

The Electric Ohana Homestead Project

Project Objectives: Students will work in small work “pods” (3-4 students) to

- Learn about designing software (CAD)
- Design and draw cross-sections (blueprints) for individual homes/buildings on the Homestead
- Learn about and develop electrical schematics for the required components in/outside the homes
- Learn about and utilize coding to develop a motion light sensor for the exterior of the building
- Learn about solar energy through experimenting with solar panels
- Design an experiment to optimize solar energy collected for a required roof array
- Build the individual 3-D models of the home/building to include required electrical/solar components
- Combine all 3-D models into a cohesive presentation of the ohana’s HOMESTEAD

General Guidelines:

- All construction and assembly will be completed in the afternoon work blocks
- Students must only consult members of their group, websites and textbooks for information. Consulting other individuals is not permissible!
- The 3-4 student’s individual home/building will be combined together and collaboratively presented together as a complete HOMESTEAD
- Additional points will be awarded for creative, original, detailed products*

Requirements for The Home/Building for the HOMESTEAD:

- The home/building should be made from cardboard (shoe boxes or other boxes), lightweight wood, plastic, foam board or Plexiglas.
- Scale: Doorways should be 5 cm in height; thus the height of people utilizing your building should be about 4-5 cm tall.
- The home/building must have at least one series circuit consisting of a switch and at least four Christmas tree lights powered by a nine volt battery.
- The home/building must have at least one parallel circuit consisting of a switch and at least four Christmas tree lights powered by a second nine volt battery.
- The home/building must have documented floor plans with drawings of the circuits using correct electrical symbols.
- The building/home must have a minimum of three solar panels on the roof to do a “lighting job”
- The base used for the home/building and outdoor area must be no larger than 0.5 m²
- The entire HOMESTEAD cannot exceed 1.5 m²
- Additional lights, circuits and batteries may be used if desired, and you are encouraged to do so.

Description of The Homestead:

The HOMESTEAD will minimally consist of at least one of each of the following:

- **House:** one story and three rooms, each individual room must be illuminated by its own light. There must be one outdoor light, such as a porch light or flood light. The circuits should be able to light the first floor lights and the porch light separately from the second floor lights.
- **Barn:** Barn with 2 stalls and a tack/feed room and a riding arena. Each of the stalls, the tack/feed room and the riding arena must have lighting. The circuits should operate the lighting for the barn separately from the riding arena.
- **Ohana Dining Area:** kitchen, dining area, restroom and porch/lanai for outside dining. Each area must have lighting and the circuits should operate the building separately from the porch/lanai

Materials for the Homestead buildings:

- A minimum of ten Christmas tree light bulbs (8 lights are needed and 2 extra, just in case)...you might want to use more ☺
- A minimum of two nine volt batteries.

- A minimum of three switches. (or some combination- You may use homemade switches from brass brads)
- A minimum of one average size roll of insulated wire. You may want to use two rolls so that you can use two colors (it is helpful to have different colors of wire for the different circuits.) Suggestion: if you are using a strand of Christmas tree lights (the small ones), there is enough extra wire to use for wiring the house! It works perfectly; however the new style of lights (short and square in shape are difficult to use for this project).
- Electrical Tape (Masking Tape will work too!)
- Wire Stripping Tool
- Card board or lightweight wood (used to make the base and building).

Questions:

Each student will answer the following questions. The answers must be hand written, in complete sentences and in the words of the student submitting the paper. Each student will hand in their own answers to the following questions the day the project is due, answers must be detailed and written in complete sentences.

1. Why are switches useful in a circuit?
2. Name and describe the three essential parts of a circuit.
3. Explain the advantages and disadvantages of both series and parallel circuits. (Give at least two advantages and disadvantages for each type)
4. You have three light bulbs. All have the same brightness when lit. Explain how you can determine that they are connected in a series circuit by unscrewing **one** light bulb.
5. You have three light bulbs. All have the same brightness when lit. Explain how you can determine that they are connected in a parallel circuit by unscrewing **one** light bulb.

TIMELINE

The due date for this project is June 18, 2021

- ❖ Tuesday June 8, 2021 - Project will be handed out and discussed by group members in breakout rooms. Members will discuss the project and what buildings and materials they would each contribute. **No portion of the building is to begin prior to floor plans being submitted and accepted, and no portion of the construction or assembly may be completed outside of class.** Items should be gathered over the next few days, but all construction and assembly is to be conducted as a group in the afternoon work sessions over the two weeks of the camp. Therefore NO assembly prior to approval.
- ❖ Wednesday, June 9 – **Training on drawing scale cross-sections (CAD?? SketchUp??)** Begin preliminary floor plans to be completed by each group member by the next day.
- ❖ Thursday, June 10 - **Learn about electricity and simple circuits. Learn how to use the multimeter.** Build models of circuits with materials provided. **Learn about electrical symbols for schematics.** Floor Plan and Schematic drawings are due by the end of the afternoon work period on this date. Project is worked on by all group members and building may begin after floor plan and schematic diagrams have been checked. Computers should be used to access information regarding circuits and electricity. **No building will commence until floor plan and schematic diagrams are submitted. Keep a reference list of all textbooks and websites accessed as you will submit this to your teacher.**
- ❖ Friday June 11 – **CODING???????sensor for light in bathroom????**
- ❖ Friday June 11 - afternoon work session. A complete materials list will be required for each group member. Discussion of any other materials that need to be procured as well as plans for the building of the model cross-section of each building for the HOMESTEAD. Design plans will be returned to the group - debrief and make any necessary corrections. Engineering volunteers will be in each breakout room with group to determine final steps prior to ENGINEERING PLANS APPROVAL. Students can begin building the 3-D model of their part of the HOMESTEAD over the weekend to include required series/parallel circuits & lights.
- ❖ Monday June 13 – **What is light? What is solar energy? How do solar panels work?** Preliminary solar panel experiments with multimeter to determine array strength and voltage produced during afternoon work session with Engineering volunteers/mentors. **- Afternoon work block will include designing an experiment to determine the best roof angle** to place the required solar array on each of the individual buildings for the HOMESTEAD. The solar panels will light an external light on/by the building.
- ❖ Tuesday - Wednesday, June 14-15 - **WORK TIME** to make sure all lights, circuits, work.

- ❖ Thursday, June 16 - Individual/group collaboration to make presentation for Friday's final day.

Materials:

My group has decided that individual group members will bring the following materials in to build the Electric Building:

A. Name: _____:Materials to be brought in:

B. Name: _____:Materials to be brought in:

C. Name: _____:Materials to be brought in:

Details:

1. My group's building will have the following rooms.
2. My group plans on having _____ indoor lights. This light(s) will be located _____
(Provide the location and number)
3. My group plans on having _____ outdoor lights. This light(s) will be located _____
(Give the location and the number)

Useful Websites:

Circuits: <https://www.khanacademy.org/science/physics/electricity-and-magnetism/v/circuits-part-1>

For circuit help and circuit symbol help check out this website. <http://www.andythelwell.com/blobz/>

For Floor Plan Symbols check out this website (scroll down to attachments as there are two to review).
<http://www.uen.org/Lessonplan/preview.cgi?LPid=5736>

For More help with circuits check this out.
<http://www.stmary.ws/highschool/Physics/home/notes/electricity/circuits/default.htm>

Help on Building Circuits
<http://www.furryelephant.com/content/electricity/parallel-circuits/>

Help on Drawing Circuits
<http://www.physicsclassroom.com/Class/circuits/u9l4a.cfm>

Research: On separate paper, maintain information as shown below for each website accessed:

Website: www.__?__

Information: What did you find to be useful?

Floor Plan: Original must be hand drawn. Final Drafts must be turned in on graph paper OR plain white computer paper and may be hand drawn or created on a computer.

Electric HOMESTEAD Grading Rubric:

CATEGORY	Above & Beyond 6*	5	4	3	2 (0 if not present)	Row Score
Floor Plan & Drawings		Floor plan is neat with clear measurements and labelling for all the rooms. Circuits are accurately drawn with symbols.	Floor plan is neat with clear measurements and labelling for most rooms. Circuits are accurately drawn with symbols.	Floor plan provides clear measurements and labelling for most rooms, but circuits are somewhat accurately drawn with symbols.	Floor plan does not show measurements clearly or circuits are not accurately drawn or may be lacking proper symbols.	
Materials/Creativity		Appropriate materials were selected and creatively used in the product that made the product have originality.	Appropriate materials were selected and there was an attempt at creativity in the product.	Appropriate materials were selected. No creativity.	Inappropriate materials were selected and contributed to a product that performed poorly.	
The Product/Circuits		The product is neat, attractive and all the circuits are in working order.	The product was neat for the most part and there is only one minor error with the circuits.	The product was somewhat neat and/or there are 2 minor errors with the circuits.	The product was not neat at all and/or there were more than 2 errors with the circuits.	
Solar System		Solar array contains more than three panels and is wired with a switch to activate a light. Maximum roof elevation produces maximum voltage.	Solar array contains three panels and is wired with a switch to activate a light. Roof elevation produces some voltage for the array.	Solar array produces limited voltage with possible activation of light.	The solar array does not effectively activate a light.	
Coding Component		Each student produces a component for the project that has effective coding to do a job on the HOMESTEAD				
					TOTAL	/ 25

*In order to score a 6 in any category, students must go above and beyond expectations.