GLITCH

ENGINEERING AN ESCAPE ROOM

Grant Proposal Template

Tried&True

GL!TCH

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DATE SUBMITTED	GRANT NAME
SUBMITTED TO	**ADDRESS OF RECEIVING PARTY**
SUBMITTED BY	**ADDRESS OF SUBMITTING PARTY**

1. PROJECT ABSTRACT

This proposal requests $XX to bring the innovative curriculum, GL!TCH, to XX students enrolled at XX School. This course builds basic skills in electronics, programming, data acquisition and analysis, constructing explanations and making simple models. Students will build their own miniature escape room experience. They will use the physical models as a hands-on learning tool as they experiment with and apply computer programming and electrical engineering concepts. At the end of the course, students will develop and play their own immersive mystery GL!TCH game.

2. PROGRAM DESCRIPTION

What activities will this project include?

GL!TCH is an interactive and creative STEAM (Science, Technology, Engineering, Art, Mathematics) experience where students will have the opportunity to build a miniature, single board computer, create simple programs within a Linux-based OS to control external hardware, and develop 21st Century skills.

XX will teach this course consisting of 18 chapters split across 2 units. The course will span one academic semester, with daily project-based learning opportunities. This course includes *80% hands-on teacher supervised lab activities* and *20% skill-building instructional time*. The lab activities include explicit information on safety and regular warnings on the dangers of electric shock. Students will work individually and in teams, progressively building their skills and applying them to real-world challenges. Learning Objectives for each chapter are outlined in *Section 6* of this proposal.

GL!TCH includes the following curriculum elements:

Teacher's Hub - website for digital resources, slides, and mini lesson videos

Student Workbooks - contain all necessary resources for students including vocabulary, schematics, code, as well as space to take notes, log data, note observations, and reflect on learning

GL!TCH Kit - all physical hardware needed for the course including a microcontroller, case, breadboard, wires, maze pieces, and various electronic components

Teacher's Manual - designed to make GL!TCH easy to teach, regardless of prior STEM teaching experience. It contains all instructions, scripts, slides, solutions, and additional resources.

How will this project enrich your students' experiences?

The GL!TCH course will stimulate and motivate students to achieve academic excellence. This course fuses mathematical skill-building and computational thinking applied to real-world scientific problems where solutions are constructed by students and instructors working together. Unlike traditional computer science and STEM programs, GL!TCH is an immersive and narrative driven learning experience. It implements many of the same gameplay elements found in escape room challenges, themed entertainment experiences, and virtual games scenarios.

How will this project build capacity where there are limited resources?

Although students have demonstrated both interest and capacity to pursue academic programs and careers in mathematics, science, or engineering, XX School lacks the resources and coursework that would help prepare students for entry into modern postsecondary programs. The materials purchased for this new course can be reused for multiple years, thereby expanding the impact of this funding request far into the future.

How will this project contribute towards the knowledge and practice of effective instructional strategies?

This course has been specifically developed to implement *Next Generation Science Standards* in the high school classroom. As such, Disciplinary Core Ideas are integrated with Cross-cutting Concepts and presented in the context of Science and Engineering design practices. Students will develop and use models, construct explanations and arguments from evidence, then report and communicate their results to peers and instructors.

This curriculum adopts a *Mini Lesson* structure. This type of teaching format maximizes information retention by reducing lecture time and increasing active student participation. By taking into account realistic student attention levels, this particular pedagogical tool helps to mitigate common classroom behavior issues. This course takes into account diverse learning style preferences and abilities. It provides developmentally appropriate lecture time and substantial peer-centered learning time. This course offers independent learning opportunities and creative challenges needed for the healthy development of metacognition.

The GL!TCH Mini Lesson structure includes the following key elements:

Bellringer - designed to allow students to mentally transition and activate previous knowledge

Story - sets an immersive narrative driven learning experience

Mini Lesson - video or slides to introduce key information

Guided Practice - help students practice appropriate procedures and scientific principles as well as clear up any misconceptions or confusion

Independent Activity - Peer centered collaborations and individual assignments where active learning takes place

Closing - Discussion and clean-up time

Reflection - allows students to reflect on their own work and contributions

3. GOALS AND OBJECTIVES

XX students will complete the GL!TCH course
XX students will demonstrate improved academic achievement and social emotional skills
XX teachers will indicate a positive impact from GL!TCH training and technical support
XX students will report STEAM postsecondary enrollment and career aspirations

4. EVALUATION PLAN

This program will implement an evaluation plan using *quantitative* and *qualitative* methods to measure progress toward achievement of the previously stated goals and objectives.

Student course participation will be determined by daily attendance and final grades.

Academic achievement and social emotional skills will be measured through the following assessments:

- Pre-Test
- 18 Chapter Quizzes
- 2 Unit Exams
- Post-Test

Teachers will submit a course survey to indicate the effect of training and technical support.

Students will submit a course survey to indicate postsecondary enrollment and career aspirations.

5. CURRICULUM

CHAPTER	LEARNING OBJECTIVES
Prologue	● Students will identify characteristics of a growth mindset ● Students will list the class rules ● Students will assess their prior knowledge of computer programming and electronics ● Students will reflect on the impact of mindset when approaching engineering design problems
Chapter One: Breadboards	● Students will demonstrate best practices for record keeping and maintaining an engineering journal ● Students will explore and make discoveries about breadboards and their internal anatomy through hands-on experiences ● Students will use diagrams or text to describe physical components of breadboards including power rails, terminal strips, mounting holes, and DIP support ● Students will trace the flow of electricity in simple circuits on a breadboard ● Students will evaluate various models of electronic circuits and predict whether or not they will function ● Students will listen, read, and/or act out a narrative that immerses the engineering concepts of GL!TCH into a story

Chapter Two: GL!TCH Kit Assembly	● Students will build the GL!TCH kit ● Students will identify basic computer hardware components and describe their function ● Students will demonstrate their ability to interact with the computer operating system with a mouse and keyboard ● Students will practice the procedure for setting up and packing up the GL!TCH kit
Chapter Three: Coding	● Students will explore various features of Thonny Python Integrated Development Environment and become more comfortable with its layout and quirks ● Students will create an organizational system and routine for a digital work environment ● Students will interpret and manipulate variables and commands in Turtle(Logo) code ● Students will predict the flow of execution of computer code through pseudocode ● Students will develop and use a series of test cases to verify that code performs according to design specifications ● Students will practice using rubber duck debugging, a systematic approach to review code and find errors ● Students will write appropriate documentation within their code
Chapter Four: Series Circuits	● Students will understand the scientific principle behind series circuits and the relationship between electrical components in a series circuit ● Students will identify the physical components of an LED ● Students will build a working series circuit with an LED and an external power supply ● Students will draw and label common electrical component symbols in schematic diagrams ● Students will differentiate between observations and inferences
Chapter Five: Parallel Circuits	● Students will identify previous patterns and materials used to wire series circuits ● Students will build parallel circuits with multiple LEDs ● Students will compare and contrast the behavior of LEDs in series circuits and parallel circuits ● Students will practice creating schematic diagrams with electrical component symbols
Chapter Six: Coding & Circuits	● Students will explore relationships between hardware and software components of the GL!TCH kit ● Students will investigate the anatomy of computer code with basic logic ● Students will modify code by adding iteration functionality with loops ● Students will debug errors in code that includes sequences and simple loops

Chapter Seven: Buttons & Switches	● Students will modify series circuits to include physical buttons ● Students will integrate input signals to their code ● Students will implement logic through if-else statements ● Students will record quantitative and qualitative observations during their investigation
Chapter Eight: Escape Room Maze	● Students will integrate their knowledge of circuit design and coding to build a maze with automated blinking LEDs ● Students will define the terms prototype and constraints as they apply to engineering design problems ● Students will create a model to test their design against problem constraints ● Students will adapt specific team roles taking into account the strengths and perspectives of potential team members
Chapter Nine: RGB LEDs	● Students will identify the physical components of an RGB LED ● Students will build a circuit and write code to power the RGB LED ● Students will investigate the color mixing properties of an RGB LED ● Students will rewrite or refactor their code with improvements to efficiency, organization, and readability
Chapter Ten: LDR	● Students will identify the physical components of a light dependent resistor (LDR) ● Students will describe the structure and function of conductors, semiconductors, and insulators ● Students will draw schematics of circuits containing resistors and capacitors ● Students will illustrate the flow of electricity through an RC circuit ● Students will design and test a prototype for a night light
Chapter Eleven: Lasers	● Students will describe the physical properties of lasers ● Students will build a circuit and write code to power a laser ● Students will investigate the interaction between a laser and the LDR
Chapter Twelve: Laser Tripwires	● Students will design a prototype for a laser tripwire that integrates both a laser and an LDR ● Students will write code that implements the communication method of morse code ● Students will transmit a message in morse code using their laser tripwire

Chapter Thirteen: For Loops	● Students will explain the function of fundamental data structures for sequences such as lists, ranges, and tuples ● Students will identify code features of functions that can be used to define abstractions ● Students will analyze a problem and design and implement an algorithmic solution using sequences and iteration ● Students will rewrite or refactor their laser tripwire code to implement the new data structure and abstraction
Chapter Fourteen: PWM	● Students will model the concept of pulse width modulation (PWM) with diagrams and graphs ● Students will investigate the properties of PWM ● Students will recognize common signal types in electronics; digital and analog ● Students will demonstrate their ability to apply abstraction by defining new functions ● Students will design a computer game that reads typed input, evaluates a function, then responds with an electronic output to an LED.
Chapter Fifteen: Intro to Servos	● Students will investigate the structure and function of servo motors ● Students will explain how computers interact with servo motors through PWM ● Students will evaluate the impact of coding decisions on the performance of the servo to reduce noise and vibrations
Chapter Sixteen: Servo Motors	● Students will optimize code to rotate a servo motor smoothly from 0 to 180 degrees ● Students will describe physical characteristics of servo motors such as torque, stall torque, and gear ratios ● Students will design a circuit that contains a servo motor and an LED that can be controlled by computer code
Chapter Seventeen: Pressure Sensor	● Students will identify physical components of piezoresistive sensors and describe their function ● Students will identify physical components of capacitive touch sensors and describe their function ● Students will construct circuits and code to compare and contrast the signals from each sensor
Chapter Eighteen: Final Game	● Students will create a complex escape room using different forms of inputs and outputs including buttons, LEDs, lasers, sensors, and a servo motor ● Students will adapt specific team roles taking into account the strengths and perspectives of potential team members ● Students will evaluate a solution to a complex problem based on prioritized criteria and trade-offs that account for a range of constraints, including efficiency, cost, performance and reliability ● Students will reflect on factors that influence team dynamics including

	leadership, trust, diversity, and communication

6. BUDGET

What is the total amount requested?

What is the total budget for this entire project?

If your total budget is greater than the maximum award, how will you cover the difference?

Class Pack Pricing

- *ideal for groups of up to 30 students*
- *Compare to $4,085 at A-la-Carte Pricing*

Includes:

- 1 Teachers' Hub Account (1 year access)
- 1, 4-hour Teacher Training
- 1 Teachers' Manual
- 15 GL!TCH PICO Kits
- 30 Student Workbooks

	Unit Price	Quantity	Total
Class Pack			
Per Teacher	**$2999**	**0**	

A-la-carte Pricing

	Unit Price	Quantity	Total
Teachers' Hub Accounts (1 year access / includes 1 Teacher Training)			
Per Teacher	**$1000**	**0**	
Teachers' Manual			
	$250	**0**	
GL!TCH PICO Kits			
	$129	**0**	
Student Workbooks			
Per Student	**$30**	**0**	
		Shipping & Handling: *see details	
		Total:	

***Shipping & Handling Details** – A 12% additional fee is charged on physical materials including Teachers' Manuals, GL!TCH PICO Kits, and Student Workbooks. No shipping & handling fee is applied to Teachers' Hub Accounts.