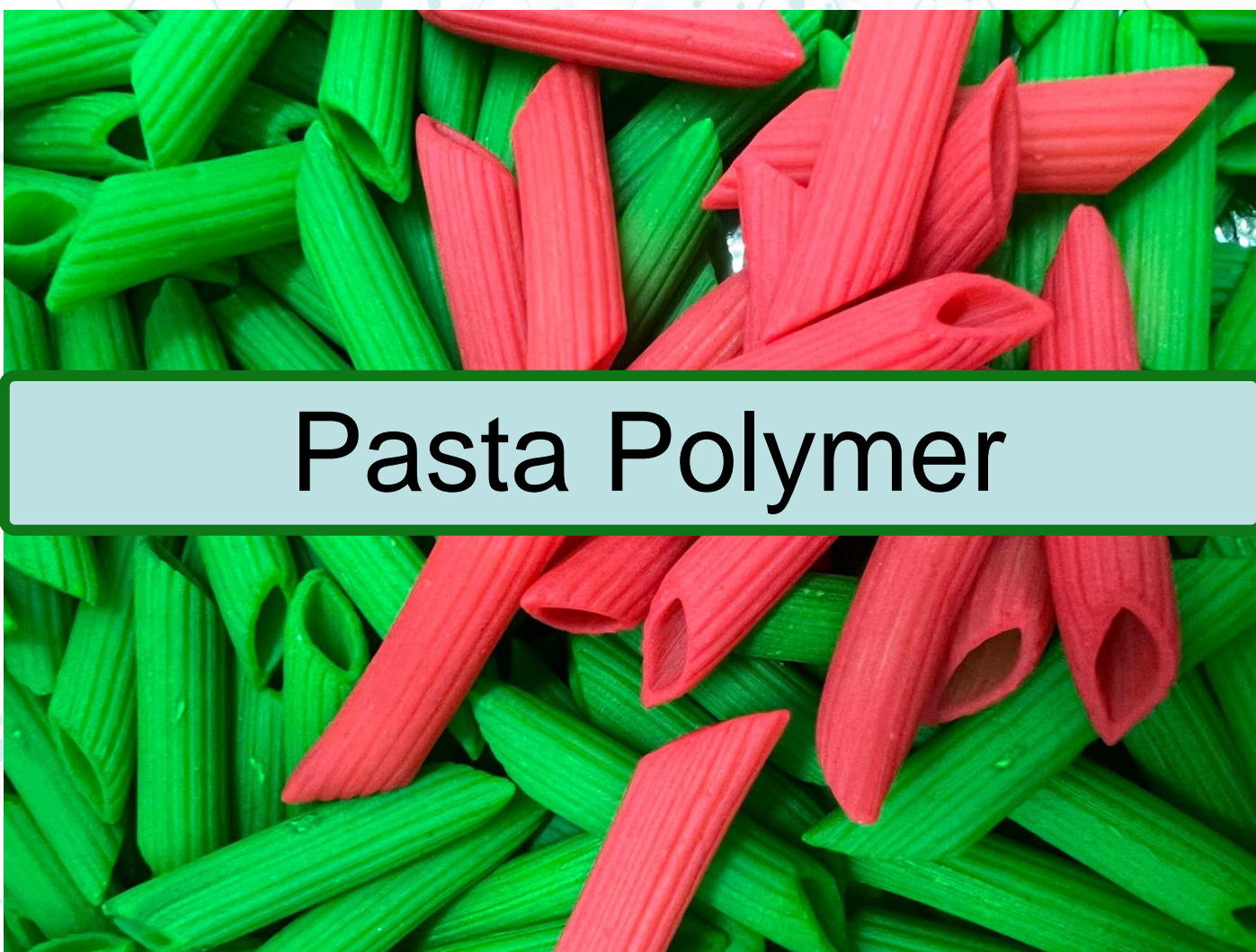




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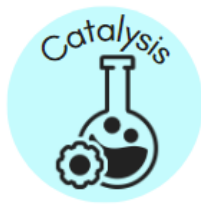


# Pasta Polymer

# 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 of the materials used to make plastics are:

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

They can take centuries to breakdown and as a result, pollute our environment.

Plastics are mainly made of non-biodegradable polymers.



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- ✗ **not** sustainable
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***How can we make plastics more sustainable?***

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



# WHAT IS A POLYMER?

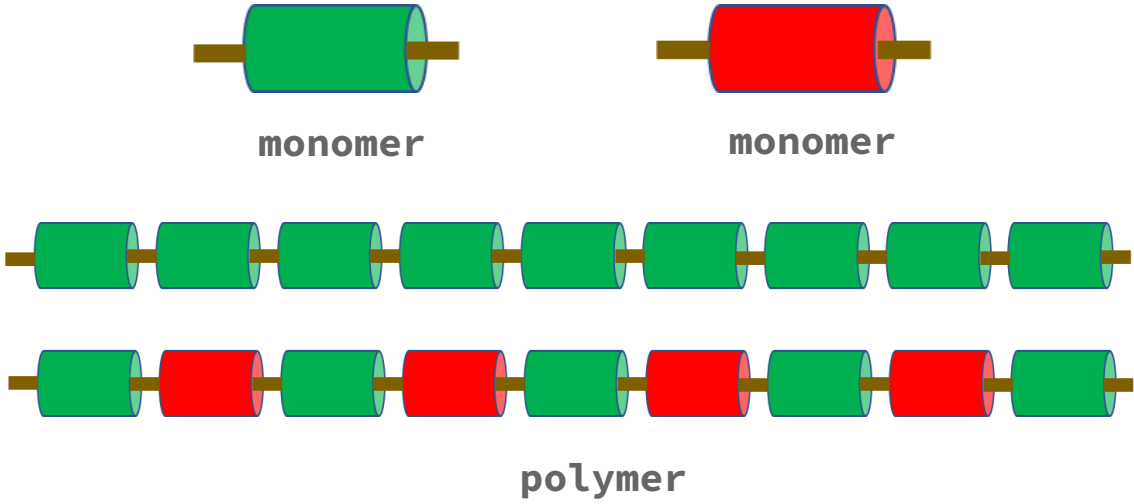
Polymers are large molecules made of connected monomers. Every monomer imparts specific properties to the polymer. (heat resistance, water resistance, antimicrobial properties)

*Definitions:*

|        |      |
|--------|------|
| 'mono' | one  |
| 'poly' | many |
| 'mer'  | unit |

Monomer = one unit

Polymer = many units



# DIFFERENT TYPES OF POLYMERS

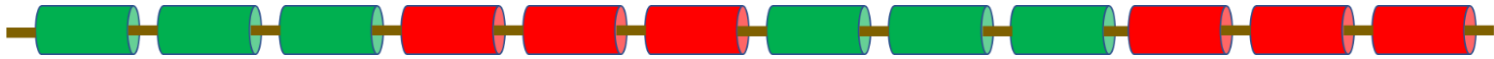
**Homopolymer** ('same' polymer): a polymer with only one kind of monomer



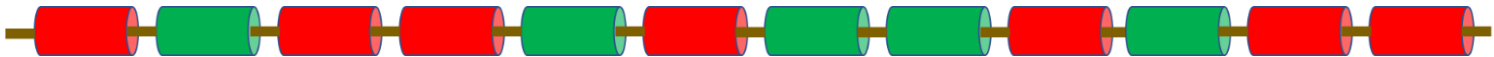
**Alternating copolymer**: a polymer with types different types of monomers that repeat



**Block copolymer**: a polymer consisting of two (or more) homopolymers

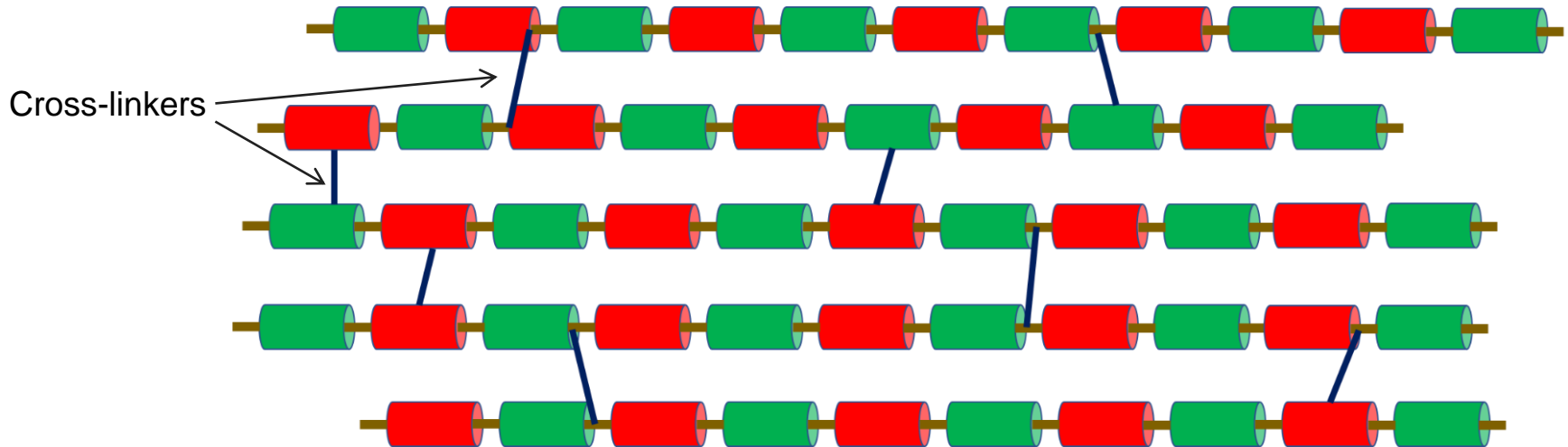


**Random polymer**: a polymer consisting of two or more monomers arranged randomly



# DIFFERENT TYPES OF POLYMERS

We can join different polymers using cross-linkers to make them more stable, rigid and stronger.



# LET'S MAKE OUR OWN PASTA POLYMERS!

## **Aims:**

- To make 4 different types of polymers and join them using cross-linkers

## **Materials:**

- Part 1: Green and red penne pasta (2 different monomer units)
- Part 2: Paper clips (cross-linker 1)
- Part 2: Black twine (cross-linker 2)



# LET'S MAKE OUR OWN PASTA POLYMERS!

## **Method - Part 1: Creating polymer chains from pasta**

1. Collect all materials
2. Each person in the group should make one each of the following polymers.
  - Homopolymer (using green pasta)
  - Alternating copolymer (green and red pasta)
  - Block copolymer (green and red pasta)
  - Random polymer (green and red pasta)

Use 10-12 pasta (monomers) per polymer chain. Thread the pasta onto the twine to make the chain (tie a knot at each end of the twine).

# LET'S MAKE OUR OWN PASTA POLYMERS!

## **Part 2: Cross-linking your polymers (groups of 4)**

From part 1, you should have 4 polymer chains of each type of polymer.

1. As a group, cross-link your homopolymer chains using 8 cross-linker paperclips.
2. As a group, cross-link your copolymer chains using the black twine.
3. As a group, using up to 10 cross-linkers of any type, create a polymer that is flexible from your block copolymer.
4. As a group, using up to 10 cross-linkers of any type, create a polymer that is rigid from your block copolymer.



monomer



monomer



Homopolymer



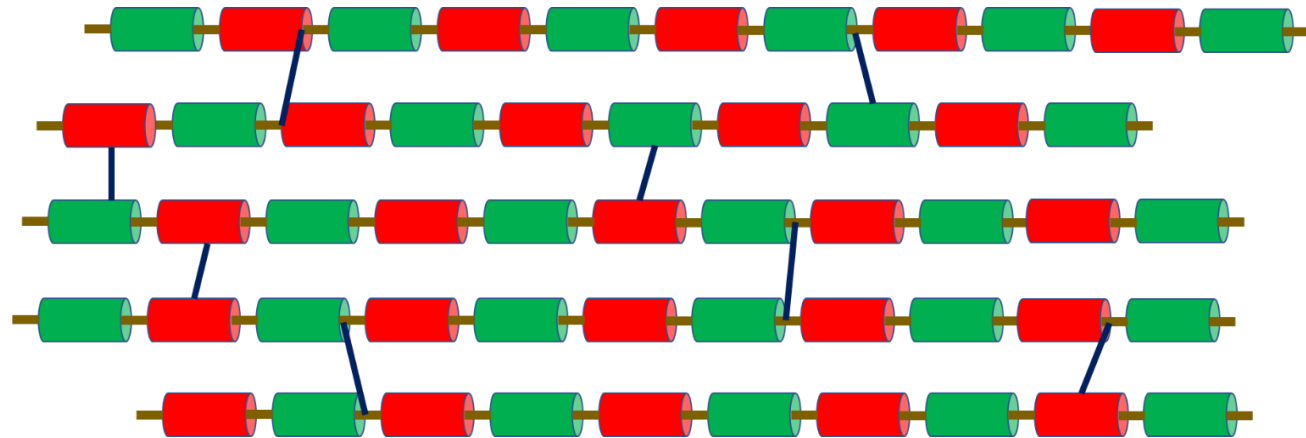
Alternating copolymer



Block co-polymer



Random polymer



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 on either replacing a synthetic polymer with a natural counterpart and if that is not possible, reducing the effect on the environment during synthesis.
- The green nature of polymers can be improved by using biodegradable cross-linkers 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.