**Subject area/course**: Science/Physics

**Grade level/band**: 9-10

**Task source**: Summit Public Schools; Author: Victoria Pennings

**Electric House**

**STUDENT INSTRUCTIONS**

1. **Task context**:

You will design, build, and evaluate a model house that demonstrates your mastery of electric circuits.

**Step 1: Design and Plan**

You can design your house with any school-appropriate theme and in any way you like, as long as it meets these criteria:

At a minimum, your house must:

* Be the size of a shoebox
* Have two rooms connected by a doorway or passage
* Have one series circuit room: two lights in series that turn on/off with a switch
* Have one parallel circuit room: two lights in parallel that turn on/off with a switch
* Operate using only two batteries or a hand crank generator
* Be neatly decorated to reflect the purpose of the rooms: all inside surfaces (walls, floors, etc.) are covered or colored and some kind of 3D objects (tables, chairs, beds, etc.) are present in each room. Be creative, but keep it simple!

Optional Challenges:

* Two rooms connected together in one circuit and use only one battery
* A third room, attic, or outdoor space with its own light(s) and a switch
* All three rooms/spaces connected together in one circuit and use only one battery

What to Submit:

1. Description: A short description (3-4 sentences) of your house and its rooms.
2. Drawing: A simple sketch, drawing, or picture of your house showing what the rooms will look like and where you will place the lights.
3. Diagrams: Both an *energy* diagram and *circuit* diagrams for your house. All circuit diagrams must be labeled and use accurate circuit symbols.
4. Materials: A detailed list of materials you need to build your house. Be specific!

Specifications: A list of the basic specifications (with units!) of your house: voltage, resistance, current and power. Report the voltage of your batteries and the resistance of your light bulbs. Use GUESS to calculate the current and power in each circuit. Show all of your work!

**Step 2: Construction and Inspection**

How you build your house is up to you as long as it meets the requirements.

Please be thoughtful about how you use materials and return any excess materials to your teacher.

Checklist:

         Is my house about the size of a shoebox?

         Does my house have two rooms connected by a doorway or passage?

         Does one room in my house have two lights that are connected together in series?

         Does one room in my house have two lights that are connected together in parallel?

         For each circuit, are there two obvious wires that will connect to a battery?

         Do I only need two batteries?

         Are all connections in my circuits secured? Can any wires be pulled apart?

         Do the lights in each room of my house turn on when I close the switch in that room?

         Are the walls in my house covered or decorated?

         Are there 3D objects/furniture/decorations in my house?

What to Submit:

1. Your completed house: It will be inspected by your teacher to make sure you have met all of the requirements, that your circuits are wired correctly, and that all lights work properly.
2. Picture. Take a picture of your completed house to submit in Show Evidence.

**Step 3: Evaluation**

After your house is completed, you will prepare a final evaluation of your house and its specifications. This evaluation should include information about the actual (measured) specifications of your house, some additional calculations about the power and energy use of your house, and a written evaluation and reflection.

What to Submit:

1. Measured Specifications: A table that compares the measured specifications of your house to the reported or calculated values you listed in your design plans. This table should include the measured voltage of your batteries, the measured resistance of your light bulbs, and the measured current in each circuit of your house.
2. Power and Energy Calculations: Use your measured values and GUESS to make the following calculations. Show all of your work!

* Calculate the power in each circuit.
* Calculate the total power used by your house.
* Calculate how much energy your house uses in one day if the lights are on for eight hours a day. Show all of your work!

1. Written evaluation: A written evaluation of your house that answers the following questions:

* What are the best features of your house?
* Do the lights work like they should? Why or why not?
* How did you pick which room used a series circuit and which room used a parallel circuit? Why does that type of circuit make sense for that room?
* Why do you think the measured specifications are different from the reported or calculated values? How much energy does your house use? What could you change about your house so that it requires less energy?
* How is energy converted in your device?
* Reflect on the engineering design process that you went through in constructing your house.

1. **Final product**:

You will design, build, and evaluate a model house that demonstrates your mastery of electric circuits using the specifications above.

**Additional Information**

1. **Knowledge and skills you will need to demonstrate on this task:**

* Design series and parallel circuits.
* Use a switch to turn your lights on and off.
* Prepare an analysis of energy considerations within your house.

**On this task, you will show that you are able to do these things:**

* Design and refine a solution to a complex real world problem based on scientific knowledge, prioritized criteria, and trade-off considerations.
* Prepare a convincing argument with evidence from your research why this is a feasible wiring solution and discuss the energy requirements in your design.
* Prepare a report that details your findings and recommendations and correctly cites your sources.
* Communicate your recommendations clearly, creatively, and effectively using evidence to support your conclusions in a way that will engage the public.

1. **Materials needed:**

* Cardboard box (shoe box with a lid is recommended)
* Batteries, insulated wire, and lights
* Electrical tape
* Scissors, wire cutters
* Materials to make switches
* Construction paper, glue

1. **Time requirements:**

This task will take approximately 3 weeks. Your teacher will provide details regarding due dates and a timeline.

1. **Scoring:**

Your work will be scored using the Summit Public Schools Electric House rubric. You should make sure you are familiar with the language that describes the expectations for proficient performance.