Good Idea Grant

1. **Project Title:** Aquaponics and Sustainability

2. **Participation**

   Number of students: 80 Grade level(s):9-10. Subject Area(s): Biology, Physical Science, Math, and CTE (construction and Engineering)

3. **Project Description**

A. Mission Statement:

To provide students with an authentic project-based learning experience that will expose them to STEM competencies and sustainability through aquaponics.

B. Scope of Work:

Aquaponics is a sustainable food producing system that combines aquaculture (raising aquatic animals such as fish, crayfish or prawns in tanks) with hydroponics (growing plants in water) in a symbiotic environment. The fish produce ammonia that would be toxic if untreated. This water is pumped to the "hydroponic component" with established microbial communities that convert ammonia to nitrite and nitrate that plants utilize for growth. The cleansed water is returned to the fish tanks for the cycle to begin again.

Students will develop an understanding of sustainability and explain how aquaponics systems contribute to local sustainability. They will design and construct an operational aquaponics system that produces food and optimizes the nutrient cycling.

This unit will provide students the opportunity to utilize science, engineering, and math practices in authentic problem-solving activities. They will also utilize a variety of technical tools throughout the project including: computers (for research, design, data presentation and analysis, and video editing), probe ware, and video cameras.

Excite, Engage, Educate

Students will develop an understanding of the importance of sustainability in Hawaii and the role alternative energy and aquaponics could play in sustainability. The excitement for students will be ongoing through collaborative activities that design, construct, test and improve the aquaponics system.

Student engagement will be achieved during the designing, constructing, testing and improvement (scientific inquiry and engineering design process) of the aquaponics system. They will be engaged by learning new technical skills (e.g. probe ware), applying digital tools to their project, and using math in authentic applications.

Students will demonstrate STEM competencies through integration of scientific, engineering, and mathematical practices. Technology will be infused throughout the project with students using probe ware, various computer applications and video production.

The aquaponics system will also bring many science and math concepts alive for students including: photosynthesis, respiration, interdependence, nutrient cycling, energy, collecting, presenting and interpreting data, calculating volumes rates and biomass.

Tentative Lesson Sequence and Deadlines:

Lesson Sequence		
	Lesson Title/Description	Time Frame
1	Sustainability Students conduct internet research on: What is sustainability? How does Hawaii get most of its food? How does Hawaii fulfill its energy needs?	1 wk
2	Photosynthesis & Respiration Students learn reactions through classroom lectures and laboratory investigations.	3 wk
3	Interdependence and Nutrient Cycling (Nitrogen) Students use results from photosynthesis/respiration lab to infer interdependence in nature. Internet research on nutrient cycling.	1 wk
4	Design Aquaponics System. Students conduct internet research into aquaponics systems already used. Then use a drafting program (sketchup or 3D CAD) to design a system, including initial plans for energy supply, fish density, plant density, water volume and flow rates	2 wk
5	Construct Aquaponics System	3 wk
6	Digital "How To Set Up Aquaponics System"	1 – 2 wk
7	Optimizing Fish Density, Plant Density, Water Volume and Flow Rates	2 wk – ongoing

Project Sustainability:

The aquaponics project is ideal for sustainability. Once the initial system and probe ware are purchased they can be reused, optimized, modified and expanded with minimal maintenance costs. The Vernier Labquest and and probes that will be used to measure aquaponics variables can also be used in other content areas (science math, CTE) and for a number of other applications

including STEM related project-based environmental field work. The aquaponics system would provide many guided and independent inquiry opportunities for students in the future, as well as continue to produce food. Aquaponics could also be expanded to other schools and the outside community.

C. Needs Assessment:

The *AMP* Complex Area plans to integrate STEM education with sustainability. Sustainability is a relevant issue for our community and is integral to Hawaiian values. *Aloha, Malama*, and *Pono,* schools rank 1st, 2nd, and 3rd respectively for having the highest percentage of economically-disadvantaged students and has among the highest Hawaiian/Part Hawaiian student populations in the State. The HSA scores for *Aloha High School* last year were 23% in Math and 55% in Reading. This year's AYP is 64% and 72% in math and reading, respectively.

By providing engaging, real world experiences that build student skills and interest we plan to reach high poverty, under-represented minorities (including women and Pacific Islanders) to help fill the growing demand for STEM-related jobs on Hawaii Island. Another goal of the project is to contribute to a 5% increase student's meeting proficiency on the math and science HSA scores.

D. Learning Standards

Science Standards:

- Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process
    - SC.BS.1.1-1.9 – Scientific Inquiry
- Standard 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT: Understand the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment
    - SC.BS.3.1- Describe biogeochemical cycles within ecosystems
    - SC.BS.3.2- Explain the chemical reactions that occur in photosynthesis and cellular respiration that result in cycling of energy
    - SC.BS.3.4- Explain dynamic equilibrium in organisms, populations, and ecosystems; explain the effect of equilibrium shifts.

Math Standards:

- G.GMD.3Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
- S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

- S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- S.IC.6 Evaluate reports based on data.

CTE Standards:

- Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems

Student Assessments:

Pre- and Post Quiz/Survey focused on:

- Nitrogen Cycle, Photosynthesis, Respiration and Interdependence
- Interest in Science and Engineering
- Math Process Skills?

Performance Assessment

- Design of Aquaponics System
- Construction of Operational Aquaponics System
- Create a digital presentation on "How To Set Up an Aquaponic System"
- Students can use appropriate probes to make measurements of of variables important for aquaponics systems. Including: NH_3, NO_2, Dissolved O_2, Temperature, pH
- Designing Experiments and communicating findings orally and written.

E. Collaboration:

Collaboration will take place at four levels for this project. The first level of collaboration will be among teachers within the same school. The aquaponics curriculum will be across content areas and will include science, math, engineering and CTE input.

The next level of collaboration will be between complex area schools. Students will communicate results with other schools using appropriate technological tools, such google docs, edmodo, wikispaces, etc. Another form of interschool collaboration will involve cross-age tutoring. For example, experienced upper level students could lead projects and provide training, instruction and assistance to elementary students.

The third level of collaboration we will strive for is community outreach. A long term goal is for students to lead community training on aquaponics systems. The outreach component would not only allow students to share their learning on how aquaponics functions and basic set-up guides, but could also include grant writing to assist interested community members to purchase and install aquaponics systems.

The fourth level of collaboration will include community partnerships. Some community partnerships established include; HELCO, Friendly Aquaponics, Hawaii Workforce Development, and Rivertop Solutions.

4. Other (*not a required section*)

5. EVALUATION AND REFLECTION

TO BE COMPLETED WITH APPLICATION

Components	Descriptors	Rating				Evaluation Comments
		1	2	3	4	
Mission Statement	The Mission Statement can be accomplished with the desired results in the timeframe needed.				X	
Scope of Work	The project Excites, Engages and Educates students with clearly defined deadlines that result in the preferred state of being.				X	
Needs Assessment	Summary of needs assessment provides a brief and concise description of existing state of being against preferred state of being. Relevant data is included in establishing the gap analysis.				X	
Learning Standards	Goal statement is specific, measurable, attainable, results-driven and timed.				X	
Collaboration	Parents, community and other external stakeholders are involved and engaged in the project.				X	

TO BE COMPLETED AFTER COMPLETION OF THE PROJECT

Components	Descriptors	Rating				Reflection Comments
		1	2	3	4	
Mission Statement	The Mission Statement can be accomplished with the desired results in the timeframe needed.					
Scope of Work	Did the project Excite, Engage and Educate students and result in the preferred state of being?					
Learning Standards	Did this project connect to a measurable learning standard? Did this project improve student scores based on that standard?					
Collaboration	To what extent were parents, community and other external stakeholders involved and engaged in the project?					
Sustainability	Can this project be replicated in other classrooms or schools?					

6. PROJECT BUDGET:
Amount of request: $7,472

Item Description	Store/Source	Quantity	Unit Cost	Subtotal	In Kind Donations	Donations Provided By
Water Pumps DC	Aquarium Supply	8	50	400		
Air Compressors DC	Aquarium Supply	8	50	400		
Solar Panel	Inter Island Solar	4	200	800		
12 V battery	Deep Cycle	8	79	632		
Vernier Probe Ware	Vernier Labquest	4	329	1316		
Vernier Probe Ware	Ammonia, Nitrate	8	179	1432		
Vernier Probe Ware	pH	4	79	316		
Vernier Probe Ware	Dissolved O_2	4	209	836		
Tanks	Del's	8	150	1200	1200	*AMP* Complex Area Funds
Miscellaneous Fitting and tubing	Home Depot Open P.O.	1	200	200		
Fish food	Del's	1	60	60	60	*AMP* Complex Area Funds
Fish Stock	Friendly Aquaponics	1	200	200		
Plant Seeds	Del's	1	25	25	25	*AMP* Complex Area Funds
Laptop	Macbook	1	940	940		
Aquaponics Guide	Friendly Aquaponics		100	100	100	Friendly Aquaponics
Total Project Cost				8857	1385	

Total Project Cost $8,857
Total In-Kind Donations $1,385
Total Requested $7,472

STATEMENT OF UNDERSTANDING

If awarded, grant funds must be used for developing and implementing the project as described in this application. An evaluation and accounting of funds used will be provided upon completion of the grant, which shall be no later than the school year for which this grant is awarded.

Signature: _____ Date: _____
(Electronic signature is allowable)

Return or email your application to:

Hawaii State Teachers Association
Stacy Nishina, Instruction & Professional Development Specialist
Phone: (808) 840-2236
Email: snishina@hsta.org