Battery **E**lectrical **R**esistance **T**ester

BERT is a simple to use resistance tester designed to allow pupils to investigate electrical resistance.

BERT operates by testing the resistance between the two sides of the circuit board. When a high resistance is present the LED will barely glow – with a low resistance it will be bright. The shape of the board is such that the end may be dipped into a liquid to test its resistance.

Once fitted the PP3 battery may be left in place provided the unit is stored such that the led is not glowing. When fitting the PP3 place your fingers on the other side of the PP3 clip to prevent straining the contacts.

Please note. BERT is very sensitive and so the LED may flash as it is being handled.
BERT has an adjustable component, which adjusts the sensitivity of the device, called a potentiometer. Adjusted fully anti-clockwise BERT will not work at all. As it is adjusted clockwise BERT's sensitivity rises to maximum. The potentiometer has been factory set to a suitable value, but some adjustment may be required for certain experiments.

Personal Resistance
Lightly push a dry finger against the contacts at the bottom of the board. The LED should glow faintly showing that your skin conducts electricity slightly. Now push harder. What happens? Now lick your finger and try again. What is the difference?

Testing Conductivity
Try bridging various things across the two sides of the unit, one at a time, and record the LED brightness. Some things have a low resistance (good conductor) and some have a high resistance (poor conductor). Suitable items to test could be: paper, cardboard, wood, paper clip, needle, plastic, leather, glass etc. Try the outside covering of the supplied crocodile clip wire. Now try the metal ends. Record a chart of conductors and poor conductors (good insulators). What do you notice about all the things that conduct?

Other things that conduct electricity
Most solids that conduct electricity are metals but there are a few exceptions. Try drawing a pencil line on the board between two opposite connectors. You may have to go over the line several times to ensure that a circuit exists. The pencil "lead" is not made from the metal lead but from a form of carbon called graphite. This is mixed with a non-conducting (high resistance) base, which is why you may need to go over the line several times to get it to conduct. The line may be removed when you have finished by using the eraser supplied.
Some liquids also conduct electricity. Try dipping the bottom end of the unit into cooking oil, salty water, sugar water, methylated spirits etc. Make sure that you thoroughly clean and dry the board between tests. Alternatively you can put a drop of the liquid between the two pieces of silver track.

Factors affecting resistance
Draw a straight pencil line between the two widest parts of the board. Go over it several times until the LED lights. Now make the line wider and see what happens to the brightness of the LED.
Clean the board and repeat the experiment with a shorter line (nearer the bottom of the board). Does the length of the line make a difference to its resistance? Does the width of the line make a difference to its resistance? Does the thickness of the line make a difference to its resistance?

The pencil supplied is an HB type, which has quite a lot of graphite in it. The harder the pencil the less graphite there is in the mix. Design an experiment to compare the resistance of lines drawn with different grade pencils e.g. 2B, 2H, 3B. Can you put the three pencils in order of resistance?

Draw a line with each type of pencil on a piece of paper. Can you see the difference?

Try the test with a colour pencil. What happens? Why do you think this is?

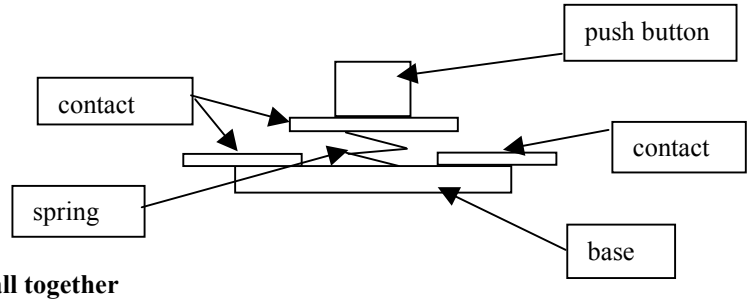
Low resistance
Clip the crocodile clip lead between the two sides of the board. What happens? Is the lead very low resistance or very high? This is like the wires used to connect electrical components in a circuit. Why do you think the wire has a plastic coating?

You conduct electricity – remember?
The first experiment you did showed that your skin conducted electricity, although not as well as metals or wires. Try gripping the board with two hands, one on either side. You still conduct! Try linking hands with your friends to form a circle, with the board forming one link in the circle? What happens to the LED brightness as you add more people into the circle? What happens when somebody breaks the chain?

Is there something else that is a good insulator (very high resistance)?
During all the experiments there has been something else connected between the two sides of BERT. As it did not cause the LED to glow it must have a very high resistance! Can you think what it is? Hint: you need this substance to stay alive!

A home made variable resistor/dimmer switch
Draw a thick pencil line most of the way between the two sides of the board. Make sure that only one end of the line touches the silver track. Connect the free end of the line and the other silver track with your fingers to make sure that you have a conducting line of graphite (the LED should light). If not, scribble over it a few more times. Now gripping the unconnected silver track, wipe the finger of your other hand along your pencil line. It should work like a dimmer switch. Can you explain what is happening?

A Switch
A switch is made from different materials, some are good conductors, some are good insulators. On the diagram below, shade the high resistance parts blue and the low resistance parts red.



Putting it all together
Try to explain why bathrooms have a pull cord to switch the lights on and off rather than a normal switch. You must include in your explanation a discussion about conductors and insulators and keeping yourself safe when switching on a light. Hint: you may have wet hands when in the bathroom.