

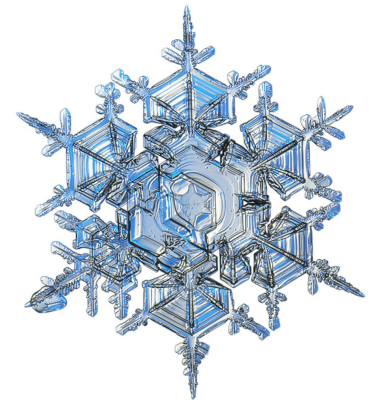
Math in Nature



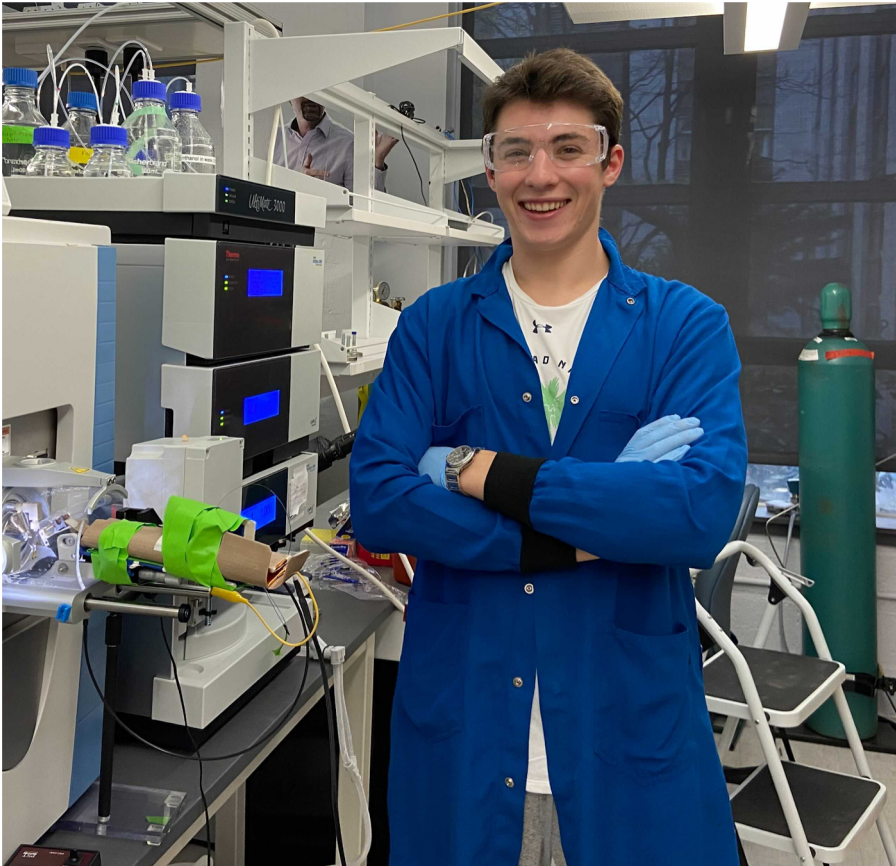
Snowflakes and Studying How they form

By Andrew Leduc

Scientist at Northeastern University in Boston



About Me



- Graduate Student Researcher at Northeastern University in Boston
- Member of the Slavov Laboratory

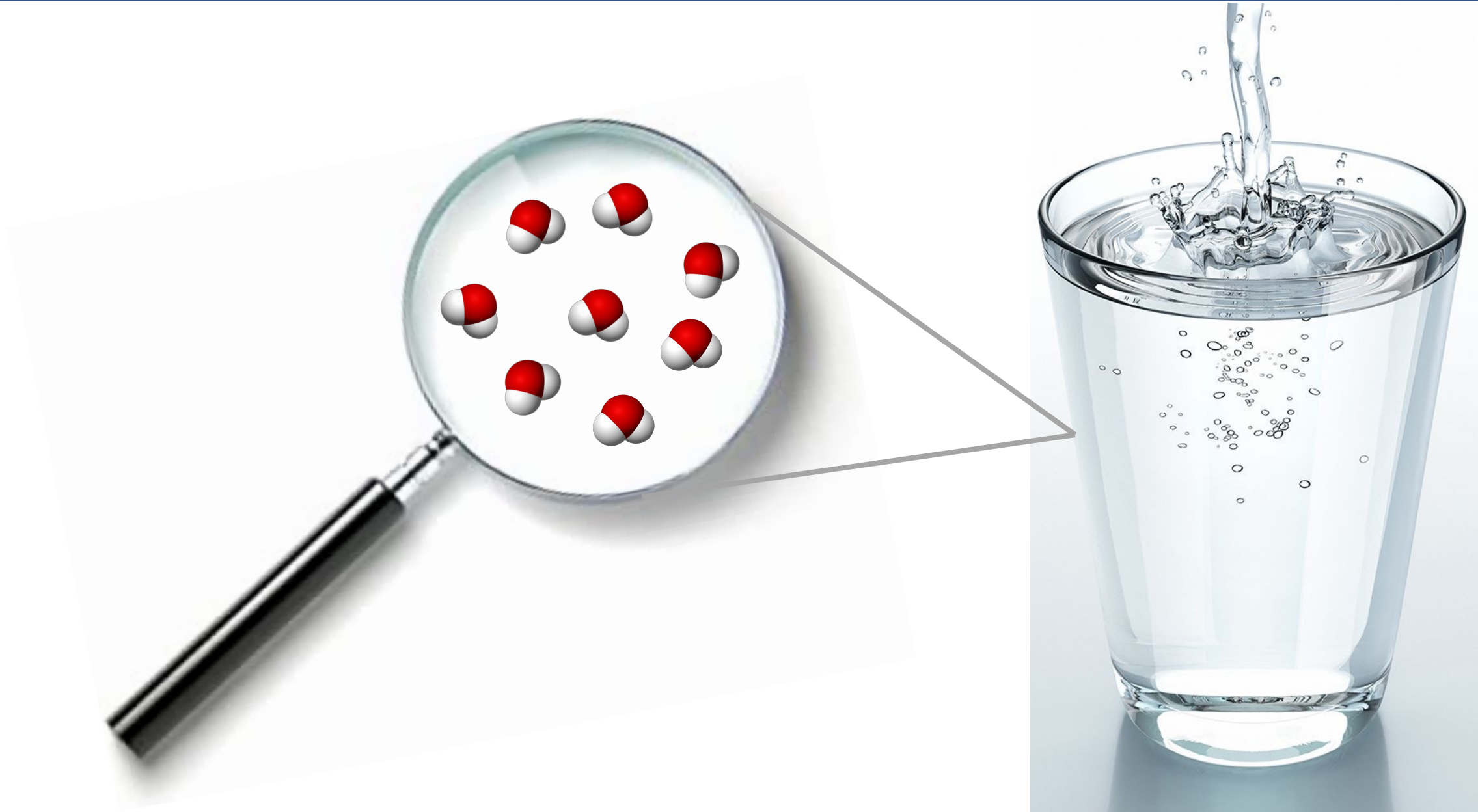




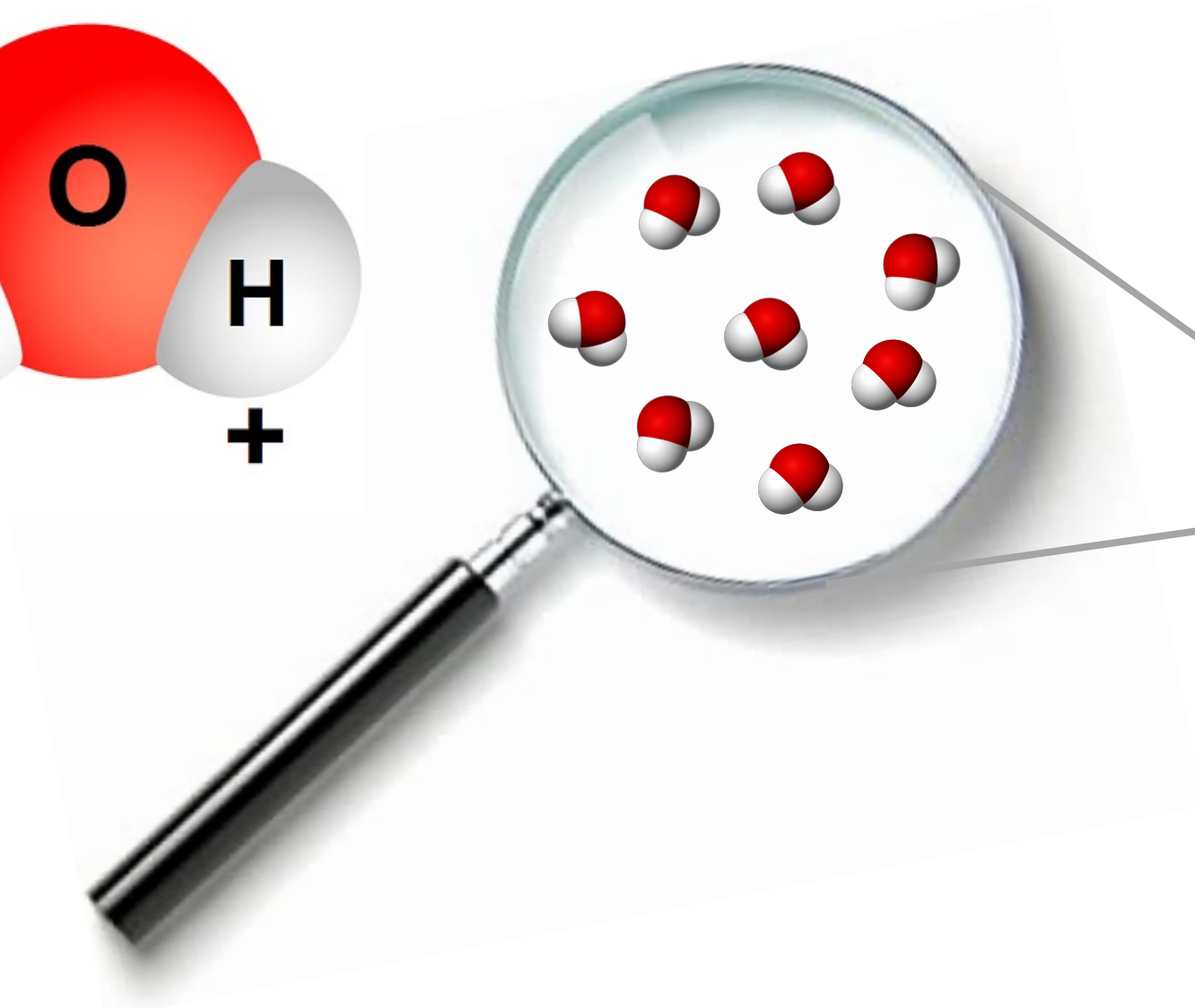
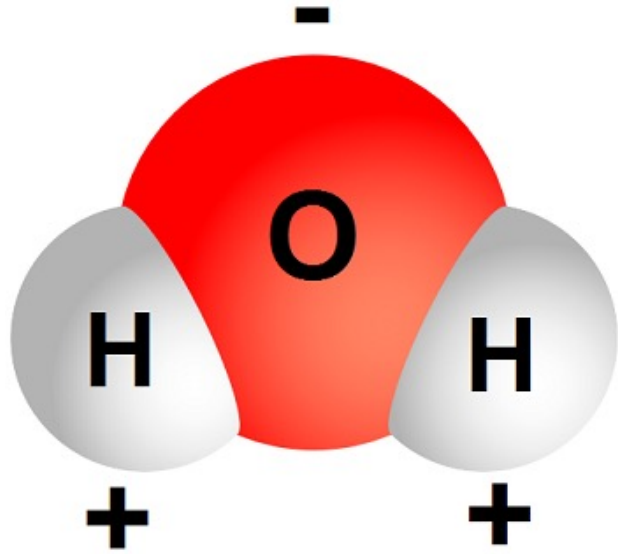
Why Are all Snowflakes Different?

What are Snowflakes Made of?

Snowflakes are Made of Water

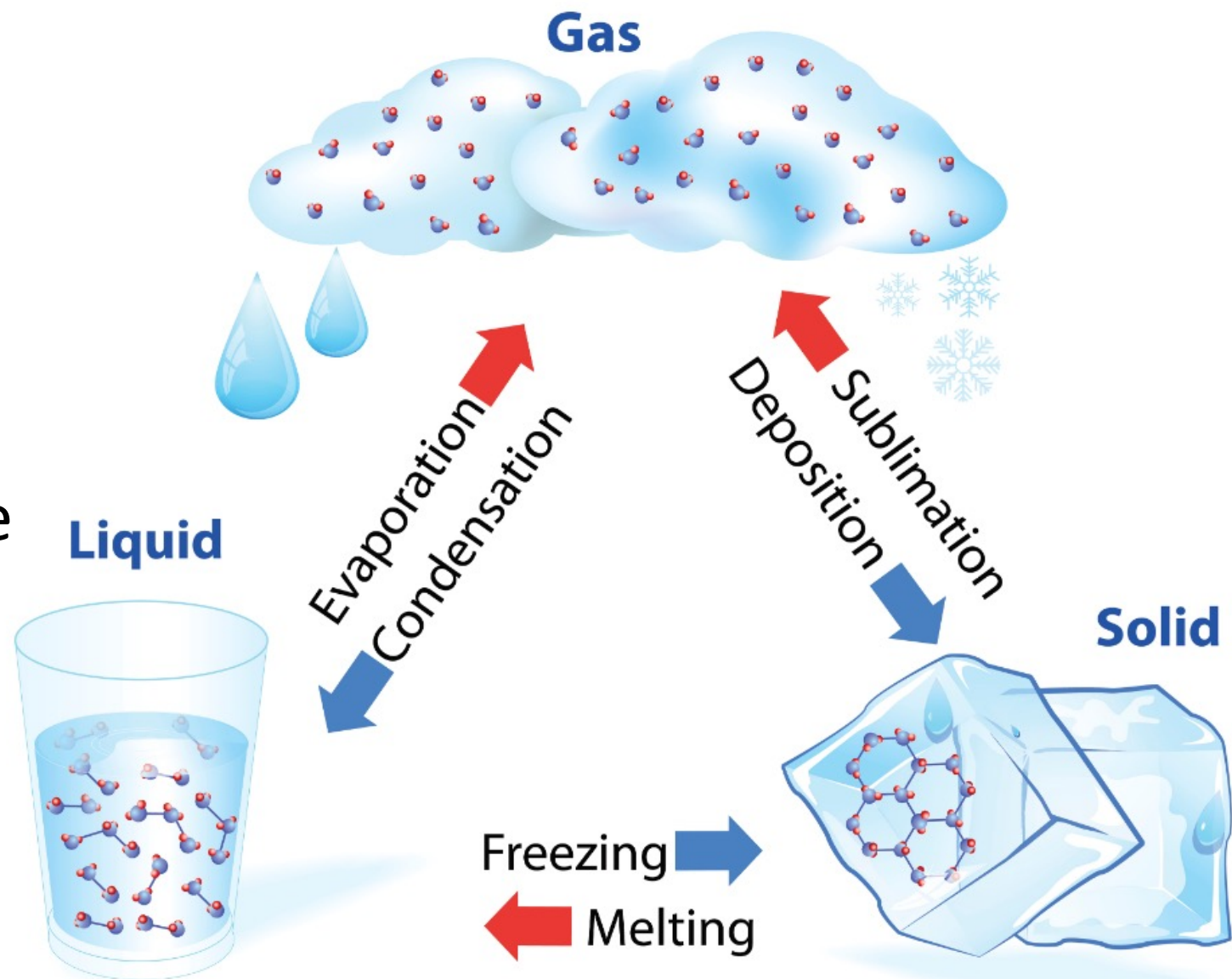


What is water made of?



Different Forms of Water

Water can take different shapes based on temperature



What is a Snowflake

Cold Air

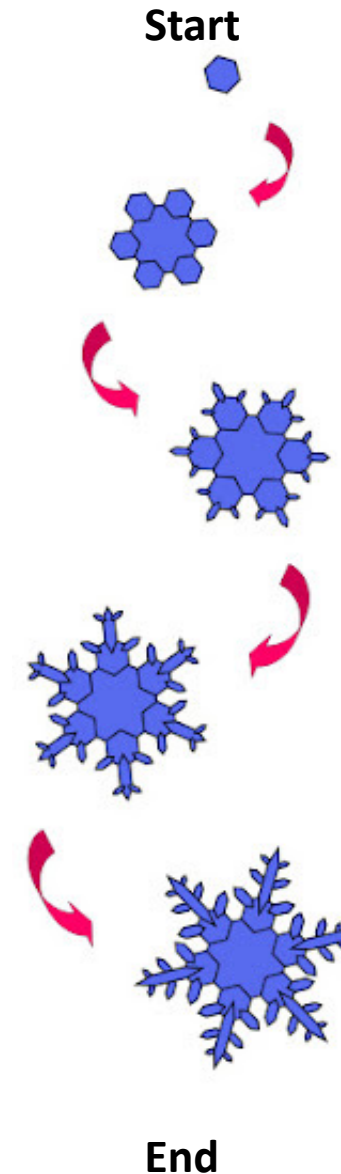


Rain Cloud



So why are all snowflakes different?

- As snowflakes fall, they collide and stick together with smaller snowflakes
- How the snowflakes stick depends on the temperature and pressure at each point along path
- Each path is random and different, so each snowflake is different!



What is a Snowflake

Faster Wind Means
Snowflakes collide
faster



More Rain Means
More Snowflakes
Bump into Each other

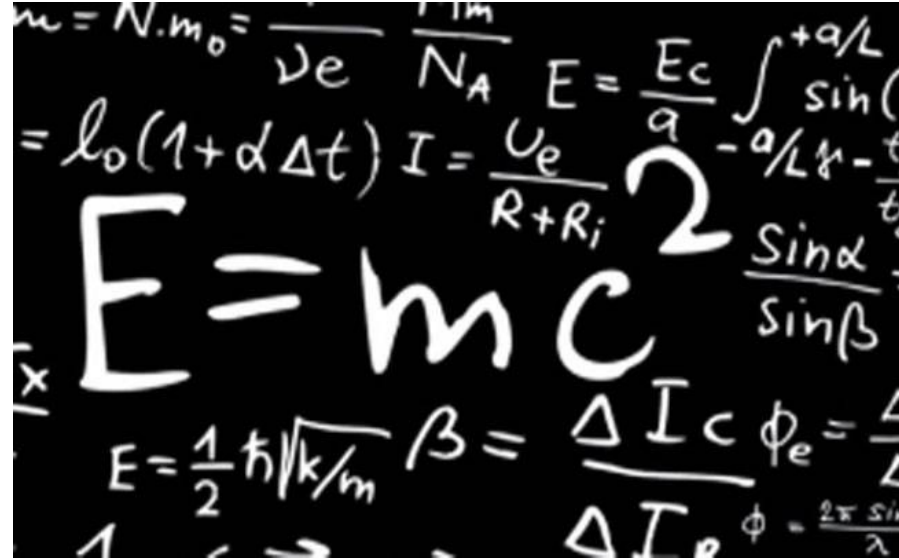


Colder Air
Means Smaller
Snowflakes



Using math to understand snowflakes

Equations?



Andrew's Law of snowflakes:

Wind + Amount of rain + Temperature = Shape of snowflake?

Using math to understand snowflakes

A different approach using simple
computer programs

Computer Program: Set of instructions you give to a
computer for the computer to follow

Using math to understand snowflakes

A different approach using simple computer programs

Step 0

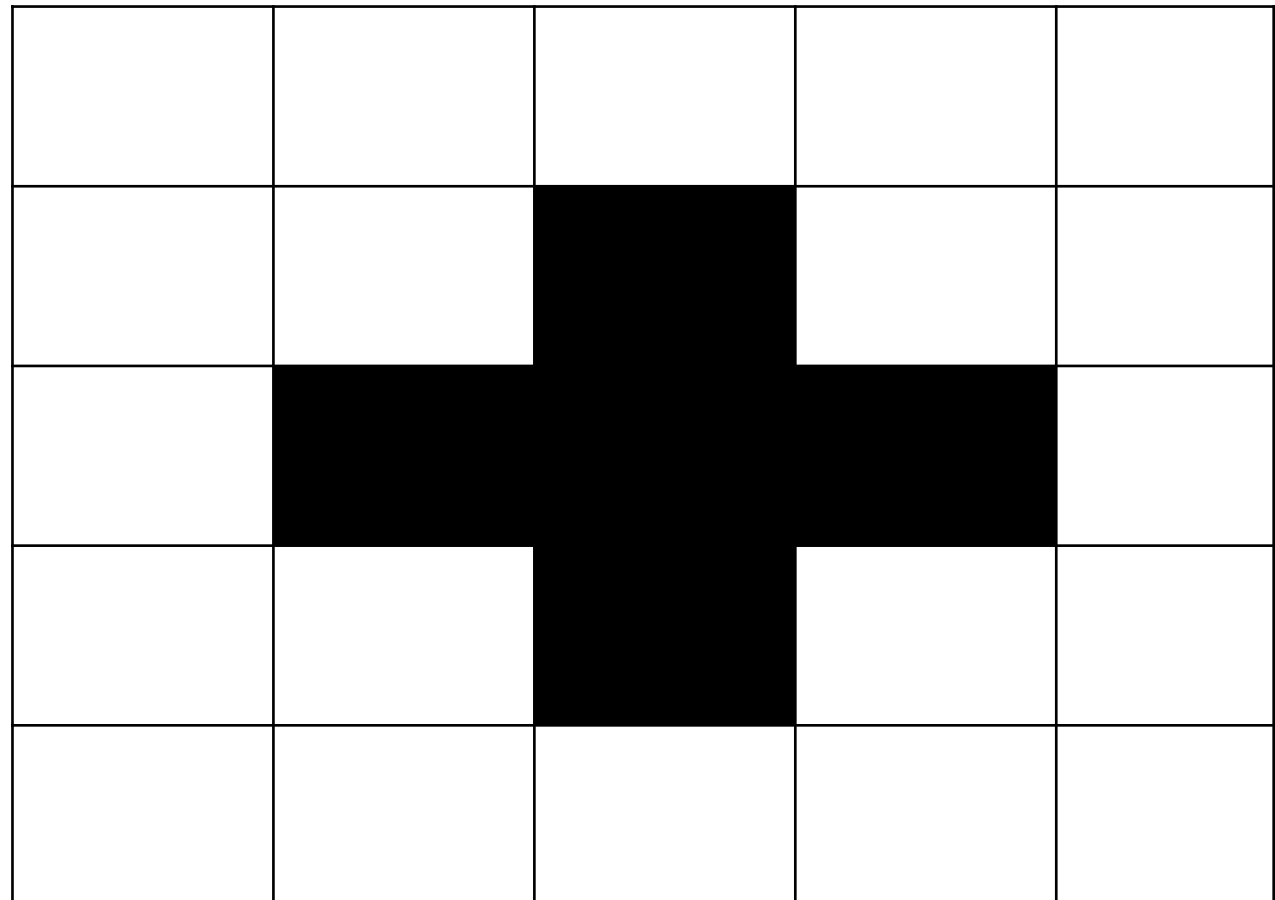
Example Computer Program

- If a white block touches a black block, change from white to black
- Repeat first step 10 times

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A different approach using simple computer programs

Step 1



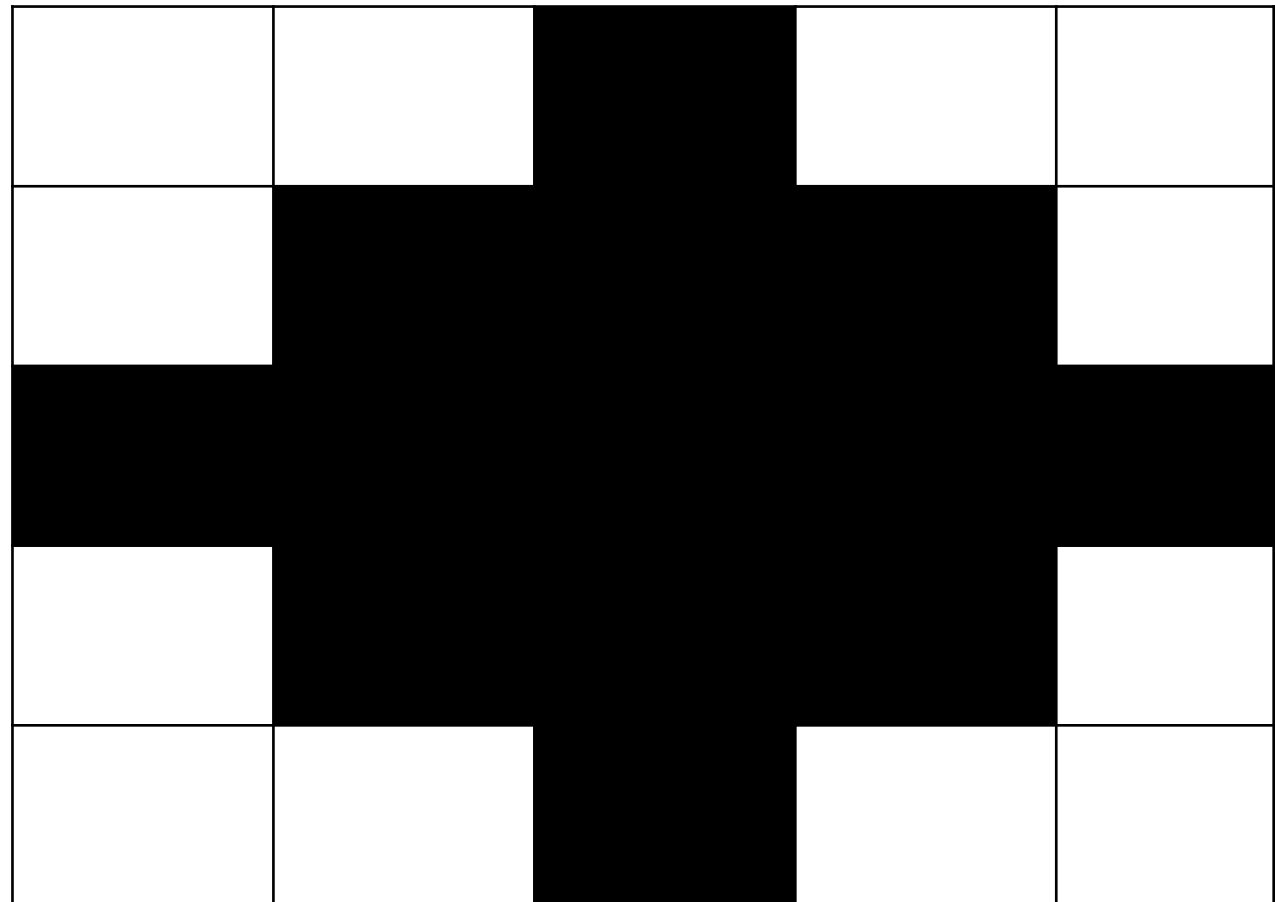
Example Computer Program

- If a white block touches a black block, change from white to black
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Step 2



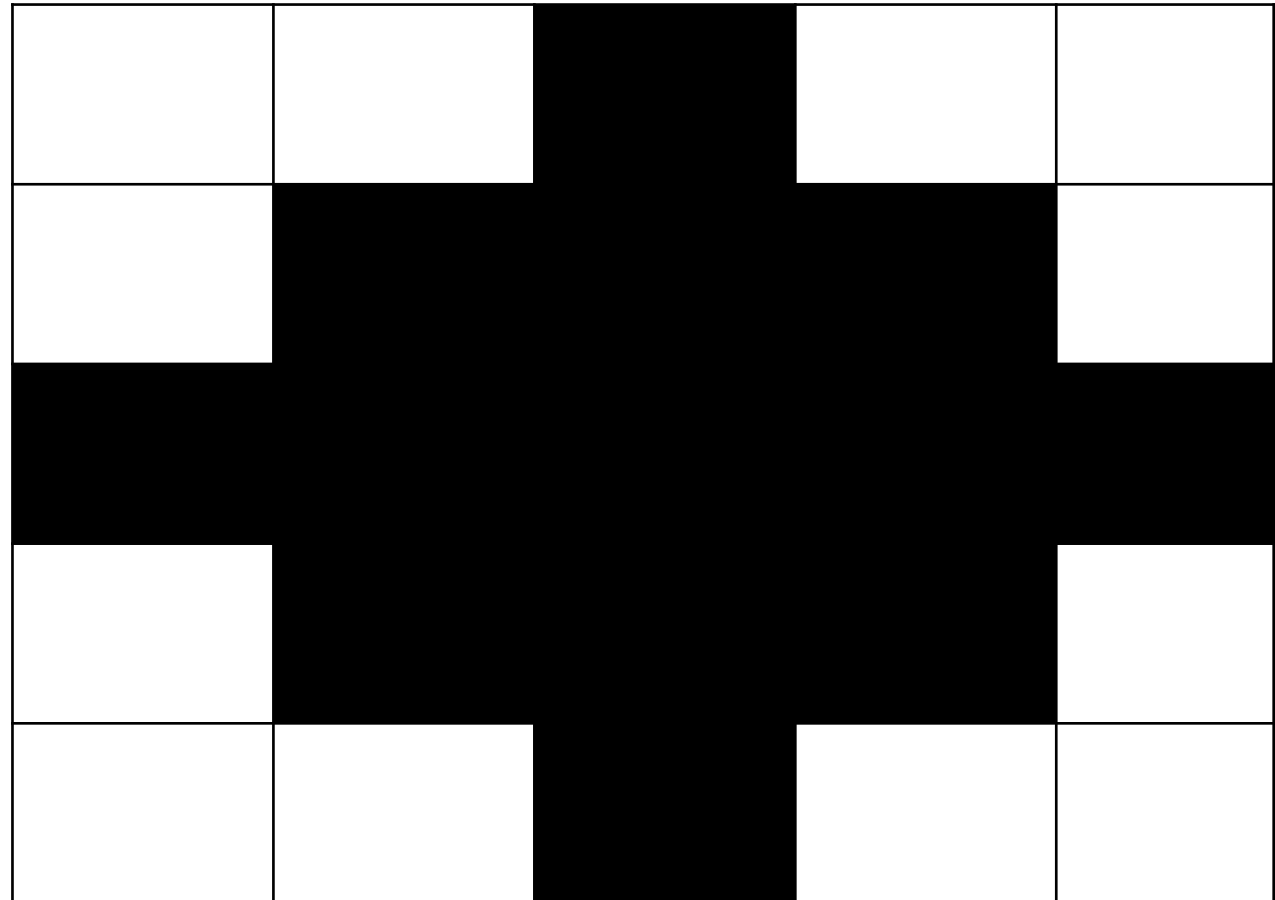
Example Computer Program

- If a white block touches a black block, change from white to black
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Step 2



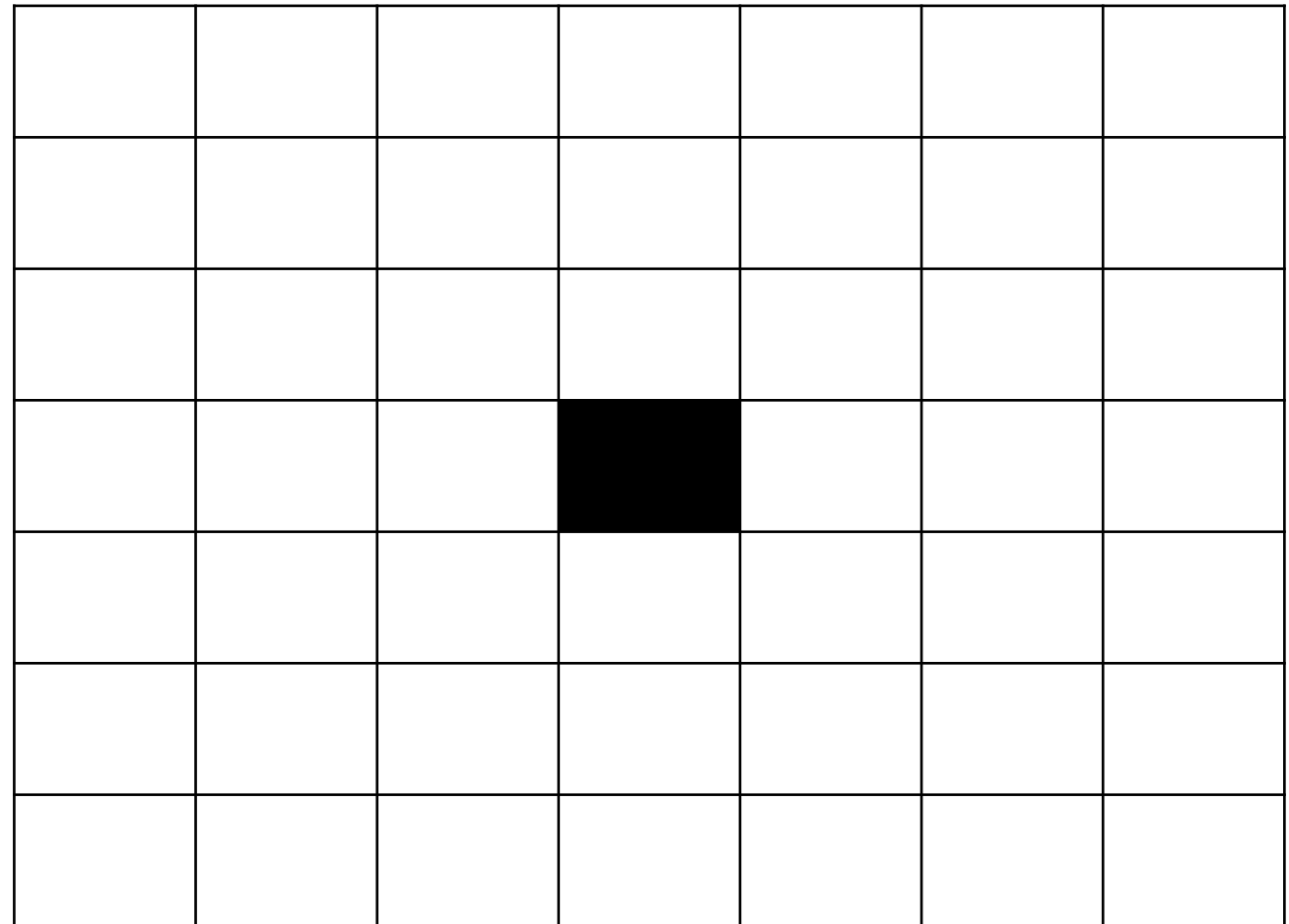
Each step represents
snowflakes colliding
together

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Step 0

- If a white block touches only ONE black block, change from white to black
- Repeat first step 10 times

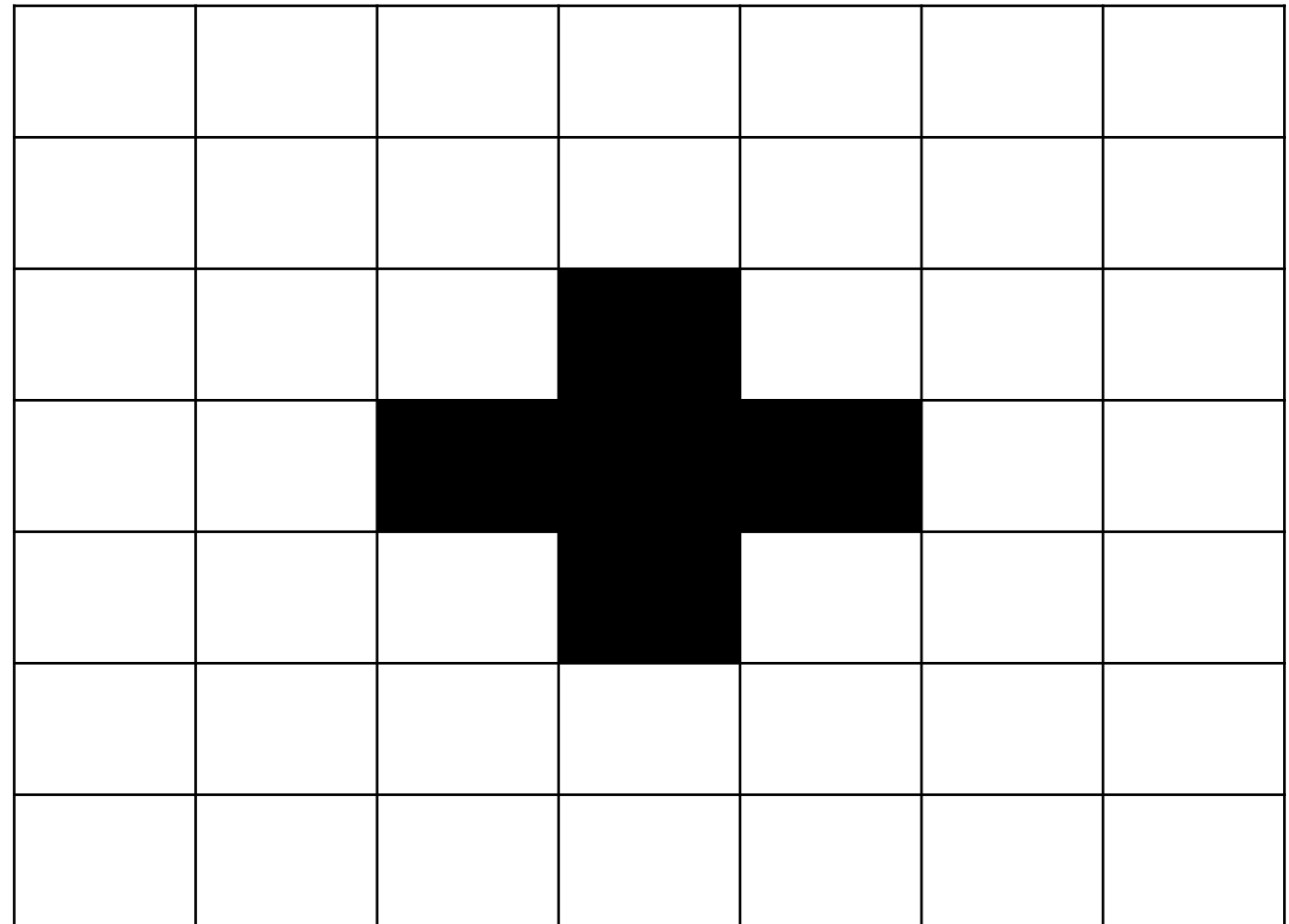


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A different approach using simple computer programs

Step 1

- If a white block touches only ONE black block, change from white to black
- Repeat first step 10 times

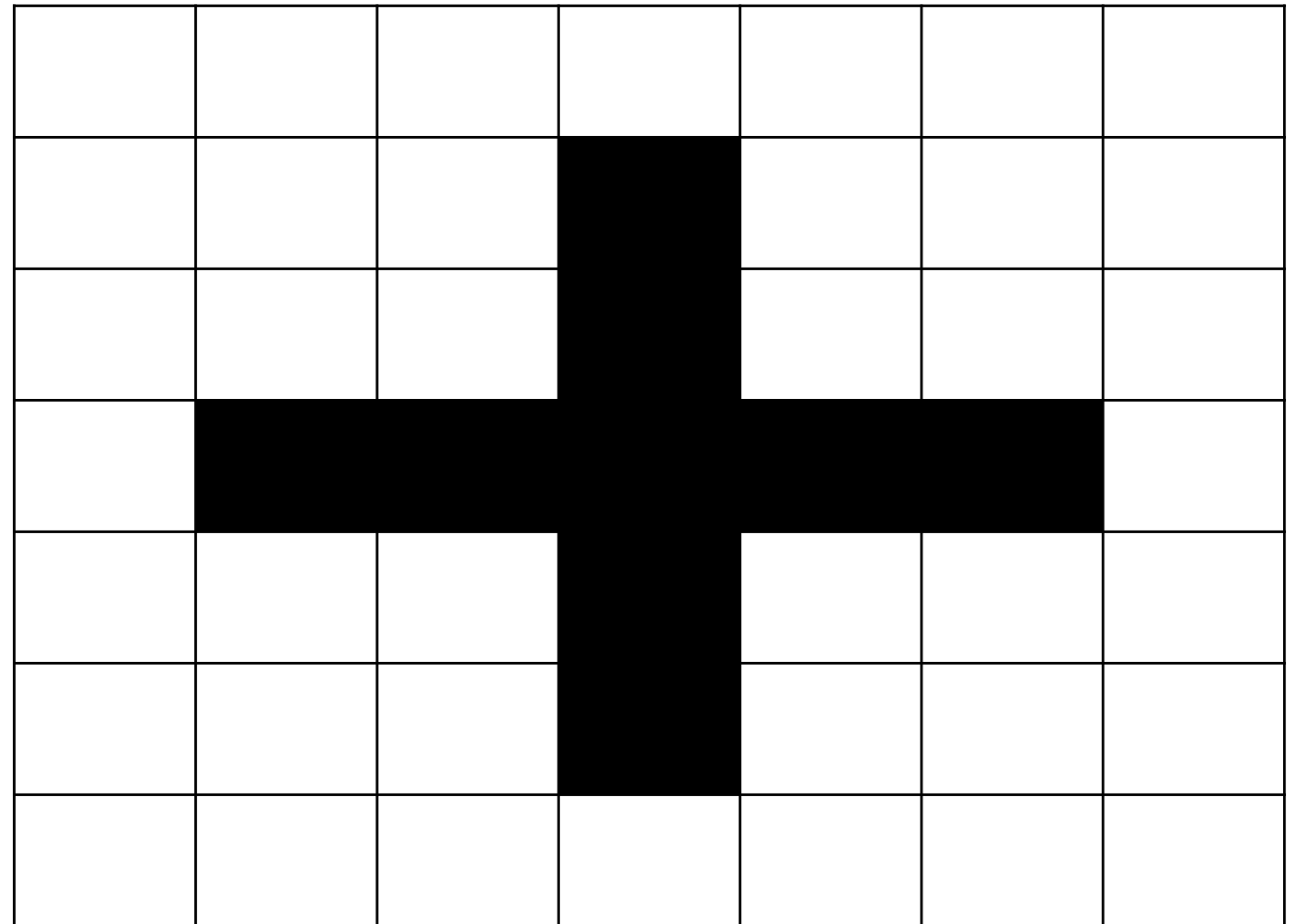


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A different approach using simple computer programs

Step 2

- If a white block touches only ONE black block, change from white to black
- Repeat first step 10 times

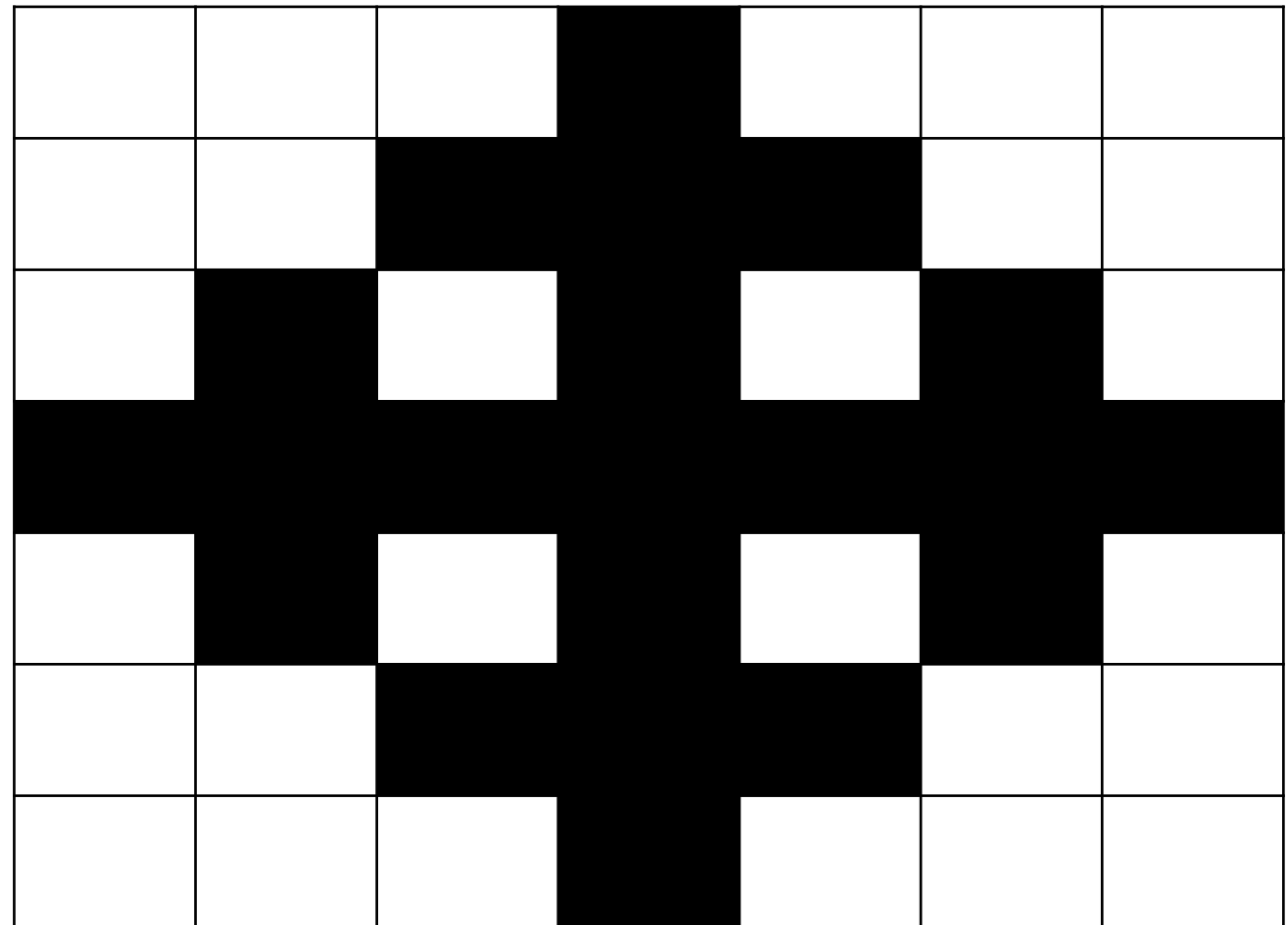


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A different approach using simple computer programs

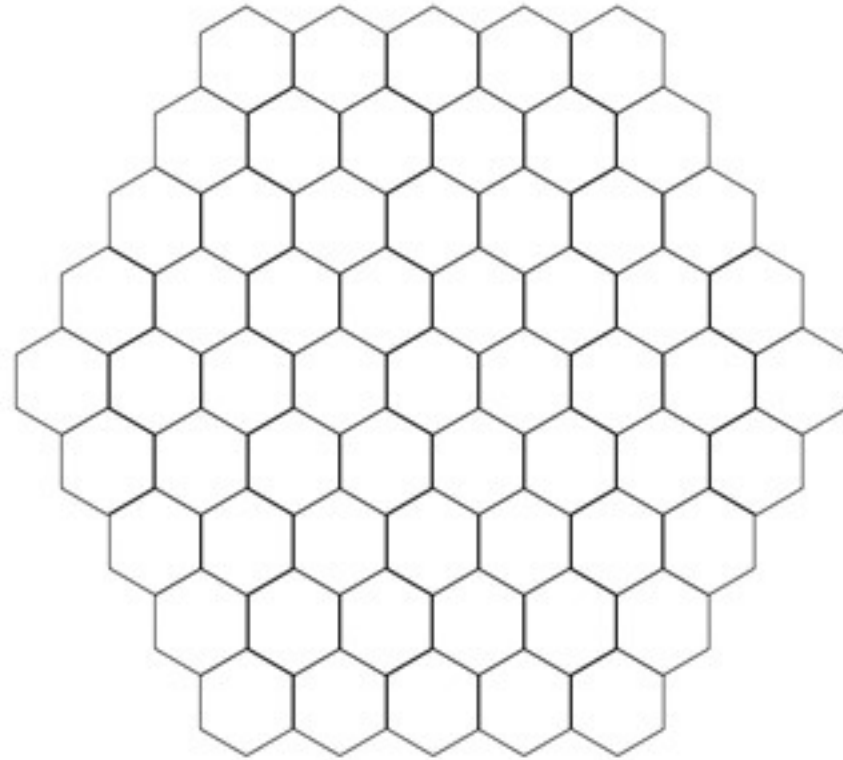
Step 3

- If a white block touches only ONE black block, change from white to black
- Repeat first step 10 times

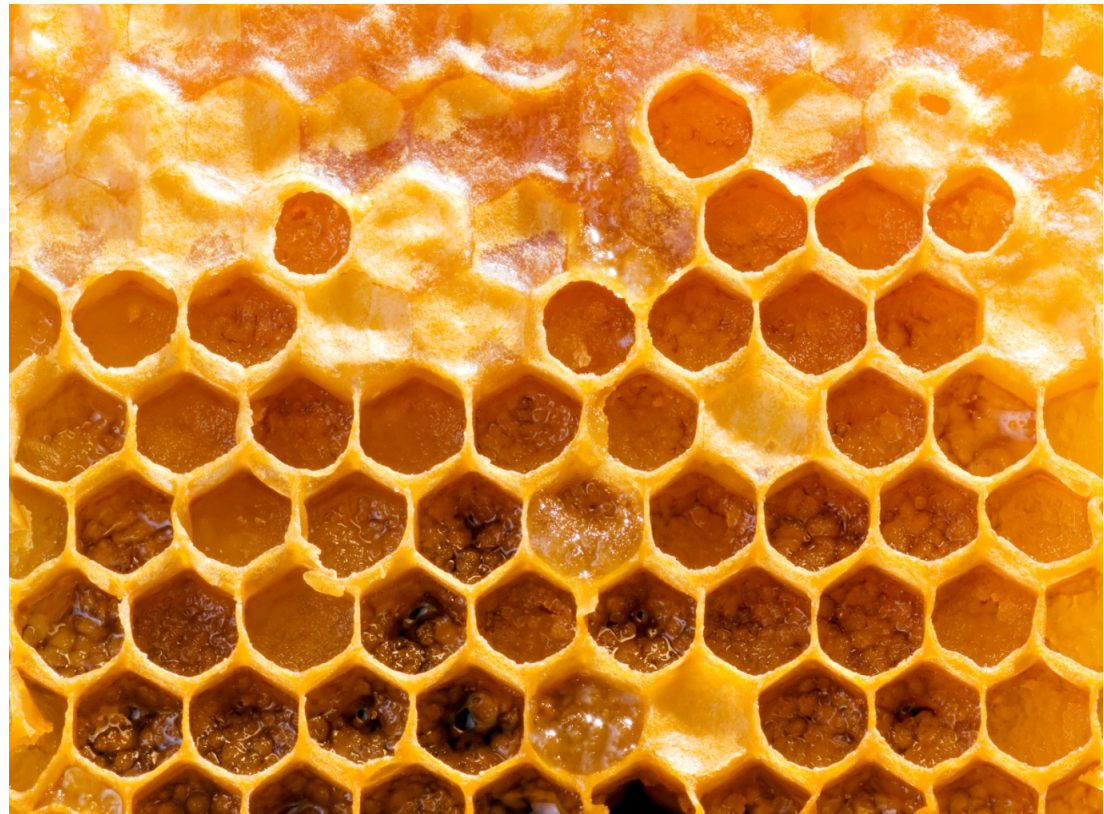
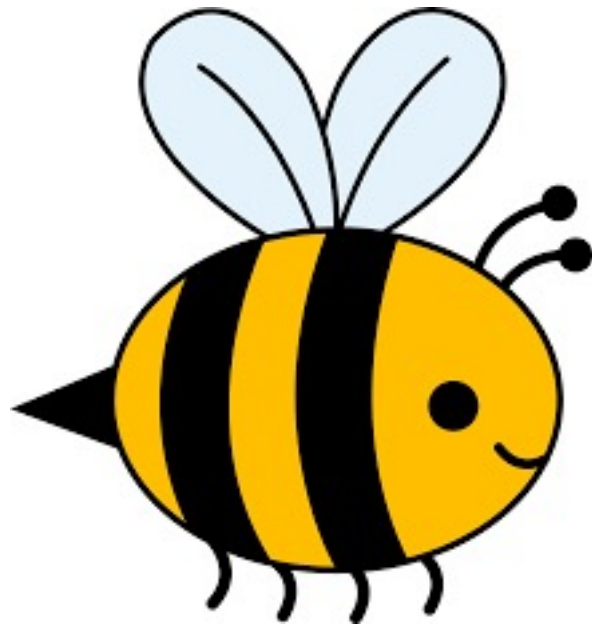


Using math to understand snowflakes

How else can we try to change our computer program?

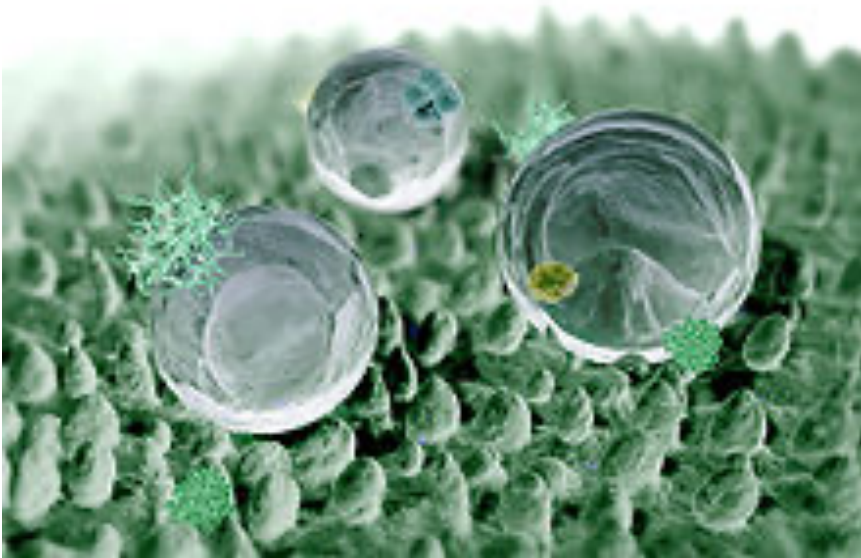


Other Examples of Math In Nature!



Other Examples of Math In Nature!

Leaves Surface Repels Water



Other Examples of Math In Nature!

Rings in Plants



Other Examples of Math In Nature!

Shapes of Animals



Thanks Guys!