













MYSTERY PLASTICS

Some plastic items do not have a symbol on them, so they have to be tested to see if they can be recycled.

The results of four plastics that have been tested are below.

Use the *Plastic sorting key* to help identify each of the four mystery plastics.



Mystery Plastic 1

- 1 Translucent
- 2 Fairly flexible, easily scratched
- 3 Easily cut with smooth edges
- 4 Floats in water



Mystery Plastic 2

- 1 Translucent
- 2 Fairly stiff and hard. Can be scratched with fingernail
- 3 Easily cut with smooth edges
- 4 Floats in water



Mystery Plastic 3

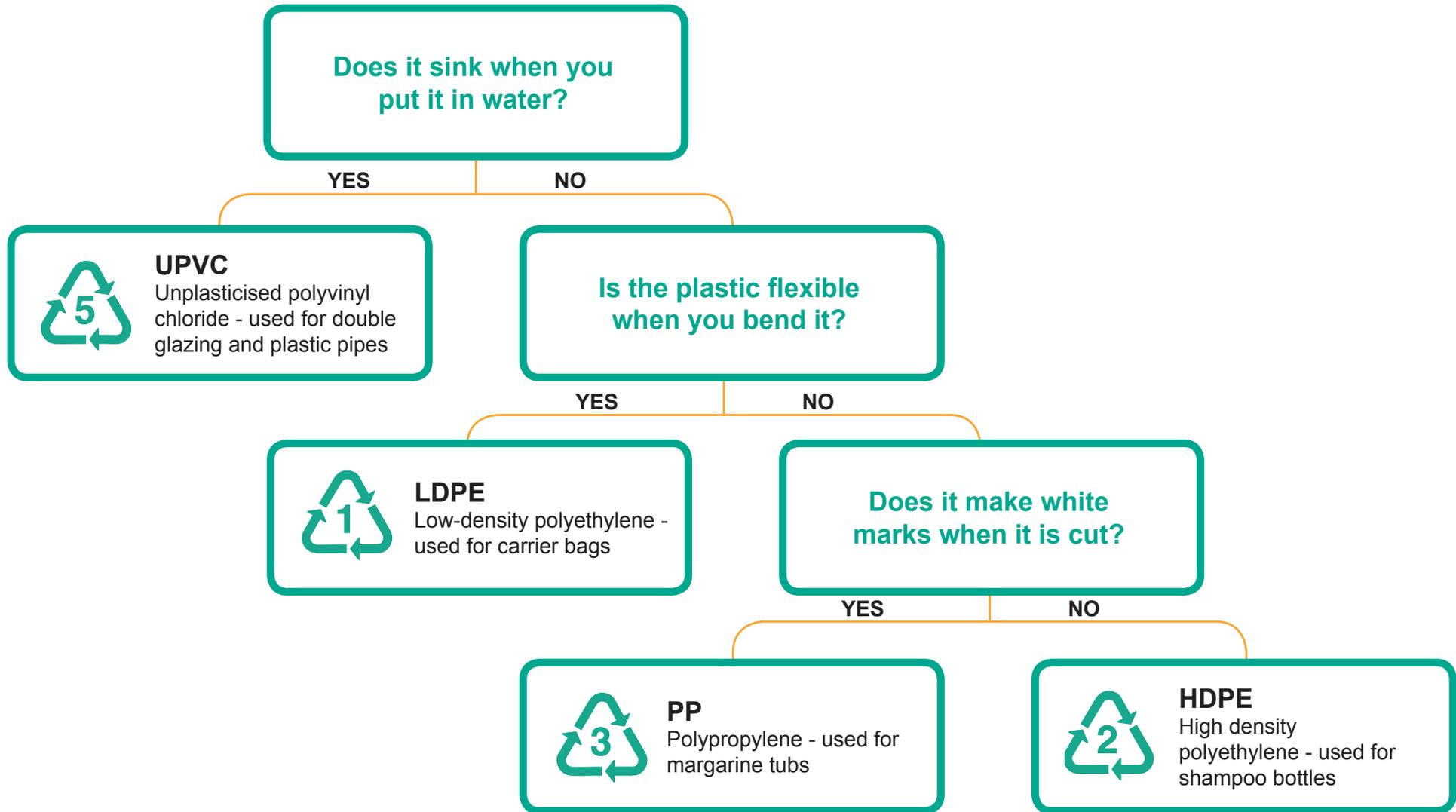
- 1 Translucent
- 2 Stiff, hard can be scratched by a fingernail
- 3 Easily cut but can have white cut marks
- 4 Floats in water



Mystery Plastic 4

- 1 Transparent unless pigment has been added
- 2 Stiff and hard
- 3 Easily cut with smooth edges
- 4 Sinks in water

PLASTIC SORTING KEY



- 1 Look for the symbol moulded on the plastic items and complete the first column in the table.
- 2 Using scissors, cut pieces of plastic approximately 5cm² from each plastic item.
- 3 Carry out the tests and record your results in the table below.

SAMPLE	Is there a symbol moulded on the plastic item? If so draw it below.	What is the full name of the plastic? Use the plastic information chart to help you.	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?
1						
2						
3						
4						

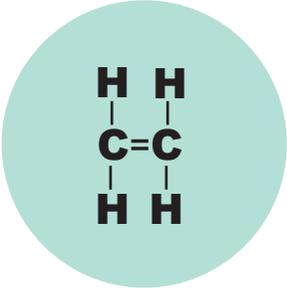
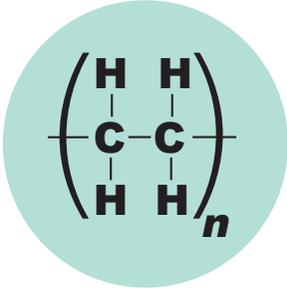
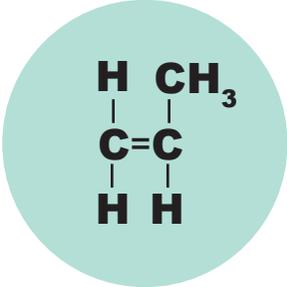
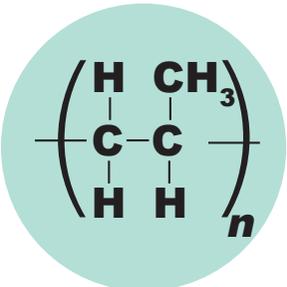
PLASTIC POLYMERS

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.

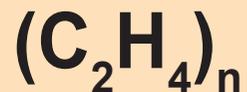
MONOMER	POLYMER
<p>Ethene</p> 	<p>Polyethene</p> 
<p>Propene</p> 	<p>Polypropene</p> 

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

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

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

Chemical formula



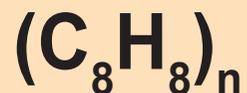
Chemical formula



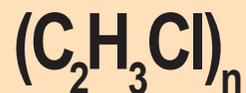
Chemical formula



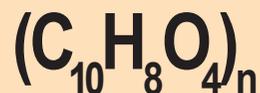
Chemical formula



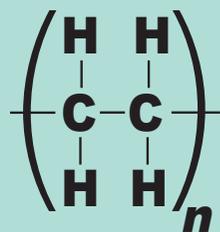
Chemical formula



Chemical formula

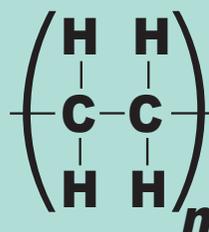


Molecular structure



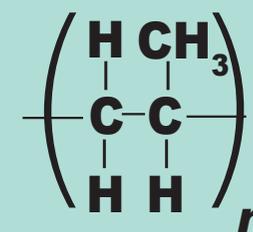
Branching structure

Molecular structure

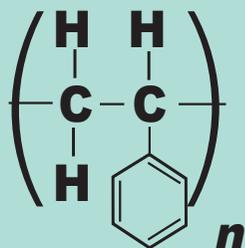


Non-branching structure

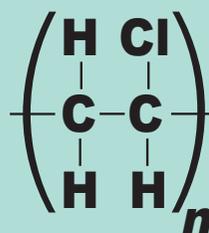
Molecular structure



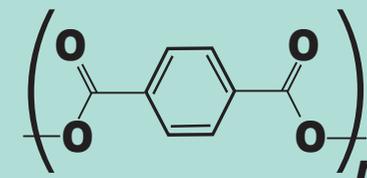
Molecular structure



Molecular structure



Molecular structure



Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polypropylene
Polypropene

Compound name

Polystyrene
(general purpose)
Poly(1-phenyl-ethylene)
(general purpose)

Compound name

Polyethylene
Polyethene
Polythene

Compound name

Polyethylene
terephthalate
Poly(ethylene
terephthalate)



<p>Type of Plastic (LDPE) Low density polyethylene</p> 	<p>Type of Plastic (HDPE) High density polyethylene</p> 	<p>Type of Plastic (PP) Polypropylene</p> 
<p>Type of Plastic (GPPS) General purpose polystyrene</p> 	<p>Type of Plastic (PVC) Polyvinyl chloride (uPVC) unplasticised polyvinyl chloride</p> 	<p>Type of Plastic (PET) Polyethylene terephthalate</p> 



Recycle Code



Recycle Code



Recycle Code



Recycle Code



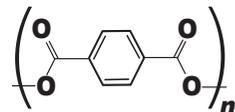
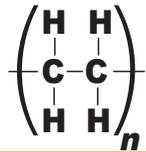
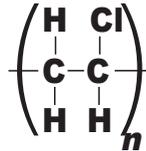
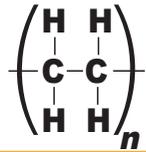
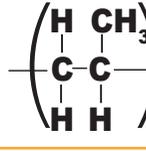
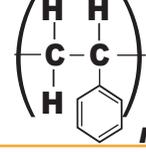
Recycle Code



Recycle Code





Symbol	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)	$(C_8H_8)_n$	

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



Teabag



Plastic bottle



Bio plastic carrier bag



Apple core



Magazine



Banana skin



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



<p>Oil is extracted</p>	<p>Barrel of oil</p>	<p>Oil made into pellets</p>	<p>Recycling bin</p>
<p>Pellets melted to form plastic bottles and lids</p>	<p>Bottles filled with water</p>	<p>Bottles wrapped with plastic label</p>	<p>Shop</p>
<p>Bottles transported to shops</p>	<p>Used bottles</p>	<p>Landfill</p>	<p>Bin</p>

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.

6. End of life: How can it be disposed of or recycled?

5. Use: How is it used?

1. Raw materials and extraction: Which raw materials are used to make the product?

PRODUCT:

4. Packaging and distribution: How is the product packaged and distributed throughout its lifecycle?

2. Production: How is the material used in the product made?

3. Manufacture: How is the product made?

Add one of the 4Rs **Rethink, Reduce, Reuse, Recycle** to match their definition.

means

looking at the whole system for the product and exploring ways to improve it that considers people and the environment.

means

reprocessing the product or some of its parts to make something else.

means

using the whole product or some of its parts to make something else.

means

cutting down the amount of energy and/or materials used to make the product.

Cut out the cards and place them on your completed lifecycle analysis sheet in the areas where you think recycling plastics, rather than making 'new' plastics could reduce the impact on the environment. You might need more than one copy of the cards.



Reduces the need for non-renewable fossil fuels (oil)



Reduces the use of energy used by 90%



Reduces the use of water



Reduces the amount of plastic waste going to landfill



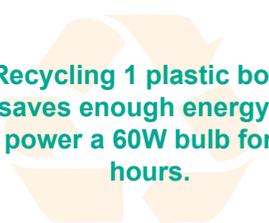
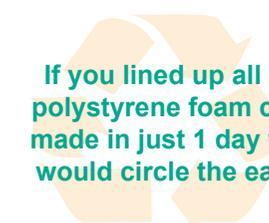
Reduces the emission of gases like carbon dioxide into the atmosphere



Reduces the cost of producing bottles

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



 <p>Recycling 1 plastic bottle saves enough energy to power a 60W bulb for 3 hours.</p>	 <p>Fleece fabric can be made from recycled plastic.</p>	 <p>75% of plastic waste in the UK is sent to landfill.</p>	 <p>If you lined up all the polystyrene foam cups made in just 1 day they would circle the earth.</p>
 <p>Most households in the UK throw away about 40kg of plastic per year, which could otherwise be recycled.</p>	 <p>Recycling a plastic bottle saves 90% of the energy taken to produce a new one.</p>	 <p>We can't recycle some plastics in the UK yet...so some are shipped abroad for recycling.</p>	 <p>1.8 tonnes of oil are saved for every tonne of recycled polythene produced.</p>
 <p>17 billion plastic carrier bags are given away by supermarkets in the UK every year - That's 290 bags per person!</p>	 <p>94% of UK local authorities now offer collection facilities for plastic bottles either through your household recycling collection or at recycling centres.</p>	 <p>Plastic can take up to 1,000 years to decompose.</p>	 <p>The UK currently recycles approximately 24% of plastic while Germany recycles 44%.</p>

Check out the following websites to see which facts are true or false or ask your teacher for the answers.

recycling-guide.org.uk/facts

recyclenow.com/facts-figures/how-it-recycled/plastic-bottles

ecoforce.co.uk/green-facts

MAKING BIO PLASTICS

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 pastry cutter and left to dry. Drying takes about 4-5 days.

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

Oil based plastic	Questions	Bio plastic
	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 pickers' were trained and supported by Practical Action in making crafts from 'waste' plastic. Their enterprise allows them to work in a safer environment whilst earning money.

Your challenge is to design 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 still 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.

For more information bit.ly/practicalaction-nepal

YOUNG ENTERPRISE



CONTEXT

Your newly set-up young enterprise company have decided to take on 'The Fiver Challenge' which aims to create a mini business idea 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
- Engage with the community either in the creation of the product or its final use

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

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.

CHARITY



CONTEXT

The charity Practical Action are looking to broaden awareness of the work they do so want you to design a product that could be sold online at Practical Presents.

They would like the design to have a strong sustainability message so would like you to use plastic 'waste' that is easily available. The product should be cheap to make but safe to use and have a high quality finish.

Your prototype can be handmade but you will need to consider how it could be produced on a large scale.

You will need to consider the target market, the charity branding and also what will happen to any profits made.

For more information practicalaction.org/buy-a-practical-present-1

WHO IS MY PRODUCT AIMED AT?

Before starting to develop ideas for your product, it's important for you to decide **who** you are developing your product for.

- Have a look at the four profiles of different groups of people, and decide whether you would like to select one of these or develop a new target group.
- Once you've chosen a group, you can begin to mind map and research ideas for products that meet your users' needs.



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:
£50 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:
Pension £30 per week after expenses



MUMS

AGE:
30-50

LIKES:
Socialising with other mums
Family gatherings
Running/Cycling
Online shopping
Decorative/ Elegant products
Reliable/ Child-safe products
Relaxing music
Nutritious food
Lifestyle magazines
Eco-friendly/ Sustainable products

SPENDABLE INCOME:
£40 per week after expenses

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

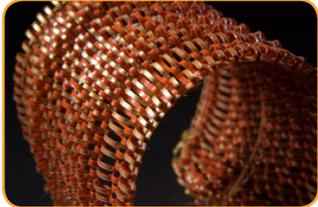
- Experiment with cutting plastic bags into a range of shapes or plaiting plastic strips before heating them with an iron or heat press to form a new plastic material.
- If you are using an iron, make sure you use baking paper on both sides of the plastics and set the iron on a medium heat.
- If you are using a heat press, experiment with heat settings of around 130°C for 10seconds.



WHAT CAN I DO WITH PLASTICS?

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.



Links to designers who reuse plastics

The Meta picture bit.ly/reuse-plastic-ideas

Jessica Perry bit.ly/reuse-plastic-jessica-perry

Sandra Guerreiro bit.ly/reuse-plastics-sandra-guerreiro

Florie Salnot bit.ly/reuse-plastics-florie-salnot

MAKING A NOTEBOOK

How to make 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

How to make plastic bunting

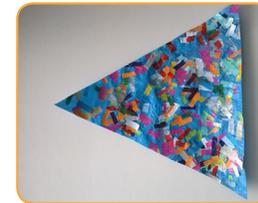


YOU WILL NEED

- 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 title

Outline your project title. Make sure you include:

What you are planning to design and make?

Who you are designing and making for

Why you are designing and making the product (its purpose).

Design criteria

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

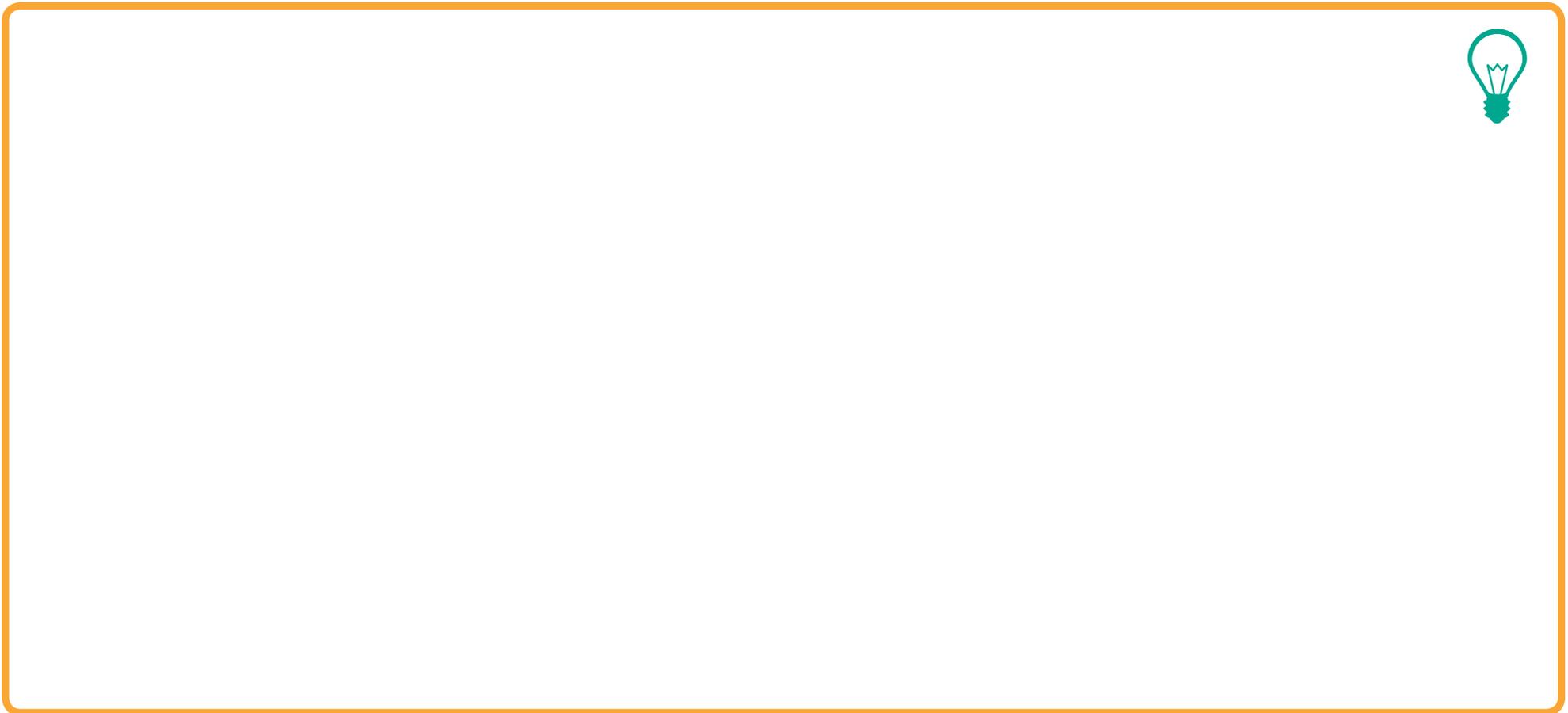
Make sure you include ideas that reflect **who** you are designing for and **why** you are designing the product.

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

Our product will...

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.

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



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.

1

2

3

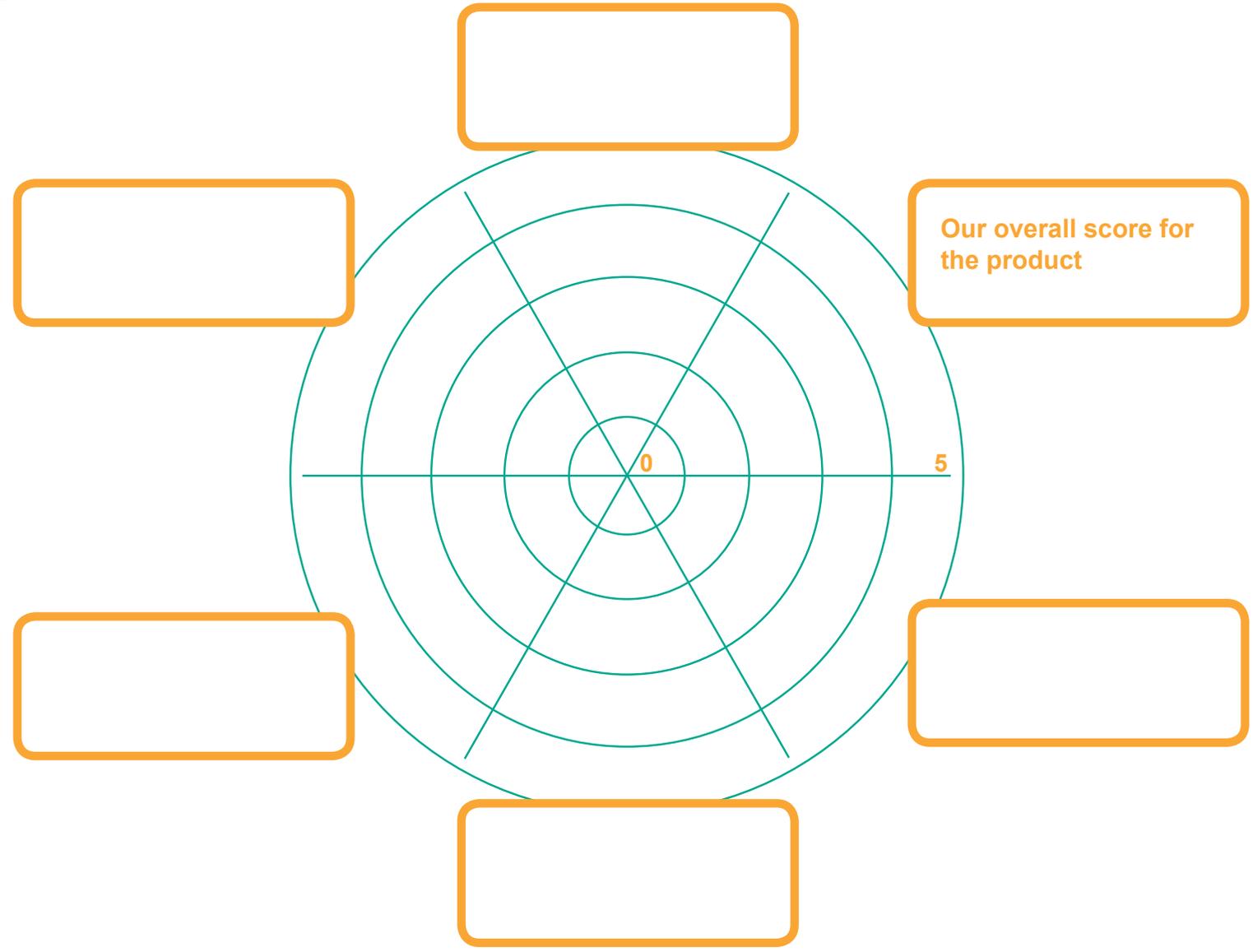
4

5

6

7

8



- Use the evaluation web below 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

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!