# SCIENTIFIC SUPERPOWERS

Google Arts & Culture

Learn Anywhere

In association with LEXICON

# How to use this lesson plan

This plan takes you on an exciting journey with plenty of links through to amazing online content so no need to print. This lesson plan is suitable for anyone but we recommend it for ages 7 to 11. It's a lot of fun to go on this journey with parents, teachers or your friends, but it is designed so you can explore independently at your own pace. There are different types of questions to answer: can you discover, explore and invent? We think so.

Check in with your parents or teacher if you need to, but you'll need a tablet, computer or smartphone. You can do this *Learn Anywhere* lesson on almost any device as long as you can get online and use a web browser. There are 6 Chapters:

Chapter 1 - Scientific Superhero Origins 25 minutes
Chapter 2 - Dr Gadget 15 minutes
Chapter 3 - The Shapeshifter 15 minutes
Chapter 4 - The Sensational Extra Sense 15 minutes
Chapter 5 - Channelling The Elements 15 minutes
Chapter 6 - Extraordinary X-Ray 15 minutes

You'll see some helpful signs on the way:

Useful information to guide you through the lesson

Things you'll need to watch, read, learn and make things with during the lesson.

Digital activity time. Take quizzes and explore.

Estimated time to do a section of this lesson

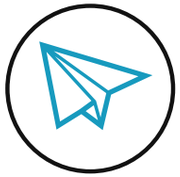
Explore online content. Discover videos, stories, or go and look at and zoom around pictures.

Activity time. This is where you get to design, make or write something of your own.

Headphones to listen to videos and audio

# Things you'll need

Things that will help you during this *Learn Anywhere* lesson.



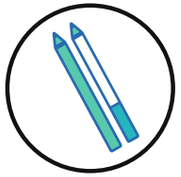
**Scrap Paper**

**Brush and Paint**

**Tablet or Computer**

**Scissors**

**Notepad**



**Pens and Pencils**

Welcome to ***Learn Anywhere: Scientific Superpowers***

In this *Learn Anywhere* lesson, you are going to learn all about how five superhuman people are using science to save the world. You'll explore the power of x-rays, discover the abilities of nano gadgets, learn about mimicry, using lasers to save lives and channelling the elements to protect us all. Get ready to investigate...

**What will you do?**

1. Go on an adventure to discover the science that inspired the superheroes that are so popular today.
2. Then you will hunt for facts and stories about these scientific breakthroughs of the past.
3. You'll write a story of your own superhero origin story based on a science.
4. You'll go on a journey of invention and discovery around the world.

Marvel, Team Up Spider Man And Power Man No 75, 1978, Museum Of UnCut Funk

**What will you learn?**

1. Find out about the atom.
2. Discover microminiaturisation and electronics.
3. Explore X-rays.
4. Learn about mimicry, transcription factors and cancer cells.
5. Discover lasers and sensors that could save us all.
6. Explore nanotechnology powered gadgets.
7. Work with the elements during climate change.

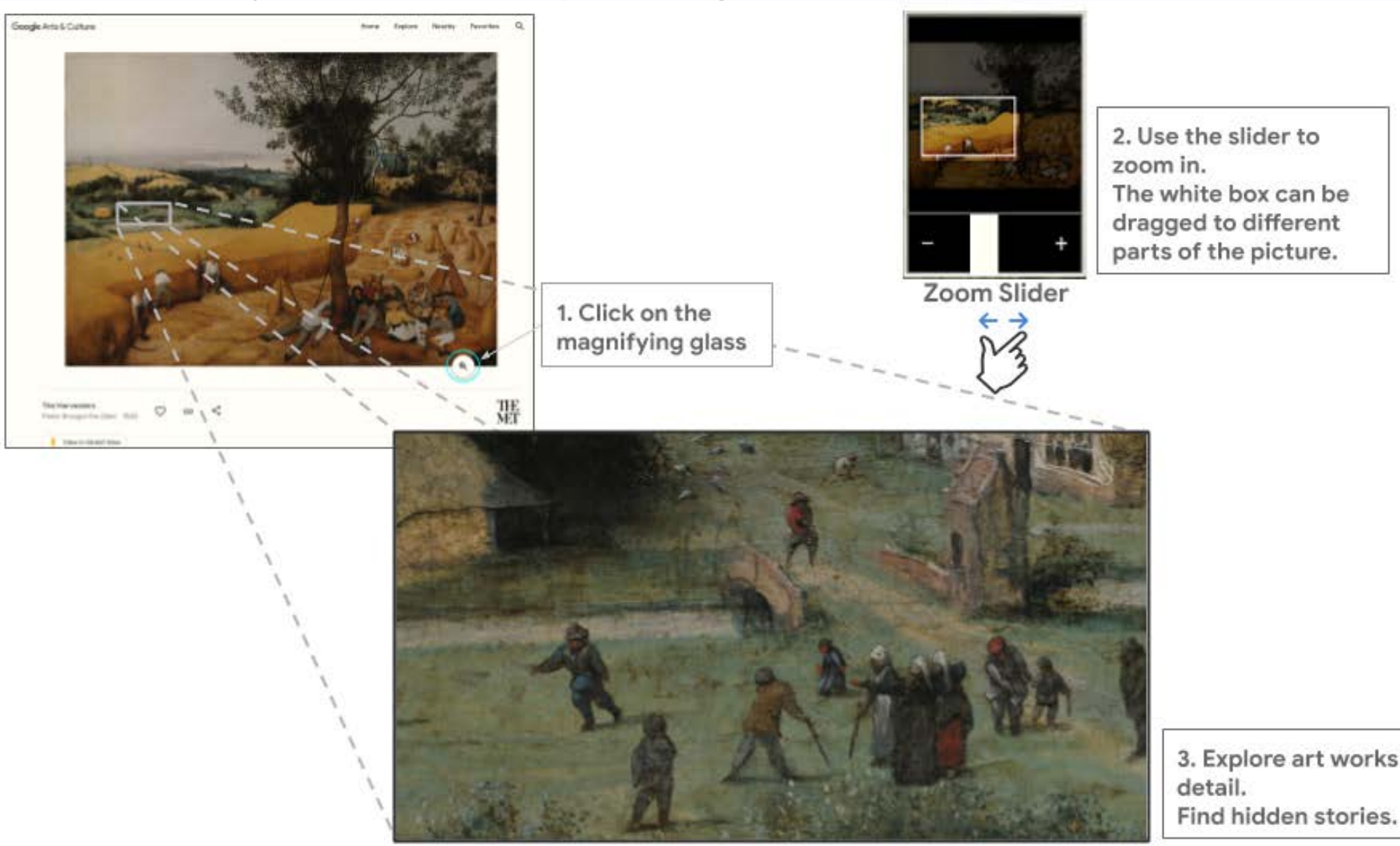
**After studying this lesson, you will be able to:**

1. Describe and identify x-ray tomography.
2. Explain how nano-materials will revolutionise our entire lives.
3. Write a story about being able to detect earthquakes and how your lasers will save thousands of lives.
4. Save millions of lives with computers detecting cancer and mimicking the actions of proteins to stop cancer spreading.
5. Understand how super scientists are going to save us from extreme weather and climate change.

**Vocabulary:** 3D printing, 3D replica, algorithm, AR, artificial intelligence, attaching, beetle, biochemist, body, butterfly, cancer, capture, cell, code, conduct, consequences, coupling, critical components, defects, designing, disassemble, disguise, disrupt, drought, electricity, electronic chip, engineer, examination, exoskeleton, fault, flexible, floods, forces, gadget, generate, genes, glass sphere, gravitational field, heart, information, innate, instantly, interface, invisible, jumbo jet, keyhole surgery, lab, laser, master villain, mismanagement, monitoring, moon, motion, motion of a virus, mutation, nanomaterials, nanosensors, nano-structures, noise, novel, optical sensors, pathways, peptides, permeable, pharmaceutical, pinpoint, polarised, proteins, rainwater, resources, response, results, rotates, sensitivity, shells, solar panels, solution, sponge city, submarine, suite, superhuman, targeting, therapies, tissue, touch, transcription factors, transparent, treat, tumour, undruggable molecule, universe, utility belt, visible, VR, white light, x-ray computer tomography, x-ray micro-tomography, x-ray vision.

There’s one more thing to know before you go on your lesson. Google Arts & Culture pictures are big. So big that you can zoom in. Explore. Sometimes right down to the size of the stitching on a super-suit.

So you just need to click on a link, then on the Magnifying Glass symbol and zoom in with the Zoom Slider. Drag the white box around and you can explore the picture. You’ll find out for yourself. Here’s an example of a Google Arts & Culture picture and the zoom slider.




Pieter Bruegel the Elder, The Harvesters, 1565, The Metropolitan Museum of Art


Marvel, The Avengers No 87, 1987, Museum of UnCut Funk

# Chapter 1

What's this chapter about?

"SCIENTIFIC SUPERHERO ORIGINS"

What will I do?
Discover the secret history of superheroes
Find out how new science and news headlines of the day inspired their origins
Write a short 200 word story

How long will this chapter take?
25 minutes

Nuclear Test Blast, 1956. LIFE Photo Collection

The great superheroes of today were born in an era defined by war and the advancements of technology that went with that conflict.

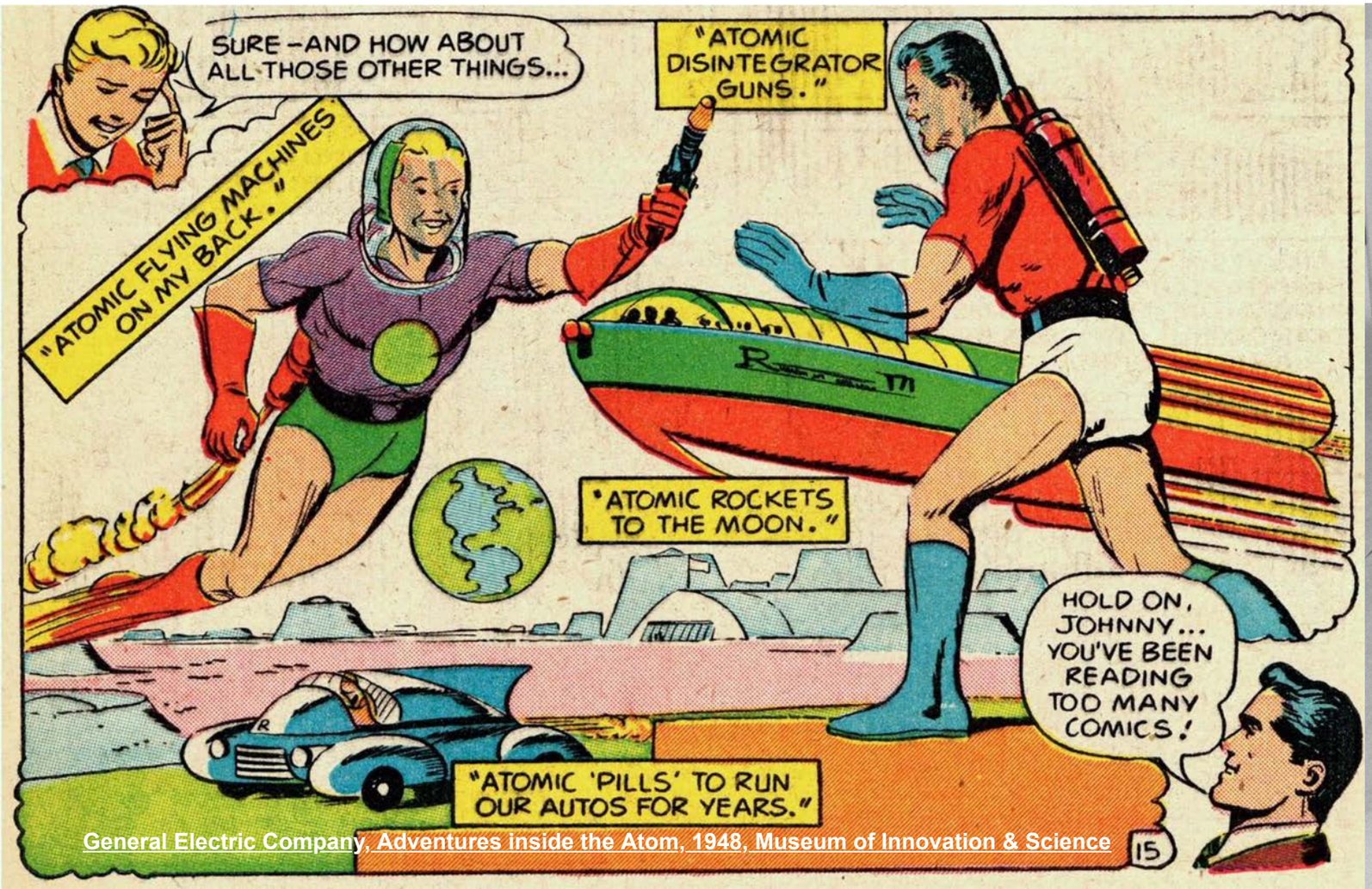
On 18 April 1938, as storm clouds of war gathered over Europe and the war that became World War II was growing closer, a baby was fired from a remote planet called Krypton, in a rocketship, to escape from catastrophe on his homeworld, which faced disastrous environmental change. That baby landed in Kansas, USA, was adopted and grew up to realise that his homeworld's higher gravity and its red sun, made his genetics superhuman on Earth. He became Clark Kent. Mild-mannered journalist, but his alter ego was the incredible Superman.

30 March 1939, a man donned a cape and a cowl. He had trained hard since living through the murder of his parents as a child. He had vowed to defend the innocent and to act to help others. He was at peak physical and mental fitness, skilled in martial arts, capable of incredible detective work, a brilliant physicist, chemist and criminal psychologist. He applied science at every opportunity: forensic science to detect villainy; advanced technology to build his car, plane, boat, bike, and his utility belt. He adopted a theatrical persona to scare villains: he was the Batman. The modern superhero era had begun.

As we rushed to the end of World War II, in 1945, the pace of innovation in technology had moved incredibly fast over the five years of the war. Secret attempts to create a bomb that could split one of the building blocks of nature - the atom - releasing phenomenal forces of nature, had been attempted by Germany and Japan, and the Allied Forces, led by the USA and Great Britain. In August 1945, the Allied Forces succeeded in dropping two terrible weapons. The atomic bomb changed everything.

The terrible explosions of two small atomic bombs over the Japanese cities of Hiroshima and Nagasaki on 6 and 9 August, 1945, left terrible devastation and loss of life. As many as 225,000 people were killed in the both cities, but these horrible explosions also effectively ended World War II. As a result, the unimaginable power released by the two nuclear bombs transformed the future of humankind. A new technology and science was born: atomics, later known as nuclear science. Not only was nuclear technology destructive in war, it could potentially revolutionise virtually every walk of life. And in many ways it has.

Click here to discover how scientists at America's General Electric Company helped to teach young people about the potential of nuclear energy, in the 1950s. Initial enthusiasm for atomics lasted into the late 1950s. Then health problems with radiation and a race to arm the world with nuclear weapons transformed the initial enthusiasm into widespread concern. The campaign for nuclear disarmament (CND) began in 1957.




General Electric Company, Adventures inside the Atom, 1948, Museum of Innovation & Science


Martha Holmes, Atomic Energy Chemistry Set, 1948, LIFE Photo Collection

The Incredible Hulk, created by writer Stan Lee & Artist Jack Kirby, Italian American Museum of Los Angeles

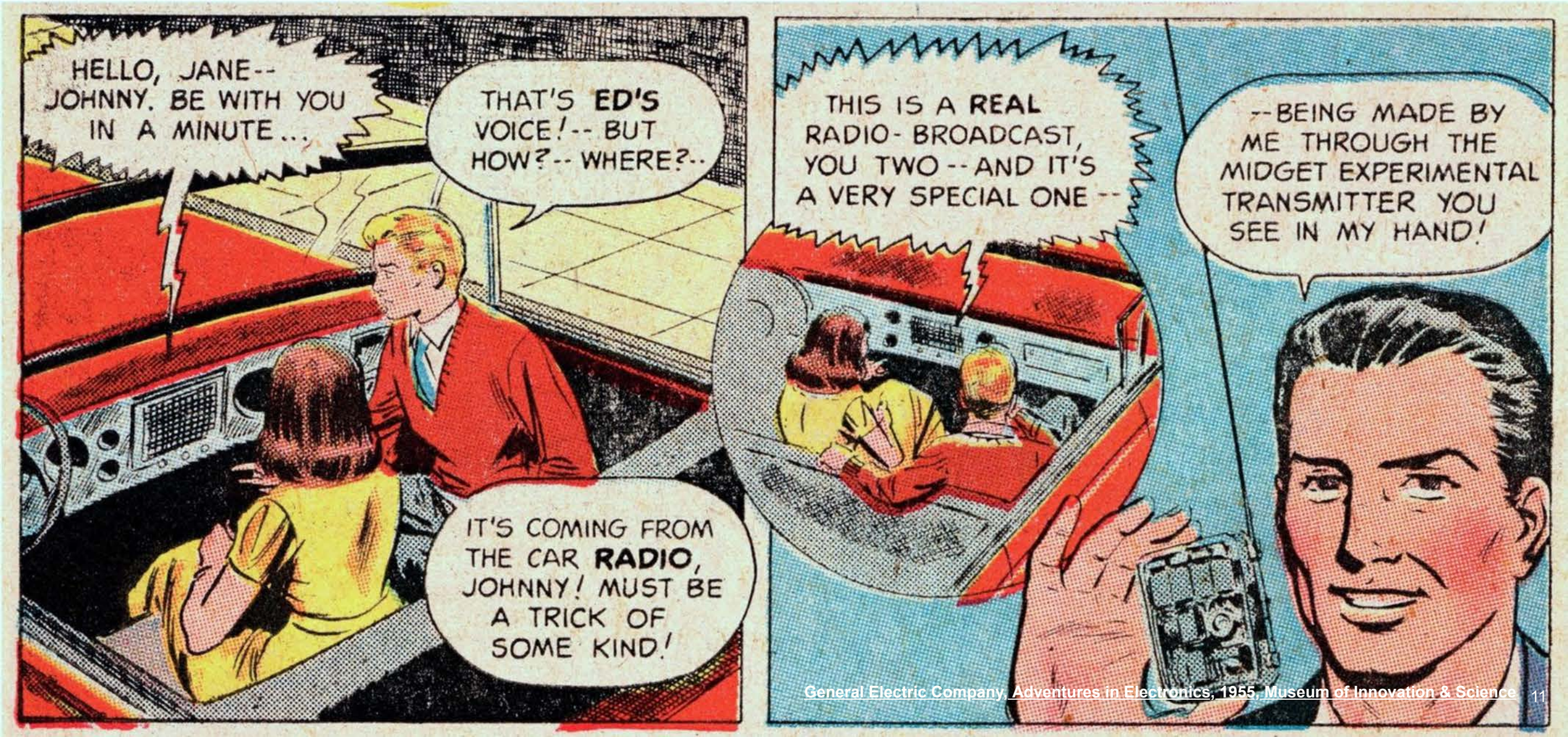
It is easy to see how much the atomic age influenced the development of superheroes after World War II. Whereas Superman's creators, Joe Segal and Jerry Schuster, had imagined a genetic superman, an alien on earth, and Bob Kane and Bill Finger created Batman to be a modern-day caped hero, protecting the innocent, later storytellers could not help but be influenced by the potential dangers and excitement of the new sciences around them.

Stan Lee, the amazing storyteller who created many of the wonderful costumed superheroes of Marvel Comics, was reading headlines declaring the power of the atom and the incredible revolution that tiny electronic components would bring to everyday life. To a storyteller with his fertile imagination, Stan Lee saw that radiation might change a human being.

In May 1962, scientist Doctor Bruce Banner, a frail and kind man, was working in the dangerous new field of nuclear weapons. Banner had developed a gamma bomb. As he was about to detonate the test bomb, a teenager roamed into the test site and Banner, horrified, rushed to save the boy but was caught in the blast. Hours later, still screaming in horror, Banner found that when he was greatly upset or angry his body and mind would transform into an unstoppable monster: the Incredible Hulk. Banner's DNA and cells were changed forever by radiation.

In August 1962, high school student, Peter Parker, a geek who was gifted at science but was bullied by the football team at school, was shocked to be bitten by a spider. He was at a science demonstration of radioactive rays and the spider was caught in the ray beam. That radiation mutated the spider's DNA and the bite passed the mutation on to Peter, making him the Astonishing Spider-Man. He was able to climb walls and have incredible strength, agility and healing. Creators Stan Lee and Steve Ditko ensured that it was Peter Parker's human genius for science that allowed him to create a webshooter, webfluid and spider trackers, making him an even more capable superhero.

Click here to discover how, at the same time the atomic revolution was taking place, the shrinking of electronics into new compact technology, known as microminiaturisation, and the use of metal wafers called transistors were amazing the general public, and heavily influenced superhero origins. Batman's famous utility belt is full of "microminiaturised gadgets". Iron Man's exoskeleton suit was possible because of microminiaturisation. Comic book creators were directly influenced by the news headlines of the day.




General Electric Company, Adventures in Electronics, 1955, Museum of Innovation & Science

# Questions for Chapter 1

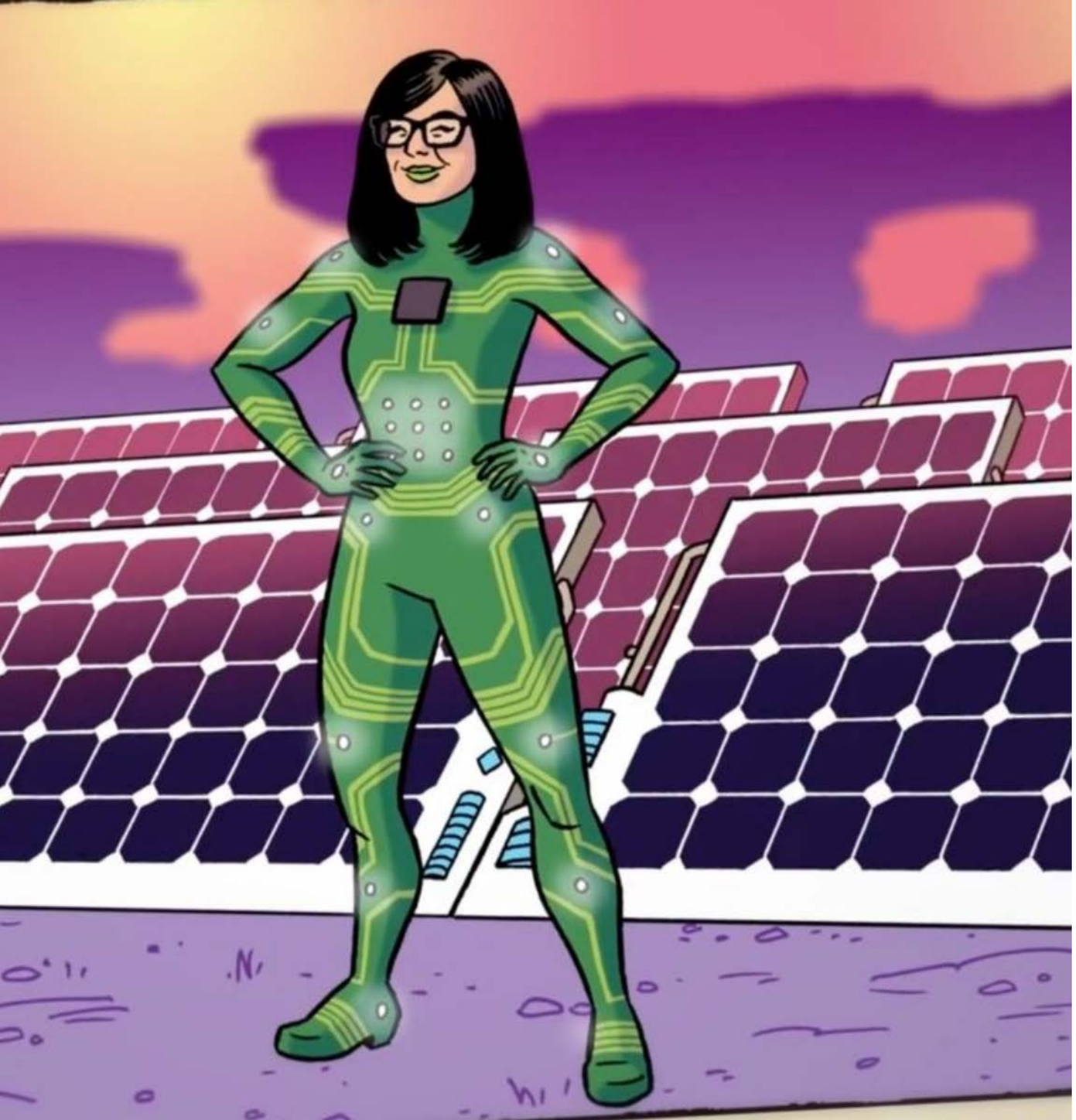
Let's finish this chapter with some questions. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
Why did Superman have to escape from his homeworld, as a baby?

**Explore:**
Why do you think Stan Lee and Jack Kirby made Bruce Banner a nuclear physicist who suffered a terrible life changing accident that ruined his DNA and made him a monster? What message do you think they were trying to convey?

**Invent:**
What do you think it would be like to have something affect your DNA? See if you can write a short 200 word story about it. Would you become a superhuman and if so, would there be downside to that? Peter Parker discovered that with great power comes great responsibility...


Golden Books, Coloring book | activity book:The Adventures of Batman & Robin, 1995, The Strong National Museum of Play



# Chapter 2

What's this chapter about?

"DR. GADGET"

What will I do?
Discover how Dr Gadget is using nanotechnology to change our lives
Unlock the secrets of the nano- and bio-domains

How long will this chapter take?
15 minutes


It would be nice to be born with superhuman abilities, or have some mutant power force, but even the most beloved superhero needs a little bit of help from their gadgets. Think about Iron Man's exoskeleton or Black Panther's bulletproof suit. In fact, some of this incredible technology could soon be within the grasp of us non-super folk.

Jess Wade is a physicist working on next generation materials with super powered functionalities.

Right now, if you use any personal electronics to monitor and tell you about your body, for example how many steps you've done today, like a FitBit, you have to rely on an electronic chip that's attached to a plastic strap. Dr Gadget wants to develop a high-tech plastic material that is flexible like a strap, and is able to do the monitoring itself - without the need for a separate chip.

Dr Gadget is also working on technologies based on the way nature creates some of its very small structures. These nano-structures are incredibly small - between 500 and 100,000 times smaller than a human hair. That is small. Dr Gadget is attempting to be able to make things at that level.

Click here to meet Dr Gadget.

Dr Gadget is working on a gadget that will rely on very tiny components inspired by nature, and they will perhaps be as much grown in a lab as they are made electronically. Click here to discover the secrets of nano- and bio-technology.


Small Secrets, Deutsches Museum

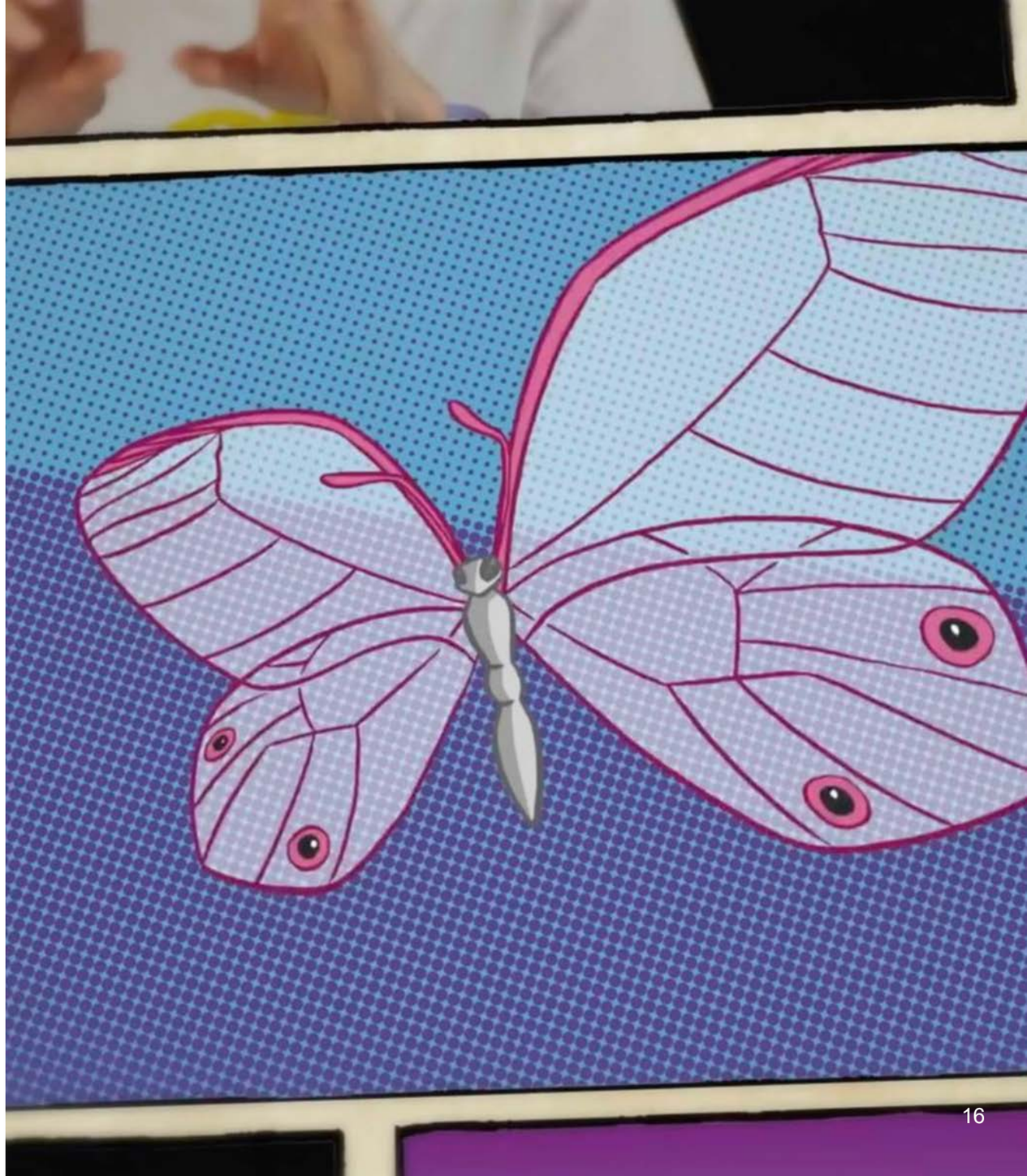
# Questions for Chapter 2

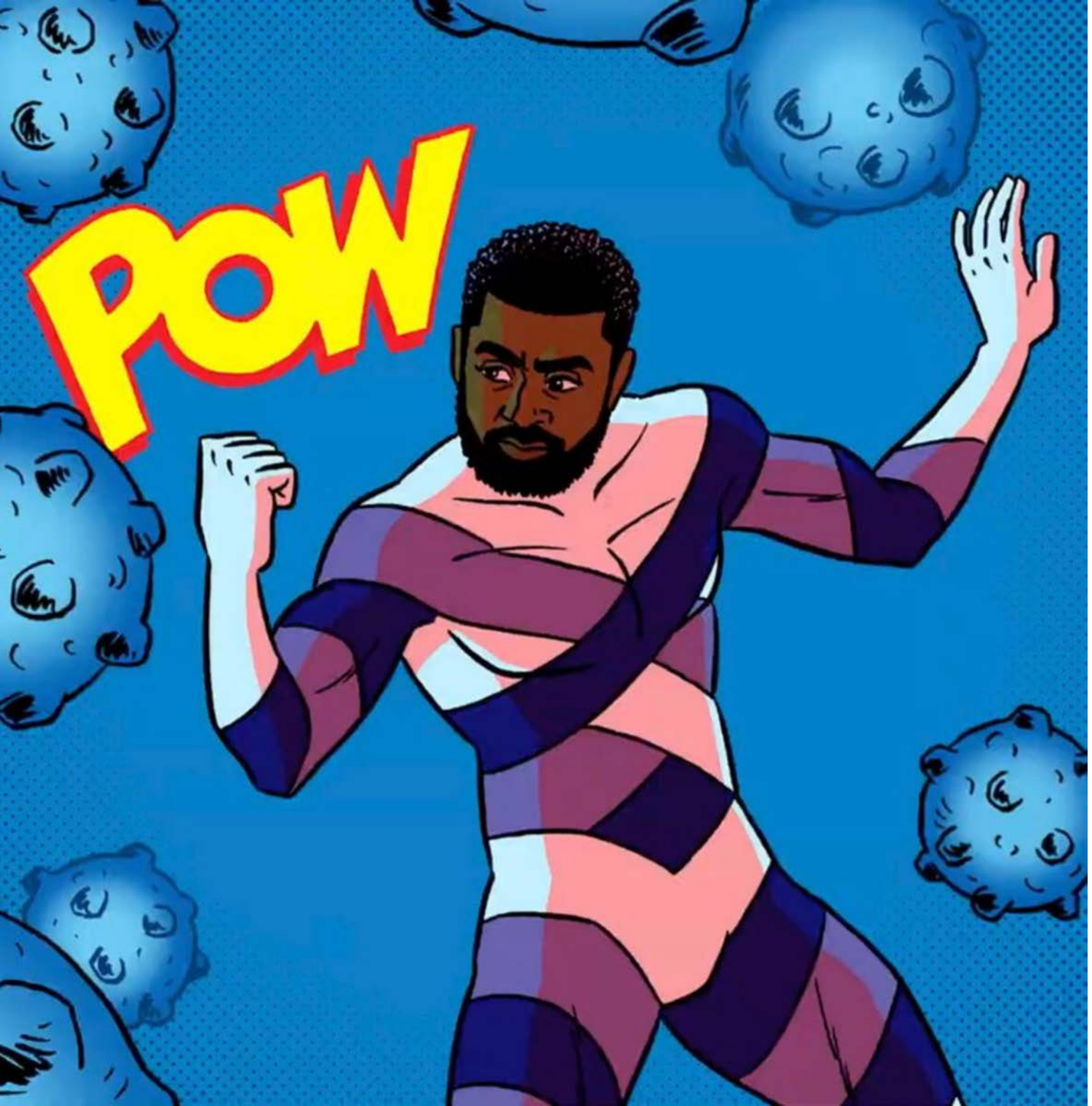
Time for some questions. Here's a reminder of how it works. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
How small are nano-structures compared to a human hair?

**Explore:**
Why do you think rollable solar panels would be helpful?
Why would they be used in deserts?

**Invent:**
Dr Gadget said beetle shells can polarise or change the direction of light with their shells, and some butterflies are transparent, tech that could inspire nanotechnologists to make new screens and lenses. What other creatures should we learn from? Click here for a massive clue... Second clue think about chameleons...





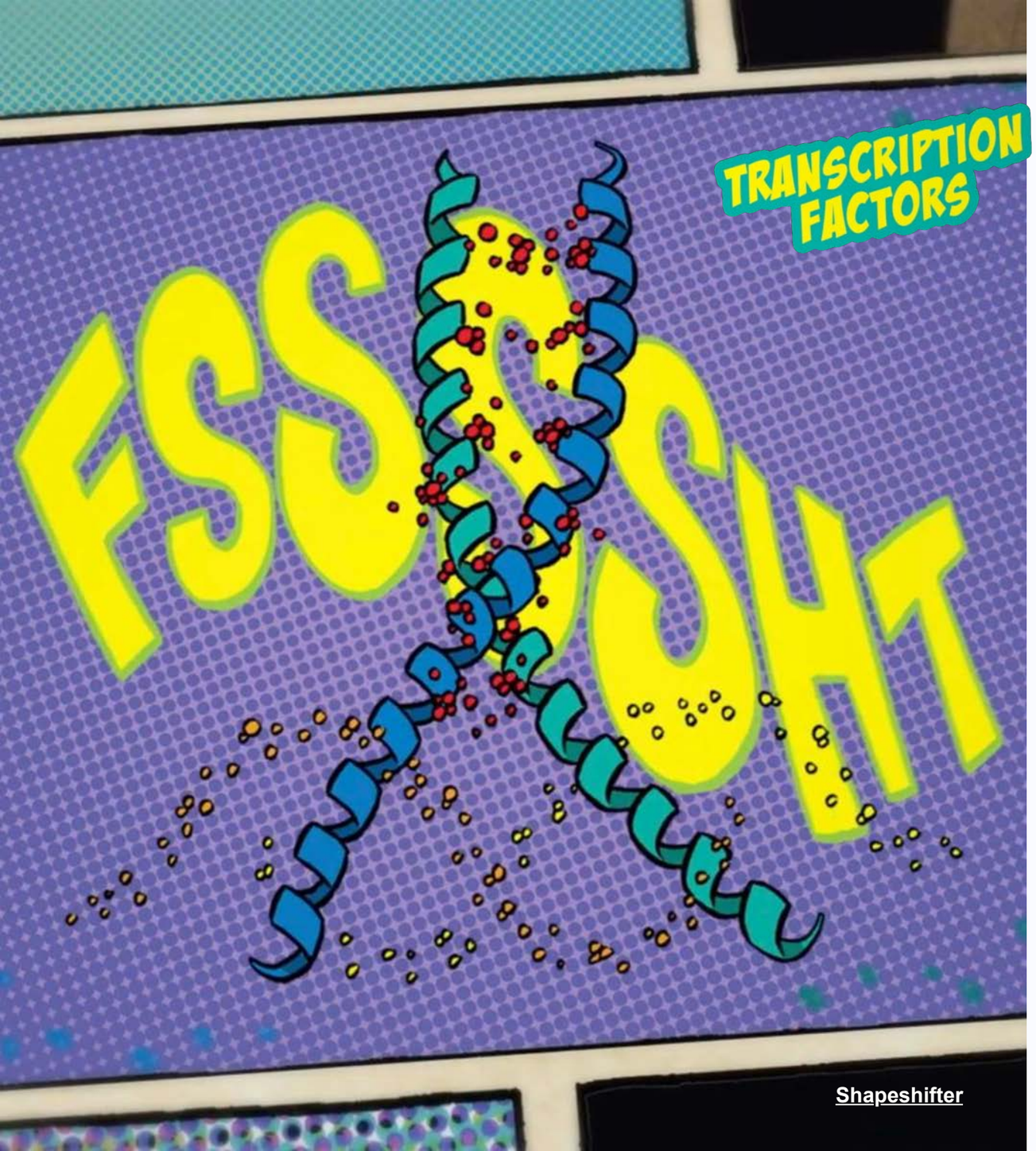

# Chapter 3

What's this chapter about?

"THE SHAPESHIFTER"

What will I do?
Find out how Shapeshifter is using AI and biology to fight the evil known as cancer
Reveal the secrets of the inner world of the human body

How long will this chapter take?
15 minutes




**Shapeshifter**

Many superheroes use the power of disguise. But what if we could save thousands of lives by giving the proteins in our body the power of mimicry? The power to imitate and pretend to be something else.

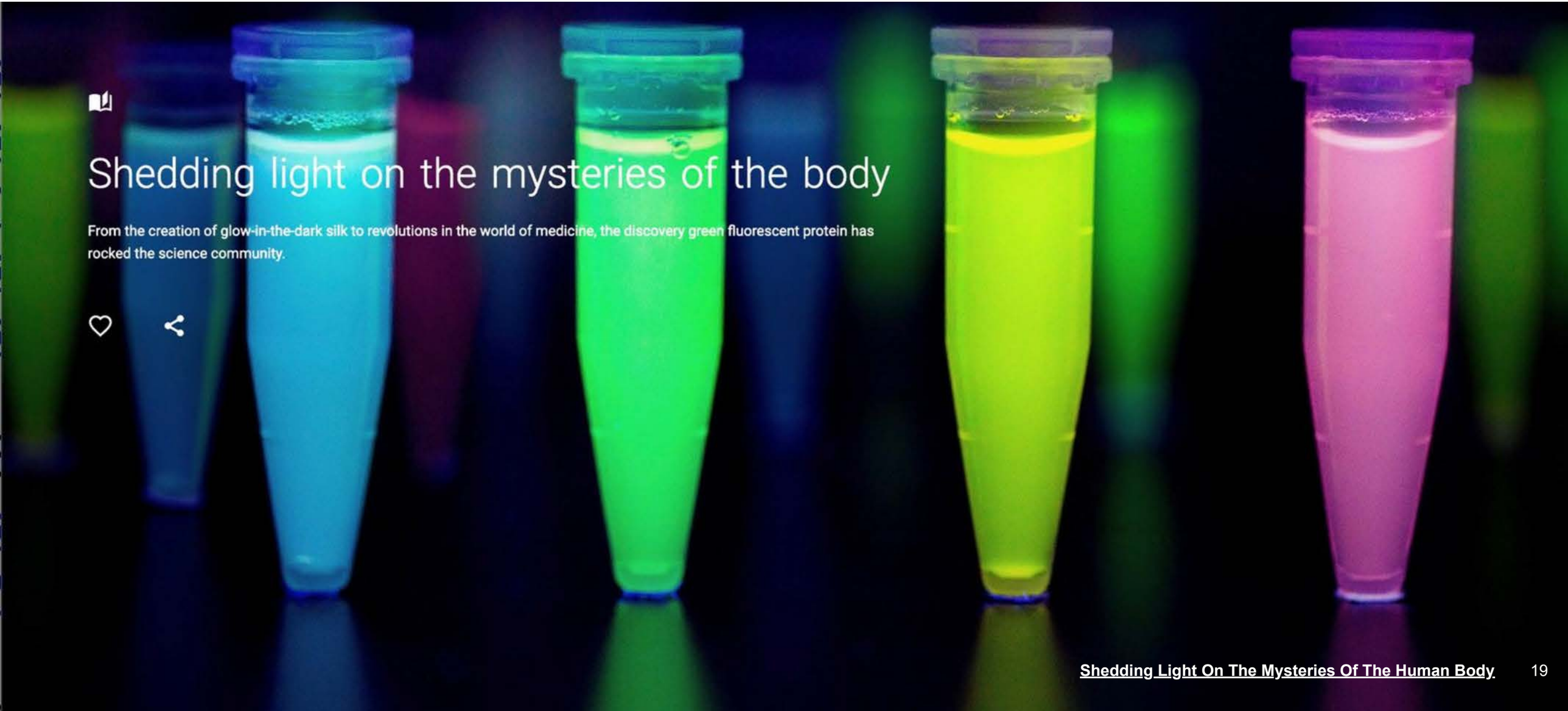
Cancer is a term we give to different kinds of failures and alterations to our cells that can cause tumours. Which is why it can be difficult to treat. And that's why different cancers need different solutions. Some use strong chemicals to attack tumours, called chemotherapy, or like the Incredible Hulk bombard cells with radiation called radiotherapy. Shapeshifter is doing something new. He has a sneaky way of trapping cancers. A novel, unusual way of targeting it.

Shapeshifter is using transcription factors. They are complicated biological material, molecules called proteins that are made up of other proteins. Like a meal cooked with many ingredients. When transcription factors come together, they operate like a mini computer that control and dictate how our genes behave, inside our DNA. Remember these are tiny - there are 20,000 genes inside every cell, so transcription factors have a lot of superpowers!

Shapeshifter knows that sometimes proteins have gone wrong when they were made inside the body. They are faulty and can bind to other proteins and sometimes create cancer tumours. Shapeshifter is using machine learning in computers to predict the shape and look of a protein so that he can create mimic proteins that will lure and grab the faulty protein in the body, getting it out of the way before it locks onto healthy proteins and triggers cancer.

Click here to meet Shapeshifter.

Shapeshifter is using mathematics and biology to create new ways of protecting us from the evils of cancer and disease. He's working on protein mimicry. But how else have proteins been used and how have they shed light on the mysteries of the human body? Click here to find out.




Shedding Light On The Mysteries Of The Human Body

# Questions for Chapter 3

Time for some questions. Here's a reminder of how it works. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
What is Shapeshifter's superpower?

**Explore:**
What are transcription factors? Why do you think Shapeshifter is targeting them?

**Invent:**
Shapeshifter is trying to trick cancer triggering proteins into handshaking with a special laboratory-made protein that will trap them and get them out of harm's way. Shapeshifter is using computer modelling to work this out and then testing it in a laboratory. Why do you think he's using computer modelling? What disease would you like to see AI combat? Big clue here...

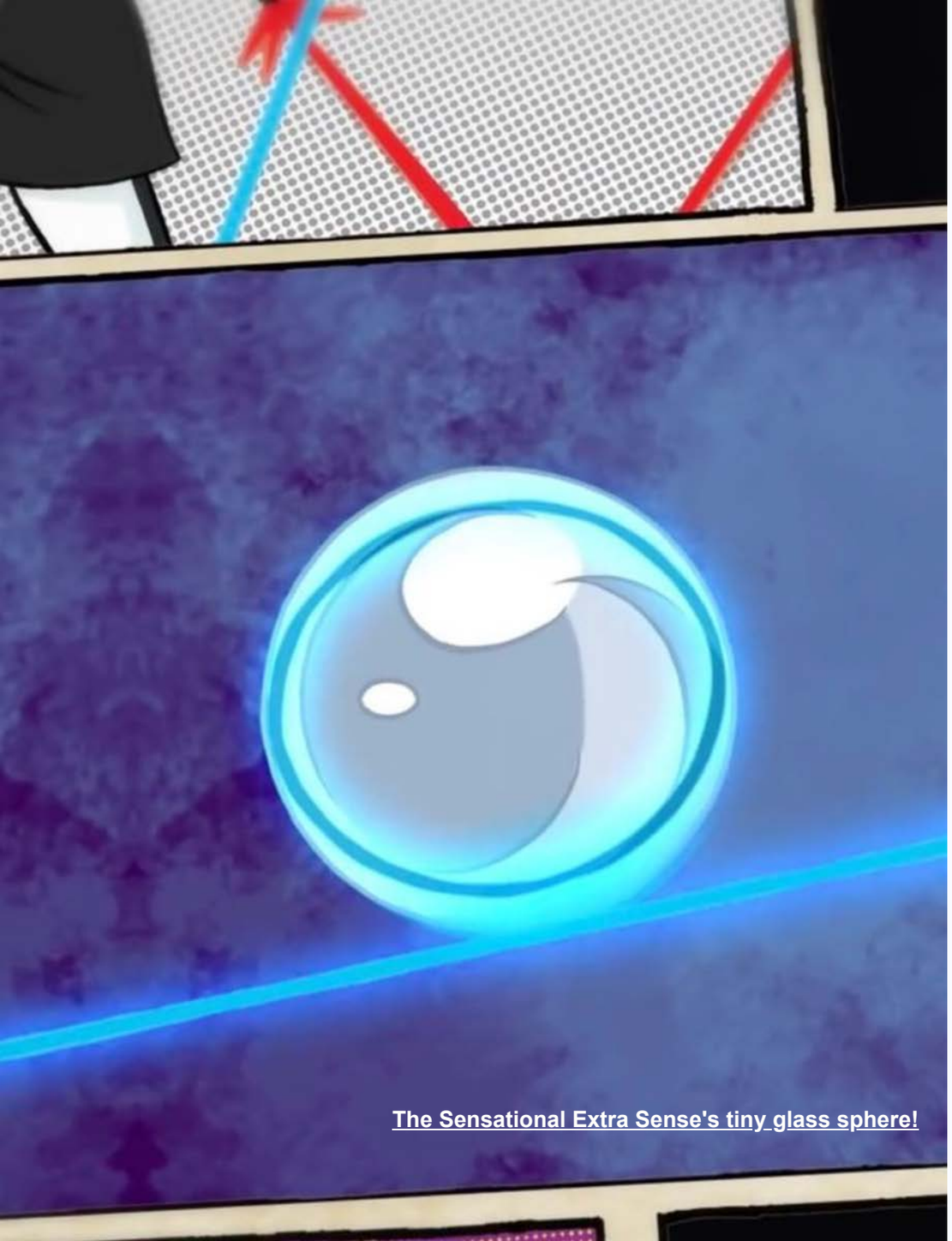

# Chapter 4

What's this chapter about?

"THE SENSATIONAL EXTRA SENSE!"

What will I do?
Reveal the secret work that Extra Sense is doing with laser light
Find out about particles like photons

How long will this chapter take?
15 minutes



The Sensational Extra Sense's tiny glass sphere!

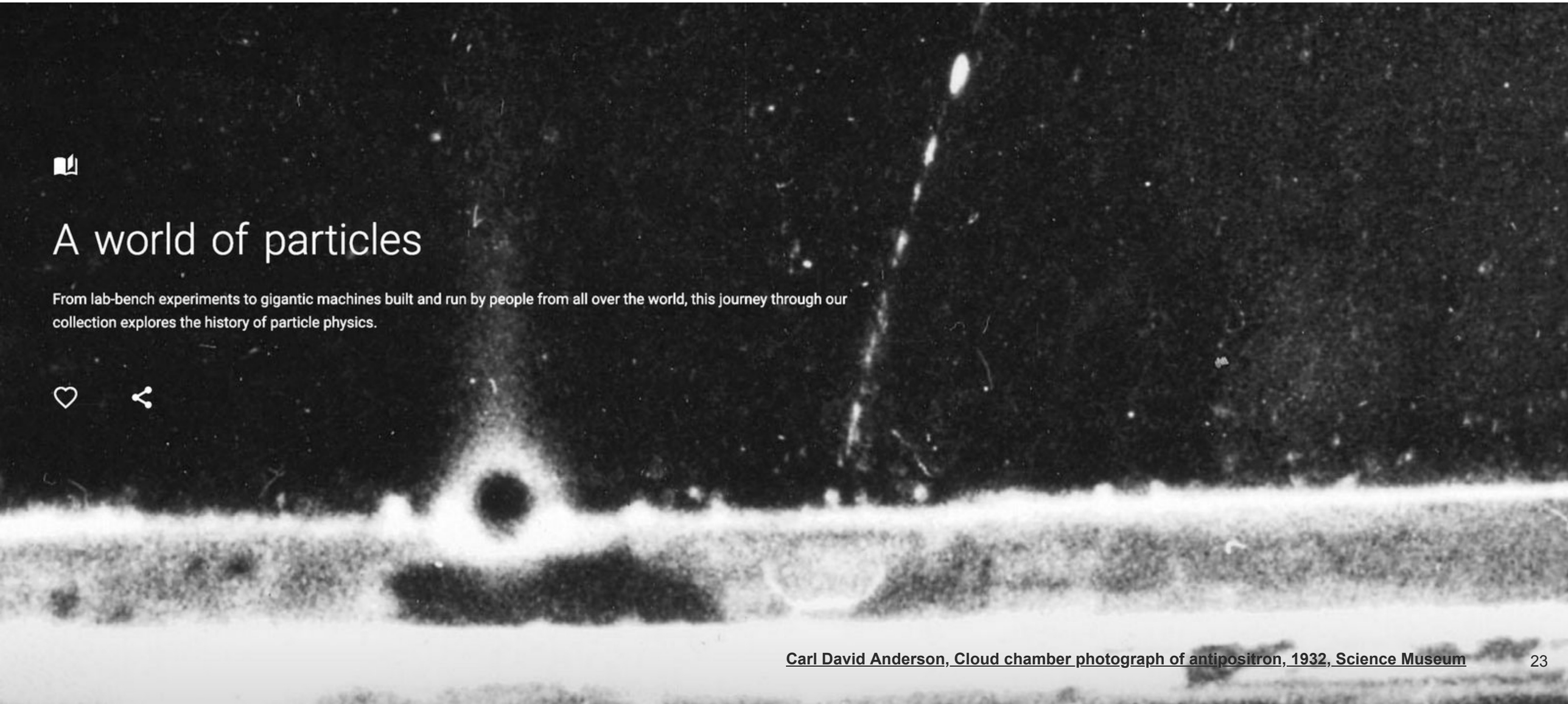
What if you had an extra hidden sense? One that lets you detect when people were moving behind walls or when a volcano was about to erupt. There are sensors available to us today that are remarkable, detecting earthquakes or even when you move your phone. But they are limited and only detect part of the movement or some vibrations and sounds happening around us. They are not perfect. Their electronics create a lot of unneeded signals, known as noise, as they operate, which makes them inefficient. So, they are not sensitive enough to predict earthquakes, volcanoes and when people are in trouble early enough to really save lives. Sometimes they do, but as you will see in the news headlines, volcanoes and earthquakes still take cities and people by surprise. Extra Sense is working on science that might allow her to detect what's going on behind a skyscraper across the planet, or even across the galaxy.

By firing a laser into a tiny glass sphere, allowing the laser to interact with the sphere's movement Extra Sense is creating something called "coupling". That is when the light waves from the laser can transfer information, known as data, about the glass sphere's movement. In a sense it is measuring the sphere's movement. Because light waves and particles, called photons, are so small, a detector made this way would be very sensitive. Much more sensitive than one using electrical circuits and less noisy. So a lot more accurate. This is the secret behind the Sensational Extra Sense's "sixth sense".

In time, Extra Sense hopes to be able to create a sensor that could even detect the movement of a virus, like coronavirus, as it attaches itself to a cell. She hopes to discover new forces that are unknown to science. And perhaps be able to prevent huge environmental disasters, long before they were likely to happen...

Click here to meet The Sensational Extra Sense.

Extra Sense uses light particles, called photons, to measure minute reactions so that she can create the most accurate sensors ever conceived, and detect anything from earthquakes to tiny changes in the Moon. So what are particles? Click here to take a tour and find out.




Carl David Anderson, Cloud chamber photograph of antipositron, 1932, Science Museum

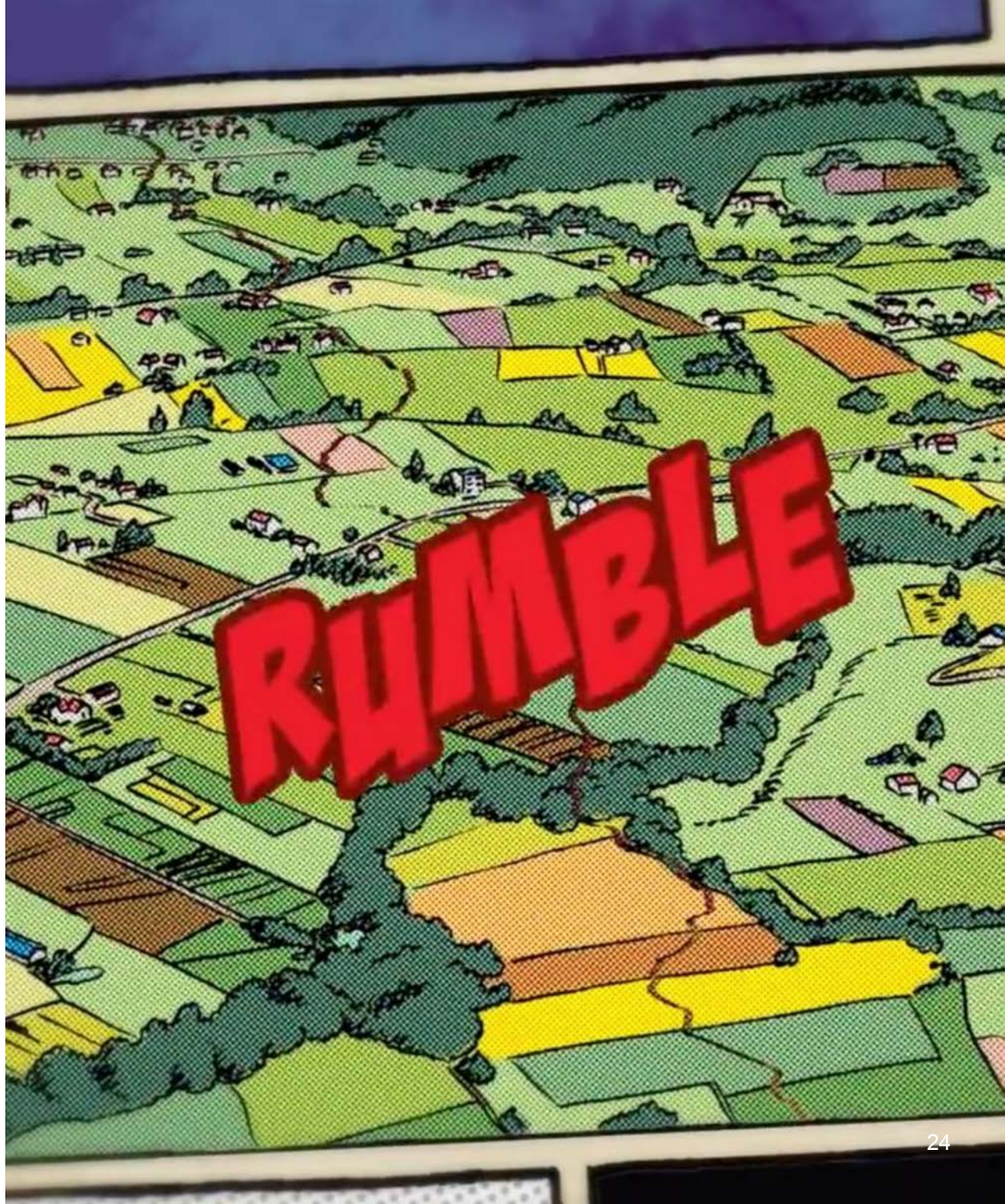
# Questions for Chapter 4

Time for some questions. Here's a reminder of how it works. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
What is Extra Sense's powerful sixth sense?

**Explore:**
What would an optical sensor detect? Here's a big clue...

**Invent:**
Why do you think it would be useful if we developed sensors so sensitive that they could detect earthquakes, volcanic eruptions and tsunamis days, or even months, earlier than we currently can? Imagine what it's like to live through an earthquake. Then what the outcome could have been, if Extra Sense's new sensors had warned everyone days earlier? Here's a clue if you need it. Write a short story where you are Extra Sense's sidekick and use new sensors to save people from an earthquake before it happens.



# Chapter 5

What's this chapter about?

"CHANNELLING THE ELEMENTS"

What will I do?
Find out how the Element is using the forces of nature to change our cities and save humankind and the planet from climate change
Uncover the secret identity of a hero in India using pine needles to save her people

How long will this chapter take?
15 minutes


The evil Master Villain's plan has worked. The city is ruined. The taps have run dry. And those who are left fight for the remaining resources. Sounds like the end of a superhero comic book or movie that's gone wrong. But these aren't the workings of a criminal mastermind. These are the actual consequences that could come from the mismanagement of water.

But wait! To the rescue come a force of real life superheroes, like The Element herself, whose secret identity is engineer, Yewande Akinola. Ready to fight back floods, deter drought and bring environmental order back to our cities.

Water is vital to life. Where there is water, there is life. We drink it, clean with it, even generate power with it. The Element's vision is to create a different kind of city, one that's able to store and use water in entirely new ways.

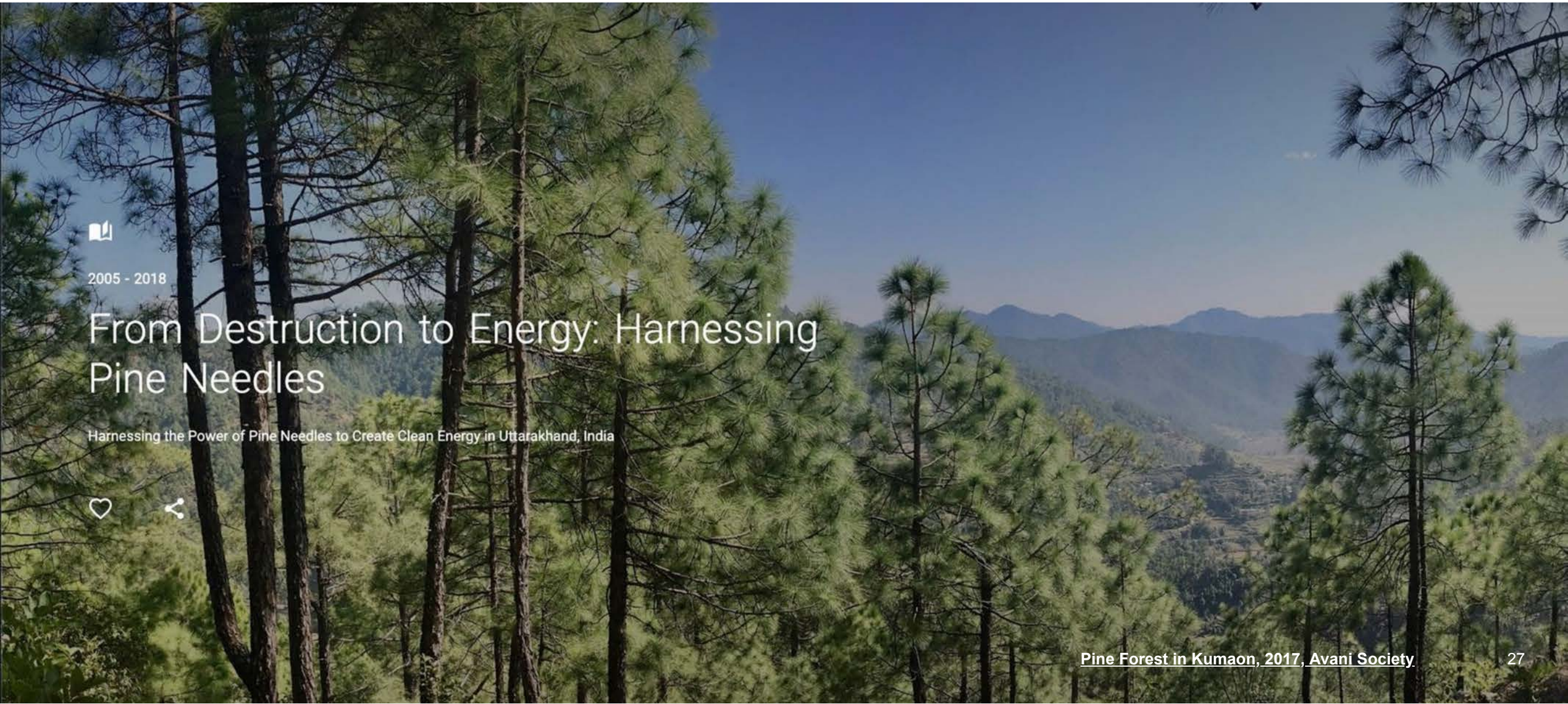
Imagine our roofs with plants and scenic wetlands, all able to absorb, store and reuse rainfall water. Even the streets under our feet could be permeable - allowing water to soak into them - so that they could store and reuse water captured from rainfall.

The Element wants to use Artificial Intelligence to predict and monitor the level of rainfall, redirecting water automatically to prevent flooding, or channel water to places that may soon have water shortages.

In this way, the future city could be monitoring and reacting like a living organism.

Click here to meet The Element.

Channelling the elements to protect humankind and the planet is Yewande Akinola's superhero mission. There are many people around the world who are accepting a similar call to be a hero. Click here to take a tour and find out about one of them.




Pine Forest in Kumaon, 2017, Avani Society

# Questions for Chapter 5

Time for some questions. Here's a reminder of how it works. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
What was the evil Master Villain's plan?

**Explore:**
What does China want to do with water in urban areas? What name do they give to these water friendly cities?

**Invent:**
By 2050, 70% of the world's population will be living in cities and we will need new, innovative cities that will support us in an environmentally friendly way. List five very important things that you think future cities must be able to do.

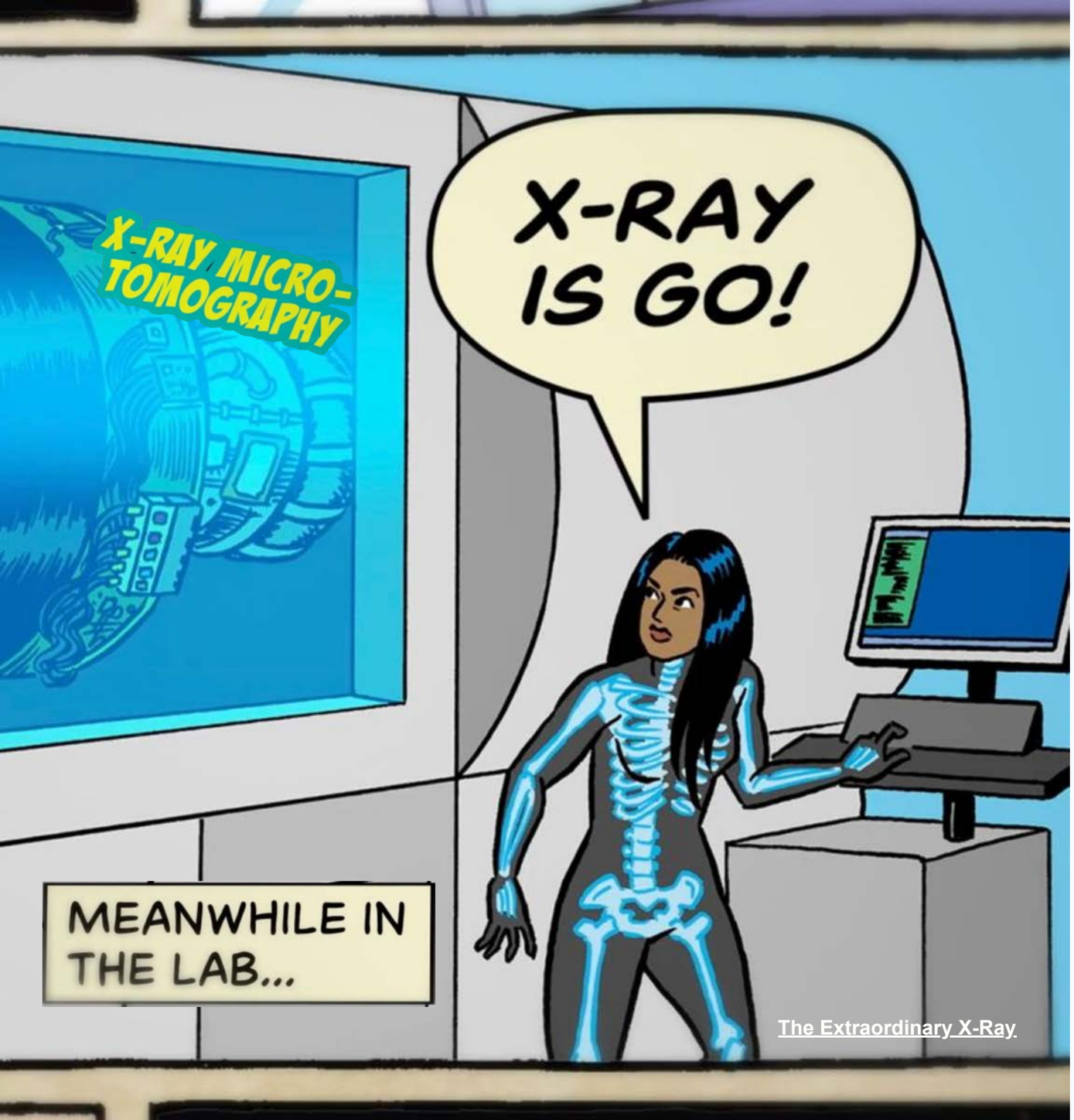
# Chapter 6

What's this chapter about?

"EXTRAORDINARY X-RAY"

What will I do?
Discover the Extraordinary X-Ray's ability to make the invisible visible
See X-Ray rescue a submarine with X-ray tomography
Find out about the mystery of X-rays

How long will this chapter take?
15 minutes




A dark and stormy night. Deep underwater a submarine explores the depths. Suddenly an alarm sounds. Red lights begin flashing. At any moment water could start rushing in. The crew search for a fault, they have a theory but they can't disassemble the machinery and time is running out. What do they do? This calls for a hero. A hero with x-ray vision.

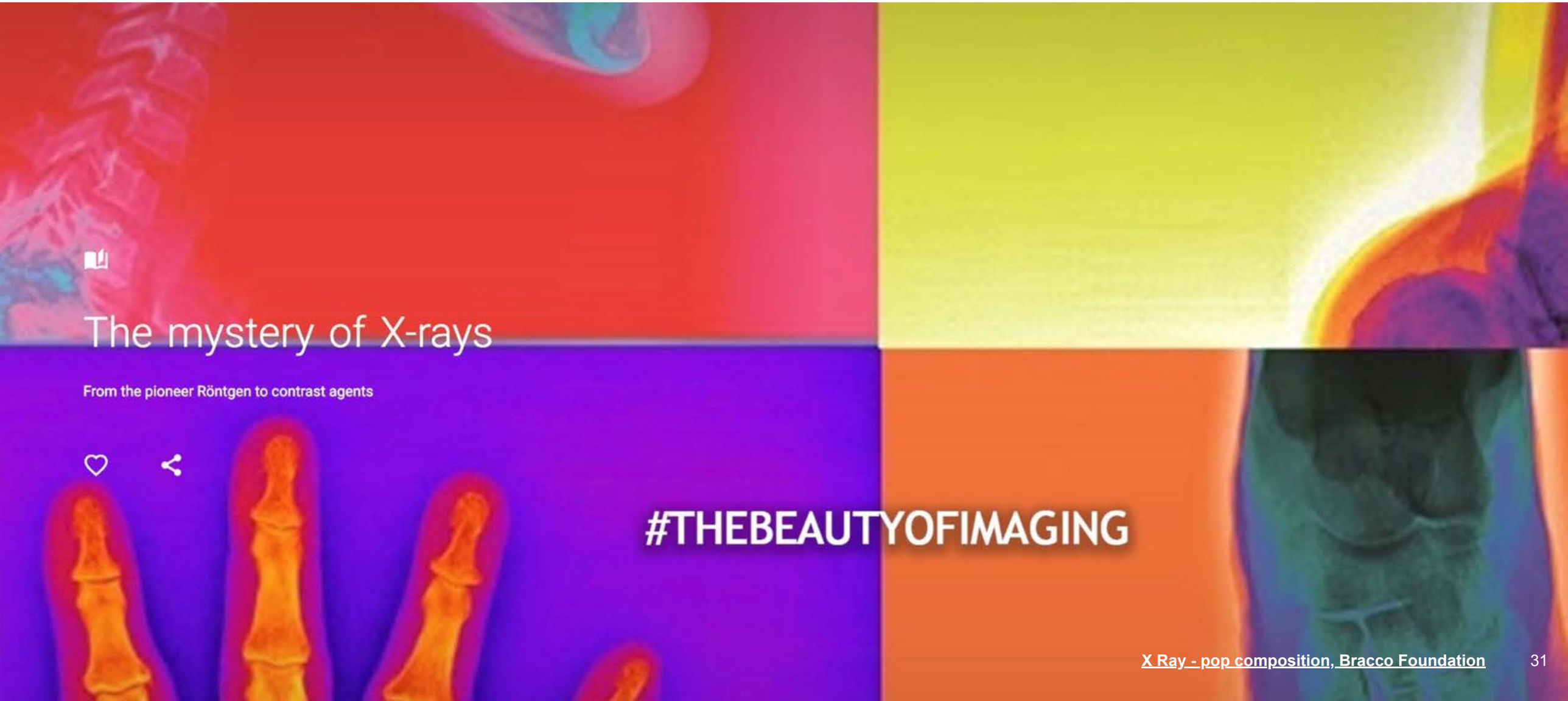
The Extraordinary X-Ray, whose secret identity is Dr Farah Ahmed, likes to understand how things work. And so she uses her science super power, X-ray tomography, to understand what's going on.

X-ray tomography fires precise slices of x-rays through something and builds up a three dimensional virtual model, known as a 3D model. Dr Farah can do this without destroying, damaging or changing the original machinery or object. The 3D model can operate like the real thing and show her where things are going wrong, or how to step in and rescue a situation before it gets out of hand... like the submarine about to burst inwards and let water pour in.

If something is really crucial, The Extraordinary X-Ray uses her 3D printer to print out a physical model that she can move around, look inside of and test, which will operate exactly like the real thing. Literally making the invisible visible!

Click here to meet the Extraordinary X-Ray.

The Extraordinary X-Ray uses X-ray tomography to make the invisible visible. So what are X-rays and who discovered them? Click here to take a tour and find out!




X Ray - pop composition, Bracco Foundation

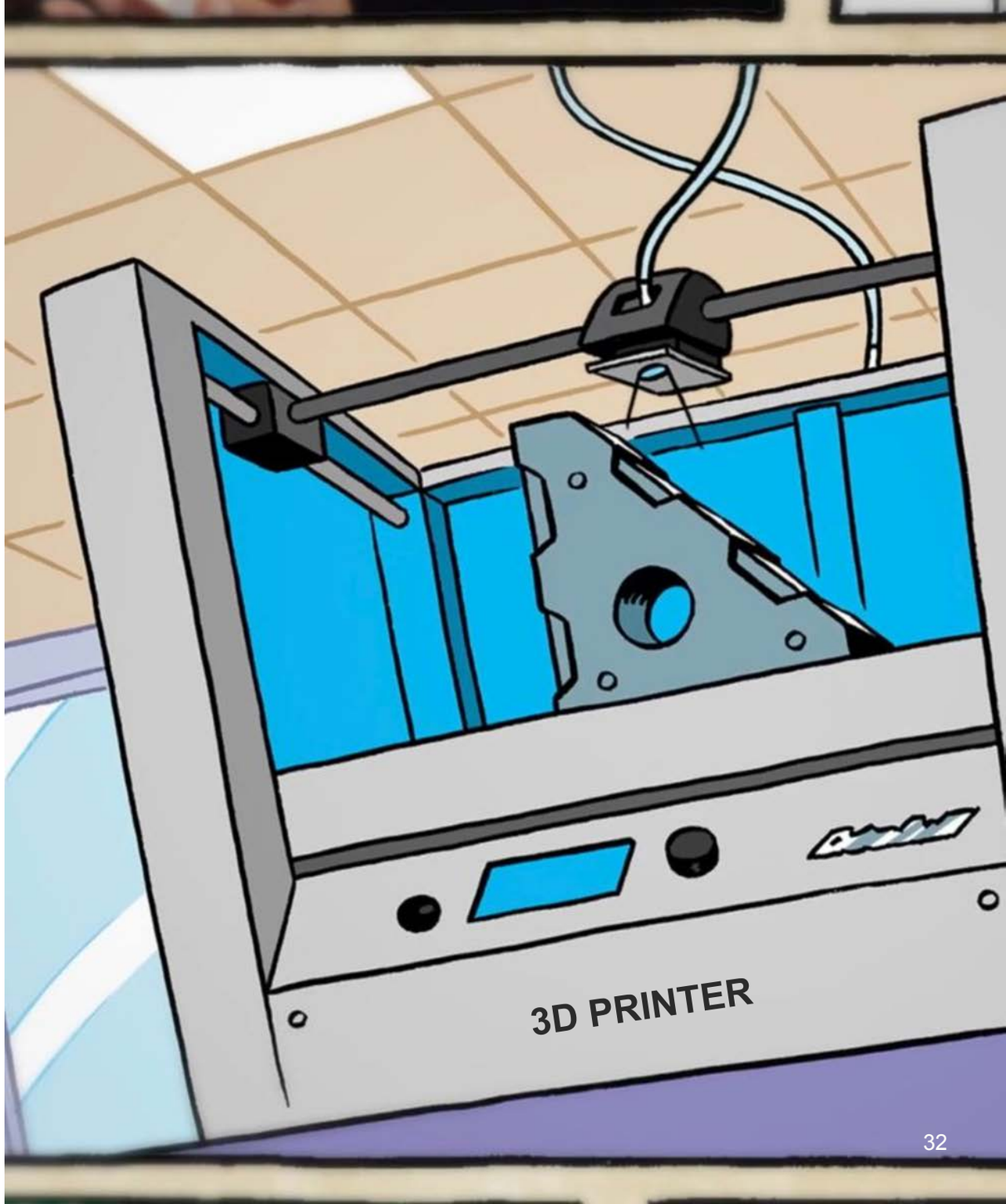
# Questions for Chapter 6

Time for some questions. Here's a reminder of how it works. When you **Discover**, you are comprehending and remembering. When you **Explore**, you are really able to understand it and think it through. When you **Invent**, you are able to comprehend, understand, remember, analyse and do something cool with your new knowledge.

**Discover:**
What could happen aboard the submarine when the alert goes off? What does the crew need?

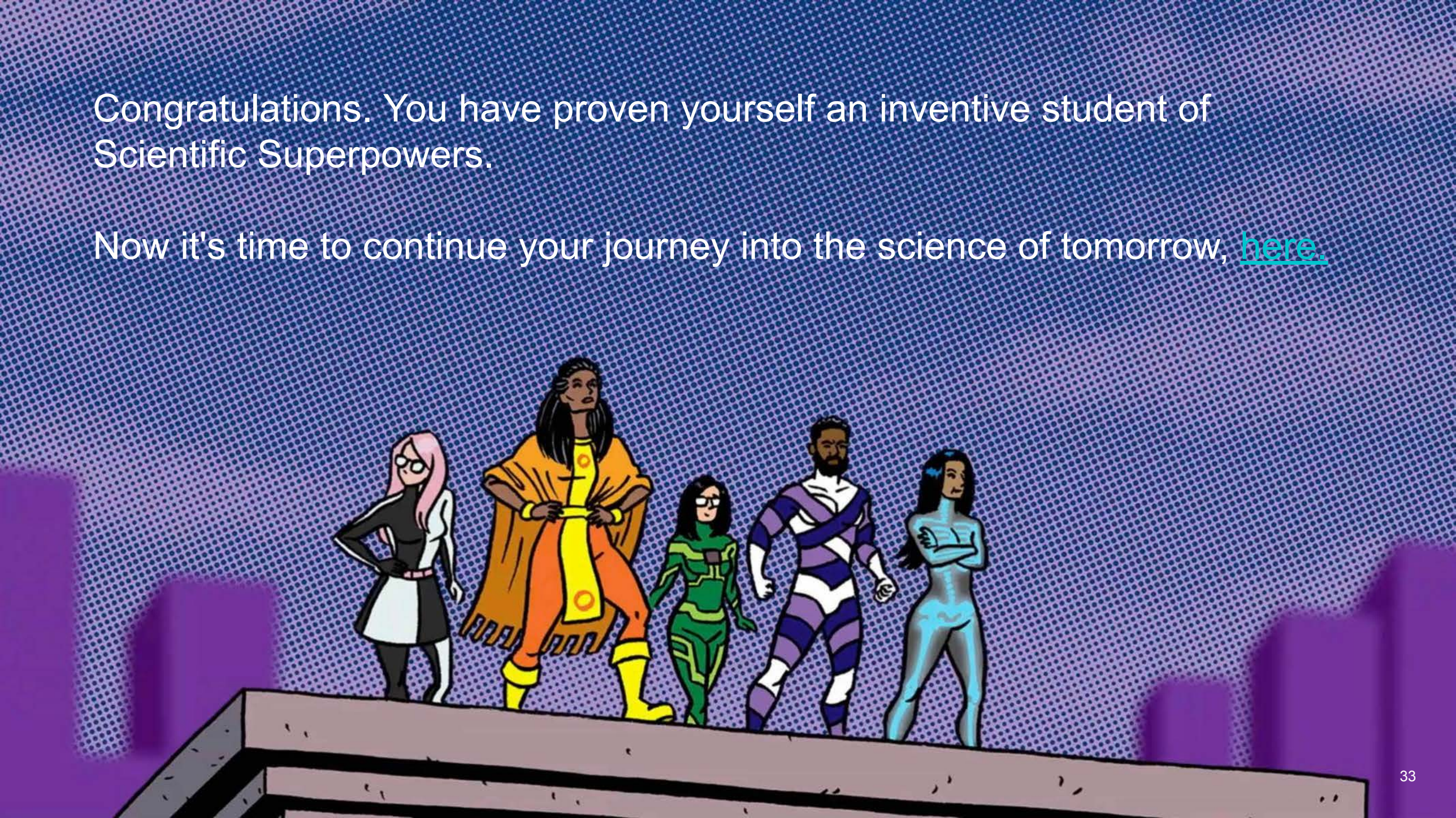
**Explore:**
What technique allows The Extraordinary X-Ray to figure out how things work and enhance her understanding? Why is it crucial that a critical part like a jet engine is not disassembled to check its function?

**Invent:**
The Extraordinary X-Ray uses her X-ray tomography to create a 3D model in a computer of a component. She then uses a 3D printer to make a perfect model of it. Why do you think this is an efficient way to understand something? What would you scan and 3D print and why?



Congratulations. You have proven yourself an inventive student of Scientific Superpowers.

Now it's time to continue your journey into the science of tomorrow, here.



# Answers to all the questions

**Chapter 1**
Discover: Why did Superman have to escape from his home world, as a baby?
Answer: His birth parents put him on a rocketship to escape environmental disaster that was destroying his home world, Krypton.
Explore: Why do you think Stan Lee and Jack Kirby made Bruce Banner a nuclear physicist who suffered a terrible, life-changing accident that ruined his DNA and made him a monster? What message do you think they were trying to convey?
Answers may vary, but should include the idea that nuclear weapons were dangerous and had life-changing consequences. This was a nuclear disarmament message.
Invent: What do you think it would be like to have something affect your DNA? See if you can write a short 200 word story about it. Would you become a superhuman and if so, would there be downside to that? Peter Parker discovered that with great power comes great responsibility...
Answers will vary. Think about the emotion of something happening to you that you were not expecting. It's amazing but will turn your life upside down. How do you feel?

**Chapter 2**
Discover: How small are nano-structures compared to a human hair?
Answer: Nano-structures, are incredibly small - between 500 and 100,000 times smaller than a human hair.
Explore: Why do you think rollable solar panels would be helpful? Why would they be used in deserts?
Answers can vary. Rollable solar panels would be very easy to move, roll out and rapidly begin generating power. Desert areas have very high levels of sun each year and are an ideal place to generate solar electricity.
Invent: Dr Gadget said beetle shells can polarise or change the direction of light with their shells, and some butterflies are transparent, tech that could inspire nanotechnologists to make new screens and lenses. What other creatures should we learn from?
Answers will vary. A chameleon's ability to change its colour is a great example of a creature we could mimic. They do not necessarily change colour to blend with the environment, but to signal and communicate. Perhaps we could do that too, using nanomaterials that change colour to transmit data over long distances. There are many other examples students might choose.

**Chapter 3**
Discover: What is Shapeshifter's superpower?
Answer: Mimicry.
Explore: What are transcription factors? Why do you think Shapeshifter is targeting them?
Answers can vary but should refer to proteins that control our genes. They could be given the ability to mimic and trap proteins that trigger cancer.
Invent: Shapeshifter is trying to trick cancer triggering proteins into handshaking with a special laboratory made protein that will trap and get them out of harms way. Shapeshifter is using computer modelling to work this out and then testing in a laboratory. Why do you think he's using computer modelling? What disease would you like to see AI combat? Big clue here...
Answers will vary but could include the fact that proteins are very small and mysterious. By using computer modelling and AI he may be able to quickly figure out what the proteins look like and mimic them. Any superbug or disease could be fought with AI, including coronavirus. In fact AI is being used in the battle against it.

# Answers to all the questions

**Chapter 4**

Discover: What is Extra Sense's powerful sixth sense?
Answer: Super sensitivity.
Explore: What would an optical sensor detect?
Answer: Optical sensors detect light. As seen in the clue, Ibn al-Haytham discovered how we see and was one of the founders of optical science, approximately 1,000 years ago. He influenced Leonardo Da Vinci and other scientists, including Extra Sense, whose secret identity is Dr Ying Lia Li.
Invent: Why do you think it would be useful if we developed sensors so sensitive that they could detect earthquakes, volcanic eruptions and tsunamis days or even months earlier than we currently can? Imagine what it's like to live through an earthquake. Then what the outcome could have been, if Extra Sense's new sensors had warned everyone days earlier? Here's a clue if you need it. Write a short story where you are Extra Sense's sidekick and use new sensors to save people from Earthquake before it happens.
Answers will vary. Think about the emotion of the situation, hundreds of thousands of lives could be saved by you and your invention. What would you use to alert everybody? How do you feel?

**Chapter 5**

Discover: What was the evil Master Villain's plan?
Answer: The city is ruined. The taps have run dry and those who are left fight for the scarce resources.
Explore: What does China want to do with water in urban areas? What name do they give to these water friendly cities?
Answer: 80% of urban areas absorbing and reusing 70% of rain water.
Invent: By 2050, 70% of the world's population will be living in cities and we will need new innovative cities that will support us in an environmentally friendly way. List five very important things that you think future cities must be able to do.
Answers will vary but could include: Rooftop water capture. Scenic wetlands. Permeable pavements that store and use run off water. Artificial intelligence prediction of water needs and delivery. Solar panels. Wind power generation. Hydroelectric power plants.

**Chapter 6**

Discover: What could happen aboard the submarine when the alert goes off? What does the crew need?
Answer: Water could leak in and swamp the submarine. They have a theory but can't find the fault or fix it as they would have to disassemble the submarine. They need a hero with x-ray vision.
Explore: What technique allows The Extraordinary X-Ray to figure out how things work and enhance her understanding? Why is it crucial that a critical part like a jet engine is not disassembled to check its function?
Answer: X-ray tomography. If you take complex components apart you will lose data and it may be that it's in a dangerous situation where the component can not be disassembled, like the submerged submarine in danger under the ocean.
Invent: The Extraordinary X-ray uses her x-ray tomography to create a 3D model in a computer of a component. She then uses a 3D printer to make a perfect model of it. Why do you think this is an efficient way to understand something? What would you scan and 3D print and why?
Answers will vary but should include: 3D models, and physical models 3D printed based on the x-ray scans, allow Extra Sense and the people she is helping to see perfect replica's of their components, identify problems without ever needing to take them apart and waste crucial time or put themselves in danger. A 3D model, on a computer or printed, allows Extra Sense to move around it and see it work as if it was the real thing, but in fact it's a replica based on her scans.