



**GRAHAM
SUSTAINABILITY INSTITUTE**
UNIVERSITY OF MICHIGAN

Supporting Energy Efficiency for Michigan K-12 Schools



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Executive Summary

We worked with The Ecology Center on re-launching the “My Solar School Project” competition that began in 2018. The competition encouraged student teams (grades 6-12) to pursue solar electric installations at their school, but it stalled due to lack of personnel. Our team worked closely with Katy Adams, the Education Director at the Ecology Center, to revamp the program and add in curriculum to support the mission. Considering resources available and project scalability, we created an online mini-course for students with a focus on renewable energy basics and risks with fossil fuel usage while exposing them to real-world applications of solar power and developing a solar assessment report for their school.

Our curriculum consists of a five day lesson plan including the language of energy, solar technology experimentation, state and federal solar energy existing incentives, and a template outlining how to write a solar assessment report. The goal of the report is to encourage administrators to install solar power generation on their school’s property. This course material engages students with various interactive materials such as presentations, graphics, worksheets, articles, online games, and hands-on experiments. The mini-course was made to flow sequentially for students to build on their knowledge from previous day’s lesson plans in order to give them a full understanding. Given the deployment of this course will be widespread within Michigan, we created content that is flexible in both depth and complexity to be implemented in 6-12th grade classrooms.

Additional resources are also included in the mini-course for both students and administration. This allows interested students to seek more detailed information on writing a grant proposal and further diving into solar energy. Additionally, the administration can find more information on financing and energy auditing if they want to make this switch to solar energy.

In order to gain traction for this course being implemented, we recommend that The Ecology Center take the mini-course and implement it in Ann Arbor Public Schools first to monitor success and efficacy. However, before implementation is it imperative that this initiative gets supported by funders to help the deployment of these mini-courses in the state of Michigan (so the Ecology Center can send necessary materials for experiments to these schools).

Additionally, we recommend that the Ecology Center uses our resources and other external resources to create a step-by-step process of how administrators would install solar on their school property. This could include topics like what to look for in hiring an energy auditor, solar installation price ranges, and preferred types of solar panels.

Introduction and Background

We worked with The Ecology Center to re-launch the “My Solar School Project” competition that began in 2018. When it was launched, the competition encouraged student teams (grades 6-12) to pursue solar electric installations at their school. The Ecology Center’s role in this competition was to provide student-led teams with the resources they needed to determine the potential for solar, develop a solar installation proposal, and develop a plan to secure administrative approval and funding. Unfortunately, this state-wide project was led by an employee at the Ecology Center that switched jobs, and the project stalled.

Our team was responsible for revitalizing this initiative. Throughout this endeavor, we worked closely with Katy Adams, the Education Director at the Ecology Center. Considering the Ecology Center is a nonprofit organization, they rely on external funding to be able to implement projects and initiatives. Therefore, before we could work with schools directly, we needed to show the value of a competition like this from both an educational and environmental standpoint. We decided to create an online mini-course focusing on renewable energy basics, the development and incentives for renewable solar energy installation, and how to encourage their schools administrators to get an energy audit through a Solar Assessment Report of the school. This mini-course was created on Google Classroom as it is a user-friendly platform and many students are familiar with using Google applications already.

Throughout the year, we worked to create the backbone of this course, and spend the summer concentrating on creating the content we wanted to present to students in daily lesson plans. The Ecology Center previously created extensive lesson plans for understanding the subject of renewable energy for grades 6-12. These lesson plans were called the “Energy Rework Michigan Curriculum Support Guide”, but they did not have the concise focus our team was hoping to create. Nonetheless, we were able to take selected sections of this curriculum and incorporate additions. These additions include having students calculate their own ecological footprint, learn the basics of renewable energy in a short but informational presentation, and learn which governmental incentives and rebates exist when installing solar. Using these resources and our own research, we were able to make a five day lesson plan for teachers to facilitate with their 6-12th grade students.

This new course will complement our goal of revitalizing the “My Solar School Project” by providing necessary background information students must know in order to push administrators to make the switch to solar energy, in addition to more generally encouraging young students to engage and be environmental leaders. We created a teacher guide to assist teachers in facilitating the mini-course by providing pre-lesson readings and to-do lists, suggested outlines for how to run each day’s lesson plan, and any resources or slides they may need for that day’s lesson.

Methods

Inclusivity

We prioritized inclusivity when developing our online course. We recommended that Katy and the Ecology Center team reach out to Michigan urban and suburban schools to understand the demographics of these schools. We wanted to be purposeful and ensure the lessons could be presented to students that come from a variety of socio-economic classes, backgrounds, religions, ethnicities, etc. Also, due to the misconceptions and lack of education surrounding climate change, we made the course non-partisan and backed by science rather than politically charged.

Engagement

The goal of the course is not only to educate but also encourage students to consider the environmental sector as a career path. In order to do this, we provided students with fun and interactive educational materials through graphics, videos, powerpoint slides, article links, online games, and additional resources. We used Ecology Center's experiential resources such as digital multimeters and small-voltage solar panels for students to conduct their own experiments, like testing and tracking the output voltage of various locations within and outside of the classroom to identify which variables are most important when maximizing energy output.

User-Friendly Interface

After the COVID pandemic, it was imperative that we created an easily accessible course that could be implemented both in the classroom and virtually. In order to do this, we chose to create our mini-course on Google Classroom, as nearly all 6-12th grade students are familiar with this platform. We split each lesson into "Days" and each day had a presentation clearly noting the flow of the lesson plan with each next activity hyperlinked. Also, each video, student sheet, and presentation has a description of what students can expect to learn before clicking on the material.

Pivoting

Depending on the adoption of our course, we created content that can be flexible. Considering this course will be presented in 6-12th grade classrooms, we made the complexity of information variable with potential for information to be altered in case there are certain worksheets or topics that are too simple or complex for a given classroom. This can be decided by the teachers.

Piloting in Schools

In order to gain traction for this course being implemented, we suggested to Katy and the Ecology Center to pilot in Ann Arbor Public Schools first and monitor its success and efficacy. Assuming success, we suggest then that they expand this course to nearby communities and reach out to receive more funding for this course to be implemented in more schools across the state.

Results and Recommendations

Our online mini-course was created to introduce students to the My Solar School Project in a fun, interactive way with the goal of switching their school to renewable solar energy (Figure 2). This lesson plan is split into five days to ensure flexibility for teachers who want to do one lesson each day for a week, one lesson each week for five weeks, or any other lesson spacing to complete the mini-course. Each day has its own lesson plan, with a clear flow from the first activity to the last. Before starting each lesson, students are provided with a short summary on what they can expect to learn and do in the description.

The lessons have a variety of activities including class discussions, worksheets, presentations, online interactive games, experiments, and a case study (Figure 3). The five unique lesson plans have the students sequentially consider how they can support a healthier and more sustainable electricity system at their school, consider how language and energy is used in everyday life, calculate their individual ecological footprint, use Ecology Center resources to do an energy efficiency experiment, educate on the costs and benefits of solar energy, and lastly allow student teams to write their own *Solar Assessment Report* for the school. The goal of the report is for students to advocate to switch their current energy system to renewable solar energy on school property.

Resources outside the five day lesson plan are included in the Google Classroom. An “Additional Resources” section (Figure 4) in the Google Classroom is provided for both students and administration. This allows especially interested students to seek more detailed information on writing a grant proposal and further diving into how solar panels work. From the administration standpoint, it allows them to find more information on financing and energy auditing. For certain hands-on projects, small solar panels and digital multimeters are needed, which are shown in a “Materials Provided by Ecology Center” (Figure 5) section with images and descriptions of their use. Finally, a teacher guide (Figure 6), separate from the classroom, would be provided to help teachers facilitate the daily lesson, covering pre-lessons, suggested outlines, and resources they may need for the class.

A recommendation to further the project in addition to the actual implementation of this mini-course in Michigan’s schools, is to create a step-by-step process of how school administrators could go about installing solar on school property. This could include what to look for in hiring an energy auditor, price ranges for solar installers, what kind of solar panels to use, and determining which stakeholders need to be involved to make the switch to solar energy. Brief lists of solar installers and energy auditors are in the additional resources for administration section of the Google Classroom, which includes contact information. We hope administrators would use these resources to get an initial energy audit to see where they could increase energy efficiency and potentially switch to using renewable energy sources.

Anticipated Impact

By creating educational materials that can be used for multiple environments and skill levels, we have the potential to impact a broad range of students. We purposefully developed our project with the intention of accommodating students from many backgrounds. Our results primarily impact students from 6th to 12th grade, as well as teachers and administrators from across the state. In our efforts, we hope to be inclusive and accommodating by implementing this course to as many students as possible. We understand that many students do not learn about environmental related topics in depth until highschool, and even then may only learn about it for a day. With the increasing importance of environmental education paired with the worsening impacts of climate change, we do not have time to waste in educating our youth on how they can get involved in reducing their own individual ecological footprint and positively influence their local community.

This course teaches students the basics of renewable energy and how energy sources influence the broader environmental landscape. It also encourages them to be environmental leaders in their community and advocate for reducing the carbon footprints of their school. In conjunction with the students learning about this topic, the understanding the teachers have on these topics will also increase as they take the time to learn this topic through the teacher guide, videos, and other resources.

Lastly, we anticipate the program will encourage middle and high school administrators in the state of Michigan to hire energy auditors (via the encouragement of these student-team solar assessment reports) and install solar panels on their school property. This would not only be beneficial from an environmental impact standpoint, but also illustrate the efficacy of the mini-course while linking student voices to tangible impact. With the revitalization of the “My Solar Schools Project”, we hope that similar environmental educational programs alike will be piloted and implemented across the country. Considering the straightforward nature of these five lesson plans, students should be able to leave the mini-course with a more comprehensive understanding of the impact their decisions have on the environment, career paths in the renewable energy industry, and how to write a convincing assessment report.

Our development of this mini-course will revitalize the implementation of the “My Solar School Project.” With the hope that Ecology Center can present this course to potential funders of this program and receive funding, the deployment of this online mini-course could be implemented in a variety of schools in a short period of time. Our overall anticipated impact involves greater education of renewable energy for both students and teachers and an increased number of installed solar panels on 6-12th grade school properties in Michigan.

Appendix

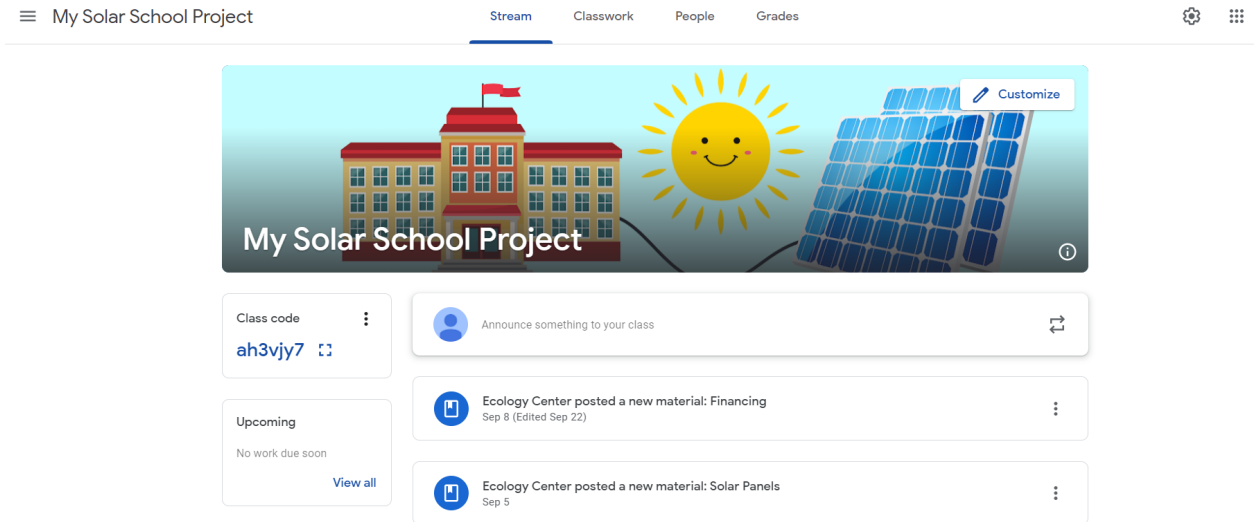


Figure 1: Homepage Stream Includes New Material and Banner

















DAY 1		⋮
	Lesson 1.1: Driving Question	Edited Sep 2
	Team Formation - Student Sheet	Edited Sep 2
DAY 2		⋮
	Lesson 1.2: Language of Energy	Edited Aug 1
	Ecological Footprint Calculator	Posted Jul 22
DAY 3		⋮
	Lesson 1.3: Solar Technology	Posted Jul 22
	Video - How Do Solar Cells Work?	Posted Aug 9
	Get to Know Solar - Student Sheet	Posted Aug 16
	Getting to Know Solar - Google Slides Prese...	Edited Jul 22
	Case Study of a Solar Installer - Reading	Edited Aug 16
DAY 4		⋮
	Lesson 1.4: Why Solar?	Edited Sep 2
	Solar Incentives Available in Michigan	Posted Jul 26
DAY 5		⋮
	Lesson 1.5: Solar Assessment Report	Edited Aug 9
	Project Sunroof	Posted Aug 9
	Google Project Sunroof Student Sheet	Posted Sep 2

Figure 2: Google Classroom Categorized Each Lesson by Day


DAY 1







 Ecology Center posted a new material: Lesson 1.1: Driving Question 

Posted Jul 21 (Edited Sep 2)

In this lesson, students will begin to consider what they think about energy and what they need to know in order to develop a proposal to answer the driving question: "How can our school support a healthier and more sustainable electricity system in Michigan?"


 Lesson 1.1: Driving Quest...
Google Slides

 Add class comment... 

 Ecology Center posted a new material: Team Formation - Student Sheet 

Posted Sep 2 (Edited Sep 2)

Make a copy of this Team Formation - Student Sheet by clicking on file and then make a copy. Rename the assignment with your team number and then fill out the necessary information.

 MAKE A COPY - Team Fo...
Google Docs








 Add class comment... 

Figure 3: Each Day Includes Lesson Presentations, Worksheets, Videos, etc.





Additional Resources for Students



 Grant Proposal	Edited Sep 22
 Cost of Solar Panels	Edited Sep 22
 Renewable Energy Infographic	Edited Sep 22
 Types of Solar Panels	Edited Sep 22
 Solar Panel Diagrams	Edited Sep 22

Additional Resources for Administration



 Financing	Edited Sep 22
 Solar Installers	Edited Sep 22
 Community Solar Handbook	Edited Sep 22
 Energy Auditing	Edited Sep 22

Materials Provided by Ecology Center









 Solar Panels	Posted Sep 5
 Digital Multimeters	Edited Sep 5



Figure 4: Additional Resources for Both Students and Administration Given



Materials Provided by Ecology Center

 Ecology Center posted a new material: Solar Panels 





Posted Sep 5
These small solar panels can generate a voltage from sunlight.

 3.0x3.0 in. Solar Panel.jpg Image	 2.5x2.5 in. Solar Panel.jpg Image
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 Ecology Center posted a new material: Digital Multimeters 

Posted Sep 5 (Edited Sep 5)
These devices can be used to measure the voltage generated by solar panels.

 DVM810 Multimeter.jpg Image	 AstroAI Multimeter.jpg Image
 Neoteck Multimeter.jpg Image	 How to Use a Multimeter... YouTube video 9 minutes



 

Figure 5: Pictures and Explanations for Materials Needed for Hands-on Projects

Facilitation Guide: Day 1

Pre-Lesson to-do:

- Look at “How to Use this Course”

In lesson 1.1 slides:

- Fill in the project calendar under Activity 2.
- Fill in dates to remember
- Determine amount of teams to make based on number of students

Suggested Outline:

Start with Day 1, lesson 1

- Activity 1: Ask the question, “How Can Our School Support A Healthier and More Sustainable Energy System in Michigan?” and record student responses on the next slide.
- Activity 2: Review project calendar for students and dates to remember.
- Activity 3: Assign teams.
 - Once teams are assigned, have each team make a copy of the “Team formation student sheet.” Then, have them look over the sheet and assign themselves project roles, as well as make a team contract.

Resources:

- “How to use this Course”
- Lesson 1.1 Slides
- Team formation student sheet

Figure 6: Separate Teacher Guide to Help Facilitate Lessons