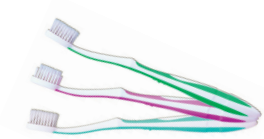
THE EXCITING WORLD OF SYNTHETIC POLYMERS

1 **Here is a list of common objects and materials containing polymers or made from polymers. Tick the ones you use *every day*, *often*, *sometimes*, *never*.**

	EVERY DAY	OFTEN	SOMETIMES	NEVER
bicycle	☐	☐	☐	☐
bubble gum	☐	☐	☐	☐
car	☐	☐	☐	☐
CDs	☐	☐	☐	☐
comb	☐	☐	☐	☐
computer	☐	☐	☐	☐
contact lenses	☐	☐	☐	☐
cosmetics	☐	☐	☐	☐
credit card	☐	☐	☐	☐
eye glasses	☐	☐	☐	☐
frozen food	☐	☐	☐	☐
Gore-Tex clothing	☐	☐	☐	☐
iPod	☐	☐	☐	☐
hair-dressing products	☐	☐	☐	☐
nail polish	☐	☐	☐	☐
panty hose	☐	☐	☐	☐
pen	☐	☐	☐	☐
plastic bags	☐	☐	☐	☐
plastic cutlery	☐	☐	☐	☐
protective helmet	☐	☐	☐	☐
roller blades	☐	☐	☐	☐
rubber bands	☐	☐	☐	☐
salad dressing	☐	☐	☐	☐
shampoo	☐	☐	☐	☐
smartphone	☐	☐	☐	☐
soccer ball	☐	☐	☐	☐
stereo	☐	☐	☐	☐
swim fins	☐	☐	☐	☐
take-out containers	☐	☐	☐	☐
Teflon cookware	☐	☐	☐	☐
tennis racket	☐	☐	☐	☐
toothbrush	☐	☐	☐	☐
watch	☐	☐	☐	☐
windbreaker	☐	☐	☐	☐



PET bottles

Synthetic polymers are artificially manufactured and are commonly referred to as industrial polymers. They include a wide range of useful and successful materials. The first synthetic polymer product invented was Bakelite. Today, synthetic polymers are being used for many applications that were unimaginable just a few years ago. Rapid advances in polymers are enabling the nanotechnology revolution to move forward.

Polyesters are long chain synthetic polymers that have ester linkages. Polyester materials are used as fibres, plastics and films, in composites and elastomers, and as coatings. They are truly versatile materials. PET bottles are today one of the most popular uses of polyesters.

Polyethylene (IUPAC name: polyethene) is the most widely used plastic. It is primarily used in packaging.

Polypropylene has a wide variety of applications in packaging, containers, car components, lab equipment, textiles, stationery, etc.

PVC (polyvinyl chloride) is widely used in construction because it is durable, cheap and easily manipulated. It often replaces rubber and can be made softer and more flexible by the addition of plasticizers. In this form, it is used in clothing and upholstery, electrical cable insulation, inflatable products.

Polystyrene is one of the most widely used plastics, for example, in disposable cutlery, CD and DVD cases, packaging, and foam drink cups. Since polystyrene cannot be biodegraded by microorganisms, it can cause pollution of the environment but fortunately, it can be recycled.

Polyester fabrics and fibres are extremely strong, very durable, resistant to most chemicals, wrinkle-resistant, and can be easily washed and dried.

Microfibers are polyesters. Being extremely small, they are great for absorbing water, very flexible, soft to the touch and durable. They can be tightly woven so that the wind, rain and cold do not easily penetrate them. They also allow perspiration to pass through them.

Nylon was the first commercially successful synthetic polymer. It replaced silk in many applications, now it is used in fabrics, carpets and ropes. **Polyurethane** is very similar to nylon but softer and more elastic and is used as a substitute for rubber and in elastic and Lycra.

Rubber can be found in nature but it can also be synthesized by man. Synthetic rubber is preferable to natural rubber because, thanks to the process of vulcanisation (by which the rubber is heated in the presence of sulphur), it has better flexibility, elasticity and durability. Being waterproof, stretchy, and a good insulator, neoprene is a synthetic rubber used in a wide variety of applications, among which electrical insulation, car belts, scuba diving suits and orthopaedic braces. Silicone (not to be confused with the chemical element

to allow: *to let*
brace: *support*
breast implant: *prosthesis to correct the size or form of a woman's breast*
cookware: *pots and pans*
coating: *covering*
cutlery: *knives and forks*
disposable: *not reusable*
to enable: *to support*
foam: *plastic in a spongy form*
hence: *that is the reason for*
plasticiser: *a chemical added, especially to rubbers and resins to impart flexibility and workability*
range: *variety*
referred to as: *called*
stationery: *materials for writing*
stretchy: *elastic*
threat: *menace, danger*
upholstery: *materials used to fill cushions, armchairs, etc.*
woven: *knitted*
wrinkle: *fold*

Silicone rubber bag

Chair made of polyurethane foam

silicon), heat-resistant and rubberlike, has a variety of forms and uses: in sealants, adhesives, lubricants, cookware, medicine (e.g. breast implants). Plastics made of polymers offer many advantages but they also represent an environmental threat, due to the fact that they are non-biodegradable, that is, they cannot be decomposed by bacterial action. Hence the need not only to develop biodegradable plastics, but also to work on more effective means of recycling. To meet the environmental challenges posed by plastics, polymer chemists continue to research new methods of recycling and of using recycled plastic.

2 **Complete the table with the main uses of these synthetic polymers.**

SYNTHETIC POLYMER	MAIN USES
Neoprene	
Nylon	
Polyesters	
Polyethylene	
Polypropylene	
Polystyrene	
PVC	
Silicone	

3 **Answer the following questions.**

1. What are polyesters?
2. What are the qualities of PVC?
3. What is the main disadvantage of polystyrene?
4. What are the advantages of microfibers?
5. What are biodegradable polymers?

Nanotechnology (*nano* = billionth) is an exciting and fast-moving area dealing with the manipulation of atoms and/or molecules to produce materials and devices.

ACTIVITIES

4 **'Unimaginable' in the passage means that cannot be imagined. Choose the correct prefix to make the opposite of the following adjectives choosing from the ones in the box below.**

a • an • dis • il • im • in • ir • un

1. able: .....
2. aerobic: .....
3. approval: .....
4. colouring: .....
5. exhaustible: .....
6. legal: .....
7. possible: .....
8. regular: .....
9. septic: .....

5 **Listen to *Five synthetic materials with the power to change the world* and number these topics in the order they are dealt with.**

- ☐ Bioplastics
- ☐ Nanocomposites
- ☐ Plastic composites
- ☐ Plastic electronics
- ☐ Self-healing polymers
- ☐ Smart and reactive polymers

Plastic 'Skin': New Synthetic Polymer Has Self-Healing Properties

Human skin is a special material: it needs to be flexible, sensitive to stimuli such as touch and pressure, which are measured as electrical signals, so it needs to conduct electricity. Importantly, if it has to survive the wear and tear which it has to undergo every day, it needs to be able to repair itself. Now, researchers in California may have designed a synthetic version of human skin, a flexible, electrically conductive, self-healing polymer. Chemical engineer Zhenan Bao of Stanford University in Palo Alto, California, and her team explored the potential of self-healing polymers in epidermal electronics. To demonstrate that both the mechanical and the electrical properties of the material could be repeatedly restored to their original values after the material had been damaged and healed, the researchers cut the polymer completely through with a scalpel. After pressing the cut edges together gently for 15 seconds, the researchers found the sample went on to regain 98% of its original conductivity - and crucially, the Stanford's team polymer could be cut and healed over and over again. Now, Bao and her fellow researchers are working to make the polymer more like human skin.

by Tim Wogan (Adapted)