

## 2018 Spring CEF Classroom Teacher Grants: Great Teachers. Great Ideas.

Deadline : February 12 2018 at 11:59 PM EST (Midnight) - CLOSED

### Applicant Information

**Name:** Daniel Marble  
**Email:** dmarble@ccs.k12.in.us  
**App ID:** 01740452  
**Status:** Submitted  
**Last Modified:** Feb 11 2018 13:06 EST by dmarble@ccs.k12.in.us  
**App Submitted:** Feb 11 2018 13:06 EST by dmarble@ccs.k12.in.us  
**App Created:** Feb 11 2018 09:58 EST by dmarble@ccs.k12.in.us  
**Last IP Address:** 10.189.245.4

### Contact Information

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<b>First Name</b>	Daniel
<b>Last Name</b>	Marble
<b>School Phone Number</b>	317-846-7721
<b>School Extension Number</b>	7064
<b>School e-mail</b>	dmarble@ccs.k12.in.us
<b>Secondary e-mail</b>	dmarble@ccs.k12.in.us
<b>Type of Grant</b>	Individual Teacher

#### School Information

<b>Name of grant applicant's school</b>	Carmel High School
<b>Please provide the number of Carmel Clay schools that will participate in this project.</b>	1
<b>If your activity includes more than one school, please check all applicable schools below.</b>	Carmel High School

#### Other Teachers Included in the Grant

Please provide the name, school, and grade taught of other teachers and/or administrators submitti...

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## Assurance Statements

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### Personal Verification

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I have read this application and do hereby certify that all of the data and representations made i...

Yes, I verify the above statements.

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### Principal Approval

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I certify that my principal has given prior approval for the submission of this grant applicatio...

Yes, I have prior written approval from the principal for this grant application.

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### Superintendent Approval

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I certify that I (we) have prior written approval from the Superintendent of Carmel Clay Schools f...

No, this grant does not include more than one CCS school.

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### Technology Approval

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I certify that Terry Howell, CCS Technology Supervisor, has reviewed and has provided prior approv...

No, My grant application does not include the acquisition of software, hardware, peripherals, or other information technology.

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### Co-Submitter Verification

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Grant writer has received approval from each teacher, staff, or administrator submitting this grant.

No, I am the only one submitting this grant.

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### Grant Overview

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**Project Title (5 words or less)**

Equipment for Neurophysiology Investigations

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<b>Please provide the total amount of grant funds requested in this application.</b>	700.00
<b>Please estimate the total number of students who will benefit from this activity.</b>	90
<b>Please provide the grades of the students who will benefit from this activity.</b>	10~11~12
<b>Curricular Area of Grant (e.g., math, writing, reading, science, etc.)</b>	Science
<b>Targeted student population benefiting from the grant</b>	General Education

### Grant Summary

#### Activity

**Provide a brief summary of the project in 280 words or less.**

This grant proposal is a request to help fund equipment to assist AP Biology students in investigating neuroscience. A funding request of \$700 will provide for the purchase of combined electroencephalogram (EEG)/ electrocardiogram (EKG) equipment and sensory-motor reflex analysis equipment. Using this equipment in student-lead investigations will allow CHS students to acquire hands on experience that is on par with college-level neuroscience techniques. Use of simple, but powerful, physiology and analysis tools will prepare them for advanced scientific studies as well as the AP Biology exam.

**If you are seeking a grant for a specific product and there is a helpful website to further explain...**

<https://backyardbrains.com/products/heartAndBrainSpikerShieldBundle>

### Needs Assessment

**Describe specific educational need(s) that the activity addresses, indicating how the need(s) was/...**

The AP Biology curriculum is very broad in scope. In practice, due to the need to cover so much material before the AP Exam in early May, limits teaching of certain essential aspects. For example, to fit in all the physiology necessary for the course, it needs to be condensed into just a couple of weeks. It is challenging to learn comprehensively about the nervous, digestive, skeletal-muscular, endocrine, reproductive, cardio-vascular and excretory systems in only about a month. Because of this, the laboratory exercises suggested by the College Board are relatively basic and, in my opinion, do not sufficiently challenge students, nor prepare them for college-level investigations.

The grant will be used to purchase EEG/EKG and Reaction Timer Bundles to be used by AP Biology students. These devices allow for the demonstration of neurological function via graphic outputs. Using the Heart and Brain (EEG/EKG) SpikerShield Bundle, students can view and record the action potentials of their heart and the slow rhythms of their brain. An optional exercise, that will likely be performed, can use this device also to measure eye muscle movements. The Reaction Timer can be used to assess a student's own cognitive and reflex pathways, all just using their own mobile device.

It should be noted that all this equipment can and will be used over several years and will likely benefit many hundreds of students over its working lifetime.

When set up as an experimental EEG recorder, students will learn about the "broad communication" among hundreds of millions of neurons, and will observe this through the alpha rhythm electroencephalogram of their visual cortex in the presence or absence of light. Students will have a glimpse of the electrical activity of their own brain. Students can observe the oscillating slow fields of neurons in the upper layers of the cerebral cortex: specifically, the excitatory post-synaptic potentials. These result in 8-10Hz alpha waves of the visual cortex. These post-synaptic potentials are the small changes in electrical potential caused by neurotransmitter binding in the neuron's synapses. These changes in electrical potential lead a neuron to be more likely or less likely to fire action potentials, and are important in encoding information in the brain. For example, as students' eyes are closed the "noise" of the active visual cortex starts to synchronize and specific alpha wave patterns will begin to emerge.

When set up as an experimental EKG recorder, students will learn about the cardiovascular system through the use of electrocardiograms. Students should gain an understanding of the communication taking place between their brain and heart, and can see and listen to the contractions of their heart. Experimenters can observe the coordinated contraction of the heart muscle cells with the Heart and Brain SpikerShield. Normal heart contraction has a very distinctive electrical profile (often observed in medical dramas): the classic P wave, QRS complex, and T wave. Students can go beyond this initial observation by creating their own inquiry-based experiments such as investigating the effects of stress or exercise on heart rate and function.

The Reaction Timer is an expansion product that works with existing equipment, already in use in class, which allows students to measure their reaction time by recording how quickly they can flex their muscles in response to a stimulus. Investigators can be stimulated with two different colors of light in three different locations to test for visual reaction time. A tone can also be emitted from the built-in speaker and comparisons can be done to measure which response, visual or auditory, will be faster. It is also possible to experiment with multiple stimuli at once for more complex experiments.

Importantly, all of these data visualizations and analysis can be done simply and elegantly on students' own mobile devices, likely not requiring any use of other school technology.

Standards of Relevance from the AP Biology curriculum:

Learning Objective 2.12: The student is able to use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes.

Learning Objective 2.15: The student can justify a claim made about effect(s) on a biological system at the molecular, physiological or organismal level when given a scenario in which one or more components within a negative regulatory system is altered.

Learning Objective 2.20: The student is able to justify that positive feedback mechanisms amplify responses in organisms.

Learning Objective 2.42: The student is able to pose a scientific question concerning the behavioral or physiological response of an organism to a change in its environment.

Learning Objective 3.44: The student is able to describe how nervous systems detect external and internal signals.

Learning Objective 3.45: The student is able to describe how nervous systems transmit information.

Learning Objective 3.46: The student is able to describe how the vertebrate brain integrates information to produce a response.

Learning Objective 4.6: The student is able to use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions, provide essential functions.

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## Assessment/Evaluation

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### Assessment

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**How will you assess the success or failure of your project? Provide specific details on how you e...**

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These activities would strongly complement other exercises also done in class as a result of the kindness and forethought from previous CEF grantors. As a former research neurophysiologist, I feel I can lend much of my expertise in creating a suite of activities that engage students and allow them to investigate concepts above and beyond what they would do in an average AP Biology course. I have had many students, current and former, express their interest to further pursue biology, and especially neuroscience, having been grabbed by what I call the "brain bug". Many people, once they understand how complicated and powerful the human brain is, feel compelled and want learn more about it. It happened to me, and am very happy to share that inquisitiveness and desire with my students as well.

It is envisioned that this equipment will be used in a quantitative exercise to measure basic principles of neuroscience. Although it is not intended to describe in detail all the aspects of the human nervous system, it can serve to pull together the key concepts that we will have learned up until then in the unit. The goals of this grant include:

- Increased understanding and application of all academic standards previously stated in "Needs Assessment"
- Statistical significance in student assessment scores on unit and cumulative tests compared to previous years.
- Complete understanding by students of the technology within the experiment.
- Gain of skills to perform the tasks necessary to use the equipment with aptitude and mastery.
- Surveys of students on how the activity helped them learn the unit's material.

There are multiple ways to assess the success or failure of this project. Anecdotal evidence such as student excitement and interest in the experiment is obviously desired. More quantifiable assessments will include comparing scores on subject assessments from previous years. For example, of my students that took the AP Biology Exam last year 83% of them received a score above the national average on questions in the category "Cellular Processes: Energy and Communication", which includes neuroscience concepts. I will compare this year's results to last year's to try and quantify any significant improvements in this content area.

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### Grant Timeline

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**Please provide the beginning date of your grant.** 03/08/2018

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**Please provide the ending date of your grant.** 05/14/2018

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**Please provide a timeline, noting beginning and ending dates and dates of other key activities or ...**

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Purchased items will be utilized mostly during the Communication unit of the AP Biology calendar. Significant dates are listed for this year:

Mar 8/9	Signaling Pathways, Learning & Memory
Mar 12/13	Endocrine Pathways
Mar 14/15	Neuroprosthetics
Mar 16/19	Behavior Lab
Mar 20/21	Neuron Structure & Function
Mar 22/23	Muscles, Neuronal Systems
Mar 26/27	Neuronal Conduction Lab
Mar 28/29	EEG, EKG, Reaction Time Exercises
Apr 9/10	Sensory Receptors, Review
Apr 11/12	Communication Test
May 14	AP Biology Exam
Jul 11, approx.	AP Exam Results Released

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### Grant Promotion

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**Describe how you will share this CEF grant activity with your colleagues and with parents, PTO, C...**

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CEF will be credited in all publicity, advertising, and public notification about this project with the following credit line and CEF logo: "Funded by an education grant from the Carmel Education Foundation." Promotional activities within school include the school website (including individual teacher websites/Canvas) and the school newspaper (previous grants have been featured in CHS Hillite newspaper articles). Outside of school, promotional activities will include emails to parents, communication through the PTO newsletter. Photography documentation of the project will be provided to CEF after it is implemented, however it seems fit.

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### Grant Budget

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**Attach budget here.** 2018\_Grant\_Budget-Marble.xlsx

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**Is there a possibility of obtaining additional funds for this grant (PTO, school budget, etc.)?**

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I will be providing the balance of funds to cover shipping.

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