

CRAFTING MATERIAL INTERFACES

MAS S62, E14-493

Instructor: Leah Buechley

Tuesdays 3-6pm

<http://material.media.mit.edu/>

CONDUCTORS



UNITS & MEASUREMENT

Resistance (R)

an empirical measurement, dependent on material
and length, area, or volume
measured in Ohms Ω

Resistivity (ρ)

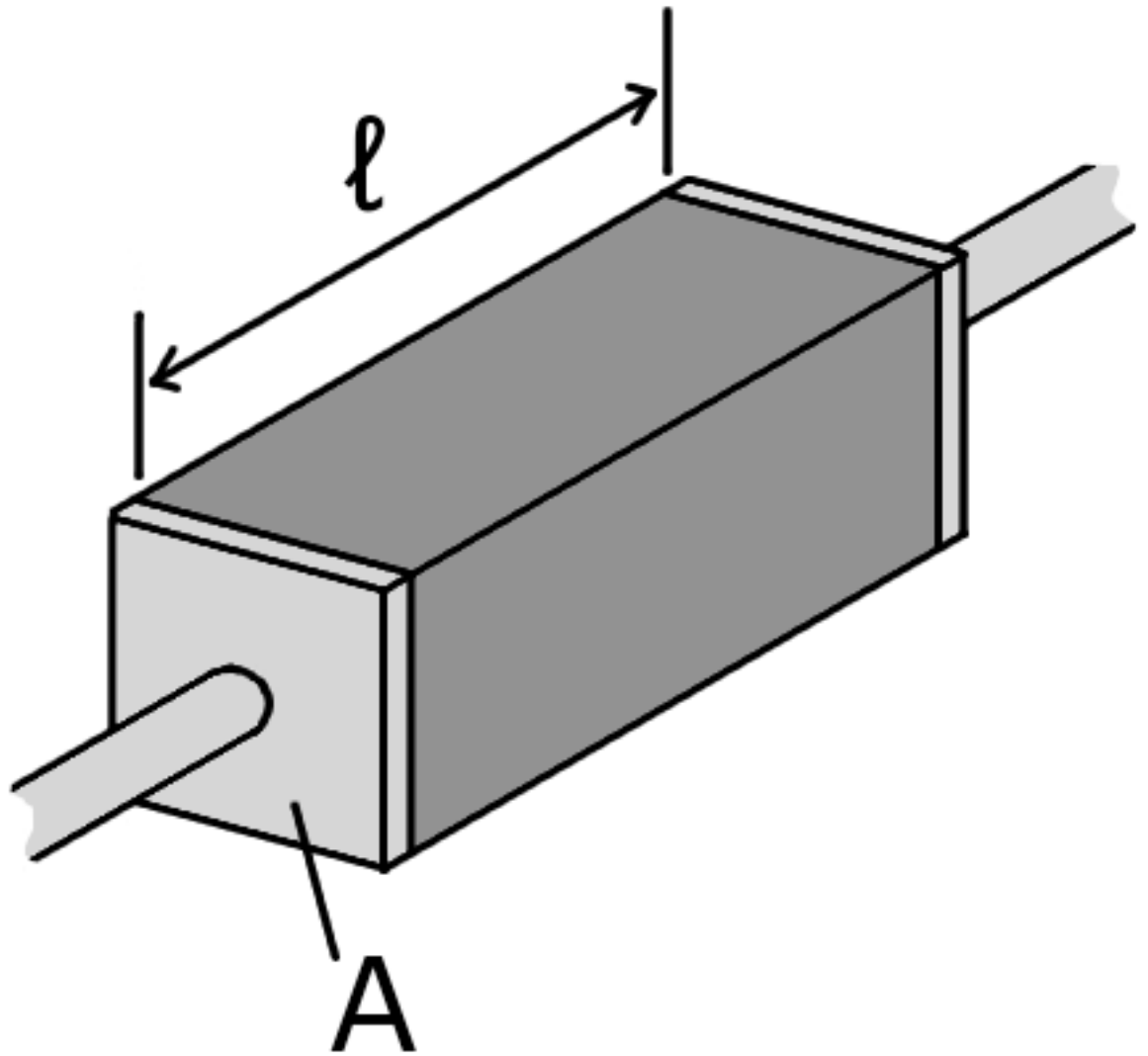
an intrinsic property of a material
measured in Ohm meters Ωm

Conductivity (σ)

an intrinsic property of a material
the inverse of resistivity
measured in siemens/meter S / m

$$\rho = R \frac{A}{\ell}$$

$$\sigma = \frac{1}{\rho}$$



Material	ρ (Ωm)	σ (S/m)
Silver	0.0000000159	63,000,000
Copper	0.0000000168	59,600,000
Gold	0.0000000244	58,000,000
Aluminum	0.0000000282	35,000,000
Nickel	0.0000000699	14,300,000
Tin	0.0000000109	9,170,000
Carbon (graphite)	0.0000078	128,200
Sea water	0.2	4.8
Distilled fresh water	180,000	0.0000055
Glass	1.0×10^{10}	1.0×10^{-10}
Air	1.3×10^{16}	8.0×10^{-15}

All measurements at 20°C

The Physics Factbook: <http://hypertextbook.com/facts/index-topics.shtml>

http://en.wikipedia.org/wiki/Electrical_resistivity_and_conductivity

Material	ρ (Ωm)	ρ ($\Omega \cdot cm$)	ρ ($\mu\Omega \cdot cm$)
Silver	1.59×10^{-8}	1.59×10^{-6}	1.59
Copper	1.68×10^{-8}	1.68×10^{-6}	1.68
Gold	2.44×10^{-8}	2.44×10^{-6}	2.44
Aluminum	2.82×10^{-8}	2.82×10^{-6}	2.82
Nickel	6.99×10^{-8}	6.99×10^{-6}	6.99
Tin	1.09×10^{-7}	1.09×10^{-5}	10.9
Carbon (graphite)	7.8×10^{-6}	7.8×10^{-4}	780
Sea water	0.2	0.002	2.0×10^7
Distilled fresh water	1.8×10^5	1,800	1.8×10^{13}
Glass	1.0×10^{10}	1.0×10^8	1.0×10^{-18}
Air	1.3×10^{16}	1.3×10^{14}	8.0×10^{-23}

All measurements at 20°C

The Physics Factbook: <http://hypertextbook.com/facts/index-topics.shtml>

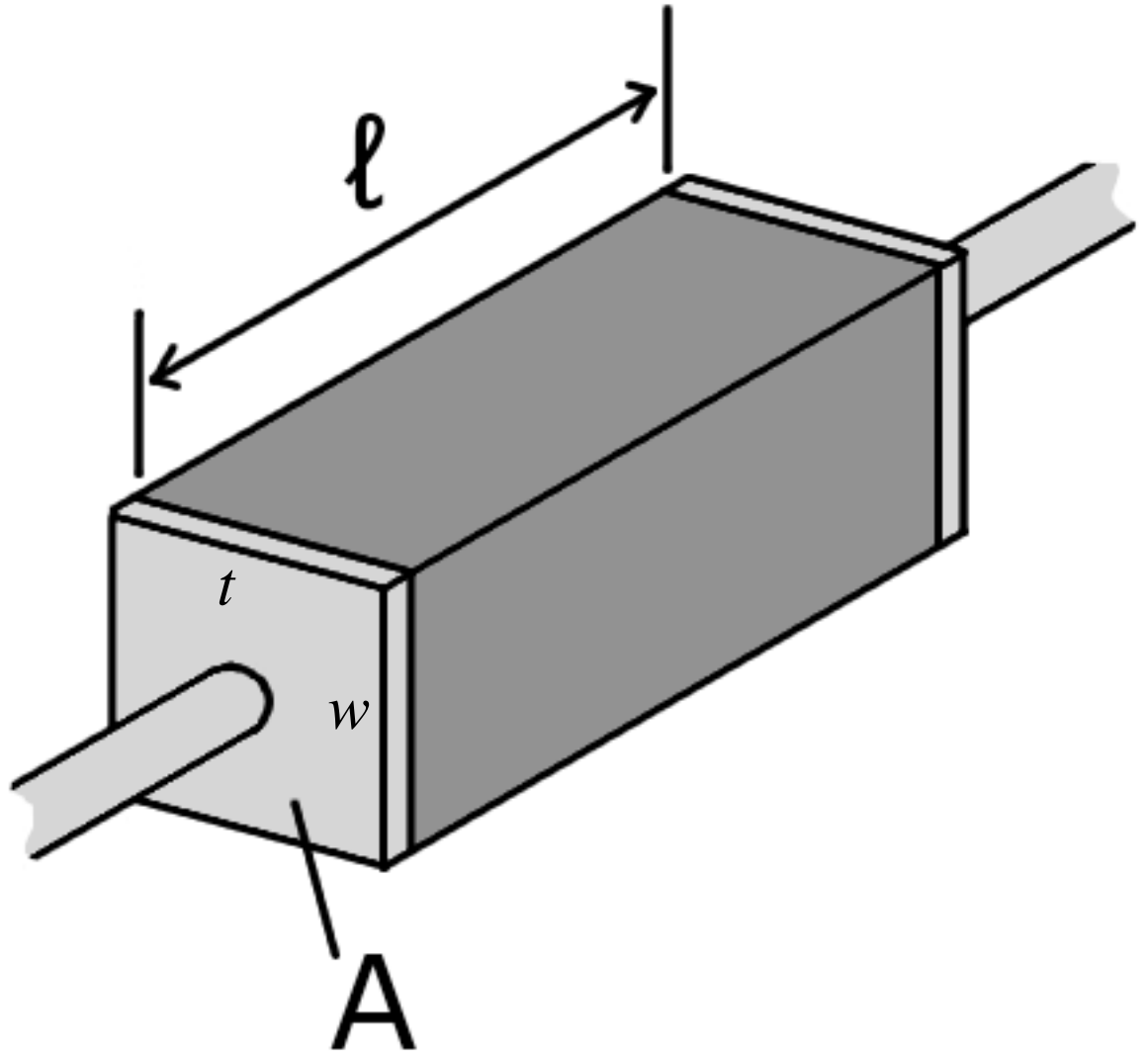
http://en.wikipedia.org/wiki/Electrical_resistivity_and_conductivity

Sheet resistance (R_s)

an intrinsic property of a sheet material
measured in Ohms/square Ω/\square

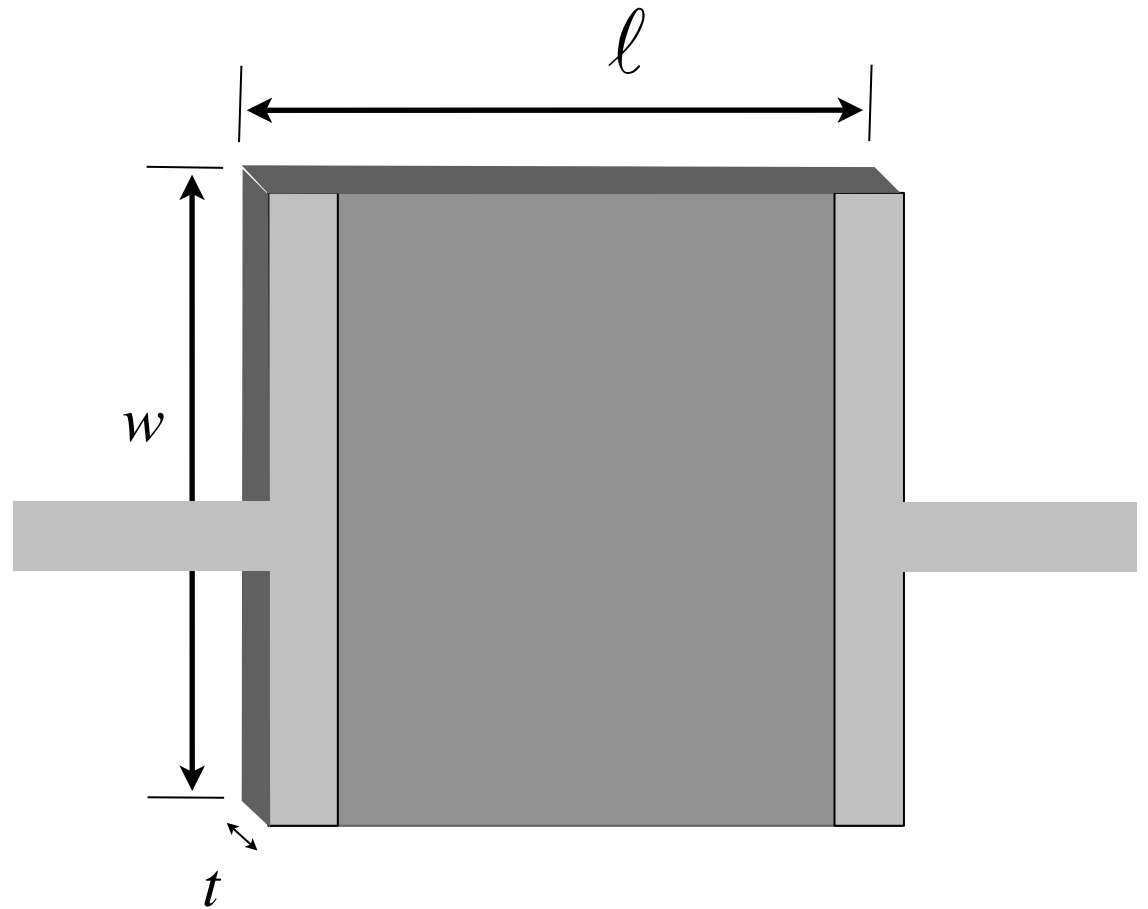
$$\rho = R \frac{A * t}{l l}$$

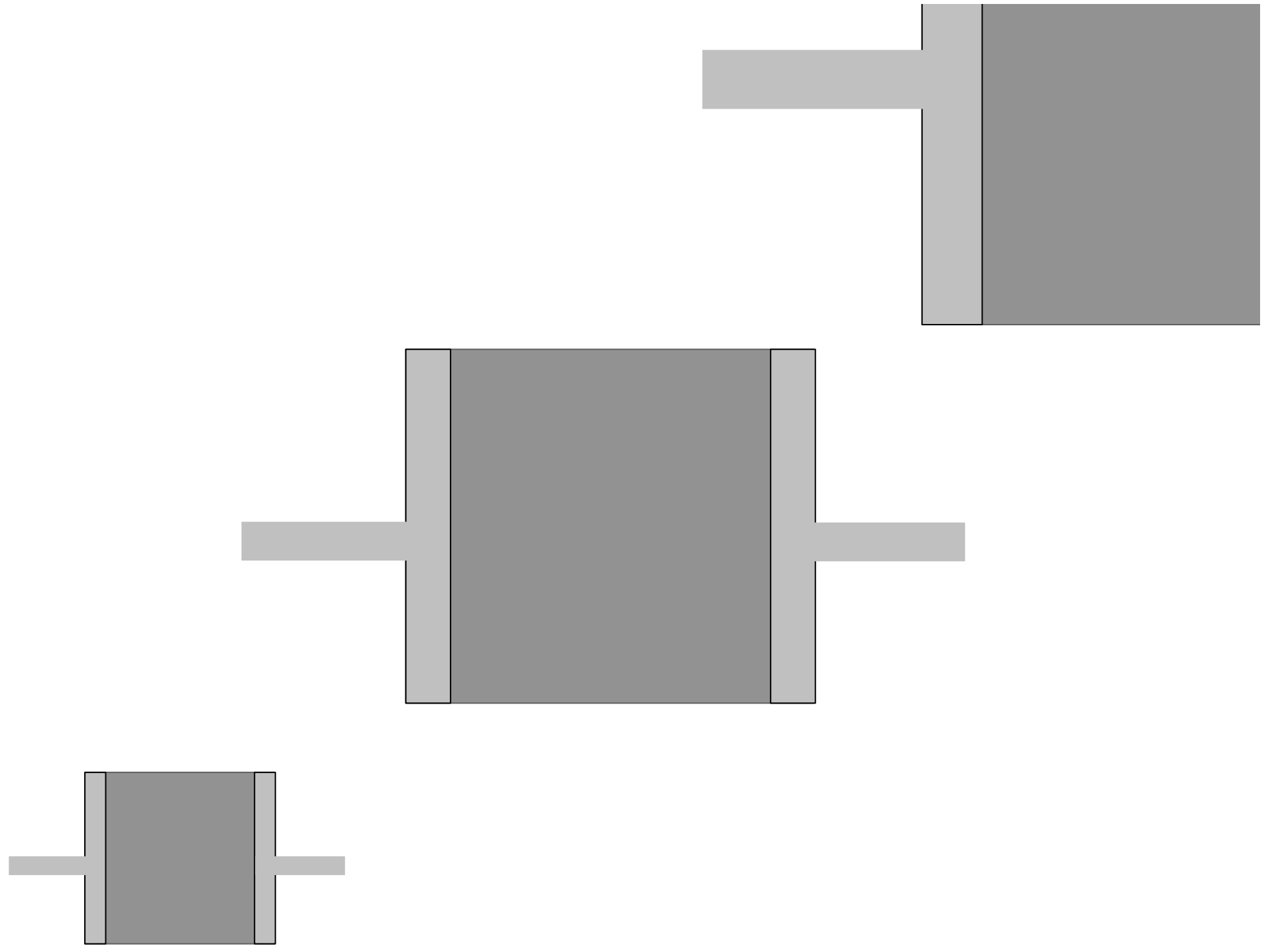
$$\frac{\rho}{t} = R \frac{w}{l}$$



$$\frac{\rho}{t} = R \frac{w}{l}$$

$$R_s = \frac{\rho}{t}$$





Material, 1 micron thick	R_s (Ω / \square)
Silver	1.59×10^{-2}
Copper	1.68×10^{-2}
Gold	2.44×10^{-2}
Aluminum	2.82×10^{-2}
Nickel	6.99×10^{-2}
Tin	1.09×10^{-1}
Carbon (graphite)	7.8
Sea water	2.0×10^5
Distilled fresh water	1.8×10^{11}
Glass	1.0×10^{16}
Air	1.3×10^{22}

All measurements at 20°C

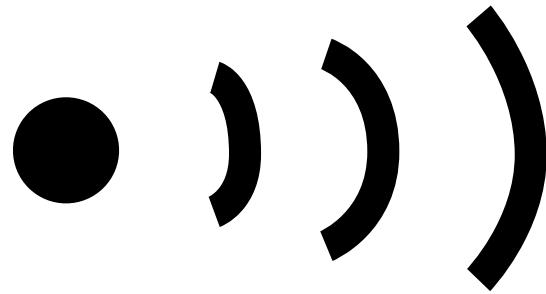
The Physics Factbook: <http://hypertextbook.com/facts/index-topics.shtml>

http://en.wikipedia.org/wiki/Electrical_resistivity_and_conductivity

MEASURING CONDUCTIVITY (RESISTANCE) IN THE LAB



“Continuity”: conductivity, connectedness
is point A connected to point B? is this material conductive?

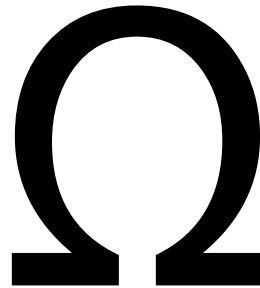




Resistance

How conductive is this material?

measured in Ohms





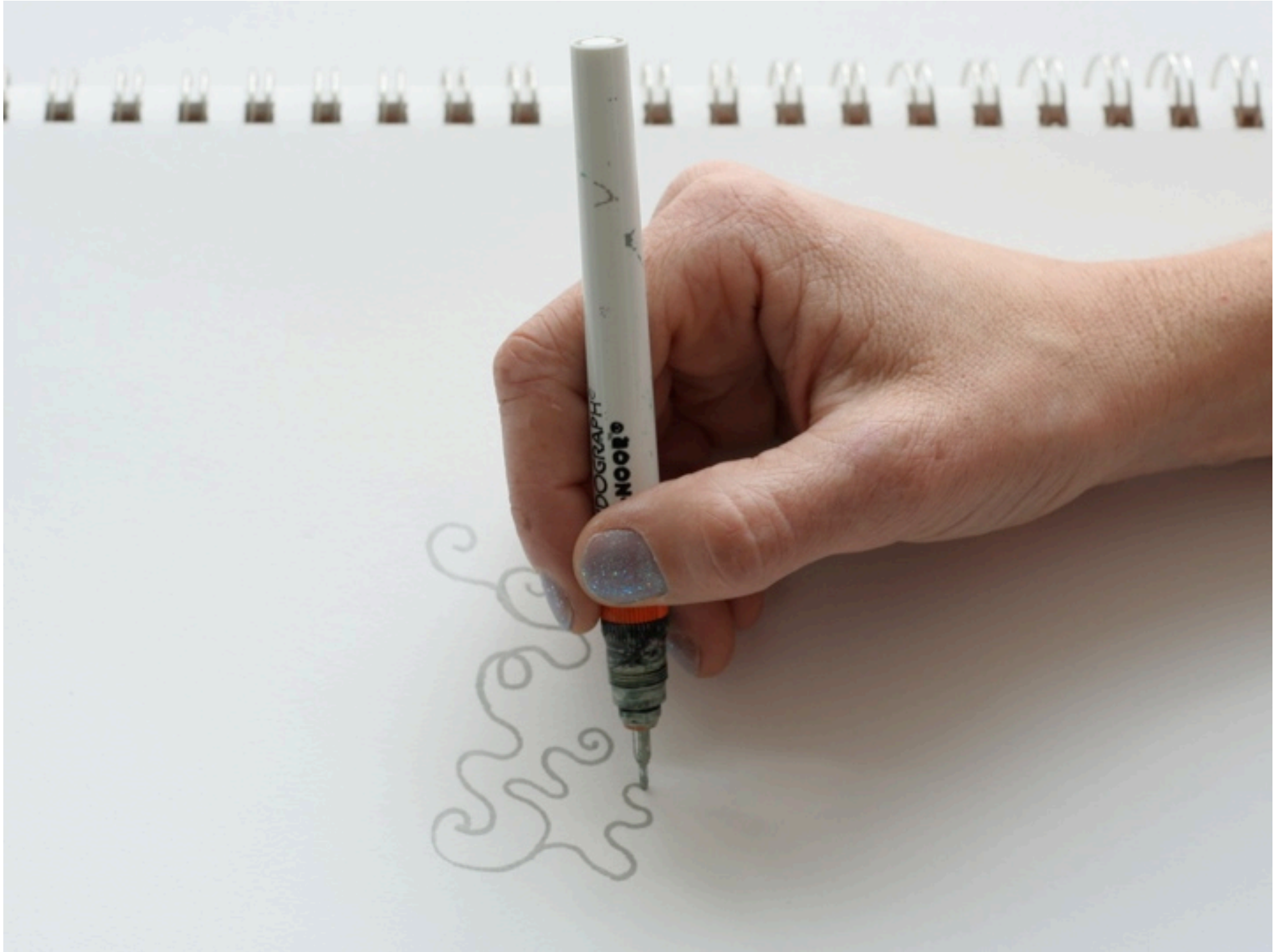
resistance

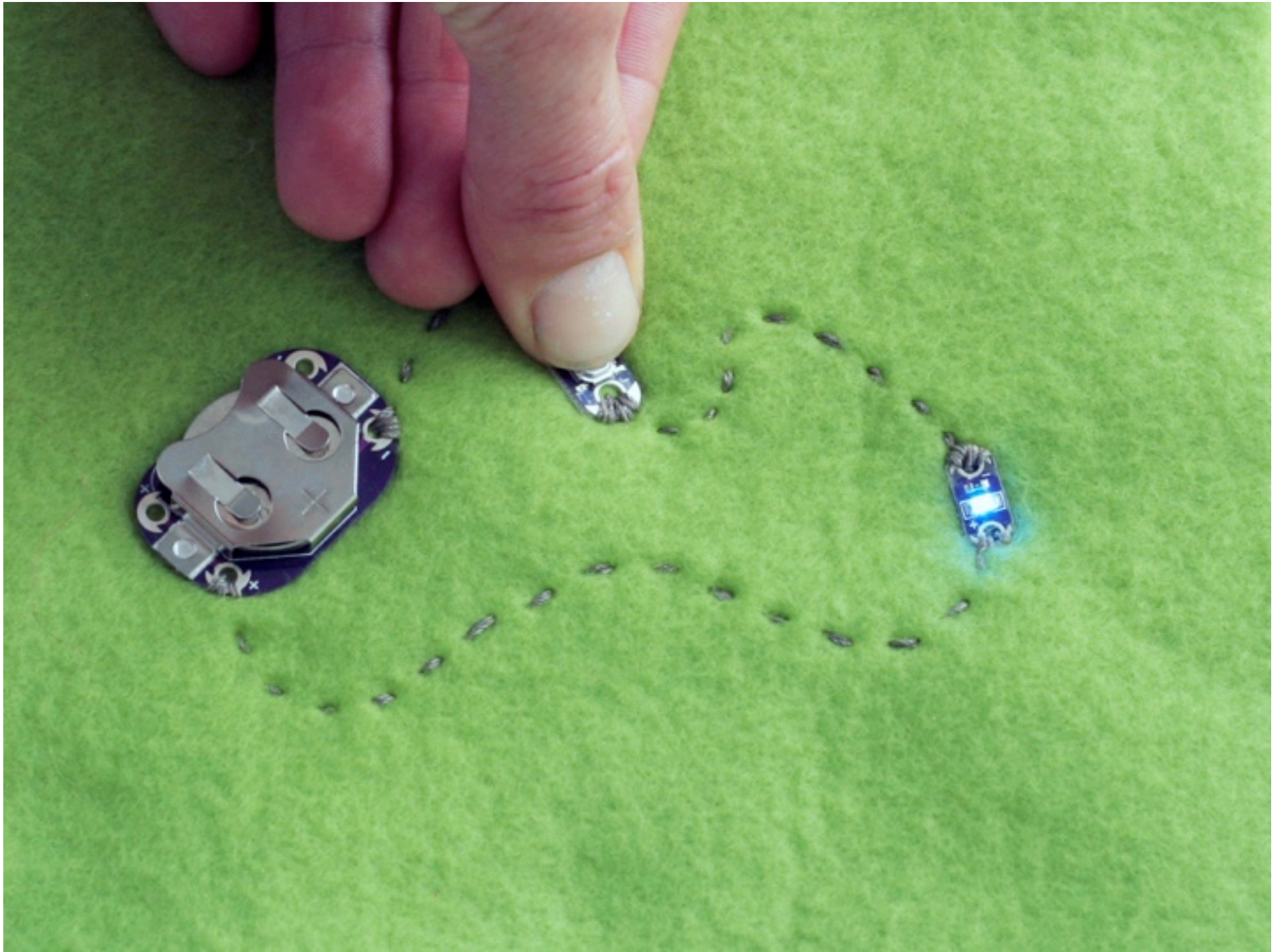
	x1	Ω
kilo	x1,000	K Ω
mega	x1,000,000	M Ω

Mini Assignment

Research Assignment

CONDUCTIVE MATERIALS IN THE LAB





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