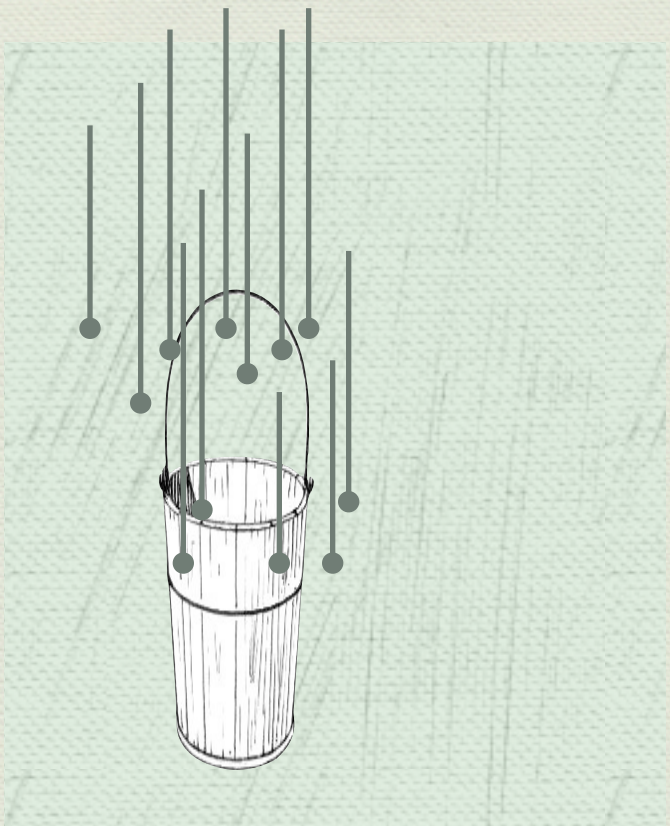
Magnetism
Day 3
Flux

Catching some rain

fill the bucket faster...

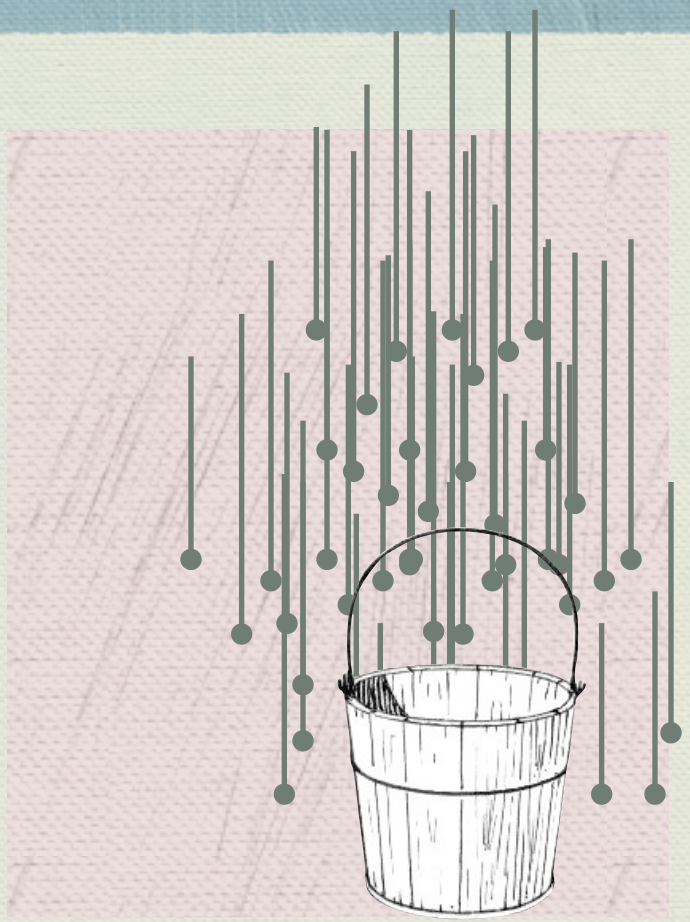


or

same volume but wider opening?

fill the bucket faster...

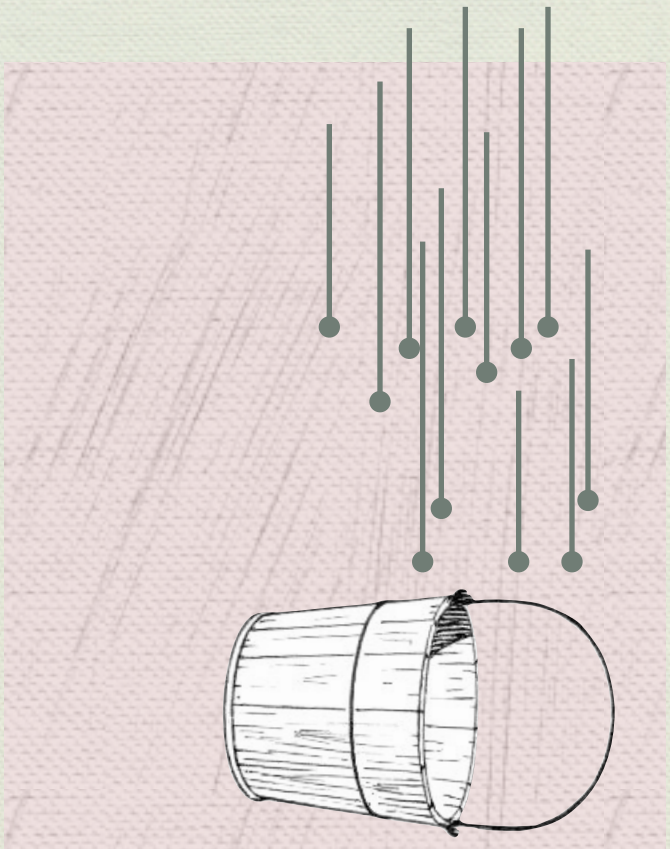
or



same bucket but more rain?

fill the bucket faster...

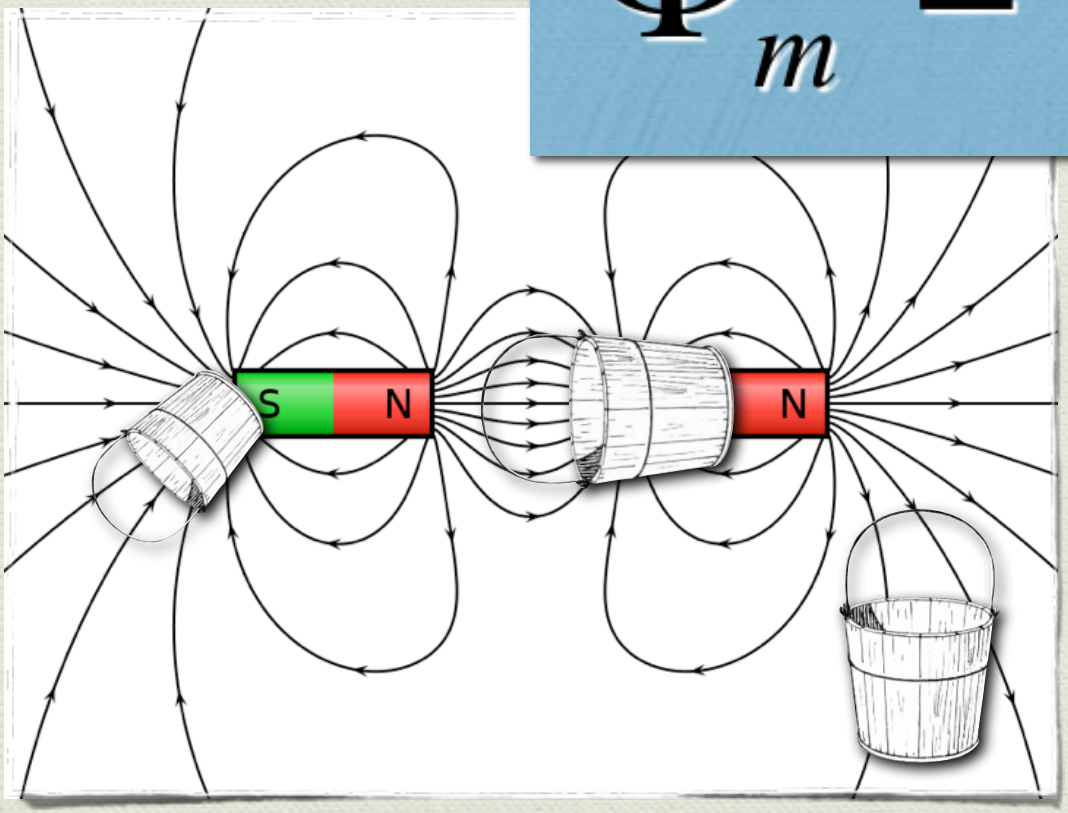
or

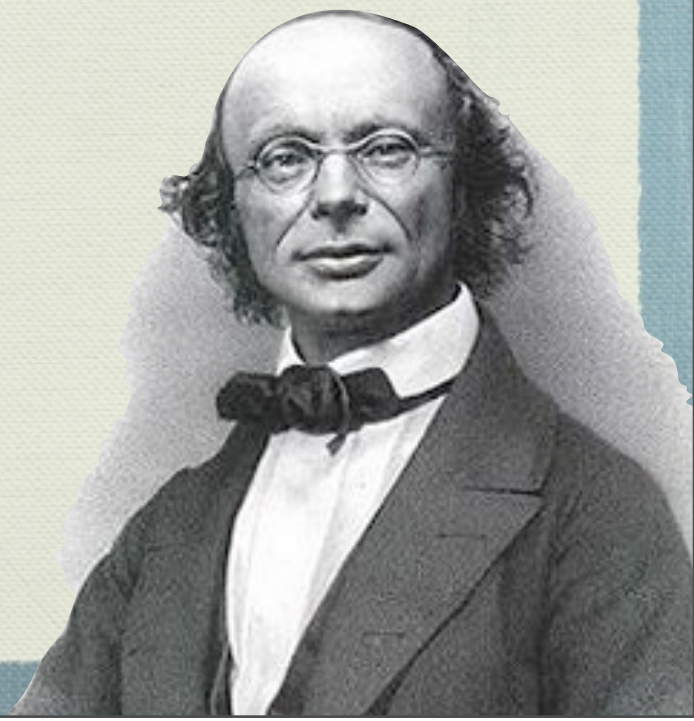


same bucket but from the side?

Magnetic Flux

$$\Phi_m = AB\cos\theta$$

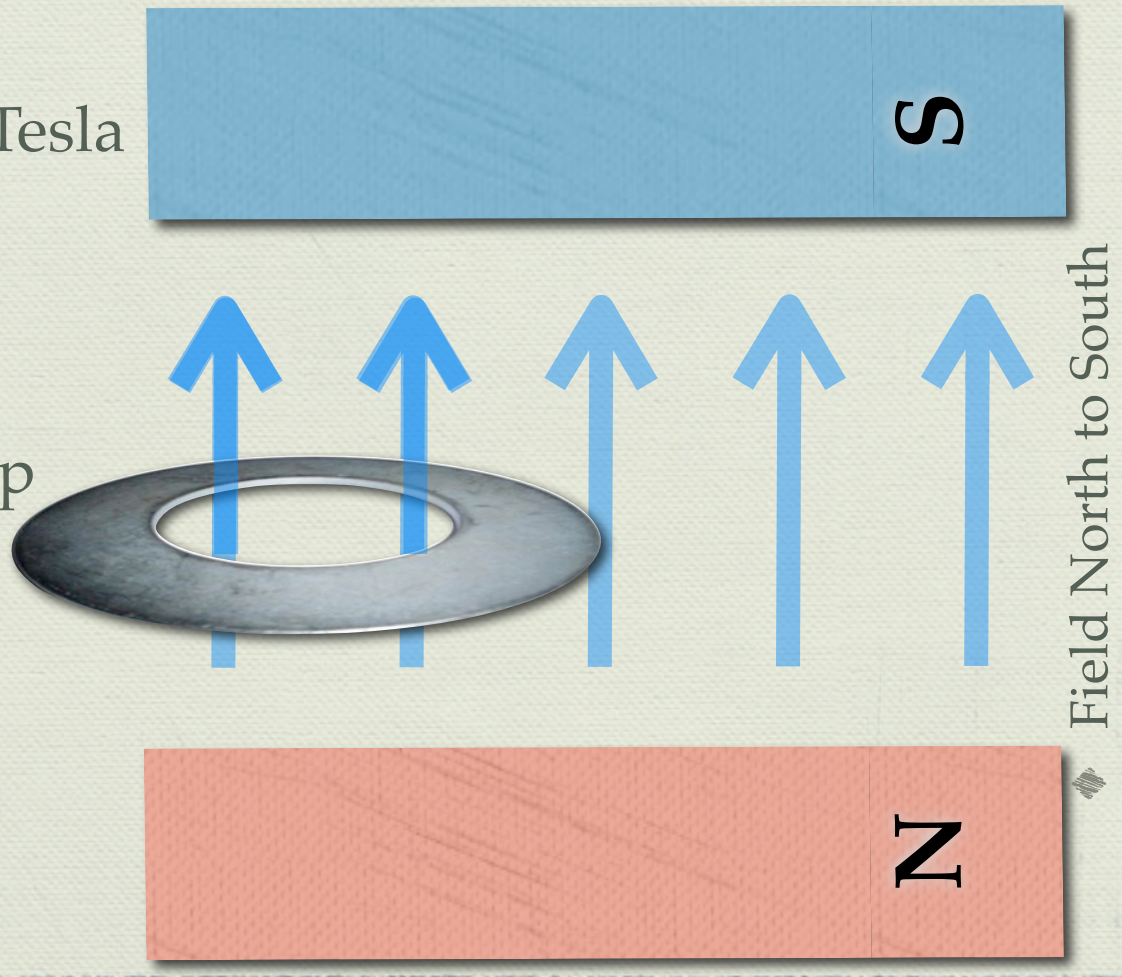




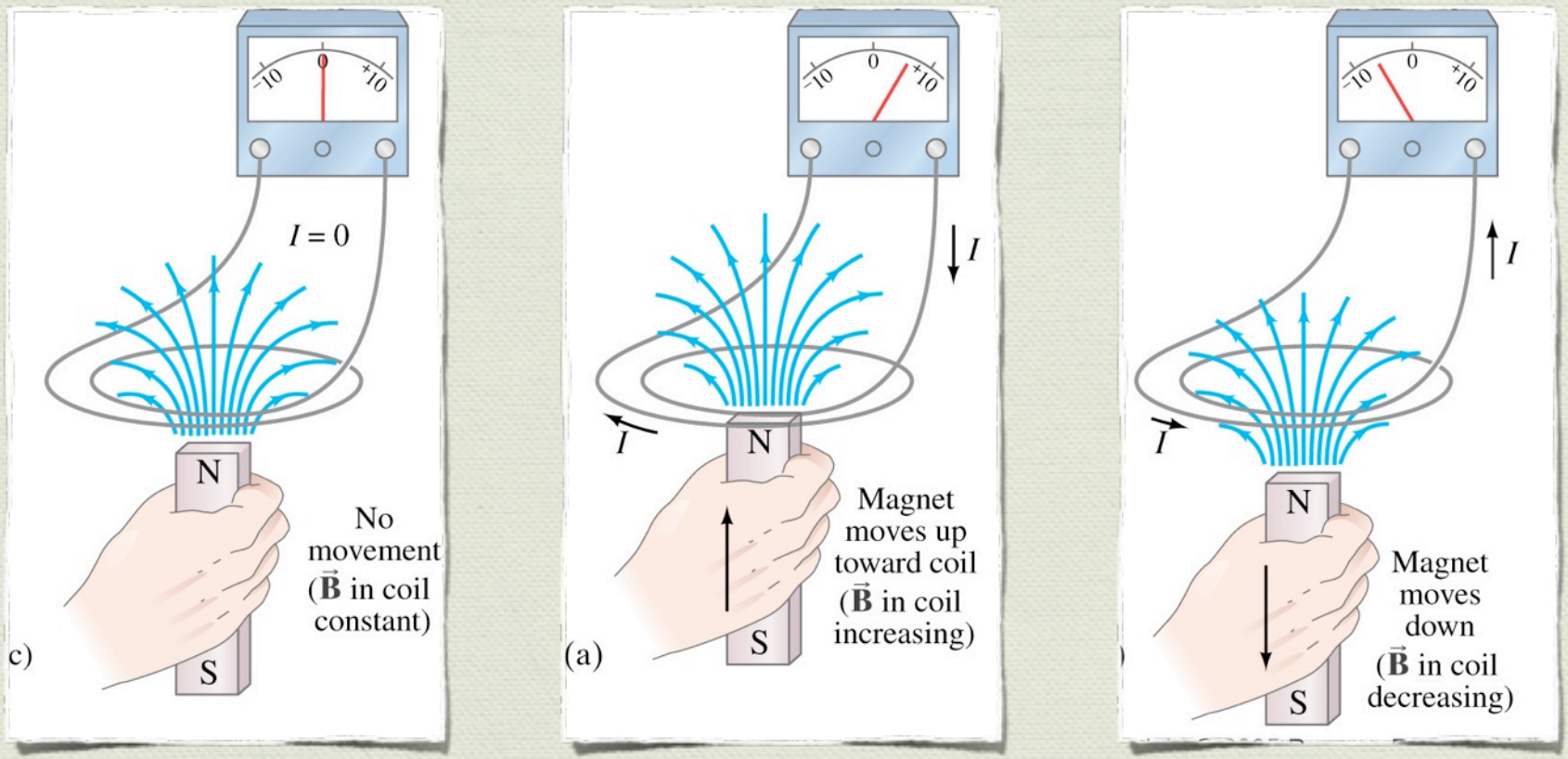
- Unit of magnetic flux is the weber, Wb.

Calculate Flux

- Magnetic Field = 4 Tesla
- radius = 30 cm
- Area = 0.2827 m^2
- straight into the loop
- angle = 0
- $\Phi = AB \cos \theta$
- $\Phi = 1.131$ Wb



Induced EMF (voltage)

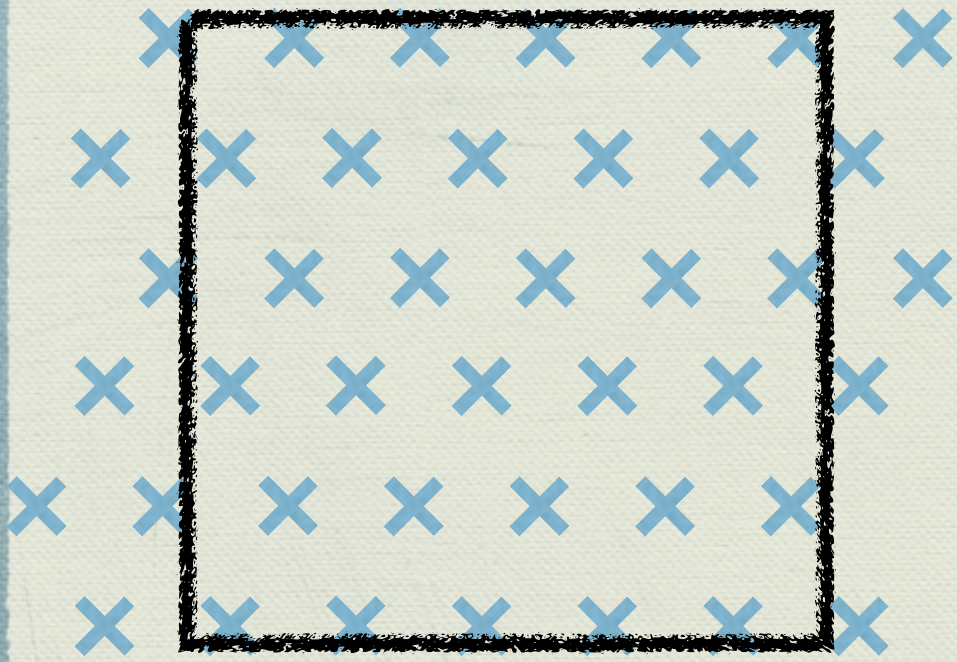


Lenz's Law

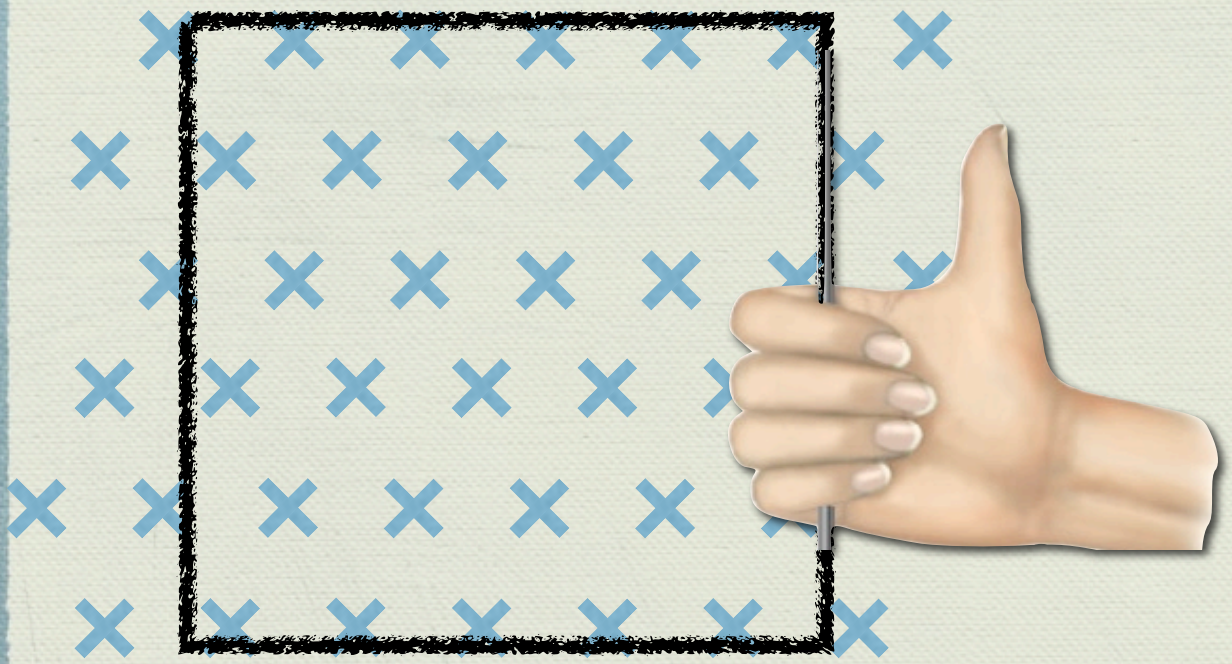
- "An induced current is always in such a direction as to oppose the motion or change causing it"

Nature hates change

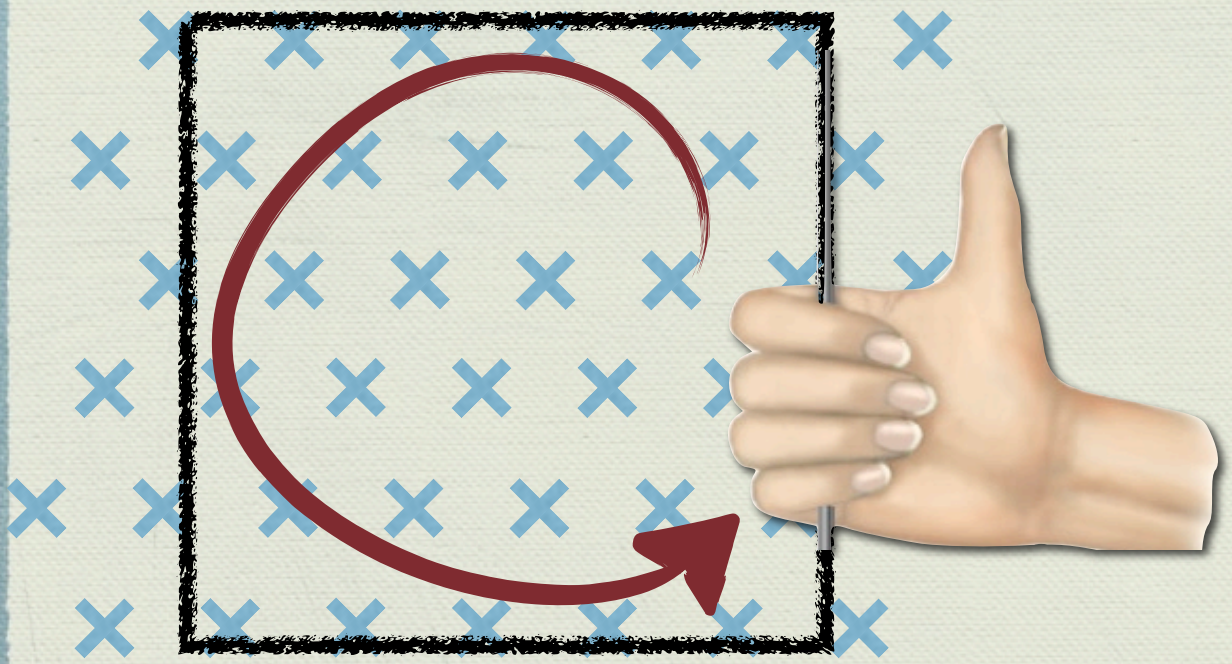
Nature hates change



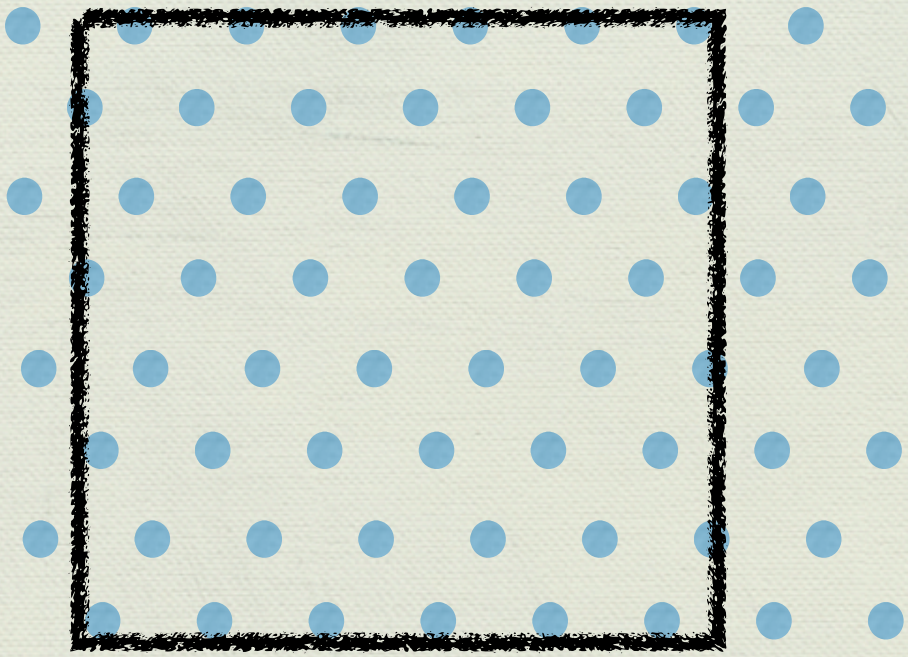
Nature hates change



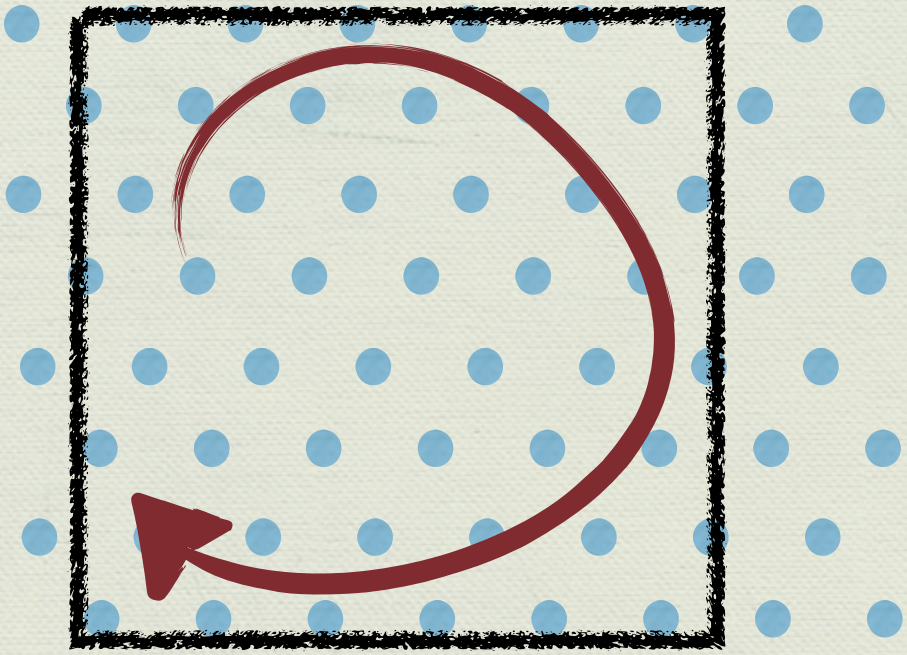
Nature hates change



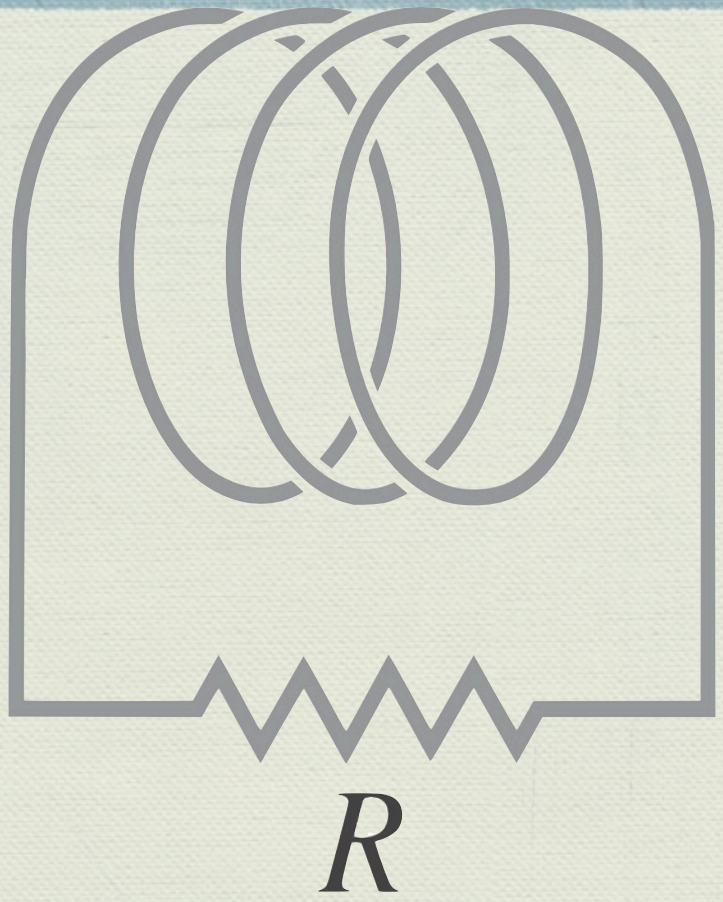
Opposite directions



Opposite directions

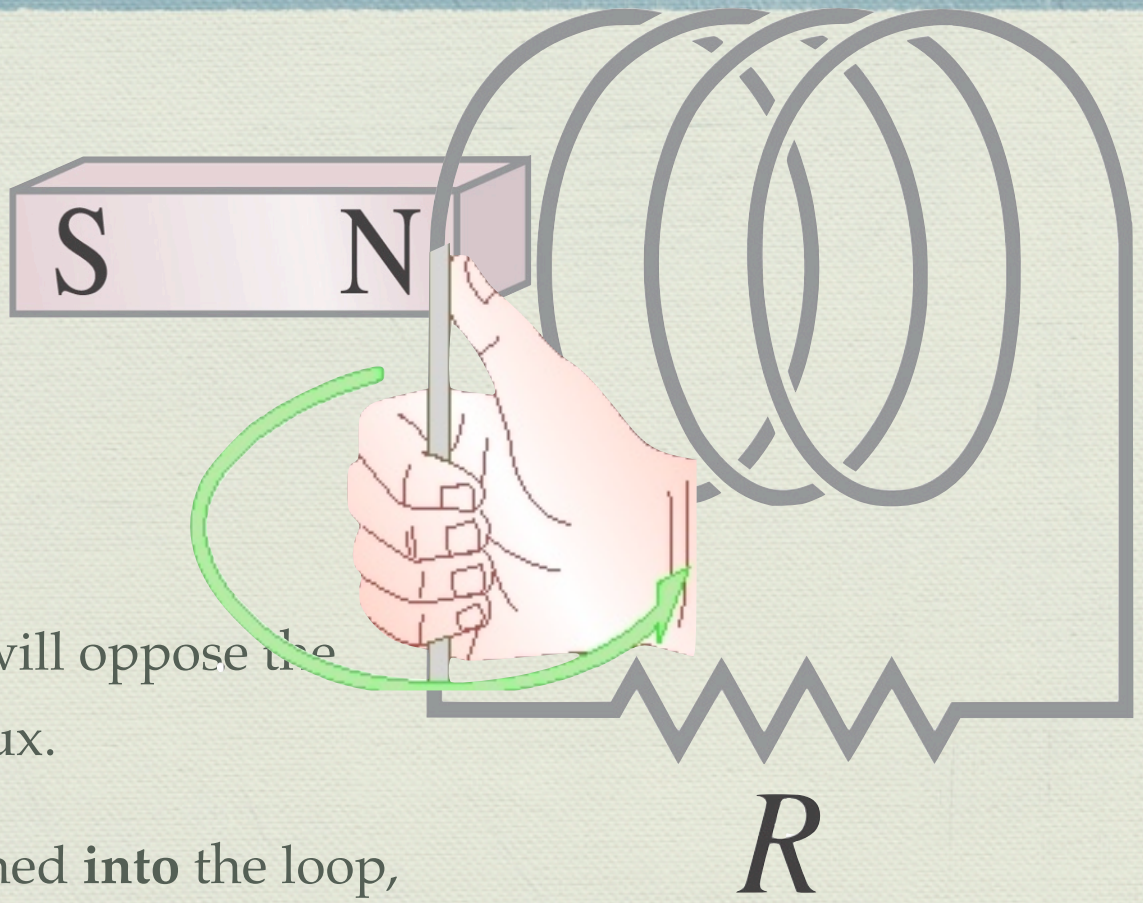


Electromagnetic Induction and Faraday's Law



- The induced current will oppose the change in magnetic flux.
- If a North pole is pushed **into** the loop, the hand will try to push it back **out**

Electromagnetic Induction and Faraday's Law



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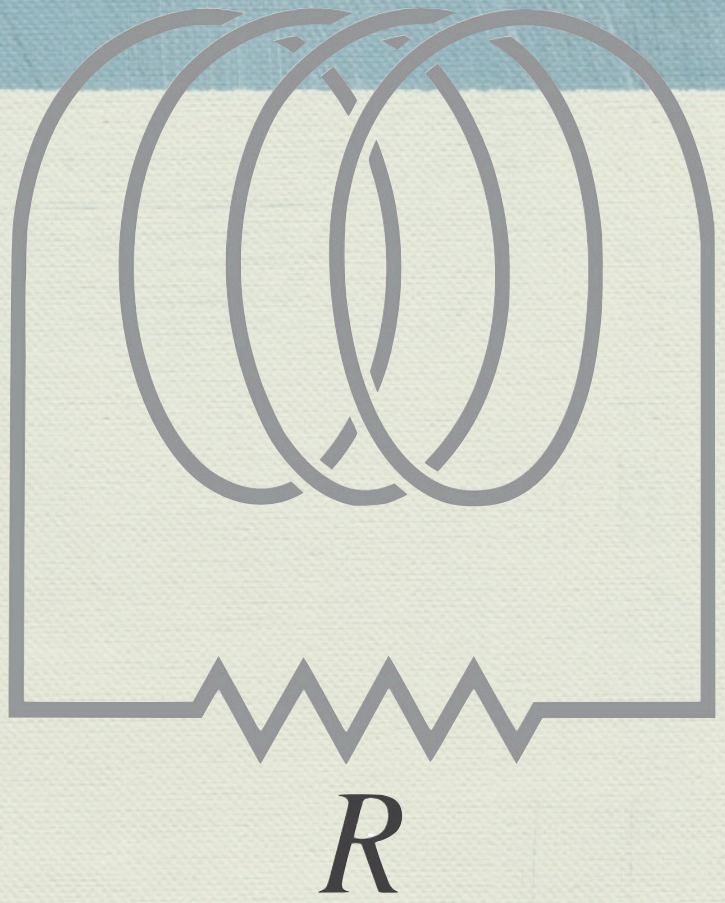
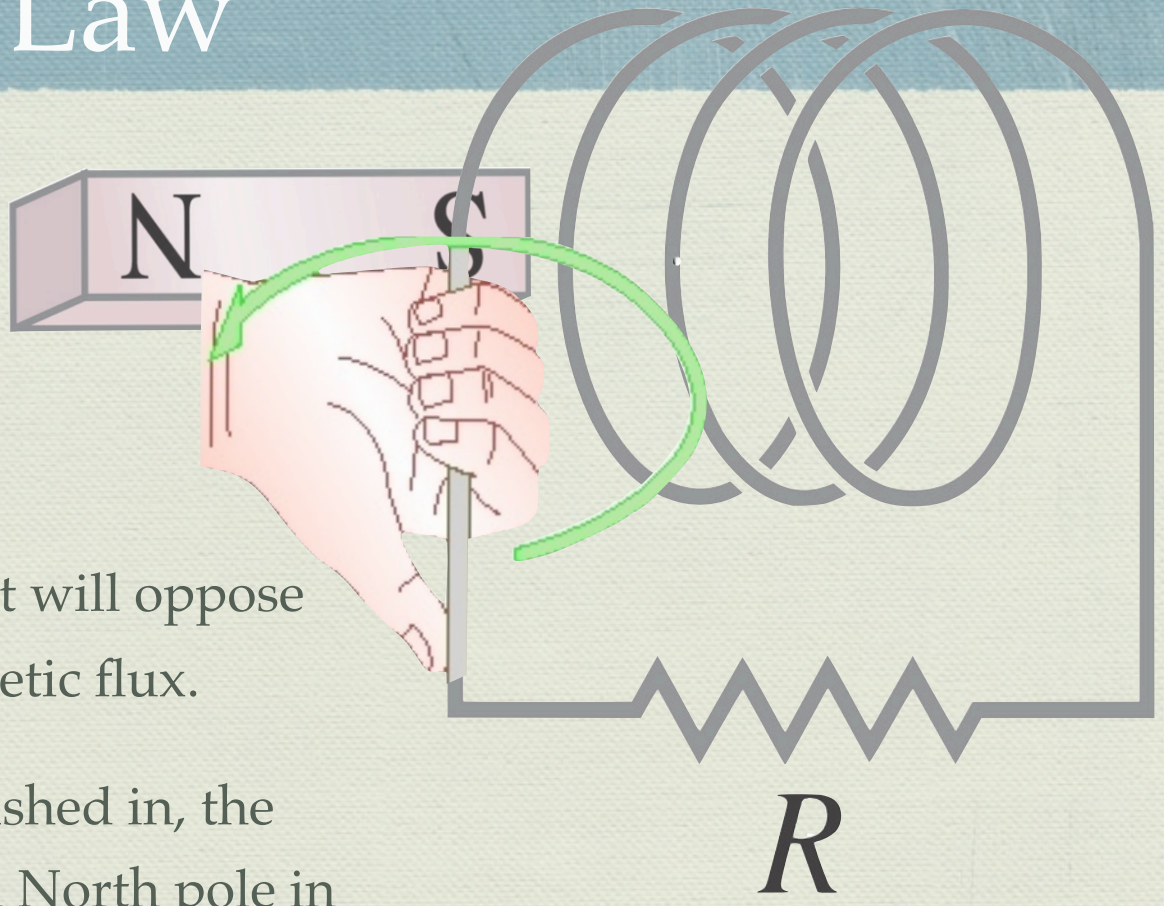


- The induced current will oppose the change in magnetic flux.
- If a south pole is pushed in, the hand tries to push a North pole in to balance.

Electromagnetic Induction and Faraday's Law



- The induced current will oppose the change in magnetic flux.
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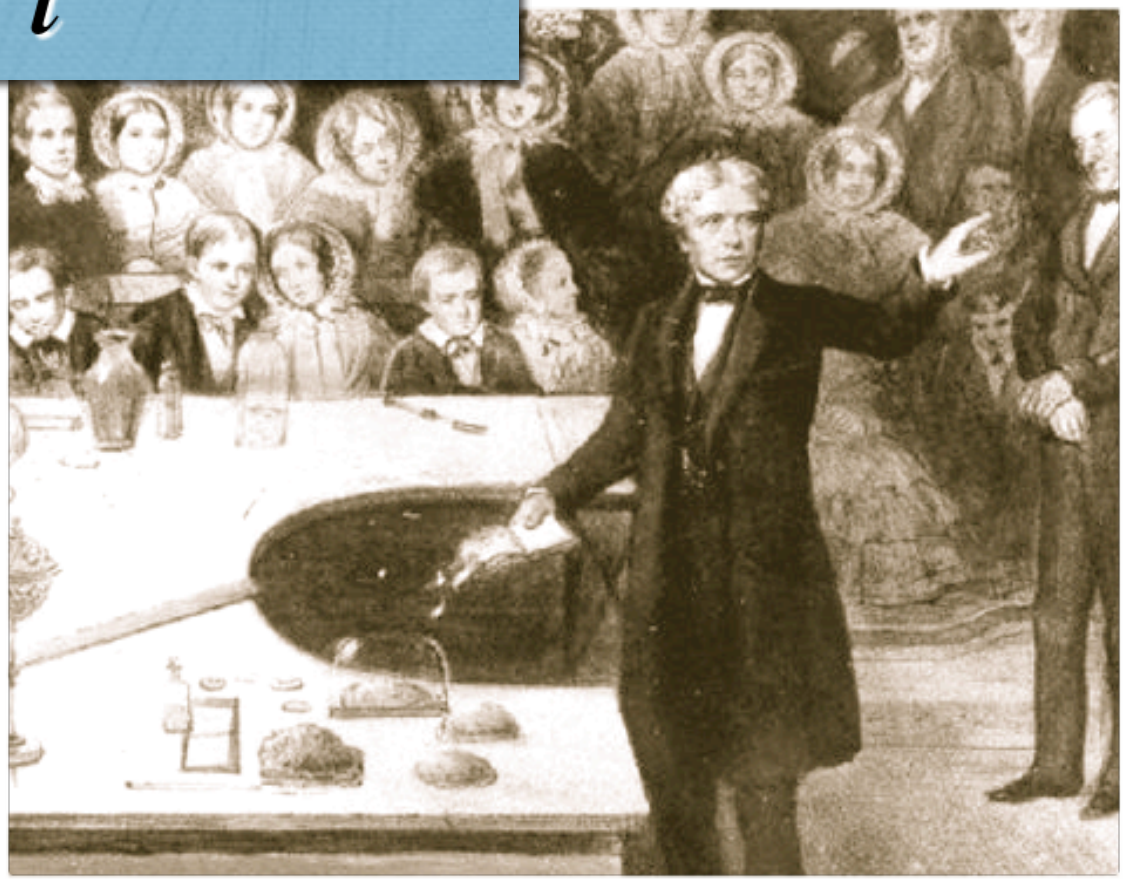
Faraday's law of induction:

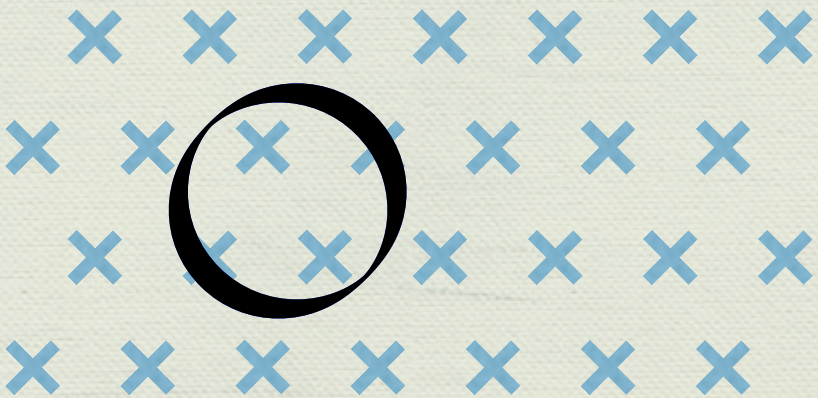
$$EMF = \frac{\Delta \Phi_m}{t}$$

Bigger voltages with faster or greater changes in flux.



Induced Voltage

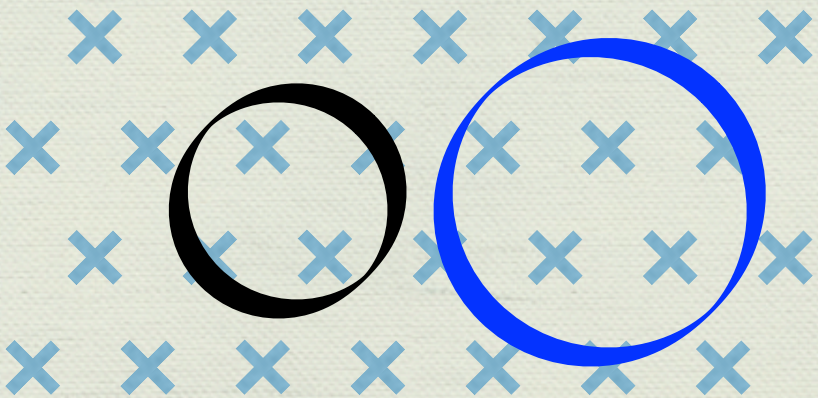
- A circular loop, 10 cm in diameter, is placed in a uniform field of 1.5 T. Find the flux through the loop.
  - $\Phi = 0.0118$ Wb



- $\Phi = AB \cos \theta$
- $\Phi = \pi(0.05^2)(1.5)(\cos 0)$
- $\Phi = 0.0118$ Wb

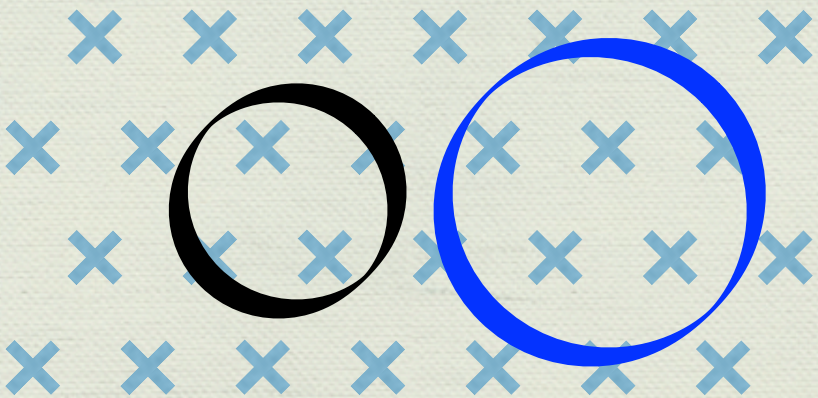
Induced Voltage

- A circular loop, 10 cm in diameter, is placed in a uniform field of 1.5 T. Find the flux through the loop.
  - $\Phi = 0.0118$ Wb
- If the coil is stretched to 24 cm diameter in 0.07 s, what is the induced voltage?



- $\Phi = AB \cos \theta$
- $\Phi = \pi(0.12^2)(1.5)(\cos 0)$
- $\Phi = 0.0678$ Wb

Induced Voltage



- A circular loop, 10 cm in diameter, is placed in a uniform field of 1.5 T. Find the flux through the loop.
  - $\Phi = 0.0118$ Wb
- If the coil is stretched to 24 cm diameter in 0.07 s, what is the induced voltage?
  - $\Phi = 0.0678$ Wb

$$EMF = \frac{\Delta \Phi_m}{t}$$

- $V = (\Phi - \Phi) / t$
- $V = (0.0678 - 0.0118) / 0.07$
- $V = 0.8$ V