

STEM Leadership Professional Development Proposal

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What is the title of your STEM professional development? • Why did you select the topic?

Title: STEM: Project-Based Learning through Engineering

Rationale: Today's science classroom is much different than it was decades ago. Long gone are the days of "sage on the stage" lecture heavy lessons. Over the past few decades, a shift to student-driven science education has been slowly and systematically occurring. Science is not simply a noun- a collection of knowledge, but it is also very much a verb. To truly understand the underlying science concepts, one must engage in the act of doing science. This type of learning utilizes students innate sense of curiosity about the world where they question what they observe and with the help and guidance from the teacher look for answers to these questions. Project-based learning is an educational technique that seems tailored to science concepts and skills. Through the NASA engineering process, students will learn to ask the right kinds of questions, as well as the necessary problem-solving skills that will help them throughout their lives.

I plan to share the following examples of student-driven engineering projects:

Egg Car Crash/Egg Drop
Passive Solar House
Desalination Contraption

I have had my students complete these projects in previous years and thus can show solid examples of student work through these examples as I walk my colleagues through the process. Along with this, I plan to have participants perform an engineering task within the allotted time of the PD

How does your PD integrate NASA assets and/or content from the Endeavor courses?

I will be utilizing the following NASA assets and content form Endeavor courses in my Professional Development session.

- Teaching via the Engineering Process. The following list consists of readings and videos shared through the Endeavor course: The "E" in STEM taught by instructor Josh Brown.
 - <https://drive.google.com/file/d/0BzFzgQ8LXrSfTjBPanhYZUYyN2M/view?usp=sharing>
 - <https://drive.google.com/drive/u/0/folders/0BzFzgQ8LXrSfZTJqUTB4WThkUVU>
 - <https://svs.gsfc.nasa.gov/vis/a010000/a010300/a010341/>
- Utilizing Science Content from NASA and NASA labs. The following list consists of videos and real time data collected through various NASA labs that relate directly to some of the middle school NGS standards.
 - Space Science- landing
 - <https://www.youtube.com/channel/UCSv7zzf9wjmQmNk6zzN5gYQ>
 - NASA Temp, CO2 Data, Sea levels
 - <https://www.jpl.nasa.gov/edu/teach/tag/search/Climate+Change>

Who is your proposed audience (minimum 12)? Which teachers will you serve with your PD and activities? What grades, subjects, and how many students do they teach?

The proposed audience for this PD is the Middle School Science/STEM Teachers in my district. Each teacher's student load ranges from 130-140 students.

What STEM concepts or learning goals will you and your materials address which can potentially replace other classroom activities? List NGSS and CCSS or your state standards.

NGSS Middle School Engineering Standards:

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Examples shown at PD session will target one or more of the following NGSS Middle School science standards:

- *MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**
- *MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.*
- *MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.*
- MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
- MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.
- MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
- MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

How and where do you intend to carry out your PD? How long will the session be? When will it be held? Will teachers have access to computers?

The initial plan is to hold the PD in one of the science classrooms at the Middle School. The session will be one hour long and will be held on a Wednesday afternoon in late September or early October. I am currently working on scheduling the PD with the district science coordinator. Teachers will have access to computers and thus the shared documents and materials.

What, in general, will your pre-survey and post-survey ask?

PRE-SURVEY:

- What are you looking for in Physical Science PD? Materials? Interactive Presentation? etc...
- How complex should the math level be?
- Would you prefer shared cloud documents or hard copies?
- What questions do you have about the NGSS Physical Science Standards for Middle School?
- Are there specific standards that you would like targeted apart from the Engineering standards? If so which ones?
- On a scale of 1-5 how comfortable are you with the NGSS middle school physical science standards?
- On a scale of 1-5 how comfortable are you with the NGSS middle school engineering standards?
- On a scale of 1-5 how comfortable are you with student-designed engineering projects in your classroom?

POST-SURVEY:

- On a scale of 1-5 how helpful/useful did you find this PD session?
 - What specific aspects did you find helpful?
 - Interactive nature of the PD?
 - Shared materials?
 - Other? Please explain what other aspects of the PD you found helpful/useful.
 - None
 - If you did not find the PD helpful, please explain below with feedback on how to improve the PD experience.
- On a scale of 1-5 how likely are you to use what was discussed in my classroom this year?
- On a scale of 1-5 how confident are you in your ability to utilize the process and materials shared through this PD?
- On a scale of 1-5 how comfortable are you with the NGSS middle school physical science standards?
- On a scale of 1-5 how comfortable are you with the NGSS middle school engineering standards?
- Please share any suggestions you might have for a follow-up PD
- Please share any suggestions for other PD opportunities

- Would you be willing to participate in a short one-on-one interview regarding this PD?

What outcomes or expectations do you hope to see for your educators?

- Increased comfort level with NGSS Engineering standards
- Increased comfort level with NGSS Physical Science standards
- Understanding of engineering design projects as assessments including implementation, rubrics, and grading.
- Implementation of a student-driven engineering project
- Willingness to collaborate and seek help.

How will you follow up with the teachers in attendance?

I plan to follow up with the teachers who attend the PD via a multitude of different communication tools. The first of these being an email to thank them for their participation, followed by an online survey about the PD. This will be followed by a few selected interviews with willing participants. Finally, if possible I would very much like a follow-up meeting with all the participants a few weeks after the PD to discuss their experiences.

What data collection methods (e.g. surveys, interviews) will you use to analyze the PD's success?

I plan to utilize both pre and post PD surveys as well as selected interviews with willing participants.