

1. The Setting

- The Game of Life takes place on a **two-dimensional grid** of square cells.
 - Each cell has one of two possible states:
 - **Alive (1 or “on”)**
 - **Dead (0 or “off”)**
 - The grid evolves in **discrete time steps** (called *generations*).
 - The state of each cell in the next generation depends only on:
 - Its **current state**
 - The **number of living neighbors** (the 8 surrounding cells)
-

2. Neighborhood Definition

Each cell interacts with its **Moore neighborhood**, meaning the eight adjacent cells:

[x-1, y-1]	[x, y-1]	[x+1, y-1]
[x-1, y]	[x, y]	[x+1, y]
[x-1, y+1]	[x, y+1]	[x+1, y+1]

3. The Rules of Evolution

At every generation, the following rules are applied **simultaneously** to every cell:

1. Underpopulation

- Any live cell with **fewer than 2 live neighbors** dies (as if from isolation).

2. Survival

- Any live cell with **2 or 3 live neighbors** stays alive to the next generation.

3. Overpopulation

- Any live cell with **more than 3 live neighbors** dies (as if from overcrowding).

4. Reproduction

- Any dead cell with **exactly 3 live neighbors** becomes a live cell (as if by reproduction).
-

4. Key Characteristics

- The system is **deterministic**: the same initial configuration always produces the same evolution.
 - The evolution is **emergent**: complex, often unpredictable patterns arise from simple local rules.
 - No randomness or external input is required once the initial state is set.
-

5. Typical Patterns

Some well-known recurring structures include:

Type	Example	Behavior
Still lifes	Block, Beehive	Do not change
Oscillators	Blinker, Toad	Repeat a pattern in cycles
Spaceships	Glider, Lightweight spaceship	Move across the grid over time

Each 0 represents a **live cell**, and each . represents a **dead cell**.

Still Lives (Stable — never change)

1. Block

Generation 0:

```
.00.  
.00.  
....
```

This 2×2 square remains the same forever.

2. Beehive

Generation 0:

```
..00..  
.0..0.  
..00..
```

This six-cell oval shape is perfectly balanced and never changes.

Oscillators (Repeat in cycles)

3. Blinker

Generation 0:	Generation 1:
.....
.000.	..0..
.....	..0..
	..0..

- The blinker alternates between a **horizontal** and **vertical** line every generation.
 - **Period = 2**
-

4. Toad

Generation 0:	Generation 1:
.....
..000.	...0..
.000..	.0...0
.....	..0...

- The toad alternates between two offset bars.
 - **Period = 2**
-

Spaceships (Move across the grid)

5. Glider

Generation 0:

```
.0.  
..  
000
```

The glider moves diagonally across the grid, repeating its shape every 4 generations (with rotation).

6. Lightweight Spaceship (LWSS)

Generation 0:

```
.00.0  
0....  
0...0  
0000.
```

Moves horizontally across the grid, leaving behind empty space — a true “flying” pattern. **Period = 4**