Green Chemistry
Centre of Excellence

circa

Teesside University

ROYAL SOCIETY OF CHEMISTRY

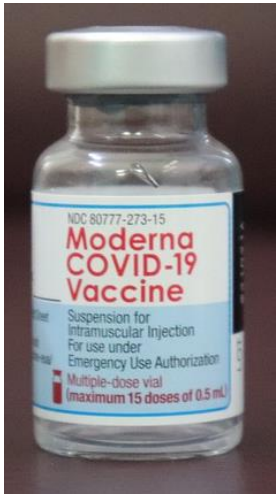
UNIVERSITY of York

What are solvents and why are they important?

Rob McElroy
James Sherwood

Research
Industry
Networking
Education

Water – the universal solvent



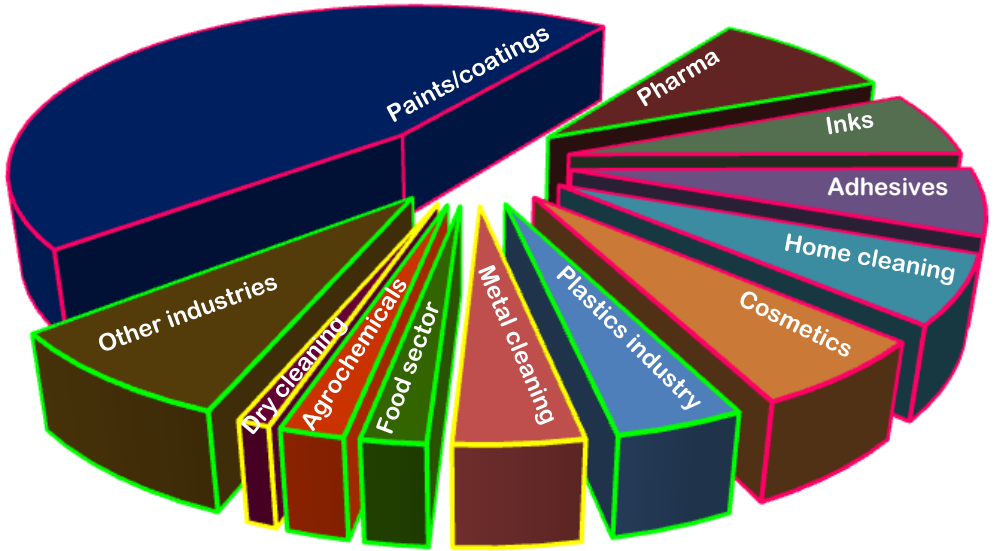
Water extracts (takes out) the tasty stuff in tea, is the liquid (moving bit) in emulsion paint, dissolves the actives (the things that do stuff) in a vaccine and lots more.

A solvent is a liquid that dissolves or disperses something.

Green Chemistry
Centre of Excellence

UNIVERSITY of York

What we use solvents for



Research
Industry
Networking
Education

www.york.ac.uk/greenchemistry

Materials

- Natural products
  - Caster Sugar
  - Cornflour
  - Cotton wool
- Solvent
  - Water

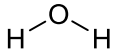
Experimental

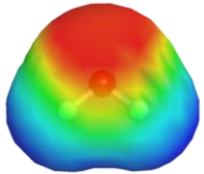
- Take one teaspoon of caster sugar.
- Place in a beaker.
- Add 20 ml of water.
- Stir.
- What happens?

Green Chemistry
Centre of Excellence

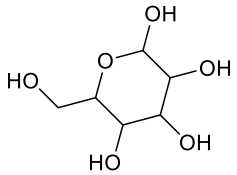
What is going on?

UNIVERSITY of York

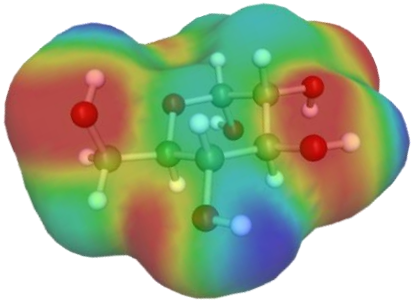




- This is the structure and a electron map of water.
- It is a “polar” solvent because there are bits with lots of electrons and bits with not much electrons.
- Water is good at dissolving things that are also polar.



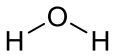
- This is the structure and an electron map of glucose which is simpler but similar to sucrose (caster sugar).
- It is polar because there are bits with lots of electrons and bits with not much.

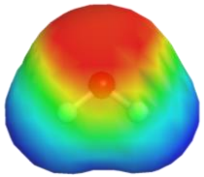


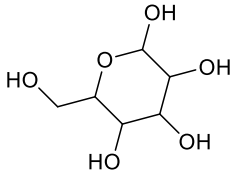
Research
Industry
Networking
Education

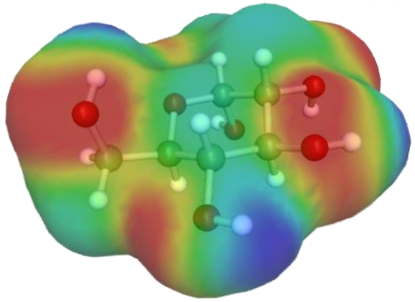
www.york.ac.uk/greenchemistry

What is going on?









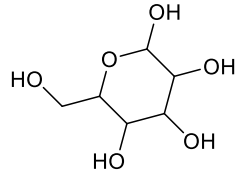
- The red bits on water match up to the blue bits on sugar and the blue bits on water match up to the red bits on sugar.
- We call this hydrogen bonding.
- The sugar happily gets surrounded by water and dissolves.

- To get something to dissolve you need to pick the right solvent.

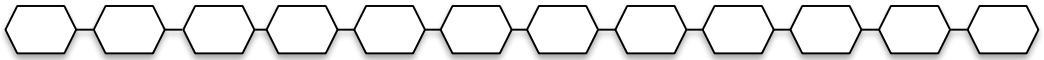
Experimental

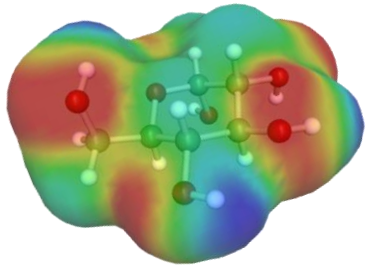
- Take one teaspoon of cornflour
- Place in a beaker
- Add 5 ml of water and mix to give a paste
- Add 15 ml of water
- What happens?
- Now heat it up to 90 °C for 5 min (or 30 seconds in a microwave)
- What happens?

What is going on?

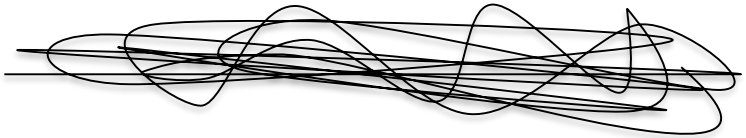


- Starch is a chain of sugars (a polymer) where there can be thousands to millions of sugars linked together.
- If we imagine the sugars as hexagons it looks a bit like this;





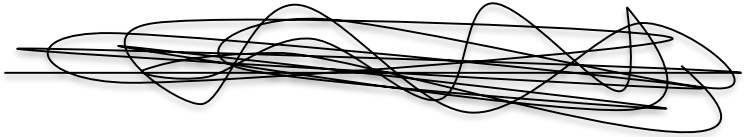
- When the starch is a powder, all the chains will be like string and mixed together
- The red and blue bits will line up so the string is happy together

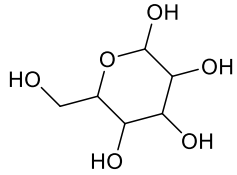


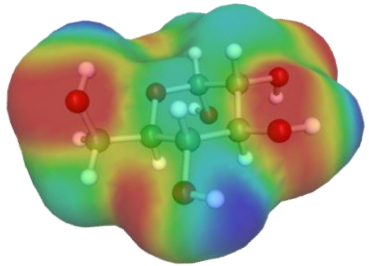
- Cold water can not get the chains to come apart

Green Chemistry
Centre of Excellence

What is going on?







- Hot water makes is so the water can line up red and blue bits (hydrogen bond).
- The water is now around the chains, but the chains are still linked in places.
- You have made a gel (not a liquid, not a solid).
- Gels are important in soaps and shampoos, for getting medicines into people, for helping wounds heal, in detectors and sensors and much more.

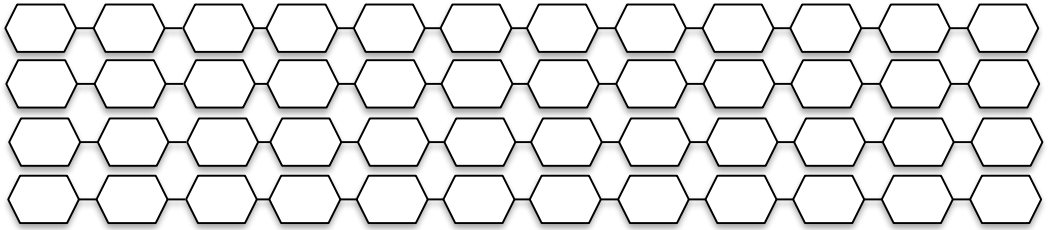
- To make a gel you need to pick the right polymer and solvent.

Experimental

- Take one piece of cotton wool.
- Place in a beaker.
- Add 20 ml of water What happens?
- Now heat it up to 90 °C for 5 min (or 30 seconds in a microwave).
- What happens?

What is going on?

- Cotton wool is nearly all made of something called cellulose.
- Cellulose is lots and lots of sugars together in a chain, with the chains all packed together.



- The chains are so happy (stable) together that even though they have all the same red and blue bits as sugar and starch, water can not get them to come apart.

Green Chemistry
Centre of Excellence

What is going on?

UNIVERSITY of York

- https://youtu.be/Xo1nCELyZsk
- Cellulose is so hard to dissolve that you need to use a special kind of solvent called an ionic liquid.

Research
Industry
Networking
Education

Conclusion

- Every day you are using things where water is the solvent.
- There a lots of different liquids that can be used as a solvent.
- Nearly everything we make a lot of will need a solvent at some point.
- It is important to choose solvents that are safe for us, safe for the environment and are low carbon.