Threats too tiny to see

Continuing ideas for exploring the environment - in the year of the global coronavirus pandemic- by Jeanie Clark

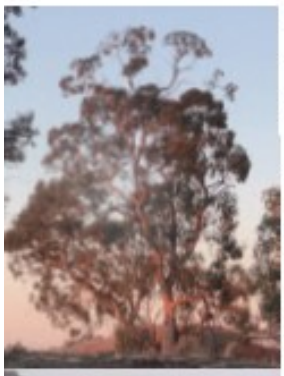
Didn't it seem bad enough to start a year with huge, frightening fires, destroying living things, especially plants, and animals and humans in their way? Now, we humans are threatened by a tiny, frightening thing that could destroy some of us from the inside! But, it is not the only dangerous tiny thing in our environment.

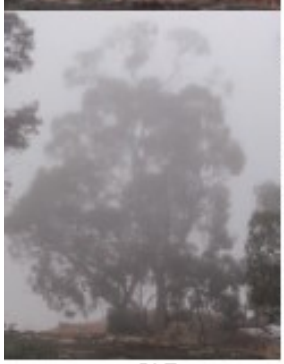
So this issue's article will be an introduction to some of those things: water droplets, pollen grains, fungi spores, bacteria and viruses and how they affect humans, especially as some are invisible threats. I hope this will be a helpful basis to build understanding of them, and of the new (nova) coronavirus, as knowledge develops.

The invisible around us

To start with, what things can your child(ren) name that they cannot see? What do they already know about these invisible things, like their size, what they do, where they are and how they know about them?

Did they name 'air' as something invisible? Are there things in the air that are invisible most of the time, but not when there is lots of it, e.g. as shown in the photo pair below? What are the similarities and differences?





There is invisible air between me and the tree in both photos, but the air is clearer in the top photo. The bottom one was taken during a fog.

Which senses can we use to detect fog? Smell - no. Taste - no. Sound - no. Feel - yes, wet, like rain. (Rain falls from clouds, and we know rain is water.) Sight - we can see fog when there is a lot of water in the air at ground level - none falls, so no rain, but water is still there.

Can we see the individual water droplets in a fog? Try to see a droplet in rain or dripping water. If there is a fog at night, try shining a torch on the droplets. Use a magnifier or your camera on zoom to try to see water droplets closer. (Or google search for some images.)

Why can water droplets be so hard to see? Raindrops are typically under 1 millimetres (mm) width. Look at a ruler's subdivisions. Can your eyes distinctly see 1/5th of a mm (0.2 mm) in it? Human eyesight has this limit to how small in size we can clearly see!

Too tiny to see

We benefit from scientists before us and so we know that liquid water is made up of lots of water molecules. Each molecule is made up of one oxygen atom with two hydrogen atoms attached, or H_2O. This arrangement gives 'water' its properties.

Can we use our senses to see, hear, feel, taste, or smell one molecule of water? No, it is too tiny. Can our instruments photograph an H_2O molecule? No, it is too tiny. We use models to give us a visual idea of what such things are like. A google search reveals lots of ways to model H_2O. So why not make your own H_2O model as an example of something tiny we can't see, but is in the air?

Noses may know

What else might be around us that is too tiny to see, but that our noses can detect? Pollens? Where would pollen be in the photos below?

On the left, pollen cannot be seen as it is inside the white dots (anthers) at the end of the thin mauve filaments. (For these terms see a plant parts diagram.) On the right photo, my camera's zoom magnifies the ant to reveal yellow dots on its legs and thorax, pollen from the anthers.

Noses help keep invaders out. While noses may be happy to let some (gas) smells into our bodies, (solid) tiny grains, like pollen, are likely to be rejected as invaders with sneezes, and may cause hay fever or asthma. Lots of pollen in the air can harm some humans.

Why don't we see this threat? Individual pollen grains vary in width from 1/10th to 1/100th of a mm (0.1-0.01 mm), so most are 'invisible' without magnification. An electron microscope can magnify things by a million times their size. Nearly a decade ago these microscopes were first used to photograph pollen grains and showed their varying shapes and sizes. Lots of pollen grains in the air, unseen due to being smaller than a pencil dot, can harm some humans.

Weblinks (in blue)
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1 pollen parts diagram = https://www.vcbio.science.ru.nl/images/pollen/pollenfloweranim-onderdelen_eng.gif
2 pollen grains = see *Amusing Planet* website *Pollen Grains under Microscope* webpage - https://www.amusingplanet.com/2011/03/pollen-grainsunder-microscope.html

Taste may tell

Have you seen mouldy bread? Why don't you eat it? Taste? The mould is a visible sign that it will not taste good - nor be good for you! Over time, the amount of mould grws, but what is it? Mould is a collection of tiny fungi, most being too tiny to see a single one. It grows from spores which were ejected into the air by older fungi. A spore has a width of about 1/50th of a mm (0.02 mm), which human *eyes* cannot see.

Fungi spores attach to surfaces and grow into fungi. Some fungi are so big that we can see them. Others are still too tiny to see easily, for example as shown on the two photos below.

On the left is a garden fungus. On the right, my camera's zoom magnifies mould on a scone to reveal white dots, the tops of individual fungi growing on the scone's surface. Try a magnifier or a camera on zoom to reveal unseen fungi on some food gone 'off', like bread or fruit. Photos of magnified fungi can be found on the web.

Would you like to grow moulds to learn more about them? Here are some webpages with experiment instructions that show how different environments affect moulds:

- The *Timaru Herald* reports on one comparing washed/unwashed hands on bread, to show this basic healthy behaviour rule.
- *My Modern Net* has more growing conditions for fungi as moulds.
- *Bright Hub Education* has three experiments about what helps fungi grow.
- *Science Struck* has further experiments.

Such experiments help one discover that, while single spores are unseen in the air, there are millions of them, and they can harm humans.

Bacteria

With an average size under 1/100th of a mm (0.01mm), we need microscopes to see bacteria, a single-cell lifeform. (See the web for photos.) There are 1800 types in the air and we can't see any! Our senses can't alert us to bacteria in the air, waiting to be breathed in to our body, or on a surface, waiting to be touched and taken in.

They multiply inside us. Most are helpful to us, like *Lactobacilli* with our digestion of food. But with others, our body's response can trigger pneumonia-like illnesses to get them out. Such illnesses harm humans, especially elderly people and those who have health problems.

Would you like to grow bacteria to learn more about them? Here are two webpages with instructions that show how different environments affect bacteria:

- *Mad About Science* creates agar first.
- *Home Science Tools* has making yoghurt.

Viruses

Viruses are even tinier things, about 100 times smaller than bacteria, about 1/10,000th mm. wide! That's hard to imagine. So try making this visual aid - a diagram to show the different typical sizes of the little things in this article. What scale will you use? If the virus of 0.0001 mm was represented by 1 mm, then, for this scale, work out how big each of these will be: a bacterium; a fungi spore; a pollen grain; a water droplet; and human *eyesight's* limit. How much space is needed to make this diagram?

Viruses do not 'live', but as parasites they multiply in the right environmental conditions, e.g. inside a human body. They do not 'die', but they fall apart from contact with soap or disinfectant or simply being out of a body environment too long. Our body tries to remove viruses, e.g. *nova coronavirus*, by creating 'flu' symptoms. This fight by/in the body may become a specific lung illness, e.g. *Covid-19*, especially harmful to the elderly and those with health problems.

There are many good web pages on viruses, e.g.

- *Care.com* - activities show transmission.
- *National Geographic's Flu Virus 101* - video covers an overview of viruses and their human history.
- *Just for kids* - cartoon information and short audio on *coronavirus* and safe behaviours.
- *ABC - Spanish Flu* history links to Covid-19.

Why are the things in this article so dangerous to humans? How do humans fight these threats? Try creatively answering this, using more web research if needed. May you all fight the tiny and unseen pest *nova coronavirus* with knowledge, soap and other safe behaviours!

Weblinks (in blue) P47
3 photos [magnified fungi] = https://www.britannica.com/science/Rhizopus
4 Timaru Herald = https://www.stuff.co.nz/timaruherald/news/120556396/timaru-schools-hand-washingtest-surprises ;
5 My Modern Net = https://mymodernmet.com/moldy-bread-scienceexperiment/
6 Bright Hub Education = https://www.brighthubeducation.com/science-fairprojects/107513-bread-mold-science-experiments/
7 Science Struck = https://sciencestruck.com/bread-mold-experiment
8 photos [bacteria legionella] https://www.sciencephoto.com/media/709708/view
9 Mad about Science = https://www.madaboutscience.com.au/shop/scienceextra/post/grow-bacteria-on-homemade-agar-plates
10 Home Science Tools = https://learning-center.homesciencetools.com/article/bacteria-experiment-guide/
11 care.com = https://www.care.com/c/stories/4211/germs-for-kidsteaching-children-about-germs/en-gb/
12 Flu Virus 1010 = https://www.youtube.com/watch?v=WSZEcpti2i0
13 Just for Kids = https://www.npr.org/sections/goatsandsoda/2020/02/28/809580453/just-for-kids-a-comic-exploring-the-newcoronavirus
14 ABC- Spanish Flu = https://www.abc.net.au/news/2020-03-07/whycoronavirus-keeps-being-compared-to-the-1918-spanish-flu/12016782