Design Proposal Template:

School: Parkrose Middle School **State:** OR **Division:** Middle School or High School

Team Members' Names: Dax Richardson, Khanh Pham, Jackson Vo

Project Title: Readers should have a general sense for what the project is about and want to read more. (20 word maximum)
Affordable, Reliable, and Sustainable Hydroelectric Water Wheel for Low-Income Households
Inequity Being Addressed: Describe the inequity that you will attempt to address with your proposed solution, and why you chose this inequity. Students are able to consider a global perspective related to their inequity. (75 word maximum)
In 2021, the United Nations reported that 675-700 million people worldwide lived below the poverty line and lacked access to electricity. One of their SDGs (Goal #7) and a goal we seek to address with this project is the need for access to affordable, reliable, and sustainable energy. Low-income households struggle to cook, clean, and receive proper heating and cooling without electricity and tend to rely on fossil fuels to get by.
Community Research and User Identification: Explain the process used to identify the inequity and select your user. Include any research done to identify issues in your community and understand which groups face challenges because of these issues. (150 word maximum)
We interviewed Danny Love, our client from Portland General Electric, on how the Portland community needs more affordable, reliable, and sustainable energy sources outside the power grids we use. Our research shows that Portland is prone to power outages caused by heavy winds and precipitation. Our users may experience a lack of refrigeration, impacting their workability. In addition, there is an increase in stress and anxiety over the safety and well-being of oneself and their loved ones. Groups most affected are low-income households with family members who are medically high risk or in need of extra care (i.e., older adults, individuals with disabilities, young children), or those who live in areas prone to outages, such as rural areas. This is a reality that affects us locally and worldwide. Therefore, we seek to address this inequity through our project in hopes that we can better support our community.

User Profile: Provide a detailed description of your selected user. Include information about challenges they face, how those challenges impact their lives, and specific project needs based on user feedback. (150 word maximum)

Our user is someone who struggles financially and lacks the education or support needed to navigate their everyday needs with other types of energy sources. For example, they are not able to afford devices that provide alternative energy sources, like solar panels. Our user resides in an area prone to severe weather conditions, including heavy winds and rainstorms. Without access to electricity, they are not able to get proper heating and cooling in their homes, refrigerate food, cook, clean, and communicate with others outside their household consistently and without disruptions.

The following needs were identified for this project.

1. A meter that can accurately read energy usage easily and with little instruction.
2. A water wheel that can accommodate the user's downspout for easy installation.
3. A device that uses materials that are inexpensive and can protect it from factors such as water, rust, heat, and more.

Project Goals: List your project goals and explain how these goals will address the inequity. Project goals should define the desired outcomes, not specific features of the proposed solution. (150 word maximum)

1. Incorporate a voltmeter that sends volts to a Micro-bit to accurately read the waterwheel's battery voltage.
    a. This allows users to be able to know how much energy is available for use and helps them conserve accordingly. This will benefit our users who may want an easy way to view energy usage.
2. Create different sizes of water wheels to accommodate different users' downspouts.
    a. This helps make the waterwheel more accessible to our users and their needs. It also helps with easy installation and management.
3. Use materials that are low-cost, waterproof, rustproof, heat-proof, and require little to no maintenance monthly.
    a. This device needs to be able to be protected from any factors that could affect its use. This also lessens the amount of stress that comes with maintaining the device.

These goals will help us create an affordable, reliable, and sustainable device that anyone can use.

Proposed Solution: Describe your proposed solution, including any innovative and unique features, and explain how this solution will address your users' needs and the inequity they face. (150 word maximum)

Our team constructed a 3D water wheel that rotates as it moves water via paddles. This wheel was created using Fusion260 and is connected to a DC motor. This motor is then connected to a rechargeable battery. The battery is then attached to a breadboard of resistors. To measure the amount of voltage or energy made by the wheel, a Micro-bit was used as it has LED lights that can light up and indicate the amount clearly to a user. The water wheel generates hydroelectricity, which is a useful renewable energy source to have, especially in cities like Portland, where there are frequent high levels of precipitation throughout the year. It is low-cost and durable, meaning our users can afford this device and can easily install it without much instruction. With this device, they will be able to power their household without worrying about the consequences of no electricity.

Initial Design: A single graphic of your first design idea with key features adequately labeled. It should be easy to understand and the reader should have a general understanding of how the prototype functions by looking at the graphic. Max size 8.5" x 11"