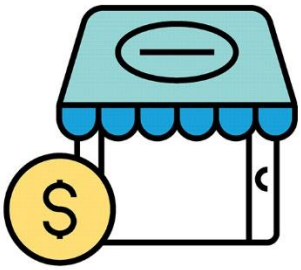
Dollar Store Math



You have shopped at the dollar store, and you have taught mathematics. Have you ever thought about combining the two? At the dollar store, the things you see filling the shelves are immediately useful—well, most of them anyway—but their long-term value may be doubtful. They are not necessarily built to last. In your mathematics curriculum, the things you are teaching have incredible value. They *are* built to last. But often their immediate usefulness is questionable, at best, in the eyes of many of your students: "When are we ever going to need this?" Can you help students see the light by bringing math to the dollar store?

The first time this idea occurred to me was many years ago at an NCTM conference in Regina, Canada. I was between sessions and had stopped at the local dollar store looking for something to take home to my then-young children. I cruised the aisles, confronted with the usual array of dollar store items: toys, plastic dinnerware, cheap batteries, and so on, and it came to me that a whole lot of mathematical activities and illustrations were lined up and waiting on those shelves.

Doll Proportions

Let's start with dolls. I have been in dollar stores on three continents now, and I can confidently say that they pretty much all feature a toy section and that all of the toy sections have dolls of one kind or another. These dolls are generally more or less human in appearance—but not quite. And the differences can be the source of endless observation and investigation. Show the class a doll and ask if anything about its appearance seems odd. For example, someone might suggest that the doll's head is too large, the hands and feet are too small, the arms may be too short, or the waist, too skinny. But are they?

Fig. 1 *Doll Proportions*

The dollar store doll shown in figure 1 is 30 cm tall. The circumference of her head is 14 cm. The ratio of her height to her head circumference is therefore 30 : 14, or constructing the fraction, $\frac{30}{14}$, = 2.14 (rounded to the nearest hundredth). My head has a circumference of 61 cm. If my height were proportional to my

head circumference as the doll's is to hers, I would be 2.14 × 61 cm = 130.5 cm tall. In fact, I am about 189 cm tall.

Students may also notice that the doll's feet are absurdly small. Again, comparing her height to the length of her feet, which measure a mere 1.5 cm, we compute a ratio of 30 : 1.5, or $\frac{30}{1.5}$, = 20. Students can measure their own height and foot length to see whether they have this same ratio. Given my foot length of 30 cm, in order to conform to this ratio, I should be 6 meters tall!

One of the big plusses about this investigation is that getting students interested is easy. Just ask them what they notice about the doll that seems odd. Model the investigation of one of their claims, give a doll and a tape measure to each team, give students some time to investigate, and encourage them to use mathematics to defend their own claims. They are in the driver's seat, and perhaps with that sense of agency and a little coaching from you, they will begin to construct for themselves the incredible usefulness and widespread applicability of ratios and proportional relationships, one of the most prominent features in the middle-grades mathematics curriculum.

Taking this investigation a step further, students might become interested in just what *is* the ratio of head circumference to height for a person at their age. A measuring tape and perhaps an inexpensive calculator, both available at the dollar store, are all that are needed to undertake this investigation. In the process, they will have an opportunity to construct their understanding of the role of division in proportions. This is one of the attractions of dollar store math. Children are much more interested in playing with things than in doing mathematics the way it is generally done in our classrooms. If we offer them experiences that are well orchestrated and that provide them with agency through their own choices and our wise coaching, we provide natural settings in which the concepts and skills we need to teach may be developed through processes that are akin to play.

Tattoo Symmetry

Here is another example: A package of temporary tattoos cost one dollar at the store in Canada and contained dozens of small, colorful designs that could be applied with water and that would wear off in a day or two. Many of the tattoos, which were depictions of flowers, ladybugs, stars, trees, and the like, featured some degree of rotational or line (aka reflection) symmetry (see figure 2). It occurred to me that I could use these tattoos to stimulate interest and to get students actively involved in their exploration and ownership of this important concept. If students were able to select tattoos that appealed to them and

apply them to their own arms, they might then listen differently to my well-worn discussion of the different kinds of symmetry. If I then gave them a chance to show me their tattoo and explain to me what sort of symmetry is present and how they know they are right, we engage in a much more authentic form of assessment. In addition, they might build a different disposition toward the concept of symmetry as a result of the circumstances of this encounter. They might like it!

Fig. 2 *Temporary Tattoos*

Sponges

One more example is less obvious perhaps: kitchen sponges, two for a dollar. The Common Core State Standards for Mathematics (2010) call for attention throughout the early grades to concepts and skills related to measurement. In upper elementary grades, they begin to consider volume, and throughout the middle grades there's a strong emphasis on proportional relationships. Kitchen sponges are rectangular prisms (see figure 3), easily picked up and measured in inches or centimeters (with a dollar store ruler or tape measure). Students can calculate the surface area of the top and the depth of the sponge, and therefore its volume. If you can find more than one kind of sponge, and you often can at the dollar store, students can compare with one another after estimating which sponge will have more volume. In upper elementary or middle grades, if you have access to an electronic set of scales, students can weigh the sponges and determine the ratio of weight to volume – density! Submerge the sponge in water, wring it out, and measure it again. Has its volume changed? It probably has not changed much, but consider the weight (and therefore the density). Pour measured amounts of water slowly onto a dry sponge. How much water can it absorb before water leaks out of the bottom? If you use the metric system, each milliliter of water, equivalent in volume to a cubic centimeter, weighs exactly one gram; so every milliliter you drip onto the sponge adds a gram to its weight. How many milliliters can the dollar store sponge absorb? Is it different for a more expensive sponge purchased at a more expensive store? Buy one of these and do the calculations yourself or let a selected student team do the calculations. But hold the data until the rest of the class has done its work and wants to make guesses about whether the sponge that costs $2.99 will be six times better at absorbing water than the two-for-a-buck dollar store sponges.

Fig. 3 *Kitchen Sponge*

My guess is that some of your students have washed dishes with sponges like these and when they pick them up again at home, they will see them in a different light. And maybe they will think about math a little differently because it enabled them to ask and answer some questions that have relevance in their lives.

Conclusion

This general approach to teaching and learning certainly has ample encouragement. NCTM's latest major contribution to more progressive mathematics curriculum and pedagogy comes from the Catalyzing Change series of books. Learners at all ages have a better chance of developing the "strong sense of agency" and experiencing "the wonder, joy, and beauty of mathematics," called for in these publications when, in the journey toward the powerful and generative abstractions of mathematics, they encounter teaching that at least occasionally enables exploration and centers on objects from their daily lives.

Another cornerstone of the Catalyzing Change series is a clear call for equitable instruction. I strongly believe that a commitment to equity comes in large part from knowing who your students are and caring about their lives. For better or for worse, those lives - all of our lives—feature everyday objects more than diagrams, exercises, and word problems. Such devices have their place in the curriculum as necessary and useful abstractions; however, our teaching becomes more engaging and valuable when it is grounded in such tangible and commonplace things as dolls, sponges, and temporary tattoos.

Lesson Plan

Learn more about implementing Dollar Store Math in your classroom by exploring the Illuminations lesson here! Then, share your experiences using Math Sightings on social media with the hashtag #MathSightings.

References

National Council of Teachers of Mathematics (NCTM). 2020. *Catalyzing Change in Middle School Mathematics: Initiating Critical Conversations*. Reston, VA: NCTM.

National Governors Association Center for Best Practices (NGA Center) and Council of Chief State School Officers (CCSSO). 2010. *Common Core State Standards for Mathematics.* Washington, DC: NGA Center and CCSSO. http://www.corestandards.org.