

## **Material World** A geography/science pack for upper KS2

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## Material World

Welcome to the 'Material World' geography/science pack for upper key stage 2 (KS2)

The pack consists of six lessons which are designed to run consecutively over a half term, or during a focussed topic week, culminating in a day of pupils taking action in their school or community.

'Material World' encourages pupils to explore the resources we find on our planet, how we use them and what we can do to conserve them and live in a more sustainable manner.

## About this pack

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The pack integrates:

- exploration of materials
- geographical investigations and case studies
- deliberation of our 'wants' and 'needs'
- exploration of the ethics of consumerism
- ideas for practical action

We recommend that you use the 'Factsheets for Teachers' section on pages 42 to 47 to familiarise yourself with the key ideas and themes before teaching the contents of the pack.

Each lesson plan also contains a glossary to explain key vocabulary. Supporting resources to the pack can be downloaded from the website <u>zone.recycledevon.org</u>

To kick-start your Material World topic, you can book a class workshop as an introduction delivered by one of Devon County Council's experienced waste educators – email <u>recycle@devon.gov.uk</u> for more information.



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## Why Waste?

As something within their daily experience, waste is a tangible and engaging topic for pupils, and one on which they can take action at home and at school. Upper KS2 children can use their growing understanding of the wider world to explore not only where our waste goes when we throw it in the bin but, even more importantly, where the materials we use every day came from. In doing so, they learn the vital lesson that our lives here in the UK have far-reaching impacts on people and ecosystems in other parts of the world.

Devon is one of the best counties in the UK at recycling and composting: we recycle or compost nearly 55% of the 370,000 tonnes of 'rubbish' produced by households each year. It is essential that our young people grow up with a thoughtful approach to the resources they use, becoming adults who are actively engaged with protecting our local and global environments.

## **Contents of the pack**

The pack contains six geography/science based lessons for KS2 with supporting resources\*

- 1. Material World; an introduction lesson plan, Material World PowerPoint\*, set of 'natural resources' cards, set of 'process' cards
- 2. Plastics lesson plan (1 of 2), Plastics PowerPoint\*, process cards
- 3. Plastics lesson plan (2 of 2), Plastics PowerPoint
- 4. Textiles lesson plan (1 of 2), Textiles PowerPoint\*, process cards
- 5. Textiles lesson plan (2 of 2), Textiles PowerPoint
- 6. Taking action lesson plan

\*Download from zone.recycledevon.org









A session introducing the concept that everyday 'things' are made from natural resources, some of which may be 'finite'. Pupils trace the journey of several objects from the extraction of raw materials, through manufacture and finally to disposal, considering the environmental impacts of each stage.

Lesson takes 1.5 hours.

During this lesson, please encourage pupils to use reusable white boards where possible, to reduce the use of paper. At the end of the lesson you could challenge pupils to explain your reason for doing this, thereby making explicit the link with the theme of the lesson i.e. reducing resource use.

#### **National Curriculum references**

#### Geography:

Geographical skills and fieldwork

- Use maps, atlases, globes and digital/computer mapping to locate countries and describe features studied
- Human and physical geography
- Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water

Locational knowledge

• Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America, concentrating on their environmental regions, key physical and human characteristics, countries, and major cities

#### Children's previous experiences:



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#### Learning objectives:

- 1) I can locate countries on a world map.
- 2) I can identify the natural resources used to make a range of everyday items.
- 3) I can describe some of the impacts on the environment of making everyday objects.
- 4) I can give examples of how people can reduce, reuse and recycle.
- 5) I can identify the difference between a need and a want.





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## Lesson 1: Introduction session, continued

<b>Differentiation:</b> For the 'process cards' activity, the processes with fewer stages may be given to groups with lower ability pupils		Other means of support:
<ul> <li>Resources:</li> <li>6 world maps</li> <li>Ball of string</li> <li>Source sets of clean objects: <ul> <li>6 glass jars/bottles</li> <li>6 plastic bottles</li> <li>6 sheets of newspaper</li> <li>6 aluminium cans</li> <li>6 pieces of cotton fabric</li> </ul> </li> <li>Supporting resource: images of natural resources*</li> <li>Material World PowerPoint*</li> <li>Supporting resource: Set of 'process cards' each for: cotton, aluminium, plastic, paper, glass*</li> </ul>		Health and safety: Ensure that the objects provided to pupils are clean and dry, with no sharp edges. Emphasise the importance of handling glass objects safely.
Organisation	Teacher Activity	Pupil Activity
Organisation Introduction: 20 mins Class seated in groups of 5/6 with jotters/mini whiteboards	<b>Teacher Activity</b> Ask the pupils to make a list of all the things they would 'WANT' if it was their birthday next week and their family had just won the lottery. A 'want' is something we would like to have. When they have made their list, ask pupils to make a second list of things they 'NEED' to live. A need is something we must have for survival – food, air, water, shelter and clothing.	Pupil Activity In pairs, pupils make a list of all the things they would 'want', if they had limitless money. Feedback and add ideas to the board. This is followed by a list of all the things they 'need' to survive.
Organisation Introduction: 20 mins Class seated in groups of 5/6 with jotters/mini whiteboards	Teacher Activity         Ask the pupils to make a list of all the things they would 'WANT' if it was their birthday next week and their family had just won the lottery.         A 'want' is something we would like to have.         When they have made their list, ask pupils to make a second list of things they 'NEED' to live.         A need is something we must have for survival – food, air, water, shelter and clothing.         Class discussion:       Compare the two lists, draw 'need'. Why do we 'want' so many things? E.g.	Pupil Activity In pairs, pupils make a list of all the things they would 'want', if they had limitless money. Feedback and add ideas to the board. This is followed by a list of all the things they 'need' to survive.



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## Lesson 1: Introduction session, continued

Main: 1 hour	<ul><li>Explain to pupils that each material has a story behind it.</li><li>Using steel as an example, trace the journey from iron ore to can using the Material World PowerPoint (slides 2 and 3).</li><li>Highlight the fact that each part of the process uses time, energy, water and has environmental impacts such as habitat destruction.</li></ul>	
	Introduce the next activity: organised into 5 groups, pupils are given an object and a set of cards showing its manufacture process.	<ul> <li>Each group is given a set of process cards for a particular material (glass, cotton, aluminium, paper and plastic).</li> <li>Their task is to: <ol> <li>Match the images with the descriptions.</li> </ol> </li> <li>Arrange the cards on a table in the correct order to show the process of manufacture.</li> <li>Discuss the images/descriptions and identify any impacts on the environment resulting from each stage in the process.</li> <li>Record their ideas on a whiteboard and leave it next to the process cards.</li> </ul>
		Groups rotate around the displayed processes. They are given a short period to read/discuss the descriptions and the list of environmental impacts. Each group is challenged to add one more environmental impact to the list.
	<ul> <li>Once each group has visited every object/process, lead a class discussion about what they have learnt, drawing out the common themes/impacts: <ul> <li>energy use and the associated carbon dioxide emissions</li> <li>water use</li> <li>transport and its associated pollution</li> <li>the generation of waste</li> <li>habitat destruction and the associated impacts on wildlife.</li> </ul> </li> </ul>	Pupils share the environmental impacts they have identified.



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## Lesson 1: Introduction session, continued

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Main:	Point out that transport is a major impact since it is involved in every manufacturing process, usually at several stages. Explain the next activity: each group is given a length of string and a world map to plot the journey of their object from extraction to manufacture to use. Which group has the longest piece of string? Pupils trace the journey of their object through its manufacture to its eventual use in Devon. They measure their piece of string and then compare it's length with those of the other groups.			
	Class discussion: Discuss the disposal of our 'waste' in Energy from from the actual object we are throwing away, what time, energy, water etc which goes into creatin PowerPoint slide 4). Revisit the manufacturing processes displayed or a line – in order to create more 'things' we have t extract, transport and process more resources. Ch this approach. Explain that many of the resources of Explain that if everybody on Earth lived the way we to provide the resources, habitats, water, energy et if we all lived like the average American!) But we or a web link which explains the concept well.	ISS discussion: cuss the disposal of our 'waste' in Energy from Waste (EfW) plants or landfill sites. Apart in the actual object we are throwing away, what else are we wasting? I.e. the raw materials, e, energy, water etc which goes into creating the objects (images on Material World verPoint slide 4). risit the manufacturing processes displayed on the tables. Point out that each system is in order to create more 'things' we have to return to the beginning of the process to act, transport and process more resources. Challenge pupils to think of disadvantages to approach. Explain that many of the resources we use are 'finite' – they will not last forever. I lain that if everybody on Earth lived the way we do in the UK we would need three planets rovide the resources, habitats, water, energy etc that we use. (This would be seven planets e all lived like the average American!) But we only have one Earth! See extension below for ab link which events the concent we use		
<b>Plenary:</b> 10 mins	How can we use fewer resources and make a circular system where materials flow round and round? Using the 3Rs (Reduce, Reuse, Recycle) is a very good place to start. (Show Material World PowerPoint slides to demonstrate how each of the 3Rs changes the linear manufacturing process.) Remind pupils again of their original lists of 'wants' and 'needs'. It is important that we distinguish the two to spend our money wisely, become responsible 'consumers' and look after our world.	Pupils use each of the 3Rs to make a pledge (this may be written down or discussed in small groups/pairs). E.g. An example for reduce could be, "I will have fewer items on my 'wants' list."		

**Extension activity 1:** Many things are made to be 'disposable' or 'Designed for the Dump'. As a homework task, challenge pupils to find things at home which have been designed to be used once then thrown away. E.g. batteries, sandwich bags, carrier bags, disposable camera, biro pens, various packaging examples, paper cups, plastic cutlery, razors, nappies. How many of these have alternatives that can be used again and again?

**Extension activity 2:** Take the lengths of string used to trace the journey of each object and use the key of the map to calculate how many miles/km the object travelled.



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## Lesson 1: Introduction session, continued

**Extension activity 3:** Look at the following webpage for a good explanation of how we have used up the Earth's resources <u>www.theguardian.com/environment/2015/aug/12/humans-have-already-used-up-2015s-supply-of-earths-resources-analysis</u>

**Extension activity 4:** Show Ellen MacArthur's inspiring film clip (approx. 17 minutes) giving insights she gained after sailing solo around the world, specifically, taking and using exactly the amount of resources she needed and no more <a href="http://www.ted.com/talks/dame\_ellen\_macarthur\_the\_surprising\_thing\_i\_learned\_sailing\_solo\_around\_the\_world">www.ted.com/talks/dame\_ellen\_macarthur\_the\_surprising\_thing\_i\_learned\_sailing\_solo\_around\_the\_world</a>

#### Key vocabulary/glossary:

Waste - any unwanted item

Natural resources - the planet's reserves of minerals, land and other natural assets

Raw material - a basic material used in the production of goods

Disposable - intended to be thrown away after use

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Consumer - a person who purchases goods and services. A person who uses or consumes something

Renewable - a resource that can replenish to overcome use or consumption

Finite/Non-renewable - a resource that does not replenish itself at a sufficient rate for extraction in human time frames, when it has been used up; that's it

Reduce - make less of; in this context to make less waste

Reuse - use an item again and again

Recycle - reprocess waste, converting it into something new

Energy from Waste - the process of burning non-recycled waste at very high temperatures (850°C) to create electricity, and potentially heat

Landfill site - an area of land where waste is buried for disposal

Assessment			
Who?	Criteria:	Strategies:	Evidence/recording:
Notes:			
Facts sourced from:	http://www.hydro.com/en/Abd http://www.ecology.com/2011 http://www.iea.org/ http://www.glassallianceeuro http://wwf.panda.org/about_c	out-aluminium/Aluminium-lif 1/09/10/paper-chase/ pe.eu/en/industries our_earth/about_freshwater/	e-cycle/Bauxite-mining/ freshwater_problems/thirsty_crops/cotton/



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## Material World - Lesson 2: Plastics (1 of 2)

Pupils discover that plastic is a versatile material, which has a range of properties. This session also examines natural resources and explores the concept of 'non-renewable/finite' and the impact of human consumption on the planet. Lesson takes 1 hour.

#### **National Curriculum references**

#### Science:

Properties and changes of materials

• Pupils should be taught to compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.

#### Geography:

Human and physical geography

• Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water

Locational knowledge

• Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America, concentrating on their environmental regions, key physical and human characteristics, countries, and major cities

#### Children's previous experiences:



#### Learning objectives:

- 1) I can explain what plastic is made from.
- 2) I can describe different properties of plastics.
- 3) I can explain what a finite/non-renewable resource is.







Differentiation:		Other means of support:
<ul> <li>Resources:</li> <li>6 world maps</li> <li>Plastic: Source a selection of plastics which are: rigid, flexible, transparent, translucent, opaque, hard, soft, light, heavy, non-conductive (heat) - enough for a pile of all types on each table E.g. a range of plastic bottles (shampoo, milk, water etc), yoghurt pots, margarine tubs, plastic film, food trays. You could ask pupils to bring these in from home.</li> <li>Plastics PowerPoint: Download from <u>zone.recycledevon.org</u></li> <li>Supporting resource: Process cards for making plastic (used in lesson 1 and 4). Print out the plastic process page only*</li> </ul>		Health and safety: Ensure that the plastic selection is clean and has no sharp edges.
<ul> <li>Key Questions:</li> <li>1) What is plastic made from?</li> <li>2) What properties of plastic make it a useful material?</li> <li>3) What is a finite/non-renewable resource?</li> </ul>		
Organisation	Teacher Activity	Pupil Activity
Introduction: 30 mins Class seated in places.	Ask pupils to look around the classroom and spot things made of plastic. Explain that plastic is a useful material for many different applications. Ask pupils to brainstorm different properties of materials. <i>E.g. heavy, light, transparent, translucent,</i> <i>opaque, rigid, flexible, waterproof, conductive</i> (bodf clasticity) hard coff	Pupils observe things made of plastic and share their findings with the class. Pupils discuss in pairs and feedback to the class. Words are collated on the board.
PETE HDPE A A A A A A A A A A A A A	(neavelectricity), nard, soft. Put a selection of plastic items on each table and ask pupils to find an example for each of the properties on the board e.g. can they find a plastic which is rigid? Transparent? Flexible? There are many different types of plastic, each with different properties. They can be identified by a symbol like those on the left. For more information see: <u>http://zone.recycledevon.org/sites/default/files/</u> Plastic Recycling Symbols 1-7.pdf	Pupils identify plastics with different properties and hold them up (this could become a race/competition between each table group). Pupils explore the pile of plastic items on their table and work together to create a table about the properties of plastic.



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Organisation	Teacher Activity	Pupil Activity		
Introduction:	<ul> <li>Introduce the table example on slide 2 of the Plastics PowerPoint. Ask pupils to create their own on scrap paper and complete the following columns:</li> <li>Which item do you have? E.g. drink bottle</li> <li>What is it used for? E.g. containing liquids</li> <li>Which properties does the plastic have which make it suitable for this job? E.g. light, strong, transparent</li> <li>Is it labelled with a plastic symbol? If so, which one?</li> </ul>			
Main:	Teacher and pupil activity:			
45 mins	Ask the class 'Does anybody know what plastic is	made from?'		
	Plastic is made from oil. Oil is a fossil fuel which household cleaners, car tyres, tooth paste and m coal and gas.	is used to make petrol, diesel, fertilisers, any other items. Other fossil fuels include		
	You can show pupils short clips to bring the subject to life: 'What's it like to take a bath in oil?' (55 seconds) or 'Living in an age of oil' (52 seconds) are both available on this link: <a href="http://www.bbc.co.uk/programmes/p02gzf5l/clips">www.bbc.co.uk/programmes/p02gzf5l/clips</a>			
	Explain that oil is found in many places around the world, usually deep under the sea or land. Display a world map. Which countries have pupils heard about that produce crude oil? Can they locate them on the map?			
	The world's top crude oil-producing countries in 2 United States 4. China 5. Canada 6. Iraq 7. Ira Mexico. The UK comes 23rd in the list, producin Russia's 10 million.	world's top crude oil-producing countries in 2014 were: 1. Russia 2. Saudi Arabia 3. d States 4. China 5. Canada 6. Iraq 7. Iran 8. United Arab Emirates 9. Kuwait 10. co. The UK comes 23rd in the list, producing 800,000 barrels per day compared with ia's 10 million.		
	Explain to the class that oil is a non-renewable or up, it cannot be replaced. Millions of years ago, sr bottom of the sea. Their remains were covered by r anaerobic conditions (without oxygen), heat, press into crude oil. Some scientists predict that oil res reserves are being found and new techniques for remains a non-renewable resource. Pupils will be a without oil? And everything it gives us?	'finite' resource. Once it has all been used mall animals and plants died and fell to the mud which eventually turned to rock. Under ure and time eventually turned the remains erves will run out in about 50 years. New extracting oil are being developed but oil alive in 50 years – can they imagine a world		
	7% of the world's annual oil production is used to r petrol consumption of Africa!)	nake plastic (this is equivalent to the entire		







Main:	Teacher activity:	Pupil activity:
	How is a plastic bottle made?	In small groups, pupils order cards
	Plastic is a 'polymer' – made from strings of carbon and hydrogen molecules. Each type of plastic has a different arrangement of these molecules which gives it different properties	bottle from extraction to disposal.
	Show the first part of this video clip (up to 4:08) for an overview of how plastic is made from oil <u>www.youtube.com/watch?v=IwdUwffecsM</u> called 'From oil to plastic.'	
	Give pupils cards to sort into order showing the process from extraction to disposal.	
	Explain that this is a 'linear system' which is very wasteful.	
	Ask what could be done with the plastic bottles instead of throwing them away and losing the valuable material?	Hopefully pupils will mention recycling the plastic bottles!
	Show pupils the video clip of what happens to plastic bottles at the recycling factory. Continue the video on the link above from 4:50	Pupils watch video clip.
Plenary:	Now Play the game of Slam on the board.	
10 mins	See Plastics PowerPoint slide 3 for questions and answers.	2.10
	To play Slam: All answers are displayed on the board and pupils compete against each other in pairs to be the first to find the right answer. Winner stays on.	
Extension activ	vity:	

Challenge the class to find a set of plastics with all 7 triangles on.







#### Key vocabulary/glossary:

Plastic - generic name for certain synthetic or semi-synthetic materials which can be moulded and shaped Crude oil/unrefined petroleum - interchangeable terms to describe oil in its natural state found under the ground or sea

Natural resources - the planet's reserves of minerals, land and other natural assets

Finite/Non-renewable - a resource that does not replenish itself at a sufficient rate for extraction in human time frames, when it has been used up; that's it

Recycle - reprocess waste, converting it into something new

Extract - remove or take out, especially by effort or force

Manufacture - make something on a large scale using machinery

Transport - to take or carry (people or goods) from one place to another by means of a vehicle, aircraft or ship

Nurdle - a very small pellet of plastic. Used as a raw material in the manufacture of plastic.

Linear - progressing from one stage to another in a series of steps or stages

Assessment				
Who?	Criteria:	Strategies:	Evidence/recording:	
Notes:				





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## Material World - Lesson 3: Plastics (2 of 2)

Having explored the origins of plastic and found out how plastic bottles get recycled in the first session, pupils go on to discover a way of recycling plastic which is 'circular'.

Lesson takes 1 hour.

#### **National Curriculum references**

#### Science:

Properties and changes of materials

 Pupils should be taught to compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets.

#### Geography:

Human and physical geography

• Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water

Locational knowledge

• Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America, concentrating on their environmental regions, key physical and human characteristics, countries, and major cities

#### Children's previous experiences:

Material World, Lesson 2: plastics



#### Learning objectives:

- 1) I can state advantages and disadvantages of plastic being a light material.
- 2) I can explain how marine litter is damaging to the environment and to people.
- 3) I can describe an action I can take to help reduce marine litter and/or recycle more.







Differentiation:	Other means of support:
<ul> <li>Resources:</li> <li>World maps</li> <li>Plastics PowerPoint: Download from <u>zone.recycledevon.org</u></li> </ul>	Health and safety:
<ul> <li>Key Questions:</li> <li>1) Why does plastic become litter?</li> <li>2) What actions can we take to reduce marine litter and recycle r</li> <li>3) How is plastic recycled?</li> </ul>	more?

Organisation	Teacher Activity	Pupil Activity	
Introduction: 10 mins	Pupils play the slam game from Lesson 2: Plastics (1 of 2) as a reminder of key learning points. Also see slide 3 of the Plastics PowerPoint.		
Main:	Revisit the properties of plastic from the previous lesson. Focus on weight: challenge pupils to think of advantages and disadvantages of plastic being a light material. Advantages include: lower cost and fuel consumption when transported; convenient for consumers E.g. to put in packed lunches. Disadvantages include: plastic is easily blown or washed from one location to another. Explain that plastic does not biodegrade/rot – this makes it an excellent packaging material, but causes problems if it ends up in the sea as 'marine litter'.	Pupils work with a partner to consider advantages and disadvantages of plastic being light. Pupils watch a short video about a company called Interface helping to address the issue of marine litter in the Philippines. A case study slide can also be	
	An excellent introductory video to marine litter (approx 4 minutes) can be found here: <u>www.youtube.com/watch?v=017bBeXhYz4</u> Called 'Sources and impacts of marine litter'	round within the plastics PowerPoint <u>www.youtube.com/watch?v=DX6Uidpg3VM</u> Called 'Interface Networks: turning waste nets into carpets'	



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Organisation	Teacher Activity	Pupil Activity
Main:	After the video clip, ask pupils to locate the Philippines on a map. Has anybody visited? Lead a class discussion around the following questions: Why is fishing such an important activity in the Philippines? What problems might the fishing nets cause if they are left in the sea or on beaches? How does recycling the nets help local people?	Pupils discuss questions and share answers with the class.
	Show pupils how to fold an A4 piece of paper into 6 equal-sized rectangles ready to make a story board, or print enough for one each from the link below: www.printablepaper.net/category/storyboard	Pupils work in pairs/small groups to create a storyboard showing what happens to the discarded fishing nets in the Philippines and how Interface transform them into carpet tiles.
Plenary:	Encourage pupils to think about actions they can take at home to recycle more plastic and to reduce marine litter.	Pupils research the materials they can recycle from home: <u>www.recycledevon.org</u> is a good source of information. This task may be set as homework instead.

#### Extension activity:

If your school is in Devon, an experienced waste educator is available to deliver an introductory workshop which uses Interface recycled carpet tiles as a case study. They have a box of related resources including discarded fishing net and the carpet tiles. Contact Heidi Diepold, Waste Education Officer at Devon County Council on 01392 383000 or recycle@devon.gov.uk

#### Key vocabulary/glossary:

Marine litter - human-created waste which has been deliberately or accidentally released into a sea, lake, ocean or waterway

Recycle - reprocess waste, converting it into something new

Rot/biodegrade - decompose via biological, chemical or fungal means







Assessment			
Who?	Criteria:	Strategies:	Evidence/recording:
Notes:			







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## Material World - Lesson 4: Textiles (1 of 2)

Pupils explore the global issues linked to textile manufacture and disposal, using maps to trace the journey of a cotton t-shirt.

Lesson takes approx 1 hour.

#### **National Curriculum references**

#### Geography:

Locational knowledge

Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America.

Human and physical geography

• Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water.

Geographical skills and fieldwork

· Use maps, atlases, globes and digital/computer mapping to locate countries

Children's previous experiences:



#### Learning objectives:

- 1) I can explain the difference between natural and man made fabrics.
- 2) I can explain where some natural resources used to make textiles come from.
- 3) I can describe the impact on the environment of creating fabrics, particularly cotton.
- 4) I can locate countries on a world map.







Differentiation:	Other means of support:
<ul> <li>Resources before the session:</li> <li>Ask pupils to each bring in an item of clothing with a clear label (easy to read, not faded from washing) showing what the item is made from and where it was made.</li> <li>Textiles PowerPoint*</li> <li>Source satellite images of the Aral Sea before 1960 and in the present day. A good example can be found here: http://bit.ly/1GOXGio</li> <li>Source images of ships abandoned in the Aral Sea desert. E.g. http://bit.ly/1G2JzeR</li> <li>Resources for the session:</li> <li>World maps x 6</li> <li>Length of string and some clothes pegs to create a class 'washing line'</li> <li>Whiteboards &amp; pens</li> <li>Snall sticky notes</li> <li>Scales for weighing clothing</li> <li>Interactive Whiteboard</li> <li>Lesson 1 and 4: supporting resource: process cards (print of a class of the of the</li></ul>	Health and safety:
*Download from <u>zone.recycledevon.org</u>	
Key Questions:         1) What are our clothes made from?	

- 2) What is the difference between 'natural' and 'synthetic' fibres?
- 3) Where did my cotton t-shirt come from? How did its manufacture affect other people and the environment?







Organisation	Teacher Activity	Pupil Activity	
Introduction: 15 mins Class seated in mixed ability groups with the clothing items they have brought in.	In small groups, pupils look at the labels in the made from?" Collate the answers on the board. <i>Likely answers include: cotton, polyester, acrylic</i> Explain that some fabrics are 'natural' i.e. the material, and other fabrics are 'synthetic' i.e. they sources such as oil. <i>You may come across clothes made from polye man-made fibres.</i> Show slide 2 of the Textiles PowerPoint: 'Natura Slides 3 and 4 show examples of clothes made Pupils read different fabric types from the board Now peg the clothes brought in by children or activity.	<ul> <li>is, pupils look at the labels in their clothes to find out "What are our clothes swers on the board.</li> <li><i>include: cotton, polyester, acrylic, wool, viscose, nylon etc.</i></li> <li>ome fabrics are 'natural' i.e. they are manufactured from plant and animal ther fabrics are 'synthetic' i.e. they have been man-made usually from chemical as oil.</li> <li><i>across clothes made from polyester cotton, which is a mixture of natural and</i> res.</li> <li>of the Textiles PowerPoint: 'Natural or Synthetic Challenge' show examples of clothes made from natural and synthetic fibres.</li> <li>ferent fabric types from the board and guess if they are 'synthetic' or 'natural'.</li> </ul>	
Main: 40 mins	Explain that the class is going to find out about the impact that manufacturing (making) our clothes has on our environment. <i>For example, explain that most 'synthetic'</i> <i>fibres are made from oil – a 'finite resource'</i> <i>(one that will run out). 40% of the clothes we wear in the world contain oil!</i> Explain that even 'natural' fibres have an impact on the environment – the class is going to look more closely at cotton. Where is cotton grown? How is cotton made? What resources does it use? What is the impact on the environment? Introduce the card activity. <i>Use class discussion to draw out points such as – pesticide use, energy, water use. See facts on the Textiles PowerPoint slide 5.</i> Ships in the desert? Focus on the Aral Sea: Remind pupils where Uzbekistan is. Show this film clip: <u>www.youtube.com/watch?v=sSEdGusF3qA</u> It is called 'Driving across the Aral Sea bed: Most the Stape'	<ul> <li>Working in small groups, pupils use world maps to locate the main cotton producing countries.</li> <li>USA, China, India, Egypt, Brazil, Turkey, Pakistan, Uzbekistan</li> <li>Pupils match the image and information cards to show the process:</li> <li>Plough field, plant seed, water &amp; feed, pesticide spray, herbicide spray, defoliator spray, harvest, → ginning plant (fibres separated from the seed pod then combed/carded &amp; spun into yarn), → mill (woven into fabric), → textiles factory (bleached, dved &amp; printed) → warehouse → shons</li> </ul>	







Organisation	Teacher Activity	Pupil Activity
Main:	Show satellite images of the Aral Sea before 1960 and the present day and images of ships abandoned in the desert. Many examples can be found using a search engine to find 'comparison maps of the Aral Sea.' The Aral Sea was once the fourth largest lake in the world, 250 miles long and 200 miles wide. In the 1960's Governments in the area diverted the water from two rivers to irrigate cotton fields. It has now shrunk to less than half its original size.	<ul> <li>Pupils use the map, images and film clip to answer the following questions:</li> <li>What happened to the Aral Sea?</li> <li>Where did the water go?</li> <li>What are the impacts on <ul> <li>a) people?</li> <li>b) animals?</li> <li>c) the environment?</li> </ul> </li> <li>Pupils may work alone, in pairs or small groups to find the answers to these questions.</li> <li>Pupils present answers.</li> <li>Depending on the needs of your class, they may be presented through class discussion, written work e.g. a letter from a family member living near the Aral Sea, or a simple worksheet.</li> </ul>
	How much water has been used to make <u>your</u> clothes? Present the class with this shocking fact: <i>Producing one cotton T-shirt uses</i> <i>approximately 2,700 litres of water - enough</i> <i>water for one person to drink for 900 days</i> <sup>1,2,</sup> Challenge the class to work out how much water has been used to make all their T-shirts combined.	Each pupil estimates how many T-shirts they have at home and then add answers together. You may like to create a simple worksheet for this activity, or add up answers on the Interactive whiteboard as a whole class.
<b>Plenary:</b> 10 mins	Use the washing line to create a visual display of learning from this lesson. Label each item of clothing with the type of fabric it is made from then ask pupils to add in facts about the resources used to make clothing. Tell the class that the next session will look at what we can do to help reduce the environmental impact of our textiles.	Pupils make labels to add to the washing line creating a visual display of their learning.



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**References:** 

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<sup>1</sup>www.triplepundit.com/2013/02/water-make-shirts-impact-environment/

<sup>2</sup>www.worldwildlife.org/stories/the-impact-of-a-cotton-t-shirt





#### **Extension activities:**

Trace the route of a cotton T-shirt from grower to manufacturer, to the consumer in the UK. Research the miles travelled using the internet.

Research into fair trade cotton www.fairtrade.org.uk/en/farmers-and-workers/cotton

Research into child labour used in cotton harvesting <a href="http://www.equaltimes.org/child-labour-and-exploitation-in?lang=en#.VdXaqntwZMx">www.equaltimes.org/child-labour-and-exploitation-in?lang=en#.VdXaqntwZMx</a>

#### Key vocabulary/glossary:

Natural resources - the planet's reserves of minerals, land and other natural assets

Finite/Non-renewable - a resource that does not replenish itself at a sufficient rate for extraction in human time frames, when it has been used up; that's it

Manufacture - make something on a large scale using machinery

Synthetic fibre - textiles made from man-made fibres

Natural fibre - textiles made by plant or animal products

Textiles - a type of cloth or woven fabric

Cotton, polyester, nylon, acrylic, wool, viscose - types of textiles

Who? Criteria: Strategies: Evidence/rec	Assessment			
	Vho?	Criteria:	Strategies:	Evidence/recording:

#### Notes:





## Material World - Lesson 5: Textiles (2 of 2)

Having explored the environmental impacts of manufacturing clothing in Lesson 4: Textiles (part 1 of 2), pupils focus their attention on the possible solutions and find out more about the textiles recycling industry.

Lesson lasts 1 hour.

#### **National Curriculum references**

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#### Geography:

Locational knowledge

 Locate the world's countries, using maps to focus on Europe (including the location of Russia) and North and South America.

Human and physical geography

• Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water.

Geographical skills and fieldwork

• Use maps, atlases, globes and digital/computer mapping to locate countries

#### **Design Technology:**

Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making. They should work in a range of relevant contexts. When designing and making, pupils should be taught to:

Make

• Select from and use a wider range of tools and equipment to perform practical tasks accurately.

#### Children's previous experiences:

Material World - Lesson 4: Textiles (part 1 of 2)

## Real Property of the second se

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#### Learning objectives:

- 1) I can locate countries on a world map.
- 2) I can explain what the 3Rs are.
- 3) I can develop sewing skills.







Differentiation:	Other means of support:
<ul> <li>Resources</li> <li>Textiles PowerPoint: Download from <u>zone.recycledevon.org</u></li> <li>World map(s)</li> <li>Sewing equipment</li> <li>Buttons</li> <li>Old socks (for puppet making)</li> <li>Scraps of fabric (to decorate puppets)</li> </ul>	Health and safety: Discuss and demonstrate safe use of sewing equipment as necessary.

#### **Key Questions:**

- 1) What happens to clothes when we throw them away?
- 2) Where do clothes go to be reused and recycled? How does this process happen?
- 3) What actions can we take to reduce textile waste?

Organisation	Teacher Activity	Pupil Activity
Introduction: 15 mins	Recap lesson 4: Textiles (part 1 of 2), using the washing line of clothes and facts as a visual cue. Ask the class 'Why do we throw clothes away?' Draw out possible answers: <i>They no longer fit, they are</i> <i>damaged/have holes, new school needs a new uniform,</i> <i>no longer in fashion, have so many that new ones won't</i> <i>fit in the wardrobe!</i> 'Where will old clothes end up if we throw them away?' Show images and discuss Energy from Waste (EfW) plants and landfill sites with the class. See factsheets on pages 46/47 and Textiles PowerPoint, slide 6. Stress the amount of resources wasted when we throw clothes away (energy, water, labour, chemicals, time and money). 'What could we do instead of throwing clothes in the bin?' Draw out key points from discussion – using the 3Rs. Answers could include, but are not limited to: - <i>Put unwanted clothes in recycling banks or the</i> <i>Council's home collection service</i> - <i>Give them to charity or friends/family (reuse)</i> - <i>Care for your clothes by mending or adjusting</i> <i>them (reducing waste)</i>	Pupils share 3 things they learnt from the last session with a talking partner. Pupils discuss ideas and feedback. Class discussion.



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Organisation	Teacher Activity	Pupil Activity
<b>Main:</b> 30 mins to 1 hour depending on activities chosen	Explain to the class that, of the textiles we put in textile collections, approximately 50% of our old clothes are reused, and 50% are recycled. Clarify the difference between reuse and recycle.	
	Reuse: means using the same item more than once, either for its original purpose or for something else.	
	Recycle: is to turn an item into something new, often by melting or shredding it.	
	Collection usually involves a 'sort' process in the UK before shipment to other countries for reuse or recycling.	
	Clothes are sent for reuse in Kenya, Ghana, Nigeria, Benin, Togo, Cameroon, Gabon, Pakistan	Invite pupils to locate some of these countries on the world map.
	How are clothes recycled?	Pupils watch film clips explaining the process.
	Three different activities follow, each taking approximately 15 to 20 minutes. Choose the most appropriate for your class and divide them into groups to undertake the tasks in a 'carousel' fashion.	The first clip (approx 2 minutes) shows how textiles are <i>collected and sorted</i> . It is called 'Wear next? What happens to the textiles you recycle': <u>www.youtube.com/watch?v=zDZuCEIHC_4</u>
		This clip shows the extensive sorting and packing process (use from 2:40 to 7:00). It is called 'A world of textile recycling - UK': www.youtube.com/watch?v=CKbxSRjldpw
		This clip shows how textiles are <i>recycled</i> into new items (use from 1:17 to 3:44). It is called 'The fibre side of textile recycling': <u>www.youtube.com/watch?v=CJka9tHkxjs</u>
	<b>Activity A:</b> Reduce - stitch and sew Pupils learn essential skills to repair clothing, giving them a longer life and reducing the need to buy more.	Activity A: Using old socks and a selection of buttons, pupils learn to sew 'button eyes' to create simple sock puppets. Other sewing skills may also be taught and practiced here as pupils decorate and embellish their creations! Activity B: Pupils design a poster to encourage
	Activity B: Reuse - buy second hand clothing!	others to buy and wear second hand clothing E.g. from charity shops, car boot sales or the recycling centre. Ask pupils to come up with a slogan and eye-catching design which will make second hand clothing look cool!







Organisation	Teacher Activity	Pupil Activity
Main:	<b>Activity C:</b> Recycle - how much are our textiles worth?	Activity C: Textiles are worth money as a recycled material sold in the UK and around the world – <i>Textiles can be worth up to £620 per tonne!</i>
		Up to date prices can be found here: www.letsrecycle.com/prices/textiles/
		Using clothing from the washing line in lesson 4, ask pupils to weigh their clothes on kitchen scales and work out their value if they were to be sold in the recycling market.
		Every time we reuse clothing, we save resources that would be used to manufacture new clothes. For every 1kg of clothing we reuse, we save 6,000 litres of water, 3.6kg of $CO_2$ , 0.3kg of fertilizers and 0.2kg of pesticides. <sup>3</sup>
		Using the weights of the clothing, ask pupils to work out how much water and other resources would be saved if all their clothing was sent for reuse when they no longer want it.
Plenary:	Use the key questions as a basis for class dis	scussion, to draw out learning points.

10 mins

#### **Extension activity:**

Challenge pupils to consider: Could we rethink the way we design, make and dispose of our clothes? Could they be used to make something else? Or turned into compost?

For compostable trainers with flower seeds in the sole, see: www.ecouterre.com/plant-oats-biodegradable-sneakerwatch-it-bloom-into-flowers/

For an example of fair trade, low impact clothing see: https://rapanuiclothing.com/traceability-clothing/

#### Key vocabulary/glossary:

Energy from Waste (EfW) - the process of burning non-recycled waste at very high temperatures (850°C) to create electricity, and potentially heat

Landfill site - an area of land where waste is buried for disposal

Reduce - make less of; in this context to make less waste

Reuse - use an item again and again

Recycle - reprocess waste, converting it into something new

Textile - a type of cloth or woven fabric





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Assessment			
Who?	Criteria:	Strategies:	Evidence/recording:
Notes:			









## Material World - Lesson 6: Taking action!

Having taken part in lessons 1 to 5, pupils share their learning with the wider school community and encourage them to take action on textile waste.

Lesson takes at least 1 hour, but may be extended over a whole day or several sessions.

#### Children's previous experiences:

As a minimum, pupils should have taken part in lessons 4 and 5: Textiles - parts 1 and 2

#### Learning objectives:

Differentiation:	Other means of support:
Resources         • Poster making materials         • Work from previous sessions as an aide-memoire         Try these websites for more information and resources:         www.ragbag.com         www.swishing.com (clothes swaps)         www.loveyourclothes.org.uk         uk.pinterest.com/search/pins/?q=upcycled%20clothes	Health and safety:





# recycle



## Lesson 6: Taking action! continued

Organisation	Teacher Activity	Pupil Activity	
Introduction: 20 mins	Explain to the pupils that they are going to share their learning from the previous sessions with the rest of the school, focusing particularly on textiles, to encourage everybody to take action. Write the most common environmental issues raised by pupils on the board (see key questions and learning existing provide action action action).	Children discuss what they have learnt and make a list of 5 key points. The focus should be on the problems associated with textile manufacture.	
	if needed). Using class discussion, recap some of the solutions to	Pupils discuss ideas and feedback	
	the problem using the 3Rs:	to the class.	
	<b>Reduce</b> textile waste: by buying less clothing and mending damaged clothes		
	<b>Reuse</b> clothes: by giving to charity/a friend/family member or by selling them		
	<b>Recycle</b> clothing: by using a recycling bank, a collection point in school or a household collection service (some areas of Devon provide this – see <u>www.recycledevon.org</u> to find out more)		
	Consider actions the school community could take.		
	Prompt pupils with ideas such as: an assembly to share learning; holding a 'pre-loved' school uniform swap or a community clothes swap event; a textiles collection for charity; raising awareness by holding an 'upcycled' (see glossary) fashion show; decorating reusable cotton bags with 3Rs messages and sell at your school fete; holding a 'wear your clothes inside- out' day to raise awareness of where clothes come from; running a sewing skills event for pupils and parents to learn how to alter and adapt clothing.		
Main:	Once the class has decided on an action, divide the pupils into groups of 4-6. Give each group a task to plan the event.		
1-3 hours over several sessions,	Allow time for pupils to rehearse presentations ahead of time.		
plus extra time to	Tasks might include:		
run ine eveni	Planning a talk/assembly to give information about the upcoming event		
Creating posters/leaflets to advertise the event			
	Researching organisations who could help e.g. with charity textile collections		
	<ul> <li>Writing letters to parents/carers to invite them along and explain why the event is being held</li> </ul>		
	<ul> <li>Preparing a space for the event to be held e.g. making a catwalk, laying out tables for a clothes swap</li> </ul>		

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## Lesson 6: Taking action! continued

Organisation	Teacher Activity	Pupil	Activity	
<b>Plenary:</b> 20 mins	Following the community event, evaluate its success with the pupils. What went well? What was challenging? Did pupils receive any feedback from their parents or classmates? Are there any ways a community event could be improved in the future? E.g. could it become an annual event? Could it raise funds for the school?			
Key vocabulary/glossary: Reduce - make less of; in this context to make less waste Reuse - use an item again and again Recycle - reprocess waste, converting it into something new Upcycle - to reuse (discarded objects or material) in such a way as to create a product of higher quality or value than the original				
Assessment				
Who?	/ho? Criteria: Strategies: Evidence/recording:			
Notes:		7		





## Interface





#### Material World - Lesson 1: Introduction Supporting resource: Natural Resources cards

Print off 6 copies and cut between the pictures. Pupils use these images to match to the every day objects (aluminium can, newspaper, plastic bottle, cotton fabric, glass jar)





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#### Supporting resource: Process cards

ecvole

Process cards for the manufacture of aluminium, paper, plastic, glass and cotton. Print out these cards and trim to separate the images from the descriptions. For lesson one you will also need to download the Material World PowerPoint.

## **Group 1: Aluminium**

#### Aluminium is made from a rock called 'bauxite'.

- Most bauxite is found close to the equator.
- The vegetation is cleared from the mining area, then the bauxite is removed from the ground by blasting, drilling and ripping with very large bulldozers
- Bauxite is mined in Australia and other countries around the world.
- More than 100 million tonnes of bauxite is mined worldwide each year.

## The bauxite is transported from the mine to a factory to be processed.

- Large lorries transport the rock to a factory called an aluminium refinery.
- There are refineries in many parts of the world including Brazil.

## The bauxite is processed at an aluminium refinery.

- The bauxite is crushed and washed with hot chemicals to produce a white powder called aluminium oxide.
- 1 tonne of aluminium oxide is produced from 4 tonnes of bauxite.











Photo credit: "Qld Alumina Refinery QAL 2008" by Vicki Nunn - Own work. Licensed under Public Domain via Wikimedia Commons - http://bit.ly/1hNCdQt

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## Group 1: Aluminium, continued

## Aluminium oxide is transported to a smelting plant and turned into aluminium ingots.

- Aluminium oxide is made from aluminium and oxygen atoms bonded together. In the smelting plant these atoms are separated using electricity.
- The aluminium is made into large ingots, ready to be manufactured into a wide range of products.
- There are smelting plants in Wales and many other countries around the world.

#### Aluminium cans are produced.

- The ingots are heated and rolled out into thin sheet sheets.
- Cans are made from the sheets and are sent to be filled with drink and decorated.
- They are then distributed around the world.
- 9 billion drinks cans are bought every year in the world.

## When people have finished using aluminium cans they often throw them away.

- When we put things in a rubbish bin they are taken by lorry to either:
  - an Energy from Waste (EfW) plant where they are incinerated (burnt) at high temperatures.
  - a landfill site where they are buried in a huge hole in the ground.

What could people do with the aluminium cans instead?















### Group 2: Paper

#### Paper is made from wood from trees.

- Most paper is made from trees which are specially grown in plantations.
- In some parts of the world there is concern that tropical rainforest is being chopped down to make paper.
- Trees are grown for paper production in many countries around the world including the USA.

4 billion trees are cut down around the world each year to produce paper.

The tree trunks are transported to a sawmill by lorry or train.

 There are sawmills in many countries. The three largest saw mills in the world are in Germany.

At the sawmill, the tree trunks are turned into woodchip.

- The bark is removed in a huge turning drum.
- Then a second machine cuts the logs into small pieces called 'woodchip'.

The woodchip is transported to a paper mill where it is turned into pulp.

- The woodchip is ground up by large grinding machines.
- Then it is mixed with hot water and chemicals to make a white pulp.

There are paper mills in many countries; China is the world's top paper producer.













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## Group 2: Paper, continued

#### The pulp is made into new paper.

- The watery pulp is sprayed onto a fast-moving mesh screen so that the water can drain out.
- Huge rollers squeeze out more water.
- The paper moves through a series of heated metal rollers to dry it.

## The finished paper is transported around the world to be made into different products.

- Paper is used to make many things including books, magazines, newspapers, toilet rolls and packaging.
- 300 million tonnes of paper are produced worldwide each year.

## When people have finished using paper they often throw it away.

- When we put things in a rubbish bin they are taken by lorry to either:
  - an Energy from Waste (EfW) plant where they are incinerated (burnt) at high temperatures.
  - a landfill site where they are buried in a huge hole in the ground.

#### What could people do with the paper instead?













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### **Group 3: Plastic**

#### Plastic is made from crude oil.

- Crude oil is a fossil fuel found deep beneath the Earth's surface.
- A lot of oil is found under the sea bed; an oil rig is used to drill down to extract it.
- Worldwide, 94 million barrels of oil are extracted per day. (One barrel is 159 litres.)
- The world's biggest oil-producing country is Russia.

## The crude oil is transported to a factory called a 'refinery'.

- At the refinery the crude oil is separated into different substances: solids, liquids and gases.
- These can be used for different things such as tar for road building, wax and polish, petrol, jet fuel and making plastics.
- The United States is the biggest oil refiner in the world followed by China, Russia, Japan and India.

The oil product is transported to a plastic factory where chemicals are added to make different plastics.

- Heat, pressure and chemicals link the molecules of the oil into long chains called polymers.
- Hot liquid plastic is pushed through a tube. It cools and hardens.
- The hard plastic is broken into flakes or beads called 'nurdles' and shipped around the world.













### **Group 3: Plastic, continued**

## The nurdles are melted and moulded into different shapes.

- Many objects in our homes are made of plastic E.g. toys, bottles, furniture, i-pods, carpets, sunglasses, food packaging.
- China produces the most plastic about a quarter of the world's production.

## When people have finished using plastic items they often throw them away.

- When we put things in a rubbish bin they are taken by lorry to either:
  - an Energy from Waste (EfW) plant where they are incinerated (burnt) at high temperatures.
  - a landfill site where they are buried in a huge hole in the ground.

## What could people do with the plastic bottles instead?











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### **Group 4: Glass**

#### Glass is made from silica which is found in sand.

- The sand needs to be white to make pure, clear glass.
- White sand is extracted in many countries including Indonesia.

## The sand is transported to a glass factory and made into glass.

- The sand is mixed with limestone and soda ash and melted in a furnace at 1,700°C to make liquid glass.
- The European Union produces about 33 million tonnes of glass each year.
- Germany produces the most glass in Europe.

#### The liquid glass is made into different shapes.

- Large machines pour, blow and shape the liquid glass to make a wide range of products.
- The glass is cooled very carefully to prevent it from breaking.
- Modern machines can produce 600 glass bottles per minute!













### Group 4: Glass, continued

## Glass products are packaged and transported for sale around the world.

- Products include: bottles, windows, glasses, scientific equipment and light bulbs.
- Packaging is essential to prevent glass objects from breaking.

## When people have finished using glass bottles they often throw them away.

- When we put things in a rubbish bin they are taken by lorry to either:
  - an Energy from Waste (EfW) plant where they are incinerated (burnt) at high temperatures.
  - a landfill site where they are buried in a huge hole in the ground.

What could people do with glass instead?













#### **Group 5: Cotton**

#### Cotton fabric is made from cotton plants.

- Cotton plants grow in warm climates in countries such as Turkey.
- The land is ploughed and cotton seeds are planted using tractors and other machinery.
- Cotton plants need a lot of water: 20,000 litres of water are used to produce 1kg of cotton (the weight of a pair of jeans and one t-shirt).
- The cotton farmer uses chemical sprays to kill weeds, pests and diseases in the cotton plantation.

## After cotton plants have flowered, they produce fluffy white fibres surrounding their seeds.

- First the plants produce hard green seed pods called 'bolls'.
- As the bolls ripen they burst open to reveal white, fluffy cotton.
- Before harvesting the bolls the famer uses chemical sprays to remove the leaves from the cotton plants – this is called 'defoliation'.
- The farmer uses a stripping machine to harvest the bolls.

## The cotton bolls are transported to a factory where they are processed into cotton.

- The cotton is dried using drying ovens.
- Then machines with rollers and grippers separate the fluffy cotton fibres from the boll casing and cotton seeds.
- The cotton is compressed into bales which weigh one quarter of a tonne.
- This factory is called a cotton 'gin.'













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## **Group 5: Cotton, continued**

## The bales of cotton are transported to a textile mill where they are made into yarn.

- The raw cotton fibre is now called the 'lint'.
- It is cleaned and spun into yarn using large machines.

#### The yarn is woven into fabric.

- The yarn is often dyed to produce different colours.
- Machines weave the yarn into fabric.
- The cotton fabric is used to make a wide range of objects including clothes, shoes, sheets and furniture.
- Around 20 million tonnes of cotton fabric are produced each year worldwide. About one third of this is produced in India.

## When people have finished using things made from fabric they often throw them away.

- When we put things in a rubbish bin they are taken by lorry to either:
  - an Energy from Waste (EfW) plant where they are incinerated (burnt) at high temperatures.
  - a landfill site where they are buried in a huge hole in the ground.

What could people do with cotton fabric instead?















## What is the Circular Economy?

The Material World pack uses geography and science to explore our use of resources around the world and how we can preserve and use these resources appropriately. As such, the pack is an introduction to the exciting new concept of the 'circular economy'.

For most of the 21<sup>st</sup> century we have been using a linear economy. Simplified, it looks like this:



As Material World helps pupils to recognise, this model is not sustainable. Most of the Earth's resources are finite, and the energy used to extract materials and manufacture everyday objects is wasted every time we throw something away.

There is growing recognition that we need an alternative: a circular economy, which allows the Earth's precious resources to be used for as long as possible (see illustration below.) Reusing and Recycling are important parts of a circular economy but so is design: ensuring products can easily be repaired and remanufactured.

As the product designers, manufacturers and purchasers of the future, our primary pupils will soon be in the position to make this model a reality.

To help pupils understand this exciting new concept, and get the most out of the learning from this resource pack, we highly recommend that they watch at least one of the video clips on the next page.

These can be accessed via <u>zone.recycledevon.org/videos</u> or from the links on pages 43 and 44.



Photo credit: Circular Economy diagram - European Commission DG Envi.



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## What is the Circular Economy?

#### What is the Circular Economy?

The circular economy demonstrated with Lego (3:00 minutes). This short clip was made by secondary pupils and is a great simple introduction for adults and pupils alike. www.youtube.com/watch?v=-3JcT-KfSfU



#### **Get Loopy!**

This film clip (11:53 minutes) is presented by comedian Steve Punt who plays the part of a mad professor questioning the way we do things.

http://bit.ly/1LGjlyT



#### The Story of Stuff

This film clip is longer (21:25 minutes) but packs in lots of information in an easy-tounderstand format. It is downloadable from the website, which also contains a host of other films which pupils may find interesting. www.storyofstuff.org/movies/story-of-stuff/





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## What is the Circular Economy?

#### **Re-thinking Progress:** The Circular Economy

A short clip (3:48 minutes) from the Ellen MacArthur Foundation. http://bit.ly/1RRQtoq

A wealth of information and resources may also be found here: www.ellenmacarthurfoundation.org



#### Ellen MacArthur

A longer film clip (17 minutes) in which Ellen MacArthur describes her sailing experiences which lead to insights about the circular economy and the use of the World's resources. http://bit.ly/1BSrFc9









## What happens to our waste?

#### Waste in Devon

Households in Devon produce about 370,000 (2014-2015) tonnes of rubbish each year. Whilst the County is one of the best in the UK at recycling and composting (over 55% of this waste is currently recycled/composted), a large amount of 'rubbish' still needs to be disposed of.

Until recently this rubbish went to a landfill site, however, the European Landfill Directive has been a key driver in encouraging local authorities to find more environmentally friendly options to landfill.

Many areas of the UK are looking into Energy from Waste (EfW) technologies as an alternative, here the waste is burnt. Devon is one of these areas and now sends 31% of our household waste to an EfW plant.



Don't let Devon go to waste zone.recycledevon.org

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## **Energy from Waste**

The new EfW plants, burn non-recyclable waste at very high temperatures (over 850°C) in a process that creates electricity, and potentially heat, for local housing and industry. We are able to recover 'energy' from our 'waste'. Excess electricity is sold to the grid. The Plymouth plant provides heat to Devonport Dockyard and is one of the most efficient facilities in Europe.

This 'recovery' from the waste is in many respects preferable to landfill, but valuable resources are still lost when the waste is burned. This 'recovery' process should therefore be used only after we have Reduced, Reused and Recycled as much as possible. When discussing this exciting new technology with children, it is very important for them to understand the place of EfW in the waste hierarchy.

When the non-recyclable waste is incinerated, it leaves two types of ash. Bottom ash, from the burnt waste, has any metal removed, and is then used in construction projects, such new roads. Fly ash, which is collected when the gases produced during the burning process are thoroughly cleaned, will be taken to a specialised landfill site.

EfW plants are tightly regulated to ensure that they do not cause any harm to the environment or public health. Gases from incinerating the non recyclable 'rubbish' are filtered so finely that few particles are released into the air.

Strict limits on emissions such as dust, mercury, dioxins and furans, are imposed by European legislation. Both plants are regulated by the Environment Agency to ensure they operate well within the legal limits.



Devon has two EfW plants. One is in Exeter (opened in spring 2014), which takes 60,000 tonnes of non-recyclable waste per year from Exeter and the surrounding area. This facility creates electricity which is exported to the national grid. www.tiru-uk.co.uk/exeter

The other is in Plymouth (opened in spring 2015) which takes 240,000 tonnes of non-recyclable waste per year from Plymouth, Torbay, South Hams, West Devon and south Teignbridge. This facility creates electricity which is exported to the national grid and heat for use locally in Devonport Dockyard. www.plymouth.gov.uk/swdwp









## Landfill sites

Most pupils will know that 'rubbish' is sent to the 'dump', and they may be aware that our landfill sites are filling up. More detailed discussion with children about waste and landfill should draw out the following points, as appropriate to their age and ability:

- Leachate, a dark coloured liquid, is produced when rainwater filters through the rubbish, and from rotting organic material such as food waste. This needs to be carefully managed to keep it out of rivers and streams.
- Methane gas is produced from rotting organic materials in the rubbish. As this is a greenhouse gas, which contributes to climate change, it is important to prevent it from being released into the atmosphere. Instead, it is sucked out of the landfill site using miles of pipes and is burnt to create electricity.
- Once 'rubbish' is buried in landfill, any resources it contains are wasted. This may include items that should have been reused or recycled, such as plastic or glass. Disposing of these in landfill also represents a waste of the time, energy and water used to manufacture them.



#### Further information can be found here:

www.plymouth.gov.uk/swdwp www.tiru-uk.co.uk/exeter zone.recycledevon.org/teachers/energyfromwaste www.southwestwaleswastepartnership.co.uk/residual-waste/energy-from-waste/ www.recycleforgreatermanchester.com/clientfiles/File/8c%20TRF%20flow%20diagram.pdf









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