The play doh: investigating resistance

Literature, Play

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The needle is acting as a conductor which is allowing the current to flow Voltage stays the same because it’s parallel to the power supply Title: Investigating Resistance – summative assessment Aim: To design and carry out an experiment to investigate one variable that affects the resistance of a conductor (moulded from Play Doh). This will be done by creating a circuit which consists of different components: a power supply, light bulb (to check if the circuit works) , ammeter and voltmeter. I connected all the components in an order. I connected from the – of the power supply i went to the ammeter and from the ammeter i used a wire with a clip and a needle to penetrate into the hole in the tube . On the other side it’s the same and it’s going directly to the + of the power supply. The tube is filled with Play Doh and the two needles gets moved to the next hole to investigate the different lengths and the effect of the resistance. Also a voltmeter was also used in parallel to the Play Doh to measure the voltage fall on the resistance.

This investigation tested the correlation between the length of the Play Doh and its electrical resistance, while keeping the voltage constant. This investigation is aimed to answer whether the length of the Play Doh increases or decreases the resistance. Hypothesis: I predict that the resistance will increase as the length of the Play Doh increases. I predict this because I’ll use more insulating material and since resistance and insulation is the same it will cause the resistance to increase. I further predict that the resistance increases as the length increases because the number of molecules increase hence making it harder to resist. The effect of the length

on a wire on resistance can be understood by looking at the atomic structure, electrons have to travel further and so the chance of collisions will increase and resistance will increase therefore I predict that the resistance will increase as the length of the Play Doh increases. The formula R= V/I is used to calculate resistance. I further assume that the Voltage will stay the same since we're using a regulated power supply which gives out constant power. I also forecast that the current will increase when the Play Doh decreases in length and when the Play Doh increases in length the current will decrease. I predict this based on the ohm's law since the Voltage is constant and so if Resistance decreases the current increases (opposite coloration)

Material list: One Power Supply One Light Bulb 50g of Play Doh One Ammeter One Voltmeter Two Needles Five Wires Four Alligator clips 15cm Tube, diameter of 1cm Independent variables: I'm changing the length of the Play Doh by bringing the needles a hole closer to the centre of the tube. The needles will start from being at the end holes (furthest from the centre) And then after the results are gathered the needles go to the next hole (one hole closer to the centre) That is how i'll change the length (cm) of the Play Doh and have it as my independent variable. Dependent variables: I'm measuring the current in Amps (A) in the electric circuit. I'll do that by using an ammeter in series and one wire connected to the ammeter and one to the power supply both holding a needle which goes into the Play doh to measure the current. Although i'm measuring the current, I am calculating the resistance, with the help of the measurement of the current. I'll do this by using the ohm's law (ohm's law shows a linear relationship between the

voltage and the current in an electrical circuit) formula: I= v / r and rearrange the formula to R= V/I to calculate the resistance. That is how i'll calculate the resistance (Ω) and measure the the current in Amps. Controlled variables: Controlled variables How ? Why ?

Length between the tube holes Calculating the distance (cm) between each hole on the tube. To see that the holes in the tubes have a pattern in their distance, so that data gotten will be clear and also have a pattern. Using the same tube Using the same tube the entire experiment and not switching to a different one. Changing to a different tube can result in using a tube with a width/diameter/volume which will mean there is a significant change in the experiment causing the results to be incorrect.

Room Temperature Keeping the room temperature the same without changing it (not changing the temperature of the aircon) Opening the switch in between readings. Changing the room temperature might affect the temperature of the Play Doh and make it colder/hotter. The change in temperature affects the resistance. If it's hotter the playdoh will increase its resistance and if it's hotter the playdoh will decrease its resistance. If the circuit is closed the temperature will build up (increase) therefore by opening the switch in between reading it'll keep the temperature constant.

Voltage from the power supply Keep the voltage at 8V without changing it in the middle of the experiment. Different Voltage would affect the current. increasing the voltage would increase the current and decreasing the voltage would decrease the current giving inaccurate results. same type of Play Doh/ different brand Won't change the Play Doh used to a different one.

Different Play Dohs might contain different ingredients which might have a different Electrical conductivity. Method: Gather the materials needed: 12V DC Power Supply 12V DC Light Bulb Ammeter Voltmeter 6 X Wires with Crocodile terminal Play Doh Two steel needles Tube 15cm Power up the power supply and adjust the voltage to 12 Volts Connect the voltmeter parallel to the power supply to assure 12V Connect the + Terminal to one of the bulbs terminals Connect the other bulb terminal to the + ammeter terminal. The bulb will verify if the circuit is working. Connect the – ammeter terminal to a needle by clipping the needle into the crocodile clip

Put the Playdough in the tube making sure the whole tube is full, this is to reduce inaccurate results to be gathered. Push the needle into one end Connect Power supply – terminal to the second needle Place the second needle on the other end of the tube Verify Light bulb is on Reading on the ammeter Disconnect and short the bulb terminals Register the ammeter reading and the length between the needles Repeat 13 with different length (each time placing the needle one hole closer to the center of the tube) Repeat 14 three times to verify consistency Average the current reading for each length by adding all three trials together for each length (separately) and dividing by three Calculate the resistance with the Ohm’s Law R= V/I Result tables Length (cm) Current (A) T1 T2 T3 Voltage (V) T1 T2 T3 Average (A) Average (V) R= V/I (Ω) 1 0. 07 0. 07 0. 06 7. 68 7. 68 7. 68 0. 07 7. 68 109. 7 2 0. 04 0. 04 0. 04 7. 72 7. 73 7. 73 0. 04 7. 73 193. 3 3 0. 03 0. 03 0. 03 7. 75 7. 75 7. 75 0. 03 7. 75 258. 3 4 0. 02 0. 02 0. 02 7. 76 7. 76 7. 76 0. 02 7. 76 388. 0 5 0. 01 0. 01 0. 01 7. 77 7. 78 7. 78 0. 01 7. 78 778 6 0. 01 0. 01 0. 01 7. 78 7. 78 7. 78 0. 01 7. 78 778 7 0. 01 0. 01 0. 01 7. 79 7. 78 7. 79

0. 01 7. 79 779 8 0. 01 0. 01 0. 01 7. 79 7. 79 7. 80 0. 01 7. 78 779 9 0. 01 0. 01 0. 01 7. 77 7. 77 7. 75 0. 01 7. 76 776 10 0. 01 0. 01 0. 01 7. 76 7. 76 7. 76 0. 01 7. 76 776

Conclusion

The results obtained from the experiment confirm that Play-Doh does indeed conduct electricity and provide resistance. The amount of resistance depends on the length of the Play Doh used. This is because the electrons have further to go, so suffer greater collisions with atoms in the Play Doh. In my Hypothesis I predicted that " the resistance will increase as the length of the Play Doh increases" Which is what happened in the experiment. You can tell this by the above tables. As the tables above show that as the length of the Play Doh increases the current decreases, voltage stays the same since we used a regulated power supply which gave out constant power. and finally the resistance increased. And so the results obtained from the experiment confirm that Ohm's law is supported. This is because the Voltage is constant and so if Resistance decreases the current increases (opposite coloration) The graph also shows an increase in between 0-4 cm the graph shows that the resistance proportionally increases with the length. In between 4-5cm there is a rapid increase in resistance something which might effected it was the material characteristic since it was its maximum resistance that it could take . In between 5-10cm the readings are almost the same. This probably occurred because it has reached its maximum resistance. As you can see from the data the Amps decreases in 0. 01 as the length increases from 2-5cm. And from 5-10cm the amps stay constant because it reached it's maximum resistance. The difference between the

resistance values increases (84, 65, 130, 390, Stays the same..) The 65 is an anomaly which could have occurred due to sensitivity of the ammeter or not keeping one of my control variable controlled or parallax error (due to incorrect positioning of the eye)

Evaluation: I think the lab went well, me and my lab partners didn't get much errors. We kept most of our controlled variables controlled: Length between the tube holes by Calculating the distance (cm) between each hole on the tube so there is a pattern and the final results would be correct. We used the same tube since if we changed the tubes to a different one that could result in using a tube with a different width/diameter/volume which will mean there is a significant change in the experiment causing the results to be incorrect. We used the same Voltage from the power supply since Different Voltage would affect the current which would lead to inaccurate results, therefore we kept it at 8V. Lastly, we used the type of Play Doh because Different Play Dohs might contain different ingredients which might have a different Electrical conductivity. We also made sure we did the experiment safely, we did so by being patient and careful, for example: we didn't use high voltage since that means potential for large amounts of current through your body, which will injure or kill you. We also made sure that when we're connecting the electrical circuit we made sure the power supply was off so that we would prevent electrocution. I think we worked at a fast pace, since we got to do 3 trials for 1-10cm, and got a fair amount of data, which made the results more clear. If we could change anything it would be doing only 1-5 since 5-10 had the exact results and so doing that would be less time consuming.

Another thing which I would change would be using a voltmeter. Using a voltmeter was completely pointless since voltage stayed constant through the entire experiment. This was because we used regulated power supply which gives out constant power and so if we didn’t use a voltmeter it would be less time consuming, since we wouldn’t have to do 3 trials on it for each length. Our results were almost accurate and seemed believable, however there is also differences between values obtained which could be due to these errors which were discussed earlier. The tables and graph support this. Anomalies could have happened because we did the experiment in two different days, meaning room temperature could’ve been different which was one of the controlled variables or maybe we used different wires which may increase the resistance internally which would lead to different measurements. Also the usage of a different voltmeter and ammeter with different sensitivities. These could all lead to anomalies.