



PLASTICS CHALLENGE

Pupil activity sheets



practicalaction.org/schools/plastics-challenge

**Practical
ACTION**

The Sustainable Development Goals

	No poverty	End poverty in all its forms everywhere.
	Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
	Good Health & Well-being for People	Ensure healthy lives and promote well-being for all at all ages.
	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
	Gender Equality	Achieve gender equality and empower all women and girls.
	Clean Water & Sanitation	Ensure availability and sustainable management of water and sanitation for all.
	Affordable & Clean Energy	Ensure access to affordable, reliable, sustainable modern energy for all.
	Decent Work & Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
	Industry, Innovation & Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
	Reducing Inequalities	Reduce income inequality within and among countries.
	Sustainable Cities & Communities	Make cities and human settlements inclusive, safe, resilient, and sustainable.
	Responsible Consumption & Production	Ensure sustainable consumption and production patterns.
	Climate Action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
	Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss.
	Peace, Justice & Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
	Partnerships for the Goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

What do you see?

Practical
ACTION



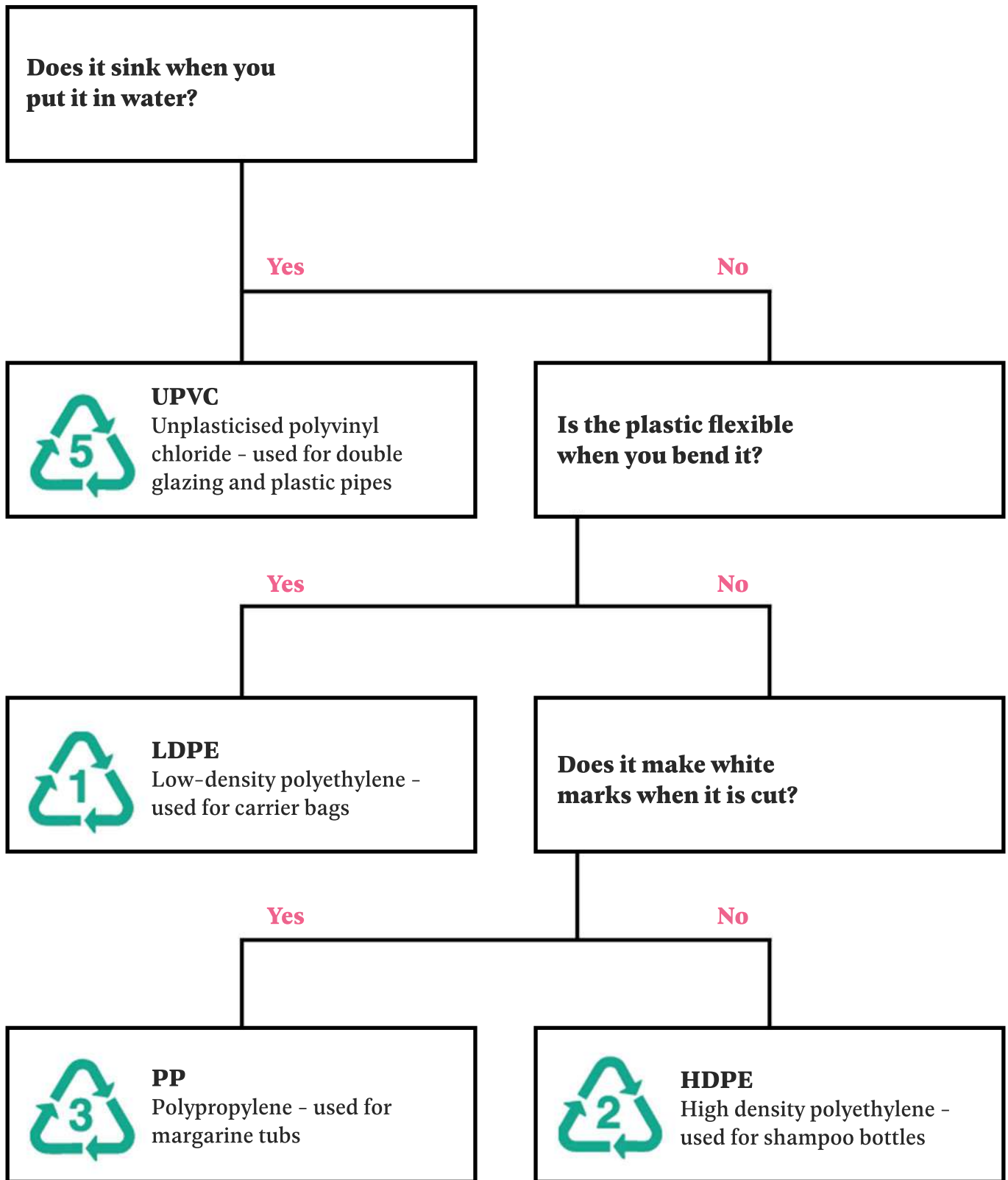
Practical ACTION



Practical ACTION



Plastic sorting key



Identifying plastics

Name: _____

Class: _____

Carry out the tests and record your results in the table below.

Sample	Is it translucent, transparent or opaque?	What happens when you bend it? Is it flexible or is it stiff and difficult to bend?	What happens when you scratch it? Does it cut cleanly or are there white marks along the cut?	Does it float in water?	Which plastic have you identified?	What is the full name of the plastic? Use the plastic information chart to help you.
1						
2						
3						
4						

Plastic polymers

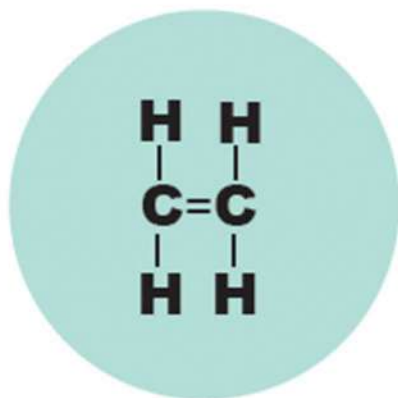
Polymers are huge molecules, made from thousands of atoms.

They are made by joining together thousands of small reactive molecules called monomers. The reaction is called POLYMERISATION.

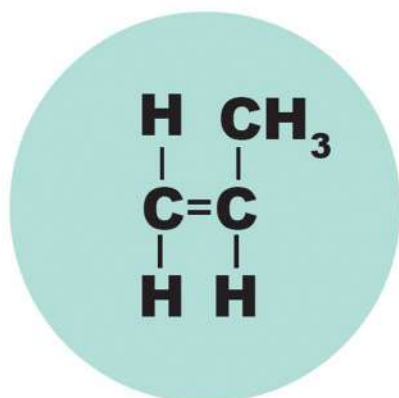
In addition reactions, the double bond in the monomer (between the carbon atoms) opens up and neighbouring monomers join end to end.

Monomer

Ethene

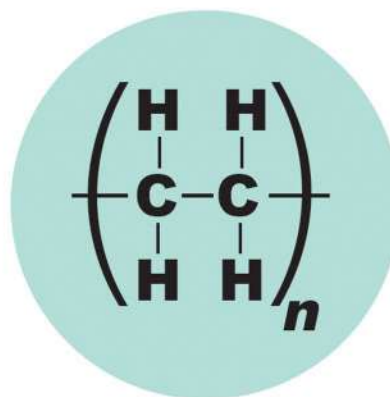


Propene

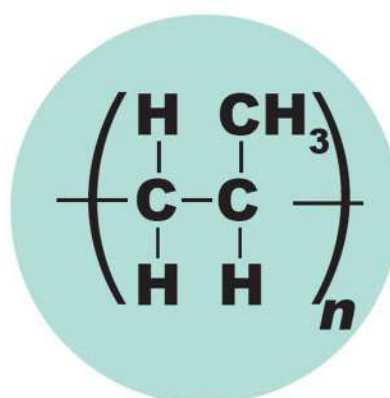


Polymer

Polyethene



Polypropene



In addition reactions, the polymer is the only thing that is formed.

Chemical Formula

Cut out the chemical formula, molecular structure, compound names, name of plastic, uses, and recycle code cards from the sheets.

Can you match each of the six plastics with their relevant cards?

Chemical formula



Chemical formula



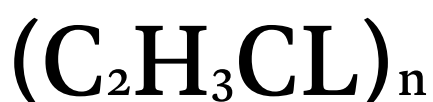
Chemical formula



Chemical formula



Chemical formula

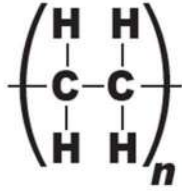


Chemical formula



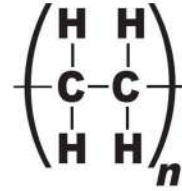
Molecular structure

Molecular structure



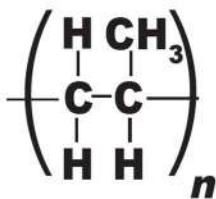
Branching structure

Molecular structure

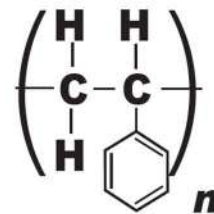


Branching structure

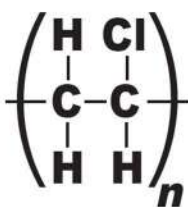
Molecular structure



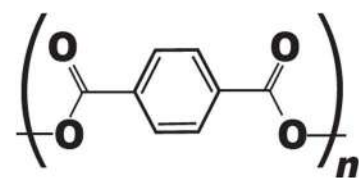
Molecular structure



Molecular structure



Molecular structure



Compound name

Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polypropylene
Polypropene

Compound name

Polystyrene
(general purpose)
Poly(1-phenylethylene)
(general purpose)

Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polyethyleneterephthalate
Poly(ethyleneterephthalate)

Type of plastic

Type of Plastic

(LDPE)
Low density
polyethylene



Type of Plastic

(HDPE)
High density
polyethylene



Type of Plastic

(PP)
Polypropylene



Type of Plastic

(GPPS)
General purpose
polystyrene



Type of Plastic

(PVC) Polyvinyl chloride
(uPVC) unplasticised
polyvinyl chloride



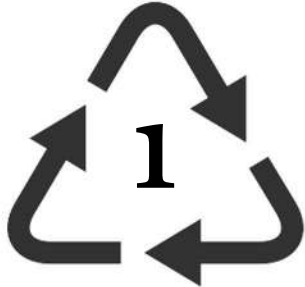
Type of Plastic

(PET)
Polyethylene
terephthalate

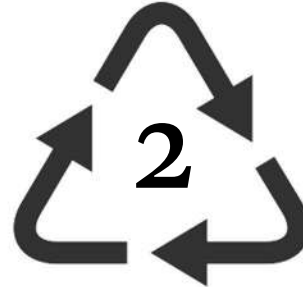


Recycle code

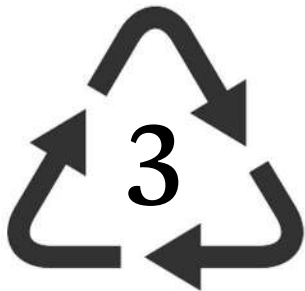
Recycle code



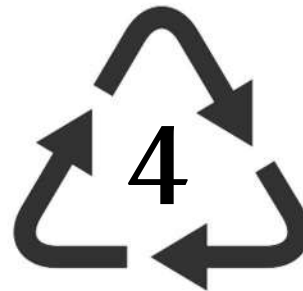
Recycle code



Recycle code



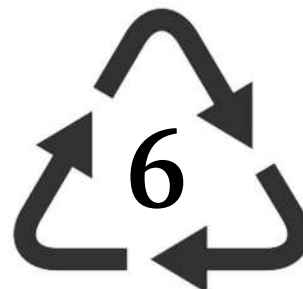
Recycle code



Recycle code



Recycle code



Uses

Uses



Uses



Uses



Uses



Uses


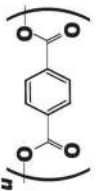

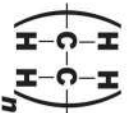

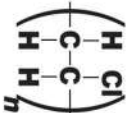

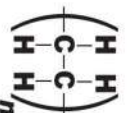

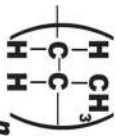

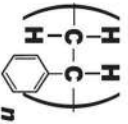


Uses



Plastics information chart

Carry out the tests and record your results in the table below.

Symbols	Uses	Type of plastic	Compound name	Formula	Molecular structure
	Engineering polymers are used in bonnet parts, window wiper holders and exterior mirrors for cars.	Polyethylene terephthalate also known as polyester	Polyethylene terephthalate or Poly(ethylene terephthalate)	$(C_{10}H_8O_4)_n$	
	Chemical drums, jerricans, toys, picnic ware, cable insulation, carrier bags and food wrapping material.	High density polyethylene (HDPE)	Polyethylene or polyethene or polythene	$(C_2H_4)_n$	Rigid polymer structure 
	Window frames, drainage pipe, water service pipe, medical devices, automotive interiors and seat coverings, fashion and footwear, packaging, cling film and credit cards.	Polyvinyl chloride unplasticised polyvinyl chloride	Polyvinyl chloride or poly(1-chloroethylene)	$C_2H_3Cl)_n$	
	Squeeze bottles, toys, carrier bags, general packaging, gas and water pipes.	Low density polyethylene (LDPE)	Polyethylene or polyethene or polythene	$(C_2H_4)_n$	Branching polymer structure 
	Coffee pot and washing m/c parts (where high temperature and moisture are critical).	Polypropylene (PP)	Polypropylene or (polypropene)	$(C_3H_6)_n$	
	Toys and novelties, rigid packaging, refrigerator trays and boxes, cosmetic packs and costume jewellery.	General purpose polystyrene (GPPS)	General purpose polystyrene or Poly(1-phenylethylene)	$(C_8H_8)_n$	

Waste timeline

Cut out the cards below and place them in the order from quickest to longest time it takes them to decompose.

Mobile phone



Wool sock



Tea bag



Plastic bottle



Bio plastic carrier bag



Apple core



Magazine



Banana skin



Lifecycle analysis picture cards

Cut out the pictures and arrange them in a way that tells the story of a plastic drinks bottle.

Oil is extracted



Barrel of oil



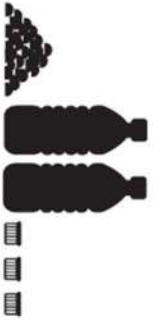
Oil made into pellets



Recycling bin



Pellets melted to form plastic bottles and lids



Bottles filled with water



Bottles wrapped with plastic label



Shop



Bottles transported to shops



Used bottles



Landfill

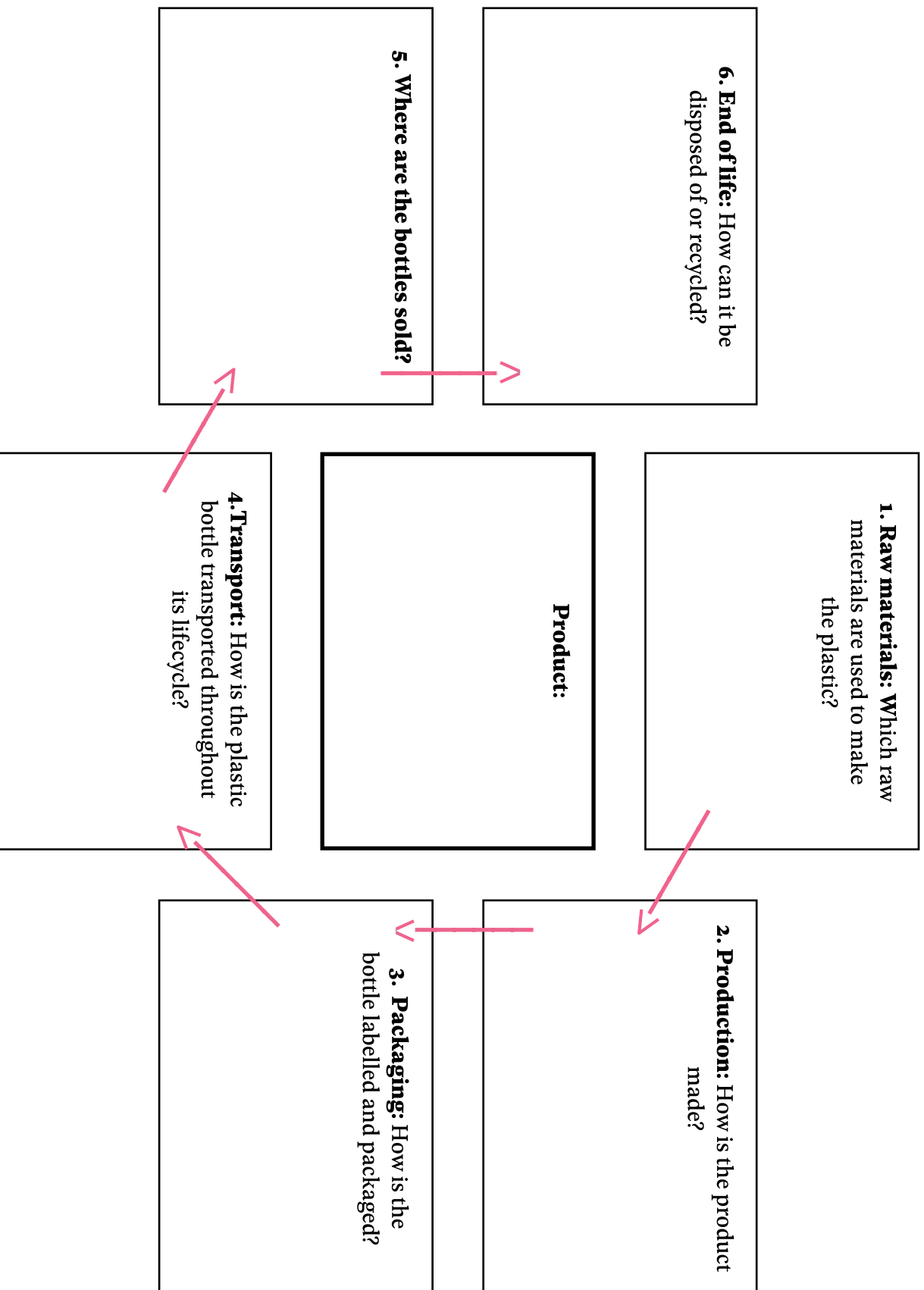


Bin



Lifecycle analysis

Draw or write the name of the product you are analysing in the middle box and answer the questions about different stages in the product lifecycle. You can use pictures to illustrate your answers too.



Recycling plastic: True or false

Cut out the cards and decide which ones you think are true of false facts about plastic recycling.

Recycling 1 plastic bottle saves enough energy to power a 60 W bulb for 3 hours.

Fleece fabric can be made from recycled plastic.

75% of plastic waste in the UK is sent to landfill.

If you lined up all the polystyrene foam cups made in just 1 day they would circle the earth.

Most households in the UK throw away about 40kg of plastic per year, which could otherwise be recycled.

Recycling a plastic bottle saves 90% of the energy taken to produce a new one.

We can't recycle some plastics in the UK yet...so some are shipped abroad for recycling.

1.8 tonnes of oil are saved for every tonne of recycled polythene produced.

17 billion plastic carrier bags are given away by supermarkets in the UK every year - That's 290 bags per person!

94% of UK local authorities now offer collection facilities for plastic bottles either through your household recycling collection or at recycling centres.

Plastic can take up to 1,000 years to decompose.

The UK currently recycles approximately 24% of plastic while Germany recycles 44%.

Making bioplastics

You will need

Ingredients

- 1.5 tablespoons corn starch
- 1 teaspoon vinegar
- 1 teaspoon glycerine
- 5 tablespoons of water
- Food colouring (optional)

Equipment

- 1 saucepan
- 1 wooden spoon
- 1 round edged knife
- A selection of pastry cutters or moulds to shape the plastic
- Non-stick baking sheets or greaseproof paper

Instructions of how to make bio plastics

- 1.** Place all the ingredients in a saucepan, including a few drops of food colouring if you want coloured plastic.
- 2.** Before heating, stir the ingredients until they are all combined.
- 3.** Place the pan over a low heat and continue to stir until the mixture turns sticky and translucent.
- 4.** Allow the mixture to cool a little. Use a spoon to place the sticky mixture on a non-stick baking sheet or greaseproof paper.
- 5.** Use a knife to spread the mixture to the required thickness and leave to cool.
- 6.** Once cooled the bio plastic can be cut with a pastry cutter and left to dry. Drying takes about 4-5 days.

Graphic organiser

Name:

Class:

Use the internet to help you find out about oil based and bioplastics. Record your finding below.

Oil based plastic	Questions	Bioplastic
	What is it made from?	
	Is it made from a renewable source?	
	What can you make from it?	
	How long does it take to decompose?	
	Can you recycle it?	
	What are the problems associated with it?	

Design contexts



Nepalese women's group

CONTEXT

The Hamro Mahila Women's Group in Nepal was set up after a group of women 'waste' collectors were trained and supported by Practical Action in making crafts from 'waste' plastic. Their enterprise allows them to work in a safe environment whilst earning money.

Your challenge is to design and make a product that could be made by the women's group from locally found waste plastic. The women have the use of a sewing machine, iron and basic craft tools. The products need to be made cheaply whilst being safe to use. You need to decide whether this product will be sold locally or internationally. In either case you will need to consider how this might affect the design characteristics.



Eco-entrepreneurship

CONTEXT

Your newly setup young enterprise company have decided to take on 'The £5 Challenge' which aims to create a mini business with a start-up fund of £5.

It is up to you what you use the £5 for but your product must reuse locally sourced plastic

You will need to consider your target market and your product branding. The retail price must reflect this.

You need to decide who your audience is and how you will market your product.

Who is my product aimed at?



Teenagers

Age:
13-17

Likes:

Socialising, Skateboarding, Shopping
Social media- Facebook, Snapchat, Instagram,
Selfies, Band music, Fast food, Magazines,
Sport, TV shows/ Films

Spendable income:
£5-£10 per week



Young professionals

Age:
23-35

Likes:

High tech gadgets, High quality clothing
Dance music, Travelling, Skincare products
Home products, Socialising in bars/clubs,
Lifestyle magazines, Running/cycling,
Comedy and drama TV series

Spendable income:
£20 per week after expenses



Elderly

Age:
65+

Likes:

Social clubs, Talking to family on the phone
Easy to use products, Comfort, Radio/TV
shows, Gardening, Traditional design
Walking, History, Home cooked food

Spendable income:
£30 per week after expenses



Mums

Age:
30-50

Likes:

Socialising, Family gatherings, Running/
Cycling, Online shopping, Reliable/
Child-safe products, Relaxing music
Nutritious food, Lifestyle magazines
Eco-friendly/ Sustainable products

Spendable income:
£30 per week after expenses

What's the specification? Ideas for design criteria

As a group choose your top 5 criteria for how you want your product to be, then decide if you want to add in any others of your own.

Needs minimum packaging.

Is attractive or useful to the users

Uses little energy to produce and transport

Can be sold to make a profit

Develops new skills for the workers making the product

Is suitable for the user

Is a quality product

Can be made using low tech equipment

Safe to use

Helps the user learn an environmental or social message

Fun to use

Made mainly from plastic 'waste'

Quick to make

What can I do with plastics?

Here are a few ideas to help you get started with developing your ideas for reusing plastics.

What products could you make using these techniques?



Reusing plastic bags

Cut out simple shapes from carrier bags, layer and stitch or glue them together to make a new material to make into a range of products.



Using strips of plastic

Use scissors to cut strips from different coloured carrier bags. For knitting make a continuous long strip from one bag.

Have a go at knitting, weaving, plaiting or making a pom-pom with the strips.



Fusing plastic

Experiment with cutting plastic bags into a range of shapes or plaiting plastic strips before heating them with an iron or heat press to form a new plastic material.

If you are using an iron, make sure you use baking paper on both sides of the plastics and set the iron on a medium heat.

If you are using a heat press, experiment with heat settings of around 130°C for 10 seconds.



Ideas with plastic packaging

Have a go at using a shaped puncher or scissors to cut repeat shapes from colourful bottles or packaging. They could be used to make jewellery or to decorate a product.

Use scissors and shape punchers to cut interesting shapes into plastics bottles to use for storage or useful products.

Making a notebook

You will need

Card from a cereal box, Plastic bags in a range of colours, PVA glue or double-sided sticky tape, Ruler, Pen, Scissors, Iron and baking sheets, Heat press (optional)

- 1.** Measure out and cut a piece of cardboard that is a good size to fold to form a front and back cover for the booklet.
- 2.** Add a spine width of 1cm in the centre to allow the booklet to close when folded.
- 3.** Score along either side of the spine to fold.
- 4.** Make your plastic covering for the booklet.
- 5.** This can be done using the heating plastic bags technique you have already practised.
- 6.** Cut the plastic to a size that will cover the card, allowing enough space to fold the plastic inside the card cover.
- 7.** Place double sided tape or glue around the edges of the inside of the cardboard. Place the card on top of your plastic and pull the edges over tightly to stretch it over the cardboard insert.
- 8.** Trim the edges to neaten up.
- 9.** If you would like ties on your booklet, plait 3 strips of carrier bag to make them. Fasten these with tape at either end of the booklet.
- 10.** Select the plastic that you would like to use for the inside of your booklet. Draw around your covered cardboard using a biro onto the plastic.
- 11.** Cut out and fold the edges over about 1 cm.
- 12.** Using glue or double sided tape place the plastic onto inside of notebook cover to neaten the appearance.
- 13.** To finish your booklet, secure sticky notes or paper onto the inside cover. Fold over and tie plaits to close the booklet.

Enjoy your notebook!

Making plastic bunting

You will need

A selection of plastic bags, paper/card to make a template, Pen, Scissors, Iron, Heat press (optional)

- 1.** Use the fusing plastic technique to make some colourful plastics material for your bunting.
- 2.** Develop a template design of your size and choice and cut it or them out of card.
- 3.** Using the template and a biro draw as many shapes onto the plastic as you can fit and cut them out using scissors.
- 4.** Make a strip of plastic (approximately 2.5cm) wide by cutting a continuous long strip from a carrier bag.
- 5.** Space your plastic shapes along the strip and use either a sewing machine, strong glue or very carefully use an iron and baking sheets to melt your shapes onto the strip.

Enjoy your bunting!



Project outline and design criteria

Name:

.....

Class:

.....

Project outline

In your own words write your project title and brief

Who you are designing and making for?

Design criteria

Before developing your ideas for your plastic product, think about what's important for you to consider when designing your product.

Make sure you include ideas that reflect who you are designing for and why you are designing the product.

Once you have agreed on your criteria write them below and give each criteria a reason why it is important.

Our product will...

Project design sheets

- Research

Name: _____

Class: _____

Record any details and/or pictures from designers and makers who reuse plastics.

Project design sheets

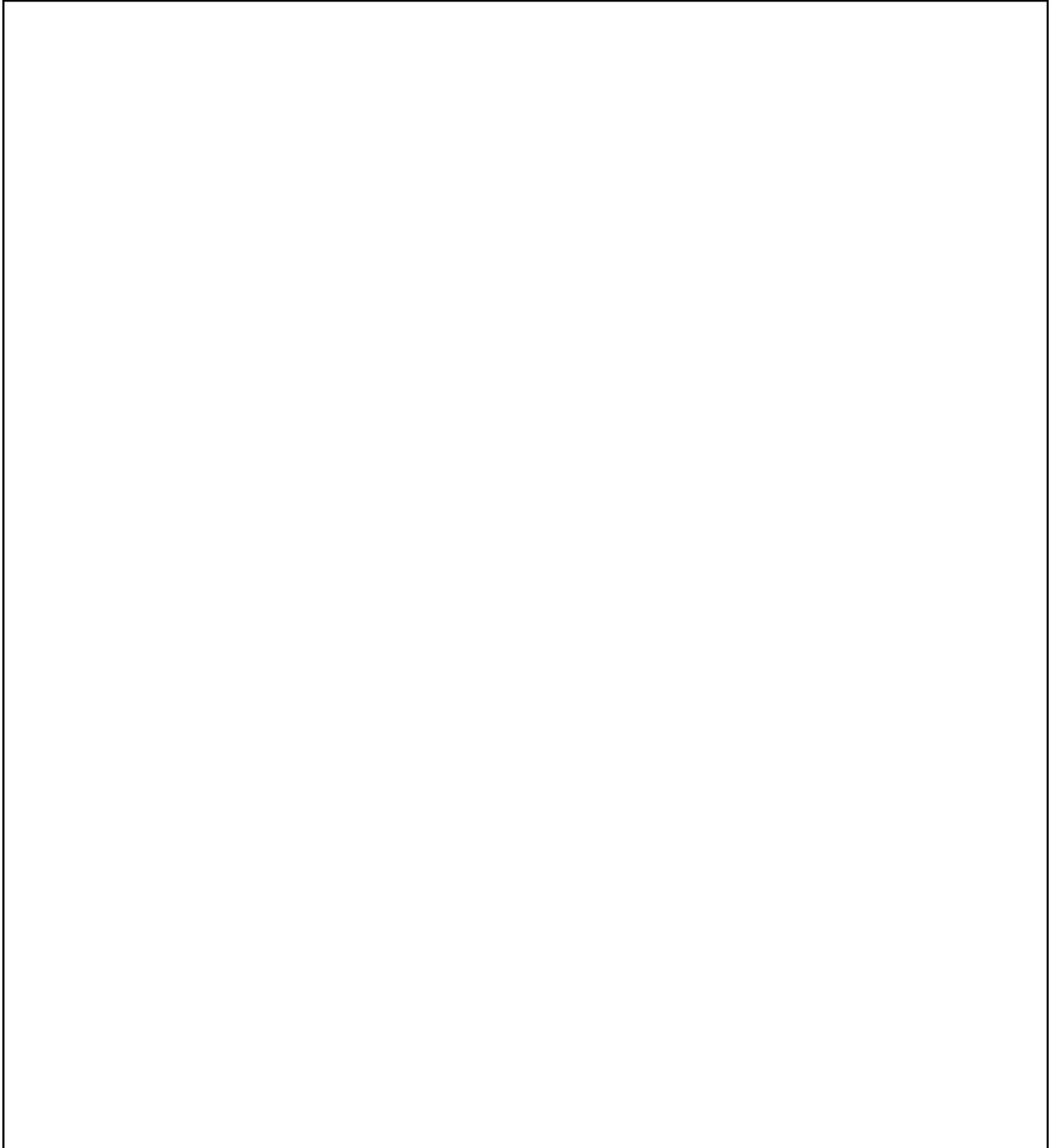
- Design ideas

Name:

Class:

Develop your ideas for your plastic product and sketch them below.

Annotate your design ideas with notes and examples of the techniques that you have practised to give additional information to your designs.



If you are working in a group, share your design ideas. Consider which ideas, or which parts of your ideas best meet the design criteria.

As a group decide which idea to take forward as your final design idea that you might choose to make.

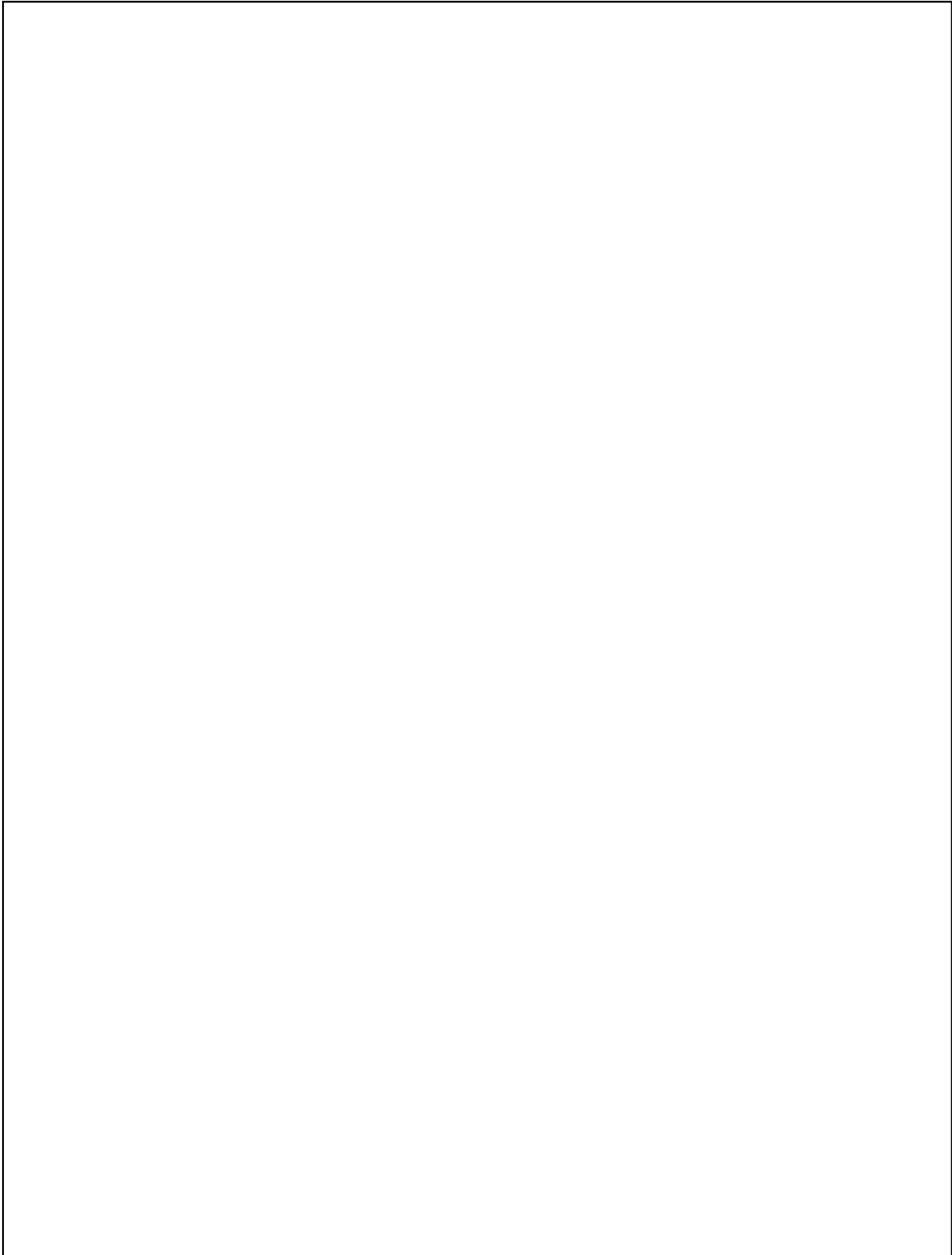
Project design sheets

- Final design

Name: _____

Class: _____

Present a final design drawing of your group's idea with annotations to explain its features.



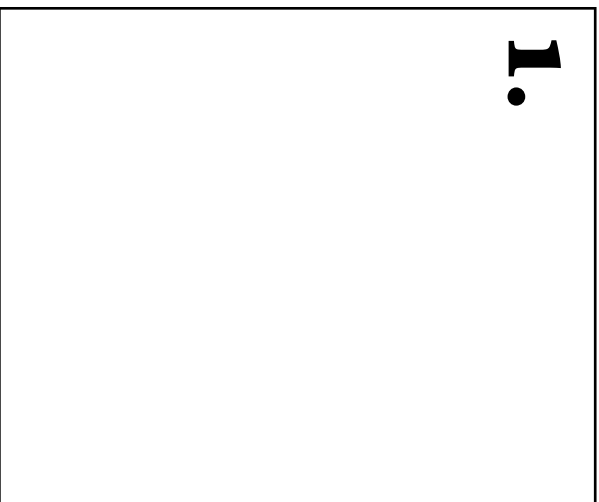
Product design sheets - Product plan

Name:

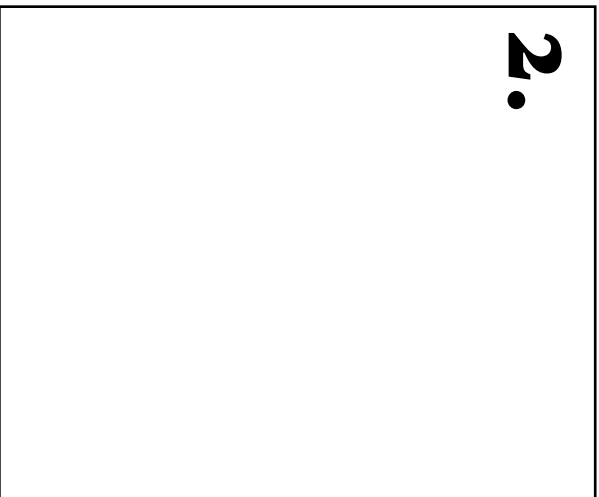
Class:

Use as many boxes as you need to produce a step by step plan of how to make your product.
Don't forget to include information about the materials and equipment you need.

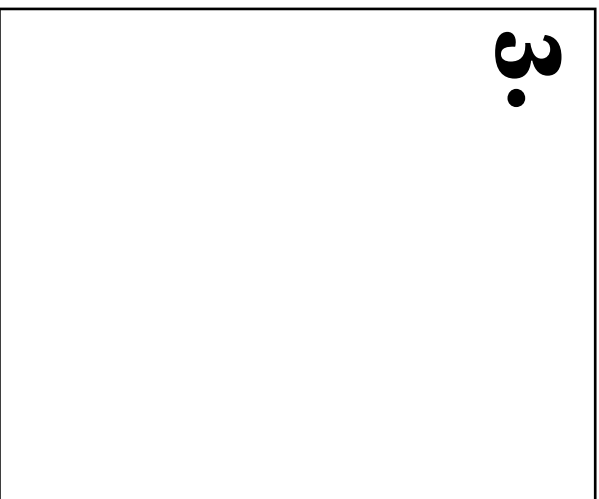
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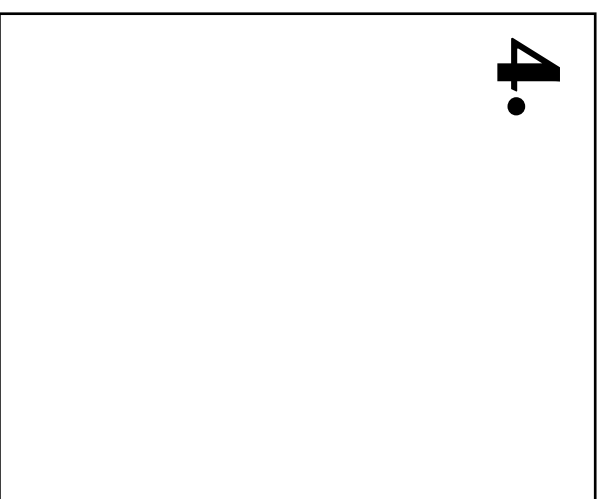
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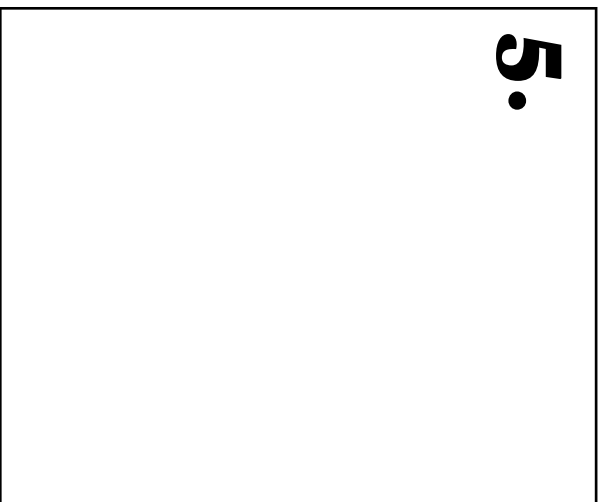
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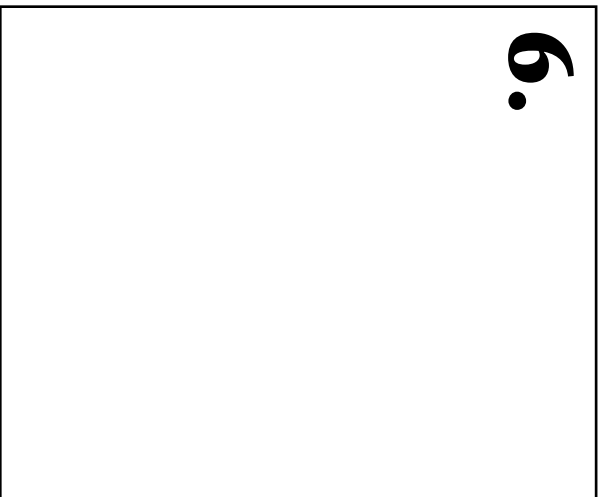
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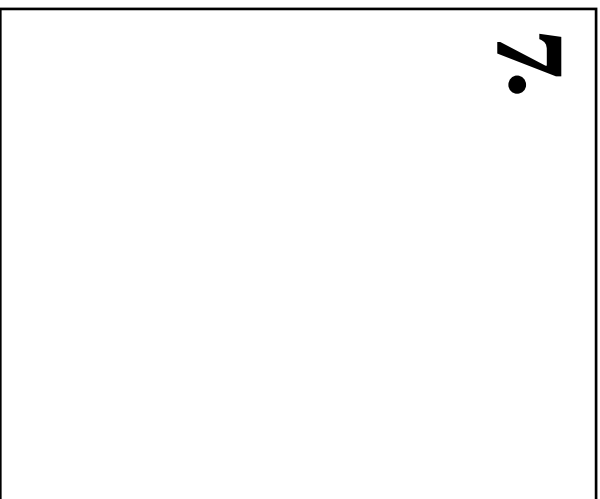
5.



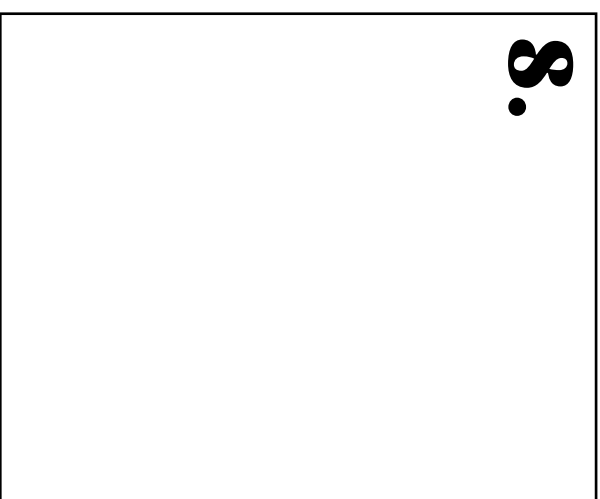
6.



7.



8.



Lifecycle analysis

Name: _____

Class: _____

0

5

Our overall score for the product

Use the evaluation web to help you evaluate your design and/or final product against the design criteria you set for your product.

Write your design criteria in the boxes around the edge of the web. As a team, discuss how well your product performed against each criteria and give your product a rating of 0-5 (0 is poor and 5 is excellent). Mark your score on the web for each criteria including a final overall score. When completed, draw a line to join up the x's.

What pleased you most about your product?

What improvements would you made if you did it again?

Plastics to profit

Name:

Class:

In the plastics challenge so far, you've focused on developing your new product. Now, it's time to start thinking about how to market and sell the product.

Earlier in the challenge you've learnt about the 4R's (Rethink, Reduce, Reuse and Recycle), but when it comes to marketing products, you need to think about the 4 P's (Product, Place, Price and Promotion).

Use the questions below to help your group think through and plan your marketing strategy.

Product

means the thing you have made

- What will you call it?
- Will it be branded with a certain identity?
- How will it stand out from other products?

Placement

means where the product is available to customers

- Where will customers be able to buy your product?
- Where is the best place to sell your product?
- What do you need to organise to sell your product?
- Where are your competitors selling?

Price

means how much customers pay for the product

- What will customers be prepared to pay for the product?
- Should there be discounts for multiple purchases?
- How does the price compare with the similar products?
- Are all the costs of your materials and time covered?

Promotion

means how customers are informed about the product

- How will you advertise your product? e.g.in press, social media, noticeboards, school newsletter, posters?
- When is the right time to promote your product?
- How do your competitors promote their products?

When you've thought through your ideas, work as a team to develop your marketing and for selling plans your product.

Don't forget to decide what you are going to do with the profits you make!

