John B. Howe and Joy A. Badillo

Capture the Flags

At the middle school level, nothing is more important than a hands-on application of mathematics. It offers students a way to progress from a concrete level of understanding to a more abstract form of thinking.

Capture the Flags is one in a series of outdoor activities that gives our students a concrete application to solidify their understanding of a pencil-and-paper classroom activity. It also helps students improve their spatial-reasoning ability.

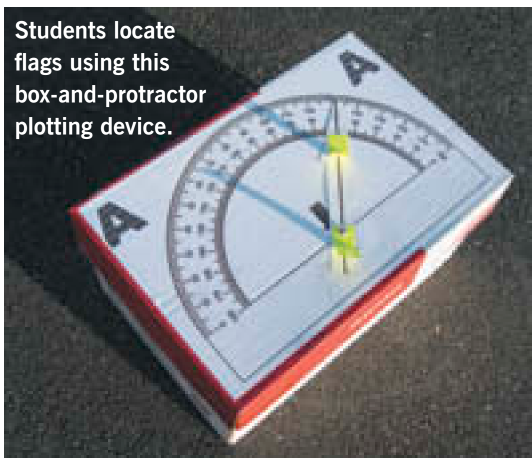
Our students often come to the seventh grade knowing how to use a protractor to measure angles, but few see any direct application of this angle knowledge to a real-world situation. Capture the Flags promotes an appreciation for the uses of this common mathematical tool; the activity also encourages collaboration and cooperative learning, since students must work in teams.

FLYING THE FLAGS

The premise is simple; students work in teams and use a form of triangulation to replicate, on paper, the relative locations of ten flags that have been placed in a field. The flags are selected from those of different countries to give the activity a multicultural flavor.

To locate a flag, each team uses large protractors to measure two angles and then transfer that information to an 11 in. × 17 in. map of the field. Teams receive points for accuracy in mapping the flags. The more accurate the resulting map is to the field representation, the more points that team receives.

To begin, students construct *sighting boxes* by photocopying a protractor on 11 in. × 17 in. paper that is then glued to the top of a copy-paper box. The protractor image is enlarged so that the markings will be distinct and students' measurements will be



Students locate flags using this box-and-protractor plotting device.

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Edited by **Hamp Sherard**, hamp.sherard@furman.edu, Furman University, Greenville, SC 29613. This department accepts "small packages"—a single, well-developed idea—addressing topics that fall under the categories of "another good idea," "research matters," and "promising partnerships." Send submissions to this department by accessing **mtms.msubmit.net**.

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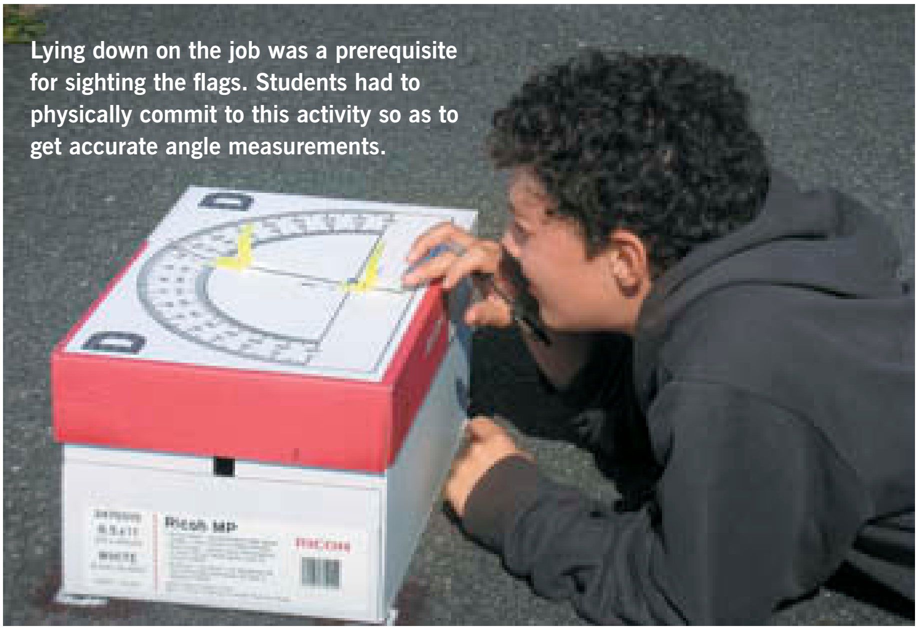

Lying down on the job was a prerequisite for sighting the flags. Students had to physically commit to this activity so as to get accurate angle measurements.

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as accurate as possible. Large arrows, printed to fit the protractor, are placed on the box and secured with a bolt, washer, and nut to allow them to spin freely. Two guide arms are glued to the arrows so that students can sight in on the flags.

The day before students go outside to locate the flags, we use about ten minutes of class time to work with the sighting boxes and become proficient with the proper use of the sight guides. (After completing the activity, we realized that placing straws through the eyeholes on the box would probably increase the accuracy of the readings.) Two books are placed inside the boxes to prevent them from blowing in the wind.

BOXING IN A GOOD LOCATION

The second part of creating the activity is finding appropriate locations for setting out the flags and working with the sighting boxes. We found a paved area on the school property where two sidewalks converge at right angles. (A paved location is important so as to avoid wet grass, since students need to lie down to use the sighting boxes.) We measure locations for the boxes using string and place wooden stakes as markers at seven-foot intervals along the sides of the right angle. (We painted small registration marks on the pavement so that future students can see where to place the sighting boxes *and* so that current students can keep them placed correctly when they knock into them by accident.)

On the day of the activity, the theme-song video from the cartoon "Pinky and the Brain," available on YouTube, is played on the SMART board™. Throughout the cartoon, the main character, Pinky, announces his desire to dominate the world. The video is shown to establish the goal for the activity, which is to capture the flags and take over the world.

Sighting boxes are placed at ten stations, five along each of the two sidewalks, at seven-foot intervals. Each team is given a uniquely ordered list of flags to capture and a list of the boxes that are to be used for those flags' measurements so that teams will not use the same boxes at the same time. It also forces team members to use *all* the sighting boxes during the activity. Each student on the three-person team rotates through the different roles of surveyor, runner, or cartographer after each flag is

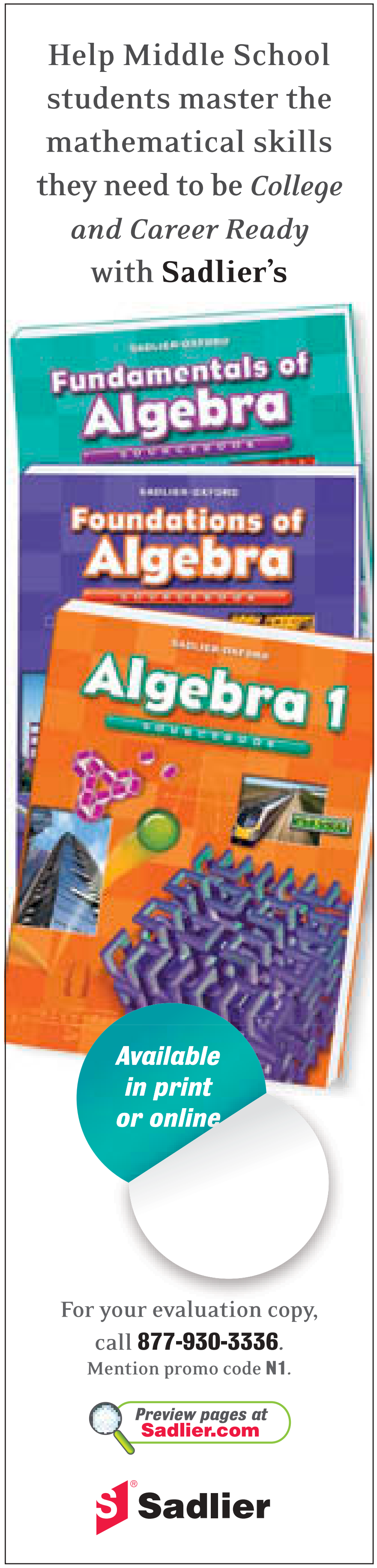
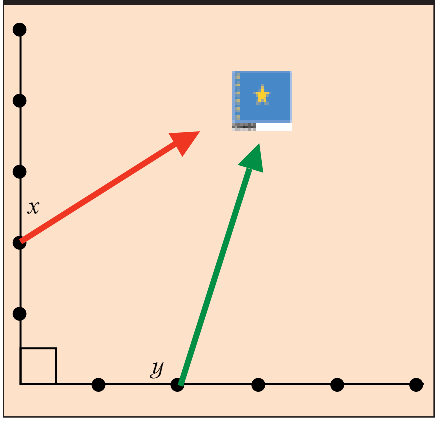


Fig. 1 The surveyor, using the top scale of the protractor, measures either an acute angle *x* or an obtuse angle *y*.



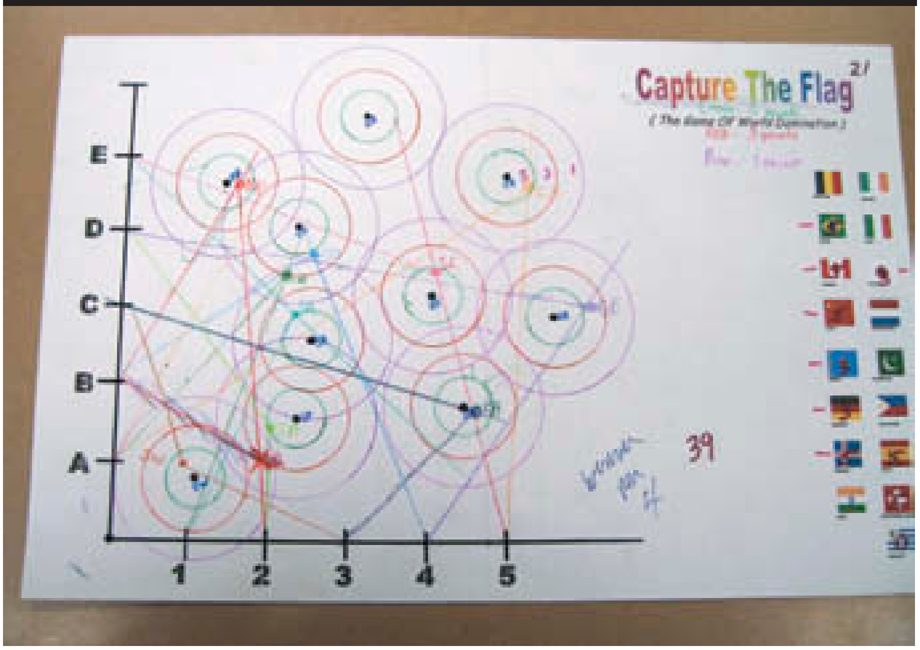
measured and its data recorded.

The surveyor is sent to two boxes, one on each sidewalk, to gather data. At each box, the surveyor measures the angle created by the side of the right angle and the line of sight of the flag being “captured.” At one point, there was confusion about which of the two numbers to record on the protractor from the sighting box. The surveyor was told to use the top scale of the protractor, measuring either an acute angle *x* or an obtuse angle *y*. (See **fig. 1**.) He or she then writes down the angle measures.

The surveyor can easily see any flag from any box location. Since the boxes are interchangeable, we supply an activity sheet for recording measurements to make sure that the students use all ten locations to find the various flags. This sheet also eliminates the possibility that students can simply read the measurement for a flag made by a previous surveyor.

When the surveyor finishes the two sightings for a flag, the runner brings the data back to the cartographer, who plots the data for that particular flag on the team map. Each team is given colored pencils, and a different color is used to plot each of the ten flags. This alleviates confusion over which pair of intersecting angles locates which flag.

Fig. 2 Concentric circles around the location of each flag determined the accuracy, and consequently points earned, by the team of students.



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In our class, the teachers preselected the teams so that students of varying abilities were mixed. Communication among the team members is important. The students are strongly encouraged to visually check that the placement of the flags on their map is consistent with the general placement of the flags in the field. The objective of this activity is not to finish quickly but to produce accurate sightings so as to capture the flags.

ANGLING FOR NO HOMEWORK

Grading the activity is relatively simple. We had created a transparency overlay of the exact placement of the flags, which were marked by three concentric circles drawn around each flag’s location. (See **fig. 2**.) The teams are given points, depending on where in the circles they locate the flags on their 11 in. × 17 in. map. (See **table 1** for the point structure.)

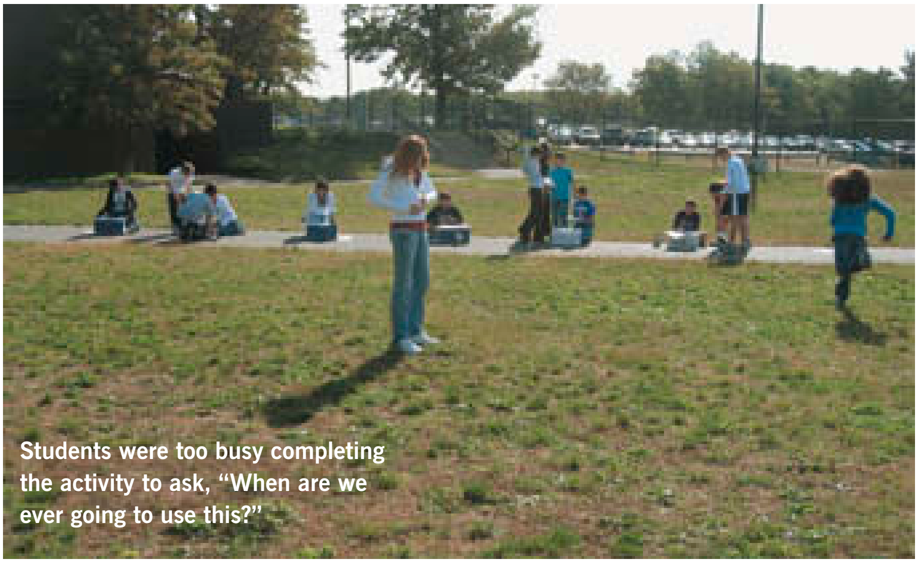
In each class, the team with the greatest number of points is declared the ruler of the world, and each team member is awarded a no-homework pass that can be used at a later date.

The student excitement during this activity is clearly evident. Students rise to the challenge of capturing the flags by working together as a team. The activity engages all types of learners, allowing them to become involved in the learning process.

We believe that this project far

Table 1 Teams receive points for their flags’ locations.

Points	Location of the Flag on the Transparency
5	Inside the 1-inch circle
3	Inside the 2-inch circle but outside the 1-inch circle
1	Inside the 3-inch circle but outside the 2-inch circle
0	Circle is missed completely



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Students were too busy completing the activity to ask, “When are we ever going to use this?”

surpasses having the students sit in class and measure angles drawn on paper, particularly since we emphasize the importance of learning by doing and try to incorporate this notion into the mathematics curriculum.

We are currently discussing how this idea can be used at the eighth-grade level to support the teaching of trigonometric ratios.

John B. Howe, jhowe@smithtown.k12.ny.us, teaches seventh-grade math at Accompsett Middle School in Smithtown, New York. He has a keen interest in exposing his students to real-life, hands-on applications of math. **Joy A. Badillo**, jbadillo@lvcsd.k12.ny.us, is a special education/math teacher at Locust Valley Middle School/High School in Locust Valley, New York. She believes that it is important to employ differentiated instruction for her students, and with the right motivation, math will be accessible to all students. The collaboration on this project took place during Badillo’s student teaching in Smithtown.

Note: Activity sheets, team assignments, and additional information can be downloaded from the authors’ Web site at http://ctfmtms.homestead.com.

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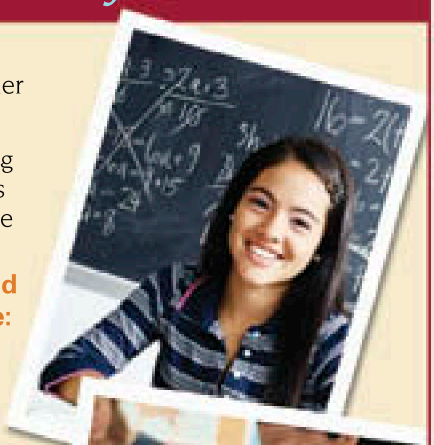

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