This page is for

Teachers

Parents and carers

Digital Technologies @ Home
Unplugged activities for students

This activity is for: Years 7-10

Cellular Automoji

This cellular automoji activity is an adaptation of *cellular automata*, but using emoji! 😉 Cellular automata are grids of cells that are filled depending on the number and type of neighbours surrounding them. The most famous cellular automata is Conway's Game of Life, a game created in the 70s; easy to get started with, but complex enough that it can simulate a computer!

This activity teaches algorithms

Algorithms are procedures that we follow to reach a goal. They can be as simple as following a recipe, or a complex set of rules like those for a game of sudoku. This activity is similar to sudoku, in that the algorithm is expressed using a set of rules, rather than an explicit sequence of steps.

By sharing the rules, we share the algorithm.

In this activity we start with a very simple set of rules and starting conditions, but by the end you see quite complex behaviour emerging from the system.

This behaviour is quite common in the natural world. For example, air behaves according to very simple rules about air pressure, temperature, and humidity, but when allowed to work across the entire Earth it creates very complex systems, like Monsoons, El Nino or the East Indian Dipole.

This activity is targeted towards secondary students, and should take about **45 minutes**.

See a demonstration

cmp.ac/automojivid

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This page is for

Getting started (read this with your child):

We're going to make cellular automojis.

In cellular automoji we start with a single row of emoji at the top of a grid.

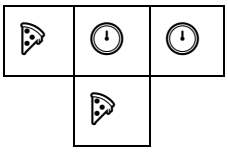
G1	🕐	🕐	🕐	🍕	🕐	🕐	🕐	🕐
G2								
G3								

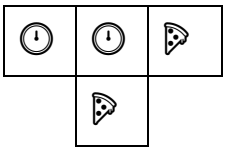
Each row of emoji is called a generation.

Each generation is created from the one before, and each cell is filled depending on the three cells above it.

For the *pizza time* cellular emoji, the rules are:

Rules:





If no rule applies, we put in a base emoji: 🕐

Following these rules, the generations will evolve like this!

G1	🕐	🕐	🕐	🍕	🕐	🕐	🕐	🕐
G2	🕐	🕐	🍕	🕐	🍕	🕐	🕐	🕐
G3	🕐	🍕	🕐	🕐	🕐	🍕	🕐	🕐
G4	🍕	🕐	🍕	🕐	🍕	🕐	🍕	🕐
G5								

Can you fill in the fifth generation row together?

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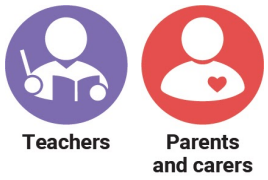
This page is for



Tips for edge cases!

Since there's no rule for this pattern…

G1	🕐	🍕	🕐

The next generation is a clock!

G1	🕐	🍕	🕐
G2		🕐	

At the edges of the rows, where there is no emoji, we pretend there is a base emoji there..

So if a row starts like this:

G1	🕐	🍕

It produces a pizza on the edge of generation 2, because we pretend there is a clock where G1 is!

G1	🕐	🍕
G2	🍕	

Step by step

1. Learn how to fill in generations of cellular automoji
2. Draw the patterns out yourself.
3. Make your own!

Hint!

You don't need to do a perfect drawing of the pizza emoji when you fill in the generations. A triangle represents pizza just fine:

▽ = 🍕

Also, you don't need to fill in the base emoji if you don't want to. Sometimes leaving cells blank makes it easier to see the pattern!

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This page is for

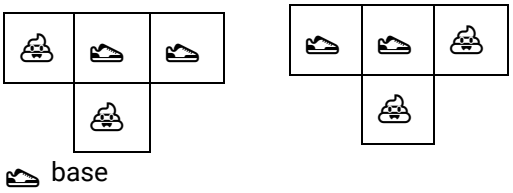
Students

Cellular Automoji

Follow the rules and fill in the cells

Question 1: New Shoe

Rules:



base

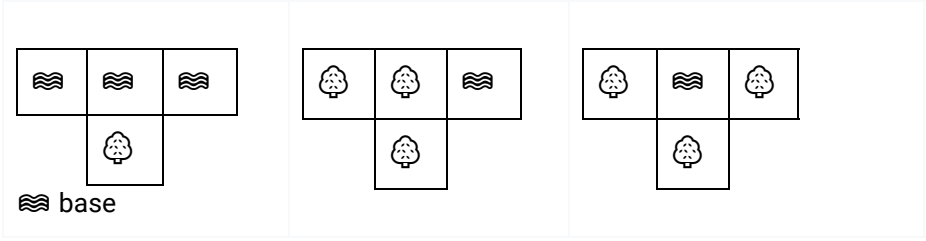
Automoji:

G1								
G2								
G3								
G4								

How many s in the 4th generation?

Question 2: Maze

Rules:



base

Automoji:

G1								
G2								
G3								
G4								
G5								
G6								

How many s in the 6th generation?

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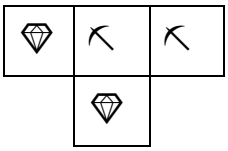
Question 3: Diamond Miners ⛏💎

Rules:



⛏ base

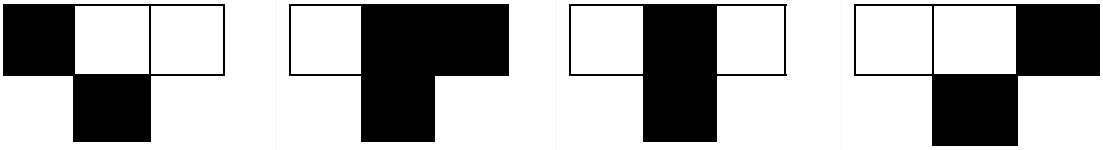
Automoji:

G1								
G2								
G3								
G4								
G5	⛏	⛏	⛏	⛏	💎	⛏	⛏	💎

Fill in the previous generations!

Question 4: Rule 30

Rules:



White square = base

Automoji:

G1								■						
G2														
G3														
G4														
G5														
G6														
G7														
G8														

What's the eighth generation?

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Answer key

Choose if you want to print this for your students or keep it to yourself!

Example: Pizza Time

The 5th generation looks like this

G5. 🕛🕛🕛🕛🕛🕛🕛🍕

Answer 1: New Shoe

There are 2 💩 emoji's in the 4th gen

G1. 👟💩👟👟👟👟💩👟
G2. 💩👟💩👟👟💩👟💩
G3. 👟👟👟💩💩👟👟👟
G4. 👟👟💩👟👟💩👟👟

Answer 2: Maze

There are 5 🌳 emoji's in the 6th gen

G1. 〰〰〰〰〰〰〰🌳
G2. 🌳🌳🌳🌳🌳🌳〰〰
G3. 〰〰〰〰〰🌳〰🌳
G4. 🌳🌳🌳🌳〰〰🌳〰
G5. 〰〰〰🌳〰〰〰〰
G6. 🌳🌳〰〰〰🌳🌳🌳

Answer 3: Diamond Miners

G1. 💎⛏⛏💎⛏⛏⛏⛏
G2. ⛏💎⛏⛏💎⛏⛏⛏
G3. ⛏⛏💎⛏⛏💎⛏⛏
G4. ⛏⛏⛏💎⛏⛏💎⛏
G5. ⛏⛏⛏⛏💎⛏ ⛏💎

Answer 4: Rule 30

G1								■							
G2							■	■	■						
G3						■	■			■					
G4					■	■		■	■	■					
G5				■	■		■				■				
G6			■	■		■	■	■	■		■	■	■		
G7		■	■			■					■			■	
G8	■	■		■	■	■	■			■	■	■	■	■	■

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This page is for

Want more?

Here are some further activities, online resources, assessment ideas and curriculum references.

Adapting this activity

Once students understand how to complete this activity, they could create their own rules, symbols and starting patterns and see what evolves!

Older students could create more complex rules that depend on two rows of cells, or five cells in the previous generation, rather than three.

Keep the conversation going

- Do you think some of these patterns will go on forever?
- Do they repeat themselves?
- What happens if you change the starting pattern?
- What happens if you change the rules?
- Rule 30 creates a really complex pattern from very simple rules. We call this **emergent behaviour**. Can you make another set of rules that causes behaviour like this?

Keep learning

For students interested in learning more about cellular automata look up **Elementary Cellular Automaton** or **Conway's Game of Life**.

To learn more about implementing algorithms, you can try the courses at the ACA website.

We recommend Javascript Space Invaders!
cmp.ac/spaceinvaders

For teachers creating a portfolio of learning or considering this task for assessment

For younger students:
Ask students to create their own set of rules for cells on a grid, and see how it develops.

Do some rules make for more interesting patterns than others?

For older students:
Ask students to write a program that follows the rules to print new generations.

Linking it back to the Australian Curriculum: Digital Technologies

Algorithms
Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input and to identify errors. (ACTDIP019 / ACTDIP029 - see cmp.ac/algorithms)

Refer to aca.edu.au/curriculum for more curriculum information.

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