QSM SAMPLE PROPOSAL – HIGH SCHOOL ENGINEERING ELECTIVE

The following sample proposal should be used to gain a better understanding of the grant application questions and components. Copying or including any part of this sample in your proposal will be considered plagiarism and your proposal will be disqualified.

I. Project Overview (9 points)

What is the approximate number of students that will be directly impacted by your project?

24

Which grade band levels will your project impact?

☐ PK-3 ☐ 4-8 ☒ 9-12

Which subject does your project fall under?

☐ Mathematics ☐ Science ☒ STEM

What class(es) will your project impact?

Engineering Elective

Standards Sources

Identify source of the standards. Louisiana Student Standards should be given priority over national standards. National standards can be used if Louisiana State Standards are not available (e.g., upper level subjects). If other is selected, identify the source of the standards.

☐ Louisiana Student Standards for Mathematics
☒ Louisiana Student Standards for Science
☐ Louisiana's Birth to Five Early Learning Development Standards
☐ Computer Science Teaching Association Standards
☐ Standards for Technological and Engineering Literacy
☐ International Society for Technology in Education
☐ Advanced Placement
☐ Common Core Standards for Mathematics
☒ Other

Next Generation Science Standards

Standards Outline

Provide the following information for each standard.

a. Provide a standard (by code and text) addressed by this project.
b. List students' actions associated with the standard.
c. List evaluation methods associated with the standard.

Standard 1

1a. *HS-LS1-2– Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.*

1b. *Describe how an electrical impulse travels from the brain to the muscle causing a muscle contraction to occur. In project groups, students will design a prototype that can be used as a prosthetic or communication device using the Myoware sensor, which collects electrical impulse measurements from human muscles.*

1c. *Homework, Quiz, Project Rubric, and in process documentation*

Standard 2

2a. *HS-LS1-3– Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis in living organisms.*

2b. *Student Action: Students will discuss how electrical currents impact our body and justify why these currents impact our body the way that they do. Students investigate times when the electrical impulses provided by the brain get scrambled which causes various neurological disorders that affect body movement.*

2c. *Homework, Quiz, Project Rubric and in process documentation*

Standard 3

3a. *NGSS HS-ETS1-2– Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.*

3b. *Student Action: Students will discuss the value of using a sensor to measure electrical impulses from the muscle and how it could contribute to the creation of prosthetic limbs, communication, etc in the case of amputee's or people with neurological disorders.*

3c. *Project Rubric and in process documentation*

QSM
QUALITY SCIENCE & MATH GRANT

Project Summary
Provide a brief summary of the project that addresses the items being requested and how this project will increase students' content knowledge, skills, and/or practices of the listed standards. (50-120 words)

The project will begin by having students gain a basic understanding of how electrical impulses from the brain control and create muscle contractions in the body (standard 2). The equipment (sensors, soldering irons, and Arduinos) that will be purchased with this grant will then be used to apply that knowledge to create a simulated medical device using computer programming and sensors (Standard 1). At the end of the project, students will be able to collect and synthesize data from a sensor which will then generate a desired output to a motor which will show a connection to the real world application (Standard 3).

II. Rationale

State the primary motivating factor in proposing this project for the students (e.g., students' weakness, new curriculum, innovative project, challenges as a result of demographics, etc.). Include evidence supporting the motivating factor (e.g., student data, past experience, observation, education literature citations, etc.). (150-250 words)

In 2017, the National Science Foundation's (NSF) Directorate for Computer and Information Science and Engineering (CISE) began a pilot effort to bring more interest and broaden participation in computing. They funded a program in Georgia called "Georgia Computes!" in order to bring computational thinking to the K-12 level thereby building a better and stronger STEM education pipeline in their state. In Louisiana, the Louisiana Department of Education (LDOE) has recently approved several pre-engineering courses which bring real world and hands-on application of science, computational thinking, and engineering into the classroom.

This project is a unique way to allow students to apply computing in a hands-on way while meeting several state standards. In addition to emphasizing computing, this project has the students use the engineering design process to create a meaningful device that could solve a real-world problem. This project is appropriate for high school students because it hits several NGSS high school standards while giving the students a look into the world of computing through an engineering project.

References: Bruckman, A., Biggers, M., Ericson, B., McKlin, T., Dimond, J., DiSalvo, B., ... & Yardi, S. (2009, March). Georgia computes!: Improving the computing education pipeline. In ACM SIGCSE Bulletin (Vol. 41, No. 1, pp. 86-90). ACM.

III. Project Description

Timeline
Provide a timeline of project implementation.

Timeline: Student learning for this project will last three weeks (roughly 800 minutes)
Day 1-2: in depth lecture concerning the human body and how muscles work
Day 3: Learn about Arduino
Day 4: Learn about the Myoware sensor
Day 5: Learn to Solder including safety, Homework
Day 6-13: Work on project, Engineering Notebook
Day 14: Give project presentation, submit lab report
Day 15: Quiz

Description
Describe the project's instructional plan and classroom activities that will be used to improve content knowledge, skills and/or practices of your students. The items requested in your budget should be included here. (350-600 words)

Student learning for this project begins with a 2-day in depth lecture concerning the human body and how muscles can contract and relax. These contractions cause an electrical impulse which is sent to the brain and control movement. After students understand how muscle contractions work in the human body, the teacher will introduce the Arduino microprocessors (including the breadboard) and the Myoware muscle sensors (including the EKG pads) over a 2 day period. Students will understand how the MyoWare muscle sensor receives the electrical impulse input data from the muscles and how that data is transformed into something that can be read by the Arduino microprocessor to generate the desired output, which is to turn a motor on and off based on the input value. Finally, the MyoWare muscle sensor requires the positive, ground, and data wires to be soldered to the sensor prior to use. Students will spend 1 day completing a hands-on lesson on soldering using the soldering irons requested in this grant making sure to have an emphasis on safety.

After successfully completing the project background information, students will have to complete homework where they will work on problems relating to the process of the human body and basics of the relationship between the MyoWare muscle sensor and the Arduino. The lecture and homework will comprise the new knowledge that students will need to know in order to complete the project and will address these needs and specific state and national standards.

After understanding the background information necessary to successfully implement a project, teams will be given a sensor and an Arduino and will have roughly 5-7 days to complete their project. With the quantities being requested in this grant, students will be in teams of 2. Using an *engineering notebook to document their daily progress and struggles, students will demonstrate proficiency by connecting the MyoWare Sensor and successfully getting the Arduino IDE to say "Contraction!" whenever their muscles contract.*

After the teacher has verified that the groups have successfully completed this task, teams will be required to use the Engineering Design Process to create a biomedical device that could use this technology. They will document each step in the engineering design process in their engineering notebook, including a sketch of their final design idea. An example of this could be for students to use muscle contraction in the bending of a wrist to start a motor that would control the grip of a robotic hand (potentially made of cardboard for a prototype) for a person who no longer has fingers.

While gaining technical skills like problem solving, soldering, and computational thinking are vital skills, Miller argues that "Today's engineers need a wide range of professional skills, in addition to technical knowledge". To this end, at the end of each project students are required to write a lab report and give an oral presentation explaining how they used the engineering design process to achieve the final product. Not only must students be able to create a functioning medical device, they must be able to communicate their ideas in a meaningful manner.

Last but not least, students must complete a quiz at the end of the project to ensure that key concepts have not only been learned but also retained. Ultimately, students will have a complete hands-on experience that immerses them in a field of engineering for three weeks that additionally meets the standards listed above.

References: Richard K. Miller (2017) Building on Math and Science: The New Essential Skills for the 21st-Century Engineer, Research-Technology Management, 60:1, 53-56.

IV. Evaluation

List and describe the evaluation method(s) that will be used to determine student growth during the implementation of your project. (150-300 words)

At the beginning of the unit, students will be given a pre-test asking them to describe the process of muscle contractions as well as the use of data retrieved using an Arduino. This will serve as a baseline for their existing content knowledge. After the students have completed the background information of the unit, they will be given a homework assignment that will serve as a formative assessment for the content covered in the background information. If students are not able to successfully complete the homework, then more time will be spent explaining concepts before moving on to the actual project. Additional problems will be worked on and partner helpers will be used to emphasize key concepts.

The quiz at the end of the unit will constitute the summative assessment that will cover all of the concepts from the unit. The quiz questions will cover all of the unit objectives. Successful completion of the quiz will show that unit objectives were achieved.

Although student learning and understanding of the "key concepts" are important to measure, some measures of growth are less tangible. Being able to use, apply, and document the engineering design process to create a device is equally important to the concepts covered through the homework and the quiz. Throughout the project, three engineering notebook checks will be conducted to ensure that students are documenting their steps towards their final project. At the conclusion of the project, they must explain their process in a formal written lab report and oral presentation, both of which are critical 21st century skills for future STEM professionals. Additionally, students will peer grade their team members based on their contribution and effort on the project. This ensures that all team members are active participants in the project.

Identify the target outcome(s) for student success. Indicate and describe the criteria for determining success at achieving the target outcome(s). (50-150 words)

Although there is no specific pre/pos-test comparison, students will show growth by successfully creating a device using muscle contractions to open and close a claw. The target would be that 100% of the groups are able to achieve a successful project and 80% of the students will score a 75% or higher on the quiz.

V. Budget (8 points)

Budget items includes equipment and materials that will be used for quality instruction to increase knowledge, skills, or practices in Math, Science, and STEM classes. The maximum award is $1,000 for PK-2 proposals, $1,500 for 3-5 proposals and $2,000 for 6-12 proposals.

The budget should include all QSM eligible items and QSM ineligible items that need to be purchased to successfully implement your project. If your budget includes QSM ineligible items and/or the total of QSM eligible items exceeds the award limitations, an explanation of how these items will be funded is required.

Click “+ New Item” to add a new budget item. For each item, specify if it is QSM eligible or QSM ineligible and fill in the Item Name/Description, Quantity, and Cost/Item. For QSM eligible items, the Vendor Name and Vendor Link is required.

QSM Eligible/Ineligible	Item Name/Description	Quantity	Cost/Item	Vendor Name	Vendor Link
Eligible	*Soldering Iron Kit Electronics, 16-in-1, 60W Adjustable Temperature Soldering Iron, 5pcs Soldering Iron Tips, Solder, Rosin, Solder Wick, Stand and Other Soldering Kits in Portable Toolbox*	*12*	*$25.99*	*Amazon*	Link
Eligible	*Muscle Sensor Surface EMG Electrodes - H124SG Covidien - Pack of 6*	*12*	*$4.46*	*Adafruit*	Link
Eligible	*MyoWare Muscle Sensor*	*12*	*$34.16*	*Adafruit*	Link
Eligible	*SunFounder Uno Starter Kit*	*12*	*$34.99*	*Amazon*	Link
Ineligible	*Silicone Cover Stranded-Core Wire - 25ft 26AWG - Red*	*2*	*$4.95*	*Adafruit*	Link
Ineligible	*Silicone Cover Stranded-Core Wire - 25ft 26AWG - Yellow*	*2*	*$4.95*	*Adafruit*	Link
Ineligible	*Silicone Cover Stranded-Core Wire - 25ft 26AWG - Black*	*2*	*$4.95*	*Adafruit*	Link

QSM Eligible Items Total: *$1,195.20*
QSM Ineligible Items Total: *$29.70*
QSM BUDGET TOTAL: *$1,224.90*

Please indicate who will fund any overage for QSM Eligible items if needed. Select all that apply.

- ☐ School Funded
- ☐ District Funded
- ☐ PTA
- ☐ Private Company
- ☐ Non-profit organization
- ☒ Not Needed- QSM Eligible Items within Total Limitations
- ☐ Other

Please indicate who will fund the QSM Ineligible items if needed. Select all that apply.

- ☒ School Funded
- ☐ District Funded
- ☐ PTA
- ☐ Private Company
- ☐ Non-profit organization
- ☐ Not Needed- Budget does not have QSM Ineligible Items
- ☐ Other