

Lorenz Attractor

Classroom worksheet · Interactive simulation: <https://lkforge.com/tools/physics/lorenz-attractor/>

Name: _____ Date: _____

Learning objectives

- Describe deterministic chaos and strange attractors.
- Observe sensitive dependence on initial conditions.
- Distinguish chaotic from random behavior.

Variables to change

- Initial conditions
- System parameters

Procedure

1. Run the system and watch the trajectory trace the two-lobed attractor.
2. Start two trajectories from nearly identical points and watch them diverge.
3. Let it run and confirm the path never exactly repeats yet stays bounded.

Observations

Describe the shape of the attractor and how quickly two close starts separate.

Questions

1. What is a strange attractor?
2. Is the Lorenz system random?
3. What is the "butterfly effect"?
4. Does the trajectory ever settle to a point or loop?

5. What did Lorenz originally model with this?

Answer key (instructors)

- **1.** A bounded set that a chaotic trajectory is drawn to but never repeats, with fractal structure.
- **2.** No — it is deterministic; the same start gives the same path, but tiny differences grow exponentially.
- **3.** Sensitive dependence on initial conditions — small changes lead to vastly different outcomes.
- **4.** No — it stays bounded but never repeats, endlessly circling the two lobes unpredictably.
- **5.** A simplified model of atmospheric convection (weather), which is why it launched chaos theory.

The Lorenz system is deterministic yet chaotic: trajectories are drawn to a bounded, never-repeating "strange attractor," and nearby starts diverge exponentially (the butterfly effect). It arose from weather modeling and helped found chaos theory.