



Moisture Tester Project

Moisture Tester

Designers often break the problem up into a number of smaller activities. This is to make it easier to solve and ensure that they do not forget any important information that might affect the design.

Situation - The situation will give us a general description of the background to the problem.

Houseplants can suffer if owners do not give them the correct amount of water. Houseplants can die if they do not receive enough water, and they can rot if they are over watered.



Design Brief - The design brief is a summary statement that clearly states the aim of the design project and in a few words states the kind of thing that is needed. For example, "Design a toy" is not very helpful to a designer. "Design a toy for a baby" gives the designer a clearer focus without applying restrictions.

Task 1

Write a design brief for your Moisture Tester.

Investigation - Before designing we must find out as much as we can about the situation. Investigation therefore involves collecting information from a variety of sources. When you investigate a situation, it is important for you to think about all the things that might affect your product.

Task 2

To help you build up a good background knowledge, investigate houseplants using the information and activity sheets.

Specification - Once you have a clear understanding of the problem, you can work out the specification for your Moisture Tester. A specification is a list of things that the final design must do. A good specification will list all the important features in order of importance.

Specifications are an important part of designing because they provide a check list against which you can review your ideas as you are working. They also give you something against which to evaluate your ideas and your finished product.

For example, "the toy should be painted" does not give the designer enough information. "The toy should be painted a primary colour" is a clear statement without restricting the designer.

Task 3

Write a specification for your Moisture Tester.

- **Make a list of all the features you need to include in the design.**
- **Place them in the correct order of importance.**

The Design Process

Design Brief

Investigation

Specification

Initial Ideas

Development

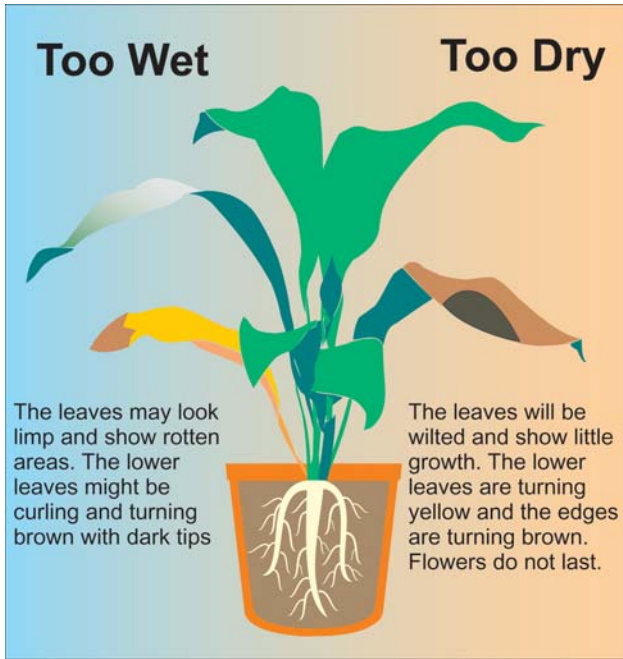
Making

Evaluation

House Plants

Millions of houseplants are bought each year from supermarkets and garden centres. However, a large proportion of these suffer because their owners do not know how to look after them properly.

The most common problem with house plants is the level of watering. Too much or too little may cause the plant to die. So it is important to get the right balance.



Plants live by absorbing chemicals from the soil through the water around the roots. They draw water into the root by chemical reactions. These reactions take place in the root and release energy. Oxygen is needed for the reactions to take place and the root takes this in from the air between the soil particles. If a soil is waterlogged air is forced out of the soil, the roots are therefore starved of oxygen and cannot draw in the minerals so the plant slowly dies.

Absorbing water

Water forms a thin film around the soil particles. The tiny root hairs grow between the particles and take in water.

The water passes from the root hair between the walls of the other cells in the root to tubes near the root centre. From here the water passes up the stem and into the leaves. The water is drawn up to replace the water in the leaves that evaporates into the air.

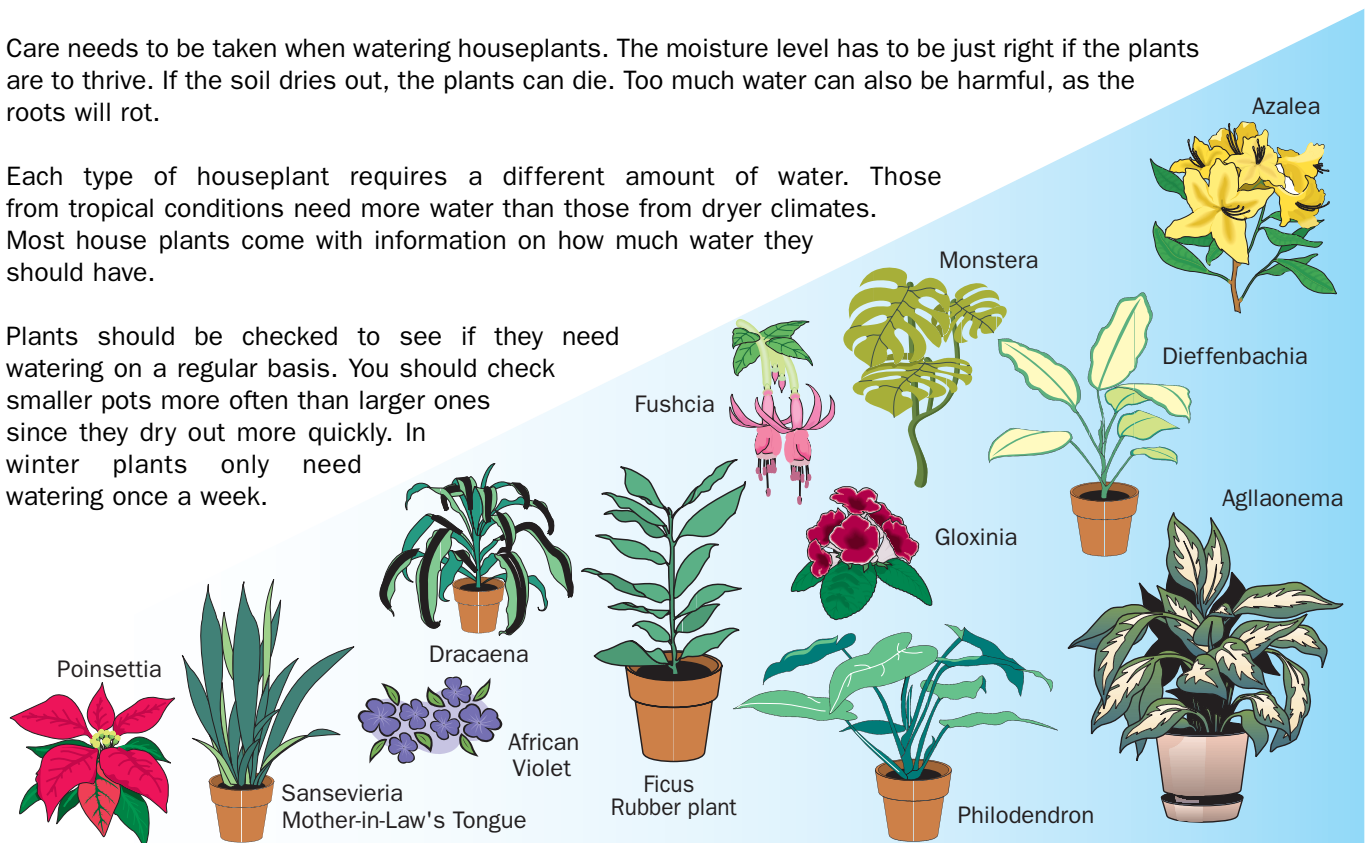
Watering plants

The chart below will help you identify some of the most common types of houseplants. The diagram also shows the relative amount of water they would need. The Poinsettia requires little water, whereas the Azalea likes moist soil.

Care needs to be taken when watering houseplants. The moisture level has to be just right if the plants are to thrive. If the soil dries out, the plants can die. Too much water can also be harmful, as the roots will rot.

Each type of houseplant requires a different amount of water. Those from tropical conditions need more water than those from dryer climates. Most house plants come with information on how much water they should have.

Plants should be checked to see if they need watering on a regular basis. You should check smaller pots more often than larger ones since they dry out more quickly. In winter plants only need watering once a week.



House plants activity

The electrical resistance of the soil is dependent on its water content. The higher the moisture content of the soil, the lower its resistance.

Task

Using a multimeter check the moisture in a variety of plants your teacher has arranged.

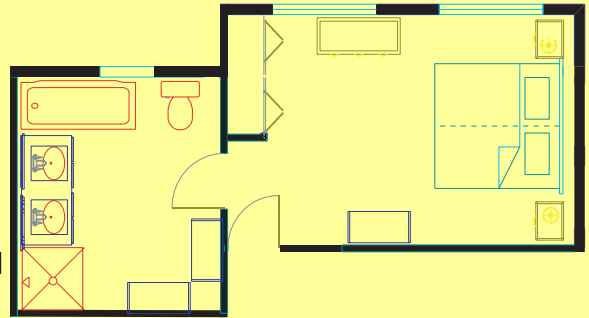
What is the resistance of a correctly watered plant?
What is the resistance of a dry plant that needs watering?

Write your answers down and produce a chart that shows your findings.

Task

Draw a simple plan of a room in your house. Include the positions of windows, doors, heating and major pieces of furniture.

Mark on the positions for the best location of houseplants, remembering they need to be placed in a light, even temperature environment.



Task

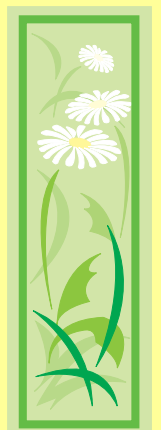
Make a list of the plants you have at home, together with a brief description of their condition (describe the plant if you are unsure, or draw an example of the leaf).

If any of your houseplants are in poor condition, what changes would you recommend to improve them?

Task

A garden centre has asked you to design a bookmark that can be given away to customers who purchase a new houseplant. The bookmark should contain information to help the customer keep the houseplant in good condition. Make sure that the information you provide is clear and easy to follow.

1. Sketch a series of ideas (you can incorporate some of the images below in your design).
2. Select the best features from your initial ideas and draw your final design in colour on the piece of card your teacher has provided.

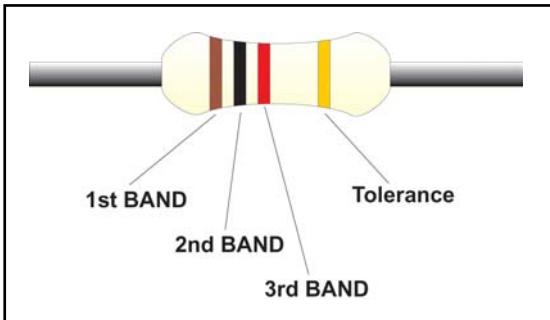


Resistors

Resistors are used to control the flow of electricity around a circuit. A resistor is manufactured by mixing conducting and non-conducting material that is then formed into a paste and attached to wire connectors. The more conducting material in the paste the lower the resistance. The more the non-conducting material in the paste, the higher the resistance.

Colour codes

It would be very difficult to read the value of a resistor if we printed it on its case. To overcome this, resistors have a colour code in a series of bands around the resistor.



1. The first band gives the first figure of its resistance.
2. The second band gives the second figure of its resistance.
3. The third band tells you how many 0's are to be added.
4. The fourth band gives us the Tolerance. This is normally +/- 5%, a gold band. A silver band would indicate a 10% tolerance so a 100R resistor would have a minimum resistance of 95R and a maximum resistance of 105R

Each colour represents a different number. So by replacing the colour code with a number it is possible to work out the value of the resistor. You read a resistor by turning it so that the tolerance band is to the right. Then read from left to right, write down the value for the first two bands followed by the number of zero's to be added by the third band.

Example:

1st Band	2nd Band	3rd Band
Brown	Black	Red
1	0	2

**=1000R
=1K**

You do not normally need to include the fourth band (tolerance) when working out the value of the resistor.

Resistor Colour Code	
Colour	Number
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

We measure resistance in Ohms. One Ohm is too small a unit for most project work. You will often use resistors of value 100,000Ω. If we were to write the full value down it would make our diagrams difficult to read, so to simplify the information electronics engineers use a shortened version. Large values of resistors use Kilo (K) and Mega (M) to denote thousands and millions of Ohms.

When you look at circuit diagrams you will often see letters R, K, M used for the decimal place. The diagram to the right shows some examples of how resistor values are written down on a circuit diagram.

4R7	= 4.7 Ohms
1K0	= 1000 Ohms
1K8	= 1800 Ohms
120K	= 120000 Ohms
1M5	= 1500000 Ohms

Preferred Values

Resistors are normally purchased in a series of set values. The most common series is the E12 range.

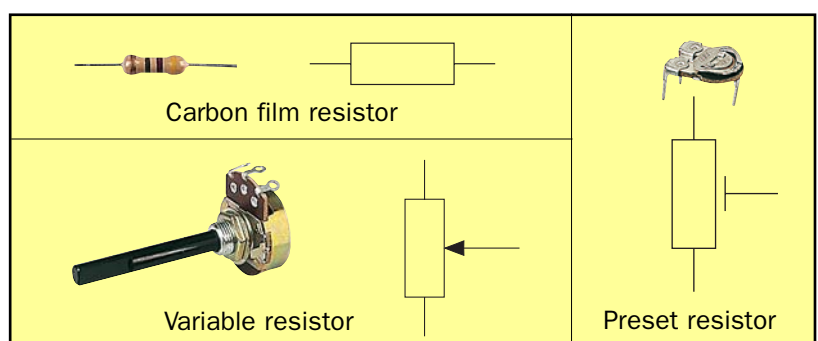
E12 range:

10 12 15 18 22 27 33 39 47 56 68 82

For each of the numbers you have a range of linked values.

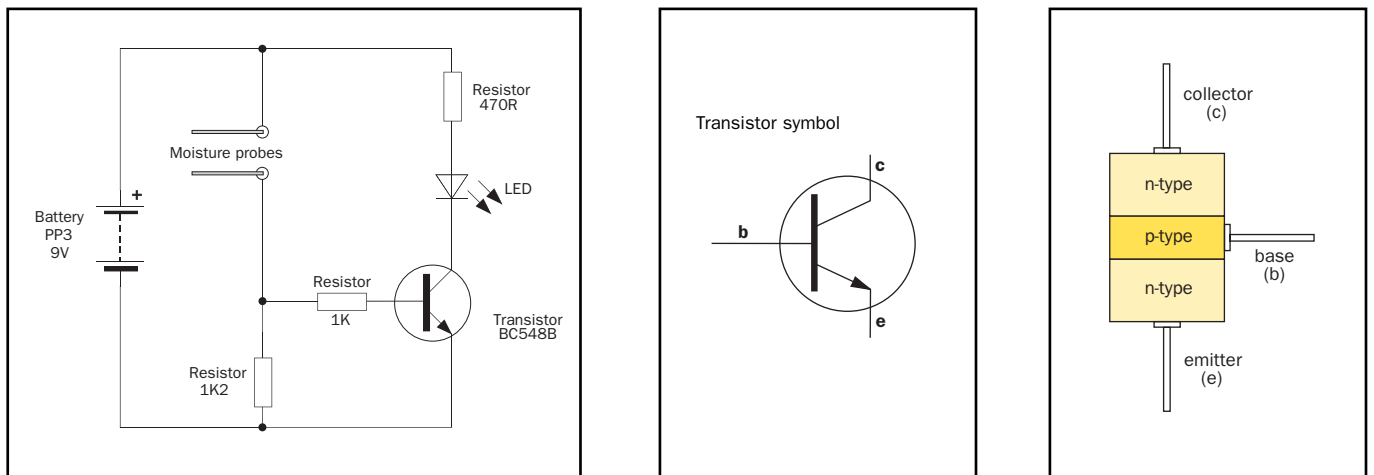
E.g. 4R7 47R 470R 4K7 47K 470K 4M7

Types of resistors



Transistors

The transistor is an important component in electronics today. It's invention in 1948 made it possible to manufacture the first portable battery powered radios.



A transistor is usually made from silicon, a semiconducting material. The transistor is a sandwich of two types of silicon. The most common transistor for project work is a npn transistor. The two n-type regions are called the collector (c) and the emitter (e). The p-type region is called the base (b).

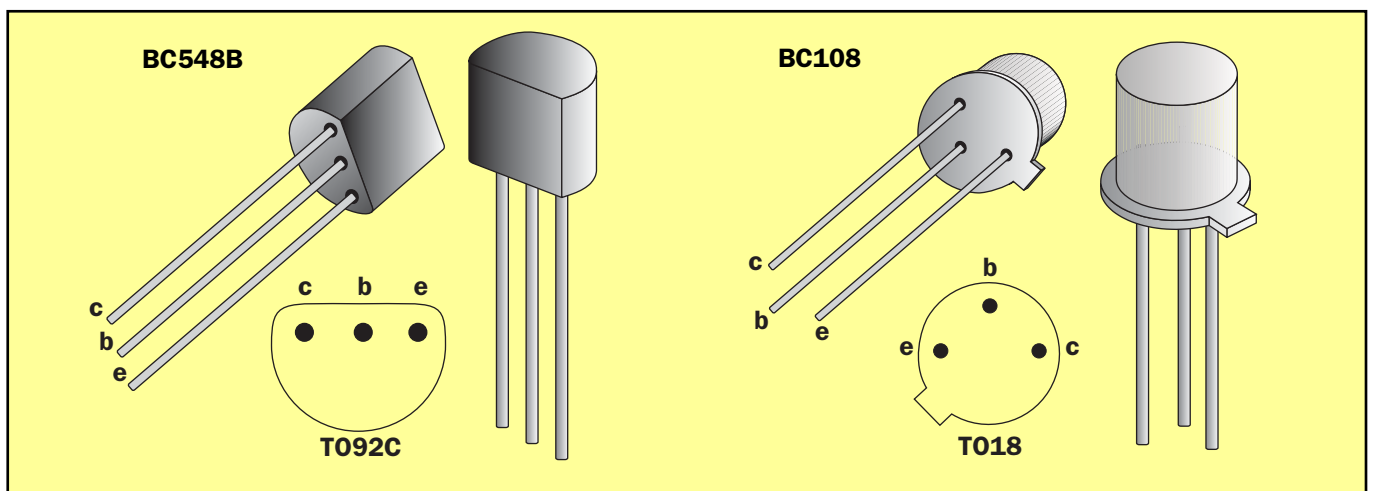
A transistor can be either a conductor or an insulator. When there is no voltage applied to the base of the transistor it is acting like an insulator and as a result does not allow electricity to flow. This is like a switch that has not been pressed.

When a voltage is applied to the base of the transistor, it becomes a conductor, allowing electricity to flow. It is now behaving like a switch that has been pressed.

A resistor is often used, in series with the base to protect the transistor. This is described as a current limiting resistor (typical value 1K). It only requires 0.6V to turn on a transistor. This voltage of 0.6V is called the threshold voltage and is the point at which the transistor changes from being an insulator to a conductor.

Pin Identification

As mentioned, transistors have three connections or legs; the emitter (e), the base (b), and the collector (c). Transistors come in a variety of case types and each type uses a different leg arrangement. You can find the pin layout in the Rapid Electronics catalogue. It is important to identify each leg before attempting to connect a transistor.



The BC548B is the modern replacement for the BC108 transistor. It offers the same characteristics, however it is less likely to be damaged by heat transfer when soldering. The BC548B is also cheaper to buy. The diagrams above show the location of the legs when viewed from under the case.

There are a variety of systems used by manufacturers for identifying the transistor legs. The emitter is frequently marked with a tag or a dot. The shape of the case is also important for pin identification.

Resistor & transistor activity

Resistors

Task

Collect together ten assorted resistors. Use the colour code to find out their resistance. Then measure their resistance with a multimeter to see if you are right.

Why do you think some of your readings might be slightly different from the colour code values?

Task

Work out the value of the following 4 resistor colour codes. You will need to use the colour chart on the resistor information sheet.

1st Band	2nd Band	3rd Band
Brown	Grey	Brown
Orange	Orange	Brown
Green	Blue	Black
Brown	Black	Brown

Task

Write down the colour codes for the 4 following values of resistors. You will need to use the colour chart on the resistor information sheet.



1K
3K3
470R
2M2

Task

As we have seen resistors are available in a range of set values. The most common range used in schools is the E12 range. The table below is a selection from the E12 range.

Write down the 10 missing blanks from the table below.

100R	120R		180R	220R		330R	390R		560R	680R	820R
1K		1K5	1K8	2K2	2K7	3K3	3K9	4K7	5K6		8K2
	120K	150K		220K	270K	330K	390K	470K	560K	680K	
1M	1M2		1M8	2M2	2M7	3M3		4M7	5M6	6M8	8M2

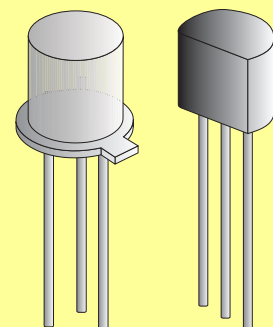
Task

Explain what you understand by the term "tolerance of a resistor". If a 470R resistor had a tolerance of $\pm 5\%$, what would be the maximum and minimum values that resistor could be?

Transistors

Task

- What are the names of the three legs on a transistor called?
- Draw the symbol used to represent a transistor. Label the connections of the transistor symbol.
- What is the purpose of the resistor applied to the base of the transistor?
- Select a transistor you have used. Draw a picture to help you identify the legs of the transistor.



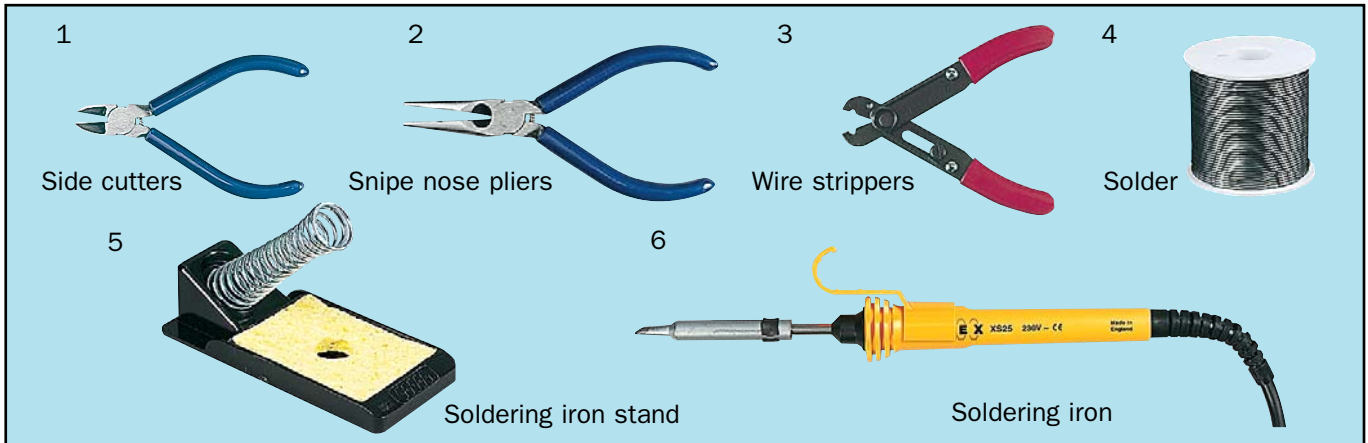
Soldering

Soldering is the method we use for joining electronic components together. Solder is metal alloy of tin (60%) and lead(40%), that becomes molten at around 200°C. Solder contains flux that helps the joint form correctly.

**YOU SHOULD ALWAYS SOLDER IN A WELL-VENTILATED AREA.
DO NOT INHALE THE FLUX SMOKE.
TAKE CARE NOT TO TOUCH THE TIP OF THE SOLDERING IRON ON THE CABLE OR YOURSELF.**

How to solder

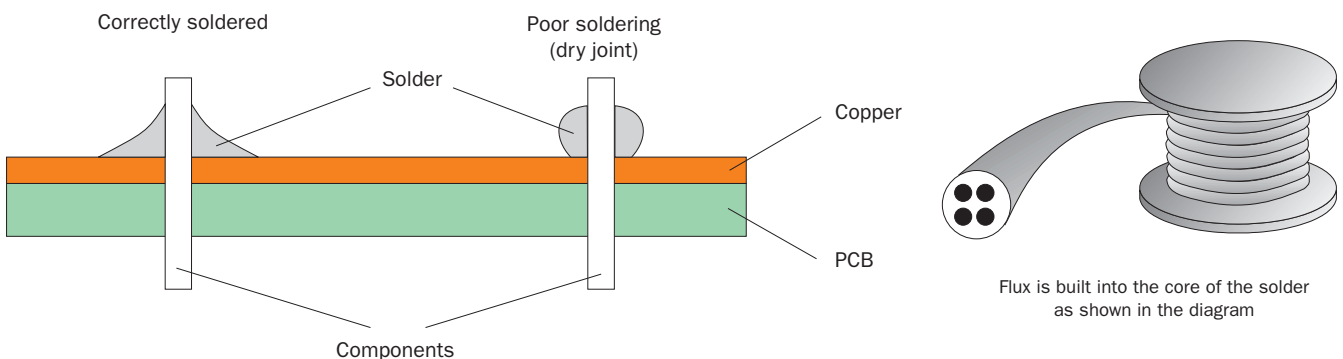
1. Collect together the soldering tools below:



2. Make sure that the sponge on the stand is damp.
3. When the soldering iron has reached its temperature (around 450°C) clean the tip on the sponge.
4. Place a small amount of solder on the tip of the soldering iron. This is called tinning and helps the transfer of the heat from the soldering iron to the components.
5. Place the soldering iron against the track and the leg of the component and hold it there for a few seconds.
6. Touch the solder against the track and leg of the component so that just enough solder runs onto both.
7. Remove the solder and then the soldering iron and allow the joint to cool before you attempt to move it.
8. Cut off any excess leg from the component just above the top of the soldered joint.

Soldering problems

A 'dry' joint is the most common problem when soldering. This can be recognised by the solder looking a dull grey colour and forming a ball that is not attached to the track.



Poor joints are usually the result of one of the following:

- Not heating the joint for long enough. A minimum of 3 seconds is needed.
- Not cleaning the soldering iron and tinning it before attempting the joint.
- Poor soldering iron contact.
- Moving the components before the joint has cooled.

Initial Ideas

Once you have written a specification, the next stage is to draw some initial ideas. Designers try to come up with as many ideas as possible. Even if you think the idea might be a little silly, you should include it because it may be useful later.

Your specification will act as a guide for your ideas. Try to think of the main features you need to include whilst you are drawing.

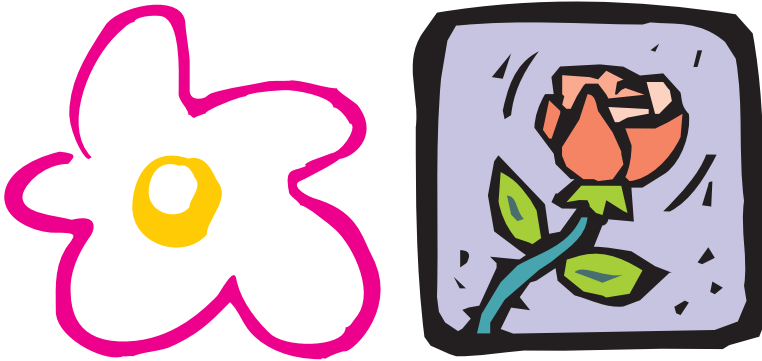
Task

In the space below draw as many different ideas as possible. Try to think of images that are linked to plants and flowers. Two examples have been drawn to help you start.

Include some notes to help explain your designs.

Indicate on your drawings where the LED and the instructions are to be placed.

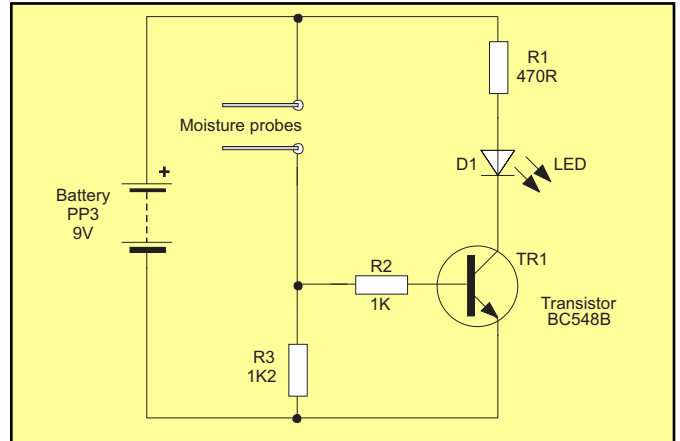
Do not make your designs too complicated with lots of small cut and turns. This will prove difficult for you to cut out.



Circuit Construction

The circuit diagram on the right is the circuit for your Moisture Tester. It is based on a transistor that operates as an electronics switch. When there is no moisture between the probes, the resistance is high and the base voltage is below the 0.6V threshold to turn on the transistor.

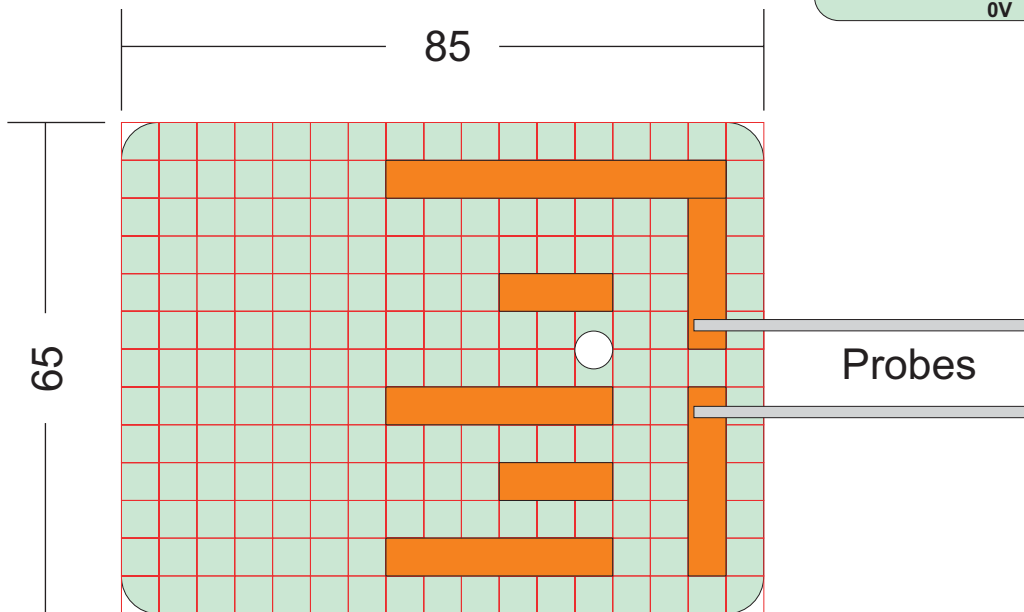
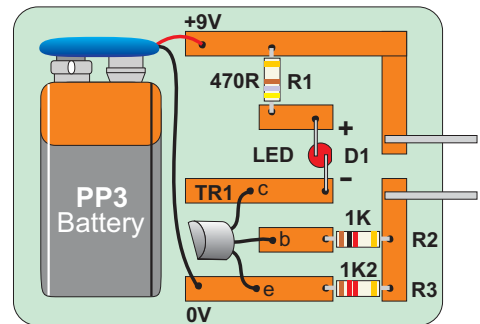
If the probes are placed in damp soil the water causes the resistance between the probes to be low. As a result there will be a voltage of greater than 0.6V applied to the base of the transistor and it will turn on, lighting the LED to indicate the presence of moisture in the soil.



Construction of circuit

You will need to collect together the following equipment before you start construction of your circuit:

- Soldering equipment set
- Card blank to build circuit on
- Two paper clips (for moisture probes)
- 300mm of adhesive copper track
- Components:
 - BC548B transistor
 - 1K resistor (brown, black, red)
 - 1K2 resistor (brown, red, red)
 - 470R resistor (yellow, violet, brown)
 - 5mm Red LED
 - Battery clip



Procedure for construction

1. Mark out and stick the copper tracks to the card background.
2. Cut the hole for the LED to pass through (taking care not to make the hole too large).
3. Solder the three resistors in place (care should be taken not to overheat the copper track or it will lift from the card base).
4. Solder the transistor in place (making sure you get the legs the correct way round).
5. Solder the probes in place.
6. Solder the battery clip in place. Take care when shortening the connecting wires.
7. Solder the LED in position. It is important to connect it the correct way round or it will not light.

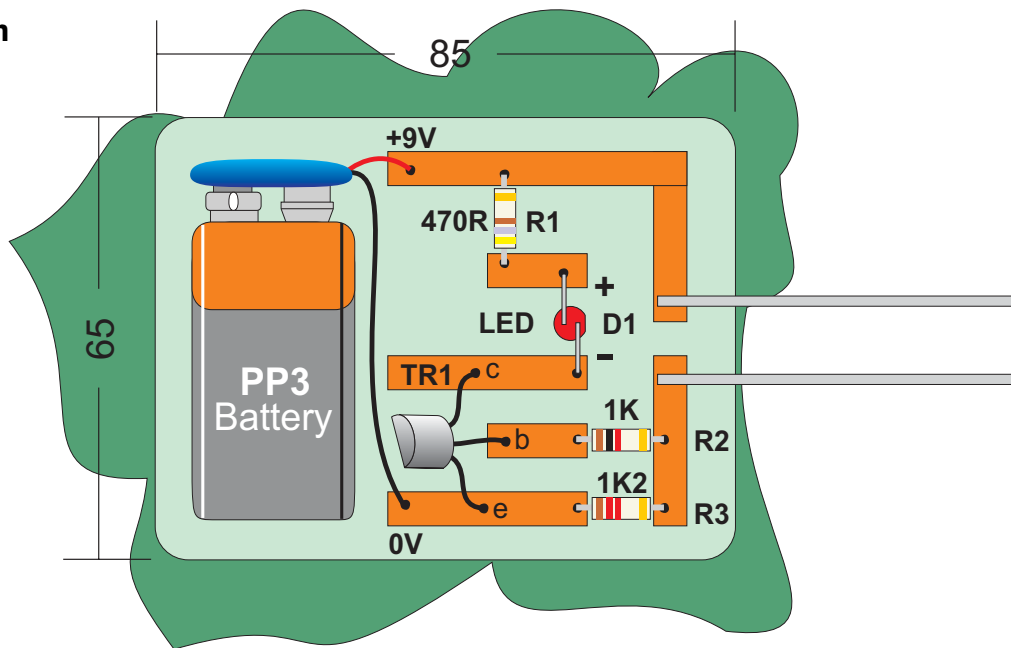
Development

To develop an idea, we need to start thinking about making the design. How will the initial idea need to be changed so that it can be manufactured from the materials available and with the workshop facilities available?

Task

Develop a final design. Make sure the design covers the circuit board and that it does not prevent the probes being placed in the soil. Remember to include the position of the LED.

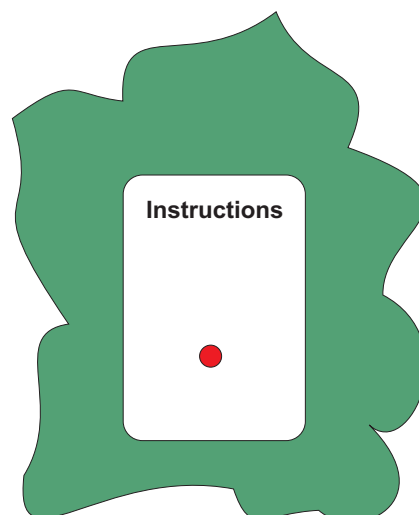
Final Design



Task

Develop a series of instructions on how to use the moisture sensor, to be included on the front of the final design. Include the following sections:

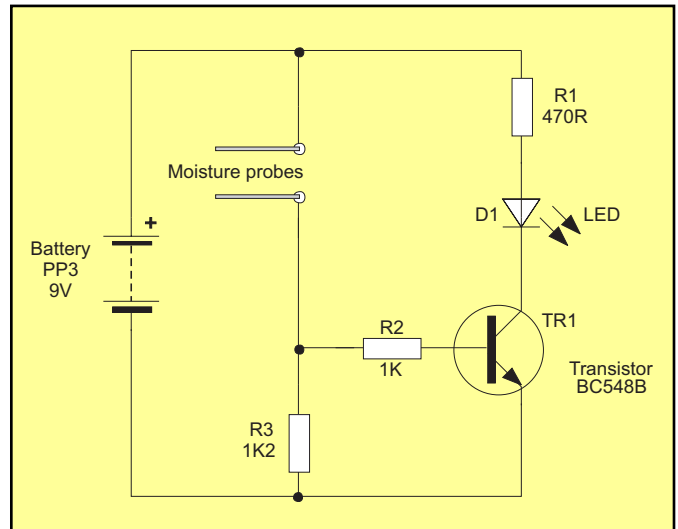
- **How to place the probes correctly in the soil.**
- **How to measure the moisture content.**
- **How to adjust the sensitivity of the sensor.**



Circuit construction

The circuit diagram to the right is the circuit for your Moisture Tester. It is based on a transistor that operates as an electronics switch. When there is no moisture between the probes, the resistance is high and the base voltage is below the 0.6V threshold to turn on the transistor.

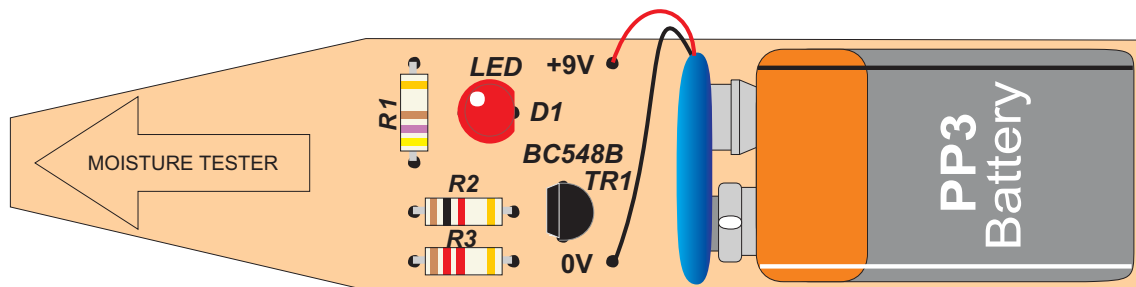
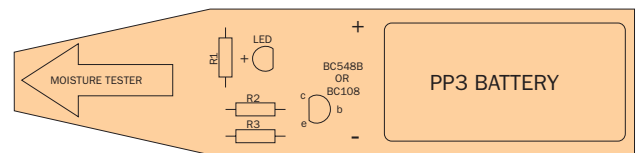
If the probes are placed in damp soil the water causes the resistance between the probes to be low. As a result there will be a voltage of greater than 0.6V applied to the base of the transistor and it will turn on, lighting the LED to indicate the presence of moisture in the soil.



Construction of circuit

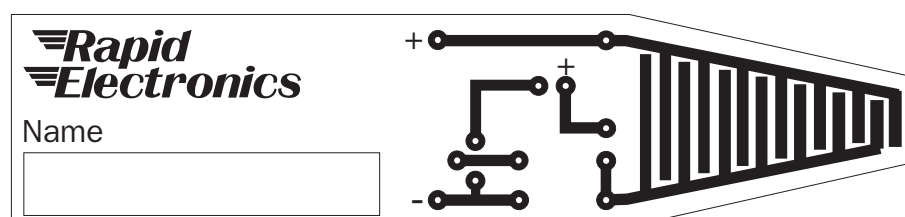
You will need to collect together the following equipment before you start construction of your circuit:

- Soldering equipment set
- Circuit board
- Components: BC548B transistor
 R2 1K resistor (brown, black, red)
 R3 1K2 resistor (brown, red, red)
 R1 470R resistor (yellow, violet, brown)
 5mm Red LED
 Battery clip



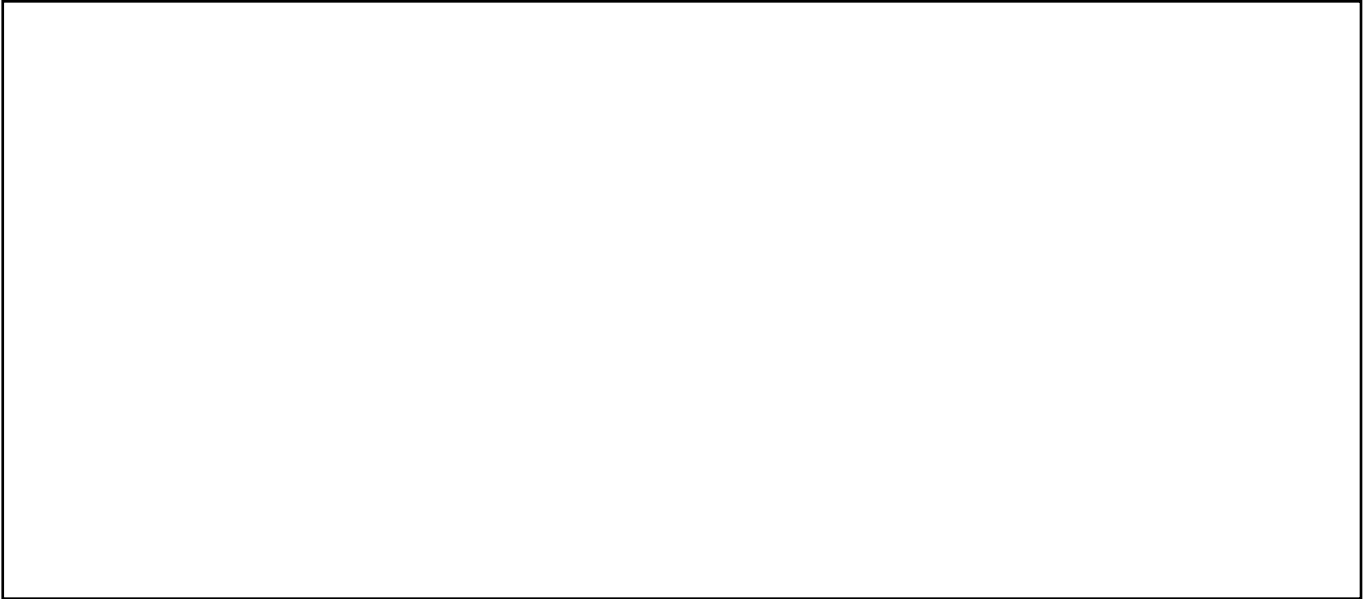
Procedure for construction

1. If not using the pre drilled PCB, shape front of circuit board to form moisture tester.
2. If not using the pre drilled PCB, drill holes for components.
3. Solder the three resistors in place (care should be taken not to overheat the copper track or it will lift from the circuit board).
4. Solder the transistor in place (making sure you get the legs the correct way round).
5. Solder the LED in position so that it sits 20mm above the circuit board. It is important to connect it the correct way round or it will not light.
6. Solder the battery clip in place. Take care when shortening the connecting wires.

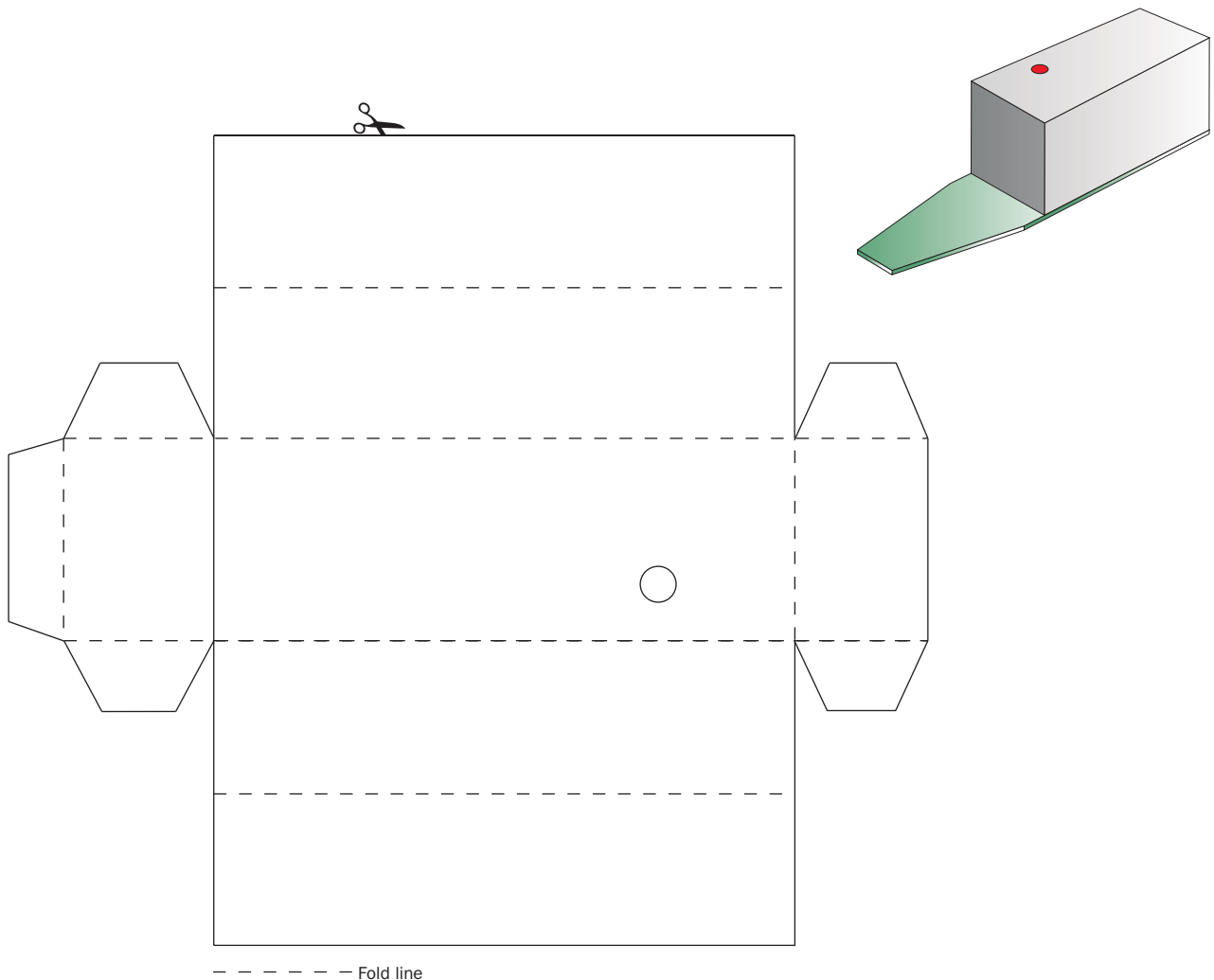


Case design

Below is printed the net of the box that will cover your electronic moisture tester circuit. In the box below make a list of all the information that you will need to add to enable someone to use your tester. A set of clear instructions along with some simple graphics to help explain how to use it might be useful. You can also include a company logo or trademark.



Once you have developed a series of images and text you intend to use on the box, you can add them to the net design below and cut out the shape. The rectangle with the small hole in indicates the top of the box. Think carefully about how you lay out the information.



Procedure Chart

Task
Draw a procedure chart, using a series of pictures to describe how you have manufactured your Moisture Tester. Make sure that your diagrams show the important detail.

Evaluation

Evaluation is an important part of the design process. It is used by designers to check they have produced a good design with all the features they identified in the specification. When you are evaluating a product you are trying to find out both its good and poor features.

Your own opinions are important, but you must also get some other peoples opinions as well. They may notice qualities you are not aware of.

Task

Evaluate your Moisture Tester project by establishing if it meets your specification. Look at your specification and write down in the boxes below two features to establish the quality of your Moisture Tester.

1.

2.

Task

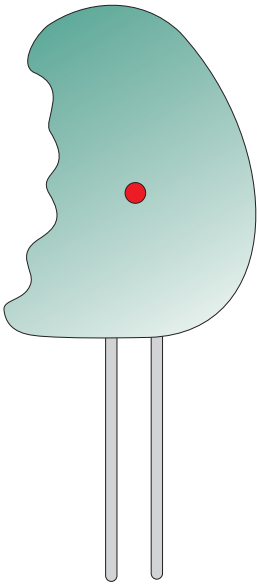
Sketch how your final Moisture Tester design could be improved.

Product development

A local electronics company has seen your prototype Moisture Tester and would like to manufacture it. However they would like you to develop a new case design.

Task

In the space below draw a series of shapes you feel would be suitable for the commercial Moisture Tester. Think about how the tester is to be used, how it is to be held in the hand and where the LED is to be located. The design will use two probes approximately 50mm in length.



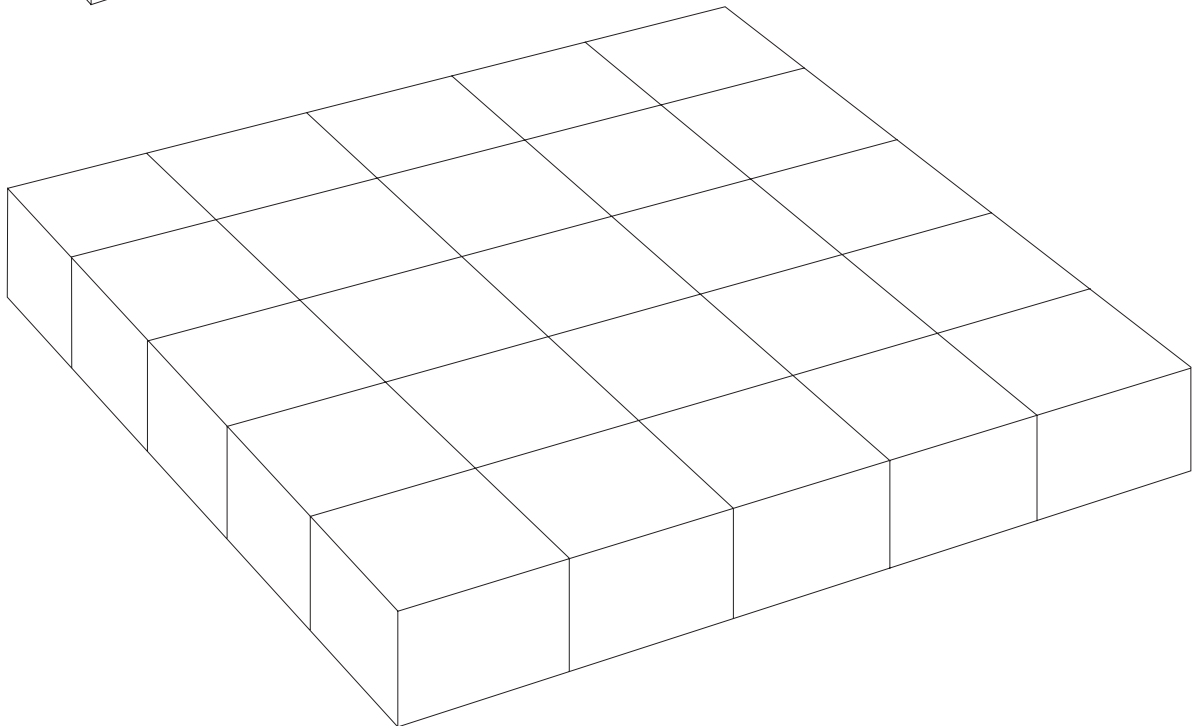
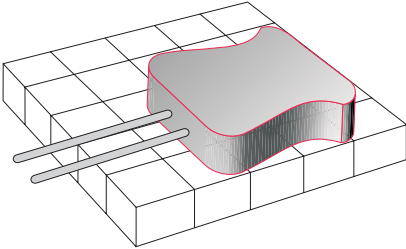
Task

Use the grid provided to help you achieve the correct perspective.

Draw a 3D picture of your final design.

Use colour pencils to try and achieve a realistic shading.

You will first need to think about where the light is coming from and as a result where the areas of darkness will be.



Task

- Mark out your design onto the foam.

A felt tip is the best method of marking out on the foam.

Take care not to dent the foam when drawing your design.

- Use a piece of medium grade glass paper to shape your design.
You can use a variety of objects to wrap your glass paper around so as to create more even shapes.
- A used piece of fine glass paper will help you achieve a better quality of finish.
 - When you have formed your shape you can now paint your design.
Water coloured paints are suitable for use directly onto the foam.
With some colours you may need to use two coats to give you a good finish.
- You can add the instructions and position of the LED by using an adhesive label cut to the correct shape.

Progress Diary

Each week, write a short paragraph about the work you have done. As well as commenting on good aspects of the lesson, try to comment on work that has not gone so well, or that you did not fully understand.

When designing, it is also important to think ahead. Write down in the second section what work you anticipate doing next week on your project.

Week 1	Today _____
	Next Lesson

Week 2	Today _____
	Next Lesson

Week 3	Today _____
	Next Lesson

Week 4	Today _____
	Next Lesson

Week 5	Today _____
	Next Lesson

Week 6	Today _____
	Final comment:

Teacher comments:



Teacher Notes

Teacher notes

Introduction

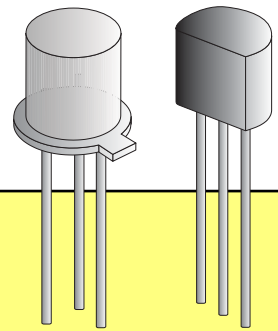
The Moisture Tester project is designed to introduce students to the use of resistors and transistors. **There are two alternative methods of circuit construction.** The project is designed for early KS3 to Design and Make in electronics. Emphasis has been placed on providing students with a complete design solution at the end of the project.

A key feature of the teaching material is that in addition to providing a student resource, it also contains detailed teacher support notes for guidance. **The teaching pack has been designed to be photocopied.** A number of the activity sheets can be used in isolation from the project. Included in the material are a series of structured homework assignments to support the work in class.

A series of lesson plans have been included based on teacher experience. However, the detailed project organisation will depend upon timetable, facilities and student needs.

The project is intended for use with mixed ability year 8 students. The practical work should be possible in a typical secondary based workshop. However, with careful organisation it is possible to manufacture the card based project without specialist workshop facilities.

The Moisture Tester project uses the BC548B transistor. This is becoming the modern replacement for the BC108. It offers the same characteristics, however it is less likely to be damaged by heat transfer during soldering.



Aims and objectives

The project is to design and make a houseplant moisture tester. The project will enable students to experience the design and manufacture of simple electronic circuits.

CONCEPTS:

- Electronic circuits.
- Design and manufacture.
- Model making.
- Evaluation.

OBJECTIVES:

Pupils should understand:

- The need to investigate the background to a problem.
- How to select appropriate components to build simple electronic circuits.
- The importance of planned manufacture.
- The need to build models to evaluate design ideas.
- How to improve a product by evaluation.

SCIENCE OPPORTUNITIES:

- Understanding of circuit theory.
- Resistance/ Ohms law.
- The working of the voltage divider.
- The transistor as a switch.

MATHS OPPORTUNITIES:

- Accurate measurement and marking out.

IT OPPORTUNITIES:

- Use of Crocodile Clips to develop and test circuit ideas.
- Graphic packages to help generate design ideas .
- PCB design and production.

OTHER OPPORTUNITIES:

- Product styling.

Project plan

Week 1 - Introduction and Investigations

Aim:

- Introduce problem and discuss background.
- Write design brief.
- Investigate houseplants to build background knowledge.

Student:

- Write design brief.
- Investigate houseplants.

Teaching input:

- Discuss background to problem.
- Assist in the writing of the design brief and specification.
- Advice on organisation of information gained from houseplants activity sheets.

Demonstrations:

- How to measure the moisture content of soil.
- The problems of over/under watering of plants.

Resources:

- Examples of existing solutions (if available).
- Example of completed moisture tester.
- 'Moisture tester project' sheet.
- 'Houseplant' information and activity sheets.
- Examples of houseplants.

Homework:

- Present findings from research from houseplants activity sheet.
- Selected questions from houseplants activity sheet.
- Diary record.

Week 2 - Components and circuits

Aim:

- Use of voltage divider.
- Develop concept of controlling resistance in a circuit.
- Concept of transistor as a switch.
- Recognition and selection of components.
- Experiment with building electronic circuits.

Student:

- Testing a variety of electronics circuits.
- Questions based on activity sheets.

Teaching input:

- Discussion on resistor colour codes.
- Discussion on transistor as a switch.
- Guidance on building and testing circuits.
- Assistance with work on resistors and transistors activity sheets.

Demonstrations:

- Construction of circuits.
- How to establish values of resistors.

Resources:

- 'Resistors' activity sheet.
- 'Transistors' activity sheet.
- Electronic components for testing, multimeters, power supplies.

Homework:

- Selected questions from activity sheet on resistors and transistors.
- Diary record.

Project plan

Week 3 - Design ideas and soldering

Aim:

- Establish specification.
- Generate initial ideas and develop final solution.
- Develop graphical communication and presentation skills.
- Soldering practice.

Student:

- Write specification.
- Draw range of initial ideas.
- Develop chosen idea and present final solution.
- Soldering practice.

Teaching input:

- Discuss specification.
- Guide students through generation and development of ideas.
- Advice on presentation techniques and layout of work.

Demonstrations:

- Graphical presentation based on coloured pencil work.
- Soldering.

Resources:

- 'Initial ideas' activity sheet.
- 'Development' activity sheet.
- 'Soldering' activity sheet.
- Coloured pencils and associated drawing materials.
- Scrap stripboard, single core wire, soldering equipment.

Homework:

- Completion of unfinished design work.
- Diary record.

Week 4 - Manufacturing design

Aim:

- Review of safe working practices in the workshop.
- Students to start manufacturing Moisture Tester.

Student:

- Manufacture Moisture Tester.

Teaching input:

- Go through safety in the workshop with students based on equipment to be used.
- Provide assistance to students to start manufacturing Moisture Tester designs.

Demonstrations:

- Demonstrate methods and tools for manufacture.
- Safe soldering

Resources:

- Student: Class set for 5 students (order code **70-0030** which includes :-
1K, 1K2, 470R resistors, 5mm LED, BC548B transistor, PP3 battery clip).
or Tracktronics copper tape (order code **34-0635**)
Class set of 5 printed circuit boards (pre-drilled, order code **70-0040**)
PP3 battery (order code **18-1020**)
Solder, Soldering tools
- Double sided tape.
- Card circuit blanks.
- Workshop tools.

Homework:

- Procedure chart for manufacture.
- Diary record.

Project plan

Week 5 - Product development

Aim:

- Complete manufacturing of any unfinished Moisture Testers.
- Design and manufacture sales model of Moisture Tester.

Student:

- Complete any unfinished construction of Moisture Tester.
- Develop design ideas for commercial Moisture Tester.

Teaching input:

- Provide support to help students finish the construction of their Moisture Tester.
- Discuss styles suitable for commercial design of the Moisture Tester.
- Help students in the development of presentational techniques.

Demonstrations:

- How to manufacture model from foam. See below for details.
- Presentation techniques.

Resources:

- Examples of similar style products.
- Foam blanks for making models.
- Glasspaper.
- Paints.

Homework:

- 3D view of model in colour.
- Diary record.

Styrofoam

Styrofoam is a high density polystyrene foam, which is excellent for making prototype models. The foam is easy to cut and sand to shape using the minimum of workshop tools. Styrofoam can be glued together using water based contact adhesive. Use a fibre grade glass paper to provide a smooth finish for applying water based paints.

Note: Work in a well ventilated area. The wearing of a protective mask is recommended.



Week 6 - Evaluation

Aim:

- Completion of commercial model.
- Evaluation of Moisture tester and student progress.

Student:

- Completion of models.
- Evaluation against specification.

Teaching input:

- Discussion on important feature to include in project evaluations.

Demonstrations:

- None.

Resources:

- 'Evaluation' activity sheets.

Homework:

- Diary record.

National Curriculum 2000

Design & Technology

Programme of Study Key Stage 3

During key stage 3 pupils use a wide range of materials to design and make products. They work out their ideas with some precision, taking into account how products will be used, who will use them, how much they cost and their appearance. They develop their understanding of designing and making by investigating products and finding out about the work of professional designers and manufacturing industry. They use computers, including computer-aided design and manufacture (CAD/CAM) and control software, as an integral part of designing and making. They draw on knowledge and understanding from other areas of the curriculum.

Knowledge, skills and understanding

Developing, planning and communicating ideas

1. Pupils should be taught to:

- a) identify relevant sources of information, using a range of resources including ICT.
- b) respond to design briefs and produce their own design specifications for products.
- c) develop criteria for their designs to guide their thinking and to form a basis for evaluation.
- d) generate design proposals that match the criteria.
- e) consider aesthetics and other issues that influence their planning .
- f) suggest outline plans for designing and making, and change them if necessary.
- g) prioritise actions and reconcile decisions as a project develops, taking into account the use of time and costs when selecting materials, components, tools, equipment and production methods.
- h) use graphic techniques and ICT, including computer-aided design (CAD), to explore, develop, model and communicate design proposals.

Working with tools, equipment, materials and components to produce quality products

2. Pupils should be taught:

- a) to select and use tools, equipment and processes, including computer-aided design and manufacture (CAD/CAM), to shape and form materials safely and accurately and finish them appropriately.
- b) to take account of the working characteristics and properties of materials and components when deciding how and when to use them.
- c) to join and combine materials and ready-made components accurately to achieve functional results.
- d) to make single products and products in quantity, using a range of techniques, including CAD/CAM to ensure consistency and accuracy.
- e) about the working characteristics and applications of a range of modern materials, including smart materials.

Evaluating processes and products

3. Pupils should be taught to:

- a) evaluate their design ideas as these develop, and modify their proposals to ensure that their product meets the design specification.
- b) test how well their products work, then evaluate them.
- c) identify and use criteria to judge the quality of other people's products, including the extent to which they meet a clear need, their fitness for purpose, whether resources have been used appropriately, and their impact beyond the purpose for which they were designed.

Knowledge and understanding of materials and components

4. Pupils should be taught:

- a) to consider physical and chemical properties and working characteristics of a range of common and modern materials.
- b) that materials and components can be classified according to their properties and working characteristics.
- c) that materials and components can be combined, processed and finished to create more useful properties and particular aesthetic effects.
- d) how multiple copies can be made of the same product.

Knowledge and understanding of systems and control

5. Pupils should be taught:

- a) to recognise inputs, processes and outputs in their own and existing products.
- b) that complex systems can be broken down into sub-systems to make it easier to analyse them, and that each sub-system also has inputs, processes and outputs.
- c) the importance of feedback in control systems.
- d) about mechanical, electrical, electronic and pneumatic control systems, including the use of switches in electrical systems, sensors in electronic switching circuits, and how mechanical systems can be joined together to create different kinds of movement.
- e) how different types of systems and sub-systems can be interconnected to achieve a particular function.
- f) how to use electronics, microprocessors and computers to control systems, including the use of feedback.
- g) how to use ICT to design sub-systems and systems.

Knowledge and understanding of structures

6. Pupils should be taught:

- a) to recognise and use structures and how to support and reinforce them
- b) simple tests and appropriate calculations to work out the effect of loads
- c) that forces of compression, tension, torsion and shear produce different effects.

Breadth of study

7. During the key stage, pupils should be taught the Knowledge, skills and understanding through:

- a) product analysis.
- b) focused practical tasks that develop a range of techniques, skills, processes and knowledge.
- c) design and make assignments in different contexts. The assignments should include control systems, and work using a range of contrasting materials, including resistant materials, compliant materials and/or food.

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If your school has a project it is willing to share, or would like to help us test and evaluate new project ideas, then please contact the Education Section at Rapid Electronics.

