

Acoustic Audio Amplifier

Aim

This project enables pupils to develop an understanding of the design and manufacture process.

Objectives

Pupils will have an opportunity to:

- develop their practical skills;
- become more aware of health and safety in a workshop environment;
- research using a variety of sources;
- develop knowledge and understanding of materials, hand tools, power tools and processes;
- select and use a range of tools, equipment and processes and use them safely and accurately;
- select a range of materials to complete the project; and
- understand the working characteristics of materials and components and their restrictions.

Prior Learning Required

Pupils will have knowledge and understanding of:

- health and safety issues with a particular focus on woodworking machines;
- marking out techniques using appropriate tools;
- accurate measurement in millimetres; and
- understanding of the different finishes available.

Overview

Design Situation

Young people like to hear loud music. Unfortunately the volume from a smartphone is not loud enough and can sometimes be distorted.

Design Brief

The challenge of the project is to design and make an acoustic amplifier for a smartphone. The design will be tailored to the individual needs of each pupil's phone.

Materials

Pupils will be given four pieces of veneered plywood, 190 × 75 × 12.

Pupils need to take accurate measurements and plan their work with precision to enable their design to be manufactured to fulfil the requirement of the design brief.

When built, pupils should finish the product to a high standard using a choice of finishes including wood stain, clear varnish, wax or paint.

This is a pupil-led project. Their ideas will shape the processes and outcome of the project. This includes not just the end product but they do to get there.

Give your pupils the topic starting point and guide them through the initial stages to enable them to develop understanding of what is required.

Using Thinking Cards to support pupil learning

Thinking Cards are designed to stimulate, guide and scaffold thinking in the classroom. They are particularly useful to help pupils when they are stuck. The prompt questions on each card help the pupils to think more skilfully about the issue and provide a framework to move forward.

Sets are available in all schools. You can also access them at the [Northern Ireland Curriculum website](#).

When using the Thinking Cards, you may prefer to preselect cards you think will be most helpful in supporting the type of thinking required for a particular activity. As pupils become more familiar and confident in using the cards, they can select appropriate cards for the task.

Pupil Workbook

This workbook is made up of the following pages. Pupils complete all sections.

- Title page: This should include some personal drawings or pictures;
- Situation, Brief, Specification;
- Investigation or Mood board;
- Research: Choose three designs and evaluate them using these headings:
 - Picture of the chosen design
 - Shape
 - Colour and material
 - Theme
 - User
- Using Maths in Technology and Design;
- My Design – Freehand sketching to explore possible design solutions;
- My Templates: Draw accurately the shapes to be cut out of each piece of wood;
- Presentation of final design to include dimensions;
- Manufacturing Diary to include tools, processes and finishing techniques; and
- Self Evaluation and Peer Assessment, which must include a photograph of the product.

Teaching Resources

- PowerPoint slides
- Audio Amplifier Testing Sheet
- Amplifier Marking Criteria and Descriptors
- A3 Blank design sheet

Lesson 1

Model making

Duration: 1 hour 30 minutes

(Teacher-led lesson)

Pupils identify an initial problem by:

- discussing a given design situation;
- discussing the design brief and materials discussed as the starting point for research; and
- making model in groups.

Overview

This is a fun, hands-on technology lesson in which pupils have the opportunity to create their own iPod or smartphone speakers using some of everyday items.

Background knowledge

Little to no prior knowledge is required for this.

Communication Skills

Pupils should:

- engage in conversations and discussions, using active listening behaviours, showing interest and contributing ideas, information and questions;
- use interaction skills, including turn-taking, recognising the contributions of others, speaking clearly and using appropriate volume and pace;
- listen for specific purposes and information, including instructions, and extend students' own and others' ideas in discussions; and
- use interaction skills, including initiating topics, making positive statements and voicing disagreement in an appropriate manner, speaking clearly and varying tone, volume and pace.

Introduction

Search YouTube for the best DIY smartphone speakers or DIY cell phone speakers/amplifiers video clips showing how to make a model amplifier using household items. You can use these clips in different ways.

- You could watch either of these two clips as an introduction to the topic. Preview each one and select the most appropriate one for your class.
- Watch your selected clip with the sound off and ask your pupils to make notes about what is happening so that they can replicate the amplifier using their own materials.
- Watch the clip with the sound on and encourage your pupils to discuss the best way to proceed. Highlight any safety features that they need to consider when using the tools.

Lower Ability Activity – Thinking Cards Set 1

Task 1

Ask your pupils to:

- use the first picture as a starting point and the second picture as their final design;
- discuss and agree the steps their group should take to create the final product;
- create bullet points explaining how they would make this product; and
- choose one group member to how the group would make the product and the role each person would take to complete the task.

Encourage your pupils to use some or all of the following Thinking Cards to help complete the task.

- Managing Information – Making a plan (1:02)
- Working With Others – Being a good team (1:31)
- Being Creative – Making ideas real (1:25)
- Thinking, Problem solving and Decision Making – What if it doesn't work? (1:14)
- Self-Management – Keeping track of time (1:43)

Middle Ability Activity – Thinking Cards Set 2

Task 1

Ask your pupils to:

- use the first picture as a starting point and the second picture as their final design;
- describe in detail how they would develop the end product;
- produce a list of instructions on how to make the product; and
- pass the instruction on to another group to follow and make the product.

Task 2

Ask the manufacturing group to:

- use the instructions provided by the design group to manufacture the product;
- explain to the design group how they completed the task and the role of each group member; and
- give the design group verbal feedback on the quality of the instructions they provided.

Encourage your pupils to use some, or all, of the following Thinking Cards to help complete the task.

- Managing Information – Being clear about what you have to do. (2:02)
- Working With Others – Working together to do the best job (2:31)
- Being Creative – Finding a unique way to do something (2:25)
- Thinking, Problem solving and Decision Making – Something has gone wrong (2:14)
- Self-Management – You've done it. Problem Solved (2:43)

Higher Ability Activity – Thinking Cards Set 3

Task 1

Ask your pupils to:

- use the first picture as a starting point and the second picture as their final design to create a detailed set of instructions on how the end product could be developed; and
- pass these instructions on to another group who will follow the instructions and manufacture the product.

Task 2

Ask the manufacturing group to:

- follow the instructions exactly and make notes to indicate if they were able to complete the task successfully; and
- note any modifications required to the original instructions to complete the task successfully.

Task 3:

Ask the manufacturing group to:

- pass the modified instructions and final product back to the design group and provide feedback on why changes to the instructions were need;
- discuss the changes with the design group and suggest further developments for improvement (if any);
- digitally present the final set of instructions along with photographs of the final completed product; and
- share these on Fronter or another online discussion forum.

Encourage your pupils to use some or all of the following Thinking Cards to help complete the task.

- Managing Information – Where can I go to look (3:02)
- Working With Others – What do you need? (3:31)
- Being Creative – Do the hardest part first (3:25)
- Thinking, Problem solving and Decision Making – ‘I think ... because ...’ Give your reasons (3:14)
- Self-Management – ‘Could I do this on my own?’ (3:43)

Plenary:

Give the groups time to decorate their speakers using acrylic paints.

Audio Amplifier Testing (Decibel dB) Use the Testing sheet to complete this section.

Ask your pupils to use a decibel monitoring device to test the volume of their device, then test it again when placed in the amplifier they have made.

Ask each group to:

- choose a team name and record it on their testing sheet;
- play a song from the smartphone for 15 to 20 seconds and record the highest level indicated on the monitoring device;
- place the device in their amplifier and play the same song, recording the highest level indicated on the monitoring device; and
- calculate the difference, recording it on the testing sheet.

Lesson 2

Design Situation, Research and Design Brief

Resources and equipment required: All available as part of the resource pack

- Pupil workbook
- PowerPoint presentation
- Materials for identification

Introduction

Recap on the Lesson 1: Manufacturing the amplifier using cardboard tubes, cups and some tape.

Introduce the material pupils will use to manufacture the finished product.

Ask questions that could help your pupils to focus on wooden products.

Give an example of a product that is made from wood.

Ask about man-made boards to find out what your pupils know about them and give examples where these materials could be used.

Investigation Activity

Introduce your pupils to the project, using PowerPoint Slide 6 on Lesson 2 and page 1 of the pupil booklet.

Using Slide 6 as stimulus, ask your pupils to note five specification points related to their own project. The suggested points are only a few samples. Suggest others from open discussion about the topic.

At this point, emphasise that to complete this project successfully, pupils must take exact measurements.

Mood Board (pupil workbook page 2, Slide 7 and 8 from PowerPoint)

Encourage your pupils to use different research methods to find examples of audio amplifiers to create a mood board. This board should include pictures, images and text related to a design situation, considering colour, shape, location and size.

Plenary

Use some of the ideas your pupils have chosen to highlight safety issues, materials, manufacturing processes and the position of the microphone in relation to the speaker. Indicate that there are limitations to what can be done with the materials provided. Encourage your pupils to suggest a range of alternatives.

Homework idea

Page 3 in the pupil workbook is for homework. PowerPoint Slide 8 is an example of how to complete this homework.

Ask your pupils to focus on three designs and evaluate them using the following headings:

- Picture of the chosen design
- Shape
- Colour
- Theme
- User

Lessons 3 and 4: Product Design

Resources and equipment required

- Pupil workbook
- PowerPoint presentation
- Materials for project
- Workshop
- Hole Saw
- G-clamp and wood for jig
- Coloured pencils
- A3 paper or isometric paper

Introduction

Ask your pupils to use a rule to draw leader lines and then add dimensions for the template. Remind them to include the unit of measurement: millimetres (mm). (pupil workbook page 4)

Activity

Give your pupils the material they could use to make their design. Ask your pupils to measure it and put the measurements onto the drawing in the workbook. Demonstrate the process of manufacture using a hole saw and explain the benefit of using a jig to hold the wood for safety and batch production. Show your pupils how to use the scroll/Hegner saw to cut the required shapes. Ask your pupils to produce a range of neatly presented design ideas. The number of ideas and teacher guidance will depend on the ability of the class. These ideas should include annotation, colour and evaluation (Pupil work book page 5). Encourage your pupils to rate their own design and ask for the opinions of their group. Then, ask each group to develop one design into different options, drawing the actual size design in the workbook.

Plenary

Check that your pupils understand the vocabulary such as hole saw or scroll saw. Make sure that your pupil complete a pupil diary at the end of each week, making notes on what has happened during the lesson and what they must complete the following week.

Extension material

At this stage pupils will be developing their own designs. This will lead to a range of more complicated designs and alternative materials. Encourage this, as it shows the creative nature of the project and helps develop a range of thinking skills. Make sure your pupils draw their designs accurately and produce a working drawing. Ask them to compile a cutting list of materials on page 6 of their pupil workbooks.

Homework idea

Ask your pupils to complete their designs and choose a final design.

Lessons 5 to 10: Manufacturing

Resources and equipment required

- Pupil workbook
- PowerPoint presentation
- Workshop tools and equipment
- Materials to complete the projects
- Paints

Introduction

Tools definitions – Tools, pictures and uses, pupil workbook page 9.

Pupils should add tool definitions to their workbooks each time they use a tool or piece of equipment. This will help with pupil literacy (spelling key words) or could be used for homework.

Encourage class discussion on which tools they should use to manufacture the product. Ask your pupils to explain what each tool is used for and why that tool is best for each part of the manufacturing process.

Pupils should use:

- a pedestal drill;
- a Hegner or scroll saw;
- a sander; and
- a workshop tools.

Activity

Pupils should use their individual designs to:

- cut and shape each piece of material,
- sand and glue their work together,
- apply an appropriate finish to their finished project, for example by:
 - painting the whole project one colour and then apply wax or varnish;
 - painting sections to give a personal look and then apply wax or varnish; or
 - achieving a natural finish with just wax and varnish; and
- test their project.

The finish that pupils use will depend on each department's resources.

Plenary discussion for each lesson

Encourage your pupils to:

- share ideas, procedures and appropriate finishing techniques;
- share problems they may have encountered during the lesson and how they overcame them;
- check their progress as a group;
- photograph each stage so that they have a record of their work;
- discuss alternative methods of finishing their project; and
- complete their pupil diary at the end of each week, making notes on what has happened during the lesson and what they must complete the following week.

Extension material

Show your pupils examples of high quality work to give them an idea of what can be achieved.

Lesson 10: Finishing Techniques

Introduction

Finishing Techniques: Show your pupils different methods of finishing their work, including using:

- forstner bits to inlay different materials to create a pattern;
- paint;
- wax and polish;
- varnish; and
- computer graphics to personalise the project.

Activity

Manufacturing the project.

Ask your pupils to decide on the best finish for their project, basing their judgement on the different finishing techniques they have seen.

Plenary

Encourage your pupils to:

- share ideas, procedures and appropriate finishing techniques;
- share problems that they may have encountered during the lesson and how they overcame them;
- check their progress as a group;
- photograph each stage so that they have a record of their work;
- discuss alternative methods of finishing their project and why they decided on the method they chose;
- use the mark sheet at the end of the pupil workbook to peer assess their work.

You should moderate their marks to ensure consistency.

This will support pupils to develop an understanding of where they need to make improvements in their work.

Extension material

As an extension activity, ask your pupils to:

- use CNC to cut out each section of the amplifier;
- investigate the acoustic properties of each material;
- use a computer drawing package to present their initial design and final design;
- research packaging design – how is the product advertise and marketed?
- investigate joining methods for different materials; or
- investigate different finishing techniques for materials.

Links to other curriculum areas

Science and Mathematics:

- How does sound travel?
- How is sound measured?
- How fast does sound travel?
- Test each product and record results on a spreadsheet to present graphs to find out who has made the product with the loudest noise.