

## STEM in the Elementary Classroom Professional Development Reflection Paper

### **Professional Development Overview**

This professional development training centered on STEM in the Elementary Classroom with a specific focus on deepening an understanding of STEM education, as well as methods for incorporating STEM with other content areas. Attending the professional development were six classroom teachers and our STEAM Humanities teacher. All attendees teach at Amerman Elementary School in Northville, Michigan and included third and fifth grade teachers. Unfortunately, due to severe weather and a case of COVID, I had three additional people who canceled at the last minute. Four of the attendees included:

- Robin Long - [longro@northvilleschools.org](mailto:longro@northvilleschools.org)
- Jamie Henderson - [hendersonja@northvilleschools.org](mailto:hendersonja@northvilleschools.org)
- Dave Babich - [babichda@northvilleschools.org](mailto:babichda@northvilleschools.org)
- David Wayne - [wayneda@northvilleschools.org](mailto:wayneda@northvilleschools.org)

I know time is precious for teachers and since all the teachers attending were volunteering their time, I wanted to keep the pre-survey succinct but meaningful.

- When planning, rank the following content areas in order of importance:
  - ELA, Math, Science, Social Studies, SEL, TLIM (The Leader in Me)
- What content areas do you find the easiest to integrate?
- What prevents you from incorporating STEM in your classroom?
- How familiar are you with NASA resources for educators?
- What NASA resources have you explored or used in your classroom?
- Is there anything specific you hope to gain from attending this PD?

The results of the pre-survey were significant factors taken into consideration as I developed the PD.

After sending out the pre-survey and in order to gather more information, I conducted informal conversations with colleagues and realized there were some significant misconceptions regarding STEM education. Additionally, it became very apparent that science gets pushed to the bottom of teacher's priority lists when they are planning and teaching, especially in the lower grades. These informal conversations with colleagues helped me to prioritize these two elements of the PD.

As a result of my conversations with colleagues and the pre-survey results, I set out to achieve four main objectives during the Professional Development:

- Have teachers participate in STEM activities
- Deepen my colleague's understanding of STEM Education
- Provide examples of connecting STEM to ELA
- Give work time to attendees for researching NASA resources

### **Professional Development Activities**

Our PD started with an activity in which attendees had to put on their student hats and participate in a “Five Minute STEM Challenge.” After the short activity, I shared the importance of providing students with low stakes STEM Challenges. Not only can these types of activities be used as team building opportunities, they also allow for meaningful classroom discussions. Inevitably, when students participate in an activity like this, one group or a few students will start to complain, “They are copying our idea!” or “They stole our idea!” After groups have completed the challenge, I typically provide students the opportunity for a Gallery Walk-Through and encourage them to pay attention to ways in which different groups were successful. A class discussion follows about how we might improve our design if we were to try this challenge again, based on what we learned from the Gallery Walk-Through. I give students the opportunity to try the challenge again and when we share our results, I ask groups to give credit to other groups that inspired their thinking. This then begins to set the expectation that we are here to learn from one another and begins to create an “abundance mentality” (Leader in Me, 2023) in the classroom. The quick STEM Challenge activity, along with the follow-up discussion, was a good launch to the PD that allowed the attendees to begin to open their minds to the possibilities of STEM education in their classrooms.

After the opportunity to get up and moving, I wanted to take some time to deepen everyone’s understanding of STEM education. For this portion of the professional development training, I looked back to my notes and readings from our **Methods of STEM Education** course. I wanted teachers to walk away understanding that STEM is not another curriculum we have to teach but a way of organizing and delivering curriculum and that STEM can be a tool for an interdisciplinary approach to learning.

Now that teachers had a better understanding of STEM education, I shared some current research with the group. I recently came across an article that shared information on the benefits of learning through play. I quickly realized this discovery learning had a strong connection to STEM education. “Researchers have found five characteristics that embody educational play experiences: those that are meaningful, actively engaging, joyful, iterative, and socially interactive” (Parker et al., 2022). These characteristics are similar to those that stand out when I incorporate STEM activities in my classroom. “STEM education makes learning “real” and gives students opportunities to see the connection between the content they are studying and the application of that content in authentic and relevant ways” (NSTA, 2020).

With this conceptual knowledge of STEM education in hand, I then provided teachers with specific ways to use STEM in their classrooms, while also keeping in mind that science is not a priority for our teachers. Since our district uses Fountas & Pinnell for ELA, I found three picture books from the first, third and fifth grade Fountas & Pinnell Interactive Read Aloud list. I chose those three grade levels since I knew these would be teachers in attendance at the PD. I brainstormed ideas for a STEM activity that could connect to each picture book, as well as links to grade level science standards and math standards. See *Image 1* for a picture of the slide I shared during the PD as an example for ways first grade could connect ELA, STEM, Science and Math.

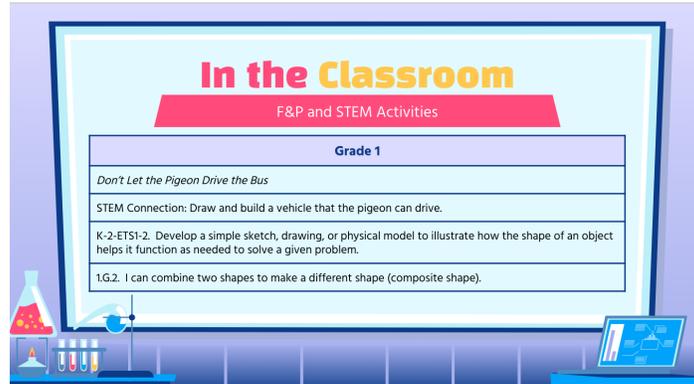


Image 1

After taking some time to explore examples for first, third and fifth grade, I gave teachers the opportunity to do their own brainstorming. I provided them a few options for picture books from second grade (*Cloudy with a Chance of Meatballs* and *Snowflake Bentley*). Teachers immediately began to discuss STEM activities that connect to *Snowflake Bentley* and I then shared the geometry standards for second grade and we discussed ways to integrate math standards, as well. I intended this brainstorming and discussion to serve as an opportunity for teachers to see there are natural connections between multiple content-areas and STEM education.

I then moved on to the more personal portion of my PD and shared what I wanted my attendees' big takeaways from this professional development to be:

1. STEM education can encompass as much as you want/need
2. STEM can connect to ELA, Science, Math, Social Studies, SEL, The Leader in Me

I shared some personal stories of my experience with the NASA Endeavor program that have been successful and not so successful. My first story exemplified a way in which STEM can be very focused and minute, which was a [multiplication game](#) I created in my **Coding, Robotics and 1:1 Devices** course. I shared this example because it was a small-scale STEM activity but one that students still found engaging and meaningful. I wanted my attendees to recognize that successful STEM education doesn't always need to be large-scale projects that encompass multiple standards.

The other example I shared was a [unit](#) I had created for my **The E in STEM: Meaningful Content for Engineering** course. This was a project which was not a huge success but one that both my students and I learned a lot from. Students were tasked with designing and creating a mechanism that met one of three SEL goals. I shared this example at the PD because it was a subtle way of reminding my colleagues that taking risks and trying new things can be beneficial for our students and for ourselves. I shared with the PD attendees that, even though I might not deem this project a huge success, it's one of two I'm most proud of that I've completed through this program.

I connected this risk-taking to our next activity, which involved putting on our student hats once again. I introduced the book *Those Shoes* to the group and, since our time was going by quickly, just gave them

an overview of the story. I then tasked the group with a STEM activity that connected to the picture book. See *Image 2* for the STEM goal, criteria and constraints.

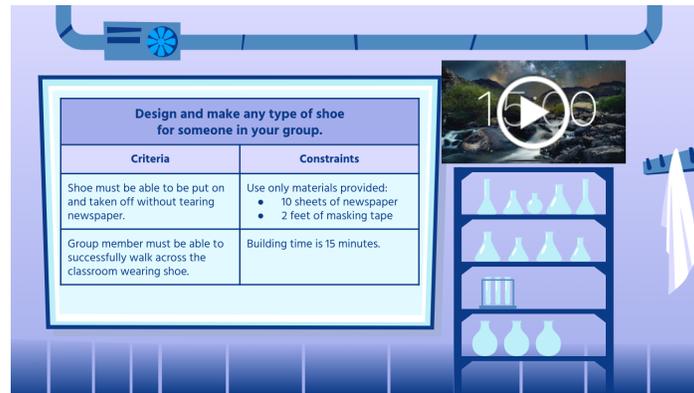


Image 2

After trying the STEM Challenge and having a few laughs, it was now time for the research and collegial work time of the PD. I provided each grade level and our STEAM Humanities teacher with a shared document that was to serve as a working document. See *Image 3* for third grade example. Attendees were also provided with a link to NASA resources, *Image 4*. As teachers found ideas from the NASA resources that connected to their standards, they could add to the working document. During this last portion of our PD, teachers explored the resources and brainstormed with colleagues about ways to incorporate STEM in their classroom, whether by integrating across content-areas or using the NASA resources to address science standards.

Grade 3 NASA and STEM Resources Shared Document

<b>Physical Science: Force &amp; Motion and Electricity &amp; Magnetism</b> <ul style="list-style-type: none"> <li>• <a href="https://www.jpl.nasa.gov/edu/teach/activity/collisions-in-space/">https://www.jpl.nasa.gov/edu/teach/activity/collisions-in-space/</a> - Forces and Motion</li> <li>• <a href="https://nasaclips.arc.nasa.gov/spotlight/magnets-and-metals/magnets-and-metals_nasa-spotlight-magnets-and-metals-aug-2019">https://nasaclips.arc.nasa.gov/spotlight/magnets-and-metals/magnets-and-metals_nasa-spotlight-magnets-and-metals-aug-2019</a> - Metals and Magnets</li> </ul>
<b>Earth and Space Science: Weather &amp; Climate</b> <ul style="list-style-type: none"> <li>• <a href="https://www.jpl.nasa.gov/edu/teach/activity/the-sky-and-dichotomous-key/">https://www.jpl.nasa.gov/edu/teach/activity/the-sky-and-dichotomous-key/</a> - Types of Clouds</li> <li>• <a href="https://www.jpl.nasa.gov/edu/teach/activity/precipitation-towers-modeling-weather-data/">https://www.jpl.nasa.gov/edu/teach/activity/precipitation-towers-modeling-weather-data/</a> - Precipitation</li> <li>• <a href="https://www.nasa.gov/stem-ed-resources/peep-and-the-big-wide-world-weather-factors.html">https://www.nasa.gov/stem-ed-resources/peep-and-the-big-wide-world-weather-factors.html</a> - Weather</li> </ul>
<b>Life Science: Life Cycles &amp; Survival, Traits &amp; Heredity, Fossils</b> <ul style="list-style-type: none"> <li>• <a href="https://www.jpl.nasa.gov/edu/teach/activity/design-a-robotic-insect/">https://www.jpl.nasa.gov/edu/teach/activity/design-a-robotic-insect/</a> - Traits</li> </ul>
<b>STEM &amp; Math</b>
<b>STEM &amp; ELA</b> <ul style="list-style-type: none"> <li>• <a href="#">Read Alouds from Space</a></li> </ul>
<b>Other</b>

Image 3

Elementary NASA and STEM Resources

Grade Level	Title & Link	Description
K-5	<a href="#">JPL for Educators</a>	A searchable database of lessons, activities, demonstrations, games, etc.
5	<a href="#">My NASA Data</a>	Not a super user-friendly site but some activities and lessons for Earth's Systems and some data visualizations
K-5	<a href="#">NASA STEM for Educators</a>	Includes some activities and lesson plans; scroll down a bit for K-4 and 5-8 specific resources
K-5	<a href="#">NASA Wavelength</a>	Activities and lessons that incorporate NASA content
3-5	<a href="#">NASA eClips</a>	Videos that connect with science standards; some overlap with NASA Wavelength
K-5	<a href="#">Intro to Engineering</a>	A kid-friendly video introduction to engineering
K-5	<a href="#">PBS Learning Media</a>	A searchable database of lessons, activities, interactive media, demonstrations, games, etc.
K-5	<a href="#">Artemis Mission to the Moon</a> Artemis is NASA's mission to head back to the Moon and put the first woman and first person of color on the Moon.	Lesson plans and activities that focus on the Artemis mission

Image 4

### Professional Development Reflection and Outcomes

Since I used the results of my pre-survey to guide the planning of my PD, I looked back at that data to see if I met the goals I had intended. Two initial data pieces I wanted to address as part of the professional development included:

- 100% of the teachers that completed the survey ranked ELA and Math as the first and second most important content areas.
- 100% of the teachers that completed the survey listed ELA and Social Studies as the two content areas that are easiest to integrate.

Recognizing that science often gets pushed down to the bottom of the priority list and knowing that STEM allows for interdisciplinary integration, my professional development successfully gave the attendees a new perspective for incorporating ELA with math and science, through the lens of STEM education. Touching base with one attendee the next day, she commented that maybe she “needed to shift her mindset” in order to use STEM education as a way to increase student engagement during ELA. The teachers that attended the professional development had never really thought of STEM education as a *tool* for addressing multiple content standards but this PD offered them the opportunity to begin to think differently about STEM education and its potential.

“Providing resources for effective science instruction” (Cheung et al., 2018, p. 40) is a way for teacher leaders to serve as instructional leaders. When planning the PD, one of my priorities was to give attendees time to explore the NASA resources. Furthermore, both the pre-survey and post-survey included the question:

- How familiar are you with NASA resources for educators?

I used a Likert scale for this question, with a 1 = Not Familiar and a 4 = Very Familiar. Prior to the PD, the average score was a 1.2 and after the PD, that score jumped to a 2.6. Considering attendees had limited time to explore the large number of NASA resources I shared, I was happy that teachers were feeling more familiar with the NASA materials available to them. As we were wrapping up the professional development, one teacher casually mentioned he wished there were more NASA resources that were student-friendly. I replied there was a resource I hadn’t included in the initial list and so the next day I shared a link to the NASA Kids’ Club site. My hope is these teachers continue to reach out to me if they are looking for something science specific; this will motivate me to “keep abreast of science-related news and resources” (Cheung et al., 2018, p. 40) which is another criteria in the Science Teacher Leader Profile.

The final topic I had planned to address during the PD, based on the pre-survey results, was what prevents teachers from incorporating STEM into their classroom. I provided teachers with multiple response options for this question and the two most common responses were:

- Students have STEAM Humanities so I don’t feel like I need to address STEM in my classroom
- Lack of time

During the professional development, I specifically addressed the first response, noting that STEM is more than just 50 minutes once a week and should be considered a *tool* for teaching content and not another content area to teach. Unfortunately, however, the lack of time is not something I can help teachers solve and was brought up during the PD itself. One attendee made the comment, “These are all great ideas but when am I supposed to figure this all out?” I didn’t have an answer. During a follow-up conversation with my principal, I spoke about our constant struggle with lack of time but, unfortunately, I think my comments fell on deaf ears. It seems that, in order to provide teachers with more time to pursue initiatives like this, the elementary administrators in my district need to think out of the box.

Almost every time we have district-provided professional development, elementary teachers sit through presentation after presentation. Wouldn't time like this be better spent on "interactive professional development experiences" that are "teacher-led" and "based on needs" (Berry et al., 2010, p. 7)?

Since my pre-survey served a specific purpose - helping to plan and develop my PD, there was little overlap with my post-survey questions:

- After taking the PD, what might still prevent you from incorporating STEM in your classroom?
- How familiar are you with NASA resources for educators?
- The training had clearly defined goals for learning.
- The learning activities and discussions deepened my knowledge of the content.
- I found the PD to be relevant and worthwhile.
- How likely are you to implement something you learned from this PD in your classroom?
- What did you find most valuable?

For most of the questions, I used a Likert Scale with 1 = Strongly Disagree and 4 = Strongly Agree. Some of the highlights of the data include:

- 100% of the respondents Agreed or Strongly Agreed that the learning activities and discussions deepened their knowledge of the content.
- 87% of the respondents are Likely or Very Likely to implement something they learned from the PD in their classroom.

Looking at these two results, I consider the PD to be a success. Not only did I help my colleagues to better understand the pedagogy of STEM education, the professional development "focused on relevant topics" (Berry et al., 2010, p. 7) which the attendees are motivated to use in their classrooms.

However, I don't want the PD to end up being a one and done kind of training. Since I teach fifth grade and had multiple fifth grade teachers in attendance, it will be easy to continue to follow-up with these teachers, share resources or even lesson ideas. The consistency and duration elements of successful PD will be more difficult with the third grade teachers and our STEAM Humanities teacher. One idea I had considered is taking a new risk and opening my classroom up to be observed during a STEM activity. "Modeling effective science instruction" (Cheung et al., 2018, p. 41) is another characteristic of a Science Teacher Leader and, perhaps, this is a way to continue to inspire my colleagues.

## Appendix I: Standards Addressed

### First Grade

- K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- 1.G.2. I can combine two shapes to make a different shape (composite shape).
- RL.1.1. Ask and answer questions about key details in a text.
- RL.1.2. Retell stories, including key details, and demonstrate understanding of their central message or lesson.
- RL.1.3. Describe characters, settings, and major events in a story, using key details.

### Third Grade

- 3-PS2-1. Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- 3.MD.4. I can create a line plot from measurement data where the measured objects have been measured to the nearest whole number, half, or quarter.
- 3-PS2-3. Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
- RL.3.1. Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers
- RL.3.2. Recount stories, including fables, folktales, and myths from diverse cultures; determine the central message, lesson, or moral and explain how it is conveyed through key details in the text.

### Fifth Grade

- 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- 5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen.
- 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- RI.5.3. Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- RI.5.4. Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

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