

# Hair Braiding

Many students from various ethnic groups have memories of hair braiding. Braiders use geometric transformations, including dilations, rotations, slides, and translations, as well as reasoning to create the patterns in their designs.

## QUESTIONS

1. Where have you seen transformations used?
2. What is the connection, if any, between reflections and rotations?
3. Start with a braid strand, as shown in the diagram. Explain what would happen to the braid strand if it were translated by  $(10, 0)$ . What about  $(-10, 0)$  and  $(0, 10)$ ?
4. Start with another braid strand. What would happen if it were rotated 90 degrees with the origin as the center of rotation?

## MATH TOPICS ADDRESSED:

- Geometric transformations
- Culturally relevant mathematics
- Geometric patterns
- Reasoning and sense making

5. Is dilating a braid strand by  $15/16$  feasible? Explain what would happen.

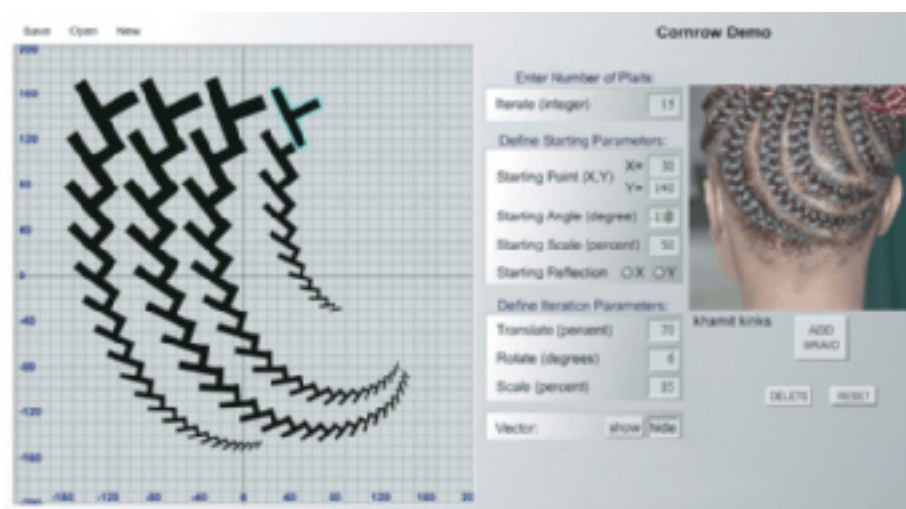
*Note:* A good resource about hair-braiding patterns is available at [http://www.ccd.rpi.edu/Eglash/csdt/african/CORNROW\\_CURVES/index.htm](http://www.ccd.rpi.edu/Eglash/csdt/african/CORNROW_CURVES/index.htm). Students might also be interested in the history and cultural significance of braiding.

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**Desha L. Williams**, [dwill178@kennesaw.edu](mailto:dwill178@kennesaw.edu), teaches mathematics education to preservice middle-grades math teachers at Kennesaw State University in Kennesaw, Georgia. Edited by **Erik Tillema**, [etillema@iupui.edu](mailto:etillema@iupui.edu), who teaches at Indiana University in Indianapolis.



The solutions are appended to the online version of "Math for Real" at [www.nctm.org/mtms](http://www.nctm.org/mtms).

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 This department highlights math concepts in the context of problem solving in the real world. Readers are encouraged to submit ideas or work with someone they know to create a manuscript. Submit your ideas to [mtms@nctm.org](mailto:mtms@nctm.org).



1. Answers may vary but may include tile patterns, quilts, and logos.
2. If a figure is *reflected* over two intersecting lines, it is a *rotation*. The center of rotation is the point of intersection of the two lines.
3. For  $(10, 0)$ , the braid strand is shifted 10 units to the right. For  $(0, -10)$ , the braid strand is shifted 10 units down. For  $(0, 10)$ , the braid strand is shifted 10 units up.
4. To determine what the new braid strand will look like, draw a line segment from the origin to key points on the braid strand. These points can be rotated by drawing a new line segment starting at the origin and rotating them 90 degrees.
5. Yes; the dilation is 93.75 percent, and the braid is an adequate size. When you dilate by a number less than 1, the dilation contracts, or shrinks, the original figure.

## FOR TEACHERS

Culturally relevant pedagogy (CRP) recognizes that a student's home culture is not absent from the classroom. It seeks to use that student's home culture to impart academic skills, knowledge, and attitudes (Ladson-Billings 1995). Teachers who employ CRP take the initiative to learn about the community in which they teach. The knowledge gained from observing surroundings, attending community events, talking with students on a casual basis, and doing other research will help create culturally relevant mathematics lessons.

Visit [http://www.ccd.rpi.edu/Eglash/csd/african/CORNROW\\_CURVES/index.htm](http://www.ccd.rpi.edu/Eglash/csd/african/CORNROW_CURVES/index.htm). This site integrates the mathematical concepts of geometric transformations with the cultural aspect of braiding. It also provides a reading component on the history of braiding. Students are shown various pictures of corn-row braiding that they have to duplicate using various geometric transformations. As students work through recreating the various braiding patterns, teachers can assist them with the reasoning and sense making involved in the mathematics.

Use of this site also provides practice with NCTM's Process Standards of Problem Solving, Communication, Representation, Reasoning and Proofs, and Connections (NCTM 2000). Exploring this site to open the unit will require students to problem solve to determine the effects of their inputs to each field, thus determining which action produces the desired results while developing definitions for these key terms independently. Mathematical communication can be facilitated through sharing the problem-solving strategies used as well as the definitions of various terms.

## REFERENCES

- Eglash, R., and Rensselaer Polytechnic Institute. "Culturally Situated Design Tools: Teaching Math and Computing through Culture." 2003. [http://www.ccd.rpi.edu/Eglash/csd/african/CORNROW\\_CURVES/index.htm](http://www.ccd.rpi.edu/Eglash/csd/african/CORNROW_CURVES/index.htm).
- Ladson-Billings, Gloria. "Toward a Theory of Culturally Relevant Teaching." *American Educational Research Journal* 33 (1995): 465–91.
- National Council of Teachers of Mathematics (NCTM). *Principles and Standards for School Mathematics*. Reston, VA: NCTM, 2000.

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$$y = A \cdot \sin(nt + \theta)$$

$$\tan(x) = \frac{h}{d}$$



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