Pasta Polymers

YEAR 6/7 – working in groups of 4

What is green chemistry?

Green Chemistry aims to change the mindset and practices associated with everyday chemistry, to be safe, sustainable, environmentally friendly, re-used and non-toxic.

Polymers

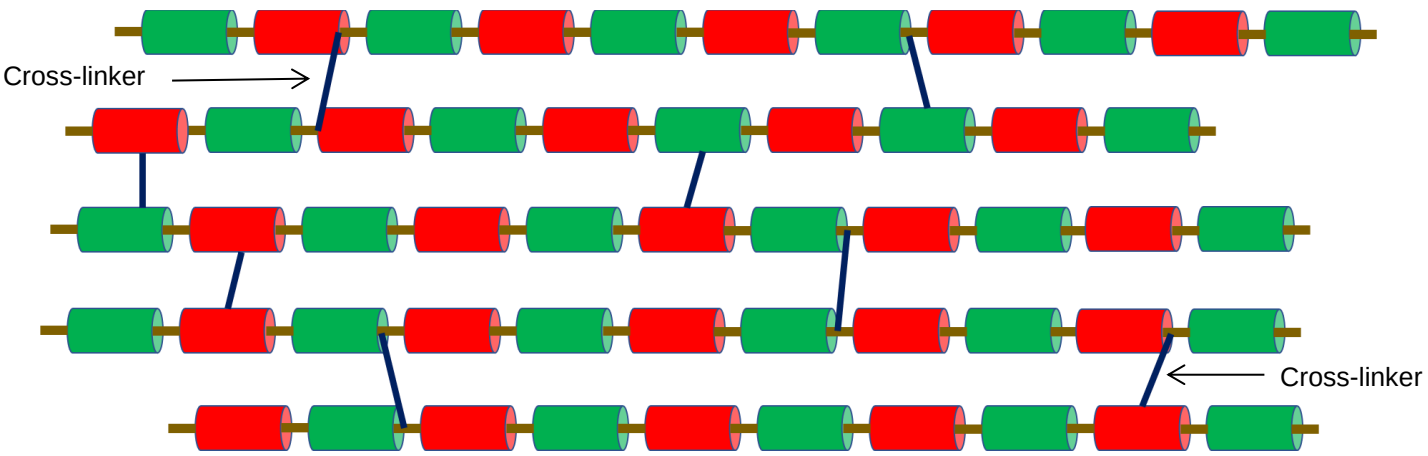
Plastics are all around us. Conventional plastics are made from non-biodegradable materials that take centuries to break down and sometimes end up polluting our environment. Most plastics are made up from polymers. Polymers are large molecules made from reacting lots of smaller ones (monomers) to form a long chain.

Understanding what polymers are is important in the development of greener replacements for traditional plastics.
The two different kinds of polymer chains we will be focussing on today are:

1. Homopolymer – a polymer consisting of only one kind of monomer.

2. Alternating copolymer – a polymer consisting of repeating units of monomers

Polymer chains can also be joined in different ways, changing their physical properties. To join polymer chains, you use a cross-linker (shown in the figure below). This stops the chains sliding past each other and creates a structure like a net.



In this exercise, you'll make homopolymers and alternating copolymer chains. Then, you'll join the polymer chains using cross-linkers.

Materials

- Green and red pasta (2 different monomer units)
  - Homopolymer (green pasta) - ~ 40 pieces per group
  - Alternating (green pasta) - ~ 20 pieces per group
  - Alternating (red pasta) - ~ 20 pieces per group
- Brown/white twine (tie a big knot in the end to stop the pasta falling off) - 8 pieces of 40-50 cm per group
- Paper clips (cross-linker 1) - ~ 10 per group
- Black twine (cross-linker 2) - ~ 8-10 pieces of 20-30 cm per group

Read through the method and discussion questions below before starting.

Method

1. Collect all materials.
2. In your group, create 4 **homopolymer** chains using the green pasta - thread the monomers onto the twine provided to create your polymer. Tie each end of the twine to stop the pasta falling off. Each chain should contain 10 pastas. Use the image on page 1 to help you.
3. In your group, create 4 **alternating copolymer** chains using the green and red pasta - thread the monomers onto the twine provided to create your polymer. Each chain should contain 10 pastas. Use the image on page 1 to help you.
4. Once you've created your polymer chains, try joining them using the paper clips - use up to 10 paperclips. Observe your cross-linked polymer chain. Take note of the way it moves.
5. Remove the small paper clips, and join your polymer chains with the black twine pieces. Observe the difference in your cross-linked chain compared to previously.

Questions

1. What does each single green/red pasta represent?

2. What does the paperclip represent? What is the difference between the paperclip and the black twine?

3. If you connect your chain with paper clips and compare it to the chains connected with black twine, does your polymer more or less freely?

4. Can you create a polymer that will hold an object on your desk? (consider a fishing net)

5. Be creative in modifying the existing polymer chain (for example: connect the two ends of the chain together, add another chain via a cross-linker). How does this flexibility of making plastics relate to our daily lives?

6. How would you, as a Scientist, develop plastics that are more biodegradable and "green"?