

STEM Leadership Seminar

Professional Development final Report: Integrating STEAM into ELA in the Elementary  
Classroom

NASA Endeavour

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## **1. Title of Project**

Integrating STEAM into ELA in the Elementary Classroom

## **II. Curriculum Topic**

This professional development is to help teachers integrate STEM with their Language Arts curriculum. The principal stressed that he wanted the teachers at my school to begin implanting Project Based Learning into our lessons. In this professional development (PD) I demonstrated how teachers could intertwine STEM concepts, with our Common Core State Standards, highlighting literacy skills (reading, writing speaking and listening) into a project-based lesson for elementary grades.

## **School Information**

Highland Park Elementary is a TITLE 1 Elementary school that houses grades one and two. The faculty presently serves 205 primary age students. The school is a traditional, self-contained classroom structure. The average class size is 17. The faculty consists of one principal, six first grade teachers, six-second grade teachers, two Title 1 intervention teachers, one special education teacher, one technology coach, one P.E. teacher, instructional partner, librarian, counselor, music teacher, speech teacher, art teacher, and EL teacher. Every classroom is equipped with one desktop computer, one Chromebook per student and one for each teacher. Highland Park Elementary receives support from parents and the community. The parent/teacher organization is powerful. The parents participate in many aspects of life at our school. Community businesses and leaders are always supportive of our school needs.

## **Participants**

This PD consisted of six first grade teachers, six-second grade teachers, one intervention teacher, and special education teacher. Because of scheduling, this professional development was presented two different times, once for first-grade teachers and once for the second-grade teachers and special area teachers. There was a total of *20 educators*. I also presented this Professional Development at a local College for teachers *nine educators* throughout our county.

## **III. Standards Addressed**

- (see Appendix I)

## **IV. Summary of Project**

In this Professional Development, I set out to demonstrate and assist teachers in learning to utilize Children's Literature to teach Science, Engineering, and Math Standards, while also teaching ELA Standards. Teachers will learn to use fiction and nonfiction books for children's literature to guide science instruction and promote Project Based Learning. They will learn about the trade book list from NSTA, that have books to introduce science and STEM subjects. Using the 5E Lesson format, teachers will learn to design lessons and teach their students to use the Engineer Design Process to understand science concepts better, define engineering problems and use data to solve real-world problems. Most importantly, my goal is for teaching colleagues to

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gain the skills, knowledge, and confidence to implement ELA into STEM lessons and Project Based lessons in their classrooms.

### V. Pre-questions Survey List

The teachers will rank their answers from 1-5, with 1-the least amount of knowledge to 5- know of and could teach it to others. I sent the survey before the meeting through a google doc for teachers to return before the Professional Development.

- Are you familiar with STEM with ranking 1 2 3 4 5
- Are you familiar with the Engineer Design Process 1 2 3 4 5
- Are you familiar with the 5E Lesson Plan 1 2 3 4 5
- Are you familiar with the Project Based Learning 1 2 3 4 5
- What are two things you hope to learn in this professional development?
- What was your favorite book as a child? Why was it your favorite book?

### VI. Brief Description of training

The Professional Development was on a Friday during grade level meetings. Once for the first-grade teachers and intervention teachers and once for the second- grade teachers and special area teachers, for approximately two hours each. The principal attended both professional developments. The professional development was continual because I meet with teachers during their planning periods to assist in planning lessons. Many of the teachers marked they wanted to learn more about Project Based Learning, STEM and incorporating reading skills into their experiences. I planned around this information. Most of the people placed marked 1 and 2 on all questions on the survey. We discussed the results of the surveys. I explained the goals for the Professional Development and told everyone we would revisit the surveys at the end of the PD with a different color pen and hopefully, they will see growth in the areas they marked low.

Next, I shared how I learned and gained my knowledge through the Endeavor courses. I discussed how the video that I watched from the *Methods of STEM* course “Creativity” from Ted Talks changed my mindset on how I taught. After the participants watched with the video, we discussed how creativity is the most critical concept in the STEM mindset, and we as teachers should allow the students the freedom to create. Teachers were introduced to the main components of the STEM disciplines, 5E Lesson Plan and the Engineer Design Process.

I asked the teachers to share their favorite book when they were a child, and we discussed why it was their choice. We explained how they were our favorites because we related to the characters or the books were engaging. Next, I shared the trade book list from the NSTA website. We discussed all of the Reading, Science and Math Standards used in each grade level by using one of the trade books from the list. Teachers could look through a selection of books from the NSTA list and search for how our State’s Standards in reading taught by using the books, (for example, Making Connections, Questioning, Compare and Contrast, Inferring, Main Idea and Key Details, Autor’s Purpose and Synthesizing.) After reviewing the children's books, I modeled lessons, using the 5E lesson plan and they participated in hands-on experiences as the students would do.

Teachers were given a chance to create lessons using a STEM Planning Unit Guide, to create a lesson with a story from our Reading Series. The lesson contained the STEM Standards of

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Practices, Engagement, Explore, Explain, Evaluate, and Extend, had a real-world connection, essential questions, and listed the content standards covered throughout or curriculum. After the training, participants completed a post-survey.

### VI. Brief Outline of the Activities in the Pick-up Unit

1. Pre Survey- Faculty completed a Pre Survey before Professional Development.

2. Introduction to Professional Development – (10 minutes) Went over surveys and watched, “Creativity.” video. We discussed favorite children’s book and why it was our favorite. Teachers were shown the NSTA trade book list and found discussed the standards covered across the curriculum by using the trade books.

3. Robot Arms – Model Lesson- Teacher modeled 5E Lesson. (30 minutes)

*Engaged*- Introduce and Infer about the cover of the Fiction story, *Beep! Beep! Go to Sleep!* Read aloud while discussing, Key Ideas and Details. Show NASA video of Mars Rover and how the robot's arm does essential jobs.

*Explore*- Learners worked with a partner for NASA’s activity, *Robot Arm Activity* to learn coding commands. One acted as a programmer, and one acted like a robot arm.

*Explain*-After everyone had the opportunity to be a programmer and a robot arm; the participants explained that the robot arm could only do what the programmer tells it to do. The teachers discussed how they could use this activity in writing, math for sequencing and addition and subtraction. (see video)

*Elaborate*-Read *National Geographic Kids Robots*- while discussing Key Ideas and Details. Learners make Text to World connections while completing, Robot Job Sort. After learning about different robots, learners worked with a partner and designed a robot that would be good for a teacher to have inside her classroom. The teacher robots were creative and comical. *Evaluate*-Learners will create an advertisement for their robot design. We did not do this together in the PD, because lack of time, but I explained how they could use this in their classroom.

*Extend*- Participants will use a model robotic arm to move items from one location to another. They will engage in the engineering design process to design, build and operate the arm.

4. Winters’ Tail – Model Lesson – (30 minutes) Showed learners poster of the Engineer Design Process from Endeavour course “ E in STEM” and discussed each step -Identify Problem, Brainstorm, Design, Build, and Test and Evaluate. We also discussed the differences between the old Scientific Method diagrams to the Engineering Design Process (EDP) and how the EDP allowed for modifications and revisions. The Learners participated in a lesson and used the EDP to solve the problem.

*Engage*- Read the fiction story, *A Winter’s Tail* and discuss the main idea and key details - Learners learned about a dolphin named Winter that lost his tail and how a team of biomedical engineers designed and built a prosthetic tail for Winter. We discussed how important it is to engage students at the beginning of a lesson with a real-world problem. Learners watched a video of a biomedical engineer.

*Explore* Learners used the Engineer Design Process to design and build a prosthetic tail for a wind-up toy. They tested their design in a tub of water and made modifications until they created a tailed, and the wind-up toy could swim. (See video)

*Explain* Learners will compare how they designed the prosthetic tail against how Kevin Carrol

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from, *Winter's Tail* and his team created a tale for Winter. Learners will sequence the steps of creating a prosthetic tail.

*Evaluate* Learners will write a paragraph to sequence the steps of creating a prosthetic tail.

5. Teacher and Learners connected ELA and STEM Lesson using the story, *Clifford the Big Red Dog*. My goal was to demonstrate to teachers how easily you could use children's literature to create a STEM lesson. After hearing the story, I discussed the process of creating a STEM lesson.

a. *Start with the content standards* (for example. Science, Technology, Engineering, Mathematics, Social Studies, and English Language Arts,)

b. *Enduring Understanding*: Identify a real-world problem.

c. *Essential Questions*: Begin to ask questions that would explore the problem and solve the problem.

d. *Connecting the cross-curricular standards*. Design activities using the 5E Lesson Plan that students can do to meet these goals.

After determining Clifford needed a new house. Teachers used the planning guide to design a STEM lesson to share with their students. (See appendix)

### 6. PD Wrap-Up -

At the end of the PD, I passed out the post-PD surveys for the participants to complete. Participants shared what they are most excited to try in their classrooms.

### VII. What NASA data did you include?

- <https://www.jpl.nasa.gov/edu/teach/activity/robotic-arm-challenge/> that I learned about during Method of STEM class. Students use the data from this class for, "Robot Arm" activity. The objective is to use a student-designed robotic arm to move as many objects as possible from the rectangular container (at the 60 cm line) to a container at the 70 cm line within a given amount of time without crossing the 30 cm line with any human body part.
- **Mars Education** <http://marsed.asu.edu/> this site contains all of the Mars orbital data NASA has ever collected. This program is the pillar of the Mars Student Imaging Project and allows students and teachers to ask simple to complex questions. This site also has, "Rock Around the World" Mars Scientists ask students from around the world to help them understand the planet. Students send in a rock collected by the classroom from our region, and they will use a special tool like the one on the Mars Exploration Rover to tell the class how the rock is composed. This resource was very beneficial for 2<sup>nd</sup>-grade teachers. Especially, during their, "Rocks and Minerals" and minerals unit.

**IX. Follow-up Activities & Post – questions Survey List** After the PD, teachers asked for me to model lessons, using their classes. After modeling lessons, I began meeting with teachers weekly, during our common planning time. We work together to design Project Based Lessons and STEM lessons that correlate with the standards they are covering.

**Post Survey-** On the Post Survey, the first four questions are the same as the pre-survey questions. I wanted to compare the participant's knowledge and growth of each area after the workshop.

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- Do you understand the components of STEM with ranking 1 2 3 4 5
- How comfortable are you using the Engineer Design Process in your lessons 1 2 3 4 5
- How comfortable are you using the 5E Lesson Plan 1 2 3 4 5
- What is your understanding of Project-Based Learning 1 2 3 4 5
- Use children's literature to enhance your Science and STEM lessons. 1 2 3 4 5
- The implementation of activities learned will improve student achievement 1 2 3 4 5
- I would attend follow-up professional development 1 2 3 4 5
- How useful are the NASA resources that you learned? 1 2 3 4 5

### X. Outcomes

**A. Survey results /content** comparing the pre-survey to the post-survey everyone's 100% of participants comfort level in all components moved up. When asked the questions "from 1-5, do you understand the components of STEM, how comfortable are you using the Engineer Design Process, how comfortable are you 5E Lesson Plan and understanding of Project Based Learning over 70% stated they feel at a 4 or above.

**B. Survey results/Pedagogy** (how are STEM activities implemented) Over 90% of the participants polled showed that the implementation of the activities they learned would improve student achievement. Over 90 % surveyed rated the NASA resources 4 or above. Over 88% stated they would use children's literature to enhance their Science and STEM lessons; they especially liked the NSTA Trade book Resource. Because 98% of the participants stated they would attend a follow-up on this professional development leads me to believe that the participants believe pedagogy is present or they would not want to continue to learn more.

**C. Was the Professional development successful-** Based on the participant's and my principal's feedback the professional development was successful. My principal has stated that PBL and STEM has a significant impact on teachers and student learning. He said when he goes into classrooms that students are more engaged & motivated to learn. Teachers have stated that since they are using children's literature to enhance their lessons students are more engaged and relate to the content better. Most importantly Ss learn essential life skills. Teachers have stated, that they use the same process of incorporating children's literature into PBL/STEM and content standards in as many units as possible. The assistant superintendent asked if I would lead this professional development to other schools in our district next school year. A colleague that I have mentored stated, "I found that in the beginning, I worked hard to plan the PBL, but after implementing the Ss did all of the work as I facilitated & the Ss were so engaged & learned more than I had planned." I thought to myself, "Yes! That is what it is all about!"

**D. Relating to the Readings -**

**Example 1:** Jenkins (2010): *Special Education PD* - article had the most impact because it caused me to reflect the most. The Special Ed. Teacher at my school attended the PD, and it was about the same time that I read this article. I discussed with the Special Ed. Teacher on modifications I could make to instruct STEM lessons with her students.

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She suggested strategies, and I have started going into her room weekly to teach STEM lessons with the Special Education students.

**Example 2:** *A Primer on Effective Professional Development* (Desimone, 2011) article caused me to reflect on my past PDs I have attended and think about the components of a successful PD. I agree with Desimone on the core features of effective professional development: Content focus, Active Learning, Coherence, Duration, and Collective participation. (Desimone, 2011). My goal when leading my first PD was to use as many of these features as I could. I believe I was successful because participants stated and have proven they have a better understanding of the STEM content and how to include children's literature into their STEM and PBL lessons. During the PD, the participants were actively learning and collectively participated in using the engineer design process.

### **E. Will, the teachers, do these activities again:**

I recently talked to my principal, and he stated that half of the staff was implementing STEM and PBL into their classrooms. My goal is to encourage the other half of the faculty to at least try some the activities. Many participants have requested additional resources and stated they love the NSTA trade book resource page. We are changing the reading series next year, which requires more individual student reading. The teachers have selected many books off NSTA recommendations. I meet weekly with some of the teachers and help design lesson plans that include activities like the ones in the PD. Based on this information I feel that many of the teachers will do these activities and use the resources again.

### **F. Reflection:**

I've never considered myself a leader, and at the beginning of this class, I thought I would be very nervous performing this PD. I was shocked that I wasn't nervous, and I enjoyed all aspects of leading this Professional Development. The morning of the PD, I began feeling a little worried, and I told myself that I believed in what I was about to teach my colleagues. I knew it was great material because I received the best training I have ever had. I began to feel excited about sharing my knowledge of what I learned in the Endeavour courses. The instructional partner stated that she could tell that I was passionate about what I was doing, and I think that is why I wasn't nervous. Because of the changes in our school in pursuing STEM mindset, I'm excited for the students and my school's future.

XI. Appendix:

Appendix A: Standards used in the unit

**Reading**

Key Ideas and Details:

[CCSS.ELA-LITERACY.RL.2.1](#)

Ask and answer such questions as *who*, *what*, *where*, *when*, *why*, and *how* to demonstrate understanding of key details in a text.

[CCSS.ELA-LITERACY.RL.2.3](#)

Describe how characters in a story respond to major events and challenges

Integration of Knowledge and Ideas:

[CCSS.ELA-LITERACY.RL.2.7](#)

Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of its characters, setting, or plot.

[CCSS.ELA-LITERACY.RL.2.5](#)

Describe the overall structure of a story, including describing how the beginning introduces the story and the ending concludes the action.

[CCSS.ELA-LITERACY.RL.2.7](#)

Use information gained from the illustrations and words in a print or digital text to demonstrate understanding of its characters, setting, or plot

**Writing**

**Text Types and Purposes:-** [CCSS.ELA-LITERACY.W.2.1](#)

Write opinion pieces in which they introduce the topic or book they are writing about, state an opinion, supply reasons that support the opinion, use linking words (e.g., *because*, *and*, *also*) to connect opinion and reasons, and provide a concluding statement or section

**Science and Engineering Practices-** Develop a simple model based on evidence to represent a proposed object or tool. (K-2-ETS1-2)

**Disciplinary Core Ideas-** ET S1.B: Developing Possible Solutions

**Crosscutting Concepts-** Structure and Function -The shape and stability of structures of natural and designed objects are related to their function(s). (K-2- ETS1-2)

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K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs. The performance expectations above were developed using

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

### Math

Measure and estimate lengths in standard units.

CCSS.MATH.CONTENT.2.MD.A.1

Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

CCSS.MATH.CONTENT.2.MD.A.2

Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen.

CCSS.MATH.CONTENT.2.MD.A.3

Estimate lengths using units of inches, feet, centimeters, and meters.

CCSS.MATH.CONTENT.2.MD.A.4

Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit

K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

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### Appendix B:

#### Classroom Activities and Resources

Outstanding Science Trade Books for Students K–12

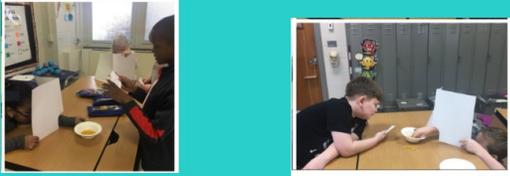
<https://www.nsta.org/publications/ostb/>

Robot Arm Activity – Taken from Nasa Resource site

<https://www.jpl.nasa.gov/edu/teach/activity/robotic-arm-challenge/>

This is a screenshot of a power point I used in PD. another activity we did during PD and pictures of my students doing the Robot ARM activity.

## Robot Arms Instructions



1. Stand the folder on the table. The first person to be the robot should place one hand through the hole in the folder and lean over until his or her forehead is touching the folder. The robot should not be able to see his or her own hand (but may use the other hand to keep the folder standing up).
2. The programmer should dump the pasta into a bowl in front of the folder, within reach of the robot arm.
3. The programmer will tell the robot how to do its job by reading a set of instructions called the Robot Program.  
When you finish, switch roles and repeat.

Picture Perfect STEM (2010)

Image of PD and classroom teacher using the activity with her students.

## Robot Arms

- What was the job the robot arms had to do?
- How well did the robot arms do their job?
- Is this a job you would want to do? Why or why not?
- What parts or structures on the robot arms helped them do their job?
- Did the programmer ever have to give the robot any additional instructions?

After everyone has had a chance to be both a programmer and a robot arm, ask

- What was the job the robot arms had to do?
- How well did the robot arms do their job?
- Is this a job you would want to do? Why or why not?
- What parts or structures on the robot arms helped them do their job?
- Did the programmer ever have to give the robot any additional instructions?

Explain that real robots can only do what they are programmed to do. Every step of a task must be spelled out in the robot's program. If the program is not detailed and exact, the robot won't be able to do its job very well or at all.

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Assessment

# My Robot

**Challenge:** Design a robot to do a job in your home or classroom.

Robot's name: \_\_\_\_\_

Robot's job: \_\_\_\_\_

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Think about how your robot can do the job better than a person could do it, or how it can do the job better than another technology. Then, list some reasons that people should buy your robot.

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Next, draw your robot and create an advertisement to sell it! Include the robot's name and its job, and label the parts of your robot that help it do its job.

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Image of Pd and teacher using activity with students.

Materials used: Plastic wind up toys, plastic lid containers to use for prosthetic, glue dots and tape,

Picture Perfect STEM (2010)



# Elementary STEM Unit Planning Guide

<b>Title:</b> This is descriptive statement about the lesson/model/unit				<b>Teacher:</b>	
<b>Overview:</b> This is a summary of what students will learn in the unit. It explains the unit's focus and real world connections.				<b>Grade:</b>	
<p><b>STEM Standards of Practices:</b> Engage in meaningful, purposeful and relevant STEM activities using the Stem Standards of Practice Frameworks; student skills and knowledge indicators, instructional examples, resources and glossary.</p> <p><i>STEM proficient students will be able to apply all seven Standards of Practice when demonstrating how to answer complex questions, to investigate global issues, and to develop solutions for challenges and real world problems.</i></p>					
				<p><b>Real World Connection:</b></p> <p><b>Product / Prototype:</b></p>	
Content Standards					
Science	Technology	Engineering Design Process	CCSS Mathematics/Practices	CCSS ELA	Social Studies Fine Arts
<p><b>Transdisciplinary Connections:</b> Questions, issues, problems or challenges to real world connections between Science, Technology, Engineering, Mathematics, and other disciplines.</p>				<p><b>Enduring Understanding:</b> Identify a Real World Problem "Homeless Dogs All Over the World" Problem-base Learning (e.g. There are many dogs who do not have a family to care for them or a home (e.g. indoors or outdoors)).</p>	
<p><b>Connection to STEM Careers:</b> This section describes careers in the STEM fields that correlate with content covered in the unit.</p>				<p><b>Essential Questions:</b> Begin to ask questions that would explore the problem and eventually solve the problem Inquiry-base Learning (e.g. How can people solve the problem of homeless dogs?).</p>	

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