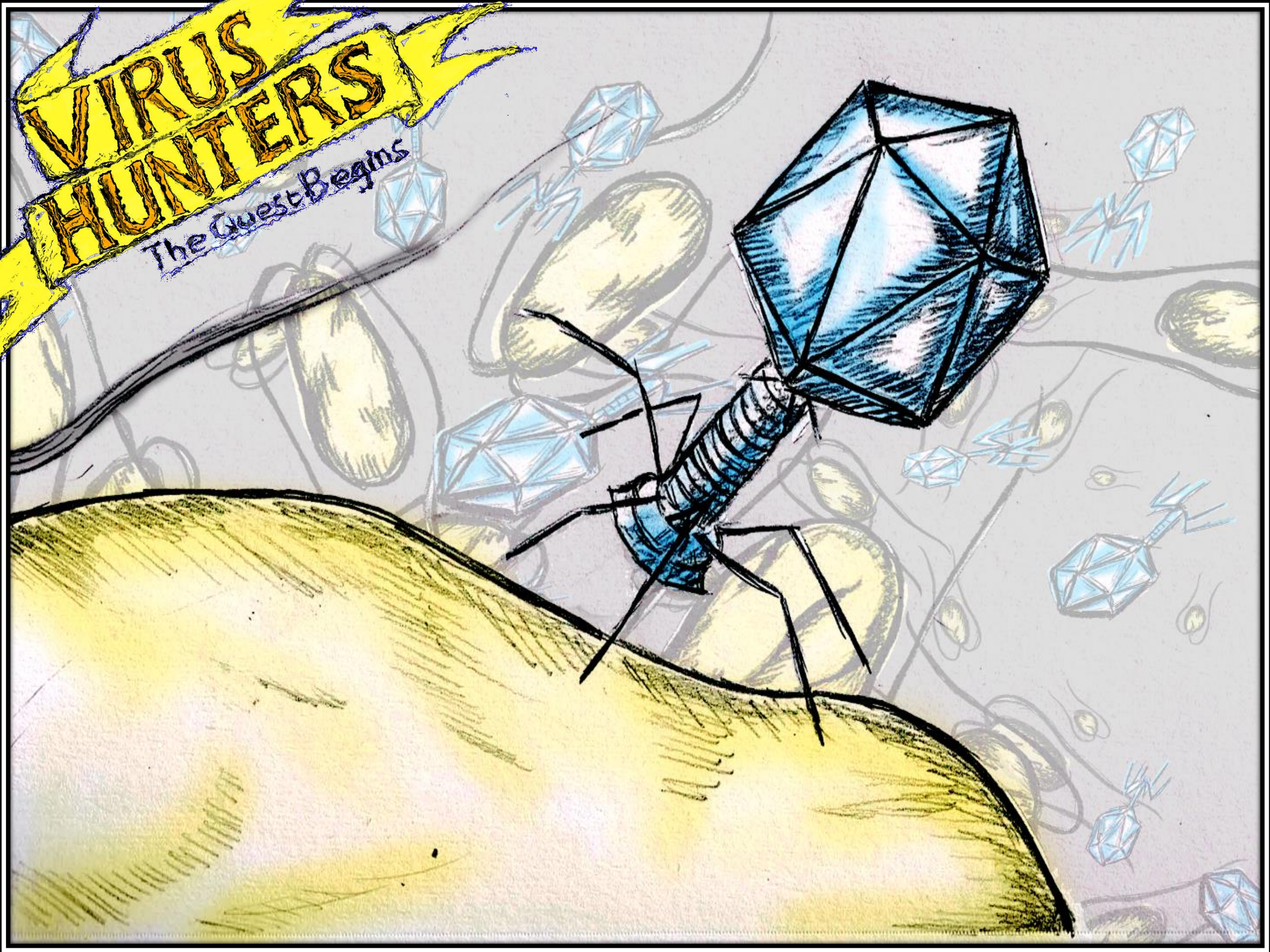
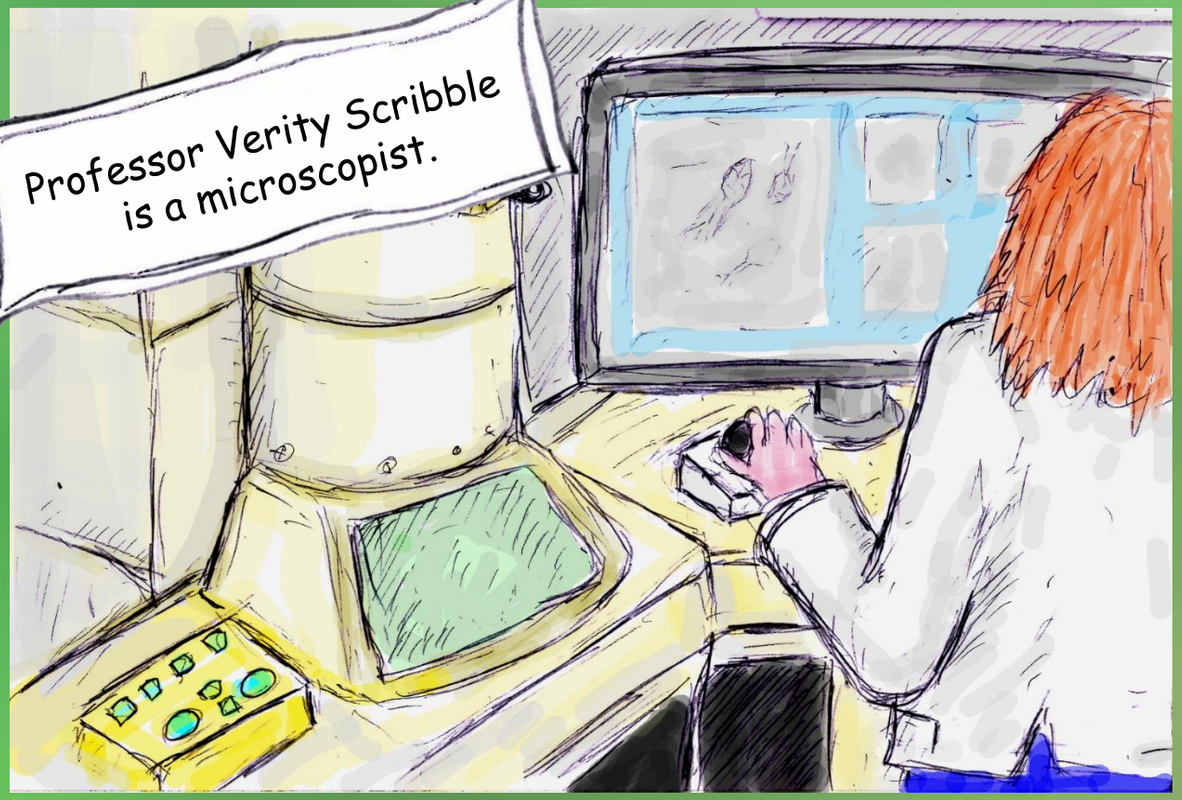
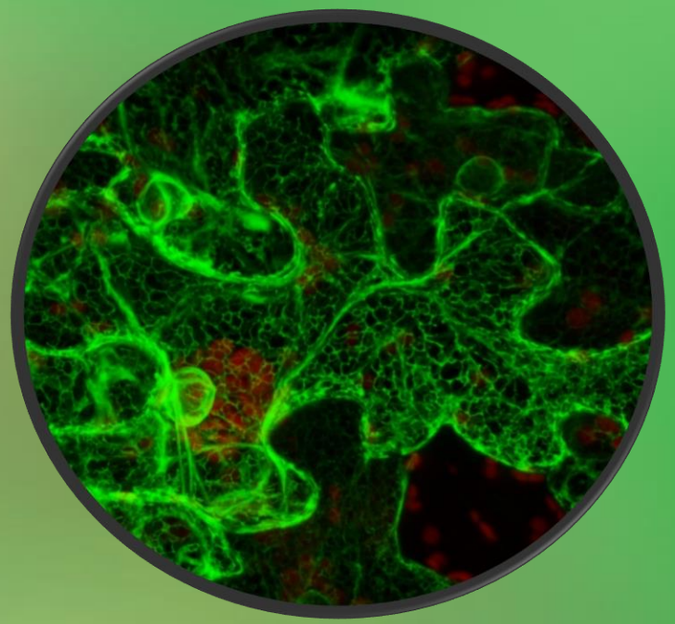
VIRUS HUNTERS

The Quest Begins





People bring her their work. She helps them study, makes small things visible – and beautiful.
Microscopists get to be the first to see things. But whether its diseases or food crops, it's usually other people's work.

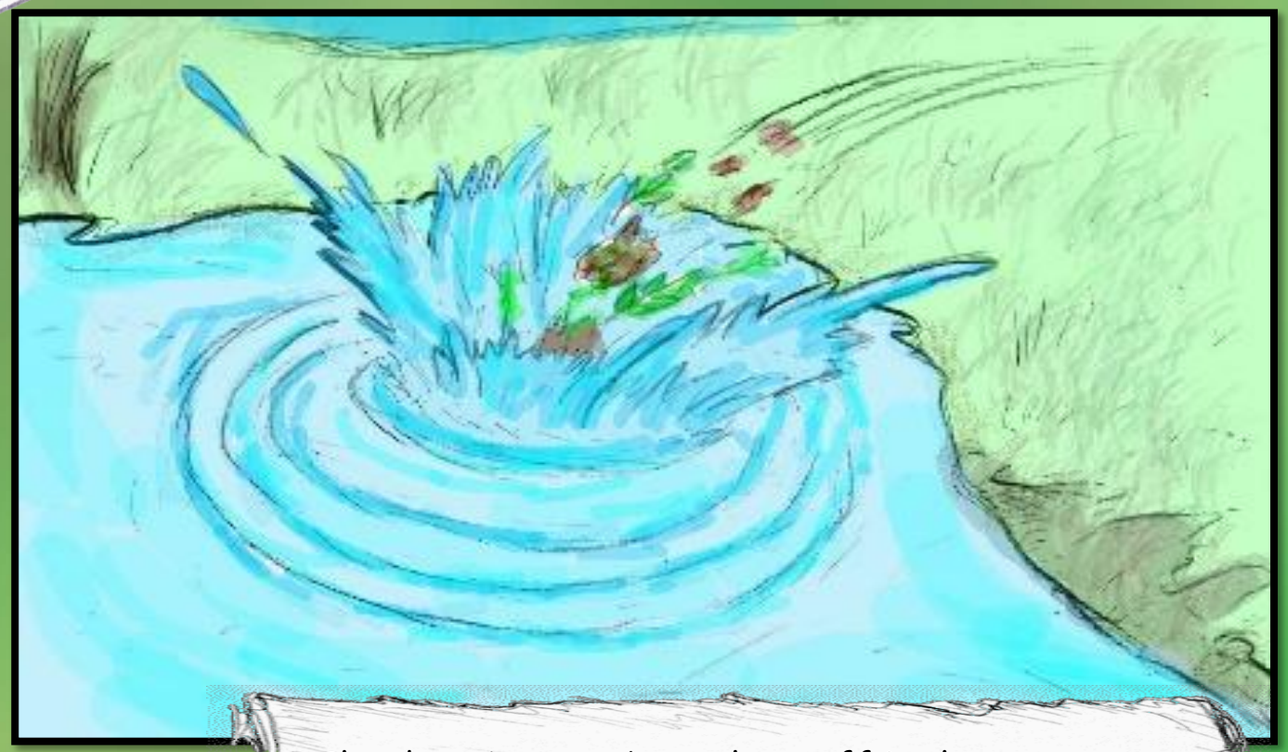


Plant cells – 20 microns

Today is different, the professor is trip to somewhere unexplored, to the truly minute, to the limits of life.

Everyone knows the local pond. But does anyone ever take a really good look?

Fishing nets are very handy for pond dipping



She doesn't care about the stuff in the net – anyone can look at that. We'll just throw it back.

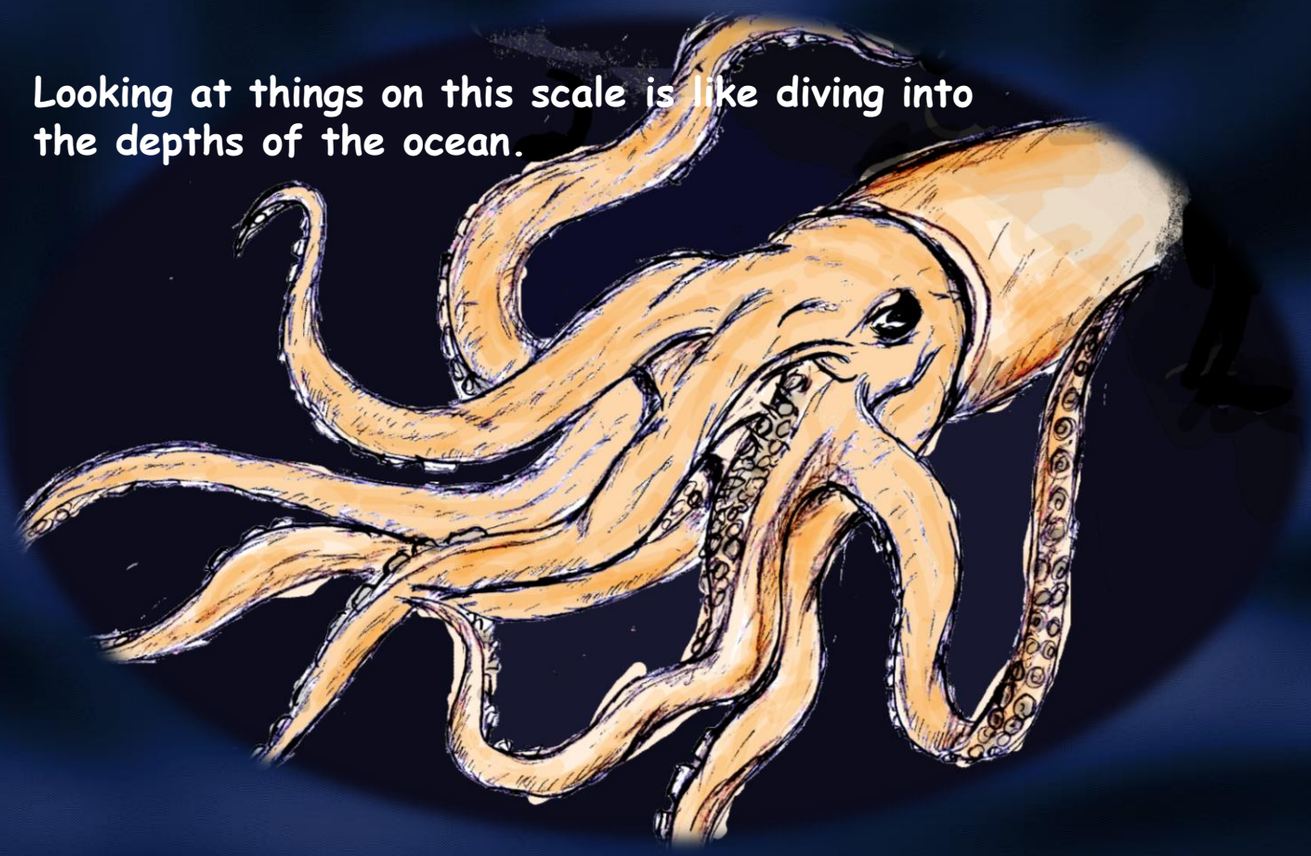
It's what the net can't catch that interests Verity

Look closer

Much closer....

It might look clear but a single drop of water under the microscope is a strange and complicated world.

Looking at things on this scale is like diving into the depths of the ocean.



Algae at 250x magnification

Life goes by different rules down here

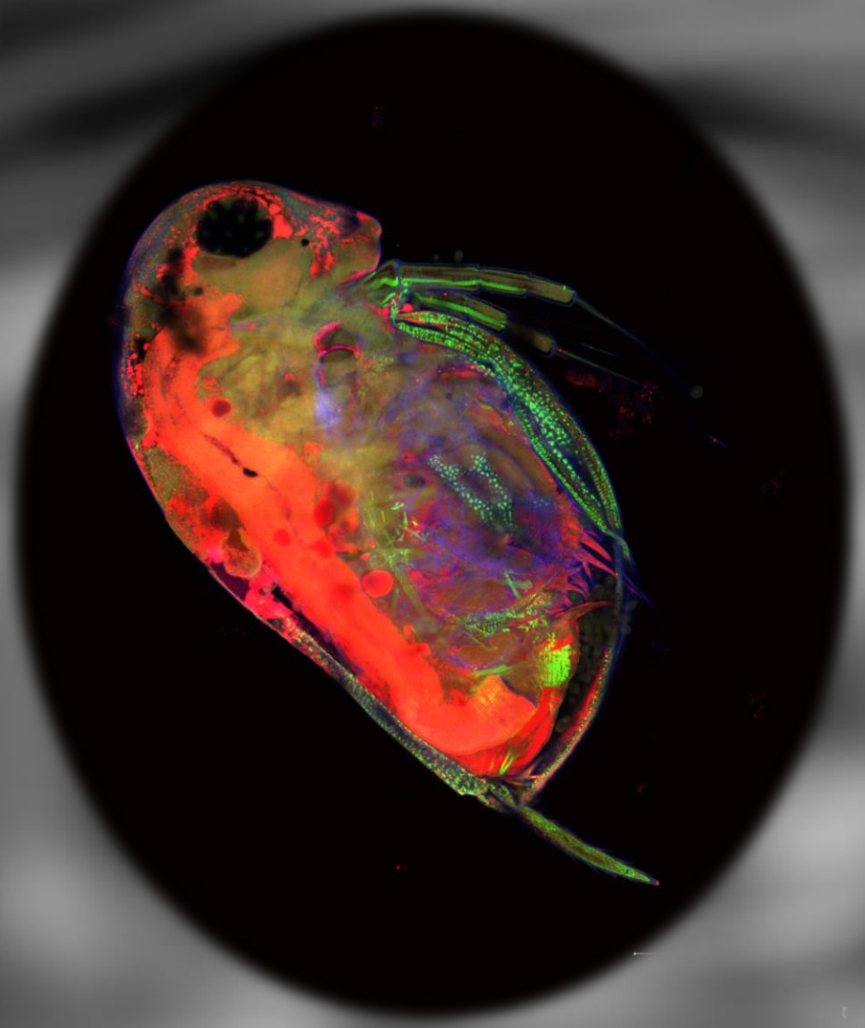
50 µm

If you want to see an alien landscape, ask a microscopist. We spend our lives exploring them

Bacterium at 5000x

All we ever see is brief glimpses. We just don't know what goes on down here

Magnification 10x – what you'd get
you get with a magnifying glass



Daphnia – easy to see by eye
They're crustaceans - the same family as
crabs and lobsters. Pretty but they're huge.

Look closer

Magnification 100x – what you'd get
you get with a small microscope

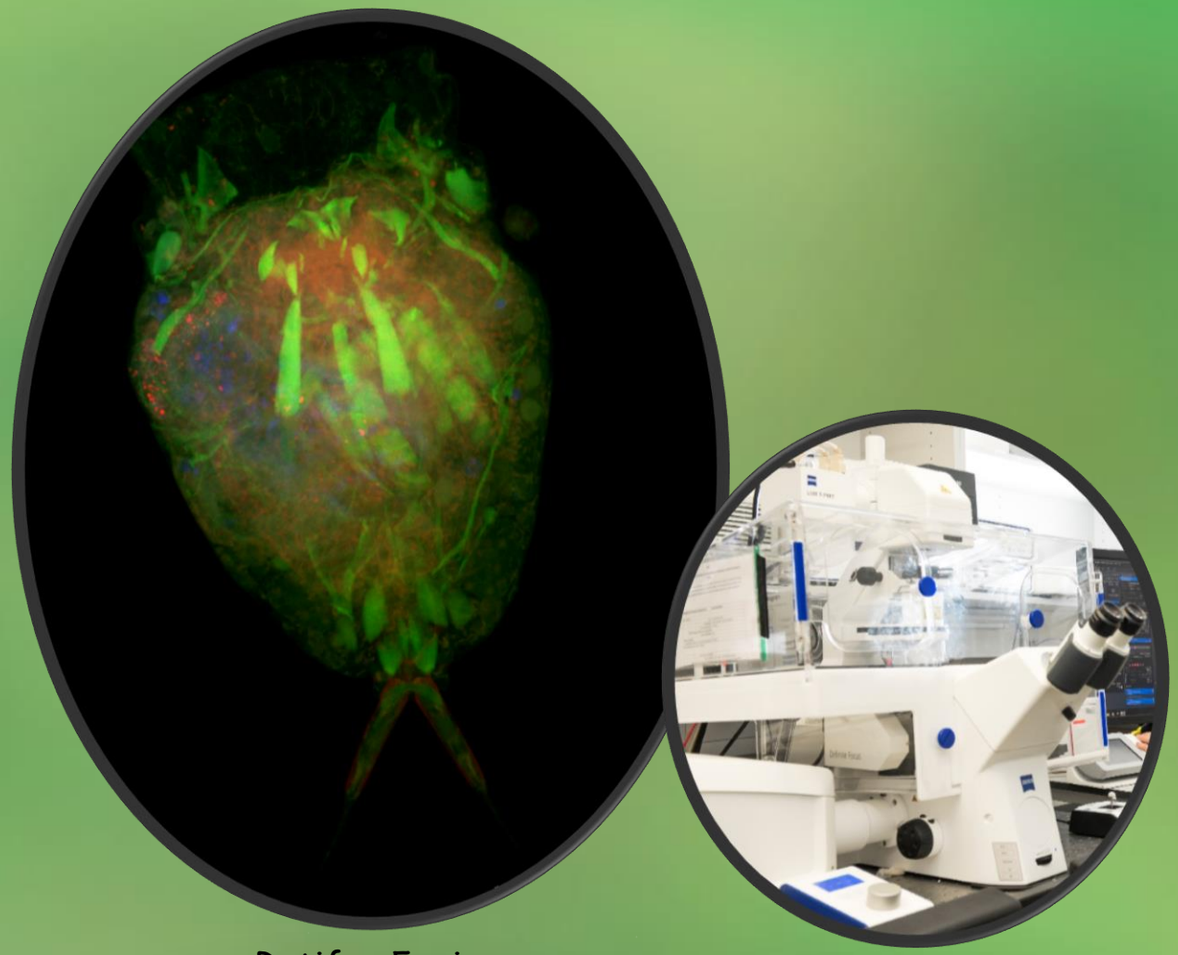
Amoeba 10 microns

Amoeba – If you've got good eyesight you might see them as specks. Microscopic, single celled. Serious predators.

Interesting but not what we're after

Look closer

Magnification 400x – what you'd get
you get with a good microscope



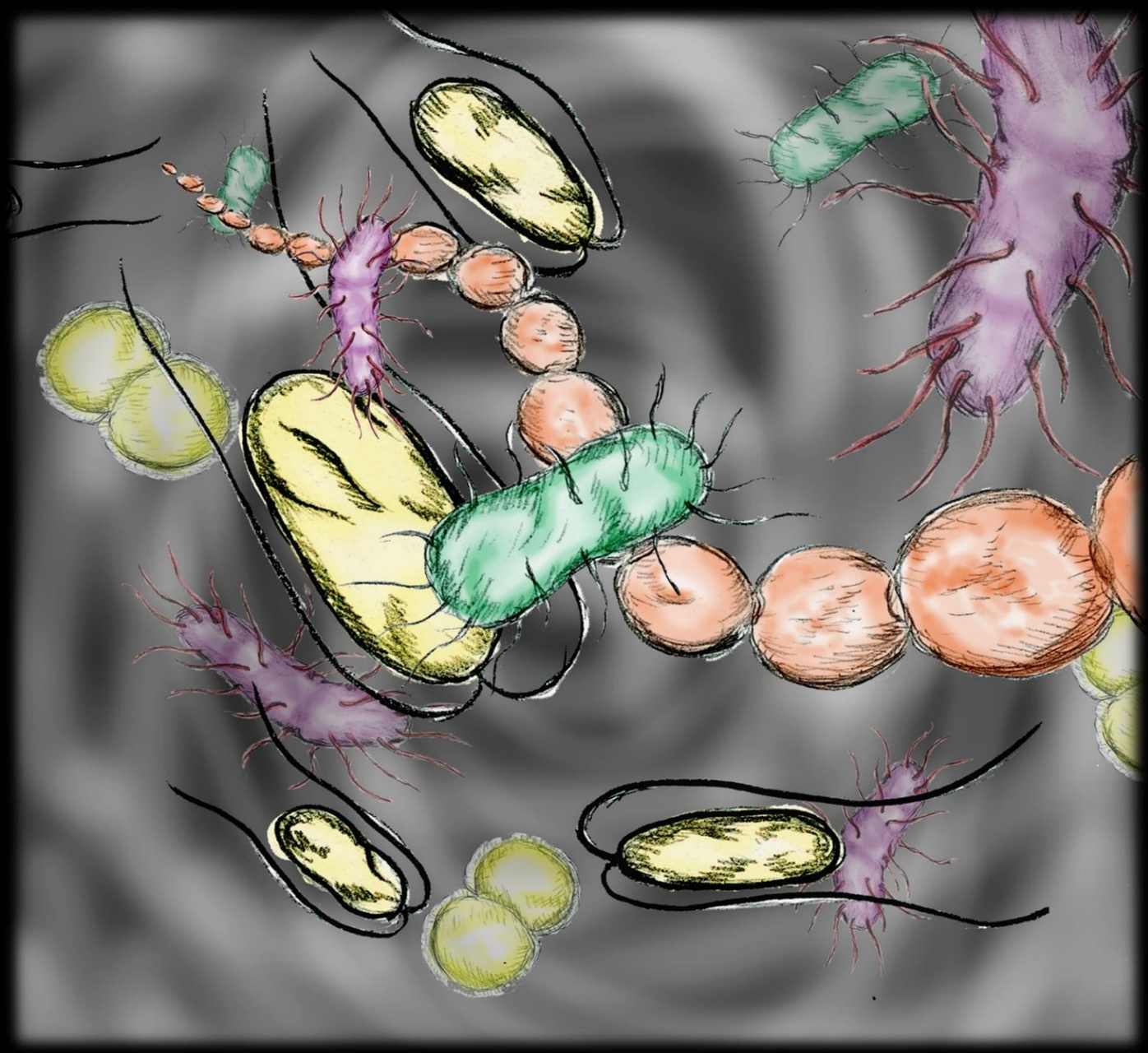
Rotifer 5 microns

Rotifers – smaller than amoebae
but they're actually animals.
They have multiple cells, a
nervous system and a gut.

Astounding creatures but the
professor isn't looking for them.

A bit closer

Magnification 1000x – what you'd get
you get with a good microscope



Bacteria – one micron

Bacteria – amazing. Weird, a bit gross. Mostly harmless.
Most bacteria aren't dangerous to people
They're about the smallest thing it's possible to see with a light microscope.
Although they're great, they're not what we're looking for.

Look closer

To zoom in any further we need some very special equipment. Electron microscopes have the extreme magnification we need to see anything smaller than bacteria. They're huge machines that fill a room and cost around a million pounds.

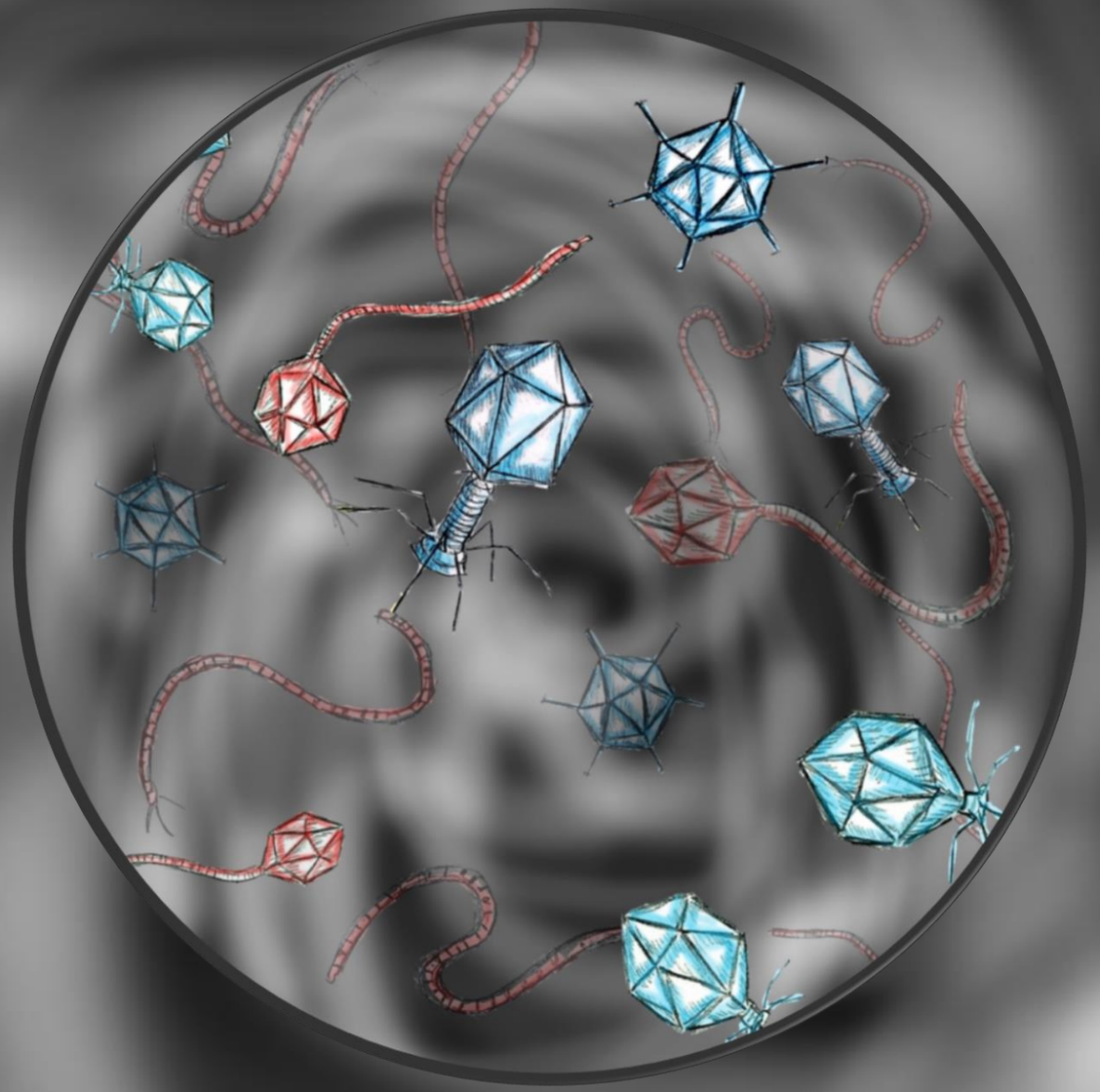
They're also Professor Scribble's favourite toy.

It takes a long time to learn to use one but if you want to see small things, you need one. They magnify up to a million times – enough to see atoms but we only need to get to 50,000x

This is what we're here for

Viruses

No one had even seen one until 1940

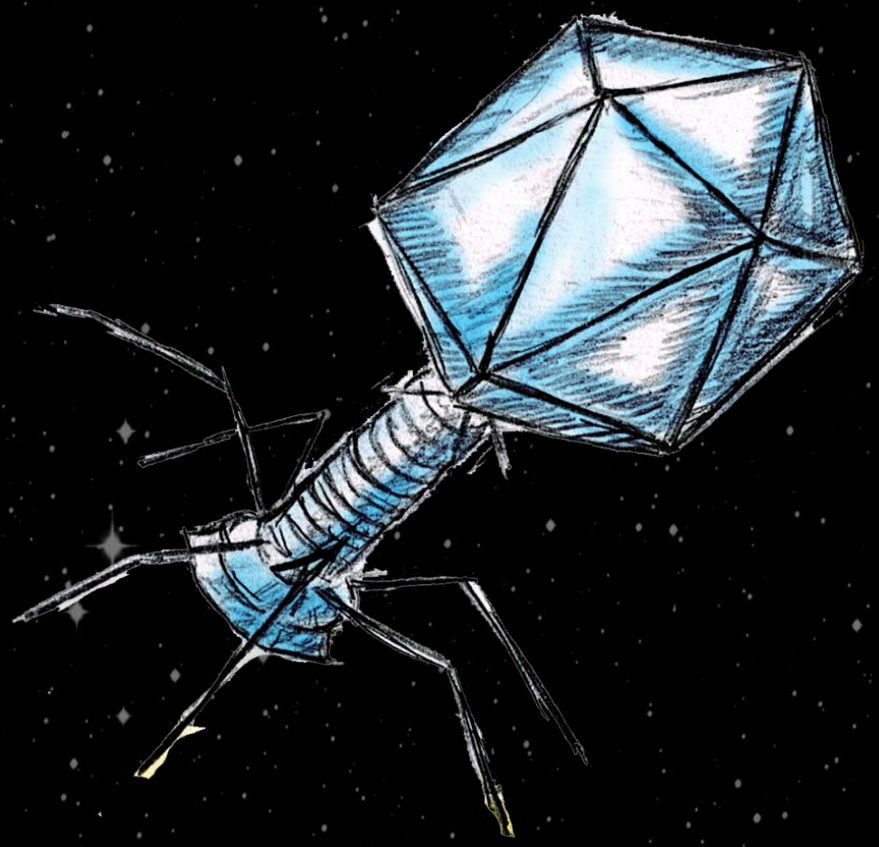


Viruses – 200 nanometers

But they're everywhere….

A virus is not alive

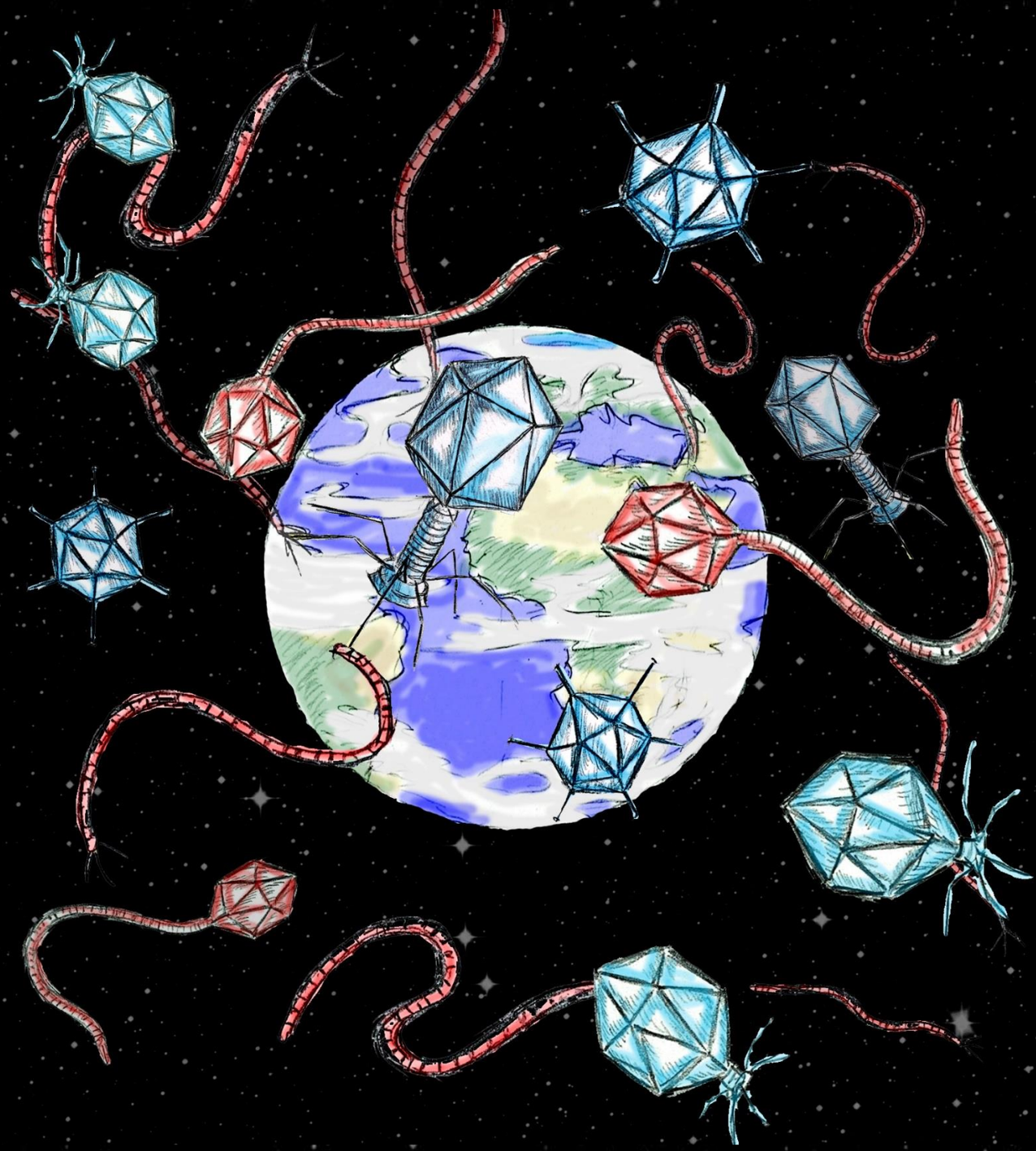
It needs a living host to reproduce in



For every living cell in the world, there are ten viruses.

Viruses outnumber Everything

Our world belongs to viruses



Everything else is just prey……

VIRUS HUNTERS

Sample preparation

50 µm

How do you get pond water Into an electron microscope?

We can't just pour it in, the microscope uses electricity - two hundred thousand volts, it'd go Bang!

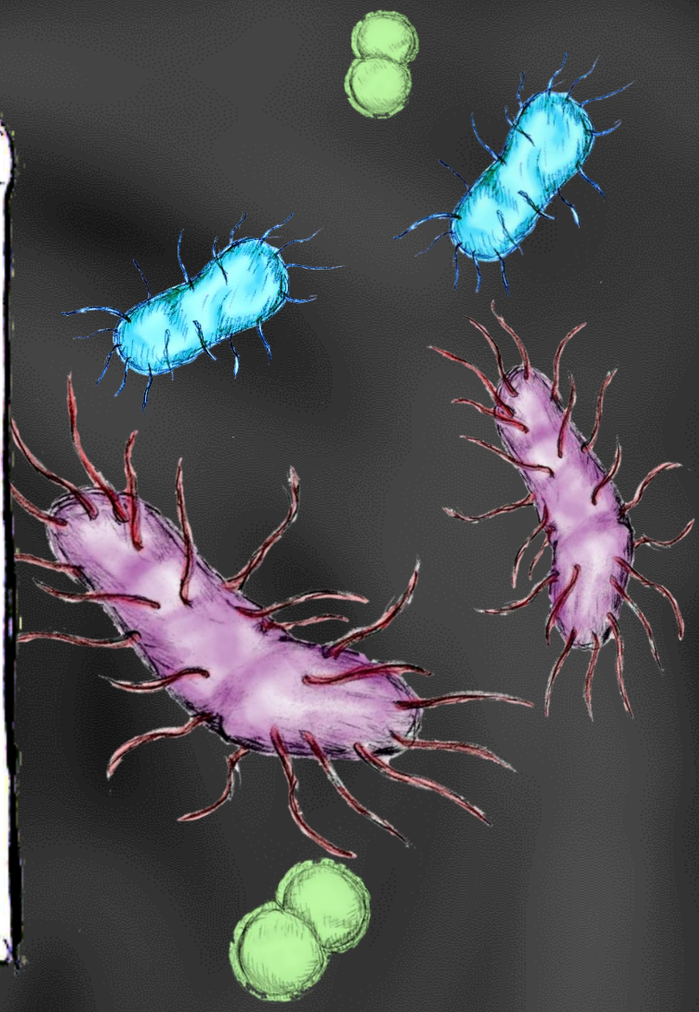
Verity needs to do some 'Sample preparation' before we can look at it.

Professor Scribble filters the water through paper.

Paper filters trap anything bigger than 20 microns – that's five times thinner than a hair.

The water looks clear but it's still full of bacteria. They're cool but there's lots of them, they'll ruin the view. So we need to get them out.

Verity puts the water into a machine called a centrifuge. It spins the sample quickly – 6000 times a minute.
Centrifugal force drags bacteria to the bottom of the test tube. At this speed you'd weigh a hundred tonnes!



The goo at the bottom is called the "pellet".

It's all bacteria and other bits that we don't want to keep.

We can just pour the liquid off the top.

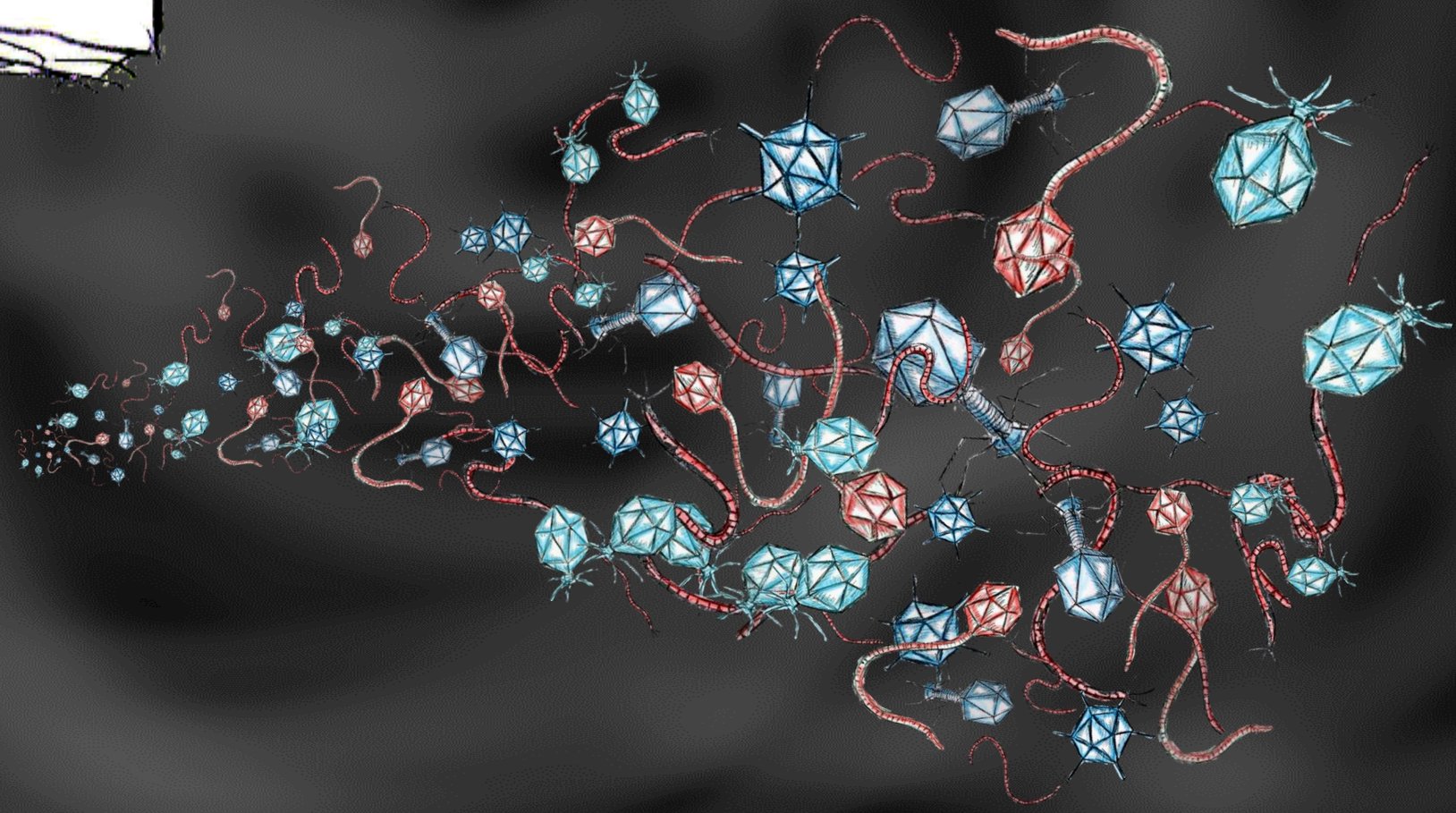
The important bit is the clear liquid – the supernatant.
It should be mostly viruses – and water.

She could put it into the microscope now but the viruses will be very hard to find – they need to be concentrated

Professor Scribble puts the supernatant back into a centrifuge and spins it again - much faster –

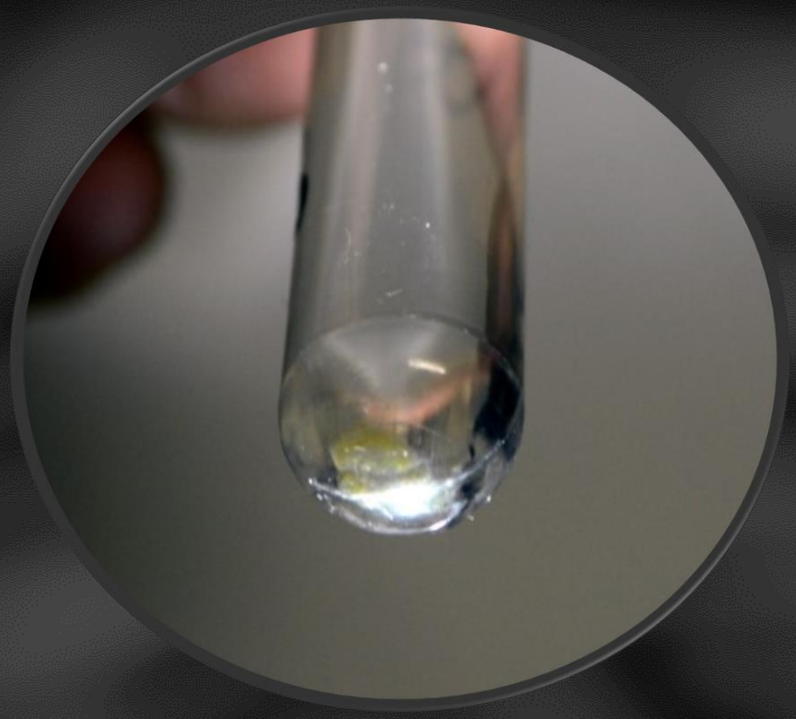
Forty thousand times a minute – that's 200,000 times the force of gravity. At this speed you'd weigh four thousand tonnes!

– that's forty blue whales

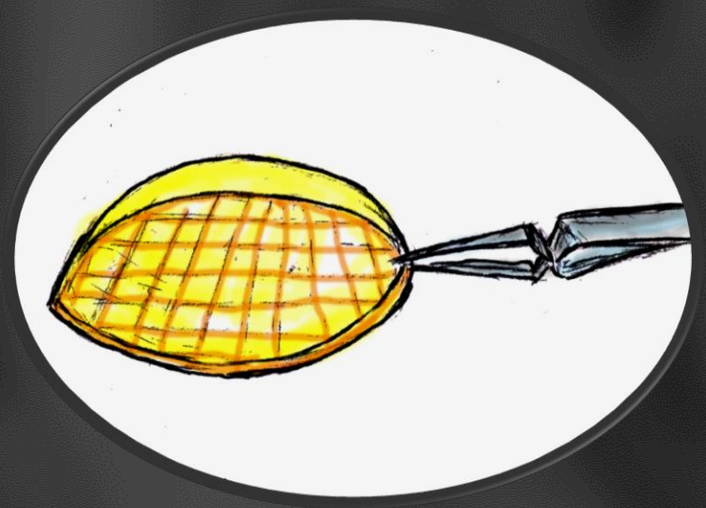


The extreme forces pull all the viruses – and everything else down to the bottom of the tube.

It takes 24 hours to pull down all the viruses – they make a tiny yellow pellet at the bottom of the tube.



It might look mucky but it doesn't smell, bacteria make smells, we threw them away.

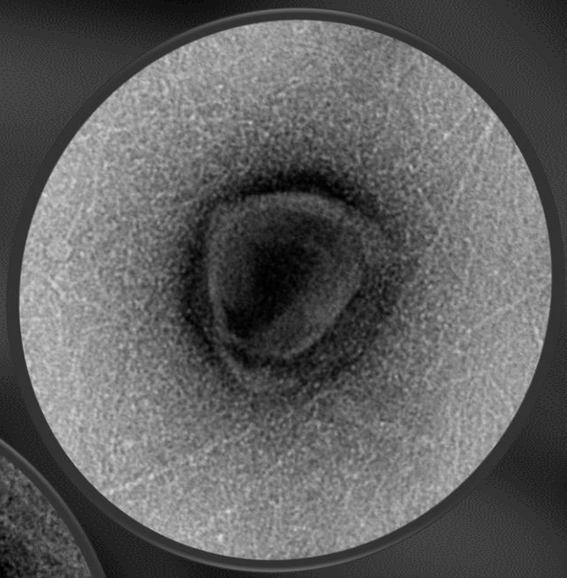


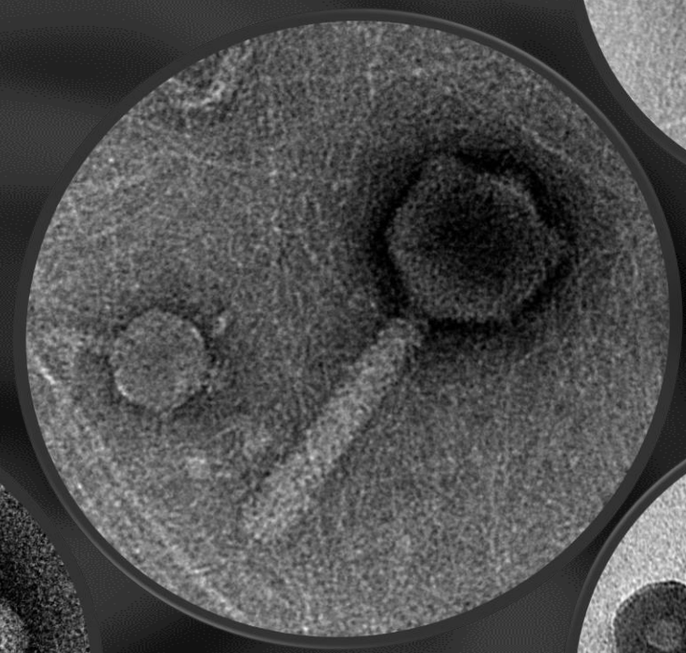
Microscopists use tiny pieces of copper mesh to hold things for an electron microscope. We call them "grids"

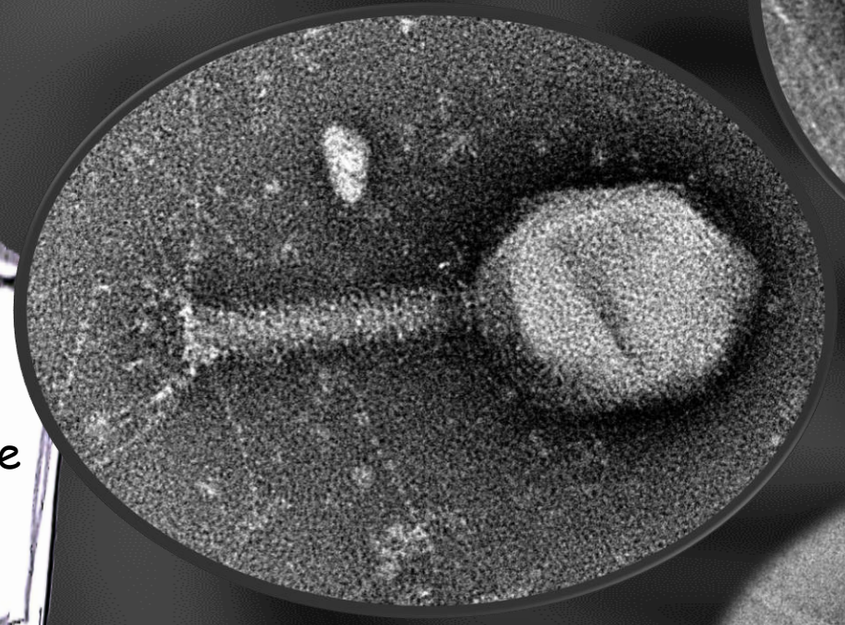
Verity uses just 5 microliters of pellet on a grid. You'd need forty thousand drops like that to fill a glass.
As viruses are so tiny she needs to stain them so they show up.

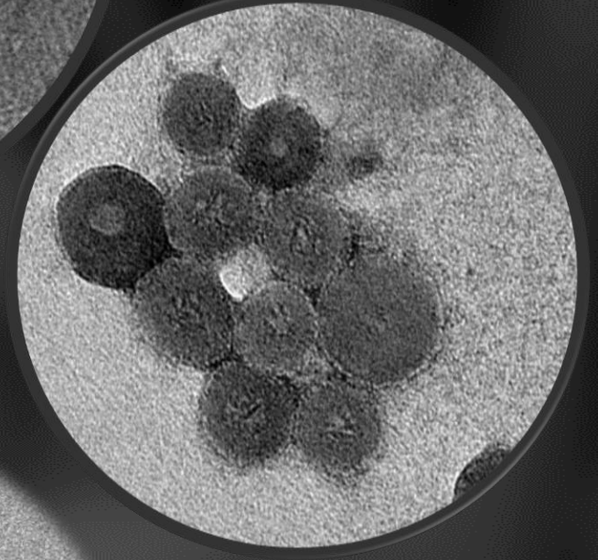
The stain is made from Uranium!

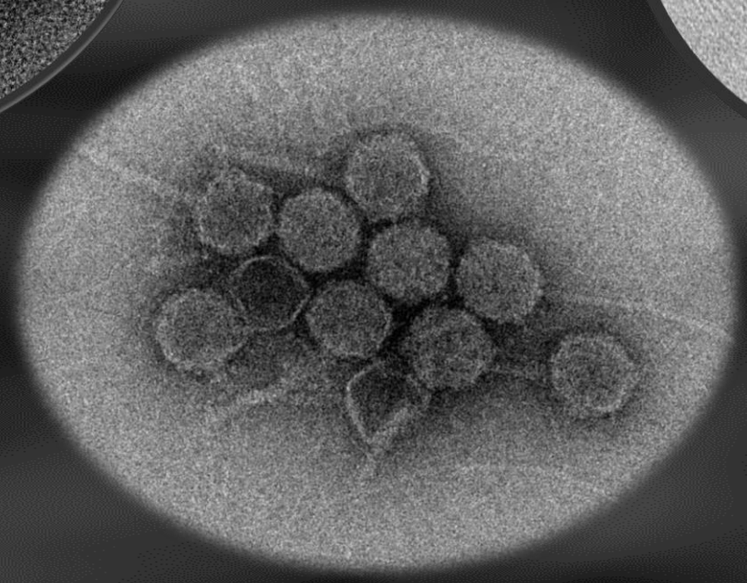
The grid goes into the sample holder – this version holds four grids. It takes ten minutes to pump the air of the microscope so it'll run.





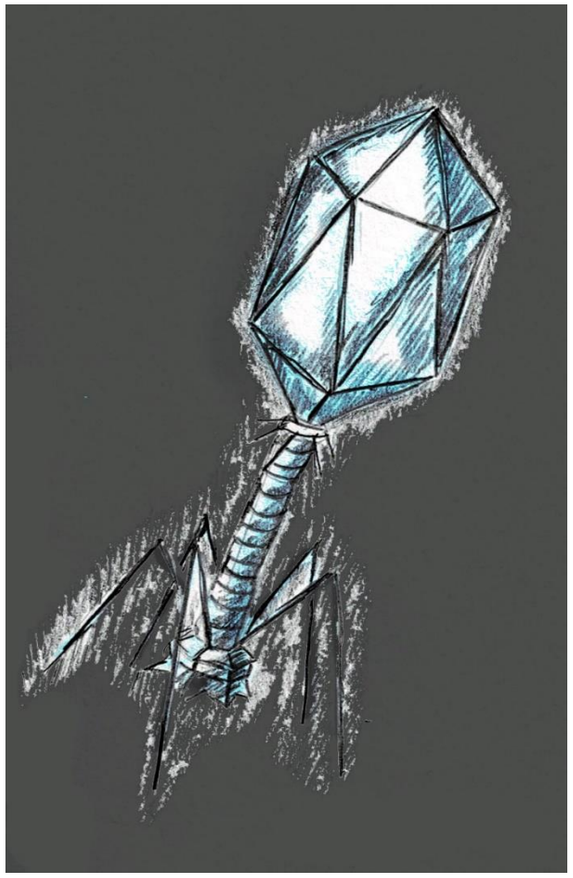






Finally after two days work, Professor Scribble gets to see what she's caught.

It's totally worth the wait!



T4 Virus – It’s not unique, there are many others like it.

But T4 is one of the fastest, deadliest viruses on the planet

It can kill in fifteen minutes.