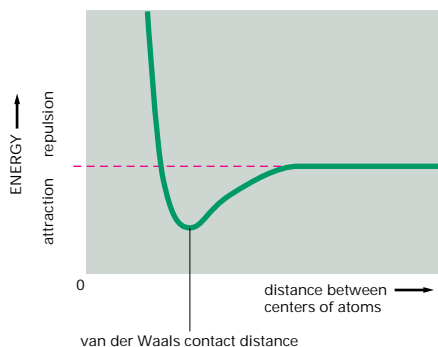


## Types of Weak Non-covalent Bonds - Part 1

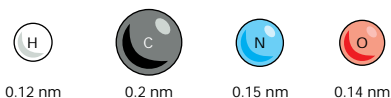
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### VAN DER WAALS FORCES

At very short distances any two atoms show a weak bonding interaction due to their fluctuating electrical charges. If the two atoms are too close together, however, they repel each other very strongly.



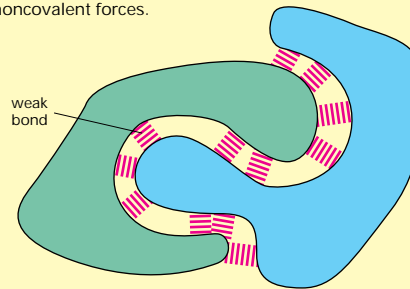
Each atom has a characteristic "size," or **van der Waals radius**: the contact distance between any two atoms is the sum of their van der Waals radii.



Two atoms will be attracted to each other by van der Waals forces until the distance between them equals the sum of their van der Waals radii. Although they are individually very weak, **van der Waals attractions** can become important when two macromolecular surfaces fit very close together.

### WEAK CHEMICAL BONDS

Organic molecules can interact with other molecules through short-range noncovalent forces.

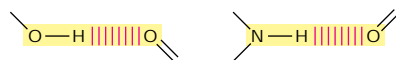


Weak chemical bonds have less than 1/20 the strength of a strong covalent bond. They are strong enough to provide tight binding only when many of them are formed simultaneously.

### HYDROGEN BONDS

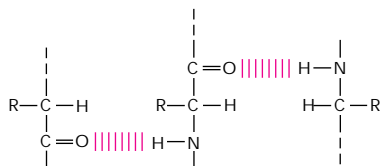
As already described for water (see Panel 2-2, pp. 50-51) **hydrogen bonds** form when a hydrogen atom is "sandwiched" between two electron-attracting atoms (usually oxygen or nitrogen).

Hydrogen bonds are strongest when the three atoms are in a straight line:

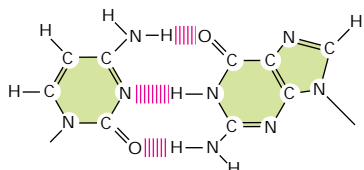


Examples in macromolecules:

Amino acids in polypeptide chains hydrogen-bonded together.



Two bases, G and C, hydrogen-bonded in DNA or RNA.



### HYDROGEN BONDS IN WATER

Any molecules that can form hydrogen bonds to each other can alternatively form hydrogen bonds to water molecules. Because of this competition with water molecules, the hydrogen bonds formed between two molecules dissolved in water are relatively weak.

