I BET YOU DIDN'T KNOW...

Catching flu might depend on the type of place in which you live

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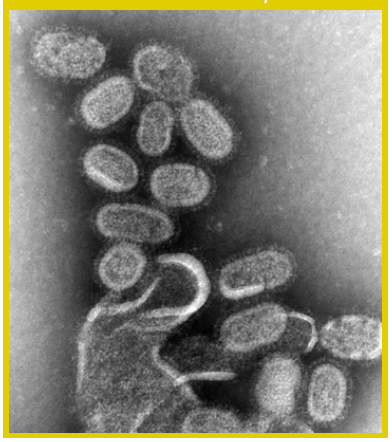
Scientists in America have discovered that the timing and scale of flu epidemics are linked to the climate and the types of cities in which people live.

Have you ever caught flu from someone?
Many illnesses are caused by microscopic organisms called microbes. There are several types of microbes and they include bacteria, fungi and viruses. Microbes are everywhere and they are not all bad. In fact, some are really useful. You may consider yeast and penicillin (both fungi) and bacteria that make yoghurt and those in our digestive tract that help break down and absorb food. Scientists now think that some viruses may also be beneficial when gut bacteria are not able to work. This article is about infections caused by viruses.

What is flu?
Flu is an illness caused by influenza viruses (Figure 1) that infect the nose, throat and sometimes the lungs. Large-scale outbreaks of the influenza virus are called epidemics. It is important for health organisations to be able to predict epidemics to allow them to prepare medical support and minimise disease spread. Like many viruses, influenza spreads from person to person in droplets of liquid, such as those released in sneezes and coughs. The influenza pandemic of 1918-1919 killed more people worldwide than World War I, somewhere between 20 and 40 million people.

Figure 1. A recreated 1918 influenza virus viewed under an electron microscope.



How can you minimise the risk of spreading viruses?
You should consider hand washing and covering your mouth when you sneeze. When you wash your hands, it removes oils from the skin's surface making it harder for viruses to 'stick' to your skin. It can also wash a virus off your skin. A virus can only survive outside the human body, or 'host', for a limited amount of time before it stops being infectious. However, some cold-causing viruses can survive for more than seven days, although most don't survive for more than 24 hours.

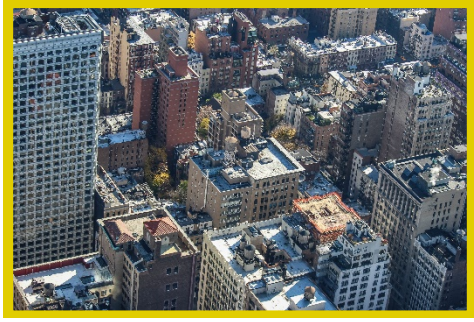
Can scientists predict when and where an epidemic might occur?
Researchers recently carried out a study using mathematical models to see how flu epidemics could be predicted. They considered factors that affect the way in which the virus spreads and compared the medical records from 603 cities in the U.S.A. showing where and when flu was recorded over a six-year period.

The first factor they considered was the production of chemicals, by the human body, to fight viruses. Once you have had a particular type of virus, your body develops chemicals (antibodies) to fight the virus so that you will be

much less likely to get ill a second time. This means that as more and more people catch and recover from a virus, there are fewer people left in the population who could catch it. In this way a population can develop resistance or 'herd immunity' to a disease.

The second factor they considered was the climate. The amount of moisture in the air (humidity) decreases when the temperature drops. The influenza virus can survive for longer outside the human body at lower humidity. This means that, at lower temperatures, if an infected person has droplets containing the infectious virus on their hand, they have longer to pass it on to an uninfected person. As a result, in countries like the UK, with distinct seasons, epidemics of flu tend to occur in winter.

Figure 2A. A high-density city. *2B. A low-density city.*



The data showed that some cities consistently had more intense epidemics, even when they had the same climate as others. The researchers compared the size of the cities, how they were laid out and how crowded they were. They proposed the existence of different types of flu epidemic in different types of cities. In crowded cities (Figure 2A), flu spreads quickly, even at high temperatures and humidity, because in a short space of time people are highly likely to interact with other people. In contrast, in low-density cities (Figure 2B), fewer people catch the virus (even in warm, humid conditions) because it takes longer for two people to 'bump into' each other, and by the time they have, the virus is no longer infectious.

Is it better to live somewhere where viruses are spread quickly or somewhere where they are only spread when temperatures are low?
You might think that it is better to live in a low-density city or town to reduce the risk of catching flu but when a city experiences a low number of outbreaks of flu, the population does not build up herd immunity. In crowded cities, there could be a large initial outbreak of flu, after which the population develops herd immunity.

These differing patterns of herd immunity (resistance to the flu virus) mean that the effect of climate change on epidemics could vary in different types of cities. In low-density areas with low herd immunity, when the temperature and humidity drop in winter, there could be epidemics with huge increases in outbreaks of the illness. However, in high-density areas, the effect of climate could be much less, as flu is spread between people over a wider range of climatic conditions and herd immunity can be high even before winter. The researchers conclude that the effect of climate change on human populations will depend on the size and layout of the cities people live in and that it may be possible to design 'smarter' cities that better control epidemics.

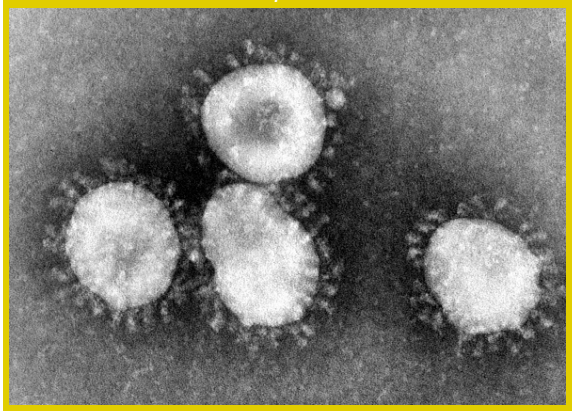
Will viruses spread quickly where you live? How many people do you meet or 'bump into' when you walk from your classroom to the playground? Imagine that the school has twice as many children in the same space. How would this affect how likely you are to bump into somebody else? How could this affect the spread of microbes? Compare 'people traffic' in different areas of your school and predict where virus spread is most likely to occur. Use maps of local towns, villages or cities to compare how evenly the population is spread out with other areas.

What would you consider if you were trying to design a city that would reduce virus spread? Would you consider how people commute and the times at which work places and schools start and finish each day? Do you think it is better to live somewhere where viruses are spread quickly or somewhere where they are only spread when temperatures are low? Why?

What is a coronavirus?

Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases. They can be spread between animals and people. Novel coronavirus (COVID-19) is a new strain of coronavirus (Figure 3) first identified in Wuhan City, China. Typical symptoms of COVID-19 include fever and a cough that may progress to shortness of breath and breathing difficulties. Standard recommendations to prevent infection spread include regular handwashing and covering mouth and nose when coughing and sneezing. Currently, there is no vaccine to protect humans against COVID-19 but scientists around the world are working to develop one. This takes time because vaccines must enter clinical trials before they can be used on humans. At the time of writing, many people have had mild cases of the virus and have recovered without special treatment.

Figure 3. Corona viruses have a halo, or crown-like (corona) appearance, when viewed under the electron microscope.



Glossary

Virus	An infective agent that typically consists of a DNA molecule within a protein coat. Unlike bacteria, it cannot grow or reproduce except from in a living cell.
Epidemic	An outbreak of an infectious disease in a community at a particular time.
Pandemic	An epidemic of disease that has spread across a large region, for instance, multiple continents, or even worldwide.

The research paper that generated this work was:

Urbanisation and humidity shape the intensity of influenza epidemics in U.S. cities.

By Benjamin D. Dalziel[1,2], Stephen Kissler[3], Julia R. Gog[3], Cecile Viboud[4], Ottar N. Bjørnstad[5], C. Jessica E. Metcalf[6,7], Bryan T. Grenfell.[4,6,7]

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