Warren J. Baker Endowment
for Excellence in Project-Based Learning
Robert D. Koob Endowment *for Student Success*

CAL POLY

Proposal Cover Page

Title of Project: Vaccine Cooler for Global Poor

Proposal Author: COOPER GIBSON **Cal Poly Email:** cogibson@calpoly.edu

Student ID: 010995760 **Dept.:** MECHANICAL ENGINEERING

Signature (Optional): [signature]

Signature provides permission to check financial aid eligibility.

Previous Baker/Koob Endowment funding? (circle one): Yes (No)

Is this request to support a Senior Project or thesis? (circle one): (Yes) No

Team Member(s)	Signature	Cal Poly Email	Department
Ben Larson	[signature]	bjlarson@calpoly.edu	ME
Eilbron Younan	[signature]	eyounan@calpoly.edu	ME
CODY VOLK	[signature]	crvolk@calpoly.edu	ME

Anticipated Start Date: 9/24/2018 **Anticipated End Date:** 5/31/2019

Total Funds Requested: $ 1500

Faculty Advisor: Eileen Rossman **Department:** Mechanical Engineering

Faculty Advisor email: erossman@calpoly.edu **Telephone:** 756-7424

Signature of Faculty Advisor: [signature] **Date:** 11/1/18

PROPOSAL NARRATIVE

I. Project Title

Vaccine Cooler for the Global Poor

II. Abstract

The topic of the project is centered around developing a portable, cheap, and effective vaccine cooler that can be used to transport vaccines from local clinics to remote villages in Africa, where grid power is unreliable and often unavailable. The purpose of this project is to improve quality of life in remote villages in Africa by improving the reliability of vaccine transport. This project has far-reaching implications as it can be used by many poor communities worldwide, and increase the availability of effective vaccines. This project was proposed by Peter Schwartz of the Cal Poly Physics Department to a team 4th year mechanical engineers. The project will be completed through a rigorous iterative design process as part of the Cal Poly Mechanical Engineering senior project class, and will undergo multiple stages of building and testing before a final product is built. The main expected outcome of the project is an affordable vaccine cooler that is solar-powered, well-insulated, and utilizes a phase change material to extend the time that it can maintain optimal transport temperatures.

III. Objective(s)

The project topic is centered around the global problem of vaccine accessibility, especially for communities that are underdeveloped. The specific project will focus primarily on the safe transport of vaccines; as strict long-term temperature control is difficult in regions where constant power for refrigeration devices is not readily available. The measurable objectives for which this funding will help attain are as follows:

1.) Develop a solar-powered, Peltier-driven cooler that can maintain vaccines between 2-8°C for up to 5 days.
2.) Develop a complete system that costs less than $50 to produce.

IV. Methodology

Carefully coordinated steps must be taken in order to ensure that the aforementioned objectives will be met to the fullest extents. First, a complete thermal model will be created in order to accurately model the heat transfer across the cooler system. After the model is theoretically verified, a design CAD will be created with verified dimensions. Materials will be selected based on manufacturability and cost, a manufacturing plan will be developed, and materials will be ordered. A risk assessment will then be performed in order to determine any potential risks in the manufacturing process, and once the risk assessment yields no potential problems, manufacturing will begin. Once the cooler is built, testing will be completed in which objective 1 will be verified. Throughout the entirety of the project, especially during material selection, we will constantly be

looking for ways to cut down on cost and choose the most economical designs and materials so that Objective 2 can be sufficiently met.

V. Timeline

Since this is a Cal Poly Mechanical Engineering senior project, the timeline of developing the vaccine cooler will be will be very structured and deadlines must be met without exception. Currently, we are in the brainstorming/concept modelling phase. On November 16th there is a preliminary design review where we will present the design direction we are heading towards and justify our decisions to get approval from our sponsor. On February 8th we will present again at our critical design review where we will have a structural prototype of our vaccine cooler and discuss results of the last three months of work. Three months later on April 25th, our cooler must pass safety and hardware tests. Finally, on May 31st our vaccine cooler must be fully operational and ready for the senior project expo.

VI. Final Products and Dissemination

The final product will take the form of a portable vaccine cooler. It will also provide a proof-of-concept for using solar-driven Peltier modules to provide sufficient cooling for vaccine storage capabilities.

VII. Budget Justification

While the goal of this project is create a vaccine cooler for as cheap as possible, designing, manufacturing, and testing our product will require supplemental funds. One of the largest costs of this project will be a solar panel. Peltiers run relatively cheap but we will likely buy several of them for testing and manufacturing. Along with the Peltiers, some type of heat sink will be required to dissipate the heat from the Peltier. The phase change material may be expensive as we have not yet selected what that substance will be yet that will meet the required threshold of 2-8 °C. We will likely need enough of the phase change material to experiment with for multiple prototypes. As for a container, we are tentatively planning on buy an existing cooler and modifying it to fit our needs or we will remove the insulation from an existing cooler and use that in a container that we design ourselves. The cooler must be durable and able to withstand the harsh conditions of Africa so that will likely require some modifications to the cooler by the team. Due to the fact that vaccines must be kept in such a strict temperature range, there must be a way for the temperature to be monitored. A thermocouple and temperature readout display will be required. At this stage in the project, it is nearly impossible to predict every piece of equipment that will be required in the design and manufacturing process of the vaccine cooler. We hope to acquire enough funds so that when problems arise down the road, we can deal with them adequately.

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PROPOSAL BUDGET

Student Applicant(s): Ben Larson, Gibson, Cody Volk, Eilbron Youna	
Faculty Advisor: Eileen Rossman	
Project Title: Vaccine Cooler for the Global Poor	**Requested Endowment Funding**
Travel *subtotal*	**$ 0.00**
Travel: In-state	**$ 0.00**
Travel: Out-of-state	**$ 0.00**
Travel: International	**$ 0.00**
Operating Expenses *subtotal*	**$1500**
Non-computer Supplies & Materials	**$1250.00**
Computer Supplies & Materials	**$250.00**
Software/Software Licenses	**$ 0.00**
Printing/Duplication	**$ 0.00**
Postage/Shipping	**$ 0.00**
Registration	**$ 0.00**
Membership Dues & Subscriptions	**$ 0.00**
Multimedia Services	**$ 0.00**
Advertising	**$ 0.00**
Journal Publication Costs	**$ 0.00**
Contractual Services *subtotal*	**$ 0.00**
Contracted Services	**$ 0.00**
Equipment Rental/Lease Agreements	**$ 0.00**
Service/Maintenance Agreements	**$ 0.00**
TOTAL	**$ 1500.00**

CAL POLY
California Polytechnic State University
San Luis Obispo, CA 93407

Mechanical Engineering
805.756.1334 FAX: 805.756-1137
me.calpoly.edu

Dear Grant Committee:

I am writing this letter to support of the Solar Vaccine Senior Project in their application for the Baker-Koob grant. The purpose of the Solar Vaccine project is to develop a low-cost, portable, solar-powered transport cooling device for vaccines. The project will benefit people in underdeveloped African countries such as Uganda, but may have wider usage. The impetus of the project is to make use of photovoltaic panels, which have undergone extreme decreases in cost over the last decade, making them an accessible source for use in underdeveloped countries. The sponsor for this project is Dr. Pete Schwartz in the Physics Department, who has worked with AidAfrica in Uganda on similar solar-powered devices.

The student team working on this project consists of four mechanical engineering seniors, working with a team in the Physics Department. To complete this project, the mechanical engineering students will be using engineering skills in design, thermodynamics, heat transfer, computer-aided design, and manufacturing. All four of the mechanical engineering students have completed classes in all of these subjects. As individuals, I have full confidence in the motivation and abilities of each member of the mechanical engineering team, including Cooper Gibson, Ben Larson, Cody Volk and Eilbron Younan. These students are working on a regular basis with the Physics team, consisting of Dr. Schwartz and his students.

The senior project team will have the use of the labs and shops (Mustang 60 and the Hangar) in the Mechanical Engineering Department. As their advisor, I meet with the team weekly to assess their progress and provide guidance. Dr. Schwartz provides additional guidance and resources as well as contacts with aid organizations.

The project objectives will be to design, build, and test a prototype of the vaccine transport. The project has a clear set of milestones, including a Preliminary Design Report (November, 2018), a Critical Design Report (Feb, 2019), followed by manufacture and testing of the prototype which will be completed by June 2019. The scope of the project was reviewed carefully by both the senior project coordinator (Dr. Peter Schuster) and myself to ensure that it is attainable in that time frame. The team can make this device out of readily-available hardware.

This project is a collaboration between Dr. Schwartz of the Physics Department and the Mechanical Engineering Department. Dr. Schwartz and his student team are providing the knowledge and results gained from various solar power projects in underdeveloped countries, and the mechanical engineering student team is charged with designing the vaccine device.

The target beneficiaries of the proposed prototype of a solar-powered, transportable vaccine cooler includes underdeveloped African countries. Dr. Schwartz has worked with AidAfrica in a past project in Uganda, which provided and tested solar-powered cookers. The proposed solar vaccine cooler will increase access to vaccines in developing countries.

The students have asked for $1500 in support of their project. To complete this project, the students will need to purchase thermoelectric coolers, phase change materials, insulation materials, and testing equipment. The requested funding will cover the cost of these materials.

When the students have completed the prototype, they will publish their findings in the digital commons at Cal Poly as part of their senior project requirements. Dr. Schwartz has previously published the results of similar solar projects in *Development Engineering* (2017) with students.

Sincerely,

Eileen Rossman , ME, PE
Senior Project Advisor
Mechanical Engineering Department
erossman@calpoly.edu
805-756-7424