

# Green Tiny House Challenge

## Description

*In this lesson, students will design a tiny house in a city of their choice that is as environmentally-friendly as possible while staying on budget. This project is designed to not only evaluate the students' understanding of the Engineering Design Process, but to also enhance their understanding of their impact on the global community.*

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## Lesson Plan Tags

**Check the standards that are met in your lesson plan, check all that apply.**

- Middle School    High School    6<sup>th</sup> Grade Science    7<sup>th</sup> Grade Science  
 8<sup>th</sup> Grade Science    Middle School Math    Middle School CTE  
 Biology    Chemistry    Physics    Energy Harvesting    Anatomy  
 Other High School Science    High School Math  
 HS Family and Consumer Science    HS BFIT    HS Marketing & Entrepreneurship  
 Agriculture    HS Technology    Trade & Industrial    Health Science

# Introduction

The Tiny House Challenge is designed for high school CTE/Engineering students as a way to assess their ability to use the Engineering Design Process when presented with a problem. This lesson can be modified to introduce the Engineering Design Process (EDP) to students, though it is primarily designed as a final project for the semester. While the focus of the challenge is on the Engineering Design Process, it also requires students to use a variety of skills in order to be successful, such as research skills, working in teams, writing composition, and presentation skills. This challenge is very student-driven, with the teacher acting primarily as the facilitator for the majority of the lesson. Students are expected to take ownership of their design and will reflect on the project as a whole at the end of the lesson.

# Curriculum Alignment

## Essential Standards

EEN 2.7.3 Explain how human activities impact the biosphere.

## Next Generation Science Standards

HS-ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

# Objectives

- Students will design and build a tiny home for one person in a city of their choice.
- The learner will develop, construct, and evaluate solutions to a Tiny Home Challenge using the Engineering Design Process and by applying and using scientific knowledge.
- Students will make drawings then build models of their tiny homes using the Google Sketchup application.
- Students will integrate and evaluate multiple sources of information presented in diverse formats and media in order to address their Tiny Home Challenge.

- Students will construct a paper explaining their city of choice for their tiny home.
- Students will complete a cost analysis of their tiny home using an Excel spreadsheet.

## Time & Location

All activities will take place in the classroom during 90-minute class periods. The following is a tentative schedule for the project:

- Day 1 – Introduction; Research and fill in the Potential Cities table about the city you would like to build your sustainable tiny home.
- Day 2 – Write your Investigate paper on your city of choice (homework if not completed in class)
- Day 3 – Research sustainable technologies; start on the People, Profit, Planet table
- Day 4 – Finish the People, Profit, Planet table
- Day 5 – Develop a basic plan for tiny home; determine the materials that will be used in the tiny home
- Day 6 – Finish basic plan of tiny home; Begin cost analysis
- Day 7 – Finish cost analysis
- Day 8 – Google SketchUp application tutorial
- Day 9 – Develop final plan using Google SketchUp application
- Day 10 – Complete final plan on Google SketchUp
- Day 11 – Presentation of Tiny Home

## Teacher Materials

- Planet 100 presentation
- Laptop/Computer for teacher use
- LCD projector
- Day 1 table hand-out\* (1 per student)
- People, Profit, Planet table hand-out\* (1 per student)
- Rubric (1 per student)
- Laptop/computers with Excel and Google Sketchup application(1 per student)
- Access to a printer

\*Note: These materials were modified from Emily Ronemus' AP Environmental Science website: <http://www.cabarrus.k12.nc.us/Page/42733>

## Student Materials

- Paper/notebook
- Pencil/pen

## Safety

None

## Student Prior Knowledge

Prior to this project, students should have a basic understanding of how to use and create Excel spreadsheets, as well as how to incorporate calculations in an Excel spreadsheet. Students should also have a basic understanding of the various ways that humans impact the environment, such as water consumption, deforestation, “carbon footprint,” etc. Some students may also have a basic understanding of alternative or “green” energy sources, though this is not required.

## Teacher Preparations

Before implementing the project, the Teacher will need to organize the students into groups of 2 (if it is an advanced class, the students could do this project individually). Prior to Day 8, the Teacher should have gone through the “Getting Started” video tutorials in Google Sketchup in order to better facilitate the students. Also, the Teacher should have a common way for students to submit their final designs digitally for evaluation, either through email or a class website.

## Activities

Day 1 –

1. The Teacher will begin the class by asking the students, “What is sustainability? What does it mean if something is sustainable?” Allow the students to brainstorm and write their ideas on the board, regardless of if they are correct or not.
2. The Teacher will then ask the students, “Do you think we are living in a world that is sustainable?” Allow the students to discuss their answers as a class for a short time.
3. The Teacher will then show the Planet 100 presentation from the Lab-aids SEPUP curriculum for Biology. This presentation gives societal, environmental, and economic data for the world if it were proportional to a single community of 100 people (for example, 53 out of 100 people in the

world are Asian). This is meant to show the students the current conditions of the world.

4. After the presentation, the Teacher will ask the students again, “Based on Planet 100, do you think our world is sustainable?” The students answer should be no.
5. The Teacher will explain that one way people are trying to fix this is by developing “green” tiny homes. The Teacher will explain that in this project the students will be developing a tiny house for one person in a city of their choice that is environmentally and economically friendly.
6. The Teacher will then divide the students into groups (if applicable) and the students will begin researching 3 different cities that they would like to live in as an adult. As they research, the students should fill in the hand-out “Potential Cities.” The rest of the class period will be spent researching their cities. If the students do not complete their research in class, it should be completed as homework.

Day 2 – Students will spend the majority of the class period (70 minutes) writing their Investigate papers. This will allow students to ask questions if they have them as well as do a peer review for the last 20 minutes of class. Students will submit their papers digitally through the class website. Students should make their final adjustments to their Investigate papers for homework.

Day 3 – Students will spend the class period (70-90 minutes) researching green technologies that they would like to use in their tiny home design. The Teacher will explain that each tiny home will need to include 10-15 green technologies. Students should write down their research either in their science notebook or in a Word document. If students finish early, they can begin filling in the “People, Profit, Planet” table with their group.

Day 4 – Students will finish the “People, Profit, Planet” table and determine as a group which technologies they will use in their tiny home (70-90 minutes). If groups finish early, they can begin designing their tiny home in their notebooks.

Day 5 – Students will develop a basic plan for their tiny home, including the dimensions and the overall layout (70-90 minutes). If they finish early, each group will then determine the materials that will be used in the tiny home (The Teacher will need to remind students that it needs to be as “green” as possible.)

- Day 6 – Students will finish their materials list if they did not finish on Day 5. Each group will then complete a cost analysis on their tiny home using an Excel spreadsheet. The Teacher will need to remind the students that each group has a budget of \$20,000 and that every single item used in the tiny home must be accounted for (all the way down to the knobs on cabinets!). This will take the entire class period (90 minutes).
- Day 7 – Students will finish their cost analysis and will make any final adjustments to their design (90 minutes). Remind students at the end of class that they need to bring headphones or earbuds to class tomorrow.
- Day 8\* – The Teacher will tell the students that they will spend the class period (90 minutes) going through tutorials for Google SketchUp. The tutorials are in the form of Youtube videos by Aaron Bishop (his playlist can be found at <https://www.youtube.com/playlist?list=PLeT7dFNA3H7UnrPqVok FEHxZx99klFx1>), so the students will need to use earbuds/headphones during class. The Teacher will tell the students that they can move at their own pace, but they will need to have watched the following videos by class time tomorrow: The Basics, Making a Simple House, Advanced House Building, and Making Detailed Objects. If students finish early, they can use the extra class time to practice what they have learned from the tutorials in Google Sketchup.
- Day 9\* – The Teacher will tell the students that they will spend the class period developing their final plan using Google Sketchup. The students will need to develop both the inside and the outside of the tiny house using the application.
- Day 10\* – Students will put the final touches on their tiny house plan. When finished, students will submit their Sketchup file and their cost analysis to the class website.
- Day 11 – Students will present their tiny homes to the class. Each group will have no more than 10 minutes to present their home and the technologies used in their design, with an additional 5 minutes for questions from the audience. Each student will complete a plus/delta evaluation for each group, which will be submitted at the end of the period.

\*If technology is an issue, students can develop a physical model of their tiny house using materials that the students bring in or that are donated to your class (cardboard, construction paper, piper cleaners, popsicle sticks, Legos, etc.)

## Assessment

Each student will turn in an Investigate paper which will be graded individually. All other documents will be submitted as a group packet to the teacher at the end of the project. The project will be graded using the rubric that is attached.

## Critical Vocabulary

By the end of the lesson, students should have an understanding of the following terms:

- Tiny home/house – this definition is subjective, but most understand it to mean a house of 400 square feet or less, either on wheels or foundation.
- Engineering Design Process - a series of steps that engineering teams use to guide them as they solve problems. The design process is cyclical, meaning that engineers repeat the steps as many times as needed, making improvements along the way.
- Green technology - technology whose use is intended to mitigate or reverse the effects of human activity on the environment.
- Budget - an estimate of income and expenditure for a set period of time.

## Author Information

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## Tiny Home Challenge – Potential Cities

Research three different cities that you would like to live in when you are an adult. Detail the specific information about each city in the table below.

Questions to Answer about each City:	My Three Potential Cities:		
What is the Climate like in this City?			
What societal factors (government/economy) could impact the house you build in this city?  Are “green” homes common/supported in this city?			
What types of resources are immediately available in your area?  What types of renewable resources would work well in this city?			
Additional info about the City that is important:			

## Investigate Paper

Once you have finished the Potential Cities table, pick one location out of the three and write a 1-2 page, double –spaced paper explaining your city of choice. Be sure to explain why your city of choice is better than others, and to include details from the table above to support your argument. Your paper will be graded based on the following criteria:

1. Structure – your paper has an introduction, 3 body paragraphs, and a conclusion.
2. Spelling and Grammar – your paper is free of all spelling and grammar mistakes.
3. Details – your city of choice is supported with the research that you did previously.
4. Compare and Contrast – your paper clearly explains why your city of choice is the best option out of all of the cities you have researched.

## People, Profit, Planet Analysis

Name of Technology (Ex: Windmill) <i>Is this a good technology for your chosen city?</i>	Technology Type (Ex: Renewable Wind Energy)	How does it benefit <b>People</b> ? Think of why you would want to buy it. Does it help you stay healthy or make your life easier?	How does it benefit <b>Profit</b> ? How much does it cost? Is it a short-term or long-term return on investment?	How does it benefit the <b>Planet</b> ? Be Specific. Include facts and statistics.	<b>MLA Citation</b> Of your Sources.  Use Easy Bib.com
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## Grading Rubric – Tiny House Challenge

**Group Members:** \_\_\_\_\_

	Criteria				Points
	1	2	3	4	
Floor Plan (external)	Floor plan is difficult to read, lacks labels, is unorganized, and lacks creativity.	Floor plan is readable, labeled, somewhat organized, and design is ok.	Floor plan is easy to read, clearly labeled, clearly organized, and design is good.	Floor plan is extremely easy to read, clearly labeled, very organized, and design is creative.	
Floor Plan (internal)	Floor plan is difficult to read, lacks labels, is unorganized, and lacks creativity	Floor plan is readable, labeled, somewhat organized, and design is ok	Floor plan is easy to read, clearly labeled, clearly organized, and design is good.	Floor plan is extremely easy to read, clearly labeled, very organized, and design is creative.	
Green technologies	Design included 5-7 green technologies.	Design included 7-9 green technologies.	Design included 10 creatively-implemented green technologies	Design included 11-15 creatively-implemented green technologies.	
Cost Analysis	Cost analysis is not detailed and does not include construction and décor materials with estimated cost.	Cost analysis has very little detail and includes some construction and décor materials with estimated cost.	Cost analysis is somewhat detailed and includes most of the construction and décor materials with estimated cost.	Cost analysis is very detailed and includes all of the construction and décor materials with estimated cost.	
Budget	Total cost is over budget (\$20,000).			Total cost is at or under budget (\$20,000	

People, Profit, Planet sheet	Information is missing for some of the green technologies mentioned. MLA format is not followed for the citation or citation is missing.	Each green technology is somewhat defined and detailed. MLA format is followed for the citation.	Each green technology is mostly defined and detailed. MLA format is followed for the citation.	Each green technology is clearly defined and detailed. MLA format is followed for the citation.	
Presentation	Presentation is confusing or difficult to follow/hear. Each group member did not have an opportunity to speak.	Presentation is somewhat clear and audible. Each group member had an opportunity to speak, though the amount presented may be unbalanced.	Presentation is mostly clear and audible. Each group member had an opportunity to speak, though the amount presented may be unbalanced.	Presentation is clear, audible, and each member of the group has equal opportunity to speak. Group members do not solely read directly from their presentation and make eye contact with the audience.	
<b>Total</b>					<b>/28</b>