MATH 1300, Mathematical Explorations

Symmetries and Dance

Two 75-minute classes

Activity

Day 1:

- Bring masking tape for making lines on the floor. Begin by having students list examples of symmetry.
- Distribute Chapter 1, pages 11-26 of Dance. Have students do the mirror game with body positions, dance moves and work on answers to questions 1-20. Then have a whole class discussion about the questions - especially 17.
- Play the switching symmetries game (21-27). Look for a conjecture about when it's possible to switch smoothly between reflectional and rotational symmetry (it's possible when the pose is bilaterally symmetric). In particular, discuss 23 and 26.
- Set up a demonstration where one person follows via a rotational symmetry and another follows via a reflectional symmetry. Get the students to see how the two followers relate to each other. Then ask how that helps resolve the problem.

Day 2:

- Have three people come to the front and stand side-by-side in a line. One is the leader (T), one follows via reflection (M), one via 180 degree rotation (R), and the other by the composition - call this a glide reflection (G). Ask them to work out at tables what the composition is.
- In tables: use groups of three students to act out what happens when one symmetry is followed by another. First student (the leader) strikes a pose; second student applies a symmetry; third student applies another symmetry to the pose of the second, then compares his or resulting pose to that of first student. Get results like MR = G, where M means mirror reflection perpendicular to the line, R = 180 degree rotation, G = glide reflection, i.e., reflection across the line and glide along it). Have each table of students fill out the T,M,G,R multiplication table.
- Next, have students work out a table for a (non-square) mattress as per Steve's NYT piece "Group Think." See if they recognize the multiplication tables as the same.

- If time: do a square mattress (dihedral group of order 8).

Questions for class

- What patterns do you notice in the T,M,G,R multiplication table? Why are they there?

References and resources

Discovering the Art of Mathematics: Dance

Article: Group Think

Follow-on activities

Frieze Patterns

Axioms of Groups - Solitaire and the Klein Four Group

Square Mattress and Change Ringing