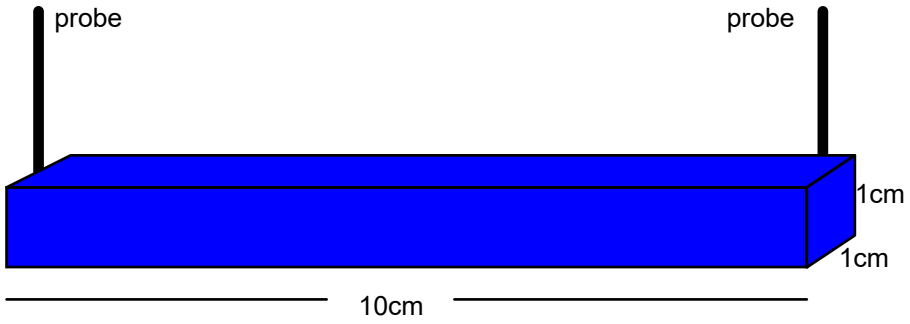
Play-Doh.

Commercial Play-Doh is essentially a mixture of flour, water, salt, boric acid, mineral oil and food colouring.
There are many DIY recipes for Play-Doh, but most are based on the ingredients above, though often the boric acid is replaced with Tartaric acid or Cream of Tartar (the potassium salt of tartaric acid).
The dissolved salt and acid in water enable Play-Doh to conduct electricity.
Below are some quick and approximate experiments made with commercial blue Play-doh.

1. Measurement of the resistance of Play-Doh.

Blue Play-doh was shaped into a bar approximately 10cm x 1cm x 1cm.



The probes from a digital voltmeter (DVM) were connected across the ends of the block. The meter displayed a '1' on all ranges!
When the probes were then placed anywhere on the Play-Doh, the same results were obtained.

The experiment was then repeated with an analogue meter and a resistance of ≈500Ω was measured across the block.
Using the formula $\rho = A.R/l$, this gave a resistivity of ≈0.5Ω.m
This value of resistivity is likely to be a product of how it is measured. (See later experiments.)

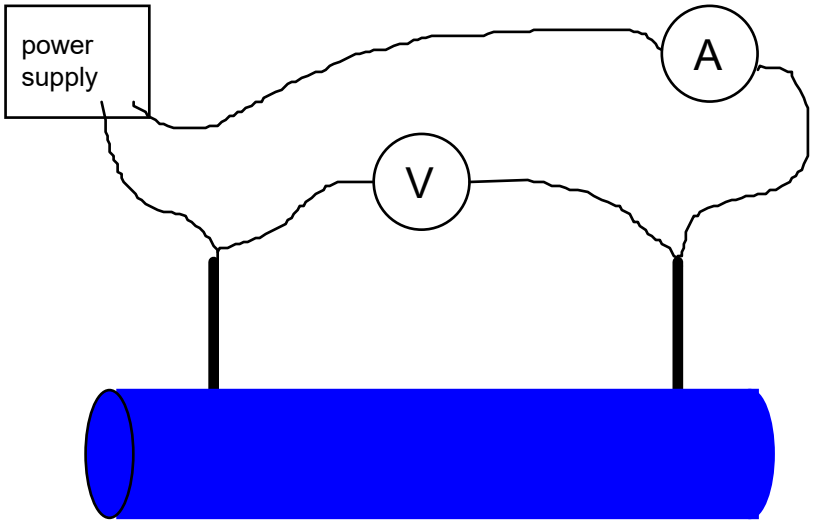
The terminal p.d. of the DVM was measured with another DVM and found to be 0.65V, while that of the analogue voltmeter was 3V on low resistance ranges, increasing to 12V on the highest range. It is possible that the electrolytic action of the Play-Doh on the metal probes of the DVM was sufficient to prevent any current passing through the meter.

2. Measurement of p.d. across Play-Doh

Two pieces of 16swg tinned copper wire were pushed into a ball of Play-Doh and connected to a DVM. A p.d. of ≈0.045V was observed when a steady state was reached - increased from ≈0.03V, when first inserted. The p.d. was essentially the same where ever the copper wire was pushed into the Play-Doh.

3. More attempts at resistance measurements.

The Play-Doh was rolled into a rod approximately 2cm diameter and around 8cm long.
16swg tinned copper electrodes were pushed into the Play-Doh 6.5cm apart.
The circuit below was set up and the power supply voltage increased.



V (V)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
I(mA)	0	0.02	0.03	0.03	0.05	0.1	0.13	0.22	0.44	1.14	0.95	1.87	1.38

Decreasing the voltage and measuring the current produced significantly different results to those above - there was a slight contamination of the tinned copper electrodes.

4. Further resistance measurements

Play-Doh was rolled into a rod approximately 1cm diameter and 30cm long.
Resistance measurements were made along the length of the rod using an analogue meter.

length (cm)	resistance (kΩ)	reverse direction (kΩ)
30	3.3	3.8
25	3.0	3.1
20	2.8	2.9
15	2.6	2.5
10	2.3	2.2
5	1.8	1.9

The resistance was measured in the reverse direction in case there were any discontinuities within the Play-Doh roll. The similarity of the results suggests that the rod was fairly uniform.

Summary.

The resistance of Play-Doh is definitely non-linear and seems to be very dependent on the p.d placed across it.
Play-Doh is sufficiently conductive to enable LEDs to be brightly lit from a 9V battery via a 1kΩ series resistor.
Its use in simple music instruments (e.g. Squeekie, 555 astable circuit) is not yet proven owing to the non-linearity of its resistance with length. Further experiments are needed.