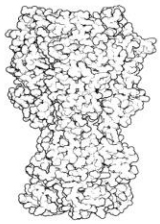
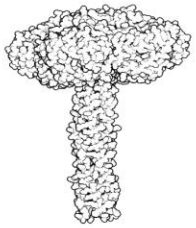
INFLUENZA VIRUS



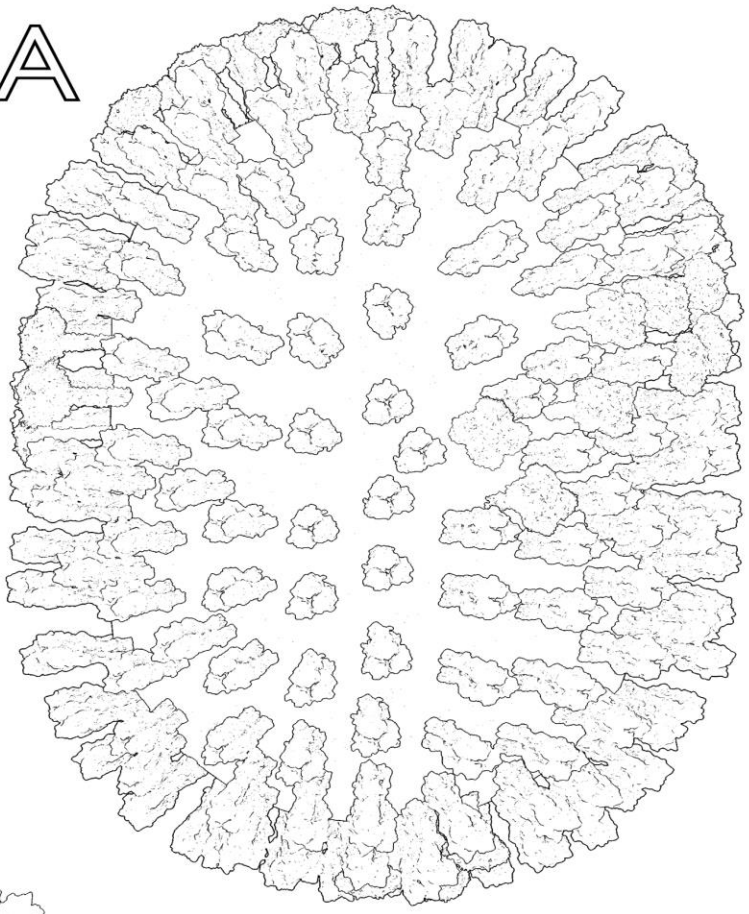
HA

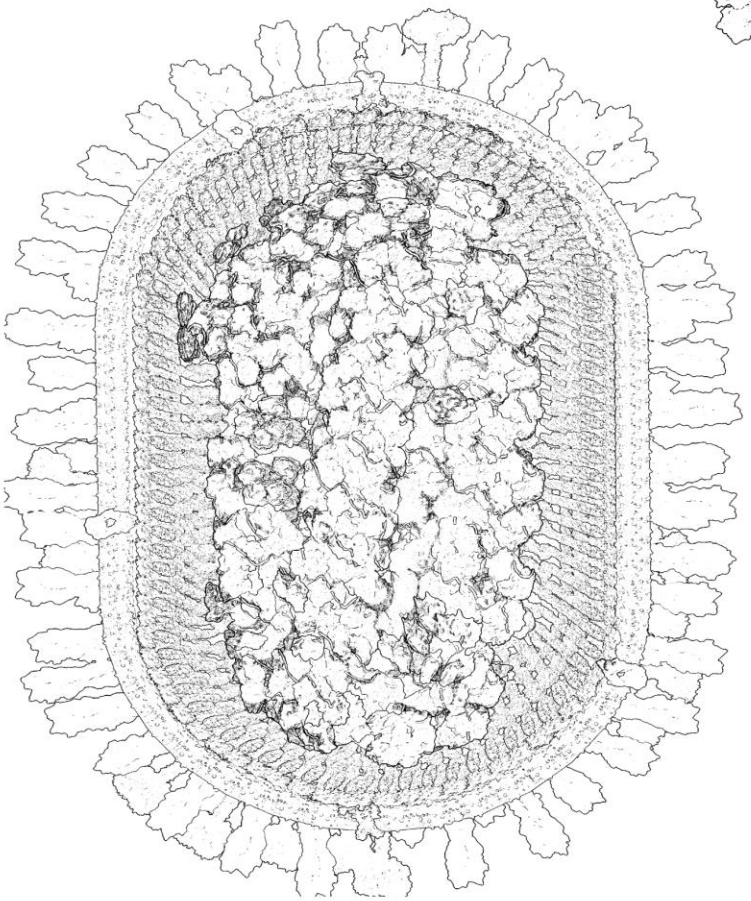


NA

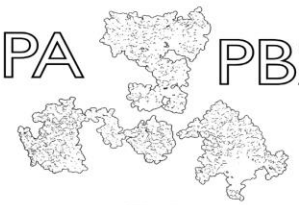
M1

M2





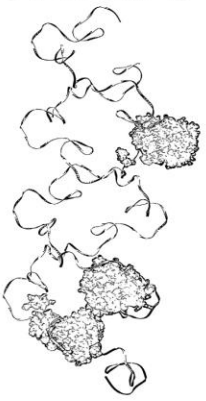
PA



PB2

PB1

vRNA



NP

NS1

NEP

21. Influenza Viruses

Ed Hutchinson & Naina Nair

Influenza viruses cause a great deal of trouble. They can infect people and spread well between them, particularly in the winter months. They can infect animals, causing enormous problems in farming and horse racing. They have been doing both of these things for a very long time.

In humans, influenza viruses will normally cause a brief if unpleasant illness which people recover from after a week or so at home. However, they can and do cause much more severe disease, particularly in older adults, pregnant women and people with underlying health conditions. Because the virus is so common, each year influenza will kill hundreds of thousands of people around the world. To make matters worse, the virus is unusually effective at jumping between different host species, and every few decades this can allow a new strain of influenza virus to adapt to humans. At first we have no immunity to these new strains, and so they race around the world and cause pandemics. The impact of influenza pandemics is hard to predict. In 2009, a new pandemic strain of influenza appeared and caused a similar level of disease to existing seasonal influenza viruses (one of which it eventually replaced). In contrast, the 'Great Influenza' pandemic of 1918-19 is arguably the worst infectious disease outbreak recorded in history, killing around one in thirty of the global population within eighteen months.

Like all viruses, influenza causes infected cells to make small, simple, infectious particles, and this sheet shows the anatomy of an influenza virus particle. It's about a ten millionth of a metre across (120 nm, roughly a quarter of the wavelength of visible light). The outside is fringed with spikes of haemagglutinin (HA), which grabs new cells to pull the virus particle into them, and neuraminidase (NA), an enzyme that chews new virus particles free from the cell that made them. As HA and NA are on the outside of the virus particle, they are targets for our antibodies. They avoid this by mutating very quickly, which is why we need an updated influenza vaccine each year. The virus particle they surround is formed from a layer of fatty membrane (which is why soap and alcohol hand gel can decontaminate the virus), given shape by a layer of matrix protein (M1) and penetrated by a pore (M2) which lets the virus sense when its inside a new cell. Once there, it releases its genome, which is formed from eight separate segments of viral RNA (vRNA), each coiled into a rod-like helix with copies of nucleoprotein (NP) and ready to be copied by the viral polymerase (PA, PB1 and PB2). Once inside the cell, the influenza virus uses proteins including NS1 to shut down its immune defences, and uses other proteins including NEP to turn the cell into an efficient factory for producing new virus particles.

Did you know?

The name 'influenza' comes from the early modern belief that an outbreak of illness in an area might be caused by an evil 'influence' – from, for example, the stars. Although we now know that influenza is caused by a virus, we still hint at the idea of a vague and unidentified malady when we call any minor illness 'the flu.'