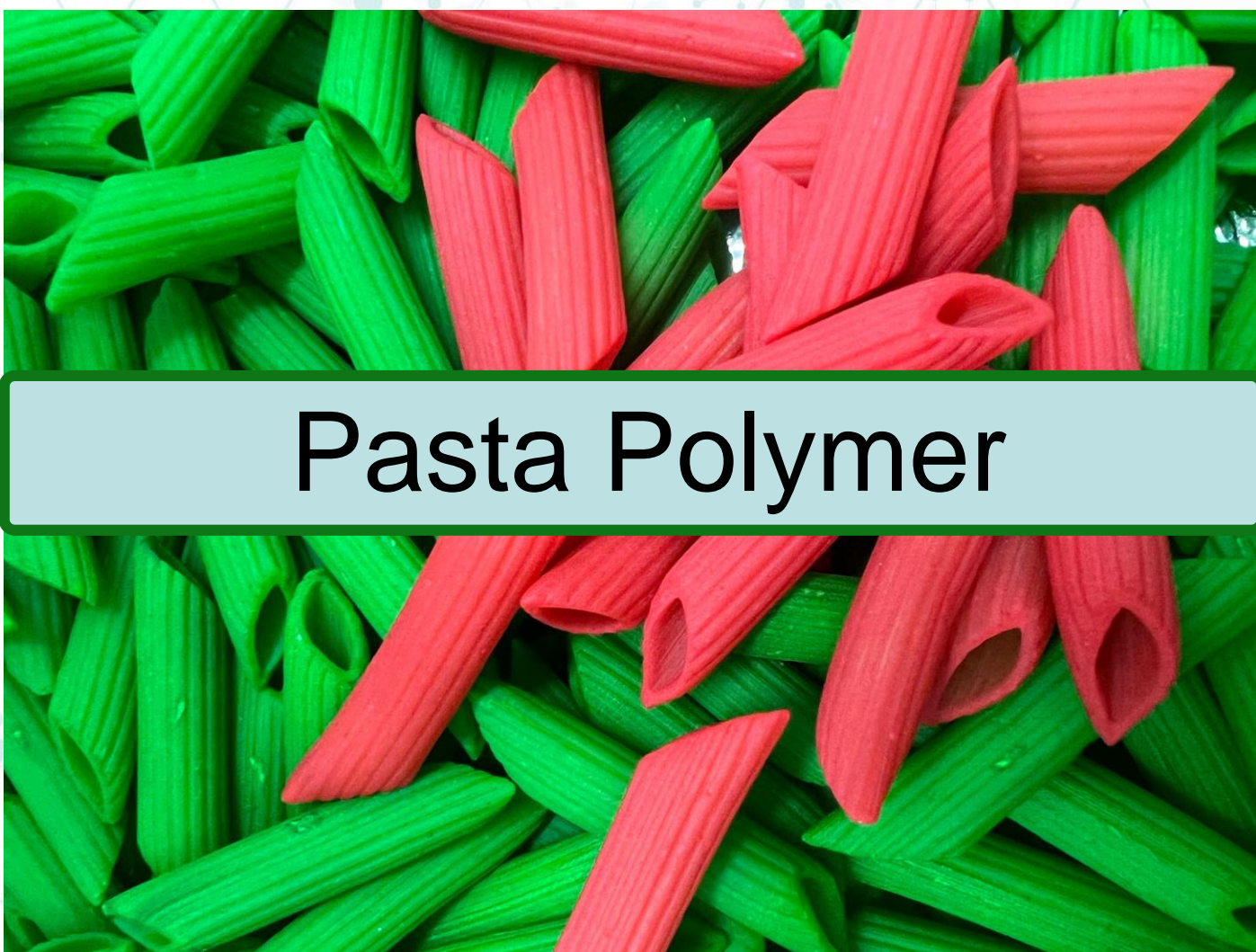




ARC TRAINING CENTRE FOR  
**GREEN CHEMISTRY**  
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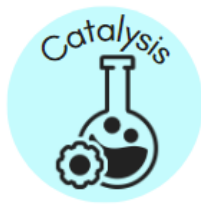


**Pasta Polymer**

# WHAT IS GREEN CHEMISTRY?

Aims to use safe, sustainable, environmentally friendly, reusable and non-toxic materials.

Looks to change the practice of everyday chemistry through incorporation of the 12 principles of green chemistry.



# PLASTICS

Plastics are all around us!

Some materials used to make plastics are:

- ✗ **not** sustainable
- ✗ **not** environmentally friendly
- ✗ **not** reusable
- ✗ toxic!

They can take centuries to breakdown in landfills and pollute our environment

Plastics are mainly made of non-biodegradable polymers.



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***How can we make plastics more sustainable?***

***..first, we need to understand the science!***

# WHAT IS A POLYMER?

Polymers are large molecules made of connected monomers. Every monomer imparts specific properties to polymers. (heat resistance, water resistance, antimicrobial properties)

*Definitions:*

'mono'	one
'poly'	many
'mer'	unit

Monomer = one unit

Polymer = many units



monomer



monomer



polymer

# DIFFERENT TYPES OF POLYMERS

**Homopolymer** ('same' polymer): a polymer with only one kind of monomer

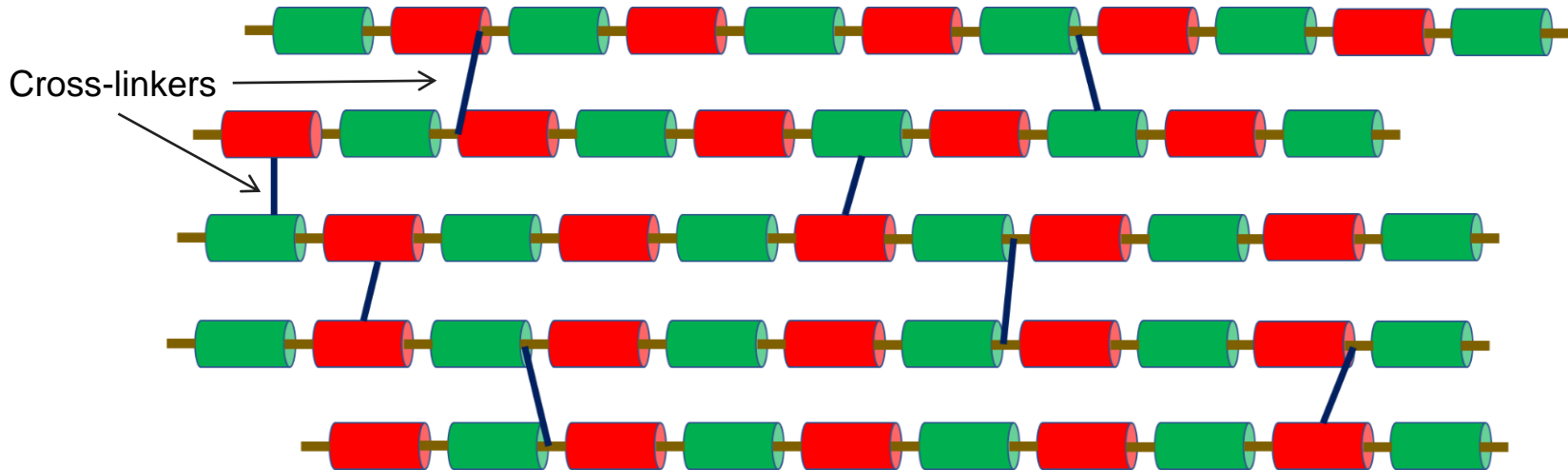


**Alternating copolymer**: a polymer with types different types of monomers that repeat



# DIFFERENT TYPES OF POLYMERS

We can join different polymers to make them more stable, rigid and stronger.



# LET'S MAKE OUR OWN PASTA POLYMERS!

## **Aim**

- To make two different types of polymer using pasta and then join them together (cross-link them).

## **Material**

- Green and red pasta (2 different monomer units)
- Small paper clips (cross-linker 1)
- Black twine (cross-linker 2)



# LET'S MAKE OUR OWN PASTA POLYMERS!

## Method

1. Collect all materials - refer to the worksheet
2. In your group create 4 **homopolymer** chains using the green pasta - thread the monomers onto the twine and tie a large knot in the end of the twine. Each chain should contain ~10 pasta.
4. In your group create 4 **alternating copolymer** chains using the green and red pasta. Each chain should contain ~10 pasta.
5. Once you have created your polymer chains, try joining them using the paperclips. Observe your cross-linked polymer chain. Take note of the way it moves.
6. Remove the paper clips, and join your polymer chains with the black twine pieces. Observe the difference in your cross-linked chain compared to previously.



monomer



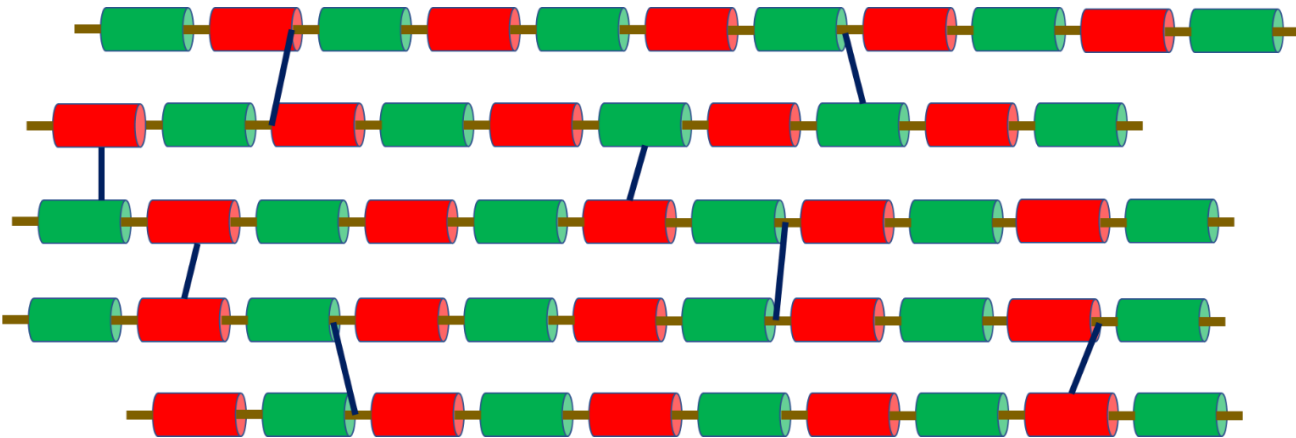
monomer



Homopolymer



Alternating copolymer



Cross-linked polymer

# WHEN ARE POLYMERS BIODEGRADABLE?

- When polymers can be broken down into individual monomer units and further break them down into natural elements in a short span of time, then they are biodegradable.
- Biodegradable polymers can be synthetic, natural or a combination of both.
- Natural biodegradable polymers- silk, keratin, cellulose, even our DNA!
- Synthetic biodegradable polymers- some types of polyester, poly(lactic acid).

# WHAT ARE GREEN POLYMERS?

- Green polymers are polymers made using sustainable methods.
- Green chemistry focusses of either replacing a synthetic polymer with a natural counterpart and if that is not possible, reducing the effect on environment while synthesizing them.
- The green nature of polymers can be improved by using biodegradable crosslinkers that join the polymer strands.
- While all biodegradable polymers can be considered green polymers(if they are made in a sustainable way), not all green polymers may be biodegradable.