Teacher's Guide

Fibres and Plastics

Part 1

Based on the Kerala State Board Curriculum for Standard VIII

JANAAGRAHA

JANAAGRAHA CENTRE FOR CITIZENSHIP & DEMOCRACY

Janaagraha's initiative to improve citizen engagement in India's democracy through their civic learning program

Developed in collaboration with Young Leaders for Active Citizenship (YLAC)

Fibres and Plastics| Teacher's Guide (1/3)
Part 1

Class VIII
Board – Kerala State Board
Subject – Social Science
Textbook – Basic Science Part-II for Class VIII (Kerala State Board)
Chapter 17– Fibres and Plastics
Number of parts – 03
Length – 70-90 minutes (estimated, for a class of 40-45 students)

Note: Teachers may divide the lesson plan into as many periods as they see fit

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Section I – What are we going to learn and why is it important?

Learning objectives

Students will:

- Define polymers and their molecular structure.
- Classify polymers based on chemical properties. (as synthetic, natural or biopolymers)
- Compare natural and synthetic polymers.
- Identify uses of polymers in daily life.

Learning outcomes

Students will be able to:

- Understand the nature, properties and usefulness of polymers.

Key Terms

Monomers	Polymers	Biopolymer	Natural polymer	Synthetic Polymer
Macromolecules				

Materials needed

5-7 different objects made of polymers like Polythene, plastic bottle, cotton cloth, plastic pipe, plastic containers, non stick pan, acrylic crayon, rubber bands

Section II – How are we going to learn?

1. Opening Session: Building a hook

Time: 5 minutes

Note to the teacher:

This activity is aimed at building student interest in the concept of polymers. Students should be shown several objects that are made of polymers and asked what they think all the objects have in common. Ask students to list the objects as they see them. Additionally, write examples of some biological polymers like proteins, DNA etc on the board, so students may add them to the list.

The objects could be placed in a small bag and taken out one by one to keep up the element of surprise. Try to carry most, if not all the objects listed. You may also use pictures of the objects if,it isn't possible to use the actual objects.

Materials Needed:

1. Objects: Polythene bag, empty plastic bottle, cotton cloth, plastic pipes, plastic containers, acrylic crayon, rubber bands
2. Along with this, write the following words on the board: DNA, proteins, Haemoglobin, cellulose

Facilitation notes:

- Today we are going to study about all the things in my bag. (Hold up the bag for all students to see)
- I would like you to write down the name of each object in your notebook and think about what they have in common.
- Some objects have obvious properties in common. You need to think of what ALL these objects have in common.
- (Once all the objects have been taken out) In addition there are some things that I couldn't carry with me in my bag, so let me write those down on the board.
- (The teacher writes the following on the board: DNA, protein, haemoglobin)

- What can all these things- DNA, proteins, cotton, rubber band have in common?
- (After a few responses) Well, let me help you- all of these things are made of polymers! But what are these polymers?
- Lets look at a few pictures to better understand what polymers are. All three pictures show the molecular structure of polymers. What do they have in common? What makes them polymers?
- There are 3 main things they have in common which make them polymers. Can you guess what these are? (Take responses)

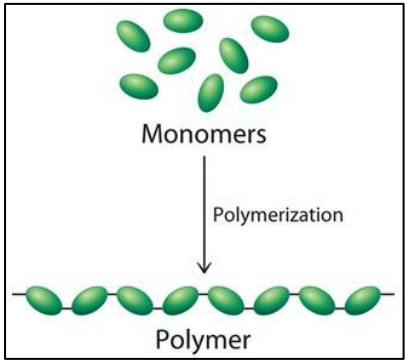

Figure 3- Source:Textbook

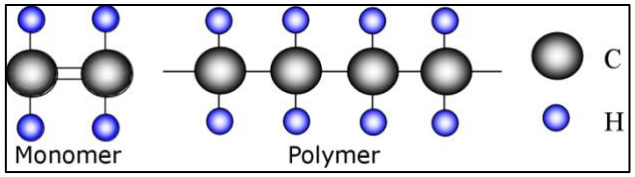

Figure 2- Source

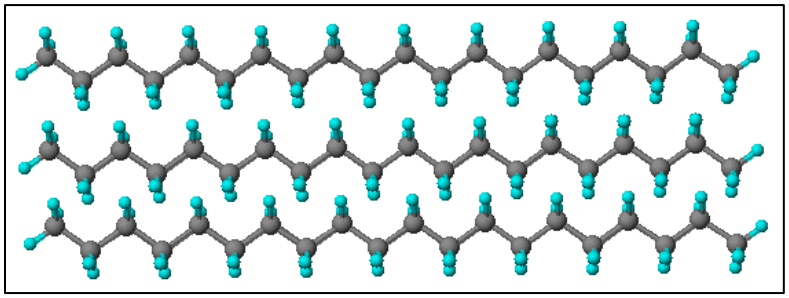

Figure 1 Source

- (After a few responses) First, they are all made of monomers or simple molecules. Figure 1 and 2 show this quite clearly.
- Second, several monomers join together to form a polymer
- Third, these monomers join together in a chain like pattern. Figure 3 shows how monomers form a repetitive pattern to form a polymer. (Ask students to note these in their notebooks)

- Polymers are also called macromolecules. Can you tell why? (Likely response- because they are larger molecules made up of smaller molecules)
- Can I request 5 students to volunteer and come to the front of the class. Now all these students are like monomers or single molecules. (Now get the students to hold hands) As they join hands together- they form a larger molecule called a polymer.

2. Activity: Types of polymers and their uses

Time: 10 minutes.

Note to the teacher:

- This activity should be done in groups or pairs depending on the class size. Students should be told to match each polymer with its correct use and then mark the polymer as a biopolymer, natural polymer or synthetic polymer.
- Following list of polymers to be put up on the board along with the sentences below. Do not share the answers written in brackets with the students.
    i. Starch
    ii. Proteins
    iii. DNA
    iv. Keratin
    v. Wool
    vi. Cotton
    vii. Plastic
    viii. Nylon
    ix. Polythene
    x. Rubber

Facilitation Notes:

- As you can probably tell by now, polymers are everywhere. They are also of different types.
- Some like DNA are found inside our body and are called 'biopolymers'. Some like cotton occur naturally and are called 'natural polymers'. Finally, some like nylon are man-made or synthetic polymers.
- (The text does not mention the three polymers in detail. However, for the clarity of the student, the teacher can mention simplified definitions of the three:
    - Biopolymers are polymers that are produced by living organisms. They are essentially monomeric substances formed inside living beings that bond together to form polymeric substances. For instance, DNA, proteins etc.
    - Natural polymers are naturally occurring polymeric substances found in nature. For instance, rubber, wool, starch etc.

- Synthetic polymers are polymeric bonds that are formed by man made processes. Synthetic nylon and synthetic plastics are examples of synthetic polymers.)

- Look at the list of polymers on the board. Match the polymer to its correct use.
- Once you have matched each polymerwith the correct type , identify whether it is a biopolymer, natural polymer or synthetic polymer.
- Let's do the first one together. Let's read the first statement. (Ask a student volunteer or read yourself) Now let's see the list, which of these polymers can be used to make a variety of things like utensils and valves.
- (After a few student responses) Excellent! Now let's write down the type of polymer plastic is. (Take responses)
- Now take the next 5 minutes and match the rest of the polymers to their correct usage and write the type of polymer they are.

a) This man-made polymer is used to make a wide variety of things, from utensils to artificial heart valves (plastic)
b) This polymer makes up our hair, nails etc (Keratin)
c) This polymer is made of amino acid monomers and has many functions like muscle movement, transporting oxygen etc. (proteins)
d) This energy giving polymer is made of glucose (monomer) (Starch)
e) This polymer is responsible for transfer of genetic information. (DNA)
f) This polymer is used to make clothes, ropes, fishing nets etc. (nylon)
g) This polymer helps keep us warm. (wool)
h) This polymer is commonly used to carry goods. (polythene)
i) This is a polymer with elastic properties and is used for a variety of purposes. (rubber)
j) This polymer makes up a common summer fabric (cotton)

Debrief:

- (The students may struggle to match some polymers with their correct uses. Encourage them to try and answer those at the end.)
- Discuss the answer to each of the questions through student responses.
- Remind students how the uses of polymers are so diverse and how they are so widespread in our lives and yet we tend to not notice them.

3. Activity- Natural vs Synthetic Fibres

Time: 15 minutes

Note to the Teacher:

- The purpose of this activity is for students to identify the properties of both natural and synthetic polymers and then understand advantages and disadvantages of both. In order to do so, students will read a passage on the history of Nylon and Rubber and fill up the table with advantages and disadvantages of:
    a. Synthetic fibres (nylon)
    b. Natural fibres (cotton)
    c. Natural rubber
    d. Synthetic rubber
- While students are filling up the table in their respective groups, you may walk around to monitor and assist groups that may be struggling.
- Once the students have filled the table, assign one natural or synthetic polymer to each group.
- Students will act as manufacturers of the polymer assigned to them. In their respective groups, they will design and enact an advertisement to highlight and promote the advantages of the polymer assigned.

Activity Flow:

- Students should be divided in groups and given the passages to read.
- Each group is to read the passages and then write 2-3 advantages and disadvantages for each polymer assigned to them in the table below. This can also be drawn in notebooks if printing is difficult.
- Once the table has been filled, each group should be assigned a synthetic or natural polymer.
- Each group will enact an advertisement as a manufacturer of either of the polymer assigned to them, to persuade people to buy their product.
- Students should use the checklist (given below) to make sure that their advertisement has all the desired criteria. (This checklist can also be used as a basis to give feedback to each group once the activity is over.)

Reading Passages:

The History of Nylon

The first artificial fibre to be produced, nylon was first used to make the bristles of toothbrushes. DuPont Chemicals, the company that first developed the fabric decided to tap a growing demand for stockings (long, thin women's socks, often worn under dresses) in the 1930. Stocking were expensive and made of silk. Once the company discovered how to create stockings from Nylon, they were a huge hit and as they became much cheaper. Many believe that the name Nylon comes from New York and London where it became most popular. In times of war, nylon was used to make parachutes as it did not tear easily. It is also

used to make umbrellas as it is made of oil-based substances and does not absorb much water. However, this makes it difficult to wear in humid weather, unlike cotton which absorbs sweat. It also does not allow much air to pass and is therefore used to make wind sheeters but isn't comfortable to wear in summer. But synthetic fibres had their disadvantages too. A huge disadvantage of nylon is that it isn't biodegradable. So, your nylon jacket could remain on Earth for hundreds of years longer than you.

Source: Encyclopaedia

The History of Synthetic Rubber

Natural rubber come from the rubber tree that produces latex. Rubber is extracted for latex and is used in a wide variety of products because of its elastic nature. As the automobile industry grew, the demand for rubber became higher. (Natural rubber sticks easily to other materials like steel which is why it is extensively used in the automobile industry) This demand along with the war time needs in the 1940s, led scientists and chemists to develop synthetic rubber. Also, natural rubber grows only in tropical climates, therefore it was advantageous to develop synthetic rubber that is produced using petroleum-based materials. Natural rubber has moderate resistance to damage from heat. Even though it is resistant to cutting, chipping etc, it can degrade rapidly in extreme conditions. This led to the development of flame-resistant synthetic rubber that is often used in electrical appliances. Since both have their advantages and disadvantages, it's a personal preference for either of the two that results in its usage.

Source: Explain Stuff

Table for Advantages and Disadvantages (with solutions)
(Printable version can be found in the appendix)

Material	Advantages	Disadvantages
Cotton	It absorbs water and sweat and is therefore more comfortable to wear in summers.	Gets wet easily and therefore cannot be used extensively during the rains.
	It is made from a plant and is biodegradable.	The plant may not grow everywhere and is therefore expensive.
	It allows air to pass and is therefore more breathable.	It cannot be worn in very cold or windy areas.
Nylon	It is more affordable since it is not made from a plant that does not grow everywhere.	It is non-biodegradable and may damage the environment.
	It is not absorbent and therefore used to make umbrella and other water-resistant objects.	Nylon is not a very airy cloth and not very suitable for high temperatures.
	It does not tear easily and is therefore long lasting.	
Natural Rubber	Is made from a plant and therefore does not damage the environment.	Not easily available in all regions where the plant does not grow.
	Sticks easily to metals and is therefore used extensively in the automobile industry.	Can be damaged by heat.
Synthetic rubber	Is not grown from a plant and can therefore be easily available in areas where the plant does not grow.	Is made from petroleum-based products and petroleum is a non-renewable resource.
	It can have made variations like flam resistant rubber.	

Note to the teacher: After completing this section, emphasise on how the natural polymers have disadvantages that made it difficult to use them widely. Owing to these, synthetic polymers were developed. These were not just cheap and easier to produce but also adept at meeting the growing demand for polymers as their uses increased.

4. Designing your own ad

Time: 10-15 minutes

Note to the teacher: This section is an extension of the earlier section. Students have already understood the advantages and disadvantages of natural and synthetic polymers. In this section, they will put to use their knowledge to design ads to convince the rest of the students to buy natural or synthetic polymers (depening on what is assigned to them)

Materials needed: Chits of paper with one of the following written on each: cotton, synthetic nylon, natural rubber, synthetic rubber.

Facilitation Notes

- So far, we have understood the advantages and disadvantages of natural and synthetic polymers. Simply saying that synthetic or natural polymers are better than the other does not make for a convincing argument. Let's see if we can do this creatively!
- Divide yourself into groups of 5 each. One member from each group will come and pick up a chit of paper: you will each be given one polymer per group.
- What you have to do is design a one minute ad to sell that polymer to the class. So for instance, if a group gets cotton, they have to make an ad stating it's advantages over all other types of synthetic polymers and convince the class to buy it. And you have to enact this one minute ad!
- On the board is a checklist that will have you think better. Take the next ten minutes and design this add, after which all you brilliant actors will come and enact this for the class.

Checklist to design the advertisement (to be written on the board)

1. My advertisement clearly mentions the advantages of the polymer	
2. My advertisement clearly mentions who all can use the polymer	
3. My advertisement clearly mentions the advantages of my polymer over its synthetic/natural version	
4. My advertisement involves all my group members	
5. My advertisement is engaging and has elements of humour/suspense to gain the attention of the audience	

Conclusion:

- So far, we have understood what a polymer is. We then understood the structures of polymers.
- We went on to discuss the different types of polymers and how human beings have developed their own polymers that are widely used today.
- In the coming sections we will understand the many uses of them, study about the most common polymer and the potential dangers of overusing polymers.

Section III: Assessment

Time: 5 minutes

1. You are an advisor to clothing manufacturer. The company is developing new products and is looking for advise on the choice of fibre. Read the product descriptions below and identify which fibre is best suited for the product. Explain your choice with reasons.

a) A range of monsoon wear including raincoats and wind sheeters-
b) A range of summer clothing-
c) A range of eco friendly garments-

2. Give evidence to support the following statement:

a) Polymers play a key role in the survival of human beings.
b) Polymers are called macromolecules.

Section IV: Closure

Recap by the teacher

Time: 2 minutes

- Polymers are types of molecules that are made by a combination of many smaller molecules called monomers. Just like in a necklace when several beads come together, they form a necklace.
- Polymers are everywhere! Many objects we see and use in our daily life are made of polymers.

- Polymers are of three different types- Biopolymers, natural polymers and synthetic or manmade polymers.
- We most commonly see polymers in 3 forms- plastic, rubber and fibres.
- Both rubber and fibres can be natural or synthetic polymers and each has their own advantages and disadvantages.
- In the next class we will study about plastics!

Recap by the students

Time: 2 minutes

As a recap each student should name an object/substance that is made of polymers. Encourage students to think of as many diverse objects as they can. Also, encourage them to think of polymers of all three types- biopolymers, natural polymers and synthetic polymers.

Section IV: Homework

1. Track your day from the time you wake up to the time you leave for school. What are the different polymers you came across in your home/ neighbourhood? Make a list of the same and classify them as natural or synthetic polymers.

2. Look at the table below and explain:

Monomer	Polymer
Ethene	Polyethene (Polythene)
Propene	Polypropene
Styrene	Polystyrene
Vinyl chloride	Polyvinyl chloride

a) What is a polymer?

b) What is a monomer?

c) What is the common system of nomenclature (naming) of polymers? (Do you see any similarity in the way all the above polymers have been named?)

Section V: Additional Resources

Resources for teachers:

1. Reading: Structure of polymers
   This is a guide that explains the different structures and properties of polymer in greater detail.
   Link: University of Wisconsin-Structure of polymers

Resources for students:

1. Article: What are some examples of polymers?
This article talks about the different types of polymers we encounter in everyday life.
Link: ThoughtCo

2. Video: From DNA to Silly Putty, the diverse world of polymers - Jan Mattingly
This video has a detailed and visually appealing explanation of polymers.
Link: TED-Ed

3. Crash course on polymers
The video mentions how polymers were discovered, synthetic polymers invented and put to widespread use.
Link: Youtube

Appendix

The following are printable versions of the passages for the activity 'Natural vs Synthetic Polymers'.

The History of Synthetic Rubber

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Material	Advantages	Disadvantages
Cotton		
Nylon		
Natural Rubber		
Synthetic rubber		

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