

How do geckos stick to walls?

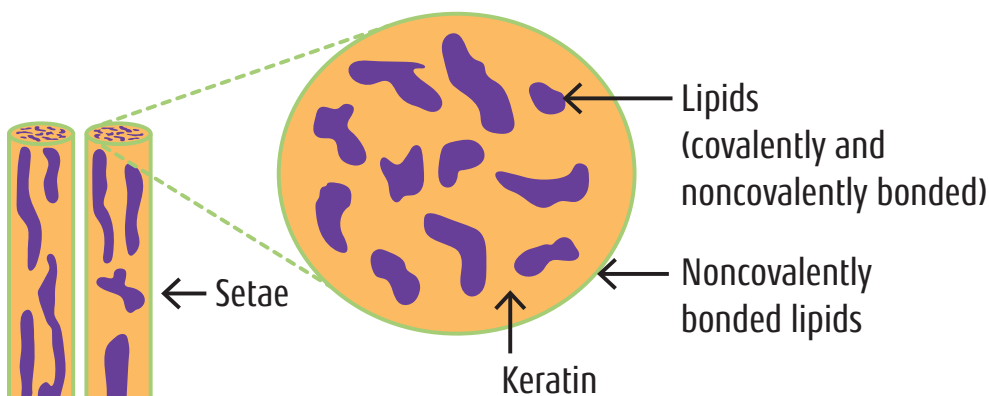
Our toe pads!

Though the hairs are tiny and the forces are weak, the millions of hairs working together allow these critters to crawl up and around!



Geckos have toe-pads consisting of thin-hairs called setae. These setae, which are little bristles on organisms' bodies, can serve a wide range of purposes from being sensory organs for spiders to helping adhesion for geckos. The setae on the feet of these creatures are made of keratin, a structural protein, and end in smaller structures—spatulae.

The spatulae on the bottom of geckos' feet interact with the surface through van der Waals forces. Van der Waal forces are intermolecular attractions that create temporary dipoles. Dipoles are caused by unequal areas of electron density around molecules, which, if covalently bonded, can either be polar or nonpolar, depending on the shape of the molecule.



Polar? Nonpolar?

These unequal electron densities create dipoles, which are electrostatic partial positive or negative charges around certain parts of a molecule. The dipole moments cause an attraction to other molecules with partial charges. A slightly negative dipole will attract to a slightly positive, and vice versa.

Van der Waal forces (also called London Dispersion forces): If a molecule is nonpolar, it has an even distribution of electrons. The presence of electrons add the ability of polarizability. Electrons can move to different areas of the molecule to create temporary dipoles that do not cancel and therefore create partial charges.

Dipole intermolecular forces: If a molecule is polar, it has an uneven distribution of electrons.

So why can't we all be Spider-Man?

Because of mass and surface area proportions! The more someone weighs, the more surface area of spatulae they need to allow them to "stick" onto surfaces. Geckos are small so only 2–4% of their surface area, their feet and hands, need to be padded. For humans, the number is around 40%, which would force us to have disproportionately large hands and feet, throwing our balance off.

