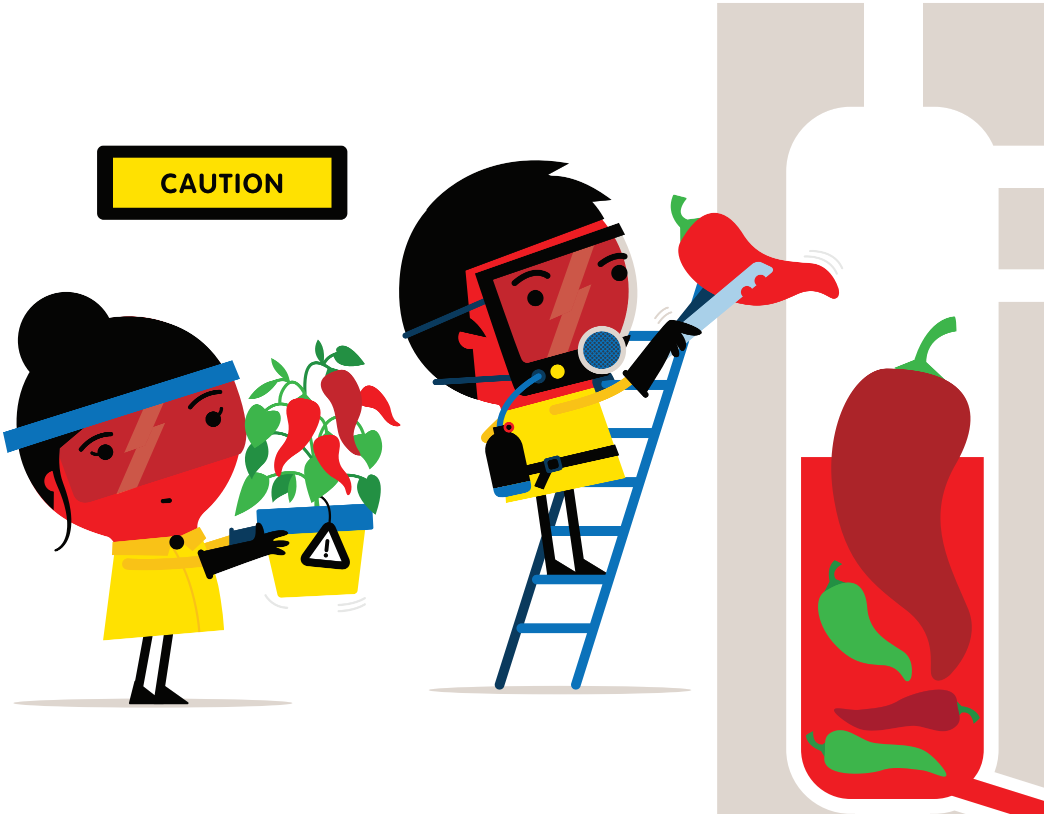
Could the heat of certain spices solve some of medicine's biggest problems? **Moheb Costandi** tackles a burning question

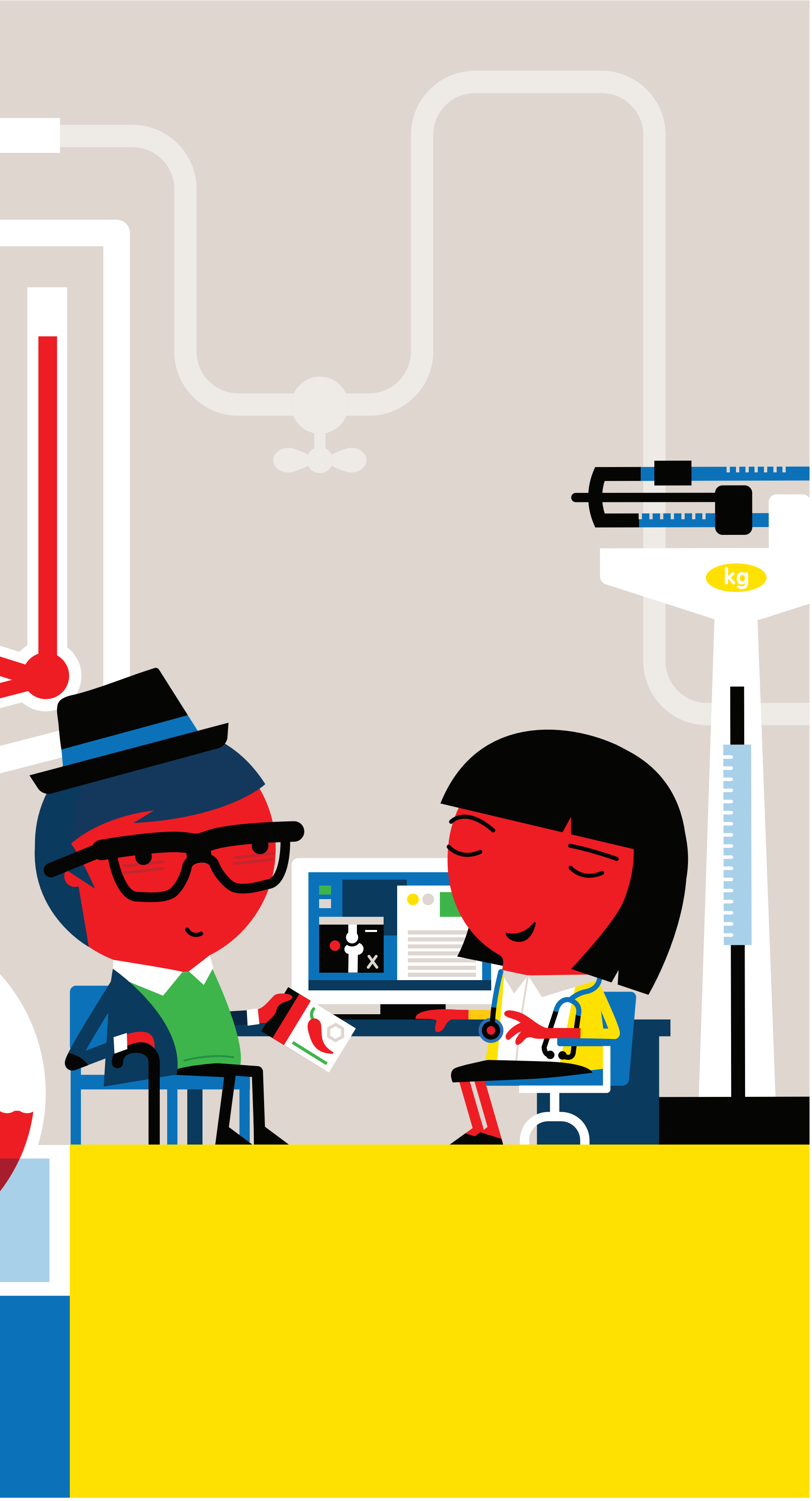


Catching fire

IT STARTS out as a pleasant tingle, before growing into a burning sensation that feels like your whole mouth is ablaze. You sweat, you cry, and your nose streams. You gasp for water, but it feels like nothing can douse the flames. Once the pain has subsided, however, you suspect you'll seek out an even more extreme fix the next time around.

Anyone who enjoys a curry knows this feeling – and chefs have been using the sensation of chillies and other peppers to spice up their culinary experiments for centuries. But it is only in the last decade or so that scientists have begun to understand how we taste piquant foods. Now they have found the mechanism that not only explains the heat of chillies and wasabi, but also the soothing cooling of flavours like menthol.

The implications of this discovery extend far beyond cuisine. The same mechanisms build the body's internal thermometer, and some animals even use them to see in the dark. Understand these pathways, and the humble chilli may open new avenues of research for conditions as diverse as chronic pain, obesity and cancer.



SPENCER WILSON

The story begins in earnest in 1997, with David Julius at the University of California, San Francisco. Although people had long speculated about the source of the chilli's fire, his team was the first to discover how its key component, capsaicin, sets our mouth aflame. Most of our sensory perception depends on specific "channels" on the surface of certain cells, each responding to a different kind of stimulation. When the channel is activated, its pores open up, allowing electrical charge in the form of ions – charged particles – to flow in. These ion channels are often found on nerves, where this influx of ions triggers an electrical impulse.

There were many candidates for the channel that responds to capsaicin, but with some nifty genetics work, Julius was able to pin it down. It is called TRPV1. Crucially, he then showed that the channel also responds to uncomfortably hot temperatures – about 43 °C or higher – that would be enough to damage tissue. This neatly explains why chillies feel like they are burning the mouth.

Other TRP (pronounced "trip") channels had previously been implicated in different kinds of sensory perception, but this was the first to represent our internal thermometer (see diagram, page 47). It didn't take long for other, related protein channels to emerge that explain our sensitivity to other temperatures and food ingredients. In 2002, for instance, Julius discovered the TRPM8 channel, which is activated by relatively cool temperatures, between about 10 and 30 °C. This channel is also triggered by menthol, giving it that cooling sensation.

Just chillin'

Having identified the TRPM8 channel, Julius and his colleagues went on to create a strain of genetically engineered mice that carried two defective copies of the gene that normally codes for its protein. They then tested the animals' sensitivity to cold by placing them in a box containing two chambers, each with a different ambient temperature, and compared their behaviour with that of their normal littermates.

The normal mice showed a strong preference for the chamber kept at 30 °C, but the genetically engineered animals happily stayed in the colder chamber for long periods of time, preferring the warmer one only when the temperature dropped to below 15 °C. They were also far less able than their littermates to distinguish between cool and warm surfaces.

The researchers are now filling in the other gaps in our understanding of the body's ›