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Section G

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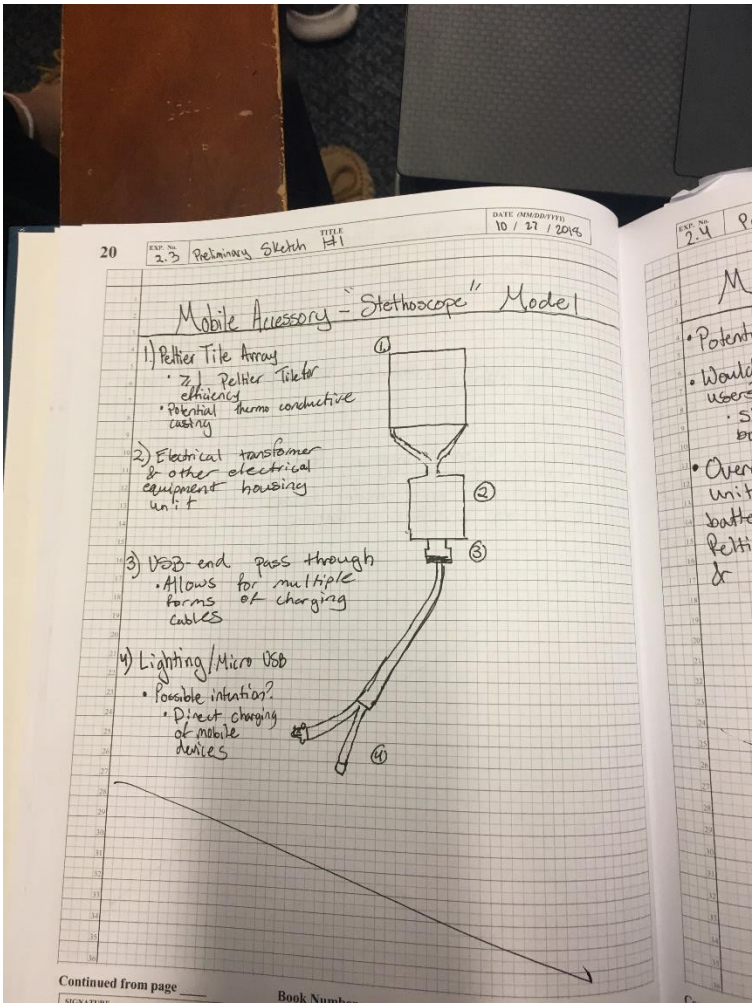
RESEARCH PLAN

- **RATIONALE**
  - An abundance of untapped energy can be found in our environments every single day. The many forms of energy that we encounter in a day to day setting can include thermal, solar/light, sound, and mechanical, chemical. An abundancy of three particular energy forms (thermal, solar, and mechanical) can be easily tapped into in our daily lives. The solar aspect is evident in the Sun itself. It consistently provides both thermal and light energy, at an immense rate without any signs of notable degradation in the foreseeable future. Solar energy has been and is in use, but it is still more of a grand scale technology (electrical grid – connected solar panels need to be huge to function efficiently). It is known for being suitable for homes and the power grid, but not particularly for consumer use. Mechanical energy, the energy of motion (sum of kinetic and potential energy), is acting all around is, all the time. Humans generate it when moving and it also occurs in the atomic level, as atoms are constantly in motion. Thermal energy, a form of kinetic energy (energy of moving particles) can be found all over. One unique source of it is from daily electronics, ranging from mobile phones to laptops and more. A lot of thermal energy is emitted while these devices are in use, yet this energy is just left to flow in to the air without being of use.
  - If even one of these forms of excess energy can be harnessed, it could be a huge step forward to ultimately reducing electricity generation demands and making consumer use devices even more convenient.
- **ENGINEERING GOALS**
  - My engineering goal is to design a product/accessory which will convert a form of excess energy (thermal energy, in particular) from daily environments into electricity and then store it for later use.
    - This product ultimately will be able to decrease wall charging significantly as well as improve battery health overtime
- **PROJECT INFORMATION**
  - **Procedures**
    - Gather Materials
      - Peltier Tiles, electrical wires, electrical soldering set, Arduino boards, thermal management materials (ex. Heat Sink, thermal paste), heat source (candle, etc), cooling agent (
    - Design the Apparatus
      - Multiple sketches
      - Based off devices already used by mobile consumers

- Potentially small battery banks



  - Use circuit-mapping software to plan circuit configuration
  - Talk to engineers and other professionals on topic specific procedures, methods, and proper practices
- Take Efficiency Measurements of Peltier Tiles in multiple different environments
- Complete the Electrical System
  - Using electrical wires, wire strippers, and soldering tools
- Optimize electrical board system to fit mobile consumer standards
  - Safe
  - Easy to Use
  - Portable and Small
  - Efficient and Useful

- **Risk and Safety**
  - There are two potentially safety risks for this project
    - Electrocution

        - This risk stems from my use of electrical materials and equipment such as: batteries, circuit boards, and electric wires
        - This safety risk will be resolved by using protective gear such as rubber gloves, protective clothing, and protective eyewear. Supervision may become a need in the more dangerous aspects of the project (Physics Teacher, Engineering Advisor, and Parents who have engineering backgrounds). Training from the Arduino club, as well as safety demonstrations online will be conducted.
        - Although lithium-ion batteries will be tested, along with AA, AAA and possibly other consumer grade batteries, they will not be intentionally tampered with or experimented on.
            - Their sole purpose is to function as designed; to store energy
    - Burn
        - The soldering process requires a material to be melted for fusing two items. This hot equipment could pose as a burn risk without supervision and caution
        - A small controlled fire, such as a candle, may be in effect
        - This safety risk will be resolved by wearing protective clothing, gloves, protective eyewear. The workspace shall remain clear of any flammable items. Supervision may become required (Physics Teacher, Engineering Advisor, and Parents who have engineering backgrounds). Training from the Arduino club, as well as safety demonstrations online will be conducted.
- **Data Analysis**
    - Using thermal sensors and voltage meters and more, actual electrical output of the Peltier tiles, under certain circumstances
    - Tests on batteries, specifically in the batteries of the mobile devices being charged with my apparatus, will be conducted to insure product safety and degradation control of battery health. These can be conducted by hooking up the batteries to a meter to analyze efficiency data or daily trials could be done to insure battery longevity on a charge.
- **Discussion of Results and Conclusion**
    - The electrical output data will be used to decide on how I use and where I implement my Peltier tiles for peak performance in energy generation
        - The data will help find the most efficient and optimal location especially if the tiles, for example it could decide whether this apparatus will be applied directly on human skin or if it will act upon items if the environment

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