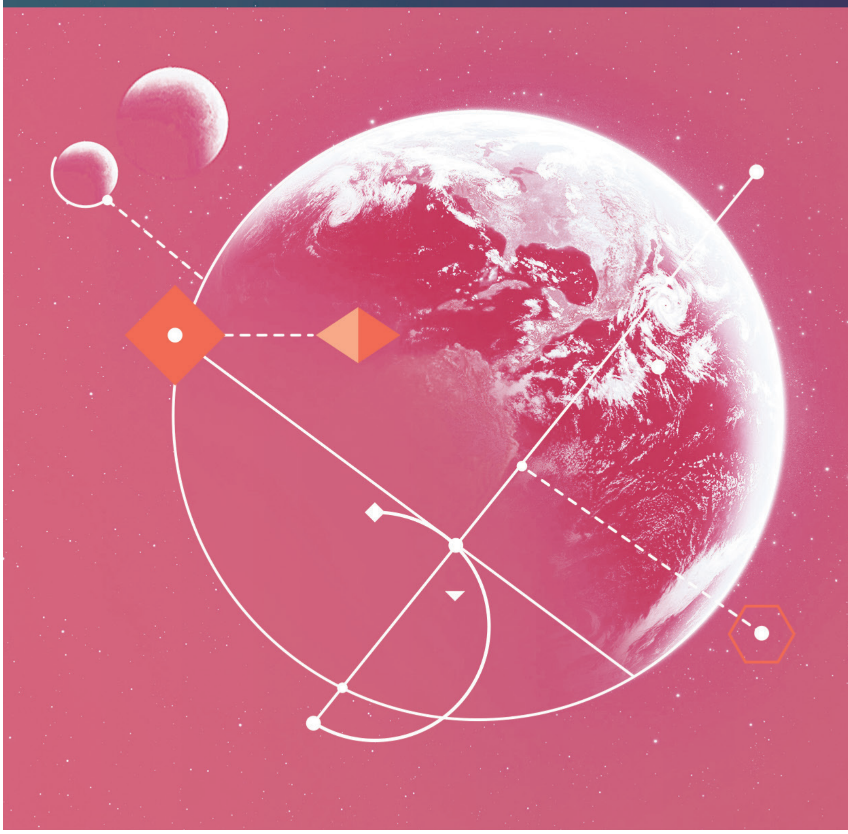
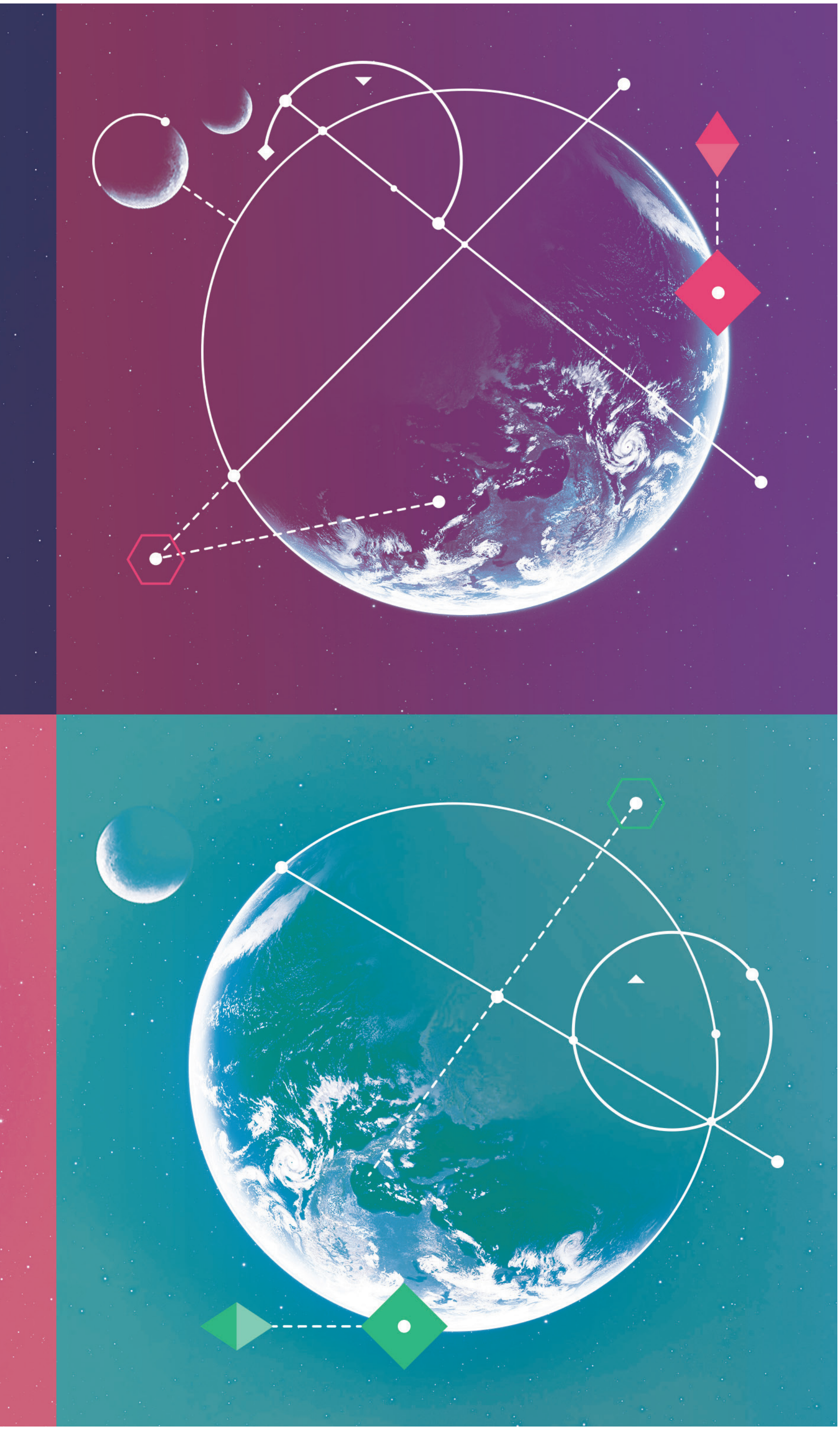
Ideal homes

There's more than one way to make a planet fit for living, says Colin Stuart





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"EPPUR si muove" – "And yet it moves". Galileo's reported utterance following his trial for heresy in 1633 is perhaps science's most famous muttered riposte. Through the newly invented telescope Galileo had seen many things that couldn't be explained by the dominant cosmology of the time, rooted in the idea that all things revolved around Earth: things like moons crossing the face of Jupiter, or the changing phases of Venus as sunlight caught it at different angles – an impossibility if Venus's orbit encircled Earth. All this had made Galileo a champion of the Copernican revolution: the idea that all the planets, including Earth, orbit the sun.

Nearly four centuries on, we are on the cusp of another revolution in our cosmological understanding. From our vantage point on this orbiting world we have now spied almost 2000 others doing the same around far-flung stars. A flood of information from planet-hunters such as NASA's Kepler space telescope, coupled with improved models of how planets and solar systems work, is forcing us to reconsider another set of geocentric views – this time about what a planet capable of harbouring life should look like. Increasingly it seems all our assumptions about Earth's "twin" are wrong. As the search continues, we may need to bear in mind that it will not look anything like Earth at all.

We take many things for granted when assessing a planet's suitability for life. First and foremost is the idea that, if biology elsewhere works anything like it does on Earth, life will be carbon-based – carbon chemistry has an unmatched complexity – and need liquid water as its essential solvent. That assumption leads directly to the concept of the habitable zone, first introduced in the 1950s. This is defined as the narrow region around a star where liquid water can exist. Too close to a star, and any water on a planet boils away; too far away, and it freezes. Only in the middling "Goldilocks zone" – neither too hot nor too cold, but just right – can life thrive.

Our sun is well placed to host a planet that hosts life. Three-quarters of the stars in our Milky Way are fainter red dwarfs that pump out significantly less heat. The habitable zone of a red dwarf would be very close in, so close in that any planet orbiting within it would be "tidally locked": the gravitational grasp of the star would hold one side of the planet constantly facing towards it. That side would bake in perpetual daylight and searing temperatures, while the other would freeze in constant darkness – scarcely ideal conditions for the development of life. The closest ›