Team TREE:
Veena Anilkumar, Alyssa Baker, Jasmine Brown, Dennis den Hartigh, Tim Lee, Sara Miller, and Ryan Strat
GT 2201
Dr. Terrell Hatz
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Project Proposal

How Might We

How might we familiarize Atlanta high school students with renewable energy such that they become informed consumers?

Background, Description of Problem, Significance, and Stakeholders

Today, people rely almost solely on the use of non-renewable energy. In 2009 alone, the United States consumed 10 quadrillion British thermal units (BTUs), of energy [1]. Furthermore, renewable energy accounted for approximately 12% of the total energy generated in 2012 [1]. The usage of renewable energy in the current system is far from reaching its potential.

The majority of people are unaware of the current advances in renewable energy, which impedes the progress of renewable energy research and development. Solar cells are reaching efficiencies near 30%, which was unheard of years ago. The fact that people are not switching to renewable energy means that fossil fuel stores will continue to dwindle, and derich the Earth in the process [2]. Renewable energy sources, such as photovoltaics, are becoming more efficient. However, without consumers to bolster the market, the energy crisis continues. Awareness should be raised of renewable energy benefits, and people should be encouraged to use their new knowledge to help slow, or even end, the energy crisis.

As nonrenewable energy resources are gradually being exhausted, renewable energy needs to be implemented to avoid the continuation of the devastating energy crisis. If this challenge is not addressed in a timely manner, then society can expect to incur serious costs. According to Dr. Phillip Jennings, Emeritus professor of Physics and Energy Studies at Murdoch University in Perth, Australia, “Our education system has failed to give us a basic understanding of energy supply options and their impact on society and the environment,” [3]. The greatest consequence is the lack of a robust, trained workforce including engineers and scientists, because these are the people society wills depends on to design, install, and maintain renewable energy systems. [4]. Others costs include the lack of public awareness about renewable energy, lack of consumer trust in renewable energy technology, and lack of trained policy analysts who are knowledgeable about the industry.

One cause of this problem is the gap in current high school curricula. Since colleges do not require advanced knowledge about renewable energy, many high schools do not teach it. However, curricula are constantly being updated, and some high schools are shifting to a Science, Technology, Engineering, and Mathematics (STEM) focus. Another cause occurs at the university level. Currently, there is a significant amount of diversity among curricula, which

means there is still a need for standardization and accreditation for degree programs [5]. As of now, public awareness of renewable energy and education and training are still lacking [6].

Society as a whole is a stakeholder in our problem, since it would reap many benefits once it tackles the challenge that is renewable energy education. More specifically, stakeholders in this problem include:

1) Atlanta high schools: The schools would gain better reputations as educational institutions. This, in turn, would encourage the attendance of higher-achieving students. Higher academic performance results in more funding to continue such renewable energy programs, and also increase the quality of other programs within the school.

2) Professionals in renewable energy technology manufacturing and design fields: A researcher at an institution such as the Carbon Neutral Energy Solutions (CNES) Laboratory at Georgia Tech is one such example. These researchers strive to design more efficient technologies as a new generation of energy-savvy consumers emerges and increases the demand for renewable energy technologies. Similarly, companies who manufacture renewable energy technologies will be eager to cater to an increased demand for their products [3].

Goal

Our team plans to update the curriculum in core classes of Atlanta high schools that will relate existing content to the implementation of renewable energy. Adjusting the curriculum to better meet the needs of students is a regular process that all schools practice with some frequency to retain relevance [7]. We chose highschool because the students would have the base knowledge needed to fully understand the concepts related to renewable energy while also being in non-specialized classes. Implementing renewable energy education now will ensure that current students have these skills by the time they become energy consumers themselves. Alternative teaching methods like what we plan on implementing have been shown to be effective in the past [8]. Individuals who partake in our revised curriculum will be empowered to make educated decisions about their energy sourcing and consumption [9]. We expect students to be more cognizant of energy issues immediately following the completion of a program and better able to make decisions in their lives relating to these issues.

External Advisors

We have consulted several experts in the field of renewable energy who have agreed to mentor us as we work towards implementing our project. Kevin Caravati, a Senior Research Scientist at Georgia Tech Research Institute (GTRI) and a faculty member in the College of Architecture, has been helpful in teaching us what to look for in a buildings' infrastructure when analyzing its potential for renewable energy. Additionally, as his research area is solar energy, Mr. Caravati will surely be a valuable mentor as we look for ways to incorporate the solar energy component into our curriculum. Specifically, he can help in deciding which equipment to purchase for the hands-on laboratory. Joseph Goodman, a Senior Research Engineer at GTRI, is involved with the U.S. Department of Energy and has agreed to help us plan the financial details

of our project. Mr. Goodman will be useful in deciding which source of renewable energy we want to pursue based on cost and output. Our other contacts are from Woodward Academy. Ethan Greenberg, physics teacher, will be an important advisor when we analyze W.A.'s energy consumption. Mr. Greenberg will also be helpful when we implement our curriculum at W.A., especially since he is already trying to integrate W.A.'s geothermal system into the school's curriculum.

Objective I: Gauge Base-level Knowledge

Woodward Academy regularly hosts events, called "lunch and learns", whereby guest speakers are brought in to present to students about a specialized topic. To incentivize the students, pizza and drinks are provided during the event. Before and after the presentation, we will ask Woodward students to take brief pre- and post-tests, which are designed to evaluate the students' knowledge regarding renewable energy technologies, policies, and other related aspects.

In order to gauge the success of our project, we need to determine a baseline knowledge level for our target population. This measure will represent the starting knowledge of the average Woodward Academy high school student, before the full-implementation of our project. Using multiple choice and A/B testing methods, we will normalize students' responses and use this information to begin constructing our curriculum. In addition, we will hold a focus group with Woodward teachers to collect their feedback on the measured knowledge levels. This will allow us to build a more effective curriculum, while also serving as a method of evaluating the success of our project after implementation.

Steps

1. *Finalize the pre- and post-tests.* We must write two tests of approximately equal difficulty. Half of the students will receive type A as a pretest and type B as a posttest. For the other half of students, the tests will be switched.
2. *Implement the program.* After all preparations are made, we will hold the lunch and learn at Woodward. There, we will attempt to teach students more about renewable energy while also gauging their interest and current knowledge levels.
3. *Collaborative data analysis.* We will need to subtly gauge the teachers' subject matter knowledge levels and also to note their advice for the program. To do this, we will hold a focus group with faculty. Qualitative data on successful teaching strategies as well as opinions on how well the collected pre-/post- test data reflects reality will be invaluable in the long-term. After this information is gathered and reviewed, we will assess all of our data collectively and ultimately determine whether or not we are ready to move onto the next objective.

Anticipated Problems

1. As students do not RSVP for this type of an event, we will not know exactly how many students to expect. Based off of conversations with previous Woodward students and current

faculty, attendance for these events varies significantly. Thus, any attempt to approximate a valid head-count ahead of time is void. This makes it somewhat difficult to plan precisely. Hence, we will have to be open to last-minute changes.

2. It may prove difficult to maintain students' interest for the entirety of the presentation. We may need to be creative with methods to catch and sustain students' interest in our presentation.

Objective II: Curriculum

We are looking to incorporate a combined classroom and project-based learning program into the current curriculum, which can easily be integrated into a high school student's agenda. We plan a balance of lecture- and activity-based learning to achieve constructive results with our curriculum. Furthermore, the curriculum will go beyond just the technical aspect of renewable energy to include segments on the economics, politics, statistical analytics, and other essential characteristics of renewable energy.

Essentially, without a proper curriculum, there is nothing to teach. It is crucial that the curriculum is well developed and decided before further measures involving the school can be addressed. If this objective cannot be met, the project cannot advance further. We will know when our tasks have been completed when we are ready to implement. Only when we are confident in our abilities to work towards implementation have these tasks been accomplished.

Tasks

1. *IRB*. We will need to finish, submit, and be IRB approved in order to implement a curriculum into a public school system.
2. *Literary Review*. In order to deem what is appropriate for our curriculum, we will first go through old syllabi, renewable energy textbooks, and online information resources.
3. *Professional Consultation*. We will consult faculty members at Woodward in order to glean the knowledge necessary to undertake curriculum production. The all possess knowledge concerning test creation, and how to know what elements to focus on when teaching.
4. *Technology Purchase.* We will need to purchase (or coordinate Woodward's purchase of) solar panels and the corresponding technologies. Calculations will need to be run in order to figure out how many and which size needs to be purchased.
5. *Writing/Creation.* Central to this objective is creating the actual curriculum and corresponding syllabus. In order to do this, we will need to make decisions about how much time to allocate to which aspects. In addition, we will create projects for the students to complete using the solar panels and the knowledge they gain from the classroom.

Anticipated Problems

1. We anticipate that a roadblock for our project will be configuring the timing of the actual in-class learning/projects. We aim to impart students with enough knowledge to be meaningful and worthwhile, but not so much that it is at the expense of the remainder of their class.
2. Another issue that may present itself is that of order-of-importance for events in the school's agenda. For instance, if school were to be cancelled for any reason, this program would likely be cancelled before many of the more established programs. We will just work through this issue and use the time we are given.
3. One more problem that we may run into is determining an appropriate "starting-level" for students. There are obviously no prerequisites, but students will need to know some fundamental concepts in order to fully benefit from this program.

Objective III: Fully Implement Curriculum and Gather Data

This project is intended to improve students' knowledge about renewable energy, so that they may go on to become responsible and well-informed energy consumers. To do this, we will implement a combined classroom and project-based curriculum (see Objective II), covering various aspects of renewable energy technologies related processes. Throughout this implementation process and after its conclusion, we seek to gather feedback from both students and teachers via periodically distributed free-response evaluation forms.

This objective is important, because constantly checking the effectiveness of the project allows us to make beneficial modifications for the current and future classes. The most essential goal of this project is to make students feel like they are influential and capable of making important decisions. In asking the students for their opinions, we are giving them a voice to offer ideas and suggestions that may not have been considered otherwise. Asking for their opinions and help with improving our curriculum is one way to accomplish this. When we have collected a minimum of four sets of survey data (each set collection occurring no less than two days apart) from the students, we will know that this objective is complete.

Steps

1. *Determine appropriate time intervals and procedure for evaluations.* The first step in this process is to decide how often we would like to collect formal feedback from Woodward students and faculty. Further, we need to establish a process for them to provide this feedback, be it surveys, interviews, or some other means. To ensure that the chosen procedures are convenient for all parties, we will seek the advice of current Woodward faculty to make these decisions.
2. *Observe how smoothly our segment is incorporated into the existing curriculum.* After having created the probationary surveys based on the theory of how the information will be taught, we will observe how it is actually taught. This will involve taking regular trips to Woodward, while the curriculum is being taught. To minimize the novelty of having a college student in the classroom, a maximum of two team members will be in attendance at

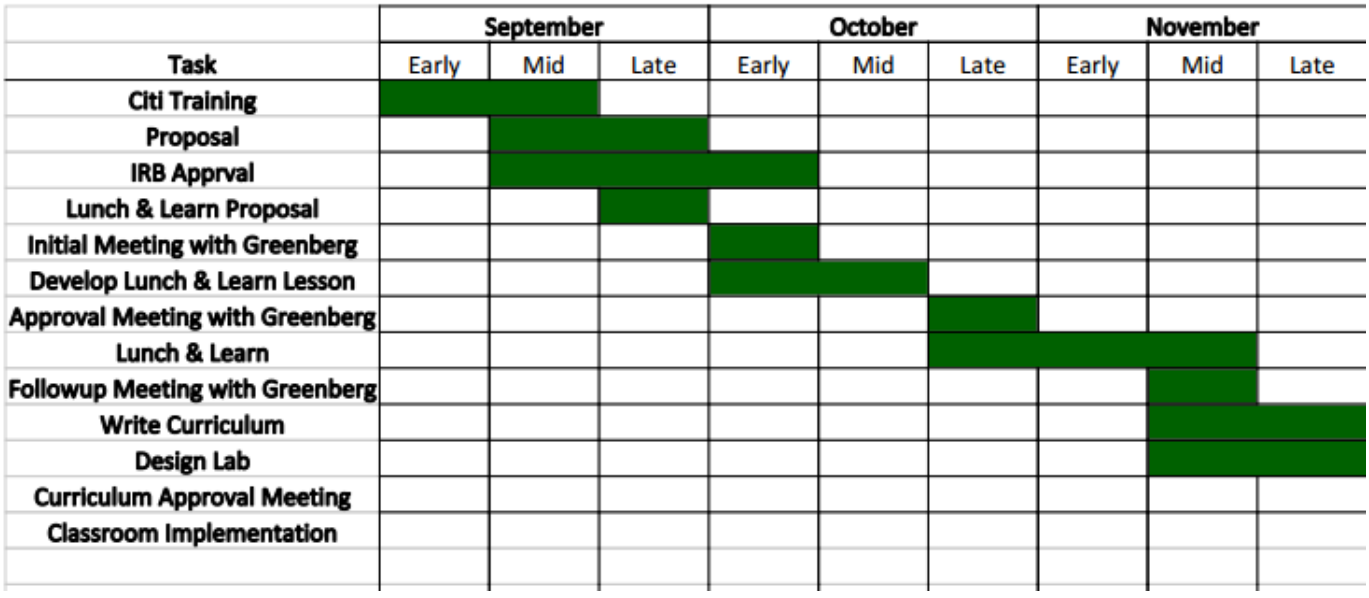
each visitation. The general protocol will involve being as unobtrusive as possible. As needed, we will alter the surveys as needed based on this new information.

3. *Analysis and action.* There needs to be a predetermined process in-place to properly analyze all of the surveys, so that they have a chance to be properly reviewed and acted upon. This process will include having all survey responses considered by a minimum of three group members before the information is either acted upon or disregarded.

Anticipated Problems

1. Students may not be willing to speak up if they have an idea or suggestion. We could try to avoid this by making the survey some form of theoretical homework, whereby students are asked to come up with a better design for the curriculum.
2. Answers may not be reviewed properly. In other words, helpful answers may be missed and unhelpful answers may be enacted. The review process will be designed to make this as infrequent as possible, by first having multiple team members review each response individually, then reviewing all responses as a team. Despite the cautious nature of this method, the aforementioned issue is still a possibility.

Timeline of Events



	December			January	February	March	April	May
	Early	Mid	Late					

Task
Citi Training
Proposal
IRB Apprval
Lunch & Learn Proposal
Initial Meeting with Greenberg
Develop Lunch & Learn Lesson
Approval Meeting with Greenberg
Lunch & Learn
Followup Meeting with Greenberg
Write Curriculum
Design Lab
Curriculum Approval Meeting
Classroom Implementation

Budget

Objective #1:

Item(s)	**Purpose**	**Approx. Cost**
Pizza	Lunch & Learn Supplies	$165
Drinks, Cups, Napkins	Lunch & Learn Supplies	$35
2 Trips to Woodward (22.4 miles)	Travel (Gasoline)	$22.40
	Sub-Total	**$222.40**

Objective #2:

Item(s)	**Purpose**	**Approx. Cost**
Solar Lab Units (10 units)	Laboratory Materials	~$1500
2 Preparatory Trips to Woodward	Travel (Gasoline)	$22.40
	Sub-Total	**$1522.40**

Objective #3:

Item(s)	**Purpose**	**Approx. Cost**
Ice Cream (for 60 students)	Student Debriefing/Social	$100
10 Trips to Woodward	Travel (Gasoline)	$112
	Sub-Total	**$212.00**

Total Budget	**$2056.80**

Outside Funding:

Giving Point Foundation	$3000

Works Cited

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