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: Cal Poly Compost Chomper

Proposal Author: Cory Parmenter **Cal Poly Email:** cparment@calpoly.edu

Student ID: _____ **Signature (Optional):** _____

Signature provides permission to check financial aid eligibility.

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

Team Member(s)	Signature	Cal Poly Email	Department
Cory Parmenter		cparment@calpoly.edu	ME
Joe McGill		jmmcgill@calpoly.edu	ME
Anthony Jungquist		djungqui@calpoly.edu	ME

Faculty Advisor: Sarah T. Harding **Department:** ME

Faculty Advisor email: sthardin@calpoly.edu **Telephone:** _____

Anticipated Start Date: 10/4/16

Anticipated End Date: 6/2/17

Total Funds Requested ($): 2000

CalPoly Comp Chomp

Signature of Faculty Advisor: _____ **Date:** 11-14-16

I. Abstract

Students in the garden program at the Captain Raymond Collins Elementary School spend excessive time and energy manually chopping garden leftovers to make compost. The students need a safe, easy to operate, pedal-powered device which chops the material while encouraging a lifelong passion of gardening and engineering. The Cal Poly "Compost Chomper" senior project team has been assigned to create a working device that will satisfy the needs of the garden. To fulfill this goal, the "CP CompChomp" team will use a "design, build, test" approach consistent with the mechanical engineering senior project structure. The final product will be transported to the Captain Raymond Collins Elementary School in Long Beach, California, where they will be able to put it to immediate use on any garden waste available. This document enumerates the specific steps that the team will take and the funding that is required in order to successfully make this goal a reality.

II. Introduction

The Captain Raymond Collins Elementary School has a spectacular garden under the direction of master gardener, Susan Deogracias. The garden teaches students valuable gardening skills, inspires a healthy lifestyle, and produces vegetables, herbs, berries, and some flowers which are shared within the community. With this produce comes a large amount of garden waste in the form of weeds, vines, stalks, and roots. These vines and other forms of garden waste are chopped up and made into compost to be used as fertilizer and show the students the full life cycle of the plants. The problem that the students have is that the garden waste is very tedious and difficult to cut into compostable pieces using their current method of processing: chopping with shovels. A better method to process the garden waste is needed in order to save time and energy as well as keep the students engaged. Mrs. Deogracias does not want the device to be powered by electricity or gas because this adds an element of danger to the process. She is looking for a pedal powered device that the students can operate, and background research has proven that existing products that fulfill this need are scarce.

The goal of the California Polytechnic State University Compost Chomper (CP Comp Chomp) team is to design and build a device that will solve the Captain Raymond Collins Elementary school garden's problem of composting garden waste. Cal Poly Compost Chomper is comprised of three fourth-year Mechanical Engineering students: Joe McGill, Cory Parmenter and Anthony Jungquist. Each of us has a passion for learning and developing effective designs that we will to apply to this project. This senior project is under the advisement of Sarah Harding from the Cal Poly Mechanical Engineering Department.

III. Objectives

After extensive conversation with Mrs. Deogracias, we determined the following list of needs that she and her students have for the device:

1. The device must be pedal powered and operable by 1st-5th graders. Preliminary calculations have suggested that a 5^{th} percentile 6-year-old will be able to produce 160 in-lbs of torque and should pedal at an optimum cadence of 60 rpm. This means our cutting device can only require 0.15 HP per student pedaling. We may employ a tandem system which would utilize multiple students pedaling at once to increase the power input.

2. The device must cut the organic waste (up to 3 inches in diameter) into reasonable sized chips. We have determined that these chips should be no larger than 1 in^3.

3. The device must process the material with a process rate of 0.8 lbs/min

4. The device must be safe. There can be no access to the cutting mechanism while it is in motion. Also, the device must prevent debris from launching itself at the students, support the weight of

its operators (up to 95th percentile adult male), and be free of any pinch points that could result in injury. The device must remain stable when pushed with 60 lbs applied to its highest point.
5. The device must be no larger than 4'x 4'10" x 10', and weigh no more than 500 lbs.
6. The device must have a feeding mechanism (like a hopper) that can hold a minimum of 2 ft^3 of garden waste.
7. Additionally, the device must have a removable receptacle and an adjustable quick release seat that can accommodate ages 6 to adult.
8. The total cost of the device must not exceed $1000 plus any additional donations. Mrs. Deogracias and the Captain Raymond Collins Elementary school are prepared to provide $1000 for the project, but in order to produce a safe, functional, high quality design, we anticipate that we will require more funding.

IV. Methodology

Since the start of our project in September, we have performed extensive background research to understand the composting process and benchmark against existing products that could fulfill a similar need. We have had several ideation sessions in which we came up with as many designs as possible, and then narrowed them down to the best design by building crude prototypes and a series of decision matrices. We have produced a rough CAD model of the layout of our design (see Figure 1) and are now ready to start fine-tuning the details.

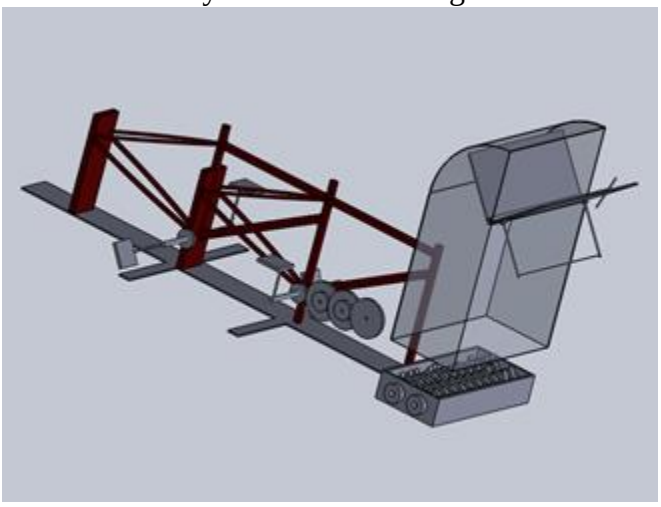

Figure 1. Rough design overview including mailbox-emulating safety mechanism, shredding devices, tandem bicycle framework, and drive train. Some aspects of the design have been left out of the model for simplicity.

Moving forward, we will rapid prototype a plastic version of our cutting mechanism in order to determine an empirical estimate of how much torque it actually requires to cut the garden waste with the device. We will also carry out calculations to determine important aspects of our mechanism such as stresses, part dimensions, gear sizes, drive train, and life estimates.

V. Timeline

We are utilizing a Gantt chart to plan and visualize the timeline of our entire project. This helps us determine how long we have to complete individual tasks associated with major milestones. A list of the major milestones for this project can be seen in Table 1 below.

Table 1. Major project milestone timetable for CP CompChomp senior project team.

Date	Task
10/25/16	Project Proposal
11/17/16-12/2/16	Preliminary Design Review
12/8/16-1/12/16	All Long-Lead Parts Ordered
2/7/17-2/16/17	Critical Design Review
3/2/17	Part Ordering Complete
3/9/17	Operator's Manual Complete
3/16/17	Project Update Report
5/2/17	Project Hardware/Safety Demo
6/2/17	Final Design Review - Project Expo, Hardware Handoff, Final Report

VI Final Products and Dissemination

The final products of this project will primarily be a working compost cutter for use by Captain Raymond Collins Elementary's garden and a comprehensive report of our process. We will also demonstrate the device at senior project expo. Our team may decide in the future to pursue producing more of these devices and marketing them, but this is outside the scope of the current project.

VII Budget Justification

We estimate that we will need $200 dollars for in-state travel because Captain Raymond Collins Elementary is in Long Beach, CA which is more than 200 miles away. Although we have been using skype and email as primary sources of contact to Mrs. Deogracias and the school, we will likely need to travel there. We estimate that it costs about $70 to travel to Long Beach and back once, so $200 would allow for two trips to Long Beach and still have remaining money for traveling to pick up materials.

The bulk of our costs will be due to materials. We anticipate that steel will be our primary material and have calculated the volume of steel required for our design using Solidworks. This volume of steel alone approached about $1000 and this does not account for unusable scrap material and potential mistakes or redesigns which could easily add another $500 to the cost. Additionally, we will likely have to purchase a tandem bicycle if one is not donated to us, which could cost about $400. We will also likely buy items like chains, sprockets, and gears from McMaster Carr, which could add up to about $300. We predict that materials could cost about $2200 or more. The reason we are only asking for $1200 for the materials category is that we have the original $1000 in funding that can be used for material cost.

Finally, we expect to pay up to $600 for contracted services because we may need to hire a machinist to help machine our more complicated parts and we will likely utilize the ME department's 3D printer. If we hire a machinist to help us for less than a day and a half, it would cost about $300 assuming a wage of about $20/hr and 8 hour working days. It costs a little more than $70 to use the ME 3D printer because of technician processing time and material cost. We may need print about four prototypes, which would cost about $300.

The value of this design goes far beyond just its functional purpose of cutting garden waste, it serves to teach and inspire students who interact with it. Concepts of sustainability and environmental awareness will be imparted on the students by experiencing the composting process. The physical design of the machine will show students a variety of engineering concepts and let them experience the "Learn by Doing" method.

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PROPOSAL BUDGET

Student Applicant(s): **Anthony Jungquist** **Joe McGill** **Cory Parmenter**	
Faculty Advisor: Sarah Harding	
Project Title: CP CompChomp	**Requested Endowment Funding**
Travel *subtotal*	**$200**
Travel: In-state	**$200**
Travel: Out-of-state	**$0**
Travel: International	**$0**
Operating Expenses *subtotal*	**$ 1200**
Non-computer Supplies & Materials	**$1200**
Computer Supplies & Materials	**$0**
Software/Software Licenses	**$0**
Printing/Duplication	**$0**
Postage/Shipping	**$0**
Registration	**$0**
Membership Dues & Subscriptions	**$0**
Multimedia Services	**$0**
Advertising	**$0**
Journal Publication Costs	**$0**
Contractual Services *subtotal*	**$600**
Contracted Services	**$600**
Equipment Rental/Lease Agreements	**$0**
Service/Maintenance Agreements	**$0**
TOTAL	**$2000**

Mechanical Engineering Department
1 Grand Avenue
California Polytechnic State University
San Luis Obispo, CA 93407

November 14, 2016

RE: RFP – Compost Cutter

Baker-Koob Endowment Committee:

I am the senior project advisor for the team Comp Chomp designing a compost cutter for a California elementary school. The team will be designing a bicycle powered device to cut vines and other garden waste for compost. The goal of the project is to give elementary students an easier way to complete a garden chore and to actively engage them in gardening.

The three mechanical engineering students on this team are working on this project in fulfillment of their senior project. They are currently enrolled in the first quarter of the three quarter mechanical engineering senior project sequence. Because of the very structured nature of the course, I have confidence in the students' ability to design, build and test a working system by June 2017.

The course is structured so that students have six hours a week with their team and advisor. As their advisor, I will be meeting with them weekly to check on progress, recommend steps they can take to improve performance, and break down any roadblocks. These meetings are crucial to the success of the project. The students also have a close working relationship with their sponsor at the school.

The students will do their best to acquire used components to build their device, but this could be difficult if their chosen design does not lend itself well to recycled components. Since this project came to Cal Poly with no funding, I hope that the Baker-Koob committee will help the project so the students can build a quality device.

Sincerely,

Sarah T. Harding

Sarah Harding
Mechanical Engineering Lecturer

(805) 756-7994