Christine Croussouloudis November 3, 2018
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A STEM Journey on a NASA Rocket!

Curriculum Topics, School Name(s)

I work at the Luisa Pineiro Fuentes School of Science and Discovery in the Kingsbridge section of the Bronx. We have 352 students who are in grades K to 5. The ethnic background of the students is 95% Hispanic, with the remainder a mix of black and Asian. 98% of the students are considered low income and receive both a school lunch and dinner. The students study math, ELA, science, social studies, gym and computer science. However, the majority of every day is dedicated to math and ELA (5 periods out of 7).

The school has been labeled a Focus School due to low state test scores over the last three years. If the scores are low this year, the entire school will be re-organized and half the staff will be let go. The main objective of the school right now is to show student progress on the math/ELA website I-Ready in both subjects.

I am a PD Lead Teacher for the NYC Computer Science For All (CS4ALL) program At my school. My overall mission for the school year is to engage other teachers in computer science concepts so they will integrate these practices into classroom lessons. My planned Professional Development Session will directly reflects the concepts of Math Connections in the STEM Classroom and also Coding, Robotics and 1:1Device related to STEM activities.

Number of Educators, Grade Level(s)

The audience included a group of 30 teachers and other specialty educators within my school as presented on the attendance sheet. They all work within grades from K to 5. The teachers each had computer access to the NASA Educational Resources website and 5 E's lesson templates.
(review following picture).

P.S. 307 PEDAGOGICAL STAFF DAILY SIGN-IN/OUT

School Year: **2018-2019**

Nasa Educational Resources

Day/ Date: 10/22/18

GRADE	POSITION	NAME	SIGNATURE	IN	OUT	IN	OUT
K	Teacher	Jessica Smith					
K ICT	Teacher	Samantha Goyco		2:45			
K ICT	Teacher	Christine Hatjygeorge		2:45			
1st	Teacher	Danielle Gentile		2:45			
1st ICT	Teacher	Betsy Diaz-Murphy		2:41			
1st ICT	Teacher	Hayley Aheam					
2nd	Teacher	Denise Shabazz		2:45			
2nd	Teacher	Amy Guzman		2:45			
2nd SE	Teacher	Alexander Compri		2:45			
3rd	Teacher	Eimear Falcone					
3rd ICT	Teacher	Elizabeth Peprah		2:45			
3rd ICT	Teacher	Ashley Bruno		2:45			
4th	Master Teacher	Lisa Rosario Roman		2:45			
4th	Teacher	Monique Myrie		2:45			
3rd/4th SE	Teacher	Kristen Koesling		2:45			
5th	Teacher	Onix Calderon		2:45			
5th ICT	Teacher	Jennifer Scharf					
5th ICT	Teacher	Nicholas Zopp		2:41			
SPECIALTY TEACHERS				2:45			
Gym	Physical Educ.	John Connolly K-5		2:45			
301	C4A Lead Teacher	Christine Croussouloudis K-5					
Rm. 401	Science/Health	Carleen Ince (ESL) K-1		2:45			
Rm. 401	Science/Health	Bermia Evora 2-5		2:45			
INSTRUCTIONAL TEACHING SUPPORT PERSONNEL							
301	Math Coach	Clara Kaplan		2:45			
202	Literacy Coach	Sheila McChesney		2:45			
117	SETSS/IEP Tchr.	Kristen Lee Garguilo		2:45			
202	Data/AIS/SETSS	Laura O'Connell		2:45			
203	Crisis Intervention/RTI	Robert Deranieri		2:45			
G-27	Lit. Spec./AIS	Marcy Schickler					
202	ESL Coordinator	Michelle Maturen K-5					
202	ESL Teacher	Elizabeth Nichols K-5		2:25			
202	ESL Teacher	Forest Bonjo K-5		2:45			
EDUCATIONAL ASSISTANTS							
	Ed. Asst.	Diana Martinez					
	Crisis Ed. Asst.	Giovanni Pichardo		2:45			
	Lead Ed. Asst.	Brenda Reinoso					
	Ed. Asst.	Evelyn Rodriguez		2:45			
	Ed. Asst.	Anna Somerville		2:45			
	Ed. Asst.	Ivory Rhodes		2:45			
RELATED SERVICE PROVIDERS							
203/204	Speech Therapist	Eve Berger					
203/204	Speech Therapist	Daniela Benisatto					
203/204	Occup. Therapist	Anna Kudlik					
203/204	Related Counselor	Denny Matos					
203/204	Occup.Therapist	Traci Richardson					
203/204	Physical Therapist	Arvimar Villanueva					
203/204	Hearing Teacher	Susan Morgenthal					

Standards (or NGSS Performance Expectations) Addressed

Standards:

MST Standards

- Key Idea 2: Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.
- Guideline F—Working with models and simulations—Learners understand that relationships, patterns, and processes can be represented by models.

NGSS Standards

- Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products.
- Cause and effect relationships are routinely identified, tested, and used to explain change.

CSTA K-12 Computer Science Standards

- 1B-A-5-4 Construct programs, in order to solve a problem or for creative expression, that include sequencing, events, loops, conditionals, parallelism, and variables, using a block-based visual programming language or text-based language, both independently and collaboratively (e.g., pair programming)

CCSS for Mathematics

- CSS.MATH.CONTENT.4.G.A.1
  Draw and utilize points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines within computer science activities. Identify these in two-dimensional figures.

CCSS Practices for Mathematics

- MP.2 Reason abstractly and quantitatively
- MP.4 Model with mathematics
- MP.5 Use appropriate tools strategically

ELA/Literacy

- CCSS.ELA-LITERACY.W.5.1.B
  Provide logically ordered reasons that are supported by facts and details.
- CCSS.ELA-LITERACY.W.5.2.D
  Use precise language and domain-specific vocabulary to inform about or explain the topic.

Summary of Project

The PD will provide an overview for teachers, coaches and para professionals about the educational resources available on the NASA website. The reason: they can incorporate NASA resource information into their lessons and increase student engagement. One specific objective is to provide teachers with example math activities that will increase computational thinking in a STEM format.

Pre-questions Survey List

1. What is STEM?
2. Have you ever taught a lesson that integrates science, literacy and/or math? If yes, what was the main objective and how did you teach it?
3. What do you know about the educational resources available on the NASA website?
4. What solar system topics would interest your students?

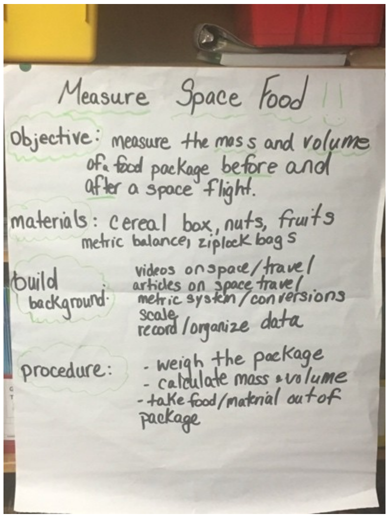
The teachers all were able to define STEM and list the subjects represented by the letters. Some had used STEM in arts and crafts., and others when solving math word problems.

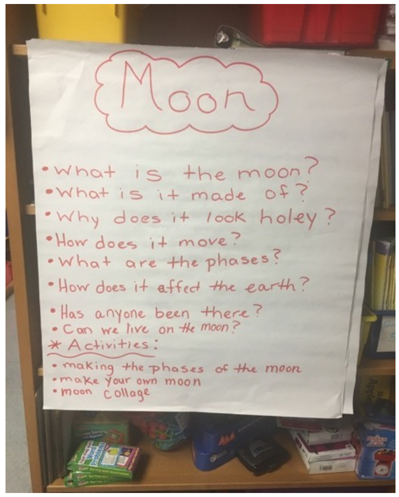
Brief Description of the Actual Professional Development Training

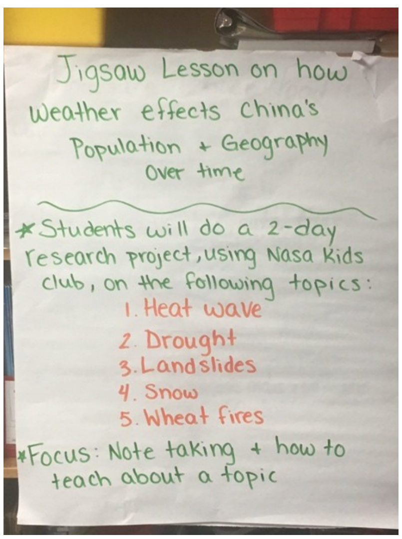
The participants arrived in the cafeteria with their belongings and computers. At the attendance signing, they received agendas and the pre-questions survey list to complete prior to the presentation. The presentation started with a video about NASA and what it has achieved. Then, a power point presentation began. Participants were directed to go to the NASA resources website on their computers using a URL provided on both a slide and the agenda list. They explored the section on their own, and later followed the slides to other sections when directed. Next, they broke into grade groups and each group prepared to present one lesson they would teach based on NASA resources. Each group presented their lessons to the whole group.

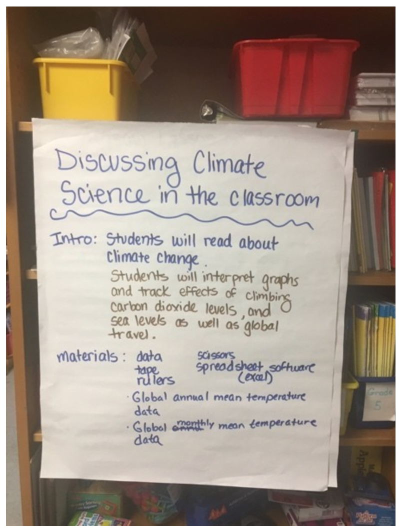
Brief Outline of the Activities in the Unit

The main activities of the presentation were the website section introductions and then an independent exploration of each section. The culmination was the development of lessons by groups of grade level teachers which included research for the students on the educational website using the resources presented. The following are some of the lessons they created:









NASA data included (e.g., visualizations, imagery, education assets, NASA websites, videos)

- 1. Introductory video
- 2. What is NASA? (www.nasa.gov/education/resources)
- 3. STEM Resources (www.jpl.nasa.gov/edu/educator-resource-center/)
- 4. NASA Kid's Club (www.nasa.gov/kidsclub/index.html)
- 5. NASA Math (www.spacemath.gsfc.nasa.gov)

Follow-up Activities and Post- questions Survey List

The follow-up activities will include the monitoring of the classroom work completed for this year. I will also send the teachers lesson ideas based on the NASA website. However, there is no school mandate for the teachers to use the website or even facilitate a STEM lesson in their classroom. The post -questions survey list is as follows:

Post-Presentation Questions:

1. What educational resources from the NASA website will you use to make your lessons more engaging?
2. What did you learn from the presentation?
3. Do you have any comments or questions about the content of the presentation?

Survey Results/Comment on the *content* included in the project

What educational resources from the NASA website will you use to make your lessons more engaging? (sample answers from post-survey)

1. "I loved the resource section"
2. "I will use Kid's Club" in my lessons"
3. "Using NASA Kid's Club to jigsaw China lessons"
4. "I like the resources of Space Math"
5. "I will use NASA TV in my lessons"
6. "I will use NASA educational resources in my lessons"
7. "I like some of the interactive games for students who need to be active"

Survey Results/Comment on the *pedagogy* in the project

What did you learn from the presentation? (sample answers from post-survey)

1. "How to incorporate STEM in the classroom"
2. "How to access online resources"
3. "Vast resources that make teaching more engaging"
4. "That the STEM teaching method incorporates higher order learning"
5. "How to use different resources available to us through the NASA website"
6. "How to get math lessons modified for your grade level"
7. "How to incorporate STEM in lessons"

Was your professional development successful? Why or Why Not?

I believe it is too soon to know if the presentation was completely successful. The staff was engaged in the website content as discovered in the post-presentation survey. And, most stated that they are planning to use it as part of a STEM lesson they are planning for their classroom lessons. However, until they actually prepare and implement a NASA-related STEM lesson, to me, the presentation may only be known as partly successful. And, as the DeSimone, 2011 article stated, "The final test of the effectiveness of professional development is whether it has led to improved student learning."

How did this project relate to the readings? Cite two examples.

My presentation was designed to be adaptable to the content and pedagogy needs of all participants. I gave them NASA educational resources and they modified them to meet their own needs in a STEM approach. This is directly related to the Lustick (2011) article, which would define my choices as PD reformed instead of a traditional method. In the traditional PD, teachers are seen as similar individuals with similar needs and learning styles. In the reform version, teachers are part of an experience, exploring information and developing lessons that can be directly used in the classroom. They are individual learners "who participate in community-centered activities which are embedded in practice. Interdisciplinary planning, content-based research opportunities, and discussions of effective standards-based pedagogy all illustrate a reform model of professional learning."

In Kanuika (2012), they spoke about the different responses to the implementation of a literacy program. This study shared the thoughts and concerns of teachers during the implementation of a successful reform. This experience was the catalyst for substantial transformations of how these teachers viewed students, their work, and what is possible. In the presentation, I spoke about using the STEM approach to make lessons more engaging for students. The teachers are stating that they want to implement STEM in their lessons, but they may alter their plans based on whether they feel this approach will be successful for their students. Once teachers evaluate the results of STEM lessons, and they are successful, then they will become more confident using the pedagogy to implement their lessons.

Will the teacher do these activities again? Include your reflections.

Last year, I was part of a PLT group who needed to design, implement and reflect on lessons which used a similar pedagogy. We decided to evaluate the effectiveness of a flipped-lesson approach. Each of us taught different grades from K to 5 and had the same results. When our targeted students came to class after reviewing the day's lessons the prior night, they were more engaged and successful in completing classwork. In fact, the target students were also able to teach many points of the lesson to those not targeted. After being presented to the other grade PLT groups, the teachers were impressed with the approach and stated they would use it. Two teachers tried it in a classroom, had similar results, but never did the approach again.

The idea of implementing STEM lessons based on topics that interests the students is not a new idea. In fact, I also implemented a PD based on STEM last year. The end result: no STEM lessons implemented in the school except for me. The main difference is that this year's PD presentation also included a specific source of ideas on the educational resources of the NASA website. Hopefully, the teachers will implement STEM activities using the NASA educational resources this year. I will be monitoring them very closely.

Assessment:

Formative: I will be meeting with teachers during the year to ensure that they are integrating NASA math and computer science concepts. Throughout the process, I will be available to help them with any issues they encounter.

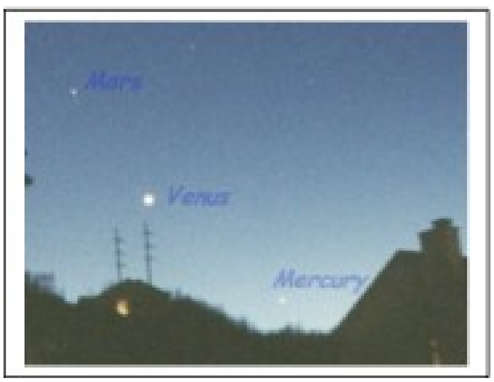
Summative: The teachers filled out a survey before the PD day, and after it on STEM and Nasa-related Issues.

Appendix:

Presentation Activities:

See related PD Presentation for a complete list of activities and NASA website resources.

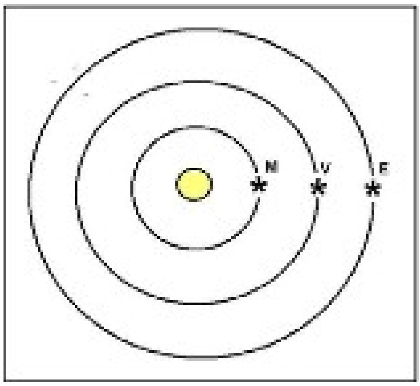
Planetary Alignments 41



One of the most interesting things to see in the night sky is two or more planets coming close together in the sky. Astronomers call this a conjunction. The picture to the left shows a conjunction involving Mercury, Venus and Mars on June 24, 2005.

As seen from their orbits, another kind of conjunction is called an 'alignment' which is shown in the figure to the lower left and involved Mercury, M, Venus, V, and Earth, E. As viewed from Earth's sky, Venus and Mercury would be very close to the Sun, and may even be seen as black disks 'transiting' the disk of the Sun at the same time, if this alignment were exact. How often do alignments happen?

Earth takes 365 days to travel one complete orbit, while Mercury takes 88 days and Venus takes 224 days, so the time between alignments will require each planet to make a whole number of orbits around the Sun and return to the pattern you see in the figure.



Suppose Mercury takes 1/4 earth-year and Venus takes 2/3 of an earth-year to make their complete orbits around the Sun. You can find the next line-up from two methods:

Method 1: Work out the three number series like this:
Earth = 0,1,**2**,3,4,5,6,7,8,9,10,11,12,...
Mercury = 0, 1/4, 2/4, 3/4 ,4/4, 5/4, 6/4, 7/4, **8/4**, 9/4, 10/4, 11/4, 12/4, 13/4, ...
Venus = 0, 2/3, 4/3, **6/3**, 8/3, 10/3, 12/3, 14/3, 16/3, 18/3, 20/3, ...
Notice that the first time they all coincide with the same number is at **2 years.** So Mercury has to go around the Sun 8 times, Venus 3 times and Earth 2 times for them to line up again in their orbits.

Method 2: We need to find the Least Common Multiple (LCM) of 1/4, 2/3 and 1. First render the periods in multiples of a common time unit of 1/12, then the sequences are: Mercury = 0, 3, 6, 9, 12, 15, 18, 21, **24**,
Venus = 0, 8, 16, **24**, 32, 40, ...

Earth, 0, 12, **24**, 36, 48, 60, ...

The LCM is 24 which can be found from prime factorization: Mercury: 3 = 3
Venus: 8=2x2x2
Earth: 12 = 2 x 2 x 3

The LCMtheproductofthehighestpowersofeachprimenumberor 3x2x2x2=24. and so it will take 24/12 = **2 years.**

Problem 1 - Suppose a more accurate estimate of their orbit periods is that Mercury takes 7/30 earth-years and Venus takes 26/42 earth-years. After how many earth-years will the alignment reoccur?

____

Answer Key

Problem 1 - Suppose a more accurate estimate of their orbit periods is that Mercury takes 7/30 earth-years and Venus takes 26/42 earth-years. After how many earth-years will the alignment reoccur?

Mercury = 7/30 x 365 = 85 days vs actual 88 days Venus = 26/42 x 365 = 226 days vs actual 224 days Earth = 1

The common denominator is 42 x 30 = 1,260 so the series periods are Mercury = 7 x 42 = 294 so 7/30 = 294/1260
Venus = 26 x 30 = 780 so 26/42 = 780/1260
Earth = 1260 so 1 = 1260/1260

The prime factorizations of these three numbers are

294 = 2 x 2 x 3 x 7 x 7
780 = 2 x 2x 5 x 3 x 13 1260 = 2 x 2 x 3 x 3 x 5 x 7

LCM = 2 x 2 x 3 x 3 x 5 x 7 x 7 x 13 = 114,660

So the time will be 114,660 / 1260 = 91 years! In this time, Mercury will have made exactly 114,660/294 = 390 orbits and Venus will have made 114,660/780 = 147 orbits

Note to Teacher: Why did the example problem give only 2 years while this problem gave 91 years for the 'same' alignment? Because we used a more accurate approximation for the orbit periods of the three planets. Mercury actual period = 88 days but 1/4 earth-year = 91.25 days compared to 7/30 earth year = 85 days. Venus actual period = 224 days but 2/3 earth- year = 243 days and 26/42 earth-year = 226 days.

This means that after 2 years and exactly 8 orbits (8 x 91.25 = 730 days), Mercury will be at8/4x365=730dayswhiletheactual88-dayorbitwillbeat 88x8=704daysora timing error of 26 days. Mercury still has to travel another 26 days in its orbit to reach the alignment position. For Venus, its predicted orbit period is 2/3 x 365 = 243.3 days so its 3 orbits in the two years would equal 3 x 243.3 days = 730 days, however its actual period is 224 days so in 3 orbits it accumulates 3 x 224 = 672 days and the difference is 730-672 = 58 days so it has to travel another 58 days to reach the alignment. In other words, the actual positions of Mercury and Venus in their orbits is far from the 'straight line' we were hoping to see after exactly 2 years, using the approximate periods of 1/4 and 2/3 earth-years!

With the more accurate period estimate of 7/30 earth-years (85 days) for Mercury and 26/42 earth-years (226 days) for Venus, after 91 years, Mercury will have orbited exactly 91 x 365 days/88 days = 377.44 times, and Venus will have orbited 91x365/224 = 148.28 times. This means that Mercury will be 0.44 x 88d = 38.7 days ahead of its predicted alignment location, and Venus will be 0.28 x 224 = 62.7 days behind its expected alignment location. Comparing the two predictions, Prediction 1: Mercury= - 26 days, Venus= - 58 days; Prediction 2: Mercury = +26 days and Venus = - 22 days. Our prediction for Venus has significantly improved while for Mercury our error has remained about the same in absolute magnitude. In the sky, the two planets will appear closer together for Prediction 2 in 1911 years than for Prediction 1 in 2 years. If we want an even 'tighter' alignment, we have to make the fractions for the orbit periods much closer to the actual periods of 88 and 224 days.

Example STEAM Classroom Activities and Problems:

Art and the Cosmic Connection Activity (https://www.jpl.nasa.gov/edu/teach/activity/art-the-cosmic-connection/). Grades K-8. Learners of all ages create a beautiful piece of art while learning to recognize geologic and atmospheric features of solar system objects.

Robotic Arm Challenge (https://www.jpl.nasa.gov/edu/teach/activity/robotic-arm-challenge/). Grades K-8. In this challenge, students 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.

Fired Up Over Math: Studying Wildfires from Space (https://www.jpl.nasa.gov/edu/teach/activity/fired-up-over-math-studying-wildfires-from-space/). In this activity, students learn how scientists assess wildfires using remote sensing. Students then use some of the same techniques to solve grade-level appropriate math problems.

Resources:

Desimone, L. M. (2011). A Primer on Effective Professional Development. Phi Delta Kappan, 92(6), 68.

Kaniuka, T. (2012). Toward an understanding of how teachers change during school reform: Considerations for educational leadership and school improvement. *Journal of Educational Change, 13*(3), 327-346. doi:10.1007/s10833-012-9184-3

Lustick, D.S. (2011). Experienced Secondary Science Teachers' Perceptions of Effective Professional Development while Pursuing National Board Certification. Teacher Development. Routledge.

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