

Practical Science

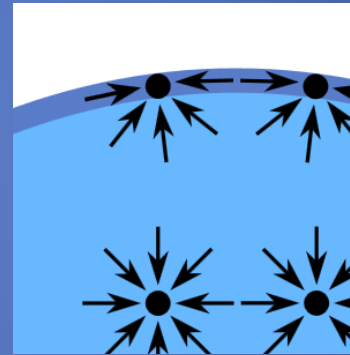
Its all around you

Water surface tension

Capillary action



Water surface tension results from molecular forces at the surface of the liquid



Capillary action allows the fine weave of the towel to absorb water

Capillary action



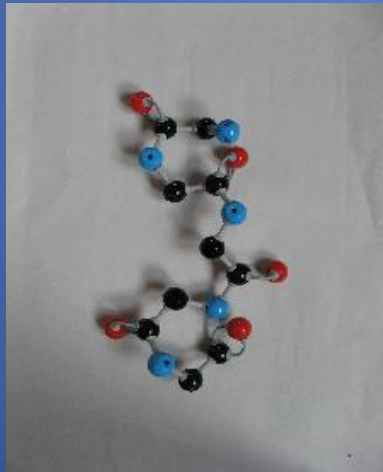
An example of capillary action is the drawing of blood

Hair hydration

- When hair is wet it changes its properties and becomes lank and elongated
- When it is dry it become curly and frizzy
- This is because of a conformational change in the structure of the hair protein keratin

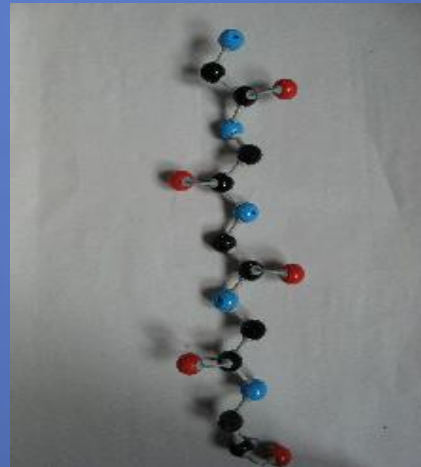
α -form

Dry - short



β -form

Wet - elongated

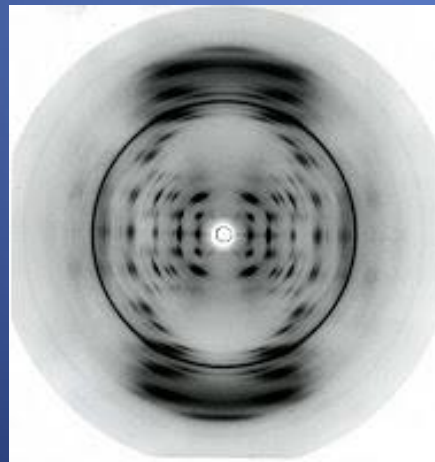


- This was first shown by William Astbury in Leeds in 1936

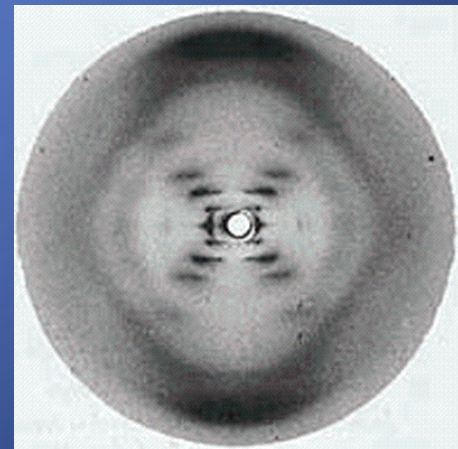
Hydration of DNA

- The hydration of keratin is similar to the hydration of DNA discovered later by Rosalind Franklin
- At low humidity DNA had a highly crystalline form (the A-form) as shown by X-ray diffraction
- But at high humidity the pattern changes to a simpler pattern of the B-form
- It was this form that Watson and Crick described as the double helical structure

A-form
(dry)



B-form
(wet)



How detergents work



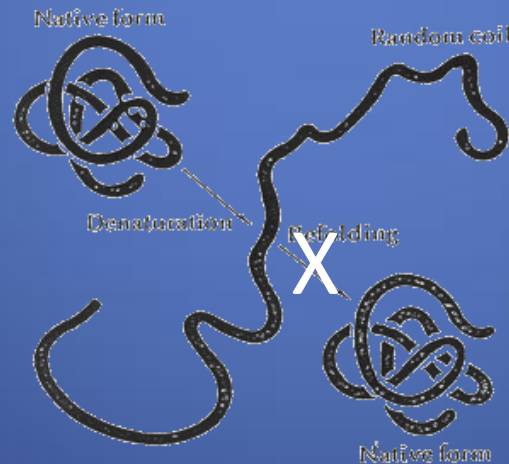
The fat globules in the milk are solubilized into the water by the detergent and the colors indicate that

A detergent molecule contains both charged (water soluble) and fatty (neutral) ends



Denaturation of proteins

- Egg white consist mostly of a protein called lysozyme (because it causes cells to lyse)
- When this protein is heated above a certain temp. it denatures
- Its folded (native) form becomes unfolded
- The process in this case is irreversible

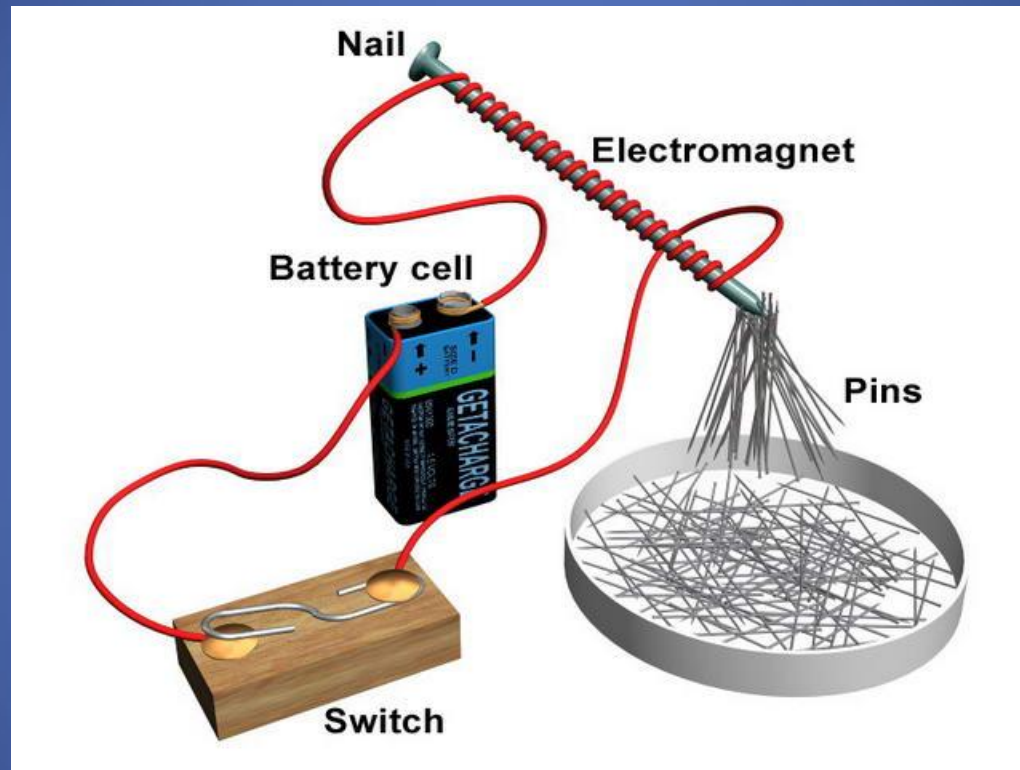


- This is why you heat things to sterilize them

Electromagnetism

- Electricity and magnetism are connected
- Passing an electric current thru a wire produces a magnetic field
- Equally passing a wire thru a magnetic field produces electricity
- This is the basis of electricity generation by a generator

Electromagnetism



How electromagnetism works

Turning water into wine or blood



- A simple substance, potassium permanganate, has an intense red color that resembles wine or blood when dissolved in water
- Addition of a few crystals can appear to transform water into wine or blood

Separation of chemicals from mixtures

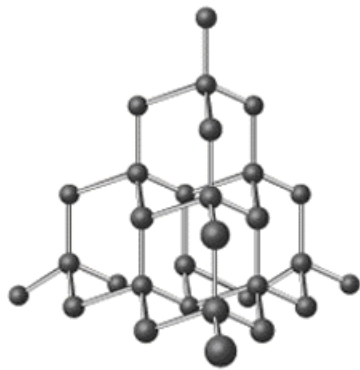
- This is called chromatography because of the use of colors
 - The separation of components of chlorophyll from green plants is a good example of the use of color to see the separation.
 - A solvent such as alcohol is used to separate the components of the mixture on filter paper



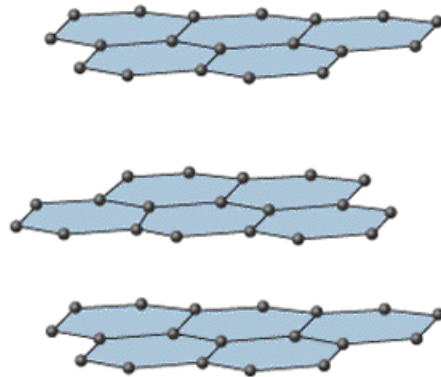
How can diamond and graphite be the same substance?

- Diamonds and graphite are the same substance – carbon
- However, their molecular structure is quite different
- In diamonds carbon exists as a hard continuous structure of tetrahedra
- While in graphite and charcoal carbon exists as planes that are soft

Structures of Carbon



(a) Diamond



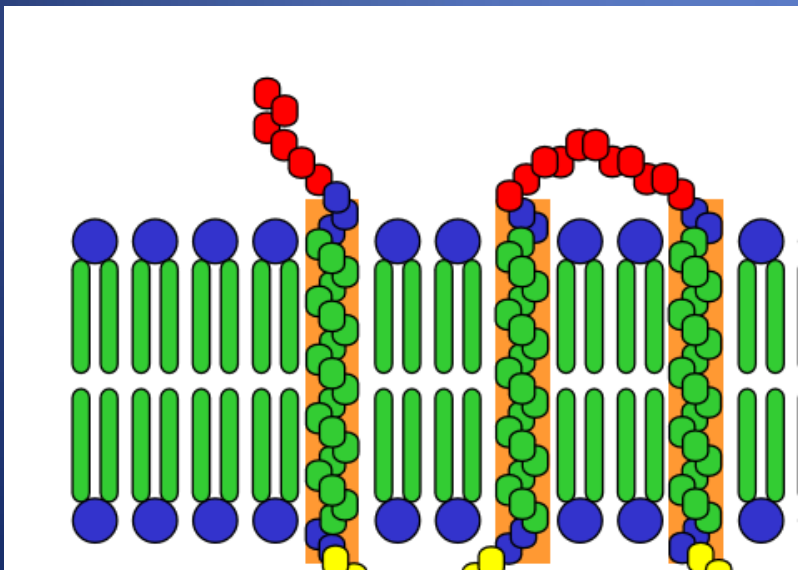
(b) Graphite

In *diamond*, carbon atoms form continuous *tetrahedra* that make the structure very *hard*

While in *graphite* the carbon atoms form *planes* that can slide over each other making the structure *soft*

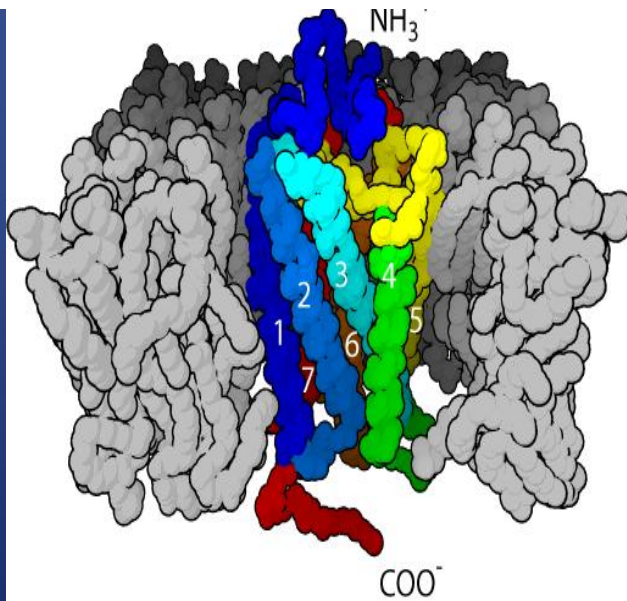
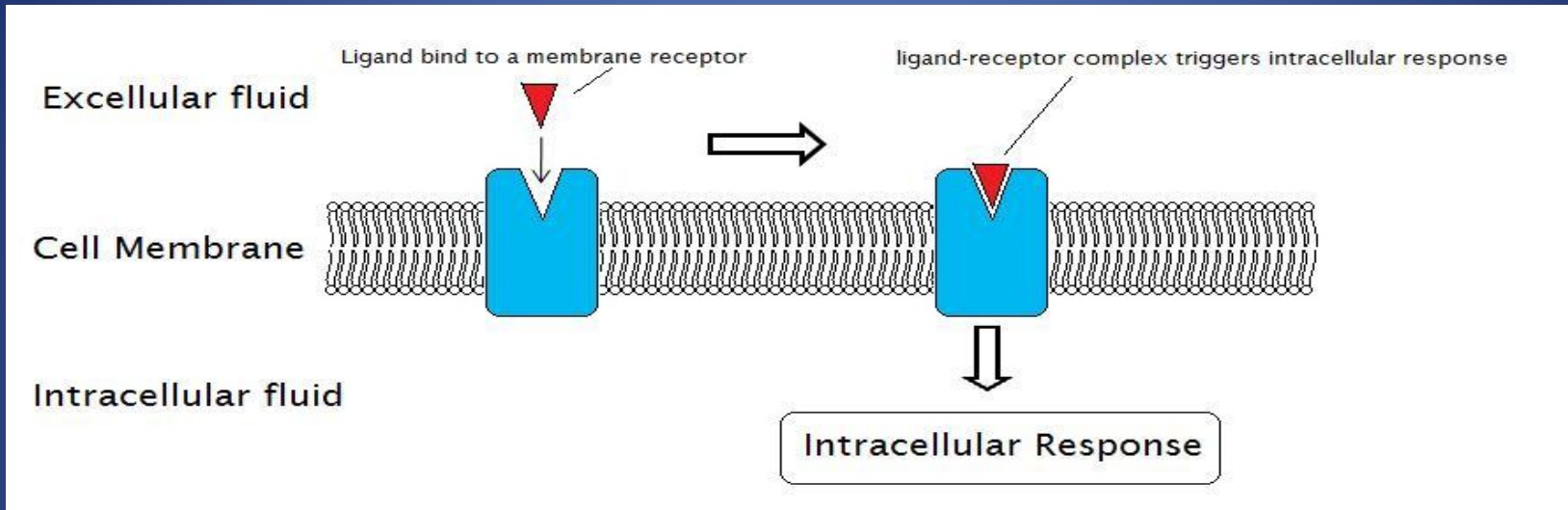
How do drugs work?

- Drugs work by binding to specific protein receptors in the cell membrane and triggering a biochemical reaction



A typical trans-membrane receptor with extra-cellular (red), membrane (green) and intra-cellular (yellow) segments

Signal Transduction



An extracellular binding event is
Converted to an intracellular signal

A typical 7-member trans-membrane
pore

Relativity

- An event looks different to stationary and moving observers
- There is no universal clock
- Space does not exist independent of time, there is a 4-dimensional space-time continuum
- Space-time is curved causing effects of gravity

Fireworks

- Fireworks work by burning mainly metal powders that give specific colors

Iron (Fe) orange

Aluminum (Al) white

Sodium (Na) yellow

Copper (Cu) green