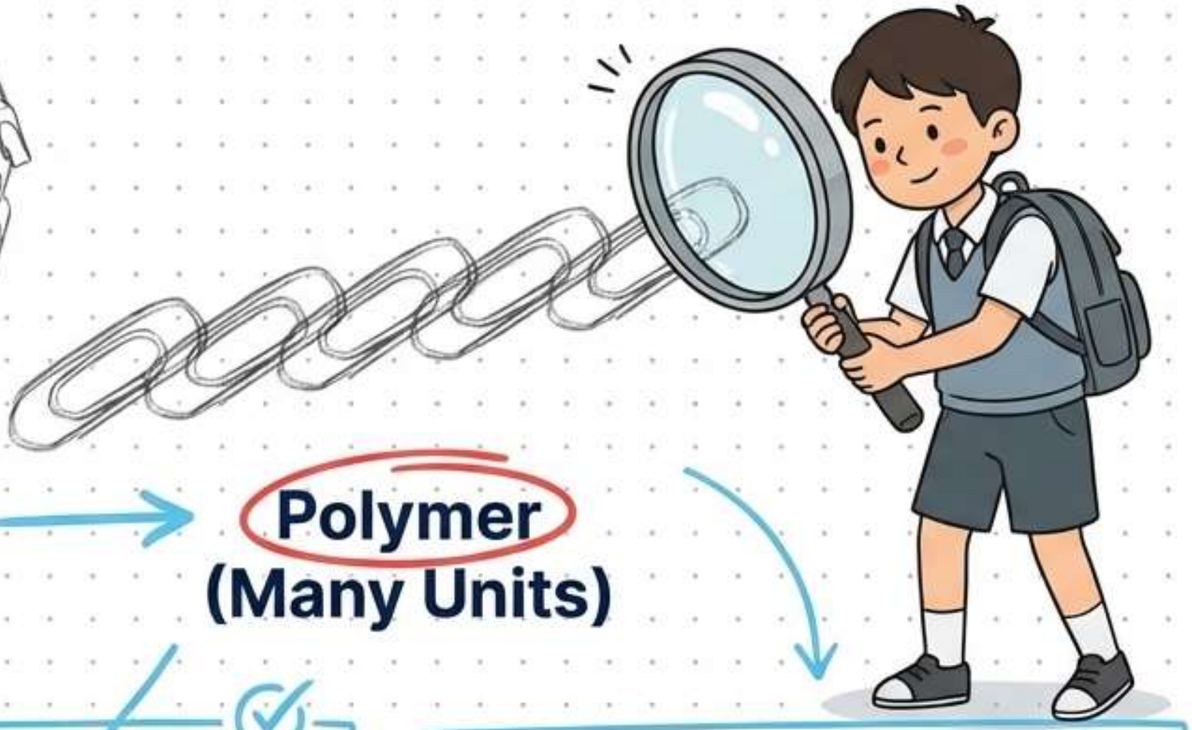
The Building Blocks of Synthetics

Monomer (Single Unit)

Polymer (Many Units)



The Problem

- Natural fibres (cotton, silk) are insufficient for global human demand.

The Solution

- Scientists engineered Synthetic Fibres and Plastics from petroleum products (petrochemicals).

The Core Concept

- All synthetic fibres and plastics are Polymers—long molecular chains made by joining many small molecules together.

The "Big 4" Synthetic Fibres

RAYON (The Artificial Silk)

Source: Wood pulp + Sodium Hydroxide = Viscose → Semi-synthetic

Traits: Semi-synthetic, lustrous, easy to dye

Uses: Blended with cotton for clothes, wool for carpets, surgical bandages

NYLON (The Super Strong)

Source: Polyamide units. First fully synthetic (1935)

Traits: Highly elastic, lightweight, stronger than steel wire

Uses: Parachutes, ropes, stockings, tyres

POLYESTER (The Crisp & Clean)

Source: Ester units (petrochemicals)

Traits: Wrinkle-resistant, washes easily

Uses: Dress materials (Terylene), PET bottles/jars

ACRYLIC (The Artificial Wool)

Source: Polyacrylonitrile

Traits: Cheaper, highly durable, moth-resistant

Uses: Winter sweaters, blankets, carpets

Why We Love (and Fear) Synthetics

The Good

- Dry up quickly (absorb very little water)
- Highly durable and strong
- Less expensive & readily available
- Wrinkle-resistant & moth-proof

The Bad

- Non-biodegradable
- Melts on heating

The Kitchen Trap

1. Heat Source
2. Synthetic Fabric Melts
3. Sticks to wearer's body causing severe burns

Never wear synthetics in the kitchen or laboratory!

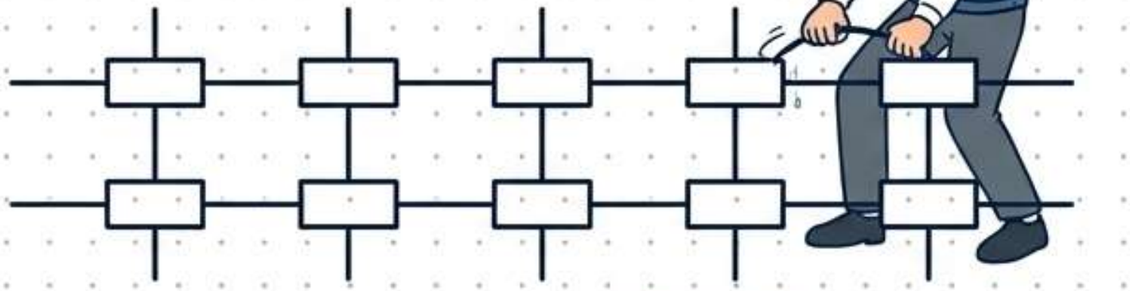
The Science of Plastics: Two Distinct Families

Thermoplastics

- **Reaction to Heat:** Softens and deforms; can be remoulded and reused.

- **Key Examples:** Polythene, PVC, Polystyrene.
- **Real-World Uses:** Toys, water pipes, thin carry bags, combs.

Thermosetting Plastics



- **Reaction to Heat:** Does NOT melt once set; cannot be remoulded.
- **Key Examples:** Bakelite (poor conductor), Melamine (fire tolerant).
- **Real-World Uses:** Electrical switches, kitchenware handles, floor tiles.

Essential Vocabulary Flashcards

Polymer

A very long molecular chain made by joining many small molecules (**monomers**) together.

Petrochemicals

Chemical compounds obtained from **petroleum** products, used as raw materials for synthetic fibres.

Spinneret

A metal cylinder with tiny holes through which liquid polymer is forced to form **continuous filaments**.

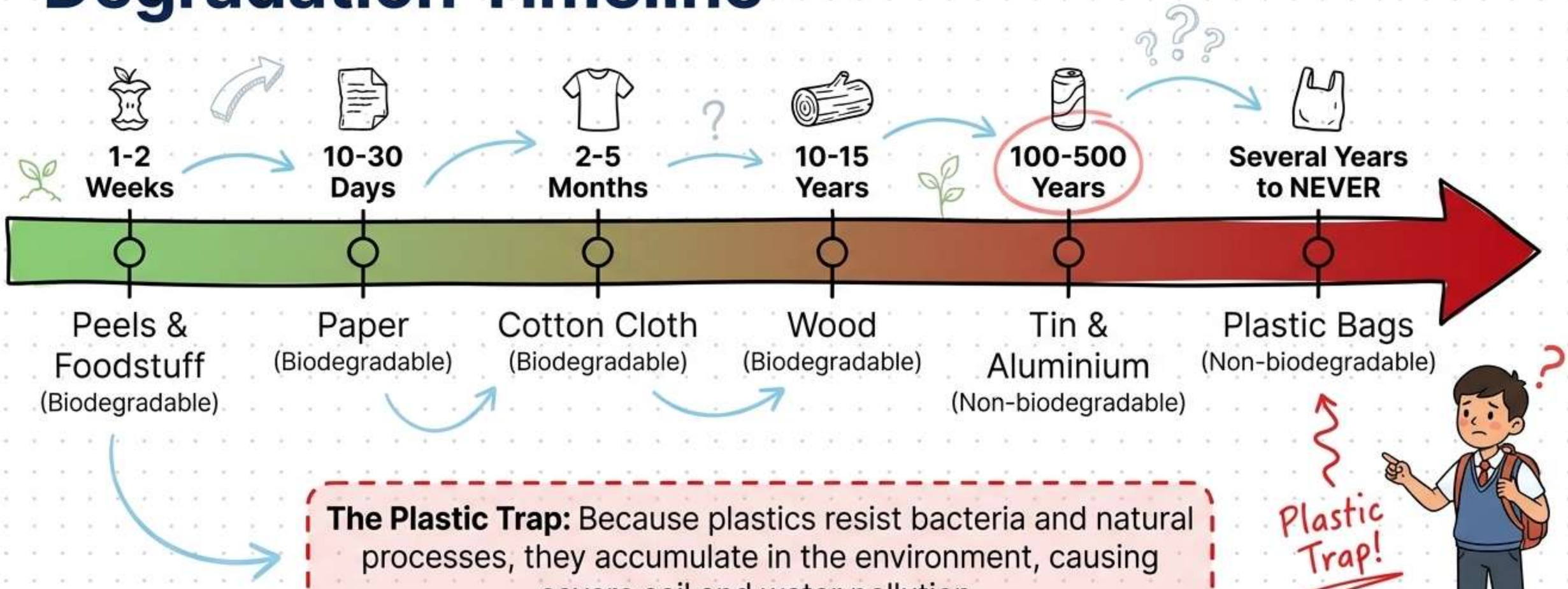
Viscose

A sticky liquid formed by dissolving **wood pulp** in an alkaline sodium hydroxide solution (used to make Rayon).

Teflon

A special plastic on which **oil and water do not stick**, unaffected by heat, used for non-stick cookware.

The Environmental Cost: Degradation Timeline



The Plastic Trap: Because plastics resist bacteria and natural processes, they accumulate in the environment, causing severe soil and water pollution.

Most Asked Board Questions

Q1: Why is Bakelite used for making electrical switches?

Answer: Bakelite is a thermosetting plastic. It is a poor conductor of heat and electricity, keeping users safe from electric shocks.

Keywords: Thermosetting, Poor conductor

Q2: Explain why Rayon is called a 'semi-synthetic' fibre.

Answer: Unlike nylon, rayon is not made entirely from chemicals. It uses a natural raw material (wood pulp), which is then processed chemically to form the fibre.

Keywords: Regenerated cellulose, Wood pulp

Q3: Why is melamine used to make kitchenware?

Answer: Melamine is a versatile thermosetting plastic that resists fire and can tolerate heat better than other plastics.

Keywords: Resists fire, Thermosetting

Common Mistakes & Exam Traps

	The Trap	The Truth
1	Thinking Rayon is a 100% artificial, man-made fibre.	Rayon is semi-synthetic because its base raw material is natural wood pulp.
2	Swapping the properties of Thermoplastics and Thermosetting plastics.	Think 'Setting = Cement'. Thermosetting plastics set permanently and cannot melt again.
3	Assuming all plastics are safe from heat because they are insulators.	Thermoplastics (like Polythene and PVC) will easily melt and deform upon heating. Only specific thermosetting plastics resist heat.

60-Second Rapid Revision Flow

POLYMERS
(Petrochemicals)

FIBRES

- Rayon (Wood pulp, Semi-synthetic)
- Nylon (Polyamide, Strongest)
- Polyester (Ester, PET, Wrinkle-free)
- Acrylic (Artificial wool)

PLASTICS

- Thermoplastic: Linear chains, melts. (PVC, Polythene)
- Thermosetting: Cross-linked, permanent. (Bakelite, Melamine)

ENVIRONMENTAL IMPACT
(Non-biodegradable -> Soil/Water pollution)

The 3-Mark Answer Writing Framework

Q: Differentiate between Thermoplastics and Thermosetting Plastics.

Basis of Difference	Thermoplastic	Thermosetting
Effect of Heat	Softens/melts	Does not soften
Polymer Structure	Linear chains	Cross-linked chains
Examples	PVC, Polythene	Bakelite, Melamine

Always draw a T-table for differences.

Use 'Basis of Difference' as your first column.

Bonus: Sketch the linear vs. cross-linked chains at the bottom to guarantee full marks!

Visual Mind Map

Composition: Made of large units called polymers (many smaller units).

Source: Chemical processing of petrochemicals (unlike natural plant/animal fibres).

Usage Goal: Enjoy good qualities while minimizing environmental hazards.

Types of Fibres: Rayon, Nylon, Polyester, Acrylic.

Environment: Non-biodegradable. Release poisonous gases on burning. Take years to degenerate.

Characteristics: Differ in strength, water capacity, burning nature, durability.

Memory Tricks & Mnemonics

The ‘Big 4’ Fibres

Real Ninjas Play Air-guitar

Rayon, Nylon, Polyester, Acrylic

Thermosetting Plastics

Bake Meals to Set

Bakelite, Melamine are Thermosetting

Silly visuals stick in your brain better than plain text.
Draw these on your rough sheet as soon as the exam begins!

Final Exam Readiness Checklist

- [ ] I can define a polymer and monomer.
- [ ] I know the sources and uses of Rayon, Nylon, Polyester, and Acrylic.
- [ ] I can explain why synthetic clothes are dangerous in the kitchen.
- [ ] I can draw linear and cross-linked polymer chains.
- [ ] I can differentiate between Thermoplastic and Thermosetting plastics with examples.
- [ ] I understand the environmental hazards of non-biodegradable plastics.

All checked? You are ready to ace this chapter!