe Bricks	Cooling Systems	Manual
Problem Solving	-Research materials & methods -Purchase materials -Setup experiments -Make bricks	-Research existing prototypes -Compile results of existing prototypes if available -Test existing prototypes as required -Design original/improved prototype -Build prototype	-Find similar manuals to study & compare -Decide on most successful method for presenting material -Design manual
Testing	-Twist test -Structural stability/ weight bearing -Record results -Make adjustments as required	-Set control & prototype to test with variety of foods -Record results -Make adjustments as required	-Survey various groups of people for overall comprehension -Record results -Make adjustments as required
Documenting	-Record supplies, mixtures, & methods -Record results	-Record supplies and methods -Record results -Save and compile research	-Record results of surveys
Analyzing	-Define requirements and standards necessary for adobe bricks -Compare results with standards	-Compare results of our prototypes with compiled results of existing prototypes -Compare results with standards	-Determine standard requirements for percentage of comprehension -Compare our survey results with standards

		-Determine if results reach our goals	

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5.0 Budget

	Cost	Quantity	Total Cost
Adobe Materials:			
Sand	Free		
Clay	?		
Hay/ Grass	$5.00	1	
Lumber for molds	$3.49	5	
Potting clay	$200.00	1	
Testing Supplies:			
Fruits	$20.00		
Hygrometer/ Thermometer	$25.00	2	
Manual Supplies:			
Printing	$100.00		
Paper			
Miscellaneous:	$40.00		
TOTAL			**$432.45**

6.0 Project Milestones

Week	Tasks	Hours	Members
1. Sept. 18-24	Prototype Research	4hrs each	Amber, Phil, John
	Background Research	4hrs each	Dole, Eliza, Bryan
	Project Plan	4hrs each	Eliza, Phil, Bryan, John, Dole, Amber
		48hrs Total	
2. Sept. 25- Oct. 1	Plan Adobe Making	4hrs each	Bryan, John, Dole
	Mold Making	3hrs each	Eliza, Amber, Phil
	Get Materials	2hrs each	Bryan & John
	Make Bricks	6hrs each	Eliza, Bryan, Phil, Dole, John
		55hrs Total	
3. Oct. 2-8	Make Pots	4hrs each	Amber & Eliza
	Work on Midterm Presentation/ Report	5hrs each	Bryan, Phil, Dole, John
	Check Adobe Bricks	2hrs	Bryan
		30hrs Total	
4. Oct. 9-15	Start Researching/ Designing	2hrs each	John, Dole, Eliza

	Manual		
(Midterm Due)	Finish Designing Prototype 2	2hrs each	Amber, Phil, John
	Practice Presentation	2hrs each	Amber, Bryan, Phil, John, Dole
	Check Bricks	2hrs	Bryan
	Start Testing Prototype 1	3hrs each	Amber, Dole, John, Bryan, Phil
	Code of Ethics	3hrs each	Bryan, Amber, Phil
		48hrs Total	
5. Oct. 16-22	Continue Testing Prototype 1	4hrs each	Amber, John, Dole, Bryan, Phil
	Start Constructing Prototype 2	2hrs each	Amber, John, Dole, Bryan, Phil
	Continue Manual	2hrs each	Dole & John
		34hrs Total	
6. Oct. 23-29	Build Prototype 2	6hrs each	Eliza, John, Dole, Bryan, Phil, Amber
	Continue Manual	2hrs each	Dole & John
	Testing	2hrs each	Amber, John, Dole, Bryan, Phil
		50hrs Total	
7. Oct. 30-Nov. 4	Test Prototype 2	4hrs each	Eliza, John, Dole, Bryan, Phil, Amber
	Continue Manual	2hrs each	Dole & John
	Start Presentation/ Data Analysis	2hrs each	John, Dole, Bryan, Phil, Eliza, Amber
		40hrs Total	
8. Nov. 5-11	Continue Presentation/ Data Analysis	2hrs each	Phil, Bryan, Dole, John, Amber, Eliza
	Continue Testing Prototype 2	4hrs each	Amber, Eliza, John, Bryan, Dole, Phil
	Work on Manual	2hrs each	Dole & John
		40hrs Total	
9. Nov. 12-18	Meeting Minutes	2hrs	Amber
	Continue Testing	2hrs each	Amber, Eliza, John, Dole, Bryan, Phil
	Finish Manual	1hr each	John, Dole, Bryan, Phil, Amber, Eliza
	Continue Presentation/ Analysis	3hrs each	Dole, Phil, Bryan, Amber, Eliza, John
		38hrs Total	
10. Nov. 19-25	Testing Wrap-up	4hrs	Eliza
(Thanksgiving)		**4hrs Total**	
11. Nov. 26-Dec. 2	Finish Everything	6hrs each	Amber, Dole, John, Eliza, Bryan,
(IPRO Day Nov. 30)		**36hrs Total**	
	TOTAL PROJECT HOURS:	**423 hours**	

7.0 Task Assignments

Team Interest/ Skill Summary

Name	Major	Skills	Interests
Eliza Bober	Architecture	Familiar w/ PC and Mac AutoCAD Accurender Photoshop Illustrator	Sustainable Architecture Learning about efficiency in water and energy usage
Shreyas Dole	Mechanical Engineering	Familiar w/ PC and Mac Microsoft Office Group Work Problem Solving AutoCAD	Discussing / Problem Solving Mathematics Power Systems Circuit Design/Analysis
Amber Heinz	Architecture	AutoCAD Hand Drafting Sketching Model Making Presentation Boards Rendering	Sustainable Architecture Discussing / Problem Solving
Phil Korol	Architecture	AutoCAD 3D Studio Max Photoshop Illustrator Rhino Dreamweaver Microsoft Office Sketch-Up Model Making	Sustainable Architecture Design/Build Philosophy Physics
Bryan Murillo	Electrical Engineering	PSPICE JMP JAVA Photoshop Microsoft Office Secretarial Work Group Work Problem Solving	Mathematics Power Systems Circuit Design/Analysis Philosophies of Science
John Sullivan	Architecture	Various CAD software with emphasis on 3D Design Ecotect Microsoft office	Sustainability Passive Climate control and thermal comfort zones

*See Project Milestones table for individual team member tasks.

8.0 Designation of Roles

Group Roles	Team Members
Subgroup Leaders	Amber Heinz & John Sullivan
Minute Taker	Eliza Bober & Amber Heinz

Agenda Maker	Amber Heinz & John Sullivan
Time Keeper	Phil Korol
Weekly Timesheet Collector/ Summarizer	Shreyas Dole
Master Schedule Maker	Bryan Murillo
IGROUPS	Eliza Bober

Project Plan Report: Energy Subgroup

1.0 Objective

IPRO 325 water subgroup's objective is to develop and implement affordable methods of efficient water filtration and disinfection that can be adapted to the needs of the rural poor worldwide. Our primary objective is to produce prototypes of adaptable water filtration devices made only from locally available materials that meet standards we will set for water quality and rate of filtration. Our secondary objective is to develop an implementation scheme that will overcome obstacles associated with language, education, and cultural barriers.

2.0 Background

The problem of water-borne disease is a worldwide pandemic. Every year more than five million human beings die from illnesses acquired from unsafe drinking water. Most of these people are living on the American equivalent of less than one dollar per day.

By eliminating the threat of water-borne disease, we will greatly improve not only the life expectancy of the poor rural populations of the world but the quality of life, as well. Most of the millions who die each year are children. Adults, too, are greatly weakened by the loss of water and nutrients that associated with diarrhea diseases. With barely enough food to provide the calories to get them through their day, these nutrients are precious. With increased health, they will be able to be more productive and happy. The sociological impact goes far beyond the prevention of loss of life.

Preliminary literature research has found two examples of relatively low-cost techniques that have been implemented in third world conditions: the SODIS solar water disinfection technique and slow sand filtration. Both of these methods have serious limitations. The former uses solar UV radiation to neutralize any microbes present in the water. However, it is inefficient in areas with inconsistent sun exposure or with water of perceptible turbidity. The latter requires high-cost equipment and/or a very long processing time. Slow sand filtration also requires the filtered water to be stored for significant periods in open areas, which often leads to recontamination. To date, there exists no sufficiently inexpensive, efficient, and self-sustaining system to filter and disinfect water in the third world.

The SODIS system has been implemented with success in many parts of the world where implementation conditions are ideal. These communities are now thriving in comparison to how they once were. By providing the ability to adapt this system to ever increasing areas of the world, we can offer more communities this same opportunity.

The main constraints on this project will be limited resources and testing materials, an unclear understanding of local cultures, and the cost and availability limitations on the materials we may use in our prototype.

3.0 Expected Results

The goal of the water subgroup of IPRO 325 is to improve the health of and facilitate the economic growth of the world's poor by designing efficient and adaptable methods with which they can provide their own potable water.

The plan of our group is to produce three main things: a set of standards for a water filtration device that may be used to increase the efficiency of the SODIS method, one or more working prototypes of filters that meet those standards using only materials available to the world's poor at a price less than five dollars, and a scheme that may be used to implement these methods while circumventing the barriers of language, education, and culture differences.

Our standards must be such that potable water will be produced more easily, at a faster rate, and in a wider range of communities than existing methods. Our prototype must be such that it will meet those standards. Our implementation scheme must be such that our target population will understand and enthusiastically accept it. If all of these criteria are met, our goal of improving the health and quality of life of the world's poor will still not have been achieved. However, it will allow future students to build upon our work by traveling to a target destination and putting our implementation scheme in place.

4.0 Methodology

To achieve the goals listed in the previous section we run into some critical problems. For the vast majority of developmental work in third world countries these problems have been largely ignored, relying instead on superior technology to overcome any fundamental cultural barriers. Such approaches have met failure time and time again, but still the technological crutch is leaned upon instead of developing a sound strategy of implementation. The IPRO 325 Water subgroup has opted out of the traditional high-tech solution to the third world problem and will instead face head on the problems that have so largely been ignored by the other philanthropic groups. These problems are identified as, but not limited to:

1. If any part of the solution fails to work the villagers cannot replace it
2. Designing a solution for a single village will not be helpful beyond that scope
3. Any design is meaningless if the villagers refuse to accept it
4. If the villagers accept the solution they cannot build/maintain it without instruction

*While there are certainly a great many more problems associated with creating and implementing a solution for water purification in the third world, these are the key problems that if left untreated will continue to spell disaster for any attempt at improving the lives of those living in extreme poverty.
In order to address these fundamental problems that have for so long been ignored, the IPRO 325 Water subgroup has come up with the following four goals to guide the research and development of their test solution.

1. We will create a solution made from 100% indigenous materials
2. We will produce a widely adaptable design for implementation over the entire region
3. We will invent an implementation strategy that works with the local community
4. We will draft an entirely visual field manual to aid in construction and operation

*Please see the attached project outline for more detail involving the research process as well as which tasks and subtasks were assigned to each team member

Once these goals have been achieved the result will be a fully functioning setup that will be able to treat any source of freshwater and yield clean, disease-free, consumable water. To test the success of these goals the solution will be subjected to the following tests:

1. Goal 1 will be considered a success if and only if the design is constructed of 100% indigenous materials of the Central/South American region, anything less will be considered failure.

2. The design solution will have its functionality tested with a variety of filters all constructed from various indigenous materials available across the Central/South American region. Goal 2 will be considered a success if and only if filtration through all filters yields from Lake Michigan water, a turbidity of less than 26 NTU. Goal 2 will also be considered failed if the various filter designs are not easily integrated into the overall design solution. This will be tested by having test subjects with no knowledge of the apparatus attempt to install each of the filters into the overall design using only the field manual.

3. Goal 3 is by far the most abstract guiding principle of this project, but it is also the most important. Success or failure of goal 3 will not be determined this semester, since it is dependent on the actual implementation of the design solution in a true third world setting. In

order to best prepare for the success of goal 3, an implementation strategy will be designed around the International Development Enterprise (IDE) model.

4. Goal 4 will be considered a success if and only if a field manual, entirely void of any type of writing, is completed. Alpha testing will be done by handing the manual to test subjects and seeing if they can properly construct/operate the apparatus. Due to the differences of symbols and gestures used in communication across various cultures it will also be necessary to perform beta tests, that will determine if someone of an entirely different culture can understand the pictures and symbols used in the field manual, but such testing will take place in another semester.

Note: The results of all tests described above will be recorded in the groups engineering notebook.

5.0 Budget

	Cost	Amount	Total
Prototype materials			**227.00**
Sand	$15/ton	5 tons	75.00
Coconut fiber		24" x 8'	25.00
Cloth	$1/shirt	1 shirt	1.00
Gravel	$15/ton	1 ton	15.00
Grass/straw	0	as needed	0.00
Human Hair	Free at barber	1 bag	0.00
Charcoal			
-wood	0	1 log	0.00
-vessel	$5	1 pot w/ lid	5.00
Kelp	$10 / 5lbs	1 bag	10.00
Algae	0	as needed	0.00
CDX Plywood	$10/ 4'x8'	4 boards	40.00
2' X 4'	$3/ 8ft	32 ft	12.00
Wood Screws (1")	$3/box	1 box	3.00
16p nails	$3/box	2 boxes	6.00
6mm Polyethylene Sheeting	$15/ 10'x25'	1 roll	15.00
55 gallon metal drum	0	1 drum	0.00
PET bottles	$1/ bottle	20 bottles	20.00
Testing Materials			**990.00**
Bacterial count sticks	$30/ 10 sticks	30 sticks	90.00
Nephelometer	$900	1	900.00
Miscellaneous			**100.00**
Transportation	100.00		100.00

TOTAL **1,317.00**

6.0 Project Milestones

Please see attached Gantt chat.

7.0 Task Assignments

Team Members

Name	Major	Skills	Interests
Curtin, Dave	Chemistry	Microsoft Office, Biology Lab, Chemistry Lab, Spanish Language	Improving quality of life through science and engineering. Eliminating the pandemic of diarrhea disease through simple water treatment.
Henson, Jessica	Architecture	Microsoft Office, AutoCAD, 3D Max, Photoshop, Illustrator, SAP2000, MathCad, Spanish Language	Improving the quality of life for all human beings, Water Systems (natural and man-made), and helping in developing countries without infringing on their culture.
Ono, Ashley	Architecture	Microsoft Office, AutoCAD, 3D Max, Photoshop, Illustrator,	Improving the quality of life for those who live in developing countries to the best of my capabilities.
Schiller, Brian	Chemistry	Microsoft Office, Spectrometry, Lab Techniques	Helping improve the quality of life in developing countries through.
Witthans, Ryan	Chemistry	Microsoft Office, Spectrometry, Lab Techniques	Improving the heath and welfare of humans, especially in developing countries.

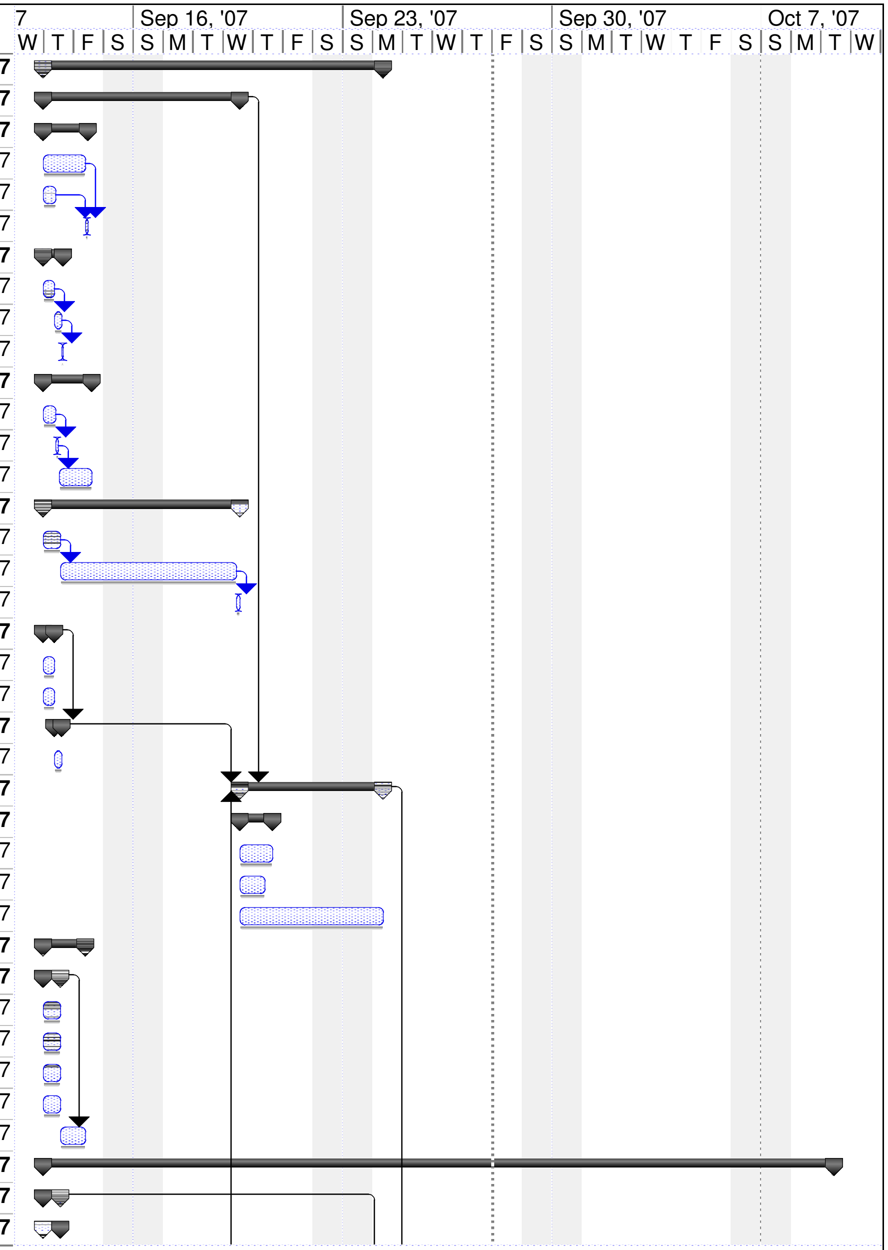
Team Responsibilities:

1. Obtain necessary resources.
2. Set efficiency standards for filtration/sedimentation through extensive research
3. Design and Build a Working Prototype
4. Test Prototype
5. Design Field Manual for Implementation of the Overall Water Treatment System

Individual Member Responsibilities:

Name	Role	Task Group	Tasks
Curtin, Dave	Chemist	Design Testing	Research Microbes, Set efficiency standard for prototype, Design and Testing of Prototype, Secure Funding for Project
Henson, Jessica	Team Leader Engineering Binder	Location	Manage administrative tasks, In-depth location research, Act as Liaison to other

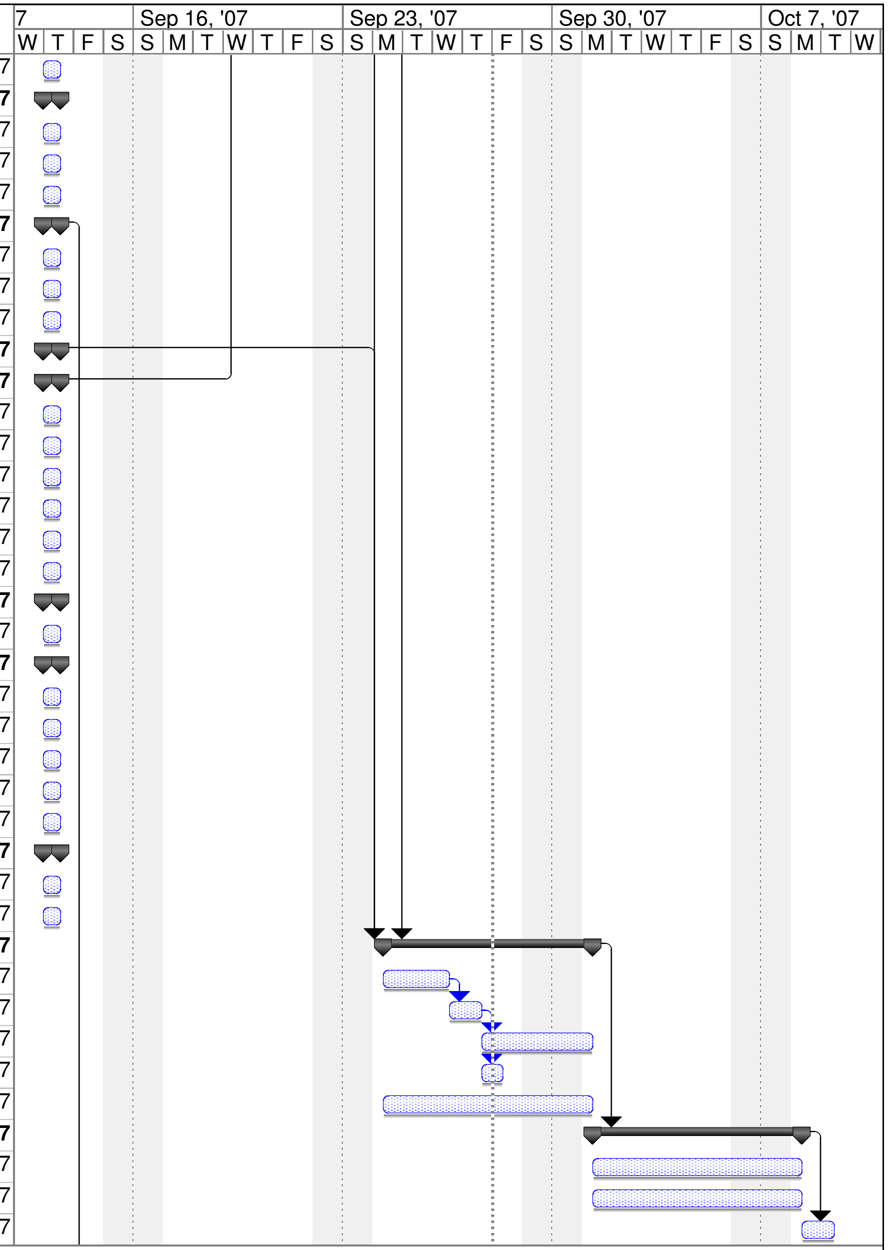
ID		Task Name	Duration	Start
1		**Aquire resources**	**7.13 days**	**Thu 9/13/07**
2		**Raise funding**	**4.63 days**	**Thu 9/13/07**
3		**IPRO funding**	**1.5 days**	**Thu 9/13/07**
4		Prepare presentation	10 hrs	Thu 9/13/07
5		Arrange meeting with Dr. Jacobius	2 hrs	Thu 9/13/07
6		Meet with Dr. Jacobius	2 hrs	Fri 9/14/07
7		**BCPS money**	**0.88 days**	**Thu 9/13/07**
8		Meet with Dr. Zasadzinski	1 hr	Thu 9/13/07
9		Prepare project summary	5 hrs	Thu 9/13/07
10		Follow-up meeting with Dr. Zasadzinski	1 hr	Thu 9/13/07
11		**Alumni BCPS newsletter funding**	**1.75 days**	**Thu 9/13/07**
12		Arrange meeting with editor	2 hrs	Thu 9/13/07
13		Meet with editor	2 hrs	Thu 9/13/07
14		Answer follow-up questions from alumni	10 hrs	Thu 9/13/07
15		**McNight fellowship**	**4.63 days**	**Thu 9/13/07**
16		Research grant proposal requirements	5 hrs	Thu 9/13/07
17		Prepare grant proposal	30 hrs	Thu 9/13/07
18		Contact grant review board	2 hrs	Wed 9/19/07
19		**Arrange space**	**0.13 days**	**Thu 9/13/07**
20		Request lab space	1 hr	Thu 9/13/07
21		Request shop space	1 hr	Thu 9/13/07
22		**Aquire equipment**	**0.63 days**	**Thu 9/13/07**
23		Turbidometer	5 hrs	Thu 9/13/07
24		**Aquire materials**	**2.5 days**	**Wed 9/19/07**
25		**Containers**	**1.25 days**	**Wed 9/19/07**
26		Bottles	10 hrs	Wed 9/19/07
27		Steel drum(s)	5 hrs	Wed 9/19/07
28		Filter media	20 hrs	Wed 9/19/07
29		**Set SSF effectiveness standards**	**1.25 days**	**Thu 9/13/07**
30		**Literature research**	**0.63 days**	**Thu 9/13/07**
31		Research microbes	5 hrs	Thu 9/13/07
32		Research turbidity units/measurement	5 hrs	Thu 9/13/07
33		Determine initial turbidity	5 hrs	Thu 9/13/07
34		Research SODIS requirements	5 hrs	Thu 9/13/07
35		Write formal standards	5 hrs	Thu 9/13/07
36		**Research and development**	**18.38 days**	**Thu 9/13/07**
37		**Literature research**	**0.63 days**	**Thu 9/13/07**
38		**Previous designs**	**0.63 days**	**Thu 9/13/07**



Project: water-timeline-1
Date: Fri 9/28/07

Task		Milestone		External Tasks	
Split		Summary		External MileTask	
Progress		Project Summary		Split	

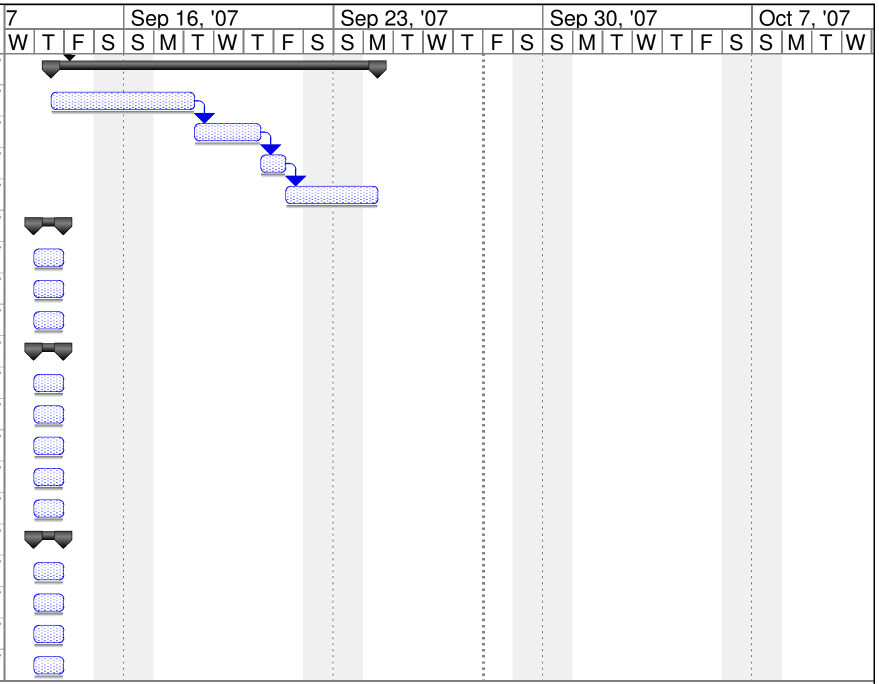
ID		Task Name	Duration	Start
39		SODIS system	5 hrs	Thu 9/13/07
40		**Filtration systems**	**0.63 days**	**Thu 9/13/07**
41		Designs	5 hrs	Thu 9/13/07
42		Materials	5 hrs	Thu 9/13/07
43		ClarAqua	5 hrs	Thu 9/13/07
44		**Introduction strategy**	**0.63 days**	**Thu 9/13/07**
45		ClarAqua	5 hrs	Thu 9/13/07
46		SODIS system	5 hrs	Thu 9/13/07
47		Contact International Development Enterp	5 hrs	Thu 9/13/07
48		**Determine specific location qualities**	**0.63 days**	**Thu 9/13/07**
49		**Materials**	**0.63 days**	**Thu 9/13/07**
50		Containers (bottles, drums)	5 hrs	Thu 9/13/07
51		Vegetation	5 hrs	Thu 9/13/07
52		Volcanic rocks	5 hrs	Thu 9/13/07
53		Soil type	5 hrs	Thu 9/13/07
54		Textiles	5 hrs	Thu 9/13/07
55		Other salvagable materials	5 hrs	Thu 9/13/07
56		**Water quality**	**0.63 days**	**Thu 9/13/07**
57		Turbidity	5 hrs	Thu 9/13/07
58		**Pathogens**	**0.63 days**	**Thu 9/13/07**
59		Bacteria	5 hrs	Thu 9/13/07
60		Viruses	5 hrs	Thu 9/13/07
61		Parasites	5 hrs	Thu 9/13/07
62		Cysts	5 hrs	Thu 9/13/07
63		Polution	5 hrs	Thu 9/13/07
64		**Weather patterns**	**0.63 days**	**Thu 9/13/07**
65		Research historical weather conditions	5 hrs	Thu 9/13/07
66		Calculate overhead/bottle requirement	5 hrs	Thu 9/13/07
67		**Create prototype**	**5 days**	**Mon 9/24/07**
68		Brainstorm preliminary designs	20 hrs	Mon 9/24/07
69		Sketch designs	10 hrs	Wed 9/26/07
70		Create CAD drawings	10 hrs	Thu 9/27/07
71		Select single design (interchangeable filter mec	2 hrs	Thu 9/27/07
72		Construct prototype	40 hrs	Mon 9/24/07
73		**Run tests**	**5 days**	**Mon 10/1/07**
74		Turbidity tests	40 hrs	Mon 10/1/07
75		Bacterial count	40 hrs	Mon 10/1/07
76		Evaluate prototype/filter media	10 hrs	Mon 10/8/07



Project: water-timeline-1
Date: Fri 9/28/07

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

ID		Task Name	Duration	Start
77		**Create implementation scheme**	**6.88 days**	**Thu 9/13/07**
78		Author field manual	20 hrs	Thu 9/13/07
79		Test manual	20 hrs	Tue 9/18/07
80		Evalutate manual	5 hrs	Thu 9/20/07
81		Revise manual	10 hrs	Fri 9/21/07
82		**Produce IPRO deliverables**	**1 day?**	**Thu 9/13/07**
83		Meeting Minutes	1 day?	Thu 9/13/07
84		Weekly Reports	1 day?	Thu 9/13/07
85		Engineering Notebook	1 day?	Thu 9/13/07
86		**Project Plan**	**1 day?**	**Thu 9/13/07**
87		Timeline	1 day?	Thu 9/13/07
88		Methodologies	1 day?	Thu 9/13/07
89		Midterm report	1 day?	Thu 9/13/07
90		Peer reviews	1 day?	Thu 9/13/07
91		Website	1 day?	Thu 9/13/07
92		**IPRO Day**	**1 day?**	**Thu 9/13/07**
93		Make posters	1 day?	Thu 9/13/07
94		Write abstract	1 day?	Thu 9/13/07
95		Create presentation	1 day?	Thu 9/13/07
96		Final Report	1 day?	Thu 9/13/07



Project: water-timeline-1
Date: Fri 9/28/07

Task		Milestone		External Tasks	
Split		Summary		External MileTask	
Progress		Project Summary		Split	

			subgroup leaders
Ono, Ashley	Subgroup Secretary Building Leader	Design Location	Lead prototype construction, Take Minutes, Aid in Location Research, Manage Schedule In MS Project
Schiller, Brian	Chemist	Design Testing	Code of Ethics, Secure Funding for Project Research Existing Methods and SODIS,
Witthans, Ryan	Chemist	Design Testing	Research Turbidity, Manage Schedule in MS Project, Secure Funding for Project