IN THE CLASSROOM

ARCs: Activities with Rigor and Coherence

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Last summer I had the opportunity to work with other teachers from across the country as part of the NCTM Classroom Resource Development Team (CRDT). CRDTs support the work of the newly formed NCTM Classroom Resources Committee (CRC). The CRC's vision is to create an online professional learning community that is the go-to site for mathematics teachers.

We first met in July at the NCTM headquarters in Reston, VA. It was exciting arriving at the office, then being escorted to a large boardroom to begin our week of work. We were warmly welcomed with personalized name tags and folders of information to guide our work. The initial group of 20 teachers were divided into grade level bands (elementary, middle and high school). I was part of the high school team. Our time was divided between whole group and small group discussions. During whole group discussions, topics included our goals, updates and feedback. Small group sessions were for our writing teams. We had full access to all NCTM resources like articles and journals, and if we needed something, they got it for us. It was pretty cool!

Our first major task was to create ARCs. What are ARCs you ask? ARC stands for Activities with Rigor and Coherence; this acronym captures our goals as we were writing them. Each ARC is a series of lessons that addresses a mathematical topic and demonstrates the vision of *Principles to Actions: Ensuring Mathematical Success for All.* They scaffold effective teaching and support enactment of the eight Mathematics Teaching Practices articulated in *Principles to Actions*, as well as the instructional guidance set forth in *5 Practices for Orchestrating Productive Mathematics Discussions*. ARCs integrate a wide array of NCTM resources to optimize opportunities for learning, including Illuminations and Student Explorations in Mathematics. ARCs also include community features that offer opportunities for social interaction, engaging in online discussions with other math educators, posting a comment, and giving feedback with ratings and reviews.

We started with *Illuminations* lesson plans that needed revamping,then generated new topics based on needs. The high school team completed two ARCs during the week—The Law of Sines and Cosines, and Coding and Decoding.

> *On a side note - If you don't know what Illuminations lessons are, you should check them out! Illuminations, a free resource on the NCTM website, has lessons and interactives. Teachers can search by grade level or topic. One of my go-to interactives is the dynamic paper teachers can use to make many different types of graphs, grids, polar graphs, net figures, etc. There is also an enjoyable KenKen interactive on the site, along with several great elementary interactives. More about Illuminations can be found at* http://illuminations.nctm.org/

Back to ARCs - In February the CRDTs met once again to continue our work. There were a few new faces this time and not everyone from the summer work session was able to make it. So we began by briefly reviewing the goals of the CRDT, then jumped right into brainstorming topics for the ARCs we would write that weekend. We searched for topics that teachers have a difficult time teaching conceptually and/or don't have many good resources. The high school group ended up choosing absolute value, triangle congruence via transformations, regressions, and graphing trigonometric functions.

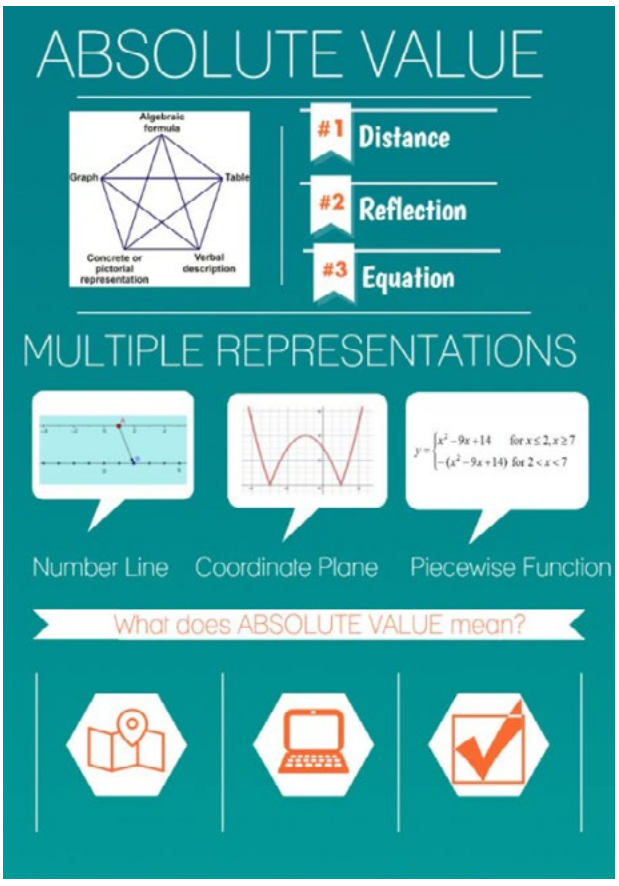
As we worked together in teams creating ARCs, we realized how much we were learning from each other as well as the writing process. This got us thinking about how to get more people involved in reviewing and creating Activities with Rigor and Coherence so that more NCTM members could benefit from the process. We felt like part of the value in these activities was not just in the products produced and used in the classroom, but in also in the process of creating, providing feedback about, and sharing ideas

around each topic.

I was on the team working with the **Absolute Value** ARC. Of the three lessons we have been working on, two are ready and made available on the website. At April's NCTM national convention in San Francisco, we offered a soft release of the ARCs website. While some of our work is still a work in process, selected activities at each grade level are now available for teachers to search for and use, complete with handouts and interactives. A road map is provided for accessing lessons.

Below is a visual of the Absolute Value Landing Page for **High School, Algebra**. Explore the meaning of absolute value as a distance from zero using a variety of visual representations.

Accessing the page, you will see a description and overview of the ARC. Some ARCs include a storyboard poster that captures the ideas of the lessons. On our storyboard, we tried to capture the idea of multiple representations of absolute value, so it includes a double number line, coordinate plane, and piecewise function representation.



Activities with Rigor and Coherence: Multiple Representations of Absolute Value

Grade Level: High School Algebra

Description: Explore the meaning of absolute value as a distance from zero using a variety of visual representations.

Storyboard: This ARC aims to create contexts for students to experience a variety of visual representations that reinforce the definition of absolute value. Explorations connecting back to elementary concepts and progressing in complexity provide intentional transitions for building deeper meaning. Representations considered in subsequent activities include the following topics:

- Number line - as the (positive) distance from zero.
- Double number lines - as functions in one-dimension.
- Coordinate Plane - as a graph of a piecewise function.

Some of the lessons, such as ours, contain audio clips of CRDT members discussing topics, strategies, or ideas for a lesson.

What makes the ARCs so fantastic is the ability for our members to now engage with one another. Check out the comments, ratings and reviews. One of the CRC members gave a great analogy related to online recipes that I would like to share: "There are thousands of sites to get recipes, but I like allrecipes.com because of how many comments there are. No site will give a comprehensive list for perfect recipes. What keeps you coming back to it is how the community *adds value* to it. You can read about people's modifications of the recipe on how to make it better, see pictures, the most popular recipes, etc."

Similarly, NCTM envisions this form of collaboration happening with its resources. They need you to get involved! NCTM would love for you to try the activities out in your classroom and provide comments: modifications, general thoughts, opportunities for differentiation, and reflections after implementation.

The following ARCs are currently on the NCTM website:

Counting Strategies Landing Page

Kindergarten, Counting & Cardinality. Students focus on understanding the relationship between numbers and quantities by counting, producing, and constructing the numbers 0-10 as well as developing 5 as a benchmark.

Growing Patterns Landing Page

Grade 5, Operations & Algebraic Thinking. Students build and analyze geometric growing patterns, determine rules, and write expressions to describe the growth models.

Discovering Area Relationships Landing Page

Grade 6, Geometry. Students discover the area formulas for triangles, parallelograms, and trapezoids, and then apply them to find areas of irregular figures.

Absolute Value Landing Page

High School, Algebra. Explore the meaning of absolute value as a distance from zero using a variety of visual representations.

Barbie Bungee Landing Page

High School, Statistics. Students collect and analyze data to help them predict the longest bungee cord that Barbie can use safely.

Triangle Congruence

Middle School, Geometry. Students discover the area formulas for triangles, parallelograms, and trapezoids. They apply formulas to find areas of irregular figures.

Go to http://www.nctm.org/ARCs/ for activities that continue to be posted and check back often for comments and feedback from other teachers.