ALGEBRA? THERE'S AN APP FOR THAT

FLORIDA GOES ONLINE WITH MATH SUPPORT FOR TEACHERS AND STUDENTS

By Joy Bronston Schackow and Stephanie Cugini

The transition to Common Core State Standards for Mathematics has created a need for high-quality professional learning on content and pedagogy. This is especially true for algebra 1 teachers in Florida, where students must pass a standards-based exam as a requirement to earning a high school diploma. But time, distance, and cost constraints can get in the way.

To address those challenges, the University of Florida's Lastinger Center for Learning and Study Edge, an educational technology company, developed an online teaching and learning system for algebra teachers and students.

This system, called Algebra Nation, launched throughout Florida in spring 2013. Funded by the Florida Legislature,

POPSICLE STICK CATAPULT ACTIVITY

Description
Students will work in small groups to build miniature catapults. They will use these catapults to make generalizations about the relationship between the distance that the catapult is pulled back and the distance that the object travels in a parabolic path.

Mathematics Florida Standards
MAFS.912.F-IF.3.7a Graph linear and quadratic functions and show intercepts, maxima, and minima.

MAFS.912.F-IF.1.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y = f(x)*.

Objectives
Students will be able to:
- Represent the path of the object that is catapulted graphically.
- Make generalizations about the pull distance on the catapult and the distance that the object flies.

Time required: 20 minutes

Materials needed (per group):
- 6 Popsicle sticks
- 5 rubber bands
- Plastic bottle cap
- Superglue
- Mini pom-poms or projectile of your choice
- Ruler (with cm)

Lesson preparation
1. Superglue one bottle cap to the end of one Popsicle stick. You will need one per group.
2. Draw a line on the floor or table where students will stand to launch their projectiles.

the program partners with students, teachers, administrators, parents, political leaders, and local communities to develop and deliver personalized professional learning.

The program includes standards-aligned instructional videos that model Common Core practices, workbooks to accompany the videos, practice assessments that mirror the state's algebra test, and interactive homework assistance where students provide and receive help from peers and study experts.

Since its inception, the program has grown to include a teachers-only area to provide targeted support to improve teachers' algebra content and pedagogical knowledge. With funding from the Bill & Melinda Gates Foundation, the teacher area launched in September 2014 to provide free, ongoing professional learning through collaboration and inquiry with activities that allow teachers to examine, analyze, and reflect on their teaching.

The professional learning support integrated into Algebra Nation is especially important for mathematics teachers in schools serving high-needs students. High-need schools and districts often have difficulty recruiting and training teachers, limited access to high-quality educational content and materials, and episodic professional development that rarely addresses specific student needs, especially in low-income areas. Economically disadvantaged students are far more likely than their peers to have inexperienced teachers (Ladd, 2011).

USING ALGEBRA NATION

To use Algebra Nation, students and teachers go to the website (**www.AlgebraNation.com**), select their school from a dropdown list, and then log in using their district credentials. Because Algebra Nation is integrated with each district, there is no need to remember a new username or password. The Algebra Nation app also allows students and teachers to access Algebra Nation using their tablets and smartphones.

POPSICLE STICK CATAPULT ACTIVITY PART 1

Name _____

Date_____

Challenge yourselves to use the elements of medieval technology to build a mini-catapult and fill the air with projectiles.

Each group will experiment with making a catapult using Popsicle sticks, rubber bands, and everyday materials. Then groups will face off to see which contraption has the best combined accuracy and quadratic function trajectories. Make sure to shoot from the labeled shooting line on the floor or table.

Materials needed:

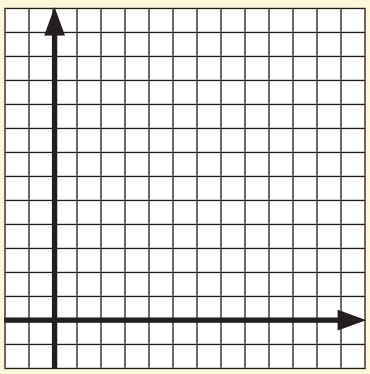
- 6 Popsicle sticks
- 5 rubber bands
- Plastic bottle cap
- Superglue
- Mini pom-poms or projectile of your choice
- Ruler (with cm)

Steps:

1. Gather your materials.
2. Stack four Popsicle sticks together. Using a rubber band at each end, tie the bundle together tightly.
3. Place the remaining two Popsicle sticks together. Bundle only one end together using an additional rubber band. Because your bottle cap has already been secured, use the Popsicle stick with the bottle cap as the top stick in this set.
4. Pry the unbundled end open enough to be able to slide the set of four sticks in between perpendicularly to form a cross. Slide the bundle of four sticks down as closely as you can get it to the rubber band holding the two sticks together.
5. Secure the body to the wings (diagonally at the point where the Popsicle sticks intersect) by criss-crossing a rubber band from the back of the right wing to the front of the left several times. Repeat with the final rubber band.
6. Place your projectile in the cap. Hold the set of four sticks with one hand and, with the other hand, push down on the angled stick just behind the projectile.
7. Release your projectile.
8. Measure the distance that the projectile traveled.

POPSICLE STICK CATAPULT ACTIVITY PART 2

1. Sketch a graph that represents the path of the objects you catapulted. Label your axes.



A. What does the *y*-intercept represent?
B. What does the *x*-intercept represent?

2. Does the distance that the catapult is pulled back and down affect how far the projectile travels? Test and record your data below:

Trial	**Pull distance** (cm)	**Distance traveled** (cm)
1		
2		
3		
4		
5		

3. Conclusion: State what your test results show about this relationship between pull distance and distance the projectile travels.

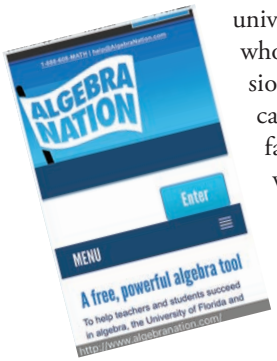
Reflection questions for teachers

- What mathematical connections do you believe students will make?
- What questions could you ask students to further develop these connections?
- What are some challenges in implementing this activity?
- What can you do to overcome these challenges?

Once on the site, teachers can navigate to the Teacher Area, which uses a variety of resources and online platforms to support teachers in their efforts to incorporate both the Common Core content standards and the eight Standards for Mathematical Practice into their mathematics classrooms.

The eight mathematical practice standards are designed to be embedded within mathematics instruction for all grade levels, starting in kindergarten. To this end, the standards are written in a very broad context.

To provide a visual representation of the standards, Algebra Nation created videos of master teachers effectively incorporating one mathematical practice standard in their classroom and then reflecting on the standard and their instructional practices, as well as students' perceptions of the lesson, instructional strategies, and their own learning. The videos include a diverse range of students and teachers to illustrate that these standards can be implemented in any type of classroom setting.



Algebra Nation Study Experts, along with a university faculty member, also serve as facilitators who provide both face-to-face and virtual professional development around the state. Teachers can follow up their face-to-face learning with facilitated sessions online, where they discuss with one another their successes and challenges in implementing what they've learned.

Facilitators use the mathematical practice videos in both face-to-face and virtual professional learning. After showing one of the classroom videos, facilitators engage participants in discussing and reflecting on the specific mathematical practice standard modeled in the video using a modified version of the National School Reform Faculty's Making Meaning Protocol. Reflection begins at the concrete stage and then moves through a series of higher-level questions, allowing for a richer conversation around the standard and leading to reflection on practical strategies that teachers can use to incorporate the practice standard in their own classroom.

Teachers can also access a resource library that houses standards-aligned lesson plans and activities that they can implement in their classrooms. These include discovery-based lessons, performance tasks, independent practices, and assessments, all designed using research-based instructional strategies with the common focus of improving students' conceptual understanding.

These resources also serve as a professional learning tool to encourage teachers to think about their own practice and how the lesson can deepen student understanding of a specific mathematical concept. After teachers complete the activity during a professional learning session, the facilitator engages groups in discussions around reflection questions. See an example of an activity and reflection questions on pp. 36-37.

Algebra Nation can also create reports on student activity that allow teachers to view data at the individual and class level. Reports on assessment scores provide teachers with real-time analyses of their students' current levels of understanding on specific topics, which helps teachers to determine which, if any, concepts are in need of remediation.

BUILDING TEACHERS' CONTENT KNOWLEDGE

Algebra Nation provides teachers with synchronous professional learning through a videoconference platform to improve teachers' depth of mathematical knowledge.

Interactive webinars offer in-depth coverage of specific Common Core math standards that are new to the algebra 1 curriculum, such as statistics concepts. Teachers deepen their own understanding of the content and also learn strategies for teaching these standards by working through lessons and activities.

Teachers can then opt to implement lessons on the topic in their own classroom and engage in a simple teacher inquiry process. Webinars are archived and available for any teacher in Florida to access anytime.

VIRTUAL TEACHER NETWORK

One of Algebra Nation's overarching goals is to build a self-sustaining network of mathematics educators who view themselves as owners of and co-contributors to Algebra Nation. This virtual community of practice, comprised of algebra 1 teachers, is one where members interact regularly to enhance their work as practitioners and develop a repertoire of resources.

One platform that supports this network is the Teacher Wall, an online social media platform comparable to Facebook that provides teachers a means to connect and collaborate across time and space.

Teachers log in at any time and from anywhere to engage in meaningful discussions with other teachers on a variety of topics. Teacher leaders act as guides by posing questions that require teachers to reflect on their practice, uncover their beliefs and attitudes regarding mathematics and mathematics teaching, and consider ways to improve student learning.

Teachers also share resources such as worksheets, lesson plans, photos, and other documents they have developed or used in their own classrooms by uploading them as attachments to the wall.

Teachers view the Teacher Area, and especially the Teacher Wall, as a place where they can find support and collaboration as indicated by the following wall posts:

- "The Algebra Nation wall helped me … in so many areas — from unpacking the standards, classroom layout, to specific algebra 1 topics and how to teach a concept."
- "The Algebra Nation wall has been a valuable tool that is unlike any other. Together, we have shared ideas, resources, questions, concerns, and even a laugh or two."
- "I find the posts uplifting; we're in this together. We share ideas and suggestions on ways to overcome different and

sometimes difficult situations."
- "I feel that I have developed relationships with the teachers on the wall and collaborated more here than in my actual algebra 1 team at my school."

IMPACT ON STUDENT ACHIEVEMENT

Algebra Nation has had a significant impact on student achievement in algebra 1. Schools in Florida that were frequent users of Algebra Nation during the 2014-15 school year experienced an average Algebra 1 End-of-Course exam score of 83% — 20 percentage points above the average score of schools with a low usage rate (63%).

The success of Algebra Nation has led to expansion into other mathematics courses. Math Nation launched in January 2016 to support mathematics students and teachers in grades 6-12. So far, Math Nation has provided teachers and students with resources similar to those on Algebra Nation for pre-algebra, algebra 1, geometry, and algebra 2, with plans to add grades 6-8 mathematics, pre-calculus, calculus, and statistics.

CHALLENGES

Developing a professional development component to Algebra Nation has had its challenges. For example, when creating classroom videos to demonstrate the development of mathematical practices, we recorded a diverse range of students that included classrooms with struggling learners and also some with advanced or gifted learners. When teachers with classrooms of struggling learners viewed a video that showed advanced students, they dismissed what they were seeing, stating that their students could not do what they were seeing students in the video do. This lack of buy-in was motivation for recording the remainder of the videos in classrooms with struggling learners.

Another challenge for Algebra Nation faced was low traffic on the Teacher Wall when it first launched. The launch of the Teacher Area coincided with the implementation of new state standards. We expected this to be a driving force for teachers to use the Teacher Area, especially the Teacher Wall. We hadn't considered just how much teachers had on their plate at the time. They had trouble finding time to post on the Teacher Wall.

To solve this problem, we designated several of the strongest teacher users as guides who would post questions or comments to the Teacher Wall to elicit responses from other teachers. This allowed new teachers to jump easily into the conversation and has helped to build a virtual community of algebra teachers that support and trust one another.

The Teacher area has evolved with time and increasing use. Through an environment built on trust and equity, Algebra Nation uses both positive and negative feedback received from stakeholders to grow and improve its professional development offerings and innovations.

REFERENCE

Ladd, H.F. (2011). *Education and poverty: Confronting the evidence.* Durham, NC: Duke University Sanford School of Public Policy.

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Joy Bronston Schackow (schackow@coe.ufl.edu) is a mathematics education professor-in-residence at the University of Florida's Lastinger Center for Learning. Stephanie Cugini (scugini@coe.ufl.edu) is the Algebra Nation project and marketing manager at the University of Florida's Lastinger Center for Learning.

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toward state-level continuing education requirements or career advancement).

Our work and the work of others show that web-based formats have the potential to increase teachers' access to expert coaching.

REFERENCES

Beck, I.L. & McKeown, M.G. (2006). *Improving comprehension with Questioning the Author: A fresh and expanded view of a powerful approach.* New York, NY: Scholastic.

Bickel, D.B., Berstein-Danis, T., & Matsumura, L.C. (2015). Clear goal, clear results: Content-focused routines support learning for everyone — including coaches. *JSD, 36*(1), 34-39.

Matsumura, L.C., Garnier, H.E., & Spybrook, J. (2013). Literacy coaching, reading comprehension instruction and student achievement: A mediation model. *Learning and Instruction, 25*, 35-48.

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Lindsay Clare Matsumura (lclare@pitt.edu) is an associate professor at the University of Pittsburgh's School of Education and a research scientist at the Learning Research and Development Center. Donna DiPrima Bickel (dbickel@pitt.edu) and Dena Zook-Howell (dkz5@pitt.edu) are fellows of the Institute for Learning at the Learning Research and Development Center at the University of Pittsburgh. Richard Correnti (rcorrent@pitt.edu) is an associate professor at the University of Pittsburgh's School of Education and a research scientist at the Learning Research and Development Center. Marguerite Walsh (MEW138@pitt.edu) is a graduate student at the University of Pittsburgh's School of Education.