

Reaction-Diffusion

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

Name: _____ Date: _____

Learning objectives

- Explain how patterns emerge from reaction and diffusion.
- Describe the activator–inhibitor mechanism.
- Connect the patterns to nature.

Variables to change

- Feed rate
- Kill rate
- Diffusion rates

Procedure

1. Start the simulation and watch spots or stripes emerge from near-uniform starting conditions.
2. Adjust the feed and kill rates and observe how the pattern changes.
3. Compare patterns that form spots versus mazes/stripes.

Observations

Describe the patterns that form and how parameter changes shift them between spots, stripes, and mazes.

Questions

1. What two processes create the patterns?
2. What is an activator–inhibitor system?

3. Do the patterns require a pre-drawn template?
4. Who first proposed this mechanism for biological patterns?
5. Give a natural example of such patterns.

Answer key (instructors)

- **1.** Local chemical reaction and diffusion (spreading) of the reacting substances.
- **2.** One substance promotes its own production (activator) while another suppresses it (inhibitor) and diffuses faster, producing spaced patterns.
- **3.** No — they self-organize from small fluctuations; the pattern is emergent.
- **4.** Alan Turing — these are called Turing patterns.
- **5.** Animal coat markings (spots, stripes), seashell patterns, and vegetation patterning.

Reaction–diffusion systems pair a self-activating chemical with a faster-diffusing inhibitor. From near-uniform starts they self-organize into spots, stripes, and mazes — Turing patterns that model animal markings and other natural patterning.