

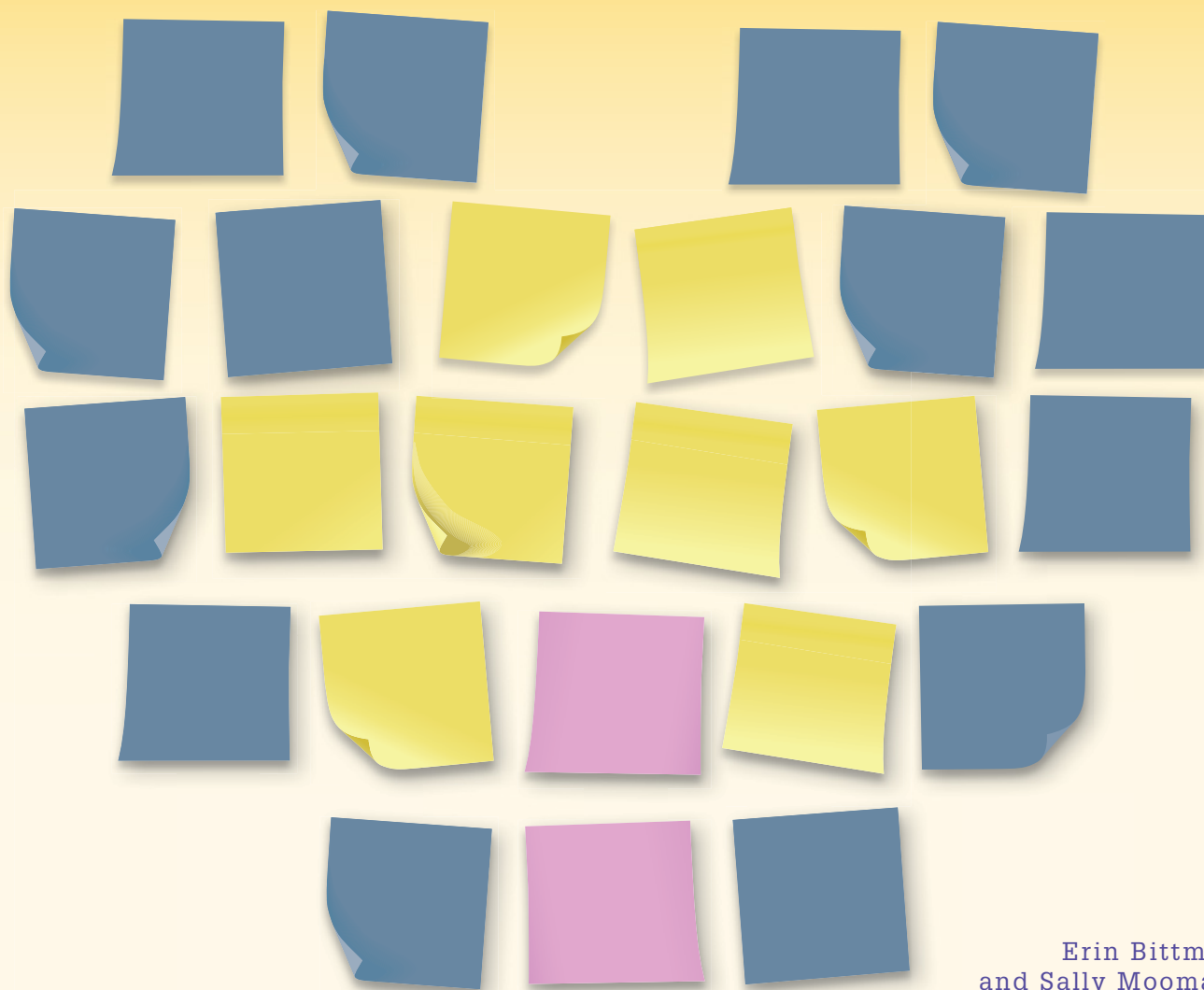
POST-IT[®] NOTES ART:

Area and Perimeter

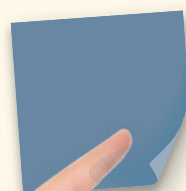
When children in this third-grade classroom used twenty-five square sticky notes to design artwork, they predicted that all the perimeters would be the same.

Surprise!





Erin Bittman
and Sally Moomaw



Members of a third-grade class were involved in a heated discussion. They were using a fixed number of links to create fences for toy cows. The children could change the shape of the field produced by the links, but they could not add any links or take any away.

"We used the same number of links for the perimeter on both fields," students in one group announced. "So, the area has to be the same."

"But this field is really skinny," a student in another group argued. "Maybe it has less area."

"Yes, but it's really long," a child in the first group replied.

"And the perimeter didn't change," claimed another.

Understanding the relationship between perimeter and area is a difficult concept for students. They have trouble conceiving that perimeter and area are two different measures: Perimeter measures the length of the boundary of a figure, whereas area measures its size.



Because calculating perimeter and area both involve sides, students often assume that if one measure remains constant, then the other must as well.



These girls made a heart-shape design with twenty of their twenty-five sticky notes.

Because calculation of both measures involves sides, students often assume that if one of the measures remains constant, then the other measure must also remain the same (Ma 2010). For this reason, NCTM has long recommended that between grades 3 and 5, students should have many opportunities to explore situations in which one measurement attribute remains constant while another attribute changes (NCTM 2000). In the Common Core State Standards for Mathematics (CCSSM), an expectation for third graders is to be able to solve real-world math problems in which rectangles have the same perimeter but different areas, or the same area but different perimeters (CCSSI 2010, 3.MD.8).

Math/art integration

Integrating mathematics and art uses the design process to make learning mathematics authentic, meaningful, and engaging for students. The design process involves five steps:

1. Brainstorm ideas of what you want to create.
2. Sketch your ideas to explore various designs and organize your thoughts.
3. Decide on the design you want to use; use your sketch to help you construct the final product.
4. Evaluate, redesign if necessary, and then make the necessary changes.
5. Share your design solution.

By following this process, students learn the connection between math and art and how math is used in creative careers. They see how symmetry, shapes, patterns, and ratios are used in both content areas. Focusing on measurement by manipulating art elements makes learning visible for the child (Hull, Balka, and Miles 2011).

Post-it notes have been used as an art medium by many artists to create wall murals to communicate a message, express emotion, or entertain the public. In 2000, the twentieth anniversary of Post-it notes was celebrated by having artists create unique designs using only the sticky notes. Many artists continued using Post-it notes as an art medium and created beautiful, innovative wall or window murals. Inspired by the use of Post-it notes as a form of expression, I wanted to use them in my classroom. According to CCSSM, children are to understand that “a plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units” (3.MD.5.b). Post-it note art is constructed using square units. Each sticky note represents one square unit. Therefore, I thought that having the children create wall graffiti using Post-it notes would be a great way to encourage deep thinking about area and perimeter.

Post-it note math

For a third-grade lesson on area and perimeter, I introduced the concept of area by showing students examples of art using sticky notes. I

then constructed a square design from twenty-five square notes. We reviewed the concepts of *perimeter* and *area*, then also discussed *regular* versus *irregular polygons*. Students identified the square design as being a regular polygon.

Next, I posed a series of questions to determine students' current thinking about perimeter and area and to elicit meaningful mathematical discourse. Both of these techniques are considered effective teaching practices in mathematics (NCTM 2014). I asked the class if anyone could figure out the perimeter of the design. Students had worked with perimeter and were able to demonstrate how to calculate the perimeter of a square that consists of square units. One student counted every outside edge of each of the sticky notes that created the large square design.

Next, I asked if any of the students could determine the area. Students used multiplication strategies. One student used the standard formula for area; he found the length of two sides, length and width, and multiplied. When I asked if anyone had a different strategy, another child focused on the array: "There are five rows of five. I multiplied five times five."

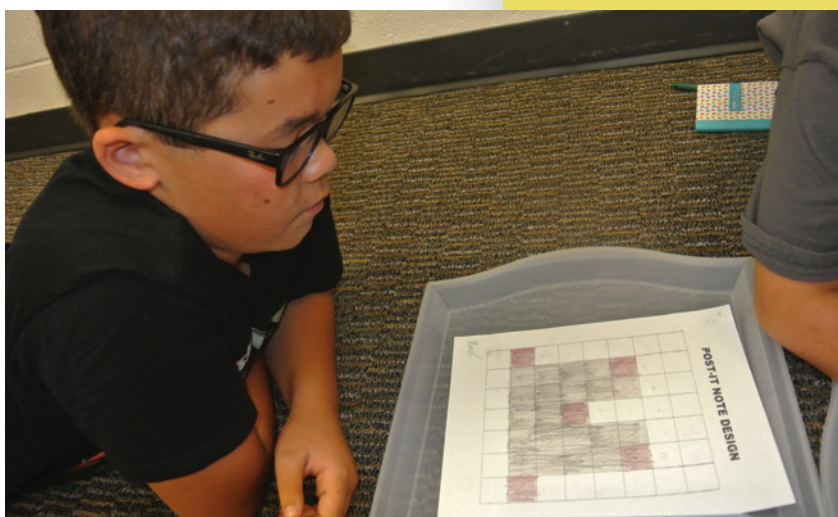
I then removed some sticky notes from the corner of the design and asked, "Is this still an array? Is the shape a regular or irregular polygon?"

Students identified the design as an irregular polygon and not an array. I asked them how they could find the area of this new design. One student responded that she subtracted the number of sticky notes that I had removed from the original number of notes. I then asked, "What if we started out with this irregular shape instead of a square?"

A student replied, "We could count the squares!" Her peers agreed with this finding.

I told the students that they would all create a Post-it note wall-art design in cooperative learning groups of four. Their design had to consist of twenty-five or fewer sticky notes, and it had to be an irregular polygon. These descriptive criteria sparked the design process because students were given certain restrictions to work with.

Before the class started on the project, I asked, "Do shapes that have the same area also have the same perimeter?" Recall that the square design introduced earlier consisted of twenty-five sticky notes, and the class was to create designs that included up to twenty-five sticky notes. Would



Most students began by designing their art on graph paper.

all these designs share the same perimeter? We took a vote. Most students believed that shapes that had the same area, twenty-five sticky notes, would have the same perimeter.

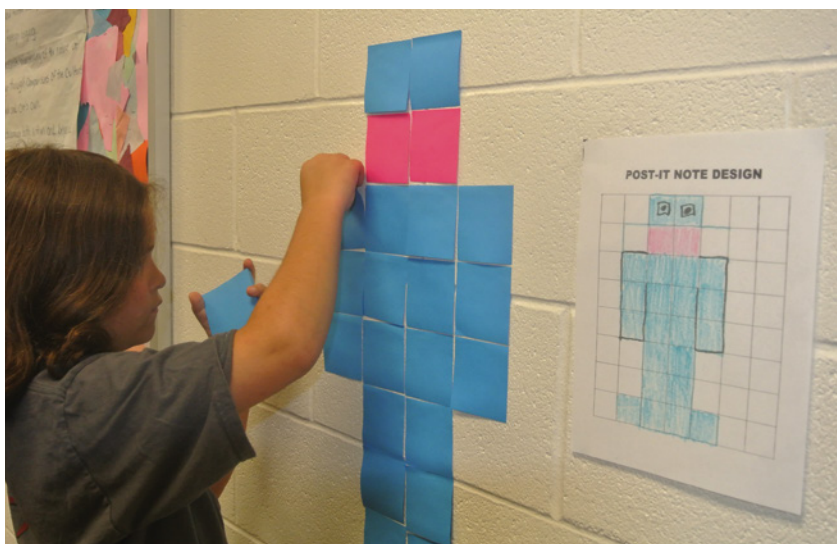
I gave each student a piece of one-inch-square graph paper and colored pencils that matched the Post-it note color options. I informed them that each group would create one collaborative design out of sticky notes. They could either have one student draw for the group, or they could each create a design and vote on which one they thought was the "coolest." Drawing their designs first introduces students to the concept of scaling and proportion, which is important in both design and mathematics. It also produces models for the group to consider before constructing their actual wall mural. All the students elected to create a design using twenty-five square units.

During the design process, one group worked collaboratively step by step. First, students chose their color palette. Then they decided on a design, and all of them created a prototype on their own graph paper. Students in the rest of the groups worked independently, sitting and conversing in their respective group about their designs. Only two groups struggled with the voting process. I reminded the class that groups are teams and that they could create only one design per group. Students had to work together to solve any disputes. Members of one group decided to combine components of each of their designs; they created a new design using components of each team member's design. Students in the other group talked through their problems and voted on one design. Students were able to experience what the design process is actually like at a real design firm. In a studio, many creative people must work together to please their client.

Students discovered that shapes that have the same area do not necessarily have the same perimeter.



At some point in the process, all students collaborated on their designs.



This student is using twenty-four sticky notes to design a robot.

After groups had drawn their designs on graph paper, they had to record the area and perimeter before construction could begin. They checked with the teacher to make sure their design met the criteria. One group used more than twenty-five sticky notes and had to rethink their design. Another group miscalculated its perimeter and had to recalculate. Groups were then given the sticky-note colors they needed. Students worked together hanging their sticky note art on the door, in the hallway, or in the classroom. Students were reminded that their design could not have any overlaps or gaps. For comparison purposes, they hung their original graph-paper designs next to their wall art, along with the area and perimeter measures and the team members' names. Finally, students walked through their art gallery and checked their peers' art and math calculations.

After we returned to a whole-group setting, I asked how many sticky notes each group had used. I then asked, "Did the designs (that used the same number of sticky notes) all have the same area?" Students replied yes, and when asked how they knew, they responded that because the sticky notes represented square units, the total number of notes was the area of their design. I asked, "Did the designs all have the same perimeter?" Their answer was no. The groups indicated that they had many different answers for their design perimeters. They had discovered that shapes that have the same area do not necessarily have the same perimeter.

All the students enjoyed using math skills and a new art medium to create an innovative design. They had never imagined that sticky notes could be used to create art. Besides math vocabulary, we also discussed art vocabulary. Students learned that *mosaics* are a form of art constructed from tiny pieces. Their sticky note art was like a mosaic because it was formed using small squares. We also discussed how *murals* are a form of artwork that can be applied to walls, ceilings, or other large, permanent surfaces. All the students expressed that the criteria of constructing an irregular polygon using twenty-five sticky notes made the design process more challenging, as was collaborating with team members.

As a follow-up activity, the students became detectives who had to solve "the case of the missing side," which was a different type of mathematical problem involving perimeter. Students were given polygons that had no square units to count. Instead, the total perimeter and the length of all but one edge were provided. Their task was to determine the length of the missing side.

Concrete understanding

Students' productive struggle, another recommended teaching strategy (NCTM 2014), provided the means for understanding important concepts in both mathematics (the relationship between area and perimeter) and design (modeling and scaling). They were the artist-mathematicians who proved that area could remain the same while perimeter changed. The next time a question related to perimeter and area comes up, these students are likely to remember this experience, which is the essence of conceptual understanding.

Common Core Connections

3.MD.8
3MD.5.B

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