

An exciting new STEM challenge for pupils to develop solutions to the problems caused by plastic waste globally.



The challenge can be used flexibly as part of the formal science or design and technology curriculum in the UK, or to run a STEM club or curriculum enrichment day.

The challenge offers opportunities for pupils aged 8-14 years to engage with:

- ♻️ **Practical science investigations** – including identifying plastic, exploring their chemistry and making bio plastic
- ♻️ **Scientific enquiry** – enabling exploration on the impact and efficacy of reuse and recycling plastic
- ♻️ **Enterprise** – encouraging the designing and making of products from waste plastics for a UK or international market
- ♻️ **A video competition** – enabling them to share their experience of the challenge
- ♻️ **A CREST Discovery Award**

To run the challenge we recommend that you carry out:

- ♻️ **The starter activity** – What do you see? (page 3)
- ♻️ One or more of the **Investigating Plastics activities** (pages 4-12)
- ♻️ A selection of the **Designing and Making activities** (pages 13-21)
- ♻️ **The plenary activity** – Belief circles (page 21)

The challenge overview overleaf gives a breakdown of each of the starter and main activities, their approximate timings and the pupil sheets needed.

The notes that follow offer fuller guidance on how to run each of the practical investigations and the designing and making for enterprise activities presented in the challenge.

⬇️ All of the materials needed to deliver the challenge, including the pupil activity sheets, PowerPoint presentation and poster are freely available to download at practicalaction.org/plastics-challenge

PLASTICS CHALLENGE OVERVIEW

STARTER ACTIVITY	TIME (MINS)	PUPIL SHEETS NEEDED
 What do you see? An activity with photographs	15	<i>What do you see?</i> - 2 photographs per small group
INVESTIGATING PLASTICS ACTIVITIES	TIME (MINS)	PUPIL SHEETS NEEDED
1 Identifying plastics Comparing the properties of plastics through testing	30	<i>Identifying plastics</i> – 1 sheet per pupil <i>Plastic information chart</i> – 1 chart per small group
2 Mystery plastics Using a key to compare plastics on the basis of their properties	15	<i>Mystery plastics</i> – 1 sheet per pair <i>Plastic sorting key</i> - 1 sheet per pair
3 Chemistry of plastics Looking at the chemistry underlying how plastics are made	20	<i>Plastic polymers</i> - 1 per pair <i>Chemistry of plastic</i> - 1 per small group <i>Plastic information chart</i> - 1 per small group
4 Waste timeline Investigating which materials take the longest to decompose	15	<i>Waste timeline sheet</i> -1 per pair
5 Lifecycle of a plastic drinks bottle Looking at the impact of plastics on the environment	30	<i>Lifecycle analysis picture cards</i> – 1 per small group <i>Lifecycle analysis activity</i> copied to A3 size – 1 per small group
6 4R's (Rethink, Reduce, Reuse, Recycle) Exploring the efficacy of the 4R's to reduce the environmental impact of plastics	20	<i>Pupils completed Life Cycle Analysis</i> of a plastic bottle sheets <i>4R's definition sheet</i> - 1 per pupil
7 Is recycling worth it? An exploration into the efficacy of recycling plastic	25	<i>Environmental impact of plastic</i> - 1 per small group <i>Plastic recycling: True or False</i> - 1 per small group
8 Bio plastics Making plastic in the classroom	50	<i>Making bio plastic</i> - 1 per group <i>Graphic organiser</i> - 1 per pupil
DESIGNING AND MAKING FOR ENTERPRISE ACTIVITIES	TIME (MINS)	PUPIL SHEETS NEEDED
1 Design contexts Introducing three design contexts	15	<i>Design contexts</i>
2 Who is my product aimed at? An activity to enable pupils to think about users' needs and wants	25	<i>Who is my product aimed at?</i> – 1 per small group <i>Product outline and design criteria</i> – 1 per pupil
3 What's the specification? Ideas for design criteria Helping pupils to choose and develop criteria	20	<i>What's the specification? Ideas for design criteria</i> - 1 per small group
4 What can I do with plastics? Exploring a range of focused tasks with plastics	30-120	<i>What can I do with plastics? Making a notebook, Making bunting</i> - 1 per small group
5 Learning from other designers and makers A research opportunity	20-60	<i>What can I do with plastics?</i>
6 Designing, making and evaluating Opportunities to develop new products in teams	60-120	<i>Product design</i> (including <i>Design ideas</i> , <i>Final design</i> , <i>Product plan</i> and <i>Product evaluation</i>) – 1 per pupil
7 Plastics to profits... Using the 4P's (Product, Price, Promotion and Placement) to help pupils' plan their marketing and selling strategy	40	<i>Plastics to profit</i> – 1 per small group
PLENARY	TIME (MINS)	ACTIVITY SHEETS NEEDED
 Belief circles An activity for pupils to reflect on their learning	20	<i>Belief statements</i> - 1 per class

STARTER ACTIVITY

WHAT DO YOU SEE?

You will need:

- ✓ Flipchart paper /sticky note pads

Pupil sheet

- ✓ **What do you see?**
2 photographs per small group

Instructions

- ♻️ Use the **What do you see?** photographs to introduce the context of global waste and to enable pupils to start identifying some problems and questions which the photographs raise for them.
- ♻️ We suggest organising the class into small groups and giving each group two photographs, one from a European context and one from Nepal.
- ♻️ Ask the pupils to spend a few minutes looking at the photographs and to think about the following:
 - What do you see?
 - What does it make you think about?
 - Are there any problems that you can identify?
 - What questions do the photographs raise for you?

- ♻️ You may wish to ask the pupils to record their responses on flip chart paper or sticky notes.
- ♻️ Ask for feedback on their responses and develop a list of the problems that they identified and any questions that the photographs raised for them.
- ♻️ Now ask the pupils to look at the list of problems and to develop ideas for solutions to the problems.
- ♻️ Enable pupils to feedback on some of their ideas.
- ♻️ Use the PowerPoint slides 2-4 to provide information about the photographs and plastic waste issues more specifically in UK and in Kathmandu, Nepal.
- ♻️ Share with the pupils that they'll be learning more about the waste collectors from Nepal throughout the project.



INVESTIGATING PLASTICS

Investigating plastics offers a selection of practical investigations and activities designed to extend pupils' knowledge and understanding of plastics. The investigations vary in length and complexity, so we suggest you select the most appropriate investigations for your pupils from the selection below.

- 1 Identifying plastics**
Comparing the properties of plastics through testing.
- 2 Mystery plastics**
Using a key to compare plastics on the basis of their properties.
- 3 Chemistry of plastics**
Looking at the chemistry underlying how plastics are made.
- 4 Waste timeline**
Investigating which materials take the longest to decompose.
- 5 Lifecycle of a plastics drinks bottle**
Looking at the impact of plastics on the environment.
- 6 4R's (Rethink, Reduce, Reuse, Recycle)**
Exploring the efficacy of the 4R's to reduce the environmental impact of plastics.
- 7 Is recycling worth it?**
An exploration into the efficacy of recycling plastic.
- 8 Bio plastics**
Making plastic in the classroom, with extension into research comparing oil-based and bio plastics and their environmental impact.



1 IDENTIFYING PLASTICS

There are many types of plastic and each one has slightly different properties, which make them suitable for a range of different uses. The Plastic sorters in Nepal sort out huge volumes of plastics very quickly by hand. This activity asks pupils to sort and investigate the different properties of a range of plastics.

You will need:

- ✓ One refuse bag per group of four pupils - containing a variety of different waste plastic items
- ✓ Tanks/Bowls of water
- ✓ Scissors
- ✓ Torches

Pupil sheets

- ✓ **Identifying Plastics** – 1 sheet per pupil
- ✓ **Plastic information chart** – 1 chart per group

Instructions

- ♻️ Use PowerPoint slide 5 to introduce how in Nepal, Sayeed and Sunil are sorting plastics by hand into different types.
- ♻️ Organise the class so that the pupils are working in small groups. Give each group a bag of different plastics items and an **Identifying plastics worksheet** per pupil.
- ♻️ Ask the group to sort the plastics into a way that they think is most likely to generate the most income from a plastic scrap dealer. You might choose to use PowerPoint slide 6 to explain the activity.
- ♻️ After a few minutes ask pupils to feedback on their reasons for sorting the plastics the way they have.
- ♻️ Ask pupils to spot the moulded symbol on at least four plastic objects and record them on their worksheet.
- ♻️ Using the **Plastic information chart**, ask the pupils to identify the name of the plastic and record on their worksheet.

- ♻️ Ask pupils to cut samples (approximately 5cm²) from the four plastic objects for testing. Pupils may need to be shown how cut the plastics safely.
- ♻️ Discuss with your pupils the various tests they are to carry out and check their understanding of the scientific vocabulary e.g. transparent/translucent/opaque/flexible/stiff/hard, etc.
- ♻️ For the scratch test you may want to show them how to use the end of a pair scissors safely.
- ♻️ Ask pupils to work through the comparative tests and record their observations on the table.
- ♻️ Discuss their findings.
- ♻️ You may to introduce how in real-life whether sorting plastic by hand or mechanically, plastics tend to be sorted by the polymer they are made from to maximise potential for reuse or recycling.

Extension activities

- 💡 To extend pupils learning, ask them to create their own set of comparative tests and ways of recording. They can be encouraged to think about similarities and differences amongst the different types of plastics and then attempt to organise the plastics into Carroll diagrams e.g.:

	Opaque	Not opaque
Float		
Not float		

2 MYSTERY PLASTICS

Sometimes plastics aren't marked and it is hard to tell what they are. The only way to sort them is according to their properties. This activity helps pupils to use a key to identify the mystery plastics.

You will need:

Pupil sheets

- ✓ **Mystery plastics** – 1 sheet per pair
- ✓ **Plastic sorting key** – 1 sheet per pair

Instructions

- 🔄 Organise the class to work in pairs and hand out the **Mystery plastics** sheet and **Plastic sorting key**.
- 🔄 Ask the pupils to look at the **Mystery plastics sheet**. Check the pupils understanding of the scientific vocabulary used in the key e.g. transparent/translucent, etc.
- 🔄 Ask the pupils to use the **Plastic sorting** key to identify each of the mystery plastic sheet.
- 🔄 Discuss their findings. The answers are
1: Low density polyethylene (LDPE),
2: High density polyethylene (HDPE),
3: Polypropylene (PP),
4: Un-plasticised polyvinyl chloride (UPVC).
- 🔄 As in the Identifying plastics investigation, you may want to tell the pupils how in real-life, whether sorting plastic by hand or mechanically, plastics tend to be sorted by the polymer they are made from to maximise potential for reuse or recycling.
- 🔄 You might want to show a short video clip of plastics being sorted before recycling. Plastic bottles – how they are recycled
bit.ly/recycling-plastic-bottles

Extension ideas

Ask the pupils to develop their own keys based on the four tests below or develop their own comparative tests.

- 1 Is it translucent, transparent or opaque?
- 2 What happens when you bend it? Is it flexible? Is it stiff and difficult to bend? Is it easy to scratch?
- 3 What happens when you cut it? Does it cut cleanly or are there white marks along the cut?
- 4 Does it float in water?



3 CHEMISTRY OF PLASTICS

This activity introduces pupils to the chemistry behind the plastics we use in everyday life. It helps pupils to make the link between familiar products and their atomic structure and molecular formulae. It makes a good follow on, or extension activity to Activity 1. Identifying Plastics.

You will need:

- ✓ Selection of plastic products (optional)
- ✓ Scissors

Pupil sheets

- ✓ **Plastic polymers** - 1 per pair
- ✓ **Chemistry of plastics** – 1 per small group
- ✓ **Plastic information chart** - 1 per small group

Instructions

- ♻️ You might choose to start with a selection of plastic products and ask pupils to categorise them into different plastics types.
- ♻️ Build upon pupils' knowledge that different plastics have different properties and introduce the **Plastics Polymers** sheet to explain or recap on polymerisation and explain that plastics are composed of different molecules (called monomers) joined together which gives them different properties.
- ♻️ You may wish to show the pupils a video clip on how different plastics are made. We recommend the 2mins clip, The Plastic revolution bit.ly/bbc-bitesize-plastic.

- ♻️ Now, organise the class into small groups and hand out a set of the **Chemistry of plastics** sheets per group. Ask the pupils to match each of the six plastics with their relevant cards.
- ♻️ Pupils can check their results by looking at the **Plastic information chart**.
- ♻️ Review their findings.

Extension activity

- 💡 Find out about the different job roles of scientists and chemical engineers who are involved in developing plastics.



Description **Classroom Ideas**
Mark Modowanik explores the history of plastics. He explains how the hydrocarbon waste products from oil refineries were first used to make nylon, PVC, polystyrene and polyester. He describes hydrocarbons as polymers and uses a paperclip chain as an analogy.
This clip is from **Materials: How They Work**
First broadcast: 11 May 2012

4 WASTE TIMELINE

This activity enables pupils to gain awareness that different materials take different times to decompose and therefore have varying impacts on the environment.

You will need:

- ✓ A selection of the items from the **Waste timeline** sheet e.g. teabag, plastic bottle (optional)
- ✓ Scissors

Pupil sheet

- ✓ **Waste timeline sheet** -1 per pair

Instructions

- ♻️ Divide class into pairs.
- ♻️ Give each pair the **Waste timeline sheet** (or set of cards if cut out beforehand).
- ♻️ Introduce the activity by asking pupils what they think happens to various items on their cards once people have finished with them. Suggest to the pupils that if the items were thrown away in a 'normal' bin (rather than recycled or composted) the mixture of items would end up in a landfill site or rubbish tip.
- ♻️ Check pupils understanding of the term 'decompose' then ask them to place their cards from fastest to slowest material to decompose on the table in front of them. You may wish to use the PowerPoint slide 7 to show a timeline.
- ♻️ Discuss the pupils' timelines. Ask them why some materials decompose before the others.
- ♻️ Show the PowerPoint slide 8 for pupils to check the order of their cards.
- ♻️ Ask pupils for their ideas of the approximate timings that it takes for the items to decompose, then reveal the answers using the PowerPoint slide 9 or read them out from the information above.
- ♻️ You may wish to have a plenary session where you ask the pupils if they think it's a problem that some things, particularly plastics and electrical goods take years to decompose. What might the solutions be?

Approximate time taken for items to decompose.

Teabag	1 Month
Banana Peel	6 weeks
Apple core	2 months
Woollen sock	1 year
Plastic bag	20 years
Magazines	50 years
Plastic bottle	450 years
Mobile phone	1000 years

Extension ideas

- 💡 Composting investigation – Allow pupils to bury a selection of materials in a marked area of soil. Dig them up every fortnight and observe the changes. Which materials take the longest to decompose?

5 LIFECYCLE OF A PLASTIC DRINKS BOTTLE

The Lifecycle of a plastic drinks bottle activity helps pupils understand the environmental impact of the bottle at different stages of its lifecycle.

The activity can also be extended to enable pupils to identify opportunities within the product lifecycle for designers, engineers and scientists to reduce environmental impact.

You will need:

- ✓ **A plastic drinks bottle** -1 for each group of 4 pupils

Pupil sheets

- ✓ **Lifecycle analysis picture cards** – 1 per small group
- ✓ **Lifecycle analysis sheet** (copied to A3 size) – 1 per small group

Instructions

- ♻️ You might want to start this activity by asking how many plastic drinks bottles the pupils use in an average day or week and whether they reuse them.
- ♻️ Hand out a drinks bottle and set of **Lifecycle analysis picture cards** to each group. Allow a few minutes for the pupils to arrange the cards in a way that tells the story of the drinks bottle from beginning to end. Ask for feedback on their story line.
- ♻️ Show the 1min info graphic bit.ly/lifecycle-plastic-bottle to show how most plastic bottles are made and processed to check whether they have their story line correct.
- ♻️ Using the PowerPoint slide 10 to introduce the concept of **Lifecycle Analysis** (LCA) and the stages that many companies use to calculate the environmental impact of their products.
- ♻️ Give each group a copy of an A3 LCA sheet and ask them in groups to discuss the questions and write their answers on the sheet.
- ♻️ Once the pupils have completed their questions, you can introduce the idea that LCA can be used to identify where in the lifecycle they think the bottle has the biggest impact on the environment.
- ♻️ Ask the pupils for their ideas of ways to reduce the environmental impact. They might include, using different materials, thinner plastic, encouraging more people to recycle bottles, etc.
- ♻️ The 4R's activity makes an excellent follow on to the LCA.

6 4R'S: RETHINK, REDUCE, REUSE AND RECYCLE

This activity enables pupils to explore the opportunities for rethinking, reducing, reusing and recycling plastics to reduce their negative impacts on the environment and people.

N.B: Pupils will have needed to have completed Activity 5. Lifecycle of a plastic drinks bottle before carrying out this activity.

You will need:

Pupil sheets

- ✓ Pupils' completed *Lifecycle analysis sheets*
- ✓ *4R's definition sheet* - 1 per pupil
- ✓ *Plastics Challenge poster* (optional)

Instructions

- ♻️ Firstly, recap on the pupils' learning from the LCA of a plastic bottle activity.
- ♻️ Introduce the idea of the 4R's (Rethink, Reduce, Reuse and Recycle) as a way to help pupils identify opportunities to reduce the environmental impact of a plastic bottle (or alternative product).
- ♻️ Use the *4R's definition sheet* to enable the pupils to work in pairs to sort out a definition for each 'R'. Make sure they are clear about the difference between reuse and recycle in particular.

Depending on your curriculum focus or areas of pupil interest, the 4R's and LCA activity can be continued and extended in a variety of ways. They include the 4Rs activity that follows and activity 7, Is recycling worth it?

Redesign...using the 4R's

- ♻️ Suggest to the pupils that they are to think as *designers* or *consumers* and identify opportunities to reduce the environmental impact of the plastic bottle (or an alternate plastic product such as a plastic bag). The pupils may find it easier to look at opportunities for improvement throughout the product's lifecycle (from sourcing materials to final disposal).

♻️ You may want to suggest that different groups look at one or two of the R's. The pupils can annotate their ideas on the lifecycle sheets or use the poster to capture their ideas. The PowerPoint slide 11 can be used as a prompt for this activity.

♻️ You might want to have a plenary session that enables the pupils to feedback their ideas. If any prompting is needed, these might be useful questions:

RETHINK: Do we need to use plastic bottles at all? What could we use instead? Can we use other raw materials to make plastic?

REDUCE: Can we use thinner plastics to make the bottles?

REUSE: Is it safe to reuse a plastic bottle? What could we do to encourage people to reuse a bottle?

RECYCLE: Can we encourage people to recycle more plastic bottles? Can a bottle be designed in a way to make recycling easier which would improve the *efficacy* of recycling?

7 IS RECYCLING WORTH IT?

This activity enables pupils to learn about the efficacy of recycling plastics

You will need:

Pupil sheets

- ✓ **Environmental impact of plastic sheet** - 1 per small group
- ✓ **Plastic recycling: True or False? sheet** - 1 per small group

Instructions

- ♻️ During the 4Rs activity, the pupils are likely to have suggested that recycling is an option for reducing the environmental impact of plastics. This activity enables the pupils to explore whether recycling plastic makes any real difference to the environment.
- ♻️ You may wish to show the pupils a video clip to increase their understanding of the process of plastic recycling.
Here are a few examples of video clips suitable for schools
Plastic bottles - how they are recycled bit.ly/recycling-plastic-bottles
Nike jersey - bit.ly/nike-recycle-bottles
Plastic bottle to fabric - bit.ly/PET-recycle-fabric
In additional Practical Action's technical brief on recycling plastics also makes an excellent secondary source of information practicalaction.org/technical-briefs-schools-manufacturing.
- ♻️ Hand out the **Environmental impact of plastic** sheet and ask the pupils to cut out the cards. Now ask them to place them on the appropriate parts of their LCA sheet. They will need to think how and where recycling plastics reduces environmental impact in the product lifecycle.
- ♻️ Review their findings.
- ♻️ You might want to back up the information on the cards with the **Plastic recycling: True or False?** card activity that should help to consolidate their learning about plastic recycling. **NB. All of the facts on the cards are true!**

Extension ideas

- 💡 You might want to extend the use of the LCA activity to look at the impact on people affected by the production, use and disposal of the water bottle/plastic products. You can either ask the pupils to use a different colour pen to highlight where on the LCA sheet people are involved and whether the impact is positive or negative or use one of our product evaluation activities that focus on impacts on people.
- 💡 The activity winners and losers practicalaction.org/d-t-starter-activities and [Social sustainability terms practicalaction.org/social-sustainability-terms](http://practicalaction.org/social-sustainability-terms) both provide great ways to enable pupils to look at a product's impact on people.

Homework ideas

- 💡 You might want to set a homework activity that enables pupils to research in more detail the work of designers, scientists and engineers who are developing more sustainable solutions to oil based plastics.

8 BIO PLASTICS

This investigation enables pupils to make bio plastic. You may wish to extend the investigation by enabling your pupils to research into the impact of oil-based and bio plastics on the environment.

You will need:

- ✓ Ingredients and equipment from **Making bio plastic** – 1 set per small group

Pupil sheets

- ✓ **Making bio plastic** – 1 per small group
- ✓ **Graphic organiser** - 1 per pupil

Instructions

- ♻️ Introduce the activity by reminding the pupils that so far they've looked at plastics made from oil.
- ♻️ If you've sourced any items made from bio plastics, you might want the pupils to handle them to see if they can spot any differences between bio and oil based plastics.
- ♻️ Now introduce the practical investigation of making bio plastic. You may choose to demonstrate the practical or allow the pupils to follow the instructions on the **Making bio plastics** sheet. If pupils are making the plastics themselves, raise the necessary safety issues related to heating and handling hot materials.
- ♻️ There are a number of different methods and ingredients for making bio plastic. You may wish to encourage your pupils to experiment with a range of methods.

Working scientifically with bio plastics

- ♻️ You may choose to extend the pupils learning about bio plastics with a research activity. Ask pupils to use the internet to research into oil-based plastics versus bio plastics. Suggest to the pupils that they use the **Graphic organiser** to structure their research and record their findings. Before the pupils get started, you may wish to check pupils understanding of key terms such as renewable/non-renewable, decompose, etc. and discuss search terms before they use the internet.

Useful sites:

- 👉 explainthatstuff.com/bioplastics.html
- 👉 explainthatstuff.com/plastics.html

Following their research, you may wish to ask pupils to do a Positive, Minus, Interesting (PMI) analysis of the two plastic types and then take a class vote on which material they feel, on balance, is best for the environment.

Extension idea

- 💡 Enable pupils to do further research to compare bio plastics with recycled plastic.

This section forms the main *designing and making* part of the challenge, where pupils explore how the reusing of plastic waste offers opportunities to apply their STEM skills to an enterprise challenge.

The challenge works well if pupils are working in small groups of approximately four pupils.

Context: Nepal or the UK?

The increased use of plastics globally is creating a huge environmental challenge for both industrialised and developing countries. Within this project, pupils are offered a choice of three contexts from within Nepal and the UK, all offering opportunities for addressing this global challenge.

The following activities have been developed to help pupils develop high quality ideas and products for their chosen context and user.

- 1 Design contexts**
Introducing the three design contexts.
- 2 Who is my product aimed at?**
An activity to enable pupils to think about users' needs and wants.
- 3 What's the specification? Ideas for design criteria:** Helping pupils to choose and develop criteria.
- 4 What can I do with plastics?**
Exploring a range of focused tasks with plastics.
- 5 Learning from other designers and makers**
A research opportunity.
- 6 Designing, making and evaluating**
Opportunities to develop new products in teams.
- 7 Plastics to profits**
Using the 4P's (Product, Price, Promotion and Placement) to help pupils plan their marketing and selling strategy.
- 8 Belief statements**
A plenary activity to enable pupils to reflect on their views of the roles and responsibilities of designers and scientists.



1 DESIGN CONTEXTS

This activity enables the pupils to select and think about the context for their project. The options are either a Women's enterprise based in Nepal or a UK based charity or enterprise.

You will need:

Pupil sheet

- ✓ *Design contexts*

Instructions

- ♻️ Depending on whether you have pre-selected a design context or whether you are leaving the pupils to decide will influence whether you hand out one, two or three of the design contexts from the **Design contexts** sheet. You might want to use the PowerPoint slides 12-15 to introduce the contexts.
- ♻️ Allow pupils time to discuss the context and any ideas or questions they may have at this stage.
- ♻️ The Nepalese Women's group and Practical Action's context both have web links that pupils could explore.



2 WHO IS MY PRODUCT AIMED AT?

This activity helps the pupils understand the importance of defining who they are aiming the product at, so that it meets the needs of the intended group.

You will need:

Pupil sheets

- ✓ **Who is my product aimed at?** – 1 per small group
- ✓ **Product outline and design criteria** - 1 per pupil

Instructions

- ♻️ Recap on the pupils' choice of project context and introduce the idea that the next stage of their project is to decide **Who** they are developing their product for.
- ♻️ Hand out the **Who is my product aimed at?** sheet and ask the pupils to discuss and decide who they feel they would like to develop their product for.
- ♻️ If they are not sure that any of the profiles suit their context, ask the pupils to develop a profile for a group of their choice.
- ♻️ If the pupils have selected a user group ask them to mind map their ideas to questions such as;
 - What might your customer want from the product?
 - What features does it have to meet these needs?
- ♻️ Suggest that pupils might follow up these ideas by researching into existing products for their user group.
- ♻️ Hand out the **Product outline and design criteria** sheet and ask pupils to complete their product outline.

3 WHAT'S THE SPECIFICATION? IDEAS FOR DESIGN CRITERIA

This activity helps the pupils to consider a wide range of design criteria and to select or develop the most appropriate criteria for their products.

You will need:

- ✓ Scissors

Pupil sheet

- ✓ **What's the specification? Ideas for design criteria** - 1 per small group

Instructions

- 🔄 Hand out the **What's the specification? Ideas for design criteria sheet** to each small group of pupils and ask them to cut out the cards.
- 🔄 Remind the pupils of the client and the intended user that they have chosen and ask the pupils to discuss and decide in their groups which are the most important criteria for their product.
- 🔄 We suggest you encourage them to select 4-5 criteria.
- 🔄 Ask the pupils to record their design criteria on their sheet.

4 WHAT CAN I DO WITH PLASTICS?

The focused tasks provide some ideas for pupils to learn techniques for reusing plastics, including cutting, knitting and fusing plastics. In addition two ideas of making a notebook and bunting have been developed with step by step guidance.

You will need:

- ✓ A selection of plastic bags/plastic containers
- ✓ Scissors
- ✓ Iron/heatpress
- ✓ Shape cutters – suited to jewellery
- ✓ Double sided sticky tape
- ✓ PVA glue
- ✓ Rulers
- ✓ Card (from cereal boxes)
- ✓ Hole punch

Pupil sheets

- ✓ **What can I do with plastics?** – 1 per small group
- ✓ **Making a notebook** – 1 per small group
- ✓ **Making bunting** – 1 per small group

Instructions

- ♻️ Decide on the focused tasks you would like to run with your pupils and carry out a range of the suggested activities as described on the pupil sheets **What can I do with plastics?**, **Making a notebook** and **Making bunting**.
- ♻️ Ask pupils to keep their work samples, so that they can include them at a later stage on their design sheets.

♻️ You might want to show your pupils a 3 minute video clip highlighting the techniques and products developed by the women's group in Nepal.

How to make a coaster out of plastic bags
bit.ly/youtube-plastic-bag-coaster

How to make a purse from plastic bags
bit.ly/youtube-plastic-bag-purse

♻️ Here are a few additional sites that are useful for teachers as they show a variety of techniques for reusing plastics.

Friendship bracelet practicalaction.org/friendship-bracelet-activity

Bottle vase bit.ly/youtube-reuse-plastic-bottle

Reusing plastic bags: fusing using an iron bit.ly/youtube-fuse-plastic-bags

Cutting plastic bags for weaving bit.ly/plastic-bags-weaving

Knitting with plastic bags bit.ly/plastic-bags-knitting

5 LEARNING FROM OTHER DESIGNERS AND MAKERS

This research activity will enable pupils to get inspiration for their products from a range of inspirational designers and makers.

You will need:

- ✓ Internet access for pupils
- ✓ Products made from 'waste' plastics e.g: jewellery, containers (optional)

Pupil sheet

- ✓ **What can I do with plastics?**

Instructions

- ♻️ Introduce the pupils to the range of products that you've sourced and ask them to discuss and make notes about the features that they like about the products.
- ♻️ Either for homework or in school, ask the pupils to carry out some research into products and designers who reuse 'waste' plastics in their work. You might want to use the list of designers from the useful websites list or ask them to find their own. The pupils can find this list on the pupils activity sheet **Ideas with plastics**.

Useful websites

- 🖱️ 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

6 DESIGNING, MAKING AND EVALUATING

You will need:

Pupil sheet

- ✓ **Product design sheets**
 - **Design ideas**
 - **Final design**
 - **Product plan**
 - **Product evaluation**

Designing

- ♻️ After the pupils have selected their context, decided on who they are designing for and experimented with some techniques with plastics, you might want to ask them to record their design ideas and final design on their **Product design** sheets.
- ♻️ Whether you are planning for the pupils to continue onto the making phase or finish at the design stage you might like to do a **Dragons' Den** type session whereby the pupils in their teams deliver a business pitch for their product idea.

- ♻️ If you do decide to run with this idea and continue onto the making stage, the class could select one or two of the 'best ideas' to run with for a whole class enterprise. Alternately, the pupils could work in teams to develop their products and marketing ideas for their own products.

Making

- ♻️ You might want pupils to develop a prototype of their design idea before embarking on making their final products. We suggest that you encourage pupils to develop a making plan for their product. Their plan, materials and equipment needs can be recorded on the **Product plan** sheet.

Evaluating

- ♻️ We suggest asking pupils to use the evaluation web on the pupil sheet **Product Evaluation** to help pupils evaluate their designs and final product.

7 PLASTICS TO PROFIT

You will need:

Pupil sheet

- ✓ **Plastics to profit sheet** – 1 per small group

Instructions

Depending on the choice of context and the time available for the project overall, some schools may decide to encourage their pupils to continue with the enterprise challenge by marketing and selling the products.

If so, you may wish to give the pupils the **Plastics to profit** sheet to provide some questions to help pupils plan their marketing and selling strategy for their products.

For pupils and schools who would like the income from their enterprise to go back into our charity Practical Action, we have a set of guidance sheet to support pupils and the school to do so. They are available at practicalaction.org/business_enterprise

8 BELIEF CIRCLES

We suggest you leave some time throughout and at the end of the challenge to enable the pupils to reflect on what they have learnt and experienced throughout the challenge. We have developed a Belief Circle activity that enables pupils to reflect on the roles of design, science and technology in addressing the global problems associated with plastics. It can be adapted to use at the end of any of the activities or tasks covered within the challenge.

You will need:

- ✓ **Paper** (approximately 10cm x 6cm) – 1 per pupil
- ✓ **Belief statements**

Instructions

- 🔄 Select 3-4 statements from below, that you feel are most relevant to your pupils and would like to discuss with them. We have left a blank statement card for you to add own statement.
- 🔄 Ask each pupil to write their name on a small piece of paper, approximately 10cm x 6cm.
- 🔄 Organise the class to stand in a large circle.
- 🔄 Place one of the statements below in the middle of the circle – then ask your pupils to place their name cards close to the statement if they agree with it and further away if they don't.
- 🔄 Ask a few pupils to justify why they have put their name card where they have.
- 🔄 Following the discussion allow pupils to change the position of their cards if their views have changed as a result of the class discussion.
- 🔄 Continue with statements until you feel that the pupils have had a good chance to reflect and contribute a range of ideas and beliefs.

STATEMENTS

<p>Designers should be free to design how and what they want, without having to care about the environment.</p>	<p>People should be fined for not recycling the plastic waste from their homes.</p>
<p>Designers should set an example by using recycled materials wherever possible.</p>	<p>It's OK for children to be waste pickers.</p>
<p>Plastic goods manufacturers should take responsibility for how their products affect people and the environment throughout the lifecycle.</p>	<p>It's OK for us in the UK to export plastic waste that we can't recycle to other countries.</p>
<p>Scientists need to develop alternatives to oil based plastics.</p>	



WHAT NEXT? COMPETITION AND CREST AWARD

Make the most of the challenge by entering pupils' project work into:

Practical Action's Plastics Challenge competition:

- ♻️ We will be awarding £250 of vouchers to a primary and secondary winning group/school to spend on Remarkable products made from recycled materials. We will accept entries from primary aged pupils (up to 11years) and secondary aged pupils (up to 14 years).
- ♻️ To enter the competition, your pupils need to send us a **video clip** on the theme **The Plastics Challenge**.
- ♻️ The clip can be up to 2 minutes long and must be produced by the pupils. We'd like to see the plastic products they made for their enterprise and how they made them. Otherwise it's up to the pupils!

The deadline for entries is the 18th December 2015. We are happy to receive your entries via:

- 📍 Youtube and then send us the link to schools@practicalaction.org.uk
- 📍 A filesharing service (eg. Dropbox, WeTransfer or WeSendIt) and send us the link to schools@practicalaction.org.uk
- 📍 Post on a memory stick, addressed to The Plastics Challenge, Education Unit, Practical Action, Bourton on Dunsmore, Rugby CV23 9QZ.

Please make sure you include your school details and pupils names when you send your entries. We will announce the winning entries on our schools website on Friday 15th January 2016.

CREST AWARD

Making the most of the Plastics Challenge with CREST Awards

CREST is a UK award scheme for 11-19 year olds recognising success, building skills and demonstrating personal achievement in STEM (science, technology, engineering and maths) project work:
britishscienceassociation.org/crest

The CREST Discovery Award requires students to complete a minimum of 5 hours work on a single project at a level roughly equivalent to key stage 3. It requires students to do the work themselves, with support from a teacher or mentor. The Plastic Challenge has been accredited as suitable for the award.

How to register your students for CREST Awards

You will need to register your students for the British Science Association's CREST Awards at the beginning of the Practical Action Waste Plastics Challenge. You will be able to find your local co-ordinator here: britishscienceassociation.org/crest-awards/finding-your-crest-local-coordinator-list-view