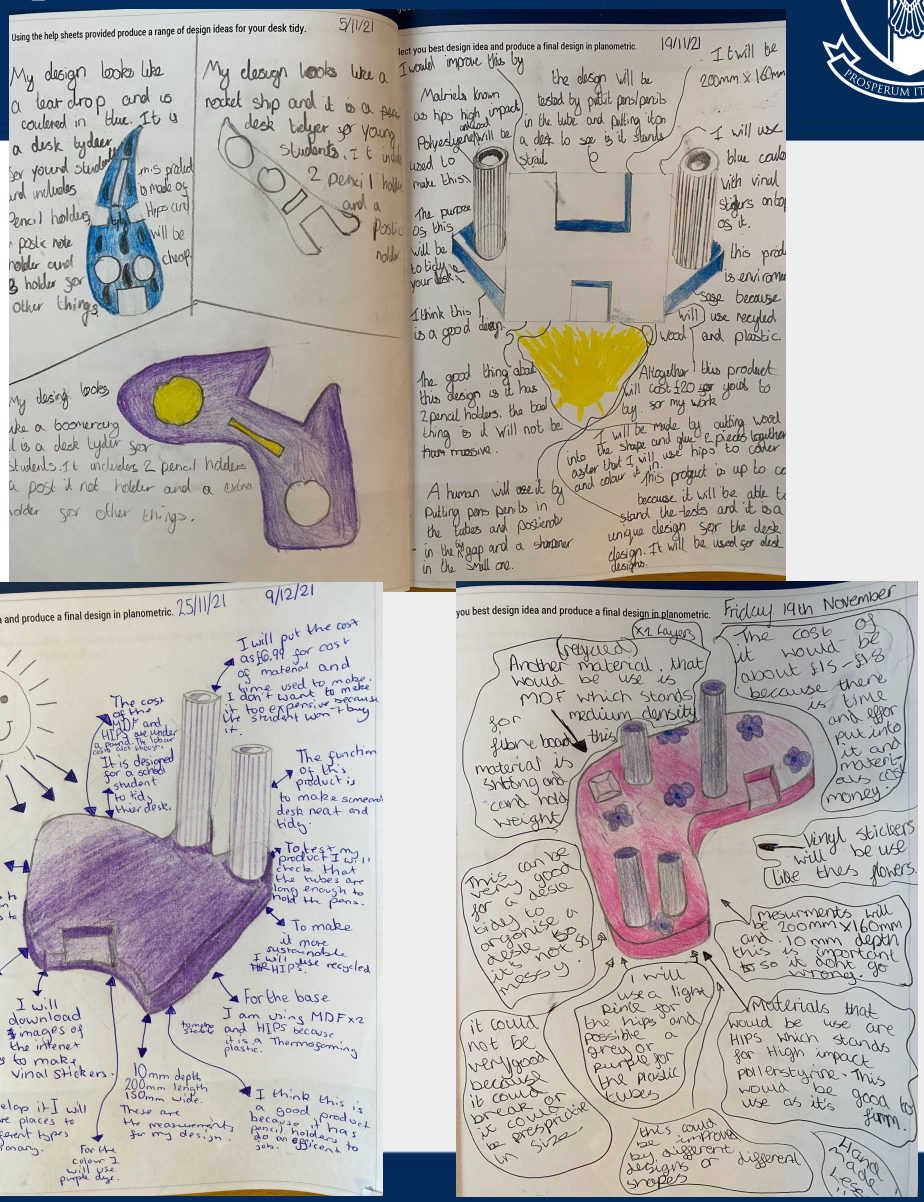
Progression in Resistant Materials

Generating and developing ideas

Key Stage 3 Year 7

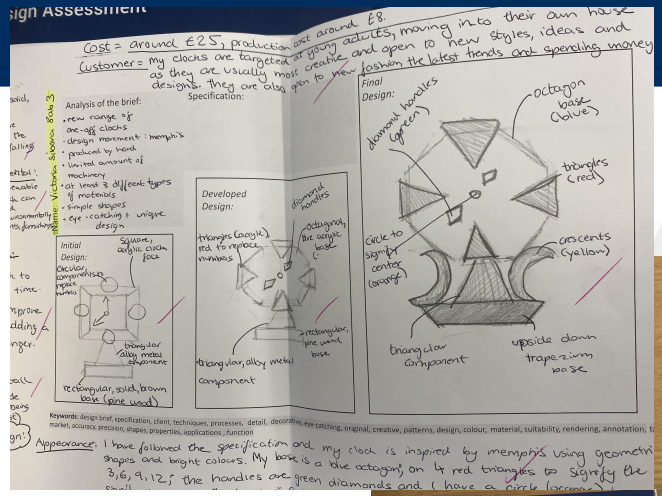
I can identify, develop and communicate design ideas to meet the needs of a user and basic specification.

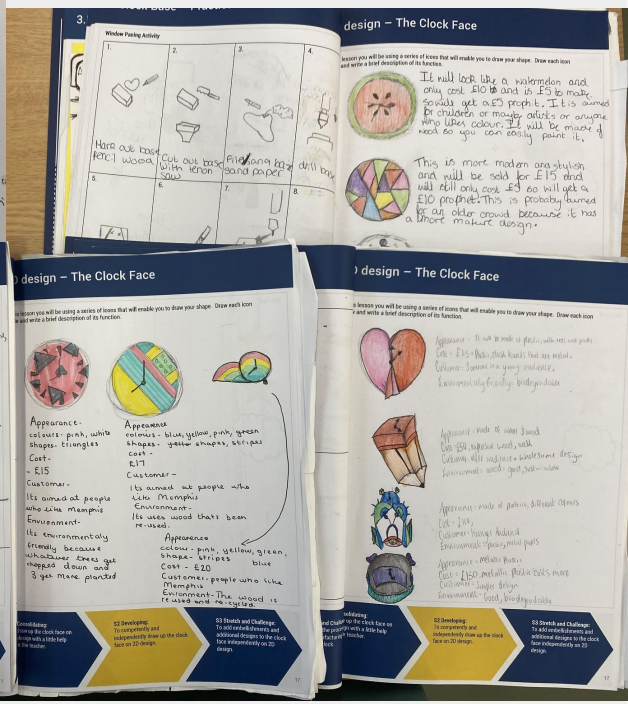


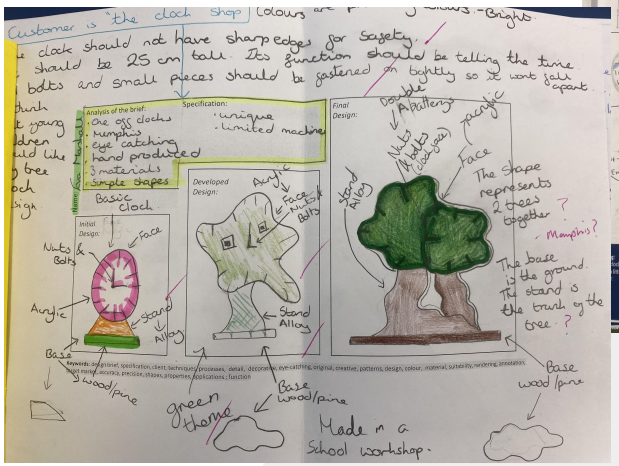
Key Stage 3 Year 8

I can further develop and communicate my design ideas by creating annotated sketches and detailed plans, to meet user needs and the specification.

I can justify my choice of skills, decorative techniques and materials.

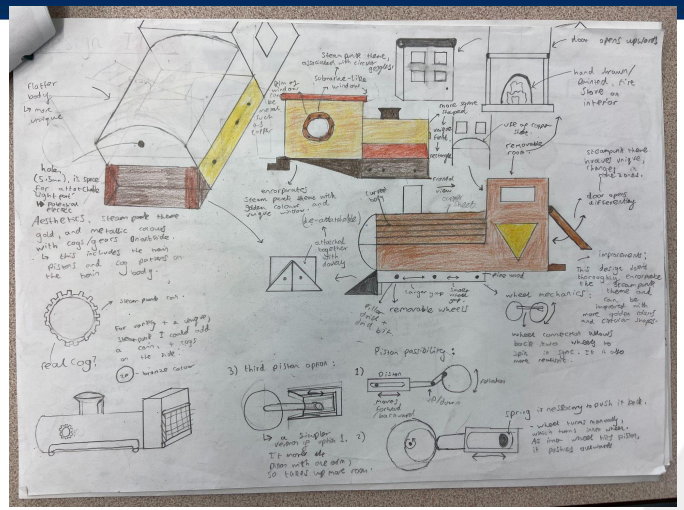


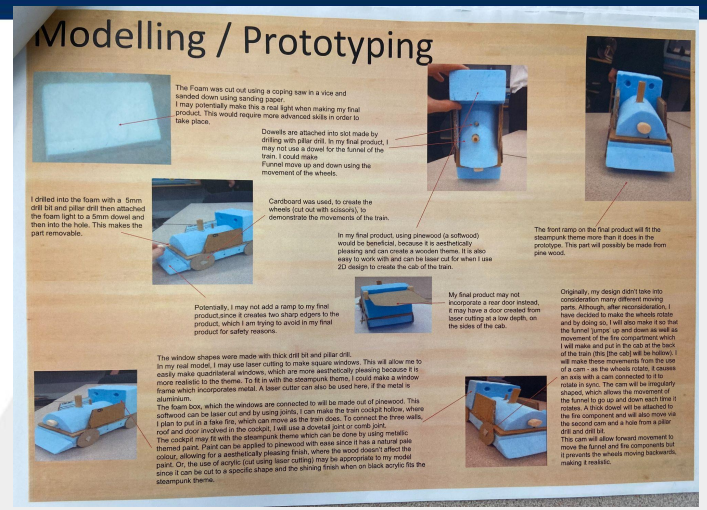


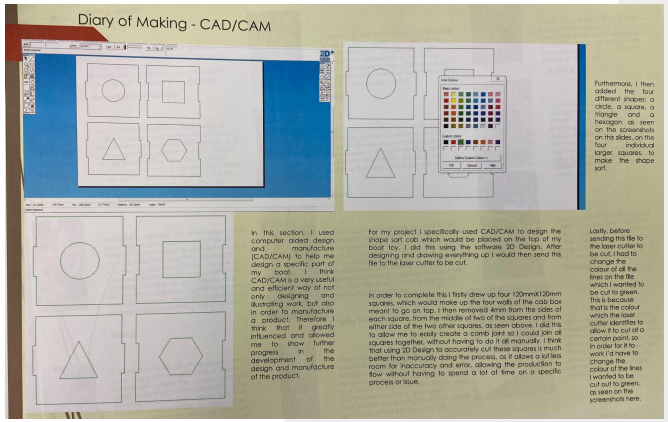


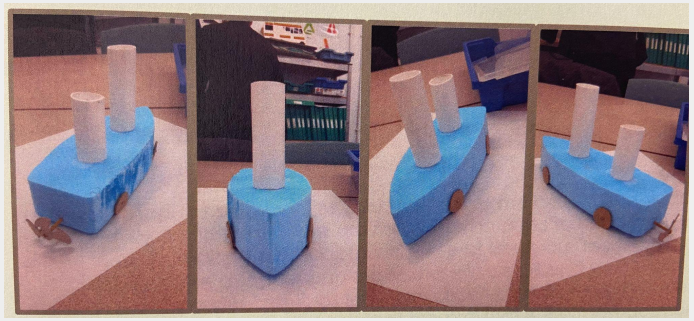
Key Stage 3 Year 9

I can generate a wide range of developments that avoid design fixation and take into account on-going investigations.



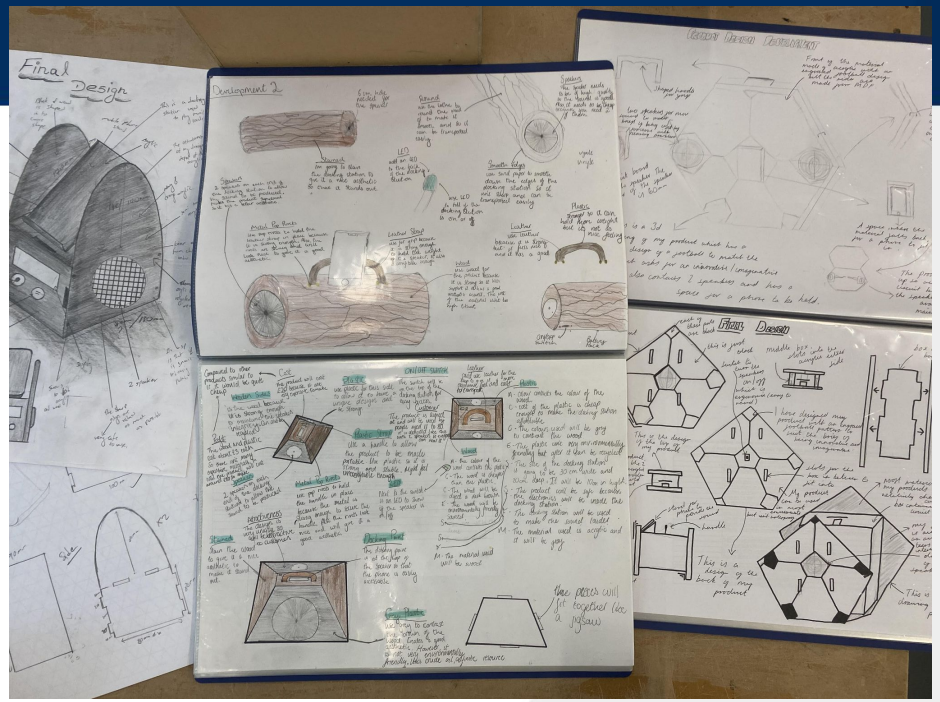


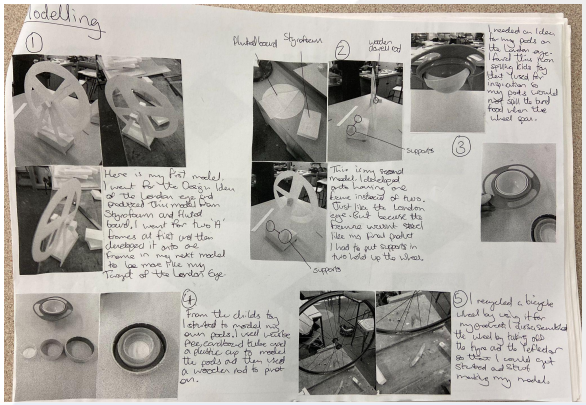




Key Stage 4 Year 10

I can explore and produce a wide range of possible design ideas and/or developments showing clear links to the context and full consideration of functionality, aesthetics and innovation..



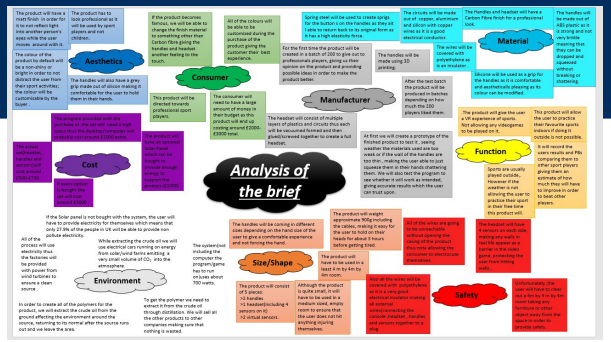


Key Stage 4 - Year 11

HESSLE HIGH SCHOOL & SIXTH FORM COLLEGE

PROSPERUM ITER FACIAS

I can independently conduct investigations leading me to produce a wide range of development proposals, through a variety of media and experimentation, accompanied by detailed analysis. I can take design risks and justify my rationale behind design decisions with full consideration of both the user requirements and specification criteria.



Analysis of Existing Products

HTC VR headset	Google Cardboard VR	PS4
Aesthetics: It is a simple black design making the product look pleasing without any bright, vibrant colours to distract the user. Also the product has a very professional look thus making it more appealing for the customer. **Consumer:** The product is targeted towards teens and adults over 13 years old as they have to be responsible while using the product as it is very expensive and fragile(if it is smashed around by a baby it is going to break) although the product is only used for playing games. **Cost:** The product costs about £500 not including the console that the games will have to run on, with the required specs thus making the console/PC cost at least another £1000.(overall the product will cost about £1700 including a few games) **Environment:** VR headsets run on electricity which has to be provided by the customer making that in the UK it has a 73% chance that the electricity comes from coal powered generator producing CO2 thus polluting the atmosphere. Also the product is mainly made out of polymer which affects the environment through the extraction of the crude oil and the boiling of it to get the polymers through distillation. **Size:** The headset is not heavy and small enough to fit a head but not big enough to be too heavy for the neck to have a hard time keeping it on. **Safety:** The product doesn't have any sharp points, edges or spikes which could hurt the user while using the product. Also the headset has a from camera which can tell the user their surroundings without taking their headset off, taking out the safety problem of hitting object or walls while using the product. **Function:** The product is supposed to give the consumer a Virtual Reality experience by making them able to play games with or without their friends in a VR environment making the games more realistic and fun. **Material & Manufacturer:** The screens are OLEDs which is made out of polyaniline. The headset, sensors and handles are made out of a polymer (not accessible to the public). The product is manufactured by Valve Corporation creating batches of the headset at a time.	**Aesthetics:** The product is made out of cardboard(as the name suggests) not making it very aesthetically pleasing as it is just a light brown headset thus not looking very professional. **Consumer:** The product is aimed toward people with a lower budget/ younger people as it is cheap and easy to assemble. **Cost:** The actual headset costs £11.40 as it doesn't have expensive components .However the product will need a phone which can run the apps the VR system comes with / has to install which could probably be another £200-£300. **Environment:** Although the product does not consist of polymer which affects the atmosphere greatly through the extraction of the crude oil and boiling it to get the distillation process in order to get the polymer, the VR system requires a lot of cardboard which means deforestations happening affecting the atmosphere as there won't be as many trees to give out oxygen. **Size:** The headset is fairly small and very lightweight making it very comfortable to hold on the head not making the neck tired. **Safety:** The headset has many sharp edges and it is made out of cardboard thus the user can get many papercuts getting infections. Also the cheap product may affect the eyes in many bad ways as the screens are not very good thus not ensuring complete safety towards the eyes. **Function:** The Google headset is supposed to give less fortunate people with a very small budget an opportunity as seeing and experiencing virtual reality. **Material & Manufacturer:** The headset is mainly made out of cardboard(wood) with a few aluminium and copper wires/electronic components. The product is manufactured by Google creating millions of headsets a year as they are very cheap to create through laser cutting and pushing the cardboard in a package that the consumer can buy and assemble themselves.	**Aesthetics:** The headset looks fairly neat with a simple design and few colours which could distract the user.The matt finished polymer also gives the product a clean look.The gloves also look pretty professional as they are small and have a very classic black design making it look like it is for children. **Consumer:** The product has been created for gamers who want to take their gaming experience to another level with the virtual games available on it through the PS4 console that Sony created. **Cost:** The headset cost £300 and the gloves cost around £200 therefore the whole product costs around £1000 including the console and to games which will be played using the product. **Environment:**The product runs of electricity using 150 Watts per hour which can come from coal power plants meaning that running this product can cause CO2 being released into the atmosphere.The same for how the polymer is extracted in order to create the plastics necessary to create it. **Size:**Both headset and the groves can be matched to the head and hands size of the user making them comfortable to wear by anyone,child or adult. **Safety:**The headset is connected with as few cables as possible ming it harder for the user to trip over them and possibly injure themselves. Also the gloves are connect through wifi thus the users hands will be able to be used without being blocked in anyway therefore if anything is to happen their hands won the restricted helping them be safe. **Function:**This product was created to give gamers a better experience while playing making the games more realistic and more entertaining giving a whole new experience. **Material & Manufacturer:** The headset and the gloves are made out of a polymer not specified to the public , most likely being ABS and nylon accordingly making the product durable and comfortable for the user to use.The product is created by Sony in batches of thousands depending on how many sales they have had in the past week.

Analysis of electronics

AMOLED Display

The displays will be AMOLED as it contains a thin film transistor (TFT) as it controls the flow of current in each pixel. AMOLED offers no limitation on the size of the display. The AMOLED displays use far less electricity then other displays. The AMOLED allows for an incredible performance. The display is thinner, weighs less it is more flexible than other types of displays such as LED, LCD technology.

HDMI port/USB port/Audio Jack Port/Power Plugin Port

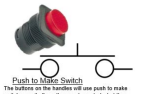
The various types of ports will be used to connect the VR system to different external hardware. For example:

- The HDMI port can be used to connect the headset to an external display e.g. a TV
- The USB port can be used to plug in any additional sound boxes and to plug the system to a computer which can operate the games/sports.
- The audio jack can be used to connect a phone or an MP3 player to the headset and play music whilst playing the sports/games
- Power Plugin Port is for powering the headset and handle controllers

The Motherboard

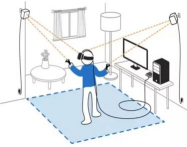
The motherboard is the component of the VR headset that controls everything: the program, the handles, the movement sensors.

The motherboard will be made of silicon, copper wiring and different electrical components.



Push to Make Switch

The buttons on the handles will use push to make switches as it allows the user to control what they are doing. When the button is pushed, the metals parts will touch allowing current to flow through thus emitting and electrical signal that the button has been pushed allowing the mother board to do an action in the simulation game.



Movement Detection System

The wireless motion sensors will detect three movement points connected to the headset system. These movement points will be placed attached to the headset and each handle. They will be connected to the sensors through the network(Wi-Fi).The way the sensors work is that they detect where the three points are in a X,Y,Z-reap, translating the position of the points in the room into the VR game.

Programming

In order to make this product work I will use Python to program how it is going to work. I will program a program which will allow the user to compare their sports results with other players on the leaderboard in order to be competitive.

I will continue to learn in order to program because I already know how to use and program and it as I am studying Computer Science thus I am able to program without learning a whole new language, making this product the best I can without coming across mistakes and error due to my unknowledge of programming .

Aesthetics

The sides of the headset have once again been rounded off to make the headset look more organic instead of it simply being a box. This design doesn't have a smooth face because I needed to insert the eye pieces on the inside. However when I am going to make the product, it will have a long piece of plastic that will cover the whole headset in order to make it look nice and neat.

Function

The eye pieces have two sticks stuck to it which are used to balance the eye pieces and not allowing them to move without the user pushing the levers at the top of the headset.

Function

The eye pieces are now movable .This allows the user to move them to the inside or towards the outside of their faces, depending on how wide their face is and how far apart their eyes are. This allows anyone to use this product ,no matter of how big their heads are.

Cost

The fact that not that much material has been used to create this design product means that the overall product will be very widely affordable by most people who have a job, paying them minimum wage.

Design No.3

Shape

Unlike before, I now made the bottom wall of the shaped in such a way that it fits the shape of the face with a hole for the nostrils in order to be able to breath whilst using the product. Also, the fact that the eye pieces will be pushed back into the headset means that the nose will not heat the wall and also the screens will not be too close the eyes, thus not damaging them.

Size

I made this design smaller than the original one but bigger than the second one is order for it to fit most sized heads even it is quite large or small(such as a child's).

Environment

The fact that I used a medium amount of material to create the actual headset means that less plastic will have to be used than in my original design, making this design more environmentally friendly. Also , because the OLED screens are so small(45 mm in diameter) means that not a lot of unrecyclable resources will be needed to be used , again not bringing a great impact on the environment

Shape/Customer

On the inside, the eye pieces have been pushed back inside of the headset and it was also moulded in order to make the shape of it more organic and more comfortable for the user. Also the edges will be covered with smooth, soft foam in order to prevent any

Size/Safety

The straps are now adjustable allowing the user to make the headset fit their head in the best way possible . This not only ensures comfortability , but it also makes sure that the headset cannot fall off the users head, making the product be safe to be used as if it falls the headset might break.

Consumer

For the head strap, I added another piece which connects the side straps and the top on. It also allows the user to adjust the size of the head strap in order to assure the best fit.

Material

I now included a plastic piece in the eye piece of the headset which represents the OLED lens which will be used in creating the actual product. These will be made of organic materials , glass, plastic and substrates.

Design Specification

Aesthetics

My product is going to look like any other VR Headsets it will have two screen to see into, a strap which can attach to your head in order for it to not fall off. It will also have a matt finish to it giving my product a neat simple look. This can be changes as the colour of the headset can be changed from the default colour of black. These colours will be kept at the same price if it's a consistent colour, however if the client wishes for a pattern on the headset, it will have an extra cost as it is hard to give a complex shape a consistent pattern. The controllers will have a silicon grips which will be a lighter shade of the colour of the controllers, making it easy to spot so the user will easily know how and where to hold the controllers from.

Cost

This product is going to be cheaper than the already existing products on the market which are at about £499.My product is going to cost £300 as my product is not going to be able to run high spec games. Although my product with have to be very precise with the movement of the user in order to give a very specific and accurate results to the users performance. The materials that are going to be used are quite inexpensive as ABS polymer only costs about £100 per squared metre which can be split into 4 pieces to make 4 headset faces. In order to run my product, the product is going to use Fibre Optic Ethernet cables which will cost £12.5 per meter thus for every system, £37.5 will be used

Consumer

This product is going to be able to be used by any age group above 10 years old(as the product is too heavy for a child to hold on their heads, thus they might get a strained neck if used for a long time).This product will mostly be used by professional sport players as the product will not be used to play videogames, thus not attracting children and teens. However my product will also be able to be used by beginners and amateur sport players who want to develop their skills and performance within their specific sport .However , armature sports players might not consider buying my product as it might cost too much for their budget and because they might give up on playing the sport very soon after starting doing the sport, wasting the product .This is why it will be mainly used by professional players as they already know that they wont give up on their sport, making the most of my product.

Environment

This product will be made out of recycled ABS plastics which will be melted down and reused thus not contributing to ocean pollution, but also helping get rid of plastic as a lot more will used than thrown away. Furthermore, if there will be any waste material out of the sheets of ABS plastic, we will be able to reuse it not creating any plastic waste which will have to be thrown away. When making this product, the factories will be powered by solar panels situated on top of the roofs, and by wind turbines located close to the factories meaning that not much electricity VIR be able to be lost through heat and sound whilst transporting it to the factories. For some extra money, our product can also come in with a solar panel which can be installed on top of the roof of the house or training boiling of the client , which can produce enough electricity for the product meaning that the electricity necessary for the product will be non-polluting. If we run out of the long lasting wasted plastic in the oceans and on the land the reactants (needed to make ABS polymer) that have to be polymerized are made of natural accruing gasses such as nitrogen, carbon, oxygen and hydrogen however the process of polymerizing the styrene and acrylonitrile releases carbon into the atmosphere thus contributing to the Greenhouse effect.

Safety

All the cables of my product are going to be sealed in a recycled rubber which will act as an insulator not allowing the user to electrocute themselves whilst using the product. Also the cables are going to come out of the headset on top and on the back of the user meaning that the cables are always going to be behind the user thus they cannot trip over whilst using it. Moreover a small camera will be installed at the front of the headset(at the clients request) which will show the user what is in front of them, thus if the user has to use the product in a very small room, they will be safe from hitting themselves on the walls .The internal circuits will be sealed within the products, meaning that they wont be able to be damaged by the outside environment and the user will not be able to get injured in them .All of the edges will be rounded off so nobody can cut in them and also the inside of the head strap will be made of soft foam or sponge thus even if there will be any head collisions, the head of the user will be undamaged.

Size

The two screen of the headset will be able to be moved and adjusted depending on the users pupillary distance(54-74 mm for adults as they will be the target consumer of this product). Also depending on how big the head of the user is, they will be able to adjust the head strap in order for the headset to be safely strapped on , not giving the user a neck sprain but also so the headset wont fall off the head damaging the internal damage to the circuits. The width of the headset will be 23cm as the average width of the human face is 21.59cm meaning the 23cm wont be too tight for the user. The cable that connect the headset to the computer will be 4m long meaning that for the average length of how much the user can move is about 1.5m.

Function

My product will a headset with two controllers that will allow the user to play sports in virtual reality. This will allow the client to train in specific sports, improving their skills and overall performance whilst still being able to compete with other players, recording their performance and compairing it to others. The product will have to fit comfortably in peoples hands(the controllers) and on the head(the headset) so the user can work their headset without being stopped and interrupted by my product being too uncomfortable. The two sensors provided must be installed in two cornercion the opposite side of the room),and they are the components of the circuit that detect the position of the user in real life and turn the location into a X,Y,Z location in the game giving an accurate location making the games played by the user very accurate to what they would be like in real life.

Material/Manufacturer

My product will be mainly made out of ABS plastic which can be vacuumed formed in order to make the headset(out of two pieces which can clip together) and the two controllers which will also be able to clip together. I chose to use ABS polymer because it is a thermoplastic therefore allowing me to reheat it in case of accidents and retry the vacuum forming process. Also ABS is hard and tough making the product hard to break when dropped and hard to be damaged protecting the circuits inside giving it a lifetime of about 10 years(or until another product is made to replace it).Once the sheet of ABS is vacuum formed into the appropriate shapes, there will be a excess plastic around it that needs trimmed down therefore a dye cutter will be used to remove the plastic(which can later be melted down and reused).The head strap will be made of recycled polyester because it is strong , durable and lightweight allowing the user to pull hard on it without it breaking .Also it being lightweight will not add excess pressure upon the persons head. We will purchase polyester in big batches, with the exact measurements that are needed for our product in order to not waste the material. It will then be fitted in a gap inside of the main headset and bonded together by heating up one side of it essentially melting it together.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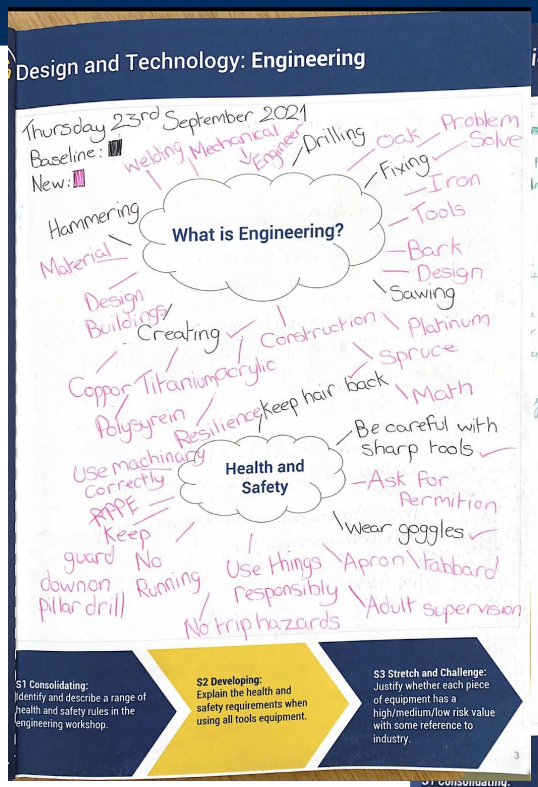
Progression in Resistant Materials

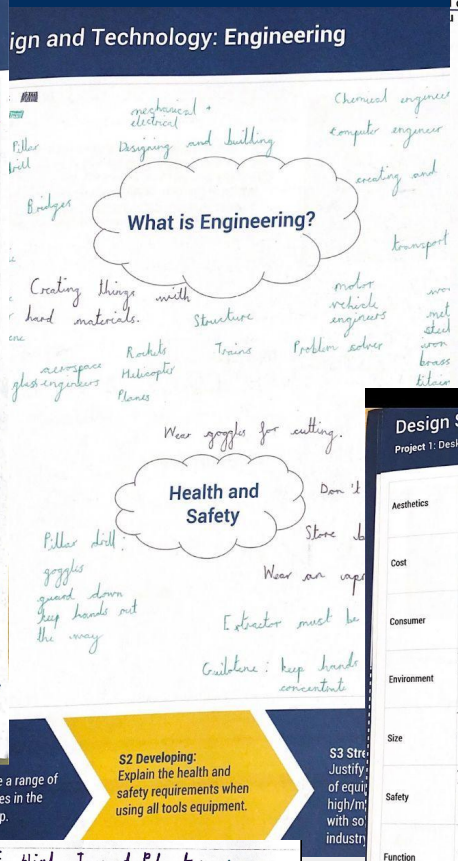
Classification of Materials

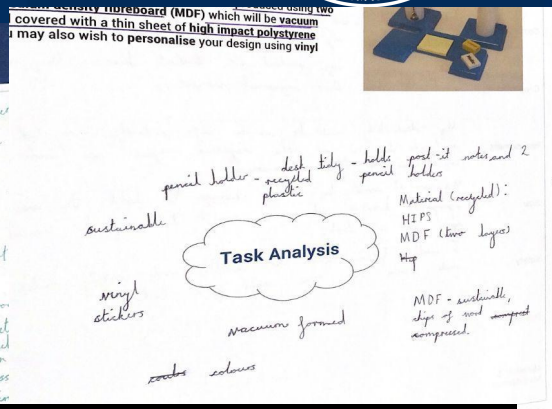
Key Stage 3 Year 7

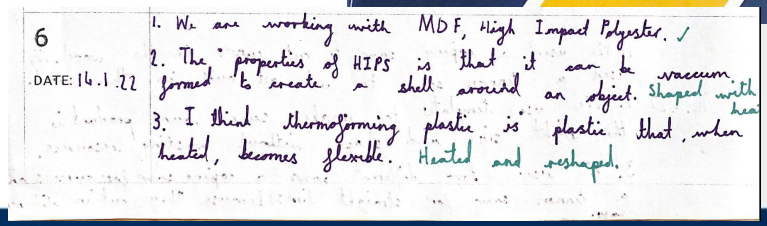
I can identify materials and their working properties.

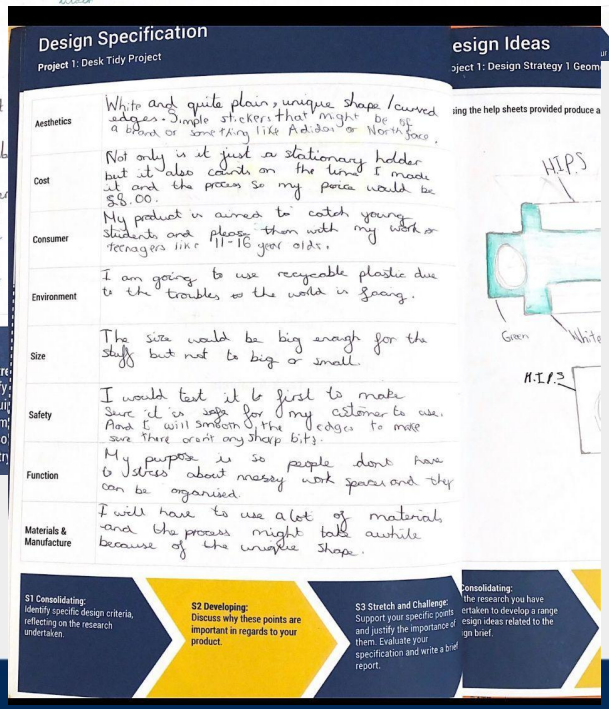
I can define the performance of materials and what is required in order to achieve functioning solutions.







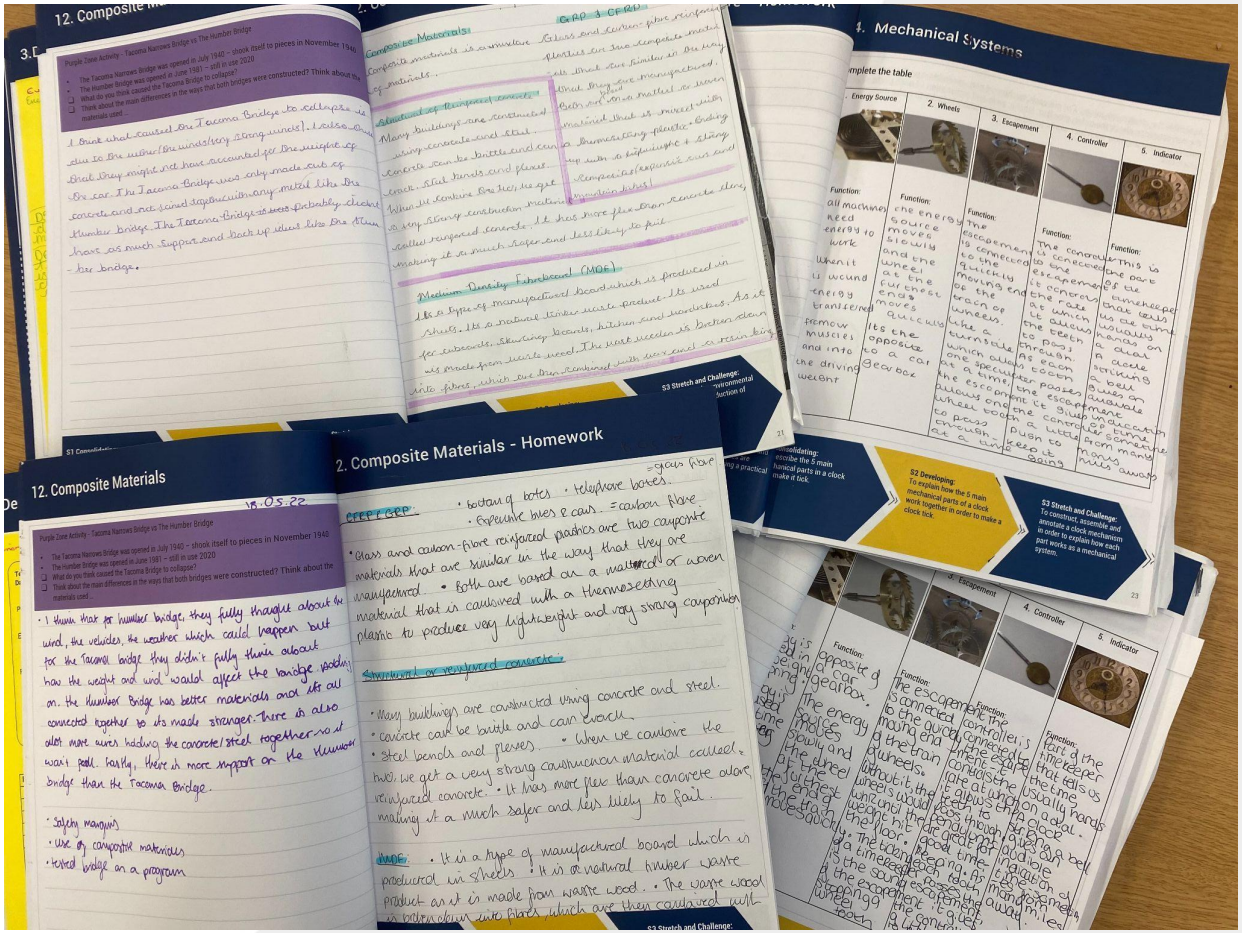




Key Stage 3 Year 8

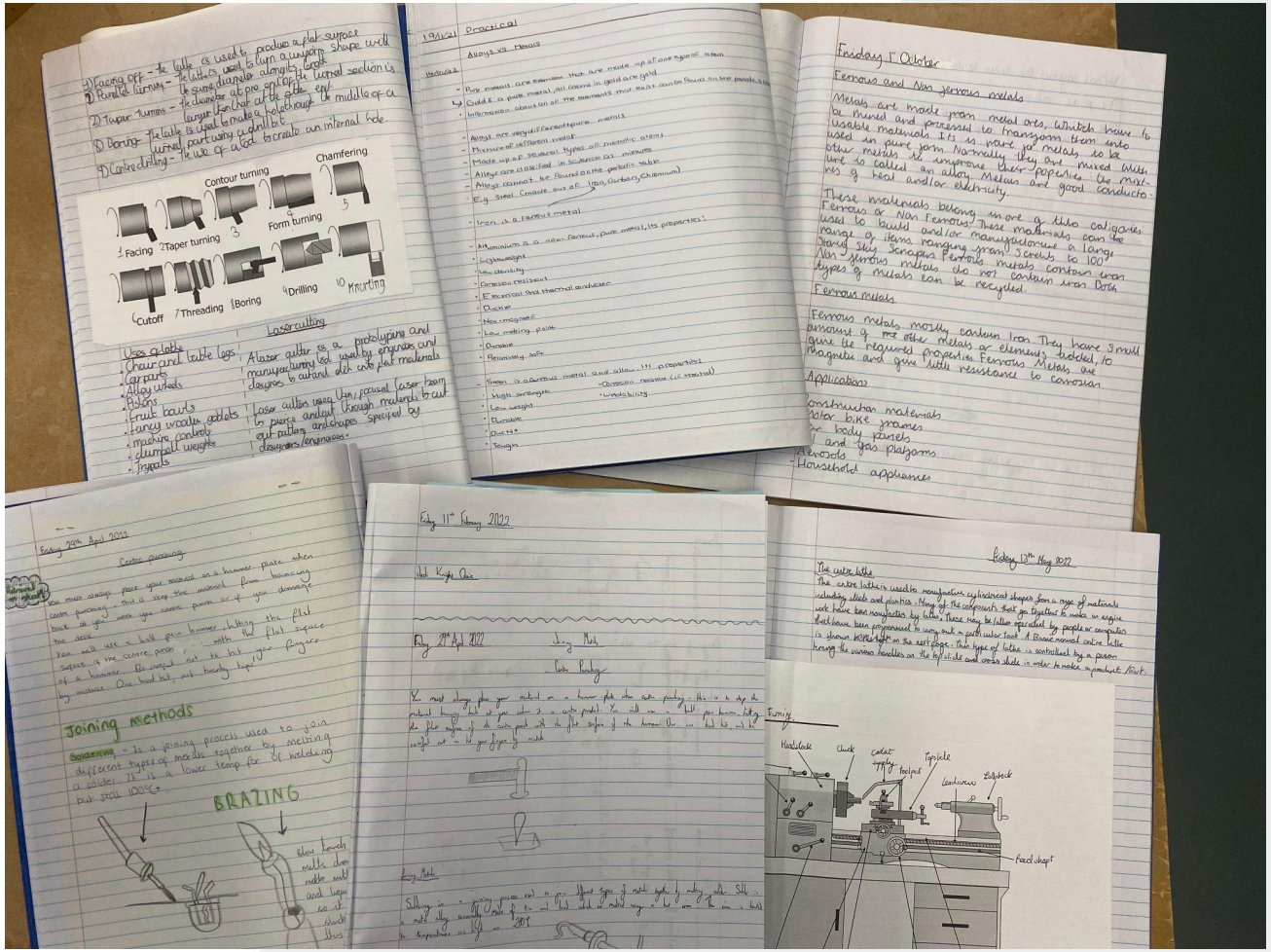
I can investigate materials and their working properties in more detail, by exploring and understanding the categorisation of the types.

I can explain the physical properties in relation to the classification and utilse this knowledge when selecting appropriate materials.



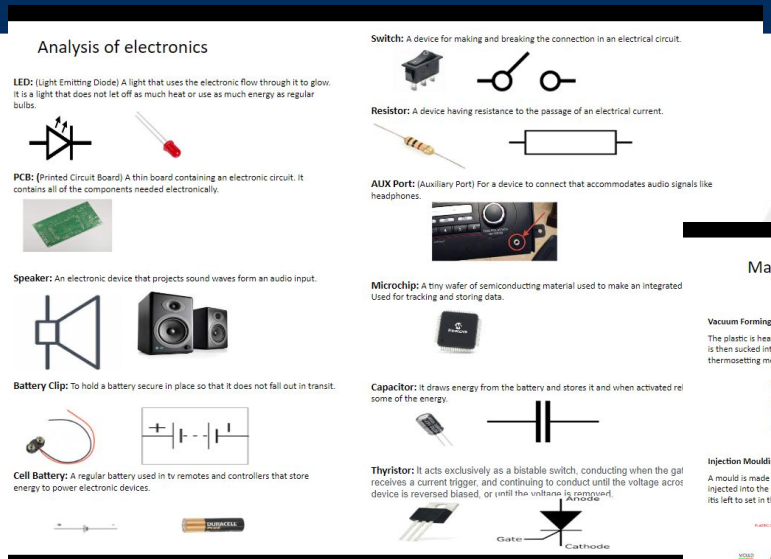
Key Stage 3 Year 9

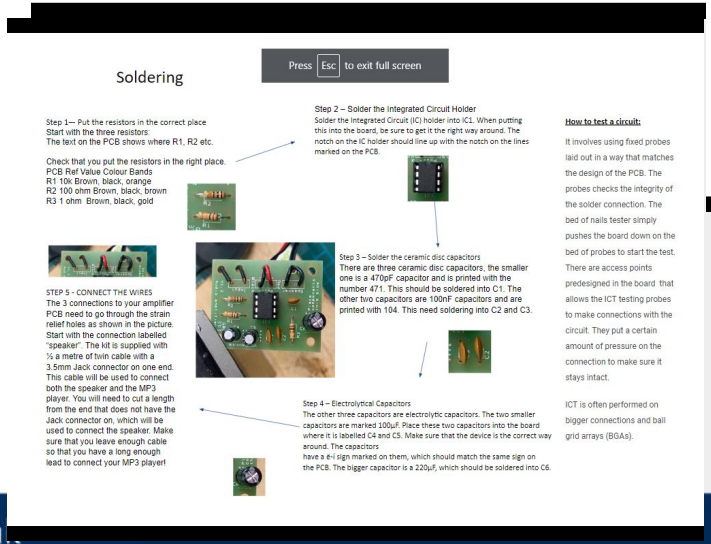
I can explore in some detail the categorisation of materials and their working properties in relation to the physical properties and sources.

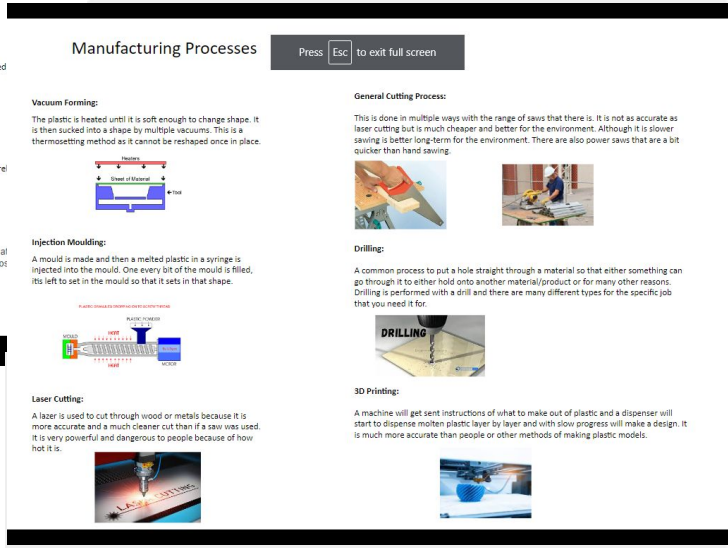


Key Stage 4 Year 10

I can demonstrate advanced understanding of specific materials for a wide range of applications, in addition to been able to provide detailed and justified explanations of why specific materials and combinations of materials are suitable for given applications with reference to: • physical and mechanical properties and working characteristics • product function • aesthetics • cost • manufacture and disposal.

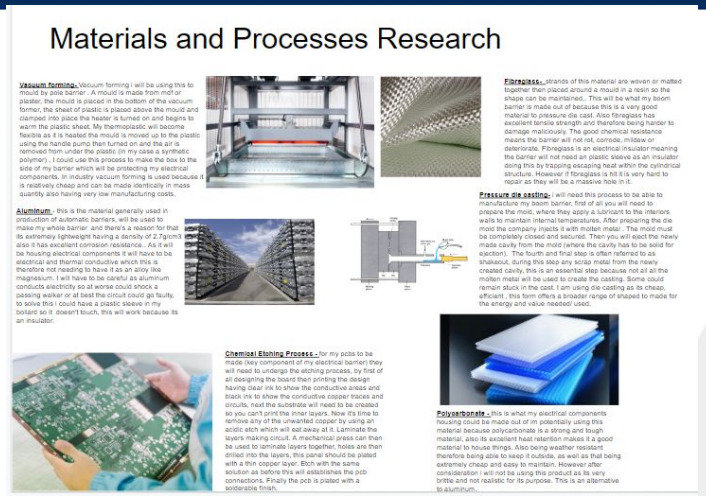


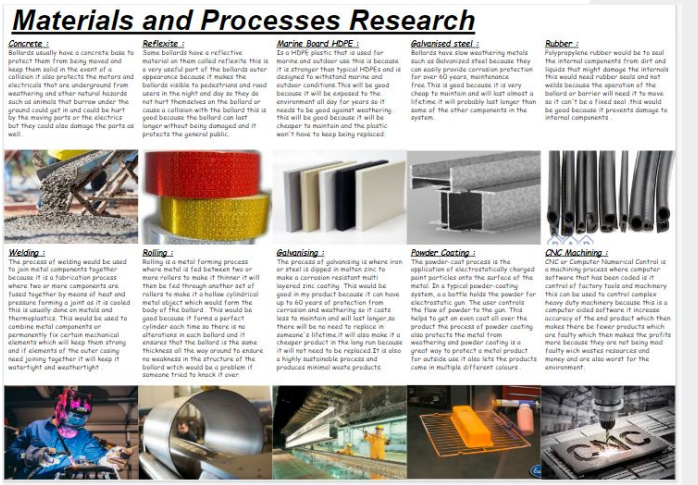




Key Stage 4 Year 11

I can demonstrate an in-depth understanding of the classifications of all groups of materials, the manufacturing processes used to make materials in relation to the source as well as thorough knowledge of processes, construction and the engineering of materials and justification of all of the above in relation to material performance and suitability.





Testing

Materials	Where it is	Test	outcome (analyse)	Against specification	Industry test	Possible developments
Polycarbonate	Exterior for boom barrier	Hardness test as polycarbonate may be brittle, to carry this out clamp a sample of the polycarbonate for the final product and hit with varying forces to find out the limit of force the material can deal with, therefore being suitable for my product as collisions may happen and you will now have quantitative data to back the hardness.	Therefore being suitable for my product as collisions may happen and you will now have quantitative data to back the hardness, in this test you would hope most of the energy is transferred in the collision, which would mean it can deal with bigger impacts.	In my specification I have said my barrier will have good chemical resistance and good tensile strength, meaning by carrying out the tests I can understand how it can deal with the forces acting upon it.	Brinell hardness test, to carry this oit a carbide ball will need to be pressed onto material to be tested with a known force. Help for certain period of time which creates a dint/ impression force is then removed and the dint is measured chart is used convert measurements into a number units are hb	As a development to this k could use abs as its less brittle and can withstand more impact, increasing weather impulses, however has very poor uv resistance so it will fade especially as it is always outside all the time.
Sheet steel	Base for barrier	Toughness test as because of the environment they are in it needs to be durable and tough, also may need to be galvanised, which would improve corrosion resistance. To carry this out hit sample of material with a hammer, secured in engineers vice if it survives the blow, without bending too far it can be classed as relatively tough	Therefore being suitable for my product as it will allow me to have an understanding on whether it can deal with the potential vandalist conditions and the environmental issues and impact.	I have said in my specification that the barrier will be corrosion resistant, and needs to be heavy so it doesn't get vandalised easily , it has a galvanised coating to prevent it from corrosion and resistant to the environmental impact that my barrier will be subjected to.	Vickers test, to carry this out, a pendulum is let to swing from a set starting position the resulting distortion to the sample material can be measured on a scale this will therefore give an indication of the materials toughness.	As a development to this I could use aluminium as it would not need a secondary finish and may improve the properties as it may be more durable and lightweight and ultimately has a good strength to weight ratio meaning less material could be used however this may come at a large cost implication
Electrical components, eg microcontroller	The interfacing component for my product to control lifting of barrier and keypad/.	A conductivity test could be used , to carry this out a voltmeter is used to measure the resistance, probes set to same distance on each sample (of electrical components) then resistance is a measure of the materials conductivity	Therefore you can know the maximum resistance it can deal with and the energy consumption needed for the product.	Compared to my specification i have now used are off the shelf components and are used as a standard pcb parts however may not be specific to the needs of my product.	In industry some sort of large scale electrical conductivity meter would be used as it will work to a higher resolution and accuracy compared to the workshop version of it	A programmable device as it improve it by giving it versatility top make it do something different it can be simply changed my moving components with a mouse. However are generally more expensive, potentially saving money long term so you don't have to replace them.
Galvanised steel	The cuboid for my stop	Ductility and malleability test, to carry this out a piece of tube is placed over piece of material, used as a lever material is then folded to 90 degrees cracks/damage on outside of bend show a lack of ductility, cracks/ damage on inside show a lack of malleability	My product will need to be able to withstand forces and energy transfers as it is directly next to the mechanical/electrical components, therefore reducing costs as i wouldn't need to replace it as often.	Compared to my specification i have said that my cuboid will be strong and aesthetically pleasing and by using a galvanised steel this meets that, also being relatively strong and chemical resistant	In industry you could use the rockwell test, to carry this out an indenter of the equipment is forced to make a residual depth, this depth is then measured and can be compared to other materials to gage a value for this which is measured in hr	A possible development could be a material made out of a carbide material as it can deal with a lot of heat and energy as it will be directly next to the systems including the microcontroller and the hydraulic system.
General test for durability		Some sort of repetitive task/ test, which would cause the whole system to run and work as intended	This would allow me to know the durability and the amount of forces my product will be able to withstand before it shatters in terms of collisions with cars and also the chemical and weather conditions.	This would allow ,me to give a realistic life span time for the consumer as in in spec it would be very durable, to improve this i would need to improve things like weather resistance, because if a part was not waterproof this could cause serious damage to the electronics/ circuitry moreover you could give all parts a surface finish to improve adhesion and solderability.	Potentially in industry for only certain parts a jig could be used to control the motion and be could be used to test if my product as a whole works towards its intended function and that if one component did not work I would need to go back to the drawing board and potentially replace this with another more powerful component.	Some possible developments would,d be changing the material used or the electronics as it is just a general test i would not necessarily know what would be the issue, but for an example the bearings used in the barrier may be weak or poor enough quality so it doesn't restrict motion very well and may eventually cause the components to seize, in testing i also obtained a value young's modulus allowing me to compare it with other materials.

Evaluation Against The Specification

Specification Point	Achieved/Not Achieved	How has this been achieved? Improvements or changes made
Aesthetics	Yes	In my original design specification I said my product would be modern and sleek in terms of its design I believe i have carried this out due to its unique and innovate design, potentially to make it even more modern I could change the shape of the boom barrier itself, maybe to a cylinder or a hexagonal shape. Moreover I said that the materials used for my design (Silicone or a vulcanised rubber) will give me an edge to my competitors however in the end I did not place much emphasis on this, ultimately being the same as my other competitors.
Customer	Yes	I believe i have achieved this as my target market is still estate, business owners who are looking to offer extras security (potentially in a given estate) who are wanting to restrict unauthorised access to cars, the main reason for this type of consumer is due to the value of that market and the demand and explicit function needed for this product. Also I am would still offer specific design requirements for a business, although at a higher price, however in my spec I said it would be difficult to transport due to the weight of it, throughout my design process i have tried to reduce this as much as possible by using material with a good strength to weight ratio and light electrical components, but if needed i could further improve this by making the base out of a different material then steel, as it's quite heavy, but the strength would still need to be there to reduce impact of collision or vandalism.
Cost	No	I said that my product would cost around £2000, I have not met this mow would most likely cost around £3000 because of the attempt to use materials which are lighter, and have a reduced impact on the environment, for example using recycled polycarbonate for the boom barrier itself. Furthermore to justify the price increase I said my product would not be very unique but now I believe it is very different compared to the generic barrier of my competitors.
Environment	Yes	I have used recycled material to make my product to ultimately ensure the impact on the environment is as reduced as possible , originally I said i'd use aluminium now i am not to also reduce the impact of mining the bauxite ore (which can pollute water) and is also a finite resource as time passes and there's less and less of it, the price of it will increase as well. The processes i said i'd use were the chemical etching process and vacuum forming which both produce a large volume of waste, so I have changed the process to injection moulding, to further improve it i could use something different to chemical etching due to its toxic emissions, but would be very expensive to change it..
Size	No	In my final design I have made the product smaller than that of i originally said as it means i could spend more money on higher quality materials and finishes. Also before the product was a bit to big meaning that if a consumer wanting to buy my product and they was in a tight area such as a small car park in a city centre, the product could be perfect for the client but if it doesn't fit i would make less money and sales than i should be (based on the product)
Safety	Yes	I said my product would be safe as there would be be the least amount of sharp edges as possible, for example rounding off the corners on the base and its improve my barriers safety I could use a cylindrical shape which would be even harder to hurt yourself on. Moreover the electrical system should be protected even more, for example by adding a layer between the steel and the components, to do this I could use a material with a low thermal conductivity so less energy is transferred by heating to the outside. But i do believe i meet the general aura of the speech to be as a safe as realistically possible by not having sharp corners and no exposed mechanical/electrical components. .
Function	Yes	The main function I set out on in the design specification was to keep an affluent area / part of a city restricted to unauthorised vehicles and would be controlled from a singular point and would have a human there to ensure everything is under control and is lifted by a motor (in my case a hydraulic) compared to now i could add sensors so no operators would have to be there, reducing costs long term as sensors are not very expensive and are say to install for people of low operating skill.
materials/manufacturer	No	I said in my design specification that I would make the housing for the barrier out of fibreglass due to its chemical resistance but I am now going to use sheet steel because it's cheaper and is easier to adapt and change the properties of the material if needed. Moreover saying it is very cost effective which with the current adaptations it is not as cheap but is of a much higher quality.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Progression in Resistant Materials

Development of specialist and technical skills

Key Stage 3

I can demonstrate basic practical skills and show understanding of how to use appropriate tools, equipment, machinery and materials.

Key Stage 3

I can demonstrate a range of practical and manufacturing skills and how to further use appropriate tools, equipment, machinery and materials.

Key Stage 4

I can demonstrate and develop a wider range of specialist practical and manufacturing skills and how to further use appropriate tools, equipment, machinery and materials with accuracy, working towards understanding how to create and develop commercially viable products.

Key Stage 4

I can independently, with some precision demonstrate specialist and technical practical and manufacturing skills and processes, and how to independently use a range of appropriate tools, equipment, machinery and materials to produce a commercially viable product.

Key Stage 4 & 5

I can innovatively demonstrate in-depth and significantly complex, specialist and technical practical and manufacturing skills and processes. I can independently demonstrate dimensional high level, accuracy and precision with a wide range of advanced tools, equipment, machinery and materials to produce a high-level, commercially viable product.


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