

Musical Symmetry

Have the activity leader show you the symmetry dance. Try some of the dance steps taped on the floor.

1. What happens when you do two reflections that meet at right angles?
2. What happens when you do two reflections that meet at a 30 degree angle?
3. Does the order matter?

A *Frieze pattern* is a pattern that has a non-trivial translation symmetry in one direction, so that all translational symmetries translate in a direction along the same line. These patterns can have other symmetries.

4. Create some frieze patterns. You can just make copies of the letter F .
5. Is it possible to have a frieze pattern with a 60 degree rotation? If so, give an example. If not, why not?
6. Is it possible to have a frieze pattern with a reflection symmetry with mirror line meeting the translation line at a 60 degree angle? Why or why not?
7. What types of rotations are possible in a frieze pattern?
8. What types of reflections are possible in a frieze pattern?
9. Take a few of your frieze patterns. For each one, find the smallest part of the pattern that you can use to recreate the entire pattern. Mark lines of symmetry in red, and put dots at the center of any rotational symmetries. Cut out a copy of the smallest part that will reproduce the entire pattern and fold/tape it up so that any two points that are related by a symmetry are touching.
10. Make a Möbius strip. Draw a non-symmetrical pattern on it. Cut it open, lay it flat and repeat copies of it to make a frieze pattern. Does it have a reflection symmetry, a rotational symmetry. You probably have just discovered the glide reflection.
11. Make a list of all of the possible symmetry elements other than translation that a frieze pattern can have. Label your symmetry elements with letters.
12. Write out all subsets of $\{A, B, C\}$.
13. For each collection of possible symmetry elements create a freize pattern having exactly those symmetry elements and no other elements, or explain why no such pattern can exist.
14. Once you have a list of all freize patterns make the folded paper models of each one.

15. Once you have your list of freize patterns play mix and match with the different dance patterns, musical scores, and music. Can you dance the dance that matches a song while holding the score and folded paper model?