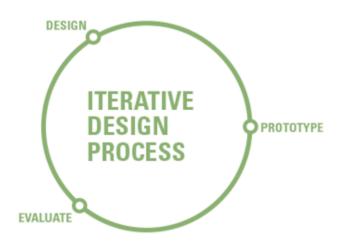
#### THE ITERATIVE DESIGN PROCESS



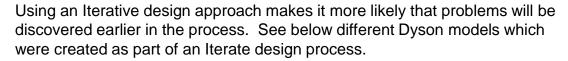


Iterative Design is a design strategy or philosophy. It is used to avoid design fixation which is when designers become overly attached to a particular idea.

Iterative design is a cyclic approach. Each Iteration of a design is tested and evaluated. Changes and refinements are then made, leading to a new Iteration.

#### dyson

Dyson vacuum cleaners are a good example of a product range designed using an iterative design process. The original DC01 was developed as a result of thousands of different prototypes.





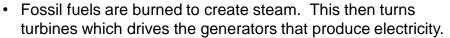


| Advantages of Iterative Design  | Disadvantages of Iterative Design   |
|---|---|
| Because each iteration is fully tested and evaluated it is more likely that problems with the design will be discovered earlier and dealt with. | Designers can be so focused on the current iteration that they sometimes lose sight of the bigger design picture. |
| It encourages focus on the most critical aspects of a product's design.   | It can be time consuming if a lot of prototypes or iterations need to be produced.                                |
| Evidence of progress in product design can be easily provided to the stakeholders.  |   |

#### **NON-RENEWABLE ENERGY SOURCES**



 Non-renewable energy sources are fossil fuels that were formed from the remains of animals and plants that lived millions of years ago.



- Burning fossil fuels releases carbon dioxide into the atmosphere, which can contribute to global warning.
- Fossil fuels cannot be replenished quickly and will eventually run out.

















#### **Nuclear Power:**

The steam needed to turn turbines and hence drive the generators is created using a nuclear reactor Nuclear fission controls the reactor heat. This requires the use of Uranium, which is a non-renewable resource.

Making greater use of nuclear power means there is less need for fossil fuels.

| Advantages of using Non-Renewable                           | Disadvantages of using Non-  |
|---|--|
| Energy Sources  | Renewable Energy Sources   |
| Stable, large-scale and high-power electricity generation.  | They use up lots of non-renewable energy sources such as coil, oil and gas.        |
| Relatively cheap to convert and extract as ready made fuel. | Burning gases and coal is highly polluting. Oil power plants are highly polluting. |

#### RENEWABLE ENERGY SOURCES



Renewable energy sources are sustainable and will not run out. They are sources that can replenish themselves quickly. Examples include solar, wind, hydro-electrical, biomass and tidal.



Photovoltaic cells or solar panels, collect and convert solar energy, light from the sun, into an electric current. Sunlight will not run out for billions of years, so there is an almost endless supply available.

**Advantages:** No waste products or greenhouse gases are emitted

**Disadvantages:** Solar panels produce less electricity when there is less light / at night time

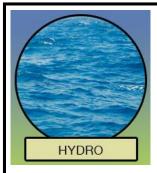
Installation and maintenance costs are high



Turbines that drive generators are turned by the wind, harnessing wind energy. The turbines are large and are usually found in groups or clusters in large open space.

Advantages: No waste products or greenhouse gases are emitted **Disadvantages:** Positioning of wind turbines is crucial as they don't run where is no wind.

Some people feel they are too noisy and do not like how they look.



To harness hydroelectrical energy, water is held in a reservoir and behind a dam. It is then released, turning a turbine which then generates electricity.

**Advantages:** Clean and sustainable, and uses waves so will last for a very long time. **Disadvantages:** Creating the reservoirs involves flooding large areas of land which destroys habitats and forces people to move to new homes.

Installation costs a lot of money



Biomass is fuel that is created from organic materials, such as crops, scrap wood and animal waste.

**Advantages:** Sources of biomass are readily available.

Growing biomass crops produces oxygen and uses up carbon dioxide.

**Disadvantages:** It can be a very expensive way of producing fuel.

#### **Advantages of using Renewable Energy Sources**

Clean and sustainable way of producing electricity without emmitting greenhouse gases.

They use sources which are not going to run for thousands of years.

#### Disadvantages of using Renewable Energy Sources

The installation and maintenance costs can be high.

Some people don't like the appearance of wind turbines and solar panels.

#### **SUSTAINABILITY**



#### **CARBON FOOTPRINT**

A carbon footprint is defined as: The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO2).

Every time you turn on a light, throw something away or even complete a google search, you are contributing to your carbon footprint which adds to global warming.



#### LIFE CYCLE ANALYSIS

A life-cycle analysis (LCA) is a systematic inventory of environmental impacts at every stage of a product's life.

Every time you buy a product you are contributing to the environmental impact, because at every stage of a products' life carbon dioxide is being produced.



#### THE 6 R'S

**RETHINK** - our current lifestyles and the way we design and make.

**REFUSE** - to buy materials and products that are unsustainable.

**REDUCE** - the amount of energy and materials used to manufacture a product.

**REUSE** - the product for something else so you don't need to throw it away.

**REPAIR** - the product so you don't need to throw it away.

**RECYCLE** - finally take the product apart and categorise the parts ready for being converted into another product. This uses a lot of energy.

#### THE ITERATIVE DESIGN PROCESS



| ning a new pair of head<br>ad strap. How would d |                  |                         |
|--|------------------|-------------------------|
|  |                  |                         |
|  |                  |                         |
|  |                  |                         |
|  |                  |                         |
| <br>   |                  |                         |
| <br>   |                  |                         |
| <br>   | <br>             |                         |
|  |                  |                         |
| you think Dyson was so<br>uum cleaner. (4 Marks) | n he was designi | ing and prototyping his |
|  |                  |                         |
|  |                  |                         |
|  | <br>             |                         |
|  |                  |                         |
| <br>   | <br>             |                         |
| <br>   |                  |                         |
| <br>   |                  |                         |
| <br>   |                  |                         |
|  |                  |                         |

#### NON-RENEWABLE ENERGY SOURCES

| Why do we burn so many fossil fuels? Discuss (4 Marks)                 |             |            |           |
|--|-------------|------------|-----------|
|  |             |            |           |
|  |             |            |           |
|  |             |            |           |
|  |             |            |           |
|  |             |            |           |
|  |             |            |           |
| Discuss the advantages and disadvantage to building more r<br>5 Marks) | nuclear pov | ver plants | in the UK |
|  |             |            |           |
|  |             |            |           |
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#### **RENEWABLE ENERGY SOURCES**



This is Mr Mason's new house. Using a pencil, draw on some details that would make his house more sustainable. Think about what could be put in the garden and on the roof! (3 Marks)

Now explain below what you have added and how they would need to be fitted in order to be

the most effective! (2 Marks)

| Greg is a farmer and wants to install some su  | -<br>etainable operav sourc | eas in one of h | is fiolds ∷Ho |
|--|-----------------------------|-----------------|---------------|
| doesn't' have lots of money so it can't be too eneighbours by installing something unattractive.  What would you recommend that Greg install | expensive, and he doe<br>e. | sn't want to ar |               |
|  |                             |                 |               |
|  |                             |                 |               |
|  |                             |                 |               |

#### **SOLAR POWER**



| Looking at image A, why are solar garden lamps effective in the UK? (3 Marks)   |
|---|
|   |
|   |
|   |
| Why does the solar powered windmill work even in overcast cloudy weather? (2 Marks)   |
|   |
| Looking at image B, why do we need to install lots of solar panels in large fields in order to help power villages and towns? (4 Marks) |
|   |
|   |
|   |
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В





#### PORTABLE SOLAR CHARGERS — EXTENDED WRITING



In pairs read the article about solar powered chargers and make your mind up about them. Use the article to answer the following question:

| Is using a solar powered battery charger for your phone practical in the United Kingdom? Discuss the advantages and the disadvantages. (8 Marks) |  |  |
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## **SUSTAINABILITY**

GESIGN &

For this project you will design and make a lamp using your chosen material. The first section of the project will be focused on Sustainability issues and how they affect a designers' decision making. At the end of this section you will sit an exam.

In the boxes below are the areas that will be covered in the exam. You need to think about some keywords that you can put into the second box, which remind you of the areas covered in the project. You must complete the confidence column before the exam; you must tick the face which best describes how you feel about the particular area. After the exam, your peer assessor will complete the question mark column and give two stars and a wish feedback, as well as put in the exam score. You must finally comment in purple pen whether you have re-attempted the questions you did not get full marks on.

|          |   | CORE KNOWLEDGE AREA          | KEYWORDS | CONFIDENCE | QUESTION | RE-ATTEMPTED QUESTION |
|----------|---|------------------------------|----------|------------|----------|-----------------------|
|          |   | The Iterative Design Process |          |            |          |                       |
|          |   | Carbon Footprint             |          |            |          |                       |
|          |   | Global Warming               |          |            |          |                       |
|          | 4 | Life Cycle Analysis          |          |            |          |                       |
|          |   | Renewable Energy Sources     |          |            |          |                       |
|          |   | Non-Renewable Energy Sources |          |            |          |                       |
|          |   | Solar Power                  |          |            |          |                       |
| Н        |   | Storage of Energy            |          |            |          |                       |
| $\dashv$ | 6 | Nuclear Power                |          |            |          |                       |

### **EXTRA COMMENTS**



PEER FEEDBACK

EXAM SCORE

/20

#### SUSTAINABILITY EXAM



| <ol> <li>Using the Designer James Dyson describe how the iterative design process can result in<br/>marketable products. (2)</li> </ol>   |
|---|
|   |
| 2) What is a Carbon footprint? (2)  |
| 3) What effect are Greenhouse gases are having on our planet? (2)   |
|   |
| 4) In order to understand the effect products have the environment designers consider the cradle to grave effect a product can have. What is this process more commonly called? (2) |
| 5) List 3 Alternative sources of energy (2)   |
| 6) Describe how electricity is generated from fossil fuels (2)  |
|   |
|   |

| 7) On average a mobile phone has to be charged everyday by the owner. Explain why in the UK the use of solar powered chargers is not always practical. (2)                        |
|---|
|   |
| 8) Portable electronic products ranging from musical greeting cards to power tools are battery powered. Describe the benefits and drawbacks of using battery power (2)            |
|   |
| 9) Nuclear power is seen by many European Governments as the power source of the future Can you describe the disadvantages of using Nuclear to generate the UK's power needs? (4) |
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Smart materials are 'reactive materials' which come in the form of metals, plastics, ceramics and liquids. Their properties can be changed by exposure to stimuli, such as electric and magnetic fields, stress, moisture and temperature.

| Name                            | Description  | Image |
|---------------------------------|--|-------|
| Shape<br>Memory<br>Alloy        | A shape-memory alloy (SMA, smart metal, memory metal, memory alloy, muscle wire, smart alloy) is an alloy that "remembers" its original shape and that when deformed returns to its pre-deformed shape when heated."   |       |
| Photochromic<br>Materials       | Photochromic materials – these change colour according to different lighting conditions.  Photochromic lenses are optical lenses that darken on exposure to specific types of light most commonly ultraviolet (UV) radiation.  These lenses may be made of glass, polycarbonate, or another plastic. They are used in eyeglasses that are dark in bright sunlight, but clear in low light conditions.  |       |
| Thermoch romic<br>Material      | Thermochromic inks or dyes are temperature sensitive compounds that temporarily change colour with exposure to heat. They come in two forms, liquid crystals and leuco dyes.  Thermochromic inks are pigments that change colour to colourless at certain temperature.  There are many different types of thermochromic pigments including textile inks for textile screen printing.   |       |
| Polymorph                       | Polymorph is a thermoplastic material that can be shaped and reshaped any number of times. It is normally supplied as granules that look like small plastic beads. It can be heated in hot water and when it reaches 62 degrees centigrade the granules form a mass of 'clear' material. When removed from the hot water it can be shaped into almost any form and on cooling it becomes as solid as a material like nylon.  |       |
| Electro-<br>Luminescent<br>Wire | A thin copper wire coated in a phosphor which glows brightly when a current is applied to it. EL glow wire or electroluminescent wire is a portable light source that works to provide a bright, colourful glow that looks just like neon. EL glow wire can light up outfits for an evening out, fancy dress costumes. Multi use EL glow wire can also be used for health and safety by dressing up a bicycle, or wearing it when running or cycling in low light. |       |

#### **SMART FIBRES**



Smart fibres have a number of medical uses. Fabrics can be encapsulated with substances required by the body or antiseptics. Allergy control fabrics can be used in bedding for people with breathing problems caused by dust mites.

Other smart textiles include sanitised fabrics for sportswear and socks which have anti microbial properties. Anti-bacterial and anti fungal fabrics have been used in clothing, linens, towels and carpets.

| Name                               | Description   | Image  |
|------------------------------------|---|--|
| Biometrics                         | Electronics can be embedded in textiles in the form of digital components. The garment then becomes a smart garment, smart clothing, electronic textiles, smart fabrics or smart textiles.  Electronic textiles can also include wearable technology where components are integrated into the garment. The technology is used to monitor athletes' performance – this is the seamless integration of textiles with electronic elements like microcontrollers, sensors, and actuators. |  |
| Micro-<br>Encapsula-<br>tion       | These are tiny bubbles of liquid or solid substances which are encapsulated and integrated within fabrics. Friction caused in the general use of a fabric breaks down the membrane of these gas or liquid bubbles. As it breaks down, the contents, such as moisturisers, therapeutic oils, and insecticides, are released slowly.  |  |
| Breathable<br>Laminated<br>Fabrics | Breathable fabrics such as Gore-Tex and Perma-<br>tex are created by bonding breathable water proof<br>membranes to the outer fabric to create all weath-<br>er wear. Two or more fabrics are mixed together<br>merging their performance characteristics. They<br>are held together either by heating and then press-<br>ing polymer foam or film to one side of the fabric<br>or by the use of an adhesive, similar to iron on<br>interfacing.                                      | Exterior  Exterior  Exterior  Gore-Tex mentions  Inferior  Brancpiration |
| Thermo-<br>Chromic<br>Inks         | Clothing or textile items printed with thermo-<br>chromic inks change colour according to wearer<br>and environment. They react to changes in tem-<br>perature such as body heat or boiling water. The<br>inks are effectively colourless without the applica-<br>tion of heat and turn into vibrant colour once acti-<br>vated. When the body or general temperature of<br>the product reduces, the inks become clear again.   |  |

#### MODERN MATERIALS

Modern materials are developed through the invention of new or improved processes, for example as a result of manmade materials/ingredients. They are altered to perform a particular function. Many smart and modern materials are developed for specialised applications but some eventually become available for general use.

| Name         | Description  | Image  |
|--------------|--|--------|
| Concrete     | Concrete is an engineering material that simulates the properties of rock and is a combination of particles closely bound together. It is used in construction a lot!  It is relatively cheap. It has a long life. It is strong under compression. It is fire-resistant. Can be easily shaped before it sets. A warm material which holds heat well.   |        |
| Carbon Fibre | <ul> <li>Fantastic strength and stiffness:         The road bike / F1 car will absorb bumps in the road and will feel very solid to the rider or driver.         Lightweight:         The lighter a road bike or F1 car the better so that it can get up hills quicker or accelerate quicker.         </li> <li>Can be moulded into complex shapes:</li> <li>Perfect for bike frames or F1 cars as they can be quite complex shapes with tricky angles.</li> </ul> |        |
| Kevlar       | Kevlar is a tightly woven fabric that has great impact resistance. It is used in racing tyres, racing sails, gardening gloves and bulletproof vests.   | POLICE |

In the grid below add detail about four smart materials and add a description of how they work. Add a

| Name | Description | Products that use this material |
|------|-------------|---------------------------------|
|      |             |                                 |
|      |             |                                 |
|      |             |                                 |
|      |             |                                 |
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| hat you think<br>material you | about health and a<br>could use and desc | or babies. It is important safety. Describe what smacribe the benefits to this. art materials also. (4) | art |  |
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|                               |  |   |     |  |
|                               |  |   |     |  |
|                               |  |   |     |  |



| ne sports training shirt below has been made<br>ermochromic smart material. Explain why a<br>promic smart material has been used. (3) |                         |                 | =                  |
|---|-------------------------|-----------------|--------------------|
| 20 70 12 W  | _                       | TE              | 3                  |
|   |                         |                 |                    |
|   | 20 20                   |                 | 2 2                |
| nis is a Kevlar police vest. Give three advan<br>e individual wearing it. (3)   | tages to using          | this vest and h | now they will help |
|   |                         | 4               | 1                  |
| ** ** ** **   | <del>30 3</del>         | P               | A.                 |
| 26 19 10 10   |                         | i on            |                    |
| (1) (1) (2) (2) (3)<br>(4) (7) (7) (6)  | - 151<br>- 152<br>- 153 | Om              | -07                |
| ere we have a road cyclist and a mountain   |                         |                 | V                  |
| imber.  |                         | · C             | *                  |
| iscuss how smart fibres can be used to<br>elp these athletes to be as comfortable as<br>ossible. (4)                                  | W.                      |                 | T.                 |
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confidence column before the exam; you must tick the face which best describes how you feel about the particular area. After the exam, your peer assessor will complete the question mark column and give two stars and a In the boxes below are the areas that will be covered in the exam. You need to think about some keywords that you can put into the second box, which remind you of the areas covered in the project. You must complete the wish feedback, as well as put in the exam score. You must finally comment in purple pen whether you have re-attempted the questions you did not get full marks on. fou are going to spend a few lessons looking at smart materials technical materials. At the end of this section you will sit an exam.

| CORE KNOWLEDGE AREAKEYWORDSCONFIDENCEQUESTIONMARK<br>ermochromic Pigment<br>ore-TexCONFIDENCERE-ATTEMPTED QUESTIONDIymorph<br>ore-TexCOCOCOCOCOCOCOCOCOCOCOCOCOCOCOCOCOCOCO  |                       |                 |                       |           |          |          |              |          |                    |
|--|-----------------------|-----------------|-----------------------|-----------|----------|----------|--------------|----------|--------------------|
| NEWORDS CONFIDENCE  Neent  Nee | RE-ATTEMPTED QUESTION |                 |                       |           |          |          |              |          |                    |
| NEYWORDS CONFIDE   | QUESTION<br>Mark      |                 |                       |           |          |          |              |          |                    |
| lent<br>Ink  | CONFIDENCE            |                 |                       | <b>①</b>  |          | <b>①</b> | <b>①</b>     | <b>①</b> | <b>(1)</b>         |
| core knowledge area  mart Materials  ermochromic Pigment olymorph ore-Tex oncrete arbon-Fibre evlar hermochromic Ink   | KEYWORDS              |                 |                       |           |          |          |              |          |                    |
|  | CORE KNOWLEDGE AREA   | Smart Materials | Thermochromic Pigment | Polymorph | Gore-Tex | Concrete | Carbon-Fibre | Kevlar   | I hermochromic lnk |
| 1<br>2<br>4<br>4<br>7<br>7<br>8  |                       | 1               |                       | 3         | 4        | 2        | 9            | 7        | œ                  |



PEER FEEDBACK

/20

EXAM SCORE

#### **SMART MATERIALS EXAM**



| 1) What is the difference between a normal material and a smart material? (3)                 |
|---|
|   |
|   |
| 2) Give an example of a product that could use Thermochromic pigment: (1)                     |
| 3) Why would Polymorph be useful for modelling design ideas? (3)                              |
|   |
| <b>4)</b> Why is Gore-Tex the perfect smart Fiber to use for a North face outdoor jacket? (3) |
|   |
| 5) Evaluate why concrete is the perfect material to use to build a car park: (3)              |
|   |
|   |

#### **SMART MATERIALS EXAM**



| 6) Evaluate the effectiveness of using Carbon Fibre for an F1 racing car? (3)                       |
|---|
|   |
| 7) Why is Kevlar perfect for making bullet-proof vests? (2)   |
| 8) Analyze the benefits of using thermochromic ink in this training top for a personal trainer: (2) |
|   |

