teachers are Latino and also teach science or math? I couldn't find this information anywhere. Curious to figure this out, Dylan Rainbow and I examined more than one million 2017 to 2018 California Department of Education records, and we found that, while about 17% of K-12 teachers teach science, math, or computer science, only 3% of K-12 teachers in California are Latino and teach these subjects, evenly split between men and women. This means that most Latino students in California will never have a Latino teacher as a role model in a STEM subject, and this is unfortunate because research has shown that having a teacher of the same race/ethnicity can have a positive impact on student achievement. For instance, Black male students are 39% less likely to drop out of high school if a single Black teacher in the third, fourth or fifth grades teaches them. Providing paid research internships in our labs and student loan forgiveness to BIPOC who are interested in becoming science and math teachers is a critical part of closing this gap.

What do you think is the biggest problem that science and society as a whole is facing today? Unquestionably, the biggest problem we are facing is climate change. This summer we've been having heat waves, with records broken for the hottest temperature in cities across California, and this has fueled massive fires — the largest in California recorded history — prompting evacuations. The fires have only exacerbated the terrible air quality in Los Angeles, Riverside, and San Bernardino counties, places where millions of people live. I also worry about the farmworkers, a majority of whom are Indigenous migrants from Mexico and Central America, who are working through the smoke, ash, and intense heat to pick the food that is feeding US Americans during the COVID-19 pandemic. Many of these people come from impoverished communities where extreme weather and drought have made making a living impossible. The pressure to migrate is only going to intensify as the planet heats up.

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Quick guide

Same-sex sexual behaviour

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What is same-sex sexual behaviour? Same-sex sexual behaviour is behaviour that is usually performed at some stage during reproduction with a member of the opposite sex, but which is instead aimed towards members of the same sex. These behaviours can include courtship, mounting, genital contact, copulation and even pair bonding and the raising of offspring together.

Isn't this something that only happens in humans? No! There is now considerable evidence for same-sex sexual behaviour across a whole range of animals.

Is this different from same-sex sexual preference and orientation? To some extent yes. Same-sex sexual preference is when, given a choice, an individual chooses to engage in reproductive behaviours with an individual of the same sex rather than an individual of the opposite sex. Same-sex sexual orientation is a step further, suggesting an unchanging life-long preference for same-sex partners. This is particularly difficult to measure in animals, given that we are unable to ask them what they desire. One exception to this may be in domestics rams in which around 8% of males are thought to be same-sex-orientated throughout their lives.

Are same-sex sexual behaviours common? Same-sex sexual behaviour, in wild and captive settings, has been documented in mammals, birds, reptiles, amphibians, fish, insects, spiders and other invertebrates (Figure 1). In some species, same-sex sexual behaviours are as frequent as opposite-sex sexual interactions, as in bottlenose dolphins for example. Moreover, same-sex sexual behaviour might be underreported, in particular in species where both males and females look the same.

What is the mechanistic basis of same-sex behaviour? In many cases we don't know, not least as often same-sex sexual behaviour has only been recorded anecdotally. However, in fruit flies mutations leading to same-sex interactions have been well-studied and helped unravel the neurogenetics of courtship and mating behaviour. Unsurprisingly, a key feature is a failure to discriminate sex, but it remains unclear how such mutations and pathways speak to same-sex sexual behaviour more broadly.

Why would animals do this? Same-sex sexual behaviour is often considered an evolutionary paradox because we should expect animals to be naturally selected to maximise their fitness by having as many offspring as possible. So why would animals engage in sexual activities that result in no offspring? Typically, it is assumed that such behaviours must, therefore, be costly. Of course, sexual interactions with members of the opposite sex are typically costly and can even result in injury or death. Sexual interactions with members of the same sex are, therefore, expected to have similar costs, along with the additional cost of not producing offspring. However, individuals that engage in same-sex sexual behaviour can still have sex with members of the opposite sex and reproduce.

What benefits might there be to same-sex sexual behaviour? There have been many hypotheses proposed to try and explain the occurrence of same-sex sexual behaviour. These fall into two categories: adaptive hypotheses and non-adaptive hypotheses. When same-sex behaviours were first observed, they were typically thought to be maladaptive, but now many evolutionary reasons for their existence have been suggested.

What are the adaptive explanations for same-sex sexual behaviour? Many of the adaptive hypotheses suggest that these behaviours have some sort of social function, beyond a purely reproductive context. For example, same-sex sexual behaviour might be used to communicate social status. Dominant individuals may express their social status by mounting subordinate individuals or *vice versa*. Same-sex sexual behaviour may also be used to manage conflict, as in female bonobos who are able to improve their chances of attaining food when entering a food patch by engaging in genito-genital rubbing

Figure 1. Same-sex behaviour is widely distributed across animals.
Top-left: female bonobos (*Pan paniscus*) engage in genito-genital rubbing as part of long-term social bonding within bonobo groups (photo: Furuichi Takeshi). Top-right: both female and male bottlenose dolphins (*Tursiops* sp.) engage in a variety of same-sex behaviours, including pseudo-copulations, again thought to be associated with developing and maintaining social bonds (photo: Richard Connor). Bottom-left: female Laysan albatross (*Phoebastria immutabilis*) may form same-sex pairs when males are in short supply, and together help rear offspring fathered by a male elsewhere in the colony (photo: Eric VanderWerf). Bottom-right: same-sex mountings by male red flour beetles (*Tribolium confusum*) appear to be due to mistaken identity, with males being confused for female mating partners (photo: Matt Gage).

with other females. Alternatively, same-sex sexual interactions might act as a form of social bonding and be used in alliance formation such as in bottlenose dolphins, greylag geese, flamingos and olive baboons. Furthermore, same-sex sexual behaviour may allow immature individuals to practice reproductive behaviours. In rhesus macaques, such opportunities when young are essential for the development of normal opposite-sex sexual behaviours when older.

What are the non-adaptive explanations for same-sex sexual behaviour? One of the most common is the 'mistaken identity hypothesis', which proposes that same-sex sexual behaviour occurs due to members of the same sex being mistaken for members of the opposite sex. Such errors may occur due to mistakes in the processing of sensory information or because the individuals that these behaviours are directed towards resemble opposite-sex partners. This may be the case in many insects, where mistaken identity is the most cited explanation for same-sex sexual behaviour (almost 80% of cases). In some species, there is evidence that, with experience, individuals are better able to recognise members of the opposite sex and reduce levels of same-sex sexual behaviour. Learning is known to be costly, however, so same-sex behaviour is likely to persist if the costs of learning outweigh the costs of making the occasional mistake. Alternatively, individuals might benefit from being less discriminating when searching for a potential mate, so as not to pass up opportunities to court opposite-sex individuals. For instance, if mating opportunities are rare or — paradoxically perhaps — so abundant that there is little cost to approaching and interacting with a same-sex partner. Here, same-sex sexual behaviour is perhaps best considered as a non-adaptive side-effect of an otherwise adaptive mate searching strategy. Recently, it has also been suggested that same-sex sexual behaviour may arise as a non-adaptive side-effect of either different patterns of selection on males and females — so-called 'sexually antagonistic selection' — or balancing selection on a locus associated with sexual behaviour. In the former case, alleles associated with beneficial behaviour in one sex are associated with the expression of same-sex sexual behaviour in the other. In the latter case, alleles that are associated with same-sex sexual behaviour when homozygous are maintained in the population due to a fitness advantage when expressed in heterozygotes. Work in fruit flies suggests that both genetic mechanisms are at least plausible.

Is it unexpected that same-sex sexual behaviour should occur then? The fact that these behaviours are now proving to be so common, finding them in more species should not be unexpected; yet, many same-sex interactions remain a puzzle. However, same-sex sexual behaviour may actually tell us something rather important about mating systems more generally. Indiscriminate mating attempts may actually be the ancestral state for animals and targeted opposite-sex sexual behaviours evolved later. This turns the question on its head — from asking "why does same-sex sexual behaviour occur?" to "why do exclusive opposite-sex sexual behaviours occur?" Similarly, it is now clear that mating interactions across a wide range of animals are not always directed only at members of the same species. It may well turn out that the ability to perfectly discriminate between potential mating partners, in terms of their sex and their species, is generally more costly than allowing otherwise unproductive sexual interactions to occur.

Where can I find out more?

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