Materials and sustainability

Teacher review edition. Ask your teacher if anything is unclear.

What happens to a product before and after we use it?

What you will learn

- Describe the stages in a product's lifecycle.
- Distinguish reducing, reusing and recycling.
- Make a fair comparison of two products.

The lifecycle of a product

> **Lifecycle**
> The stages a product goes through, from obtaining raw materials to reuse, recycling or disposal.
>
> **Raw material**
> A resource used to make a product, such as timber or metal ore.

A product's lifecycle runs from raw materials to reuse, recycling or disposal. Each stage can use resources and affect the environment.

- Obtain raw materials, such as aluminium ore.
- Process the materials and manufacture the product, such as a can.
- Transport and use the product.
- Repair, reuse, recycle or dispose of it.

Follow a product through its life

1. Obtain raw materials

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2. Make the product

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3. Use the product

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4. Reuse, recycle or dispose

Each stage can use resources and affect the environment. Recycling returns some material to production; it does not remove every impact.

Reducing and reusing

> **Reuse**
> Using an item again without breaking it down into raw material.

Reducing and reusing can help avoid waste.

- Reduce: use fewer materials. Buy only what is needed and choose less packaging.
- Reuse: use the item again without breaking it into raw material. Refill a bottle or repair a bag.

Recycling

> **Recycling**
> Processing waste material to make new products.

Recycling processes waste material to make new products, such as melting old aluminium cans into new metal products.

- It can reduce demand for new raw materials.
- Collection, transport and processing still use energy.
- Local recycling depends on the material and the collection system.

Biodegradable materials

> **Biodegradation**
> Breakdown of a material by living organisms.

Biodegradable materials can be broken down by organisms such as bacteria and fungi. Food scraps are an example.

- Breakdown needs suitable conditions, including moisture and temperature.
- Some products need industrial composting conditions.
- "Biodegradable" does not mean a product quickly breaks down wherever it is dropped.

Comparing disposable and reusable products

Compare products doing the same job over the same number of uses.

- A reusable bottle may use more resources to make than one disposable bottle, but it can be used many times.
- Example: compare carrying the same amount of water on 100 days.
- Include the reusable bottle's manufacture, washing and transport, and all disposable bottles needed for those days.

Making a decision using evidence

> **Trade-off**
> A choice where gaining one benefit means giving up another.

A sound decision uses evidence from the whole lifecycle.

- Look for data on manufacture, transport, use and disposal.
- Check what an advertisement's measurements actually compare.
- Consider trade-offs: a stronger container may last longer but require more material.
- State evidence for your choice and identify important missing information.

Worked examples

In a simple example, a disposable cup has an environmental impact of 4 units per use. A reusable cup costs 40 impact units to make and 1 unit to wash after each use. Compare 20 uses.

Work through it

1. Disposable cups: 20 × 4 = 80 impact units.
2. Reusable cup: 40 + (20 × 1) = 60 impact units.
3. The reusable cup has the lower total in this example. A real comparison would also need evidence about transport, washing and disposal.

Common mistakes

Common mistake: Reuse and recycling mean the same thing.

Remember: Reuse keeps the item in use; recycling processes its material into new products.

Common mistake: A biodegradable item quickly breaks down anywhere.

Remember: Breakdown needs suitable conditions. Some materials require industrial composting.

Answering questions

- Compare products doing the same job over the same number of uses; include manufacture, transport, use and disposal.
- Support a choice with evidence, explain a trade-off and identify missing information instead of claiming one material is always best.

Try an investigation

Choose a familiar product, such as a drinks container. Draw its lifecycle and compare it with an alternative that does the same job. Record where your information came from and check your local collection guidance for the disposal stage.

Plan, record and review

- Question and prediction: What are you testing, and what do you think will happen? Give a reason.
- Change, measure, keep the same: What will you deliberately change? What will you measure, and in what units? What stays the same to make it a fair test? For an observation, say what you will record consistently instead.
- Record and look for a pattern: Use a table with headings and units. Look for a pattern or a result that does not fit.
- Conclude from evidence: Answer your question using a result or observation. Say if the evidence is unclear.
- Improve the investigation: What would you repeat or change, and how would that make the evidence better?

Do practical work with your teacher and follow the laboratory safety instructions.