Chaotic Dancing

Participants:

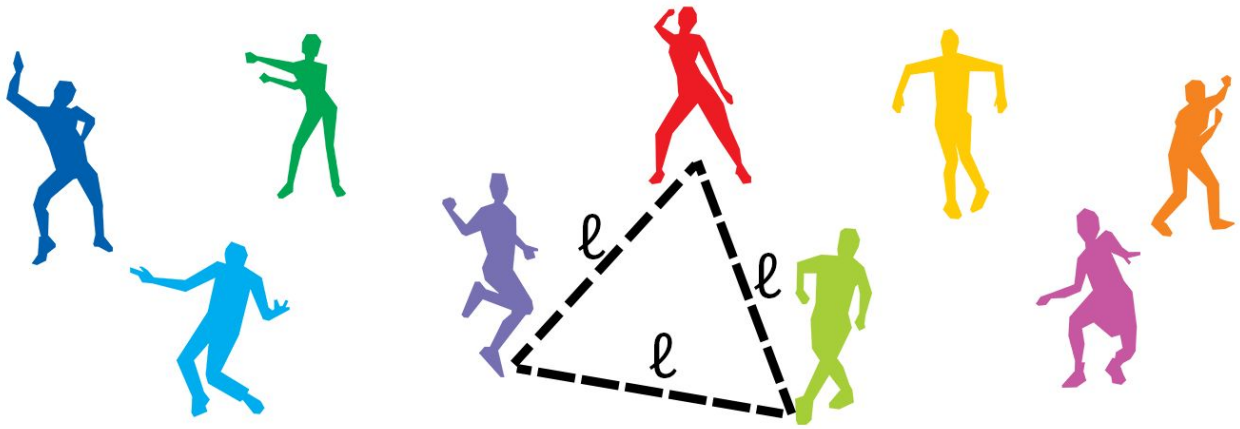
10 or more people, ages 10 and up, no math knowledge required.

Activity:

Participants gather in a large space (for example a park, gym, yard, hall etc.). Have a sound system ready to play music for everyone to hear (it should be inviting to dance). Inform all participants to follow these rules:

- Secretly choose two other people (your partners) and remember them.
- When the music starts dance along to the music while moving to a position which forms a triangle with three equal sides (an equilateral triangle) with your two partners (that is, a position that puts you at the same distance to each of your partners, which should also equal the distance between them).
- Try to maintain this relation to your partners while their positions change.
- **Optional:** If you can, try to figure out, which other triangles you might be part of.

The dance ends after the music stops playing, but it can be repeated.



After the dance

Have the group find equilateral triangles in the final constellation or take guesses at who chose them as part of their triangle. You can also have everyone point to their triangle partners with both their arms.

Ask questions:

- Was it hard to remain at the corner of your triangle?
- How did the size of your triangle change during the dance?
- What happens if three people all choose the same triangle partners?
- What happens if two people choose each other as one of their triangle partners, but the third person is different?
- Is it possible to do this activity with other shapes (i.e. line segments, quadrilaterals)?

Depending on the surface you are dancing on, you may mark down the triangles (with chalk or similar). You can do so before and after the dance to compare (best using different colors).

Dance again

Have the group experiment with different starting positions for the triangle activity (the group stands in a circle, a straight line, two parallel straight lines etc.).
If you dance in the dark, dancers can point towards their partners with two flashlights.
Try repeating the dance choosing the same people and starting at the same position. Do you end in the same place?

Alternatives:

The Flock-Dance: The group chooses a leader, who stands in the center of the group. As soon as the music plays all dancers have to follow these rules:

- no dancer can get closer than 0.5m (one long step) to other dancers
- no dancer can get further than 1m (two long steps) from the group
- all dancers should dance in the general direction of the group

The leader has an additional task: They choose the direction of the dance, move around while dancing and can also make abrupt changes in any direction.

Create and Share!

Take a video of the dance (best from an elevated position). Create new rules for different chaotic, flock or other math dances. Share your creations, videos, playlists etc. using the hashtag **#idm314dance** and **#idm314**.

Mathematical background and resources:

This activity is an interactive representation of a deterministic but chaotic system. In such systems the behaviour of all elements is previously defined so there is no randomness in the process (this means that if we repeated the experiment with the exact same conditions, the same result would be obtained). However, since the system is very sensitive to small changes in the initial state it seems as if its behaviour is unpredictable (the popular “butterfly effect”). This type of systems is studied by Chaos Theory, a branch of mathematics. It’s used to analyze, among many other things, weather, climate, financial systems, road traffic and the movement of fluids.
When performing the flock dance, the group imitates an optimization algorithm, which is inspired

by the behaviour of a flock of birds (particle swarm optimization).
This simulator app models a swarm of fish:
https://imaginary.github.io/cindyjs-apps/fish/index.html

Credits:

This activity was proposed by Demian Goos.