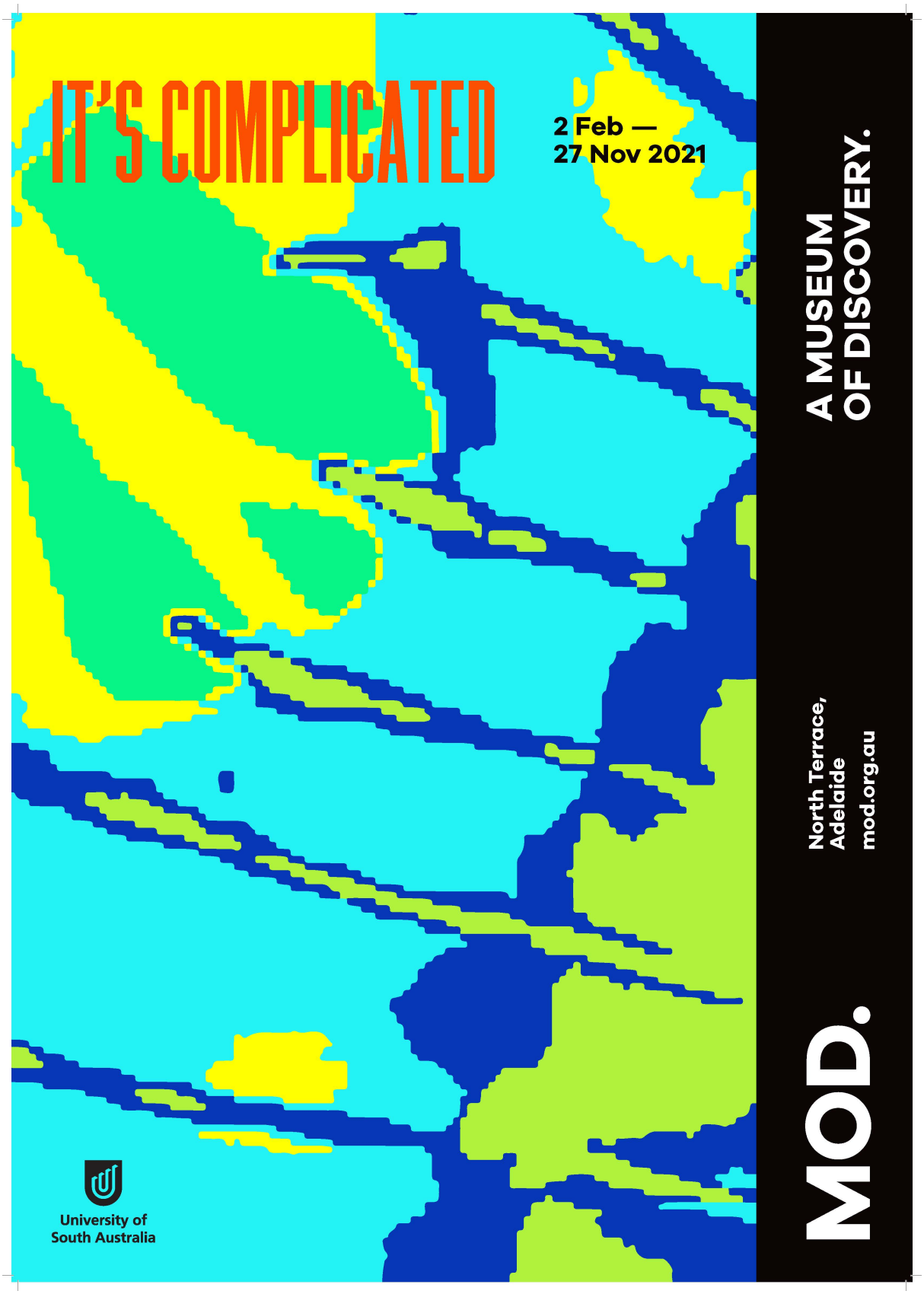
Large Print Guide



IT'S COMPLICATED

This time around, MOD. is focusing on dynamic interconnectedness. What is that? Well, it's **complicated**. Actually, it's **complex**. A system like your mobile phone is **complicated**. It may have lots of parts, but these parts are guided by simple rules which can be understood, predicted and reproduced. A **complex** system is different, and more than just the sum of its parts. Complex systems change over time, sometimes dramatically, and can lead to something entirely new and different.

All of this means that problems in complex systems are trickier to find solutions for. It also means that even well-thought out solutions can have unexpected and unintended consequences. Like trying to wipe out malaria but ending up with parachuting cats.

In an exploration of relationships between humans, nature, and technology, MOD. invites you to raise an octopus in a Tamagotchi-inspired simulation, design a home for sea creatures, or just try and predict chaos. From genetically modifying mozzies to hacking our own immune systems, and from building robots to making music, IT'S COMPLICATED pulls back the curtain on the seemingly simple and reveals just how complicated, and complex, the world can be.

Operation Cat Drop

What could go wrong?

Problems in a complex system can be tricky to solve. The more moving parts there are, the harder it is to keep track of what's going on.

We might mean well but our solutions can have unintended outcomes. Like trying to wipe out malaria but ending up with parachuting cats.

Delve Deeper

Operation Cat Drop is an example of how tipping points in populations of pests and predators can have sudden large impacts on complex systems. An increase in favourable conditions for rats, that allows disease to flourish, represents a dramatic change in the state of a system and demonstrates how nonlinear processes are important in the dynamics of pest outbreaks.

In the 1950's, people in Borneo suffered a malarial outbreak so the World Health Organisation (WHO) sprayed DDT to kill the malaria-carrying mosquitoes. The mosquitoes were killed but the DDT also killed wasps, geckos and cats, leading to a rat population explosion, along with outbreaks of typhus and plague. To cope with these problems, the WHO parachuted live cats into Borneo. This was Operation Cat Drop.

Feeding Frenzy

Is there safety in numbers?

What do salmon, bees, parrots and sheep have in common? They all flock.

Flocking is when all the animals in the group move in the same direction. It might look fancy, but each animal is following a few simple rules. A fish will try to swim in the same direction as its mates without crashing into them.

Play the role of a predator and see how the school of fish responds to you.

Delve Deeper

Shoaling behaviour is an example of self-organisation arising from local interactions between parts of an initially disordered system.

For example, a seemingly complex behaviour such as fish schooling can occur when each individual fish follows three simple rules:

1. Swim close to your neighbours, but
2. Avoid crowding them, and
3. Swim in the same direction they are.

Chaos Machine

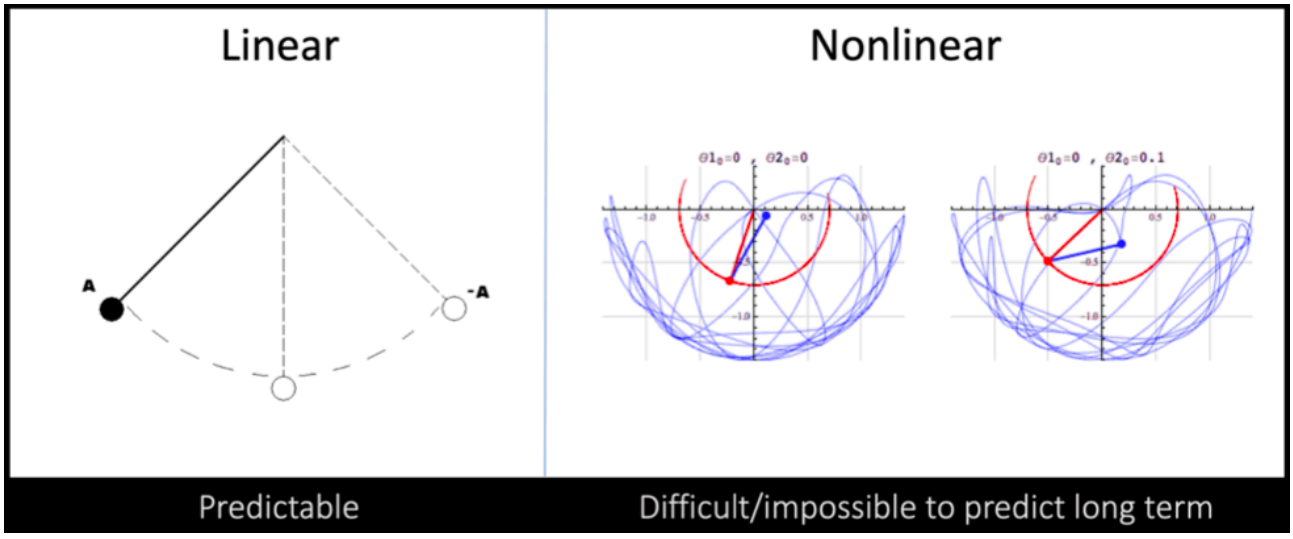
Can you predict chaos?

Double pendulums are strange things. One arm swinging from a fixed position is straight-forward enough. But add another arm to the first one and things start to get weird.

Predicting what a chaotic system will do is close to impossible, but don't let that stop you from trying.

Delve Deeper

A nonlinear system such as a double pendulum is highly sensitive to initial conditions. This means that even a minor change to an input (say the starting position of the pendulum's arms) can result in large differences in a later state (like the pattern traced by the arms).



A simple pendulum (linear system) on the left swinging back and forth; and two double pendulums (nonlinear systems) to the right, one with a slightly different starting position to the other.

Despite the behaviour of the double pendulum being deterministic—its future behaviour is fully determined by its initial conditions, with no random elements involved—predicting what pattern the arms will trace is extremely difficult, if not impossible.

Gene Drive

How can you change a population?

Mosquitos are pretty annoying, but they also can be dangerous. They spread diseases around the world that impact almost 700 million people each year.

But what if we could change the genetic makeup of a mosquito to keep us safe? We can now genetically modify mosquitos so they can't spread malaria. In labs it's easy enough to make hundreds of new, malaria-proof mosquitos. But spreading genetic change in the wild is another thing. To change the genes of billions of wild mosquitos we need new technology: the gene drive.

Delve Deeper

So what exactly is a Gene Drive? There are different kinds of gene drives including ones that occur in nature, for example a bacteria that can infect mosquitos, called Wolbachia, that leaves them infertile. This is being applied to try and control dengue, another mosquito borne disease, in Queensland.

Synthetic gene drives use CRISPR/Cas9 technology to cut out specific target genes and replace them with a modified gene, using the cells own repair machinery to copy the modified gene.

Octopus Estate

What's under the surface?

Deep in the ocean, there is an octopus lurking. A shark approaches. Will your octopus try to eat the shark? Or flee? Its life is in your hands now.

Care for an octopus and help it to thrive. But stay on your toes, it's an octopus-eat-octopus world out there, and you might not guess who's a threat.

Delve Deeper

Cephalopods are adaptable marine species and have the potential to support South Australia's growing need for sustainable seafood. However, many cephalopod species are poorly understood and it is crucial that the basics of their biology are first understood.

Crazy Little Thing Called BRUV

What's BRUV got to do with it?

Squid drive-bys. Crabs riding sharks. Octopus tentacle slaps. There's a lot going on under the sea, we just aren't around to see it. But with Baited Remote Underwater Video (BRUV), researchers are starting to get an idea.

Scavengers might eat for free, but predators are always nearby. Get ready to explore how marine animals behave when they think no one is looking.

Delve Deeper

Baited remote underwater video (BRUV) is a system used in marine biology research. By attracting fish into the field of view of a remotely controlled camera, the technique records fish diversity, abundance and behaviour of species. Sites are sampled by video recording the region surrounding a baited canister which is lowered to the bottom from a surface vessel or less commonly by a submersible or remotely operated underwater vehicle. The video can be transmitted directly to the surface by cable or recorded for later analysis.

Let's Complicate Things

As a non-extractive technique, it offers a low environmental impact way of understanding changes in fish numbers and diversity over time. BRUV surveys were developed in Australia, and are now used around the world for a variety of projects. This is a low budget monitoring system that is less reliant on the availability of skilled labour and may make sustainable monitoring more practical, over the long term.

There are two main types of remote video technique which have been used to record reef fish populations. They can both be left free standing without the need of an operator. The first system uses one downward looking camera (D-BRUV), and the other uses either one (mono) or two (stereo) horizontally facing cameras (H-BRUV), and may use underwater lighting to illuminate the target area. Stereo BRUV recordings can use software analysis to determine the size of specimens. The colour of the lighting used for video may influence behaviour of the target species.

Discover More

Read
- Underwater magic: How to film camera-shy fish
- What is Big BRUVver up to? Methods and uses of baited underwater video
- What are we missing? Advantages of more than one viewpoint to estimate fish assemblages using baited video

UniSA study links

- Marine and Arid Environments
- Bachelor of Science

Sea-habilitation

How do humans nurture nature?

Old oil platforms might be junk in the sea, but now they have become thriving marine ecosystems. We could take them out, but that would disrupt these new habitats.

Humans can barely stop themselves from intervening with nature. Do we just need to butt out and let nature do its own thing?

Delve Deeper

Co-evolution is likely to happen when different species have close ecological interactions with one another. It is one of the main ways biological communities are organised.

Two organisms living in close relation is called symbiosis. Symbiotic relationships include:

1. Predator/prey (and parasite/host) – one species in the relationship benefits at the expense of the other(s);
2. Competition – this involves intra- and interspecies competition for resources like food or shelter;
3. Mutualism – both species gain benefit from the relationship.

Oil platforms, seawall tiles and shellfish reefs all provide habitat where species have close ecological interactions, for example the interactions on shellfish reefs where oysters excrete a mucus-like substance that is rich in nutrients and provides food for small shellfish that in turn provide food for larger fish.

Custom-Made

Are you ready for the revolution?

We are living in the fourth industrial revolution. Smart Things, sensors, and cloud computing are making our lives easier.

But what about robots? How will we work with them? UniSA Engineering students have been working with Dorna, our robot arm, to build custom-made racing cars. Now it's your turn, are you ready?

Delve Deeper

Throughout previous industrial revolutions, the work of humans has been augmented with machines in order to improve productivity, reduce workloads and operate in environments that are difficult or hazardous for people.

The fourth industrial revolution (Industry 4.0) shares these ambitions by focusing on the integration of distributed smart sensing, control and communication systems using cloud computing and real-time data storage/retrieval.

Pneumatic Blooms (Launch May 2021)

How will you react?

The Hooded Lycrabot (*Flore pneumaticae*) is a synthetic organism that can detect heat from living things. When approached, a Lycrabot will react with a hissing display of colour.

Delve Deeper

Pneumatic Blooms incorporates cutting-edge soft robotic research and development from leading technology institutes such as
Harvard Biodesign Lab and Whitesides Research Group MIT. Soft robotics involve numerous STEM-relevant fields such as:

- Mechanical engineering (pneumatics)
- Electrical engineering (circuits, sensors, solenoids)
- Physics (fluid dynamics, reaction forces)
- Biomimicry and xenobiology
- 3D design and fabrication

Cave of Sounds

What will emerge?

Music has existed as long as humans have. We use it to tell stories and to create bonds. Eight artists and hackers were tasked to create a new musical instrument. Some use shadows, some use light, some use your whole body.

Cave of Sounds is an experiment in unmediated musical collaboration.

Delve Deeper

Visitors interact with each instrument in a radically different way, embodying the dynamic and creative hacker scene that this piece of work emerged from. Each instrument was designed with simple and primal input methods in mind, much like the prehistoric music makers that inspired this project, yet are capable of producing diverse and complex sounds. The musical possibilities become even greater when played together.

Cell Invaders

How can you hack your body to kill cancer?

Could the answer to treating cancer be found in your own blood?

Upstairs in this very building, researchers are investigating CAR-T therapy. This new treatment hacks your immune system to turn it into a cancer killer.

Enter the blood stream, Magic School Bus style, and check it out from the inside.

Delve Deeper

There's no single cure for cancer, because each cancer is a complex system.

Cancer is out-of-control growth of cells in the body. But it's not disorganised. Rather than growing as a random blob, cancer cells are able to self-organise in ways that help them grow, for example by blocking out immune cells or making their own blood vessels to be able to feed themselves.

Kate Little

Can you control chance?

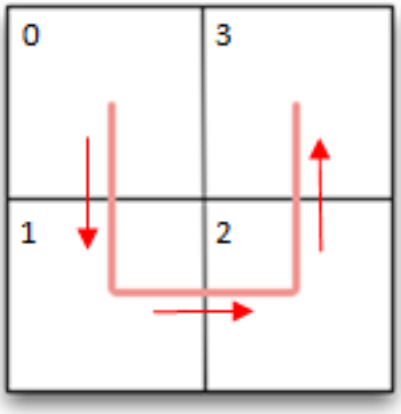
What happens when you combine patterns, randomisation and emergent properties of materials and data?

South Australian artist Kate Little creates artworks that draw from mathematics, textiles and music to offer new ways of thinking about relationships between humans, nature and technologies.

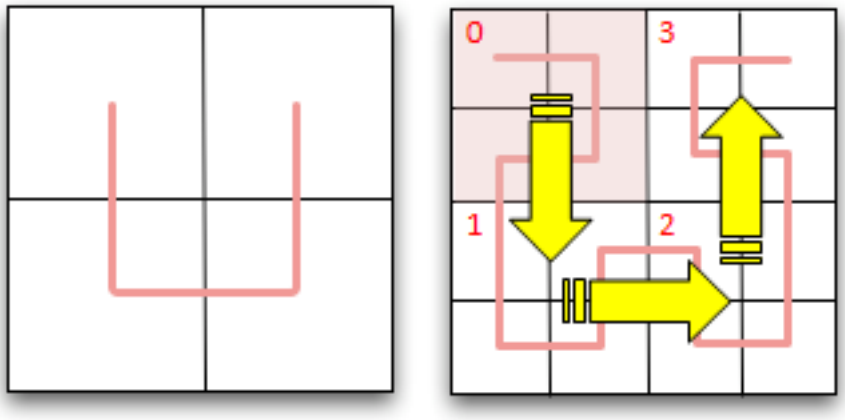
Delve Deeper

There are a selection of works along the corridor that have been created using the Hilbert Curve, a continuous fractal space-filling curve.

What does that mean? Space filling means you can think of it like trying to drape a string that covers all the squares of a grid without crossing over itself. And fractal means if you zoom in and look closely at a section of a higher-order curve, the pattern you see looks just the same as itself.

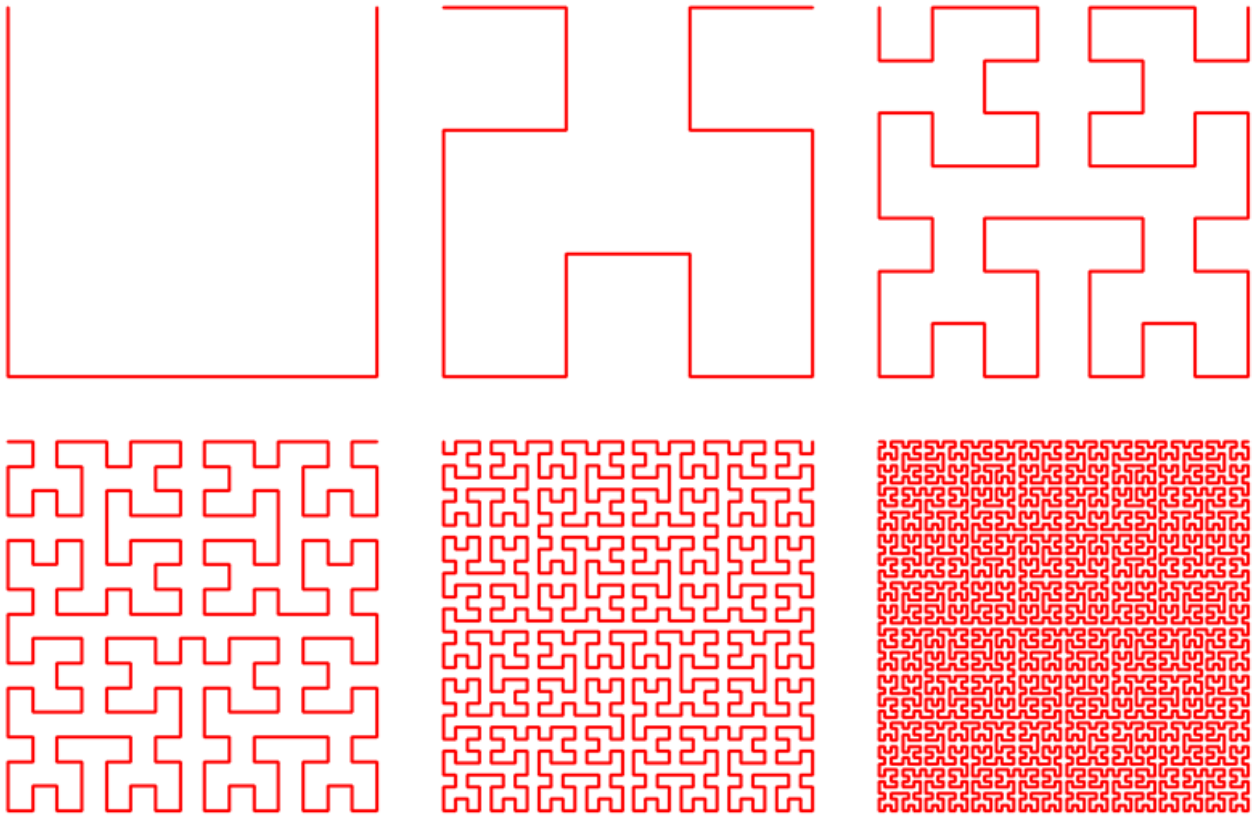


This is the basic U shape of a Hilbert curve in a 2 x 2 grid.



If you double this to a 4 x 4 grid, each containing the U shape that passes through all four quadrants of the grid.

This is a recursive pattern that can repeat and repeat giving you patterns like this:



These have applications in spatial databases and mapping, and also in graphics processing.

Always Was, Always Will Be Our Future(s)

Why tell a story?

The world is a complex place. Stories help us make sense of how things are, how things were, and how things might be.

Discover stories written by First Nations authors weaved throughout the exhibition, that invite you to reimagine the future of our world and others.

Delve Deeper

Stories define the people who tell them; they are an expression of ourselves. In a neurological sense, stories assist the human brain in navigating the world. Stories allow us to test out new ideas and scenarios in a safe way before deciding how to act in reality. Stories help us break down large systems into accessible combinations of stories.

Indigenous Futurism are speculative fictions written by Indigenous authors. Echoing Afrofuturism, these stories confront, challenge, and subvert norms associated with colonial and racist genre tropes. Instead, these stories take inspiration from the strength of First Nations knowledge systems, world views, stories, language, and traditions to reimagine this world, and others.