“MyPod”

Design and Make Assignment

Proposal & Scheme of Work (in development)

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Overview

The project involves the design and manufacture of an amplified speaker for an Ipod, MP3 player, mobile phone or any other sound source. The DMA focuses on the design process as well as the manufacture of a functional and effective outcome, namely an amplified speaker that can be connected to the student’s MP3 player allowing music to be heard without the use of headphones.

The casing is manufactured from cardboard which is a key to the low cost of the project. The use of 3D nets and graphics skills allows students to develop unique outcomes.

There is a strong design emphasis which analogues the design process in KS4 coursework. The structure of the DMA includes evidence of all NC points of study as well as cross curricular links with subjects such as mathematics, physics and science (geometry, platonic solid and electromagnetism)

Given a design brief students are to gather research materiasl to determine the needs of the client and analyse this information to develop a specification which will guide the development of their article.

Focussed Practical Tasks

The project’s manufacture is based on a number of individual FPTs allowing a structured lesson progression. Individual sub-systems can be tested and faults located before final construct.

- *Prototyping of case designs*
- *Manufacture of case design*
- *Soldering skills practice activity*
- *PCB design and manufacture*
- *Construction of amplifier PCB*

- *Manufacture of speaker voice coil and diaphragm*
- *Deconstruction of packaging*

Required Resources

- *Graphics resources, craft knives, cutting boards et.c*
- *Soldering irons*
- *Wire cutters, strippers and long-nosed pliers*
- *Printer (preferably A3 colour)*
- *Access to 2D design or SerifDraw*
- *Pillar drill / PCB drill (although PCBs can be pre-drilled)*

Additional Resources

This equipment can be used depending on the facilities available in the workshop/classroom but absence of a particular piece does not affect the quality of the product and just needs slight deviation from SOW.

- *Laser cutter*
- *PCB etch tank*
- *Access to circuit wizard software*

Curriculum

The DMA allows students to develop their knowledge and skills in the following DT areas:

Systems & Control

- *Manufacture of PCB – drilling and placement of components*
- *Electronic theory introducing key concepts and basic knowledge of component functions*
- *G&T opportunity to design and manufacture own PCB*
- *Manufacture of speaker voice coil and diaphragm*

Graphics

- *Design of logos*
- *Selection and application of appropriate typefaces*
- *Design of a 3D net suitable for the casing and diaphragm of the speaker*
- *G&T to develop have opportunity to develop own 3D net*
- *Use of hand drawing skills in the design process and manufacture of project*
- *Use of 2D design and Serif Draw to design casing*

- *Design and manufacture of packaging*
- *Deconstruction and analysis of existing packaging*

Resistant Materials

- *Use of hand tools to manufacture speaker coil and diaphragm*
- *Use of drill, glass paper and files in the preparation of PCB*
- *Option to use PCB etching facilities*
- *Option to use Laser Cutter to cut out nets designed on 2D design*

CADCAM

- *PCB design*
- *2D design and laser cutting of casing and packaging*

Differentiation and G&T

All students develop their own ideas and there is the opportunity for all to produce a unique outcome. There is therefore the opportunity for the more able to demonstrate their design skills in producing a high quality outcome. Less able students have the opportunity to use predesigned casings which they can modify themselves using graphic techniques. This also allows differentiation between Year 8 and Year 9.

The amplifier PCB is designed with a three terminal output which allows the circuit to be expanded to a second PCB. This allows more able students to construct a second PCB which can be easily connected to the original amplifier board. An option is a simple VU meter PCB. There is the opportunity of G&T students to design and make a simple PCB from a circuit diagram and a guide sheet – this also provides the opportunity for independent learning, a key skill for progression into KS4 and KS5 especially.

A4L

SOW allows opportunities of peer and self assessment. Final product is analysed by students and peers to the specification they have developed. There is the opportunity for students to objectively level their work from given NC level descriptors (modified language for accessibility, especially for less able). A4L is carried out through peer assessment throughout the design, prototyping and manufacture of the project.

At the end of the project students will have produced a complete design portfolio including evidence of the design and manufacture processes - any CAD work, PCB construction, 3D net design etc. More able students have the

opportunity to describe the processes and identify and document any changes made during manufacture, e.g. Correction of pcb faults Students write an evaluation of their project by matching the final product to their specification.

Cost

The electronic aspect of the project costs approximately £3 per unit. Most components are available in school and are easily obtainable from sources such as Rapid Electronics. The cost of the electronics is reduced by the students manufacturing their own speaker rather than using a manufactured speaker. Casing manufactured from stiff cardboard reducing casing cost. The small size of the PCB also limits cost of virgin materials and life of developer and etchant. The estimated costs are:

LM384 Amplifier IC	*£0.90*		
2R7 ¼W resistor	*£0.05*	-	
220R ¼W resistor	*£0.05*	-	
Red LED	*£0.05*	-	
470uF capacitor	*£0.10*		
4u7 capacitor	*£0.10*		
100nf capacitor (2)	*£0.05*	-	*Used in stylophone*
PCB 1 ½" x 1 ¾"	*<£0.50*		
Battery holders	*£0.20?*	-	*Used in stylophone*
Phone/MP3 jack	*£0.40*		
10K Potentiometer	*£0.50*		
Switch?	*?*	-	*Used in stylophone*
220gsm card minimum			
500g reel of 33Swg enameld copper wire	*£8.00*	-	*one reel should be sufficient for the whole of KS3*
Misc reels of wire			
Solder		-	*In stock*

VLE

Nets available in PDF for hand cutting and DTD files for use on laser cutter
Electronic PDF copies of workbook and ELT sheets

Lesson	Learning Objectives	Learning Outcomes By the end of the lesson I will be able to...	Lesson Plan	Other Details	NC POS
1	Understand the health and safety risks in the workshop/classroom Understand the rules of the workshop/classroom Understand what is meant by the terms – design brief and research. Know how to write a questionnaire to determine the requirements of a client Understand the need for carrying out research before beginning the design of a product	Explain the health & safety hazards in the workshop/classroom and how to avoid them. State the rules of the workshop/classroom Describe what is meant by the words design brief and research and how this affects the design. Write a complete questionnaire for client	**Starter:** Ask students what they think D&T is and what it involves – discuss design and manufacture. Ask what projects they have done already and what they did. **Main:** Students to fill in front cover of workbook including names, date, group and target level Record ELT in planner **Demo:** Students to the front of class, demonstrate project showing the component parts. Discuss the key concepts and a general overview of the project. **Task:** Walk around the room in pairs and jot down any identifiable hazards. Share answers. Complete H&S table in workbook – HAZARDS, WHY, HOW AVOIDED. Give an example. Discuss answers with class, add any missed to table. Students to sign H&S sheet to confirm that they understand the rules. Discuss that the DMA is about designing a product for a particular client or customer and that this must be reflected in the design. Explain the function of a design brief and discuss why it is important to carry out research before one starts to design. Fill in design brief in workbook. Guide students in writing a simple questionnaire suitable for their client, More able to develop further questions. **Ext:** – type up questionnaire **Plenary:** **ELT:** Give questionnaire to client to fill in and return next lesson Differentiation: A4L:	**Resources:** A4L: Differentiation:	
2	Be able to analyse and draw conclusions from research materials Understand what is meant by a specification and why it is required to guide the design of the product	Analyse a questionnaire and describe the findings Write a detailed specification setting out the key design criteria	Starter: Discuss findings with students,		
3	Know how to generate a mood board Understand how a mood board helps a designer to explore their ideas	Generate a mood board based on the client			

4	Know how different typefaces can be used to express a particular style Know the difference between Serif, Sans Serif, and Stylised typefaces Know the importance of branding Be able to investigate brand logos and use this to help develop their own	Identify a range of typefaces which would be appropriate for the case design Produce a range of logo ideas Generate a final logo design and annotate its features	**Starter:** Each table given a copy of a magazine or newspaper. From a wordbank on the board, students should write a list of statements that describe the style of the graphics and text. Discuss a table at a time what they notice about the magazine/paper with regards to target audience (times formal, heat informal etc) **Main:** Discuss how the typeface and general graphics influence the style of the material. Discuss how the use of graphics can be designed to suit a particular audience. On board show a selection of electronic products showing the style and use of graphics Describe the types of typefaces (sans serif etc) and what image they portray. In workbooks students to annotate typeface examples describing what style they represent using a given word bank. Students to choose a typeface they think will be most appropriate for their product and justify this – (page in workbook) Discuss how logos and brands are used, what target audiences they are aimed at and what they are trying to communicate. Show brand logos on board and discuss. Students to think of a brand name or name for the product and sketch a number of ideas out. Choose logo and develop it into a neat and rendered drawing. Annotate describing the details, colours style and what it represents. www.brandsoftheworld.com		
5	Know how to use the basic tools of 2D design or serif draw Know how to combine skills to create a more complex complete design	Use 2D design or serif draw to draw the logo design	Students to log onto computer and sit down back at desks **Starter:** TBD Explain that 2D design allows user to create any shape out of simple geometric shapes that are manipulated by a variety of different tools. Demonstrate the drawing of simple 2D geometric shapes. Students to practice drawing these shapes. Students back to desk. Demonstrate delete tools, line thickness colour and fill. Students to practice. Demonstrate example logo. Share marking criteria for logo design. Students to return to computers and draw their logo design using 2D design. – give set dimensions. Students to complete final logo designs and stick in workbook. Students to work in pairs to mark each others work against the marking criteria. **Plenary:** Project students' logo designs on screen using Impero – discuss features and quality etc		

6	Know that 3D shapes have different properties including strength and aesthetic properties Be able to investigate the properties of 3D nets and resulting shapes suitable for the casing	Describe the properties of a range of 3D nets Evaluate the 3D shapes and describe the qualities and suitability for the project Select an appropriate shape for the product	Starter: Main: demonstrate a range of 3D nets and demonstrate the construction. Students to work in groups constructing various nets. Once a few are completed students should investigate and describe the properties in their workbook following a given word bank. Eg. Strength, rigidity, appearance, complexity. Discuss that certain properties are necessary for the correct operation of the speaker. Some shapes may look more appealing but may not function well as a speaker. Explain that a a certain amount of room is required for electronics. Demonstrate the size of the PCB and the other component parts. In groups students to discuss which shapes they prefer and why this is so. Students should consider the relevant features.		
7	Understand the importance of producing design proposals Use a specification and research and analysis to guide design Develop skills in the use of graphic techniques (pen, pencil, stencils, crayons, pastels etc) Know the importance of producing a prototyping	Produce at least two case design proposals suitable for the product Use the mood board and specification to guide ideas Describe reasons why it is important to prototype a product during the design and manufacturing process	**Starter:** Explain what a prototype is and give examples of products that are prototyped before manufactured. Each group to be given an individual product an discuss why they think it should be prototyped and what the implications could be if the product was not prototyped first. **Main:** Explain how the mood board can be used to help influence the design – for example by selecting the colour scheme or any relevant themes. Explain that while producing design proposals it is important to keep the specification in mind in order to produce an effective outcome. Explain the concept of a design proposal and share marking scheme with students. Students to select an appropriate net and produce a design proposal on a small version of the selected net and form into a prototype. Once one design is complete students should work in groups to mark work against the marking criteria. Give suggestions on how individual designs could be improved by relating to marking criteria. Students to then discuss in groups and improve their design and construct a second prototype. The above sequence should be repeated. At the end of the lesson the shapes should be deconstructed and affixed into the workbook. **Plenary:** Selected students to show designs to rest of class. Discuss the marking criteria and how it could be improved.		

8	Know how to evaluate designs against design criteria and aesthetic and structural merit Know how to use 2D design (V2) to create a 3D net Know how to use 2D design (V2) to create a complete 3D net with graphics included	Evaluate the design proposals and describe their merits and weaknesses and flaws Produce a detailed developed design with annotations showing the position of parts, logos and other graphical features Use the develop design to create a 3D net on 2D design ready for manufacture	Starter: Each group given an example casing and asked to write down two good features and two poor features. Discuss with class. Encourage students to look at prototypes and think about what they could do to improve designs. Select individual students and discuss their design. Explain that it is time to create the Developed Design and that this involves using feedback from peers and their own observations. Share the marking criteria and give examples of levelled work. Students to be given full size net to draw final design on. Once completed students should construct into their 3D product. Take all of students work and line up on table. Following the marking scheme ask students to level another student's work. Discuss this with the group. Repeat for three pieces of work of varying levels. Discuss how they could be improved to achieve a higher level.		
9	Know how to construct a net to form a 3D shape Know how to evaluate a product and make modifications where necessary	Construct the 3D net of your design Evaluate the 3D product and make changes where appropriate to improve the design	Students to use template nets on VLE to produce an electronic A3 final version of their casing. Students should print out design on A3 card (or paper and then stick on stiffer card) and construct their final casing. Do not glue so can be deconstructed for storage. Marking criteria shared with students, students to return to desk and level their own work. Discuss achievements with class. Once a finished design is created students should print out in A4 and affix into workbook. As evidence.		
10	Know how to design and manufacture a printed circuit board Understand the safety issues related to PCB manufacture	Describe the 7 steps to manufacturing a PCB Design and manufacture a simple PCB	**Starter:** Groups to look at example PCB and note down what parts they notice (logo, copyright notice etc) Discuss what they notice on the PCB and what they could include on theirs. Explain that the next task is to design our own PCB. **Demo:** Demonstrate how a PCB is made and students to note down the stages involved in their workbooks. Students to return to desk and document manufacturing process using diagrams and labels. **FPT:** Students to load PCB template design into Circuit-Wizard. Add logo design (previously designed) and other information that was noted down from the starter. Class to split into two groups to perform the two activities alternately. Students work to be combined on transparency and etched by technian.		

11	Know how to use a drill safely to drill holes in a PCB Know how to solder electronic components onto a PCB	Drill a number of holes in a PCB Solder a range of electronic components onto a PCB Describe the stages involved in soldering a component in place	Starter **Main:** Demonstrate how to solder a component in place. Students to observe and jot down the key stages in workbook (page ?) Students to work in pairs to solder a number of components in place on practice PCBs. Students to work in pairs to evaluate their joints by comparing to the examples on the board. Students to decide what they should do improved their soldering. Students to practice making another few components in place. In workbooks use drawings to describe the stages in making a perfect soldered joint. **Plenary**: df s		
12	Understand that some components are polarised and what this means Know that some components must be connected the right way around and how to identify this Be able to identify components by their physical appearance Know how to drill holes in the PCB safely and accurately	Describe what is meant by the term "polarised" and what effect this has on a circuit Label the leads of a 16pin integrated circuit Label the PCB showing where components should be fitted Place all holes of appropriate sizes in the PCB			
13	Know how to solder chip sockets in place without causing solder bridges Know why a chip socket must be used with some integrated circuits Be able to identify resistors by the coloured bands Know what the function of the resistors are in the circuit	Solder the chip socket in place Identify a range of resistors from a given colour code Identify the correct resistors for the project and solder them in place Describe the effect a resistor has on the flow of electricity			

14	Understand how different capacitors are identified Understand the function of a capacitor Know why a capacitor must not be connected the right way around	Describe the function of a capacitor Identify the positive and negative leads of an electrolytic capacitor Identify the correct types of capacitors and solder them in place			
15	Understand the importance of strain relief holes in a PCB Know how to prepare multi-strand wires ready for soldering into a PCB Know how to connect wires to a PCB correctly and effectively Know how to solder a battery holder / clip onto the PCB Understand the function of a potentiometer and how to wire this to the PCB including the use of sleeving	Describe the term "metal fatigue" Cut, strip and tin wires to specified lengths and solder them in the correct locations Describe the operation of a potentiometer and what effect this has on the circuit Solder the potentiometer in place			
16	Understand that an LED is a polarised component and why it must be connected the right way around Know how to identify the anode and cathode of an LED Know how to solder the LED onto the PCB	Describe what and LED does Identify the "anode" and "cathode" of the LED and connect it to the PCB using wires			
17	Know how to connect the jack plug to the amplifier Know how to test the PCB and correct any faults	Solder the wires from the PCB to the jack socket that connects up to the MP3 player/mobile Test the circuit by connecting a pre-made speaker			

18	Understand how a speaker works Know how to construct the speaker using the materials provided Know how to prepare the enamelled wire for soldering	Describe how a speaker converts electrical energy into sound Create the coil former and wind the turns of wire onto it			
19	Know how to combine the key components to complete the electronic circuit Know how to test the circuit	Connect the coil to the magnet and diaphragm to make it operate as a speaker Wire the speaker wires to the PCB Fit the volume control and LED into the case Test and correct faults on the PCB and speaker			
20	Understand how to evaluate the finished product against the specification Know how to peer assess work using given mark scheme	Compare the finished product to the specification Compare the finished product to the developed design in your folder Evaluate your work Use the mark scheme to assess yours and others work			
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22	Know how to deconstruct existing packaging to investigate packaging design Know the purposes of packaging Be able to design packaging including all of the key features based on the theme of the product	Deconstruct packaging to identify key elements Design packaging suitable for the product you have designed	**Starter:** Groups given examples of packaging and asked to carefully deconstruct it. Note down the key elements (product name, cost, barcode, branding etc). Describe that the next task is to design suitable packaging for the project. Discuss the findings of the starter activity and list findings on the board. Discuss the purpose of packaging with students Demonstrate graphics techniques in producing packaging including barcode and pastel shading. Show how a clear window can be fitted to allow viewing of the product Share marking criteria **FPT:** More able to develop own net for packaging. Less able to use given nets to produce packaging design. Where laser cutter is available this can be used to cut nets out At an intermediate point ask students to use marking to mark work at this stage. Discuss how the quality level of the work can be improved Students to continue design and manufacture of packaging taking feedback into consideration **Plenary:** s		
	Know how to evaluate the overall effectiveness of the product Know how to use marking criteria to determine the overall level of work Be able to describe how the overall product could be improve Be able to reflect on own performance	Describe any alterations that could be made to the product Write an evaluation of the project and reflect on performance Provide evidence of all practical work	Students to take photographs of all work and produce a		