Can you make it?

Can you make it?

AN INTERACTIVE CHALLENGE TO SUPPORT THE TEACHING OF MATERIALS AT KEY STAGE 2.

Notes for teachers

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

Can you make it?

FOREWORD

Can you make it? is an interactive challenge designed to support the teaching of materials to 7 to 11 year olds.
The project has been developed by the Institute of Materials, Minerals and Mining with support from Tomorrow's Engineers and The Goldsmiths Company.
These notes have been prepared by Dr Diane Aston, IOM3 with the help of Mandy Pattison, to whom many thanks are owed.

Published by the Institute of Materials, Minerals and Mining
1 Carlton House Terrace, London, SW1Y 5DB

IOM3 The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

Can you make it?

NOTES FOR TEACHERS

- In these notes you will find out everything you need to know to enable you to host and run the **Can you make it?** challenge.
- The notes are split into the following sections:

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

INTRODUCTION

- **Can you make it?** is a hands-on, school-based project designed to support the materials topics in the Key Stage 2 Science curriculum.
- The aim of the project is to enthuse and inspire pupils to engage with science and show them that STEM subjects, in particular materials science and engineering, are vital to the modern world that we live in.
- The activities are suitable for use with lower and upper Key Stage 2 pupils.
- Although the pilot project was designed to be run by a visiting STEM Ambassador, all of the activities have been written so that they can be delivered by a teacher during the time when the pupils are learning about materials.
- You may borrow a **Can you make it?** kit for a period of two weeks and it will be delivered to and collected from your school by courier.
- If you would like the activity to be delivered by a visiting STEM professional please get in touch. The project will be delivered over two visits with time between sessions to allow your pupils to complete the challenge within their usual science lessons and if appropriate, explore the materials in the handling collection further.

Back to contents

Prepared by
Dr Diane Aston, IOM3

BEFORE THE PROJECT

Can you make it?

- The first thing you need to decide is which year group(s) you think will benefit most from doing this project and how many of them there will be. The project has been designed so that it can be run with any group size up to a maximum of about 50 children (or two classes), but individual classes work best.
- The timings given here are very approximate and during the pilot some of the activities took much longer than anticipated as the children were so keen to share their ideas! As such some schools chose to give some of the worksheets as homework or they did them at other times.
- If you don't want to run Can You Make It? as a stand alone project you can use the various activities separately to support and supplement your materials teaching.
- If your school is hosting a STEM Ambassador to deliver the two sessions you should communicate with IOM3 to arrange the dates of the visits. There should be a gap of approximately two weeks between the two sessions.

Back to contents

Can you make it?

SESSION ONE

- The first session should be allocated about two hours. A full afternoon would be ideal.
- The half day is split into a number of short discrete sessions to keep your pupils engaged:
  - Why are science and engineering important?
  - What are materials and why are they important?
  - Materials Treasure Hunt
  - Introduction to Materials Challenge
  - Round-up
- Some of the activities need a greater level of adult supervision and support than others so it would be beneficial to have as many adults available to help with the activities as possible.
- It may be useful for you to lay the room out into areas where the children can sit in small groups around tables and where they can sit as a whole group, perhaps on the floor.
- Prior to Session 1 you will need to stick the **Spot the Scientist** photocards up around the room where the children can see them and hide enough materials from the **Handling Collection** for the children to find in pairs.
- If the project is being delivered by a STEM Ambassador you should introduce them as 'the expert Scientist or Engineer' and they will then introduce themselves and tell the children what they would like to be called. The Ambassador will lead the discussion and activities with the group.

Back to contents

Why are Science and Engineering important?

Can you make it?

Duration: 30 minutes
Type of activity: Whole group discussion and individual work
Support material: Worksheet 1 & 2
Spot the Scientist or Engineer photocards

Aim: To introduce the project and get the children comfortable and confident talking to the group.

To get the children to appreciate that STEM subjects are used everywhere.

To get the children to appreciate that scientists and engineers are normal people doing vital jobs in lots of areas.

- Get the whole group together and start by asking if anyone has decided what they want to do as a job when they grow up. Go round the room and share ideas.
- Explain that most jobs involve STEM subjects (Science Technology, Engineering and Maths) to some degree. Ask them to complete Worksheet 1 individually to identify the jobs that they think involve STEM. Go through their answers as a whole group.
- Explain that if you really like STEM you could become a Scientist or Engineer. Discuss as a group what Scientists and Engineers look like, what they wear, where they work and what they do.
- Ask the children if they think they could spot a Scientist or Engineer from their photo. Ask the pupils to look around the room at the photocards and try to guess what the people do as a job. They can record their results in the table on Worksheet 2. The number of people you ask them to guess depends on how much time you have, 4 or 5 works well. Go round all the cards to see if they guessed right and explain what each individual actually does.

What are materials and why are they important?

Can you make it?

Duration: 30 minutes
Type of activity: Whole group and small group discussion
Support material: Worksheets 3, 4 and 5.

Aim: To reinforce and revise some of the terms that they should be familiar with from their science lessons.

To be able to identify different groups of materials and describe their simple properties.

- Explain that Materials Scientists and Engineers have to understand everything about all the materials we can choose from.
- As a whole group, prompt the children to name groups of materials and individual ones and try to identify their key properties, including whether they are natural or man-made. This discussion can be reinforced with Worksheet 3.
- In small groups, ask the children to identify objects made from a particular material in their homes and think about why this is. They will then feed back to the whole group. They can use Worksheet 5 to record their results. Worksheet 4 can be used to look at look at the properties of particular materials as it is common for properties and applications to be mixed up. A **property** is a word used to *describe* a material, for example strong or hard, an **application** is what it is used for.
- It may be useful for you to have split the children into their normal working groups for some of these activities if you are going to do them in class. However, these three worksheets make good homework.

Materials Treasure Hunt

Can you make it?

Duration: 35 minutes
Type of activity: Small group work and group discussion
Support material: Treasure hunt cards and materials handling collection

Aim: To encourage the students to identify objects made from a particular group of materials from a collection of artefacts that may not be familiar to them.

To work together as a team to complete a task.

To encourage the children to stand up and present their thoughts to their peers.

- Prior to this activity you will need to secrete a suitable number of objects around the room for the children to find during the Treasure Hunt.
- The group will need to be split into pairs.
- Give each pair a **Treasure Hunt Card** and ask them to find one, two or three objects made from that material before bringing them back to the group discussion area and sitting down.
- Each team will be asked to describe what they have found and why it has been made from their material. They could write this up as homework.
- You can use the Handling Collection Contents cards to reinforce the discussion.
- If time/space does not allow for the Treasure Hunt you could split the class into groups and give each one a different material group from handling collection to explore.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Can you make it?

Materials Challenge introduction

Duration: 20 minutes
Type of activity: Whole group discussion
Support material: Worksheet 6
Consumable materials

Aim: To encourage the children to work in teams to come up with a winning solution to a problem.
To encourage them to choose and use materials carefully, working with limited supplies.
To encourage good record keeping and practical skills.

- In this final part you can introduce the challenge. Crash Helmets for Eggs is a design and build activity suitable for learners or all ages and abilities. You could run this whole activity as a stand alone session at any time and it makes a great STEM activity for National Science and Engineering Week.
- The challenge is to build the lightest all round crash protection suit that will prevent an egg from breaking when the design is tested. Full running instructions are given in **Appendix 3**.
- Pupils will be encouraged to record their planning, design and results on Worksheet 6.
- The challenge uses materials which are cheap and readily available, such as bubble wrap, sponge and packing chips.
- If your project is being delivered by a STEM Ambassador enough packs of consumables will be provided to cover your group. You will only need to provide eggs and sticky tape.

Round up

Duration: 5 minutes
Type of activity: Whole group

Aim: Recap the activities of the afternoon.
Make sure they understand the what they need to do for the challenge.
Encourage the children to continue to explore materials between visits.

- Before the session finishes you should quickly recap the activities that have taken place and encourage the children to share their thoughts.

Back to contents

BETWEEN THE SESSIONS

- During the period of approximately two weeks between the main sessions the pupils will continue to work in the same pairs to develop their challenge solutions as part of their normal science lessons.
- They could do additional research into helmet design and they will need to draw their designs and build their solution. They could be encouraged to research the materials in their pack and decide which of them they would like to incorporate into their design. They could also look at alternatives that may come from sustainable sources or be easily recycled.
- The pupils can record their findings and ideas on the worksheet provided or you may prefer them to do their work in the science books and/or create poster explaining their ideas.
- The **Materials Handling Collection** will remain with you for two weeks. You may choose to make use of the suggestions described in **Appendix 4 - Materials In the National Curriculum** notes which illustrate how the objects could be used to support other areas of teaching and learning. This could be with those pupils who have benefitted from your outreach visit as well as those in other year groups.
- We would encourage you to maximise your use of the exciting materials and to incorporate them into a creative curriculum project if possible.

Back to contents

SESSION TWO

- The second shorter visit should be allocated between 60 and 90 minutes depending on the size of the group. By far the most time consuming part of this session, and indeed the main focus, will be testing the designs that the pupils have built. You should allow about 2 minutes per group for this. Therefore if you have 20 pairs you will need about 40 minutes for testing so a visit of about an hour would suffice.
- As a starter activity recap the activities of the first session and ask the children about their experiences of Crash Helmets for Eggs.
- Invite each team to describe their design to the rest of the class and then test their design to see if it works. Explore the idea of fair testing will be explored.
- Once all the designs have been tested ask the to evaluate their design and look at how it could have been improved. As an extension activity they could redesign their product and test the new improved model or they could be asked to research some modern materials used in protective clothing.
- Finally award certificates (and prizes) for the best design and best tam name. You may also want to reward good team work or good written work.

Back to contents

AFTER THE SESSIONS

Can you make it?

- Please complete the inventory check prior to packing away your Can you make it? kit. It will be collected from school by courier.
- You will be asked to complete a short questionnaire following the activity. Your feedback is very important to us as we continually strive to improve our resources.
- In the weeks and months after the pupils have completed the project we hope that you will be able to remind them of their experiences and draw on them to support other areas of their learning.
- If at any point you would like further support in teaching the materials aspects of the curriculum please do get in touch. You should contact Dr Diane Aston, Education Executive at IOM3 by emailing diane.aston@iom3.org or calling 01476 513882.

Back to contents

MATERIALS HANDLING COLLECTION

Can you make it?

- The samples contained within the Materials Handling Collection have been sourced to give you and your pupils a broad appreciation of materials and although most are commonly available a great deal of time, effort and money has been spent putting the collection together. We actively encourage you to get your pupils involved in handling and exploring the samples, but please ask them to do so with care.
- The materials have been split into eight groups: metal, plastic, ceramic, glass, composite, wood, fibres and other. The first seven groups have Treasure Hunt cards consisting of the name of the group and a relevant photographic image and these will be used for the Materials Treasure Hunt activity.
- Each sample has its own information card and a description of the each group is also given in the Handling Collection Contents pack.
- The 'other' objects in the collection have been specially chosen so they can be used to tell materials stories alongside other materials. In particular they allow the pupils to see where materials come from.
- There is deliberately some cross over in the objects and the groups to which they belong, for example the bag is made from plastic bottles. This is to encourage discussion about where the materials have come from and how materials can be reused and recycled, often producing very different objects. The more able pupils may realise that some objects could fit into more than one group.
- Please keep the collection locked in a safe place at all times when not in use as you will be responsible for replacing any samples that are lost or damaged.

Back to contents

Can you make it?

APPENDIX 1

The Worksheets

Screen shots of the worksheets are included here. Photocopiable master sheets will be included in the project pack.

Back to contents

Prepared by
Dr Diane Aston, IOM3

Worksheet 1

Write your name here ....

Can you make it?

What jobs involve STEM?

Science, Technology, Engineering and Maths are really important subjects and most jobs will need to you use a little bit of at least one of these.

Put **S**, **T**, **E** or **M** next to the jobs where you think it is important to understand some **S**cience, **T**echnology, **E**ngineering or **M**aths. Some jobs might use more than one subject.

Doctor
Lawyer
Hairdresser
Artist
Builder
Waitress
Electrician
Chef
Farmer
Dentist
Bus driver
Shop worker
Librarian
Vet
Plumber
Teacher

I have drawn a

....

They work in a

....

In the box below draw a picture of someone doing a STEM job.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by
Dr Diane Aston, IOM3

Worksheet 2

Write your name here ....

Can you make it?

What do Scientists and Engineers look like?

Have a look around the room for these people and try to see if you can work out what they do for a job simply by looking at them.

You could look for clues such as special clothing, or where they are working, but remember they might not be doing their job in the picture

Name	Do you think this person is a Scientist, Engineer or Something Else?	What do you think they do as a job?
Angela		
Carmel		
Chris		
Dave		
Diane		
Eugenie		
Hani		
Jasmine		
Joe		
Mairead		
Martin		
Pam		
Patty		
Pete		
Ronald		
Rob		
Sara		

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Worksheet 2

Prepared by Dr Diane Aston, IOM3

Worksheet 3

Can you make it?

Write your name here ....

Grouping Materials

Can you make it?

All of the materials around us have either grown in or been dug out of the ground.

We use natural materials in a form very close to the way that they occur in nature. For example wool from sheep is a natural material.

We call materials man-made if we have to do something to them before we can use them. For example, wood is a natural material but if we form it into a powder and then stick it back together again we get MDF that is used for making furniture. MDF is a man-made material.

Draw a line from these materials to show whether they are natural or man-made.

Stone
Plywood
Steel
Glass
Sand
Plastic
Clay
Acrylic
Natural
Man-made
Gold
Wool
Copper
Carbon
Cotton
Silver
Oil
Bamboo

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Worksheet 4

Can you make it?

Write your name here ....

Using Materials

Can you make it?

Different groups of materials have properties that make them useful for different things. Can you list three materials from each of these groups and give a useful property for each one? We've done one for each group to give you a clue.

Metals

Types	Properties
Iron	Hard

Plastics

Types	Properties
Polyethene	Lightweight

Ceramics / Glass

Types	Properties
Clay	High melting point

Composites

Types	Properties
Concrete	Hard wearing

Fibres

Types	Properties
Wool	Good insulator

Wood

Types	Properties
Cork	Floats on water

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Worksheet 5

Write your name here ....

Can you make it?

Materials around us

We take the materials that are used around us for granted. Have a think about some of the materials that are used around you in your home and school and try to work out why the Materials Scientists and Engineers chose them. We've done an example to give you an idea

You will be working as part of a small group and will then be asked to tell the whole class about what you have talked about.

You can write your ideas here.

My group is looking at materials used in: ___________________________________

These are the objects we thought of:	This is what we think they are made from:	This is why we think they used this material:
Pan body Pan handle	Metal – aluminium or steel Plastic or wood	Metals are good thermal conductors Wood & plastic are poor conductors

IOM3 The Institute of Materials, Minerals and Mining | Tomorrow's Engineers | The GOLDSMITHS' Company

Worksheet 6 (page 1)

Write your name here ....

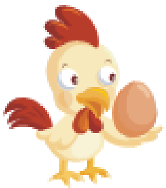
Can you make it?

Crash Helmets for Eggs

You are going to work with a partner to design and build a crash suit for an egg that will stop it from breaking when it is dropped from about 2 metres above the ground.

There will be prizes for the winning teams so good luck!

You will be working just like real scientists and engineers and you will have to:



- Research the problem
- Design a solution
- Build your solution
- Test your solution
- Evaluate your solution

You will need to decide which materials to use, how much of them to use, where to place them, how your design should be dropped and whether eggs have the same strength in all directions.

To help you understand a little bit about impact protection we will talk about crash helmets. Use the space below to write some notes about what you have heard (there is a list of words below to help you).

Crash helmets are made from special types of ________________.

They contain tiny bubbles of ______________ and look a bit like Aero chocolate.

The bubbles squash when the helmet hits the ______________ and this stops you getting hurt as badly.

Crash helmets need to be ___________________ and ______________ because you wouldn't wear them if they were big and heavy!

thin **foam** **light** **ground** **air**

Worksheet 6 (page 2)

Over the next two weeks you will work with your partner to come up with the lightest design that will protect the egg. You will need to write down what you are going to do and come up with a name for your design.

Our design is called ____

This is a drawing of what our design will look like

The materials we used were (put a circle around them)

Polystyrene packing chips   Sponge   Bubble wrap

Our results:

Our egg weighed ____________

Our egg weighed ____________ wearing its crash suit

So we used ____________ of material

Our evaluation

When our egg was dropped it smashed   cracked   survived

We could have made our design better by

____

____

____

____

Can you make it?

APPENDIX 2

Materials Handling Collection content cards and Treasure Hunt cards

Back to contents

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

Can you make it?

Can you make it?

HANDLING COLLECTION CONTENTS

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Can you make it?

Terms of use

- This handling collection has been put together to support the **Can you make it?** project to raise awareness of materials in primary schools.
- The samples contained within it have been sourced to give you and your pupils a broad appreciation of materials and although most are commonly available a great deal of time, effort and money has been spent putting the collection together.
- Though we actively encourage you to get your pupils involved in handling and exploring the samples, please ask them to do so with care.
- Please keep the case locked in a safe place at all times when not in use.
- You will be responsible for replacing any samples that are lost or damaged.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Handling collection contents

Can you make it?

Metal	Plastics	Ceramic	Glass	Composite	Wood	Fibres	Other
Door number	Bottle preform	Brick	Boiling tube	Aluminium honeycomb	Balsa wood	Bamboo socks	Yarns of other materials Bamboo fibres & stem
Drinks can	Cup cake cases	Cement	Glass fibre cloth	Carbon fibre composite	Cardboard	Kevlar glove	Silk cloth Kevlar cloth
Metal spoon	Expanded PS ball	Fuse	Lens	Concrete	Castanets	Recycled bag	Carbon fibre cloth Polymer granules
Plant pot	Foam ball	Mug	Light bulb	Crisp packet	Cedar balls	Silk cocoon	Bauxite Haematite
Slug ring	Recorder	Spark plug	Marbles	Laminate floor	Sanding block	Teflon coated skirt	Chalcopyrite Sand
Triangle	Recycled mouse mat	Tile	Optical fibre light	Plywood	Wooden spoon	Yarn - Pure wool	Quartz

IOM3 The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Acknowledgements

Can you make it?

- This project and collection would not have been possible without the support and commitment of a number of people and organisations.
- Particular thanks are owed to Tomorrow's Engineers and The Goldsmiths' Company for their generous financial contribution.
- Mandy Pattison for her input in developing the written resources.
- The teachers at the partner and pilot schools for hosting the project.
- The STEM Ambassadors that have given up their time to run the pilot project.
- All of the companies (too varied to mention all) that have supplied samples.

IOM3 The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Can you make it?

Metal

MET 1	Door number
MET 2	Drinks can
MET 3	Metal spoon
MET 4	Plant pot
MET 5	Slug ring
MET 6	Triangle

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Can you make it?

Metals

- Metals are by far the most commonly used group of materials. They tend to be strong, tough, hard, stiff materials that are ductile and malleable (which means they can be formed to shape in many different ways). They are also good conductors of heat and electricity.
- Most metal objects are not made from pure metals, they are made from alloys. An alloy is a mixture of a metal with another material which could be a metal or a non-metal. Some alloys are very simple with just two metals mixed together, others are more complex with many different ingredients.
- By changing the recipe that is used to make an alloy its properties can be very finely controlled so that they are exactly right for the desired application.
- Metals are extracted from special types of rocks called ores. A chemical reaction is used to break up the ore and release the pure metal.
- Metallic materials are generally easy to recycle and this saves energy when compared to extracting them from their raw materials.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

MET 1

Can you make it?

Door number

- This door number is made from brass and brass is an alloy of copper (60%) and zinc (40%).
- Brass is hard wearing and durable, though it will tarnish in time giving it a dull appearance.
- It is malleable so can be formed to complex shapes.
- Brass is a good electrical conductor and is also used for making the pins on plugs.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

MET 2

Can you make it?

Drinks can

- This can is made from an aluminium alloy which is 98% aluminium with 1% manganese and 1% magnesium.
- Aluminium is the most common metal in the Earth's crust but it is difficult to extract.
- Aluminium is strong and does not corrode making it ideal in food packaging.
- The walls of drinks cans like this are less than 1mm thick!

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

MET 3

Can you make it?

Metal spoon

- This spoon is made from stainless steel. Steel is an alloy of iron and carbon but in this case nickel and chromium are added to stop it going rusty.
- It is a strong, tough, hard and durable material that is used in construction, aerospace and automotive applications. Certain types of stainless steel are also used in medicine.

Prepared by Dr Diane Aston, IOM3

IOM3 The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

MET 4

Can you make it?

Plant pot

- This steel plant pot has been galvanised. This means that it has been coated in a thin layer of zinc.
- The zinc prevents the steel from rusting by acting as a barrier so that the water and oxygen in the atmosphere cannot get to the iron.
- If you look closely you can see the tiny crystals in the zinc which have formed as the coating has cooled.

Prepared by Dr Diane Aston, IOM3

IOM3 The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

MET 5

Can you make it?

Slug ring

- These slug rings are made from copper.
- Copper is an excellent conductor of heat and electricity so it is used in wiring and has been used for making pans.
- Copper also has antimicrobial properties which means it will kill bacteria, viruses and fungi on its surface.

MET 6

Can you make it?

Triangle

- This musical instrument is made from steel (an alloy of iron and carbon).
- This material is used as it can easily be formed to shape and like most metals it is sonorous. This means that it produced sound when it is struck.
- Metal musical instruments can also be made from brass.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Plastic

PLA 1	Bottle pre-form
PLA 2	Cupcake cases
PLA 3	Expanded polystyrene ball
PLA 4	Foam ball
PLA 5	Recorder
PLA 6	Recycled mouse mat

Prepared by Dr Diane Aston, IOM3

Plastic

- Plastics, or polymers are a group of materials that consist of long chain molecules, a bit like strands of spaghetti.
- Polymers can be defined as thermosoftening, thermosetting or elastomeric.
- Thermosoftening polymers consist of long strongly bonded molecules held together by weak intermolecular forces. They can be melted and formed to shape and then remelted to be reshaped.
- Thermosetting polymer are characterised by a continuous three-dimensional network of strong bonds. They experience a chemical reaction as they solidify which means that they cannot be melted again.
- Elastomers are very stretchy materials. They can be stretched to about six times their original length but will then go back to their original shape when the force is released.
- Polymer can be natural materials (such as cellulose) or synthetic and many modern synthetic polymers are derived from oil.

PLA 1

Can you make it?

Bottle pre-form

- These are the starting point for making 1 litre fizzy drinks bottles.
- They are made from a plastic called PET because it is strong, lightweight and is good at keeping the fizz in the drink.
- PET is the third most commonly produced synthetic polymer; polyethylene (PE) and polypropylene (PP) are first and second respectively.

PLA 2

Can you make it?

Cup cake cases

- These cases are made from silicone. Silicones are a special group of polymers that are based on silicon and oxygen rather than carbon.
- They are waterproof, not very reactive and they have relatively high melting points.
- Silicones are used as sealants, in medical devices and in cookware such as these.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

PLA 3

Can you make it?

Expanded polystyrene ball

- These balls are made up of many small spheres of polystyrene which grew in size by about 40 times when they were heated in steam. The steam also softened the plastic beads sufficiently for them to stick together.
- This material is often used in food containers and packaging because it does not conduct heat and is a good shock absorber.

PLA 4

Can you make it?

Foam ball

- This ball is made from a polyurethane foam.
- Polyurethanes are relatively strong and tough and they are durable.
- In this case the foam has been made quite rigid so that the ball bounces.
- This type of foam will not spring back to shape if it is squashed.

PLA 5

Can you make it?

Recorder

- This recorder is made from a material called acrylonitrile butadiene styrene, usually shortened to ABS.
- It has been made by squeezing plastic at 232°C into a mould under high pressure.
- ABS is strong, tough and durable making it perfect for toys! (Lego bricks are also made from ABS)

The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

PLA 6

Can you make it?

Recycled mouse mat

- This mouse mat is made from recycled car tyres and it is made from rubber.
- Some types of rubber are natural materials that comes from trees.
- Car tyres are made from a mixture of natural and synthetic rubber.
- The black colour comes from tiny particles of carbon that are added to the rubber mixture.

The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Ceramic

Can you make it?

CER 1	Brick
CER 2	Cement
CER 3	Fuse
CER 4	Mug
CER 5	Spark plug
CER 6	Tile

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Ceramics

Can you make it?

- Ceramic materials are defined as inorganic, non-metallic solids which are made by heating and cooling.
- They are one of the most ancient materials and include rocks, clays cement, glass and precious gem stones.
- Ceramics tens to be strong, particularly in compression, and stiff, making them ideal for use in the construction industry.
- They can be hard, brittle, and resistant to heat and corrosion.
- Clays are a mixture of different minerals which can be formed to shape in many ways. The clay is baked or fired at high temperature to dry it out and change the structure so that it becomes hard.
- Most ceramics consist of one or more varieties of a metal oxide with the atoms of the metal and oxygen forming a crystalline structure.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

CER 1

Can you make it?

Brick

- Bricks are made from natural clay which is allowed to dry out before being formed to shape and fired.
- The clay is a mixture of different minerals and the balance of these affects the colour of the material.
- Bricks made in different parts of the UK have different colours.
- Dried clay bricks date back as far as 7500BC; fired bricks were introduced in around 4500BC!

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

CER 2

Can you make it?

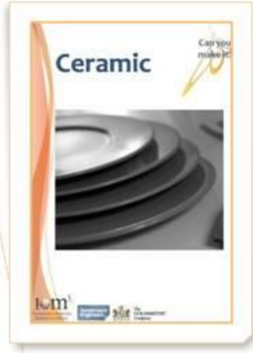
Cement

- Cement is a ceramic material that is used like glue to bind other materials together and it is one of the key ingredients in concrete.
- It is made by heating limestone rock and then grinding this to make a fine powder. When the cement is mixed with water a chemical reaction happens and it becomes hard and strong.

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

CER 3

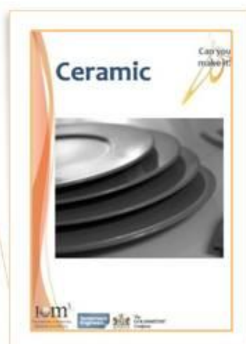


Can you make it?

Fuse

- A fuse is consists of a length of wire which is designed to break and protect a circuit if is overloaded.
- The wire is encased in a ceramic tube which acts as an electrical insulator.
- The ceramic used is a type of silicate clay as this is relatively cheap, can easily be formed to shape and is an excellent insulator.

CER 4

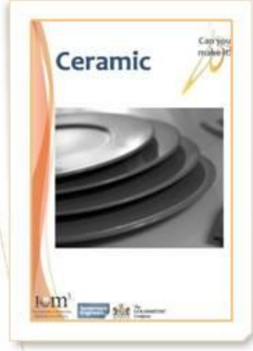


Can you make it?

Mug

- Ceramics are good thermal insulators, that is, they do not conduct heat very well.
- This makes them ideal for use in crockery as your cup of tea will stay nice and warm.
- The cup is made by slip casting. A glaze is then applied to seal the surface and it is fired at high temperature.

CER 5

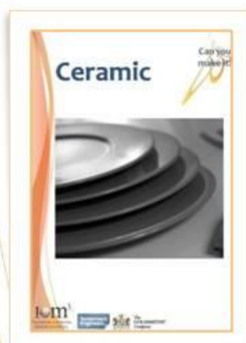


Can you make it?

Spark plug

- Ceramics are used as electrical insulators on spark plugs for car engines.
- Spark plugs are used to deliver and electrical spark from the battery to the fuel-air mixture in the cylinders.
- The insulator is made from porcelain which is a very hard material.
- It can withstand a temperature of 650°C and 60,000 volts.

CER 6



Can you make it?

Tile

- Glazed tiles such as this can be used for covering walls in kitchens and bathrooms.
- They are made from clay which has been shaped, glazed and fired.
- The glaze produces a hard-wearing, waterproof, corrosion resistant surface which is easy to clean.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Can you make it?

Glass

GLA 1	Boiling tube
GLA 2	Glass fibre cloth
GLA 3	Lens
GLA 4	Light bulb
GLA 5	Marbles
GLA 6	Optical fibre light

Prepared by Dr Diane Aston, IOM3

Can you make it?

Glass

- Glasses are a special subgroup of ceramics characterised by having a non-crystalline structure and because of this they are often considered to be super-cooled liquids rather than true solids .
- Glasses tend to be translucent or transparent and are often relatively hard and brittle at room temperature. As they are heated they go through a 'glass transition temperature' where they become rubbery or more viscous before they finally melt.
- The term glass is most often used to describe the glassy material made by melting silica (silicon dioxide) in the form of sand with other ingredients and then forming it to shape. It could be formed in to sheets, cast or blown to form complex three-dimensional objects or drawn in to fibres. This material is called soda-lime glass.
- It is possible to make glasses from other materials by cooling them very rapidly so that crystals cannot form.

GLA 1

Can you make it?

Boiling tube

- This is made from a special type of glass called borosilicate glass.
- This type of glass is safe to be used at high temperatures because it does not expand very much when heated.
- It is made by mixing soda-lime glass with boron oxide.
- Borosilicate glass is commonly known as Pyrex and is used in cookware.

GLA 2

Can you make it?

Glass fibre cloth

- This fabric consists of very fine diameter 'threads' of a glass which have been woven together.
- The glass is made by mixing silica with aluminium oxide and compounds of boron, barium and magnesium.
- Glass fibre cloth can be stuck together with a type of resin to make a strong, tough composite.

GLA 3

Can you make it?

Lens

- This lens is made from soda-lime glass.
- Glass is used for making lenses because it is transparent to visible light.
- It can be ground to shape accurately and it will keep its shape.
- Polymers such as polycarbonate are much lighter than glass so they are now more commonly used for spectacle lenses.

GLA 4

Can you make it?

Light bulb

- The glass in a light bulb has to be able to withstand high temperatures for many hours of use.
- Soda-lime glass is usually used to make light bulbs.
- The first light bulb, as we know it, was patented in 1841.
- Traditional incandescent bulbs are very inefficient, converting only 5% of the electricity into light.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

GLA 5

Can you make it?

Marbles

- These marbles are made from soda-lime glass and various colours have been added to give the swirl effects in the middle of the spheres.
- Clay and stone marbles date back to ancient Egypt and Roman times.
- Modern glass marbles were introduced in 1846.

GLA 6

Can you make it?

Optical fibre light

- Optical fibres are thin fibres of silica glass about the same diameter as a human hair.
- They are used for carrying high-speed internet and cable television signals.
- Optical fibres work by 'bouncing' light along the length of the fibre. This is how a lamp like this works.
- They can also be made from plastic or glass made from aluminium oxide.

Can you make it?

Composite

COM 1	Aluminium honeycomb
COM 2	Carbon fibre composite
COM 3	Concrete
COM 4	Crisp packet
COM 5	Laminate floor
COM 6	Plywood

Prepared by Dr Diane Aston, IOM3

Can you make it?

Composites

- Composites are a diverse group that are made by mixing two or more different materials together.
- The idea is to produce a new composite material that has properties that are better in some way than either of the ingredients on their own.
- Man-made composites can be described by the background or matrix material or the reinforcing material and their properties can be changed by altering the proportions of the ingredients.
- Natural composites have been used through the centuries for the useful properties that arise from the fact that they are mixtures of different materials.
- Composites are used in a wide variety of applications ranging from sports equipment to artificial limbs and aircraft parts to furniture.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

COM 1

Can you make it?

Aluminium honeycomb

- This composite sheet has been made by sandwiching a layer of aluminium honeycomb between two layers of glass fibre epoxy composite cloth.
- The outer layers have been made by adding epoxy resin (a type of glue) to glass fibre cloth to make a rigid sheet.
- This structure is very strong, stiff and lightweight and is perfect for making things like aircraft floors.

Prepared by Dr Diane Aston, IOM3

COM 2

Can you make it?

Carbon fibre composite

- Carbon fibre composite (CFC) is made by mixing cloth consisting of fine, woven carbon fibres with a type of polymer resin to create a strong, lightweight structural material.
- By changing the way the fibres are woven together the composite can be stiff or flexible.
- CFCs are used for making many types of sports equipment.

Prepared by Dr Diane Aston, IOM3

COM 3

Can you make it?

Concrete

- Concrete is made by mixing cement with sand, gravel and water.
- The Romans made a type of concrete for building bridges and buildings and many of these are still standing today.
- Concrete is strong and durable and is the most commonly used construction material. It is estimated that we use between 21 and 31 billion tonnes of concrete each year!

COM 4

Can you make it?

Crisp packet

- Crisp packets are made by sandwiching a very thin layer of aluminium between two outer layers of polypropylene plastic.
- The metal layer provides a barrier to moisture and gas extending the shelf life of the product.

COM 5

Can you make it?

Laminate flooring

- Laminate flooring consists of a structural layer of MDF sandwiched between a bottom layer of special paper which protects the underside from moisture and a top layer of another paper coated in plastic which gives the desired surface appearance.
- It is a type of manufactured wood product that is designed to be hardwearing and retain its shape better than natural wood products.

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

COM 6

Can you make it?

Plywood

- Plywood is made by gluing together thin sheets of wood (usually pine) with the wood grain running in different directions (usually 90° to each other)
- Plywood has the same properties in all directions so it more versatile than natural timber. It also keeps its shape better.
- Plywood always has an odd number of layers.

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Can you make it?

Wood

- WOO 1 Balsa wood
- WOO 2 Cardboard
- WOO 3 Castanets
- WOO 4 Cedar ball
- WOO 5 Sanding block
- WOO 6 Wooden spoon

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Can you make it?

Wood

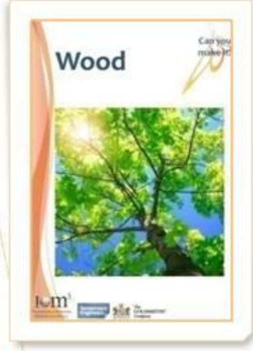
- Wood is a natural material that comes largely from trees. We have been using wood as a construction material and a fuel for millennia and timber products are still extensively used today.
- Wood is a natural composite made up of strong cellulose fibres embedded in lignin. This means that it is very strong in the direction of the fibres but it is relatively easy to pull the fibres apart.
- Wood is a sustainable resource and the planet has about one trillion tonnes of wood, which grows at a rate of 10 billion tonnes per year.
- Wood can be split into hardwoods which tend to come from broad leaved species and softwoods which tend to come from conifers. Some softwoods are harder than some hardwoods and vice versa. The third group of wood products are the manufactured or engineered wood products which range from plywood to paper.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

WOO 1



Can you make it?

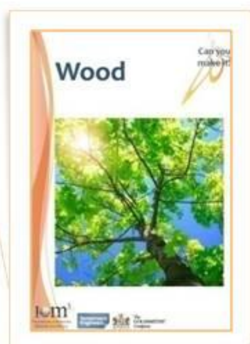
Balsa

- Balsa is a type of hardwood that originates from *Ochroma pyramidale* or balsa trees which grow in Ecuador, Brazil, Bolivia and Mexico.
- The trees are fast growing and can grow to be up to 30m tall in just 10 to 15 years.
- Balsa is extremely lightweight and relatively soft. It has been used in aircraft, wind turbines and sports equipment.

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

WOO 2



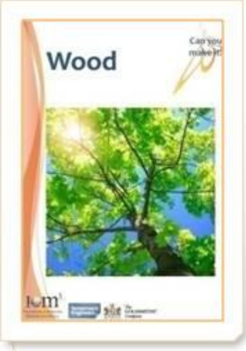
Can you make it?

Cardboard

- Cardboard is a manufactured product made from wood pulp.
- It is extensively used in the packaging industry for boxes as it is lightweight, recyclable and relatively cheap.
- Corrugated card is much stronger than a single sheet of card and is idea for box manufacture.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

WOO 3



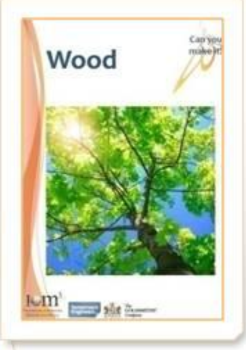
Can you make it?

Castanets

- Wood has been used to make musical instruments through the ages as it can easily be shaped and it is readily available.
- The castanets have been shaped to produce a pleasing sound when the two halves are hit together.
- Wood is used in many percussion instruments but is also used for making flutes, pipes and the bodies of violins and guitars.

Prepared by Dr Diane Aston, IOM3

WOO 4



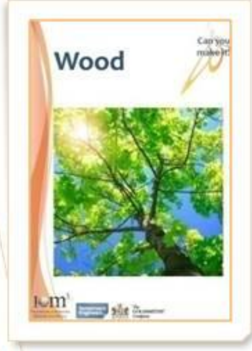
Can you make it?

Cedar ball

- Cedar is relatively lightweight and has an attractive red colour which weathers to grey.
- It is classed as very durable and resists decay so is used for greenhouses, sheds, trellis, cladding and roof shingles. Despite its name it is not a type of cedar.
- It is made in to balls like this to repel moths from attacking clothes.

Prepared by Dr Diane Aston, IOM3

WOO 5

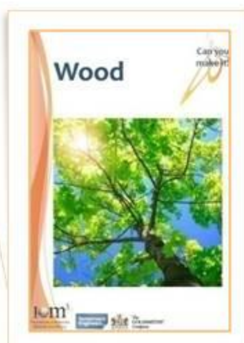


Can you make it?

Sanding block

- This block has been made from cork which comes from the Cork Oak tree, commonly found in Portugal.
- The cork is harvested from the bark of the tree in a sustainable process.
- Cork floats on water but will not absorb it. It is also relatively soft, lightweight and fire resistant.
- The most well known use of cork is for making bottle stoppers.

WOO 6



Can you make it?

Wooden spoon

- The spoon is made from beech wood.
- Beech trees are a deciduous species, common across the temperate regions of the globe, that can grow up to 35m tall.
- Beech is probably the most useful hardwood. It is strong, it machines and finishes well and holds nails and screws exceptionally well.
- Rayon fibres are made from beech pulp.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Fibres

Can you make it?

FIB 1	Bamboo socks
FIB2	Kevlar glove
FIB 3	Recycled bag
FIB 4	Silk cocoon
FIB 5	Teflon coated skirt
FIB 6	Yarn – pure wool

Prepared by Dr Diane Aston, IOM3

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Fibres

Can you make it?

- Fibres are hair like materials of varying diameters that can be woven or knitted together to make cloth.
- Natural fibres can be of animal or vegetable origin. These include cotton, hemp, flax, bamboo, wool, alpaca, angora and mohair. These fibres can also be converted into non-woven materials such as felt.
- Man-made fibres are produced from polymers which can come from natural sources such as wood (for example rayon or viscose from wood) or oil.
- A wide range of polymers from oil are used to make textiles including polyester, acrylic and nylon.
- By changing the way in which the fibres are woven or knitted together the texture and properties of the cloth can be changed.
- The textile industry was at the heart of the Industrial Revolution.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

FIB 1

Can you make it?

Bamboo socks

- Bamboo can be turned into fibres that can be used in the manufacture of a wide range of clothing from socks to t-shirts and even reusable nappies.
- Bamboo fibres a lightweight, soft, absorbent and antimicrobial.

FIB 2

Can you make it?

Kevlar glove

- Kevlar is a type of polymer that is used for its excellent strength, toughness and resistance to both high and low temperatures.
- It is used in fire-fighter's uniforms and oven gloves.
- Kevlar is also used for making abrasion resistant clothing.

FIB 3

Can you make it?

Recycled bag

- This bag has been made from recycled fizzy drinks bottles made from PET.
- The other name for PET is polyester.
- Waste plastic is washed, shredded, melted and then turned into fibres which are made into cloth.
- Recycled PET is now commonly also used in clothing.

FIB 4

Can you make it?

Silk cocoon

- Silk is a natural material produced by the larvae of the mulberry silk worm.
- The silk is made by the larvae as they spin their cocoon.
- The use of silk fabric dates back to 3500BC in China and for centuries it has been seen as an expensive high status textile.
- As silk fibres are very fine, silk fabric tends to have a very dense, close weave.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

FIB 5

Can you make it?

Teflon coated skirt

- This polyester school skirt has been coated with a special material called Teflon.
- Teflon is just a trade name, the actual polymer is polytetrafluoroethylene or PTFE.
- Teflon is non-stick so this fabric is water repellent and stain resistant. The same material is used to coat non-stick pans.

FIB 6

Can you make it?

Yarn – pure wool

- The yarn used to knit this square has been made from the wool from one particular breed of sheep, the Shetland Moorit.
- The fleece has undergone the minimum of treatment and this is the natural colour of the wool.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Can you make it?

Other

- Yarns from different sources
- Silk cloth
- Bamboo pole and fibre
- Kevlar and carbon fibre cloth
- Metal ores
- Quartz and sand
- Polymer granules

Can you make it?

Other

- This collection of other materials have been put together to help you to tell a story with some of the materials.
- A number of raw and intermediate materials have been included so that you can show where things come from or so that you can demonstrate the different stages of production.

Can you make it?

Yarns of different materials

- **Top row left to right:**
- 100% wool (single breed) FIB 6
- 70% kid mohair, 30% silk OTH 1
- 100% acrylic OTH 2
- **Bottom row left to right:**
- 93% Recycled wool, 7% acrylic OTH 3
- 36% recycled cotton, 36% recycled silk and 28% recycled viscose OTH 4
- 100% alpaca OTH 5

OTH 1

Can you make it?

Yarn – silk and mohair

- Silk is natural material that is made by the mulberry silk worm.
- Mohair is a natural material that comes from the angora goat.
- Mohair yarn was spun in Yorkshire from the 1820s and exported around the world.
- Mohair has a halo, or fluffiness which traps air between the fibres, keeping you nice and warm!

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

OTH 2

Can you make it?

Yarn – acrylic

- Acrylic is a synthetic polymer that can be produced as fibres for knitting or weaving.
- The texture of the yarn can be changed by altering the length of the fibres from which it is spud.
- Acrylic is resistant to sunlight, moth attack and most chemicals and oils.
- It is also machine washable!

OTH 3

Can you make it?

Yarn – recycled wool

- This blend is made from 93% recycled wool and 7% acrylic.
- Wool garments have been chopped up, mixed with acrylic and then new yarn spun from the fibres.
- This has a coarser texture than the pure wool.

OTH 4

Can you make it?

Yarn – recycled silk, cotton, viscose mix

- Viscose is a man-made fibre produced from wood cellulose.
- Viscose can be made to feel like many other fibres and was first made in the UK by Courtaulds in Coventry in 1905.
- This blend of recycled fibres has virtually no stretch and resembles string!

OTH 5

Can you make it?

Yarn – alpaca

- Alpaca comes from the fleece of the alpaca, a smaller version of the South American llama.
- It is warmer and smoother than wool and like wool it is flame resistant. It does not absorb water so is excellent as a fine base-layer for clothing.
- Alpaca has been spun and woven in Bradford since the early 1800s.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

OTH 6

Can you make it?

Bamboo fibres

- Bamboo fibres are made by breaking down bamboo stems and leaves into pulp and they are essentially made from cellulose.

OTH 7

Can you make it?

Bamboo pole

- Bamboos are amongst the fastest growing plants on the planet and they are actually a type of grass. One species of bamboo can grow up to a metre a day! There are around 1600 species of bamboo.
- Bamboo poles have been used in construction of buildings, scaffolding, plumbing systems and musical instruments.

OTH 8

Can you make it?

Silk cloth

- Silk fabric has been produced for many centuries and its has long been regarded as a high status cloth.
- The machines used to weave silk damask during the Industrial Revolution can be thought of as the earliest form of programmable computer, able to weave complex patterns from many coloured threads.

OTH 9

Can you make it?

Kevlar cloth

- Kevlar was developed by DuPont in the 1960s as an alternative to steel wire for reinforcing car racing tyres.
- It is a strong, tough, durable, lightweight material that can be woven (right) or knitted (left) to make fabric that is used for protective clothing such as butchers gloves or motorcycling trousers.

OTH 10

Can you make it?

Carbon fibre cloth

- Carbon fibre cloth is made by weaving or knitting carbon fibres and it is soft and flexible like any other fabric.
- The individual threads have about the same diameter as a human hair but they are extremely strong.
- The fibres are made by heating special polymer threads to high temperature to burn off the unwanted parts and then pulling them to align the carbon plates.

OTH 11

Can you make it?

Polymer granules

- Most polymer processing starts with the plastic in the form of granules like these.
- The granules are melted and then formed to the desired shape using processes such as injection moulding or extrusion.

OTH 12

Can you make it?

Bauxite

- Bauxite is the main ore of aluminium and it consists of aluminium oxide (alumina) and other minerals.
- Alumina is a very stable compound so electrolysis has to be used to split it and release the aluminium.
- Electrolysis uses vast amounts of electricity so recycling aluminium saves a huge amount of energy.

OTH 13

Can you make it?

Haematite

- Haematite (sometimes spelled hematite) is the main ore of iron. It is a type of iron oxide which is why it is rusty coloured.
- This sample comes from Cumbria but haematite deposits are found all over the world.
- Iron is extracted by mixing hematite with coke (carbon) and limestone in a blast furnace.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

OTH 14

Can you make it?

Chalcopyrite

- Chalcopyrite is one of the main ores of copper and is composed of copper and iron sulphide.
- The copper is extracted by heating in air once the iron compounds have been removed.
- There are several huge open pit copper mines in North and South America. These vast holes in the ground can be seen from space.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

OTH 15

Can you make it?

Sand

- Silica sand is the main starting ingredient for most types of glass.
- It is formed as quartz-containing rocks are eroded by water over many years.
- The particles in sand are between 0.0625 and 2 millimetres in diameter.
- Many different types of sand are available for different applications.

OTH 16

Can you make it?

Quartz

- Quartz is sometimes called rock crystal and it is a mineral called silica.
- Silica is silicon dioxide and it is one of the most common minerals on the planet.
- Quartz is usually found in the form of much smaller particles in rocks but crystals such as this can grown when the cooling conditions in the Earth's crust are just right.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by Dr Diane Aston, IOM3

Can you make it?

Treasure Hunt materials cards

Give one of these cards to each pupil or group of pupils so that they know which material to look for.

Can you make it?

Metal

The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Can you make it?

Plastic

The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Can you make it?

Ceramic

The Institute of Materials, Minerals and Mining · Tomorrow's Engineers · The GOLDSMITHS' Company

Can you make it?

Glass

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

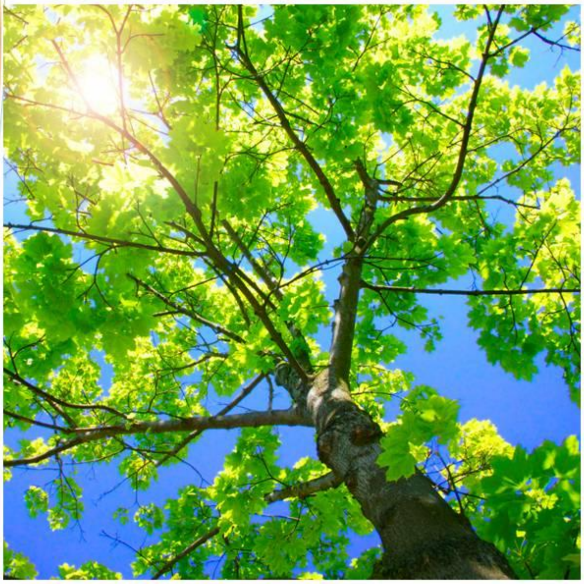
Can you make it?

Composite

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Can you make it?

Wood



The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Can you make it?

Fibres

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Can you make it?

APPENDIX 3

Full running instructions for Crash Helmets for Eggs

Back to contents

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

Crash Helmets for Eggs

Can you make it?

- Crash Helmets for Eggs is a design and build activity in which pupils investigate the materials used in the construction of crash helmets.
- It is a useful way of introducing some of the scientific thinking concepts pupils will have been learning, such as the idea of fair testing, forces and energy, structure of materials and how they link to properties, key stages in performing an experiment.
- The activity works equally well as part of a science or design & technology lesson and is in fact a really good way of linking the two subjects.
- Pupils work in teams to complete the task and the number of teams is only limited by the amount of space and time that you have to run the activity. Ideally no more than 20 teams should take part (40 pupils in pairs or 60 in groups of three) as with more than this the testing phase becomes very drawn out. With larger numbers you could introduce heats.
- This activity has been incorporated into the **Can you make it?** project where the initial introduction and research phases are done at the end of the first session, the design and build phases are done in science lessons between sessions and the test and evaluation phases are done during the second formal session.
- Crash Helmets for Eggs can also be run as a standalone activity in about an hour and approximate timings are given in brackets for this purpose.
- These notes are split into the following sections:
  - Preparation and materials
  - Introduction
  - Research phase
  - Design phase
  - Build phase
  - Test phase
  - Evaluation phase

IOM3 The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The Goldsmiths' Company

Prepared by
Dr Diane Aston, IOM3

Preparation and materials

- If you are running this activity as part of the **Can you make it?** project all consumables except sticky tape and eggs will be provided.
- If you are running this activity yourself you will need to start squirreling away packaging materials to use to build the designs. I usually provide **packaging chips** that come in all sorts of varieties (you can buy these cheaply from stationary shops or get people collecting them for you), **foam or sponge** (I usually buy cheap pan scourers and pull off the scouring bit!) and **bubble wrap** (again I get people collecting this for me but usually end up buying some from the stationers). I bag up the materials beforehand to make it easier on the day; each group gets about 15 packing chips, a roughly 15x15cm sheet of bubble wrap and a piece of foam approximately 8x8x2cm. During the activity the groups each get a 50cm length of **parcel tape** to stick their designs together with and **scissors** to cut the stuff up with.
- You will need to buy enough **eggs** for one per team. I usually buy free range medium (free range have much tougher shells), varying in weight from about 55 to 70g. Just before the activity I number and pre-weigh the eggs to save time during the activity. You will need some **scales** during the activity so the groups can re-weigh their eggs wearing the crash suits. A pair of ordinary kitchen scales will do fine.
- A set of **stepladders** is useful to stand on to test the designs I would also recommend that you get some **plastic sheet** or a bin bag to put on the floor as a drop zone during testing as things can get messy!
- You will need to enough **worksheets** for one per team and you will need a **master sheet** so you can record the results. The worksheet has a summary of the introduction on the front and on the back has space for the pupils to write their team name, draw their design and record their results.
- I would recommend that you do this activity in a classroom or workshop without a carpet as dropping the eggs can be messy and it is difficult to get bits of expanded polystyrene out of carpet (speaking from the experience of picking it out by hand!).
- If appropriate you can layout and number each workstation with a worksheet, pencil(s), bag of materials, sticky tape and scissors prior to the group coming in and ask the pupils to go their numbered station as they enter the room. Always hand the eggs out later!

Can you make it?

Introduction (5 minutes)

- Explain to the pupils that they will be working on their challenge in teams just as real scientists or engineers would do if they were working on a multi-million pound project in industry.
- Explain that it is important to be able to put aside personal differences to work together to come up with the most effective solution; this is how the real world works! Sometimes when you get a job you start out working with people you do not know and after a while you may find that you don't get on, but you have to make the best of the situation.
- Explain to the group that they will be working with limited resources and will have to work to tight time deadlines.
- Explain the importance of good record keeping through out the project just as real scientists and engineers do. Sometimes university or industry projects go on for years and it is important to be able to refer back to earlier work.
- Explain that their project will be split into four sections:
  - Research the problem
  - Come up with a design to solve the problem
  - Build the design
  - Test and evaluate the design
- Introduce the challenge:
  - **To design and build the lightest possible crash protection suit to prevent an ordinary (not hard boiled) hen's egg from breaking when dropped on to the ground from a height of about two metres.**
- Explain that certificates and prizes will be given for the lightest design that protects the egg and the best team name.

Research phase (10 minutes)

Can you make it?

- Rather than getting the pupils to go and do their own research in the library or on the internet we look at cycle helmets and why it is important that you wear one.
- Encourage the pupils to think about all the things a cycle helmet needs to do or be when you are wearing it, such as it has to:

  be streamlined · be cheap · be easy to mass produce · be comfortable · be durable · look nice / be different colours · fit your head and lots of other sizes and shapes of peoples heads · fasten on to your head so it can't fall off · have holes in to keep your head cool
- But the most important things are that it is **lightweight** and **compact**, that it is a **close fit** (if you wear a helmet that is too big, when you fall off your helmet hits the floor and then your head hits the inside of the helmet and it can still do serious damage) and crucially it is a **good shock absorber**, i.e. it will absorb the energy of an impact.
- I usually have a real helmet on hand to demonstrate and explain that cycle helmets are generally made from three layers of material (see next page).
- The idea is for the teams to use cycle helmets as the basis for their design, i.e. to design something which will absorb energy on impact rather than slow the fall of the egg; **parachutes and wings are banned!**
- It is worth re-iterating to the pupils that their design needs to go all the way round the egg to make a suit rather than on just one end like a helmet, as you can't easily control the way it will fall when dropped.
- Introduce each of the different materials that they can use to build their designs and explain that these materials all contain air bubbles. In some cases these are big enough to see, such as in bubble wrap but in other cases they are too small to see. I encourage the pupils to look after the air bubbles as these will protect the egg. If they pop the bubbles in the bubble wrap (tempting as it is) they will ruin its energy absorbing properties!
- Introduce the concept of fair testing and get the pupils to identify all the variables and decide whether they are constant (e.g. egg size, amount of material, height of drop etc.)
- Encourage the teams to come up with a name – the eggier the better! Past contenders include Eggheads, Eggineers, Eggsperimentalists, Eggsterminaters, Eggsperts, Eggstremists, all things scrambled and cracking, I've had an Egghog that looked like a hedgehog and an Eggloo that looked like an igloo and my favourite from a year 11 team, an oeuf is an oeuf! One of the best was SupaAntiCrackaNotAChanceAShockAbsorba!

Cycle helmets explained...

- Cycle helmets are generally made from three layers of material:
  - An outer layer of hard plastic is designed to make the helmet durable and wearable in lots of different kinds of weather. It can be coloured to make the helmet look nice, but its main function is to protect the middle layer from minor damage such as denting and scratching.
  - The innermost layer is usually made of sponge and its function is to make the helmet fit closely and be comfortable. In many helmets you get several bits of this foam in different thicknesses so you can fine tune the fit
  - The middle layer is the most important as this absorbs the energy of the impact. It is usually made from a polymer foam such as expanded polystyrene.
- Foams are types of plastics that are full of air bubbles. They are made by puffing up beads of plastic when it is soft and if you look at foam under a microscope it will look a bit like Aero chocolate - it is full of bubbles.
- When you fall off all the little bubbles in the area of the helmet that you have landed on squash and as they do this they absorb the shock and stop it going through to damage your skull.
- The reason that you have to buy another helmet if you have fallen on yours once is that these little air bubbles or cells don't spring back to shape when the squashing force is removed. This is different to the foam in the soles of your training shoes which is designed to squash and unsquash repeatedly.

Can you make it?

Design phase (10 minutes)

- It is useful to put the materials packs on the tables so the students can look at and explore them during the design stage.
- Encourage the teams to assign a scribe to document the ideas. Perhaps ask them to draw a neat labelled diagram of their idea or create a flow chart of how they are going to build their design.
- Write the names of the materials on the board so that they know what they have to choose from and how to spell them correctly.
- Explain that they can choose to make their crash suit from one type of material or a mixture of all of them, which ever they think will work the best. To give you an idea of the sort of designs they should be aiming for, the lightest design ever to win in the 15 or so years I have been doing this used just 2g of packaging material. They strategically stuck about a dozen packaging shapes end-on around their egg with tiny bits of tape folded to make it double-sided. More realistically, winning designs usually weigh in at between about 8g and 15g of material, this is equivalent to a couple of layers of bubble wrap or an egg shaped shell of expanded polystyrene carved to fit closely to the egg. I usually say that the design must fit easily on to the pan on my scales, so there is no need to produce anything the size of a football, aim for something more like the size of a tennis ball. Get them to think back to cycle helmets - you wouldn't wear it if it was huge!
- Get the teams to think about the properties of eggs, whether they are stronger in one direction whether they can use this to their advantage in their design.
- While they are doing the designs walk around and discuss them with the groups and at the same time, give out lengths of tape (about the length of the short side of a school table). With relatively small groups this works better than having the tape on the workstations already as it can get damaged.

Build phase (10 minutes)

- Before the groups start building their designs I usually give them a few important instructions (most of these are commons sense really but worth noting):
  - Be careful with the scissors while cutting the materials. If they need help with a tricky bit, ask for it.
  - Be very careful with their egg as it is the only one they will get. No breaking other group's eggs either! If you have spare eggs you can introduce a weight penalty for teams that have broken one so that they can still take part; a 5g penalty is about right.
  - Be careful with the tape, if they fold it up and get it stuck to itself they won't get anymore.
  - Use their materials sparingly, as these are the only ones they'll get!
  - Keep their work area tidy. I usually get the teams to tidy up and put everything away before testing.
  - There is no rush to finish. Everyone will get the same amount of time and if they finish in the first couple of minutes they will just have to sit around and wait for everyone else.
- Build time is often a bit frantic and it is useful to have an extra pair of hands or two to keep an eye on the group.
- Each group will need an egg. You can either give these out or get one person from each team to collect and egg while the other gets the scissors.
- On the pupil worksheet there is space for them to record their egg number and how much it weighs. On your Master Sheet there is space for you to record the mass of the eggs and the team names, I usually walk round the group while they are building to write the names down and make sure they have recorded their egg number and its mass. An extra pair of hands is very handy at this point!
- At the end of the build time I get them to come and reweigh their eggs wearing their crash suits. There is space on the pupil handout and master sheet to record this and to work out and record how much material has actually been used. Once this is done and everything is tidied up its time for the fun bit…

Can you make it?

Test phase (20 minutes)

- The duration of the test phase depends very much on the number of groups, their age and ability to get on with it. Testing will generally take 1 to 2 minutes per team.
- While the groups are finishing tidying up I work out the order that the designs will be tested in. Rather than just go down the list, to make things a bit more interesting I test the designs heaviest to lightest, as it's the lightest design that wins! I also tape a bin bag or plastic sheet on to the floor to act as a drop zone (to contain any eggy mess!). Your extra pair of hands will be of greatest use at this stage as your Official Eggsaminer whose decision is final!
- Call out the teams in turn and ask each group to come to the front and tell the others about their design. Ask them to present you with their design the way round that they would like you to hold it and then drop it!
- Your Eggsaminer should pick up the dropped designs and carefully get in to them to see if the eggs are OK. As a broad rule of thumb, if the design bounces the egg is usually OK, if you see yellow get a paper towel!
- This bit is really good fun! We often have a count down for each drop or a drum roll but then try to get the pupils to be quiet during the actual drop to see if they can hear the splat!! Try to make this bit as exciting as possible, maybe even a bit theatrical!
- Deciding the best design prize is easy, it is the lightest one that doesn't breakI
- It is good to get the pupils to decide the best team name by putting their hand up for the one they like best. I tend to say they can only vote once and they can't vote for themselves.

Evaluation phase (5 minutes)

- Once all the designs have been tested encourage the teams to discuss and record whether their design worked and how it could be improved. If it failed could they have used different materials and if it survived how could they make it lighter?
- Encourage them to compare their design to a real helmet and scale the sizes up. For example a 65g egg wearing a 10g suit would scale up to a 65kg person wearing a 10kg suit which is very heavy! Real cycle helmets tend to weigh well under 500g.
- While the teams are completing their evaluations you will have a chance to fill names in on the certificates for the winners.
- Small prizes will be provided as part of the **Can you make it?** project.
- Finish off by awarding the prizes and encouraging the group to go away thinking more about the materials around them and taking them less for granted.

Extension ideas

- You could run this project in a number of other different ways depending on the age group and ability of the pupils you are working with and the amount of time you have got to spare. These are just a few suggestions.
- FORCES – Get the pupils to think about the forces acting on the egg as it falls and see if they can calculate the speed that the egg hits the ground at.
- HEIGHT OF DROP – Test the designs from increasing heights. You could use a stairwell to do this and count the number of stairs. Keep going up a step until the design fails. You might need to give the groups extra materials to do this.
- USE OF DIFFERENT MATERIALS – Introduce other materials to the challenge.
- AMOUNT OF MATERIALS – Do not make up individual material packs. Instead give the teams a monetary allowance and get them to buy materials. Make up prices for each of the material types. For example allow each team £5 and then charge 25p for each packing chip, £2.50 for each 10x10cm sheet of bubble wrap, £1.00 for each 8x8x2cm sponge and 20p for every 10cm of tape. See who comes up with the best (lightest) design for the cheapest price.

Back to contents

Can you make it?

APPENDIX 4

Materials in the National Curriculum for Science

Back to contents

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

MATERIALS IN THE SCIENCE CURRICULUM

Can you make it?

- The following notes have been prepared to show where materials topics appear in the draft National Curriculum for Science (2013).
- In the broadest sense MATERIALS AND THEIR PROPERTIES appear throughout all strands and Key Stages of the Science curriculum. With the planned changes in the primary science curriculum now through the consultation stage it seems appropriate to suggest areas of how this proposed curriculum could support the teaching of materials within your science lessons.
- The correct use of SCIENTIFIC LANGUAGE continues to be of significant importance with pupils being expected to read and spell scientific vocabulary at a level consistent with their increasing word reading and spelling knowledge.
- In terms of SCIENTIFIC ENQUIRY the principal focus of science teaching in lower Key Stage 2 is to enable pupils to broaden their scientific view of the world around them whereas in upper Key Stage 2 the main objective is to enable pupils to develop a deeper understanding of a wide range of scientific ideas.
- Pupils in Years 3 and 4 should use practical science to raise their own questions about the world around them. By Years 5 and 6 pupils should use their science experiences to: explore ideas and raise different kinds of questions; select and plan the most appropriate type of science enquiry to use to answer scientific questions; recognise when and how to set up fair tests and explain which variables need to be controlled and why.
- In addition to the main activities the following grid aims to offer suggestions for using the Handling Collection within your school (in between the formal sessions) primarily, but not exclusively, with the year group who are undertaking the activity. It also suggests investigations, extension activities and research opportunities for your pupils; some of which could be done as homework.
- If you use the materials to enhance and enrich any other aspects of the curriculum – perhaps another area of science or another subject – please let us know so that we can share your top tips with other teachers.

IOM3 The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company

Prepared by
Dr Diane Aston, IOM3

Can you make it?

Key Stage 1 – Year 1

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
EVERYDAY MATERIALS		
Using the properties from the *Notes and guidance* ask pupils to sort the objects into groups (hard/soft; stretchy/stiff; shiny/dull; rough/smooth; bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent). Can they group the same objects into man-made or natural in terms of the material they are made from? Can they think of an easy way of deciding which are heavy and which are light? (Pupils should be encouraged to compare objects of similar sizes as this will introduce the idea of a fair test)	Pupils should be taught to: • distinguish between an object and the material from which it is made • identify and name a variety of everyday materials, including wood, plastic, glass, metal, water, and rock • describe the simple physical properties of a variety of everyday materials on the basis of their simple physical properties • find out how the shapes of solid objects made from some materials can be changed by squashing, bending, twisting and stretching	Pupils should explore, name and discuss everyday materials so that they become familiar with the names of materials and properties such as: hard/soft; stretchy/stiff; shiny/dull; rough/smooth; bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent. Pupils should explore and experiment with a wide variety of materials, not only those listed in the programme of study, but including for example: brick, paper, fabrics, elastic, foil. Pupils might find out about people who have developed useful new materials; for example, Dunlop, Macintosh or McAdam. Pupils might work scientifically by: performing simple tests to explore questions such as: 'What is the best material for an umbrella? ...for lining a dog basket? ...for curtains? ...for a bookshelf? ...for a gymnast's leotard?'

Key Stage 1 – Year 2

Can you make it?

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
USES OF EVERYDAY MATERIALS		
After the pupils have identified the various materials and discussed their uses in the different objects, challenge them to find examples by doing a survey of materials in their school and its grounds. Have they discovered any unusual uses of the materials?	Pupils should be taught to: • identify and compare the uses of a variety of everyday materials, including wood, metal, plastic, glass, brick/rock, and paper/cardboard.	Pupils should identify and discuss the uses of different everyday materials so that they become familiar with how some materials are used for more than one thing (metal can be used for coins, cans, cars and table legs; wood can be used for matches, floors, and telegraph poles) or different materials are used for the same thing (spoons can be made from plastic, wood, metal, but not glass tables can be made from plastic, wood, metal, but not paper). Pupils might work scientifically by: comparing the uses of everyday materials in and around the school with materials found in other places (at home, the journey to school, on visits, and in stories, rhymes and songs); observing closely, identifying and classifying the uses of different materials, and recording their observations. Pupils should be encouraged to think about unusual and creative uses for everyday materials.

The Institute of Materials, Minerals and Mining
Tomorrow's Engineers
The GOLDSMITHS' Company
Prepared by
Dr Diane Aston, IOM3

Can you make it?

Lower Key Stage 2 - Years 3&4

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
FORCES AND MAGNETS		
Using a selection of the objects and a magnet ask the pupils to predict which of them will be attracted to the magnet and which will not. Ask them to test their predictions and using what they have discovered challenge them to find other objects in the classroom which will be attracted to a magnet.	Pupils should be taught to: • observe how magnets attract or repel each other and attract some materials and not others. • compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials.	Pupils might work scientifically by: sorting materials into those that are magnetic and those that are not.
LIGHT		
Using a selection of the objects and a torch ask the pupils to group the objects into those that reflect like and those that do not. Do they notice any difference if the torch is removed? Are they still reflecting light and if so where is it coming from?	Pupils should be taught to: • notice that light is reflected from surfaces • associate shadows with a light source being blocked by something;	Pupils should explore materials to help them to understand the differences between the meaning of transparent, translucent and opaque. Pupils might work scientifically by: investigating the suitability of materials for different purposes, such as blackout curtains; exploring whether shiny things shine in the dark

Can you make it?

Lower Key Stage 2 - Years 3&4

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
STATES OF MATTER		
All of the material samples are solids, ask the pupils to make a list of the properties of a solid, Challenge them to think of how they could make a metal into liquid. Can they name a metal that is liquid at room temperature?	Pupils should be taught to: • compare and group materials together, according to whether they are solids, liquids or gases • observe that some materials change state when they are heated or cooled, and measure the temperature at which this happens in degrees Celsius (°C), building on their teaching in mathematics	Pupils might work scientifically by: grouping and classifying a variety of different materials
SOUND		
Using the various musical instruments pupils could investigate ways of making sound and the best materials for doing so. They could consider the properties of metal and wood that make them a good choice. They could investigate what happens to the sound a percussion instrument makes when they place it on different surfaces or as suggested in the draft *Notes and guidance* the best material for making ear muffs.	Pupils should be taught to: • observe and name a variety of sources of sound, noticing that we hear with our ears • identify how sounds are made, associating some of them with something vibrating	Linked with work in music, pupils should explore various ways of making sounds, for example using a range of musical instruments to make louder and softer, and higher and lower sounds. Pupils might work scientifically by: exploring how the pitch and volume of sounds can be changed in a variety of ways, and finding patterns in the data (for example, blowing across the top of bottles, changing the length and thickness of elastic bands). They might make ear muffs from a variety of different materials to investigate which provides the best insulation against sound.

The Institute of Materials, Minerals and Mining

Tomorrow's Engineers

The GOLDSMITHS' Company

Prepared by Dr Diane Aston, IOM3

Can you make it?

Lower Key Stage 2 - Years 3&4

Potential extension activity	**Draft National Curriculum** (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
ELECTRICITY		
Using a selection of the materials pupils could investigate which are the best electrical insulators and which would be used to conduct electricity. Challenge them to explain why we do not have power sockets in bathrooms and whether they think that water is an insulator or conductor.	Pupils should be taught to: • recognise some common conductors and insulators, and associate metals with being good conductors.	Pupils might work scientifically by investigating that metals tend to be conductors of electricity, and that some materials can and some cannot be used to connect across a gap in a circuit.

Upper Key Stage 2 - Years 5&6

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
PROPERTIES OF EVERYDAY MATERIALS AND REVERSIBLE CHANGE		
Ask the pupils to design an experiment to determine the hardness of a set of suitable materials. Can they produce a table of hardness and use this to explain why certain materials are chosen for particular jobs (matching properties to function) Challenge them to find out why we can only recycle certain materials and to decide which of the materials they have could be recycled, burnt or become waste in land fill sites.	Pupils should be taught to: • compare and group together everyday materials based on evidence from comparative and fair tests, including their hardness, solubility, conductivity (electrical and thermal), and response to magnets • give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic	Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials and relating these to what they learnt about magnetism in Year 3 and about electricity in Year 4. Pupils might work scientifically by: investigating questions such as 'Which materials would be the most effective for making a warm jacket, or for wrapping ice cream to stop it melting?' They might compare materials in order to make a switch in a circuit.

Upper Key Stage 2 - Years 5&6

Can you make it?

Potential extension activity	Draft National Curriculum (available from www.education.gov.uk/nationalcurriculum)	
	Programme of Study (statutory requirements)	**Notes and guidance** (non-statutory)
CHANGES THAT FORM NEW MATERIALS		
Do the pupils know what Chemistry is? Ask them to draw a picture of a "Chemist" and then to use a dictionary to find a definition of the word Chemistry and Polymer. Challenge them to find a chemist from the past who has changed their lives with their invention/discovery. Ask the pupils to think about how polymers are very important in the making of sporting equipment. For example how have football boots and balls changed in the last 100 years.	Pupils should be taught to: • explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible,	They should find out about how chemists create new materials, for example Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton. Pupils might research and discuss how chemical changes have an impact on our lives, for example cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials

Back to contents

Can you make it?

APPENDIX 5

About us

Back to contents

The Institute of Materials, Minerals and Mining

Prepared by
Dr Diane Aston, IOM3

The Institute of Materials, Minerals and Mining

Can you make it?

- The Institute of Materials, Minerals and Mining (IOM3) is a major UK engineering institution whose activities encompass the whole materials cycle, from exploration and extraction, through characterisation, processing, forming, finishing and application, to product recycling and land reuse.
- It exists to promote and develop all aspects of materials science and engineering, geology, mining and associated technologies, mineral and petroleum engineering and extraction metallurgy, as a leading authority in the worldwide materials and mining community.
- The Institute has 17 technical divisions, societies and associations which act as special interest groups, forming a focus for activities within specific sectors. The Wood Technology Society is one such group. We also have a network of some sixty affiliated local societies throughout the UK, and in a number of other countries.
- The Institute has been supporting the teaching of the materials topics in the 11 to 19 curriculum through the Schools Affiliate Scheme since 1999. Membership of the Scheme is split between science and design & technology departments and is a mixture of state and independent secondary schools, sixth form colleges and FE colleges.
- Can you make it? Is our first resource for primary schools.
- For more information visit www.iom3.org, www.iom3.org/sas and www.iom3.org/canyoumakeit

Back to contents

Tomorrow’s Engineers

Can you make it?

- Tomorrow’s Engineering is an initiative led by Engineering UK, the Royal Academy of Engineering and supported by other organisations.
- It has been set up to give 9 to 16 year old access to clear, consistent and up to date information about engineering careers and opportunities to discover and explore engineering first hand.
- Tomorrow’s Engineers programme is made up of a number of initiatives, such as industry visits, workshops, Science, Technology, Engineering and Maths (STEM) Ambassador partnerships and careers resources, to help schools to incorporate engineering into the current curriculum and plant the seeds needed to grow local engineering talent needed by businesses.
- Many of the programmes direct pupils to the Tomorrow’s Engineers website where they can find out more about engineering careers.
- For more information visit www.tomorrowsengineers.org.uk or email contactus@tomorrowsengineers.org.uk

Back to contents

Can you make it?

The Goldsmith's Company

- The Worshipful Company of Goldsmiths, more commonly known as the Goldsmiths' Company, is one of the Twelve Great Livery Companies of the City of London and received its first royal charter in 1327.
- The Company was founded to regulate the craft or trade of the goldsmith and since 1300 has been responsible for testing the quality of gold and silver. In 1975 platinum was added to this regime and palladium was included in 2010. The word hallmark originates from the fifteenth century when London craftsmen were first required to bring their artefacts to Goldsmiths' Hall for assaying and marking. This requirement continues unchanged today and the Company still carries out its statutory function through the operations of The Goldsmiths' Company Assay Office.
- The Company continues to play an important role in support of the craft and industry today. funding apprenticeships and assisting with the technical training of aspiring craftsmen.
- It also supports a number of charitable activities and educational projects for schools and teachers. These include courses for teachers and grants for primary and secondary schools.
- For more information visit www.thegoldsmiths.co.uk or email education@thegoldsmiths.co.uk

Back to contents