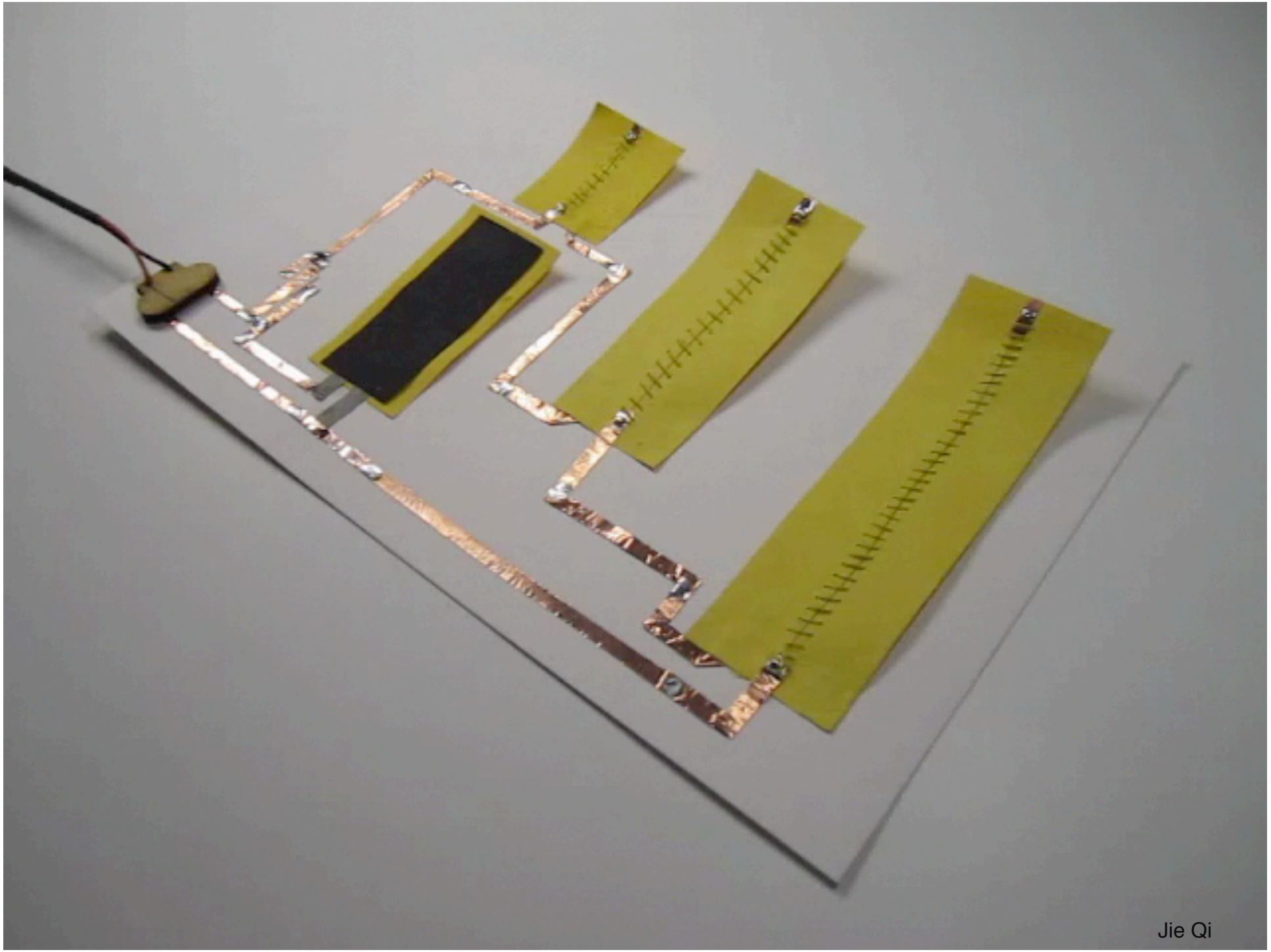
NEW TEXTILES

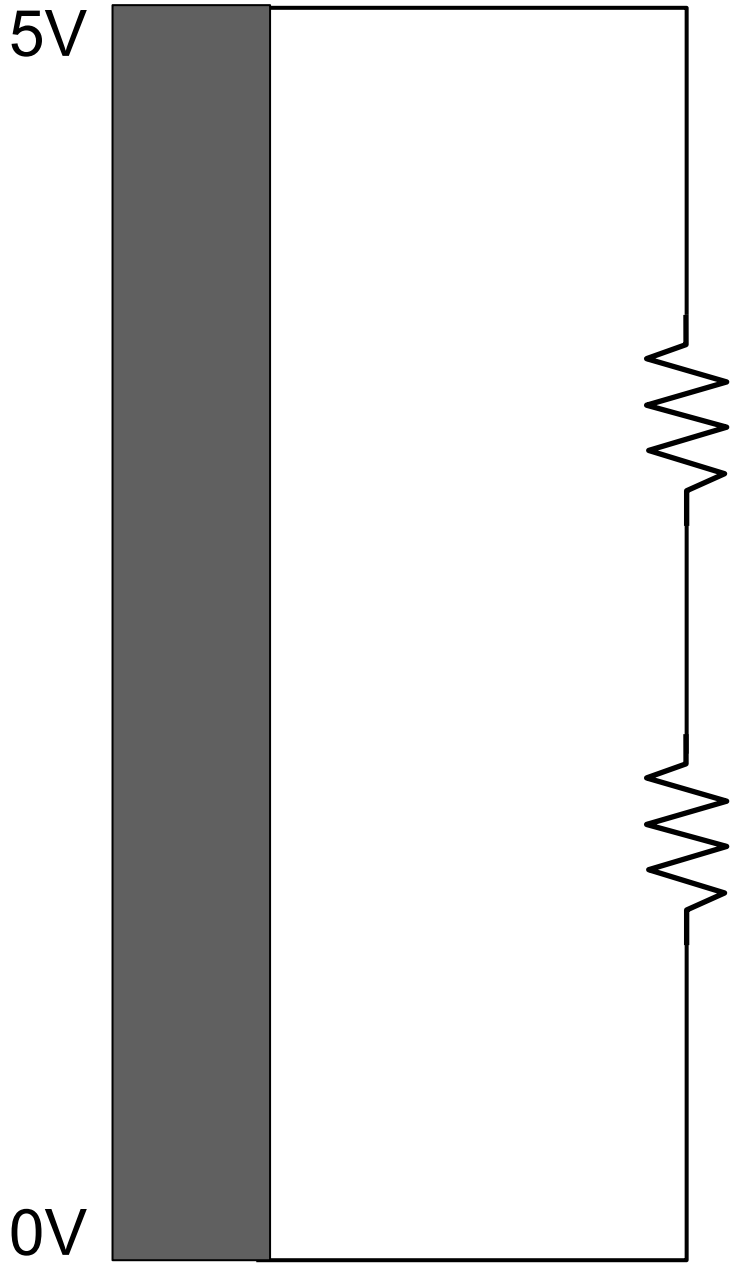
pay Emily for your kits

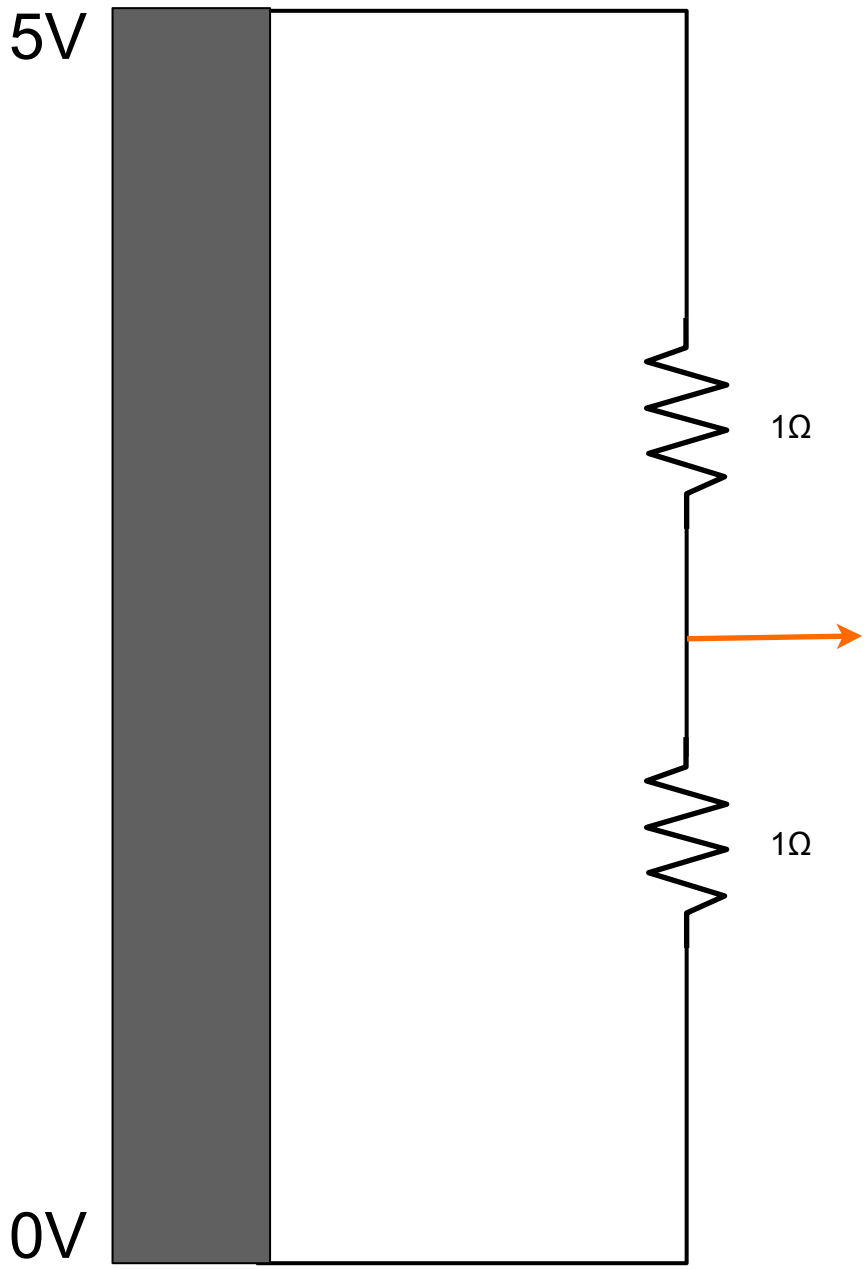
SHAPE MEMORY ALLOYS & MOSFETS


Jie Qi

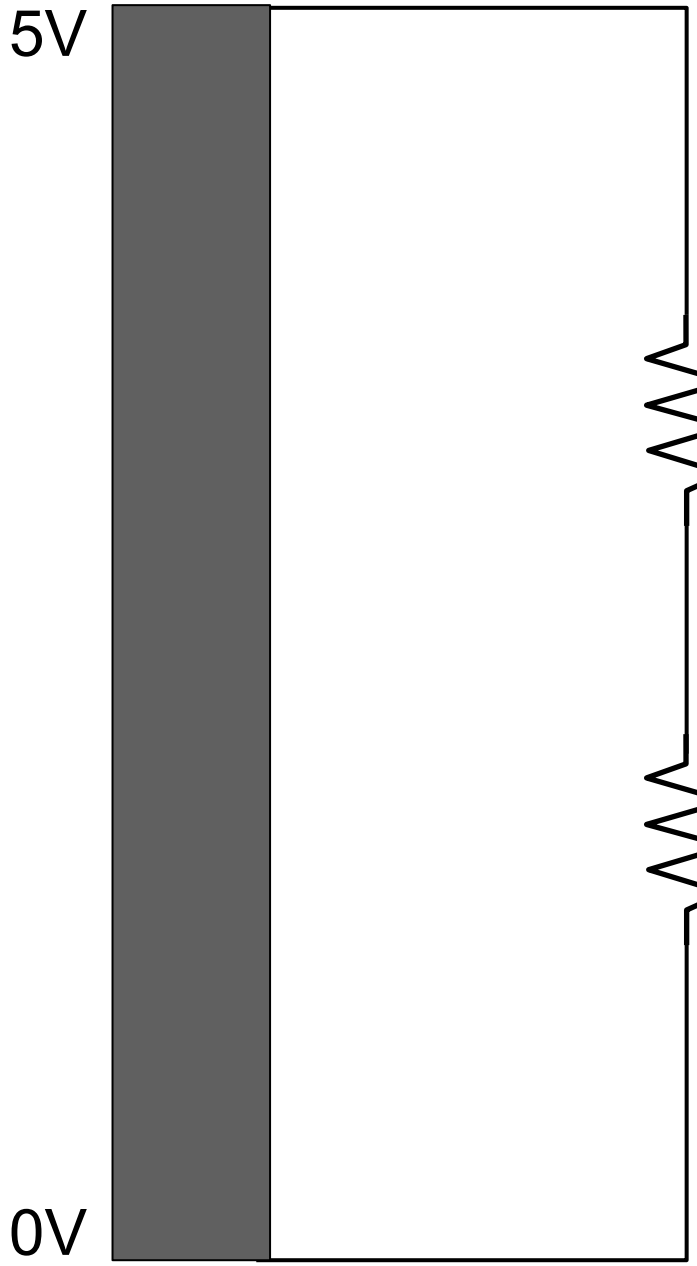
REVIEW...

V (voltage) = I (current) x R (resistance)


5V
0V


5V
1Ω
1Ω
0V

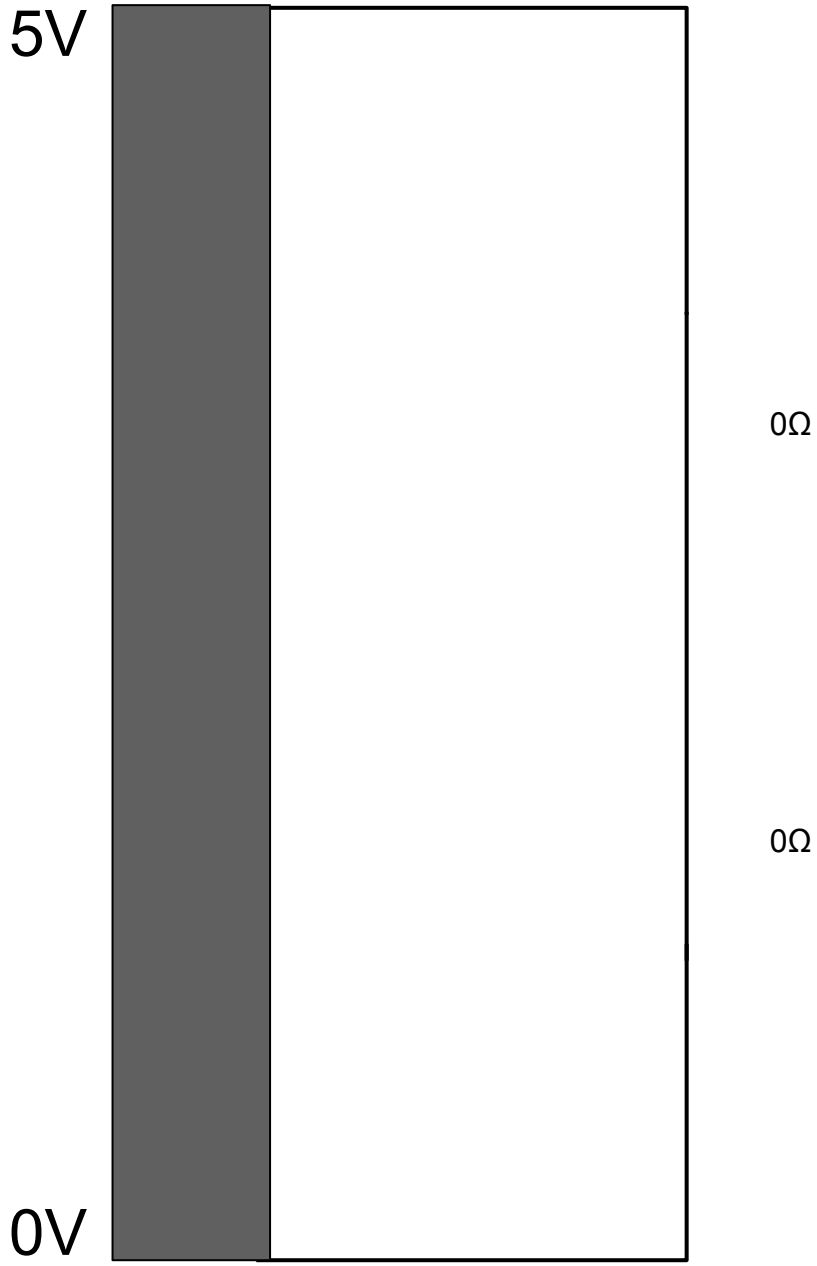
why is this a “bad” voltage divider?



current draw?

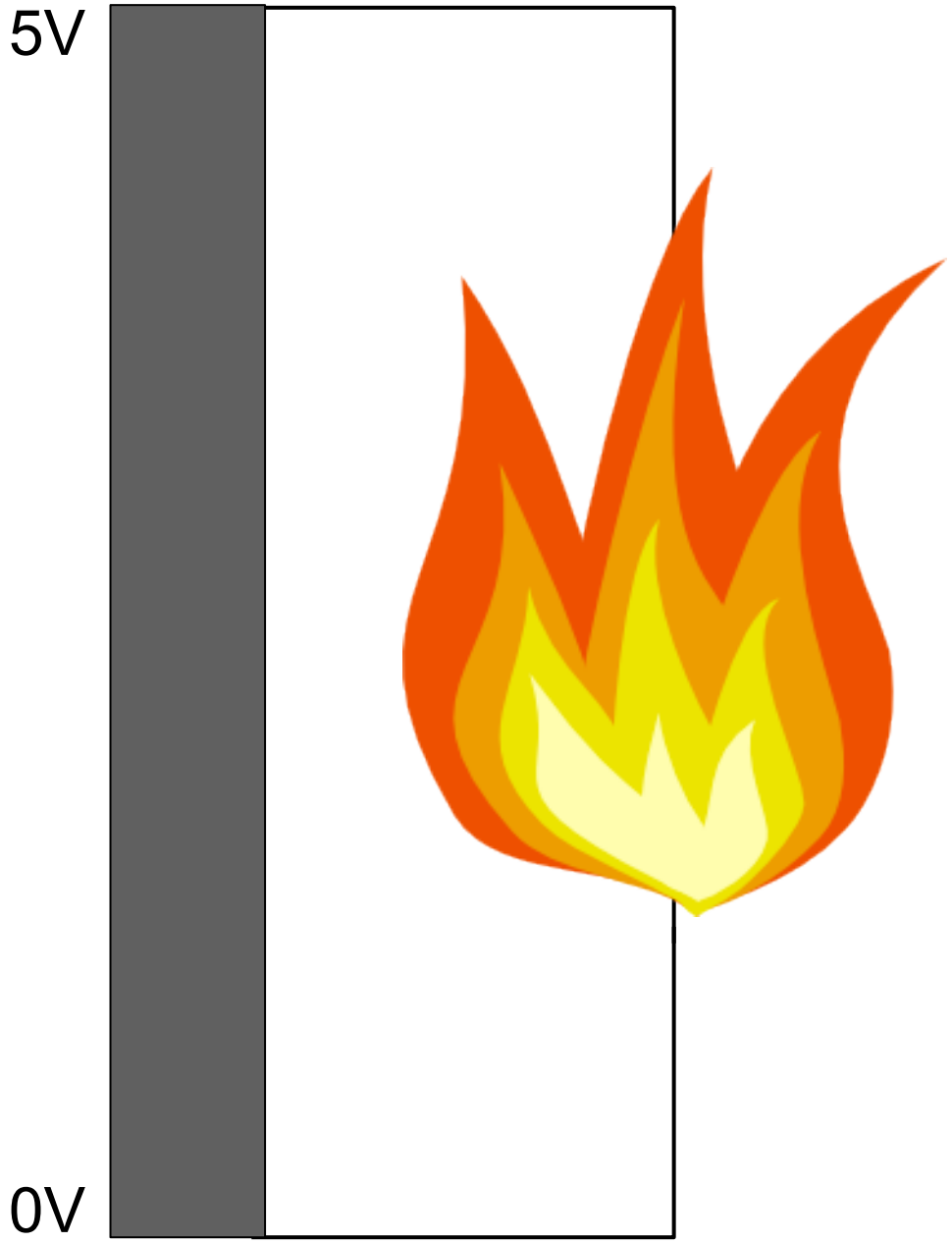
$$I \text{ (current)} = \frac{V \text{ (voltage)}}{R \text{ (resistance)}}$$

battery capacity = 110mAh
110 mA for 1 hour
220 mA for 1/2 hour
2.5A for ??


5V
0Ω
0Ω
0V

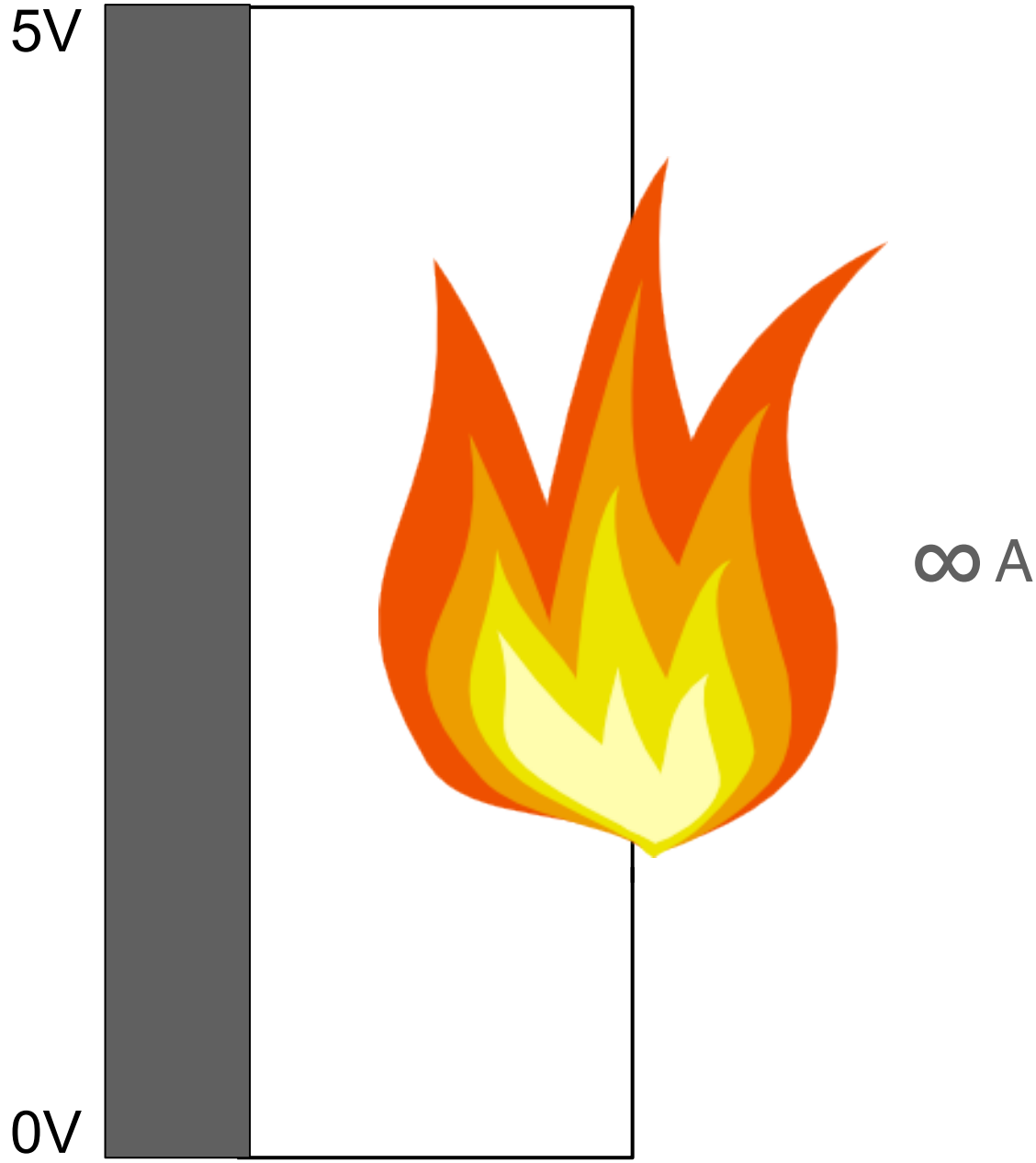
battery capacity = 110mAh
how long will the battery last here?

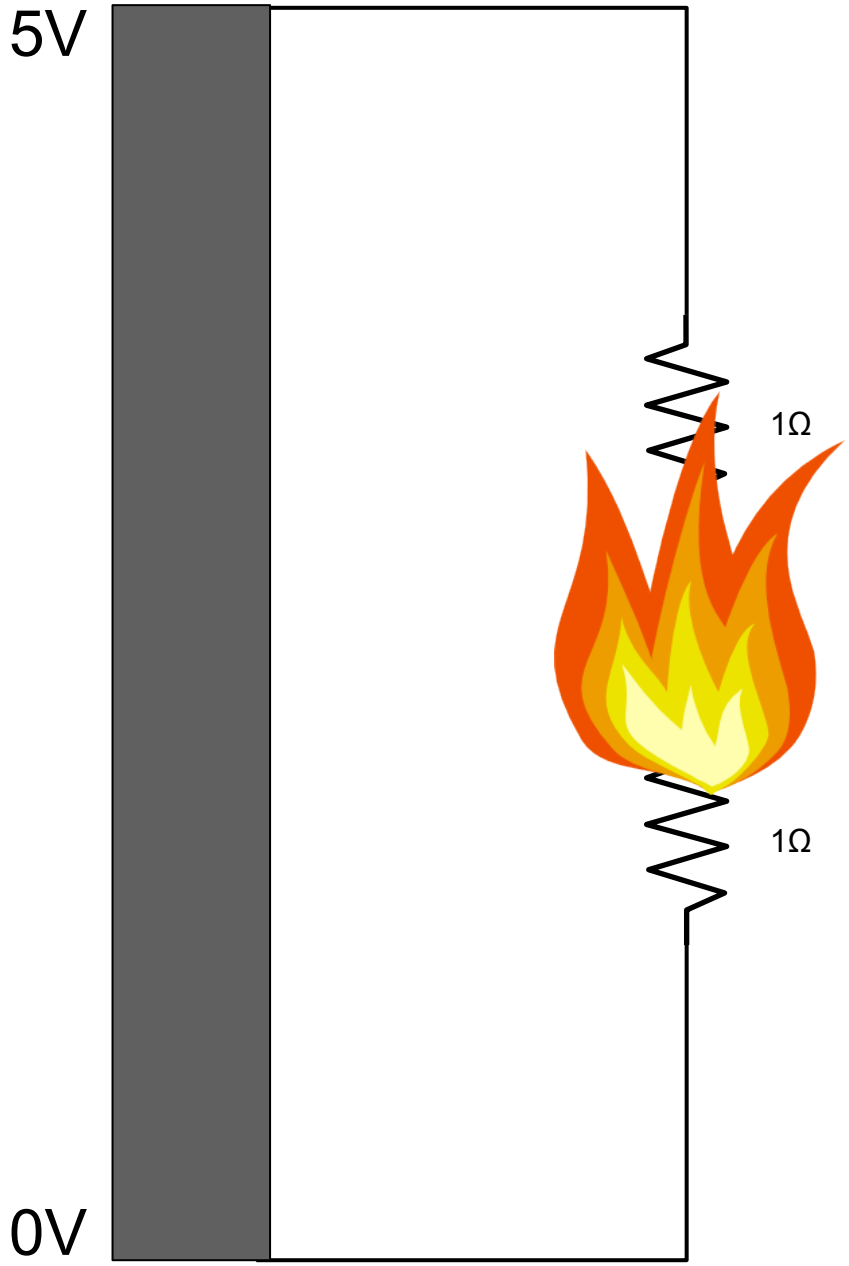
where does all that energy go?


5V
0V

power (watts) = voltage (volts) x current (amps)
= energy (joules)/second

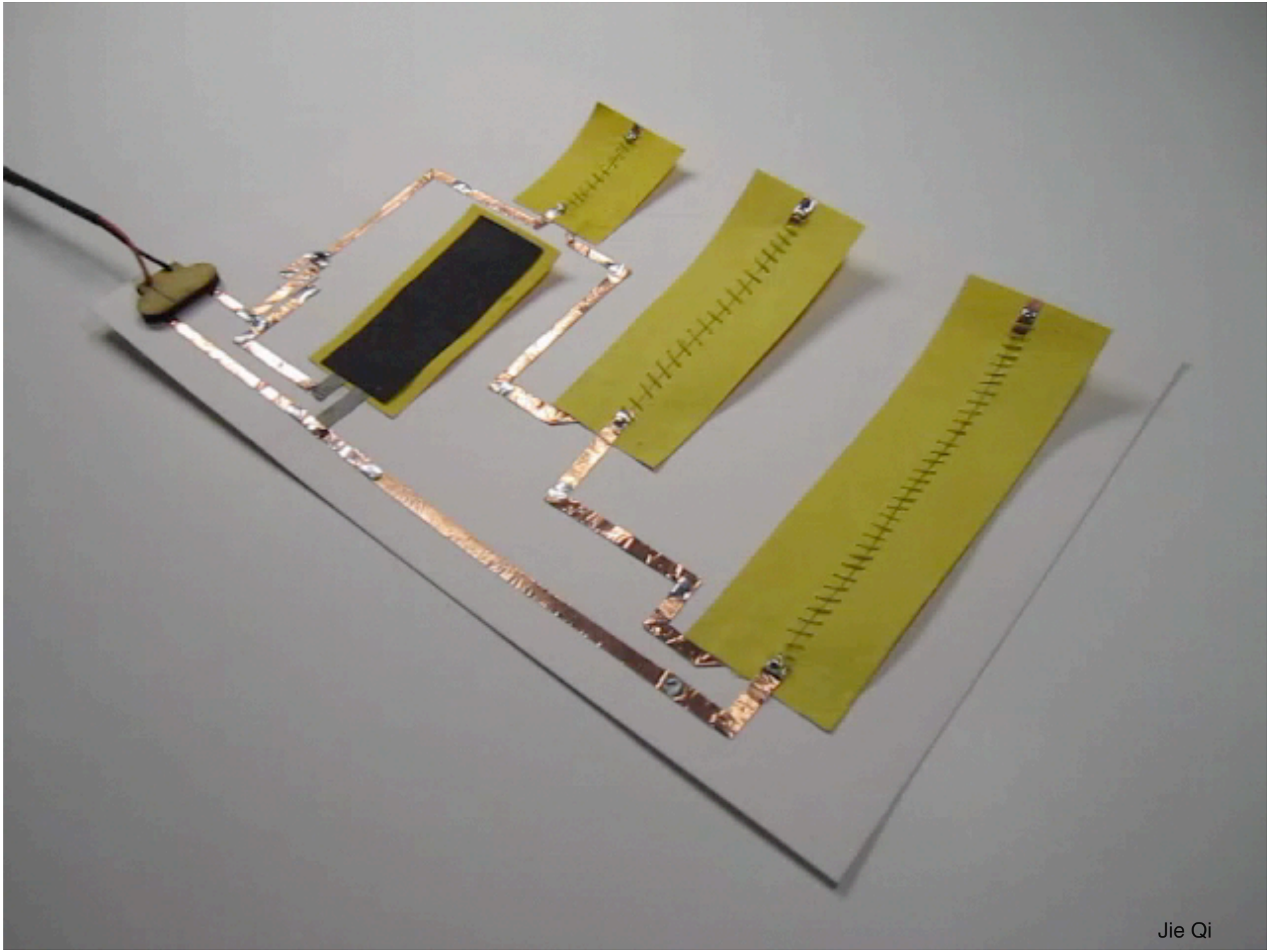
a “short”


5V
0V
∞ A



2.5 A

SHAPE MEMORY ALLOYS


Jie Qi

martensite phase: deformable

transition temperature (~50-150 C)

austenite phase: remembers parent shape

shape setting temperature (~500 C)

set parent shape

Nitinol
Nickel Titanium alloy
“Nickel Titanium Naval Ordnance Laboratory”

http://www.stanford.edu/~richlin1/sma/sma.html

sheet, tape, wire, blocks

untrained wire from McMaster

http://www.mcmaster.com/#nitinol-wire/=gg08x4

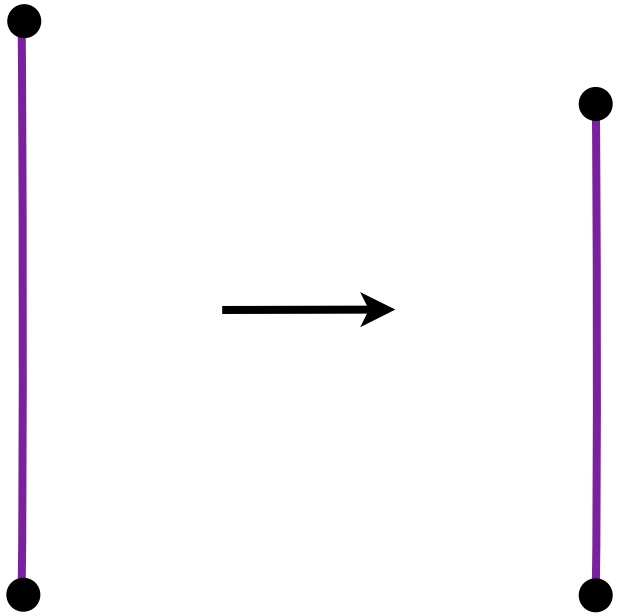
pre-trained wire

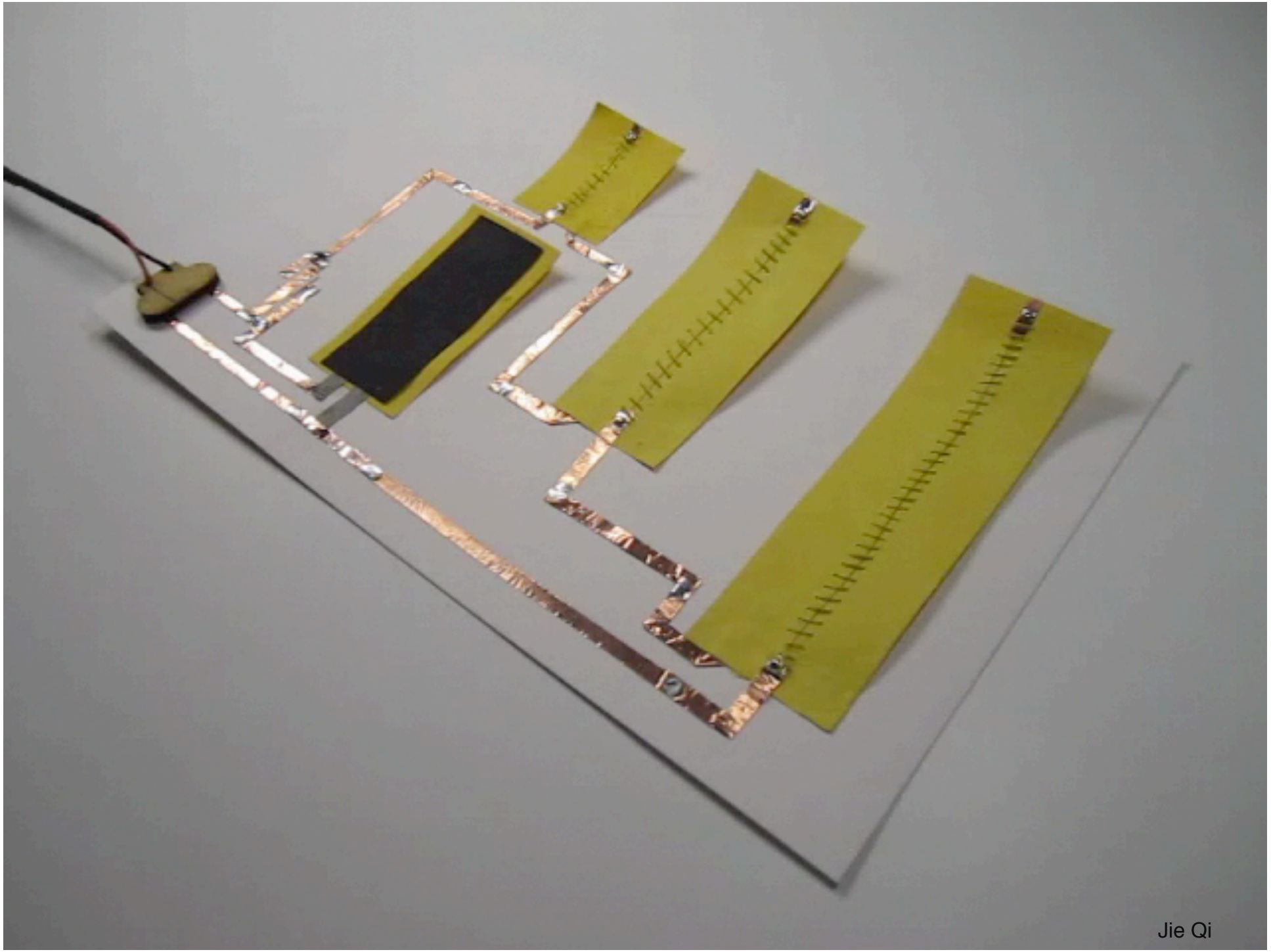
Dynalloy: http://www.robotshop.com/dynalloy-flexinol-006-lt-actuator-wire.html

Biometal: http://www.imagesco.com/nitinol/biometal-helix.html

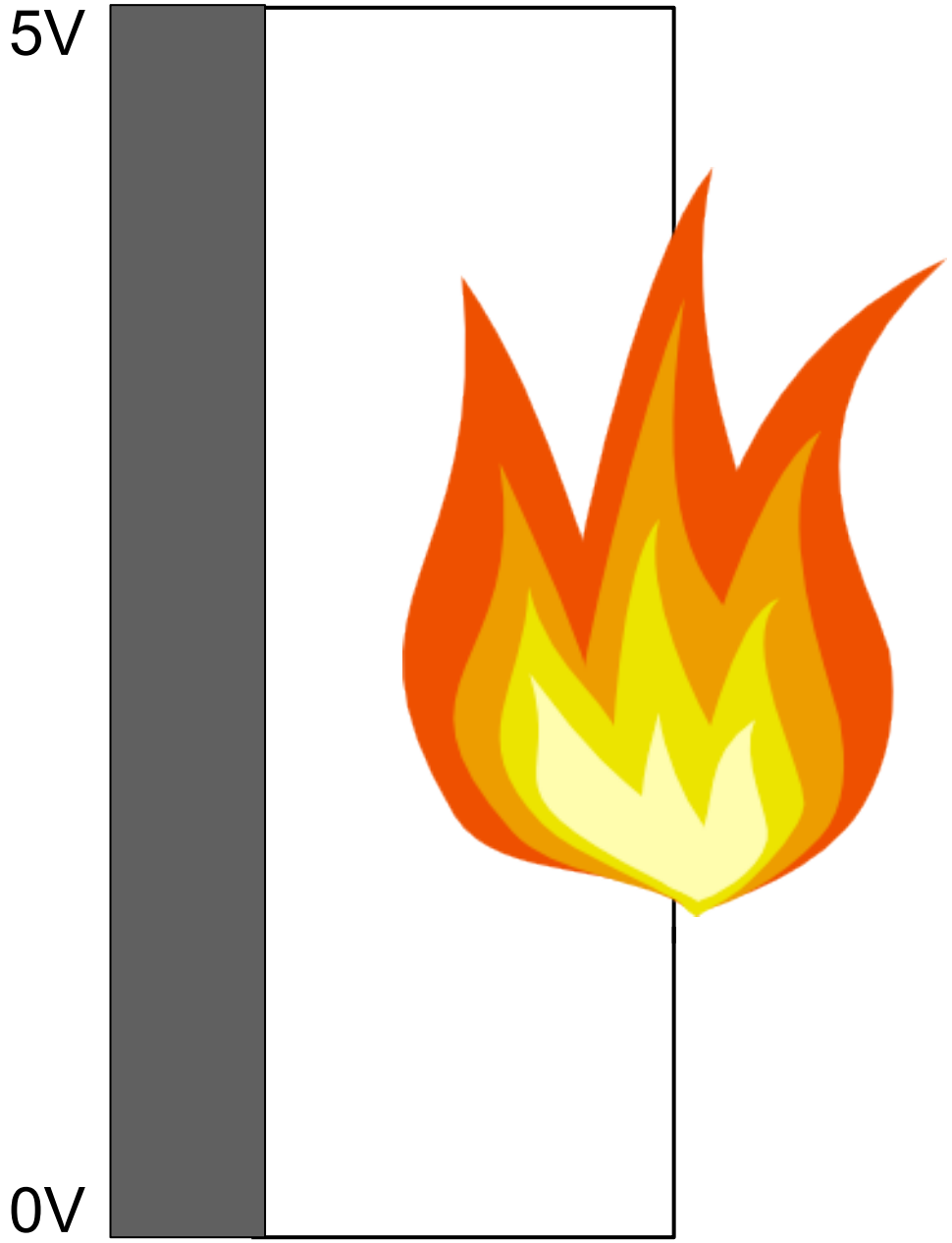
we’ll be using:
“Flexinol”, “muscle wire”

we'll be using:
Flexinol or "muscle wire"



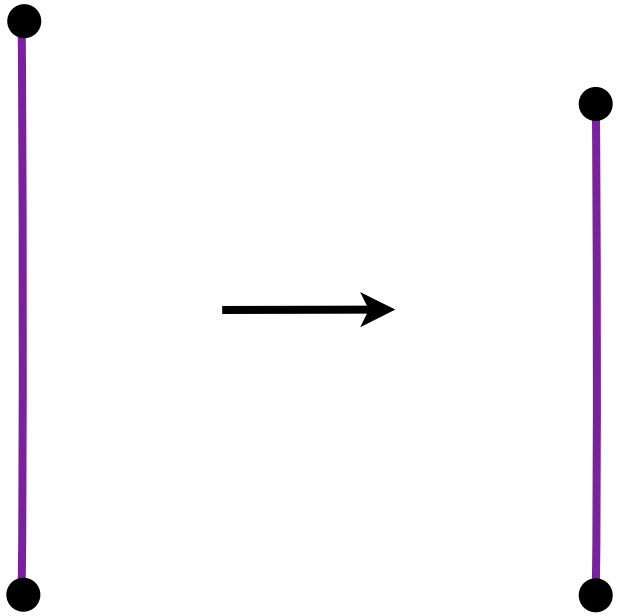

Jie Qi

POWER & ENERGY


5V
0V

power (watts) = voltage (volts) x current (amps)
= energy (joules)/second

we'll be using:
Flexinol or "muscle wire"



Diameter Size inches (mm)	Resistance ohms/inch (ohms/meter)	Pull Force* pounds (grams)	Approximate** Current for 1 Second Contraction (mA)	Cooling Time 158° F, 70°C "LT" Wire*** (seconds)	Cooling Time 194° F, 90°C "HT" Wire*** (seconds)
0.001 (0.025)	36.2 (1425)	0.02 (8.9)	45	0.18	0.15
0.0015 (0.038)	22.6 (890)	0.04 (20)	55	0.24	0.20
0.002 (0.050)	12.7 (500)	0.08 (36)	85	0.4	0.3
0.003 (0.076)	5.9 (232)	0.18 (80)	150	0.8	0.7
0.004 (0.10)	3.2 (126)	0.31 (143)	200	1.1	0.9
0.005 (0.13)	1.9 (75)	0.49 (223)	320	1.6	1.4
0.006 (0.15)	1.4 (55)	0.71 (321)	410	2.0	1.7
0.008 (0.20)	0.74 (29)	1.26 (570)	660	3.2	2.7
0.010 (0.25)	0.47 (18.5)	1.96 (891)	1050	5.4	4.5
0.012 (0.31)	0.31 (12.2)	2.83 (1280)	1500	8.1	6.8
0.015 (0.38)	0.21 (8.3)	4.42 (2250)	2250	10.5	8.8
0.020 (0.51)	0.11 (4.3)	7.85 (3560)	4000	16.8	14.0

power (watts) = voltage (volts) x current (amps)

if voltage is constant, as current increases....?

power (watts) = voltage (volts) x current (amps)

as power (energy/s) increases, so does...?

what happens to nitinol + too much heat?

what happens to nitinol + not enough heat?

martensite phase: deformable

transition temperature (~50-150 C)

austenite phase: remembers parent shape

shape setting temperature (~500 C)

set parent shape

we want to control the change with an Arduino, but...

maximum IO pin output 40mA, .04A

we need 410mA, .41A

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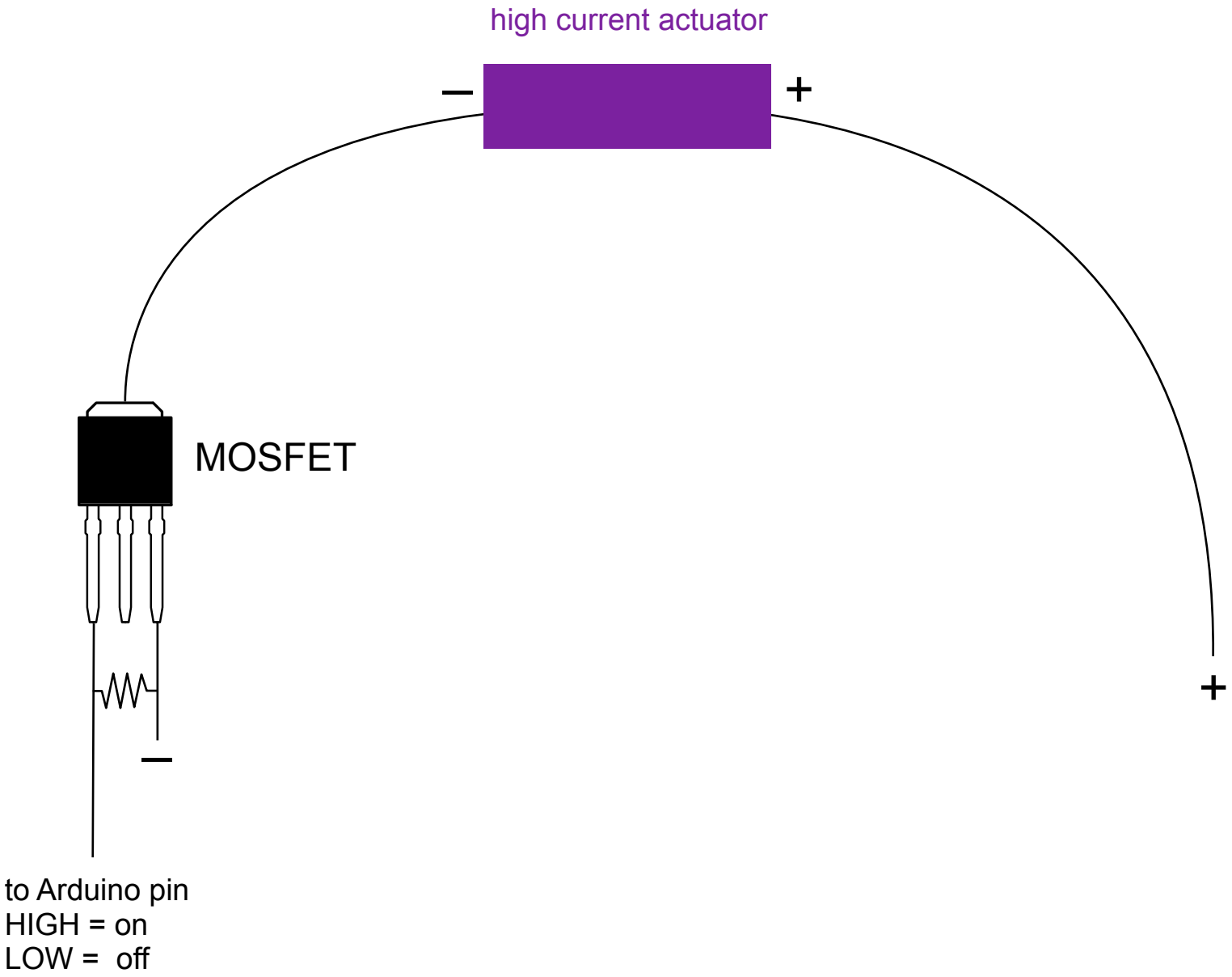
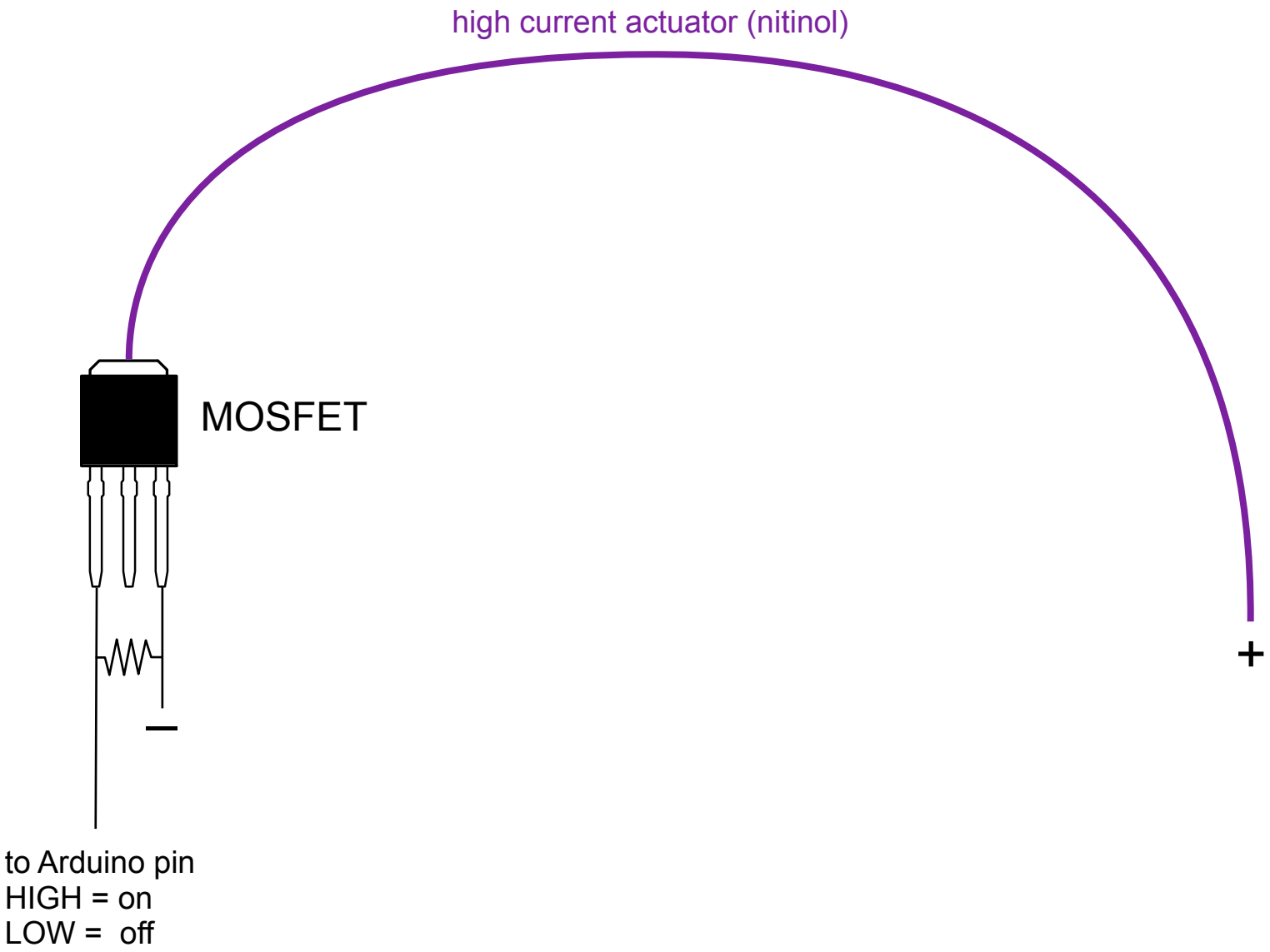
MOSFETS

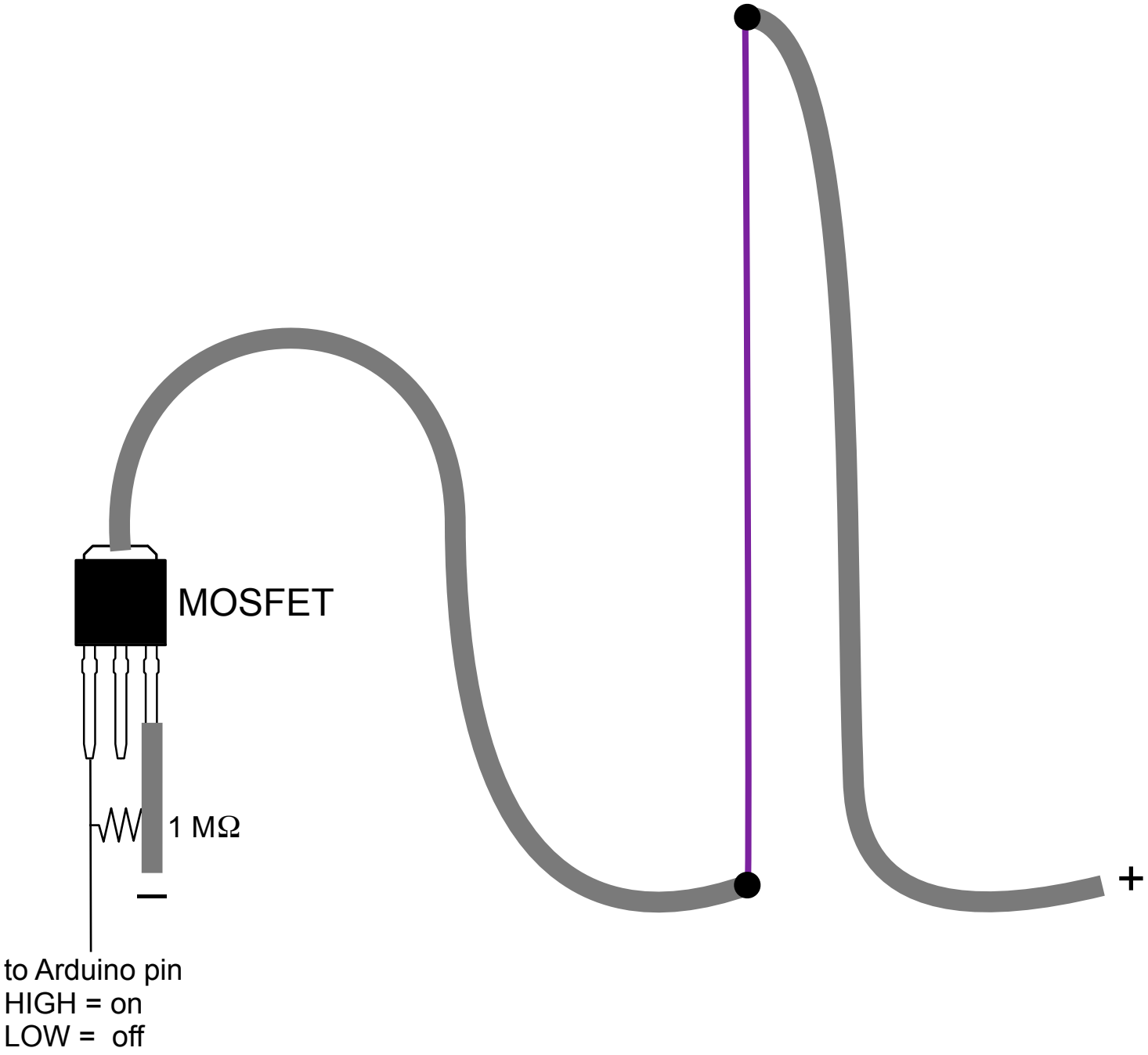
MOSFETs

metal-oxide-semiconductor field-effect transistor

voltage controllable switch


high current actuator
–
+
MOSFET
+
–
to Arduino pin
HIGH = on
LOW = off


high current actuator (nitinol)
MOSFET
+
–
to Arduino pin
HIGH = on
LOW = off


MOSFET
1 MΩ
–
+
to Arduino pin
HIGH = on
LOW = off

next week’s assignment

a prototyping trick...

open lab hours tomorrow
no formal lab session

optional lab session: training nitinol
Friday at 11am with Sam

pay Emily for your kits!