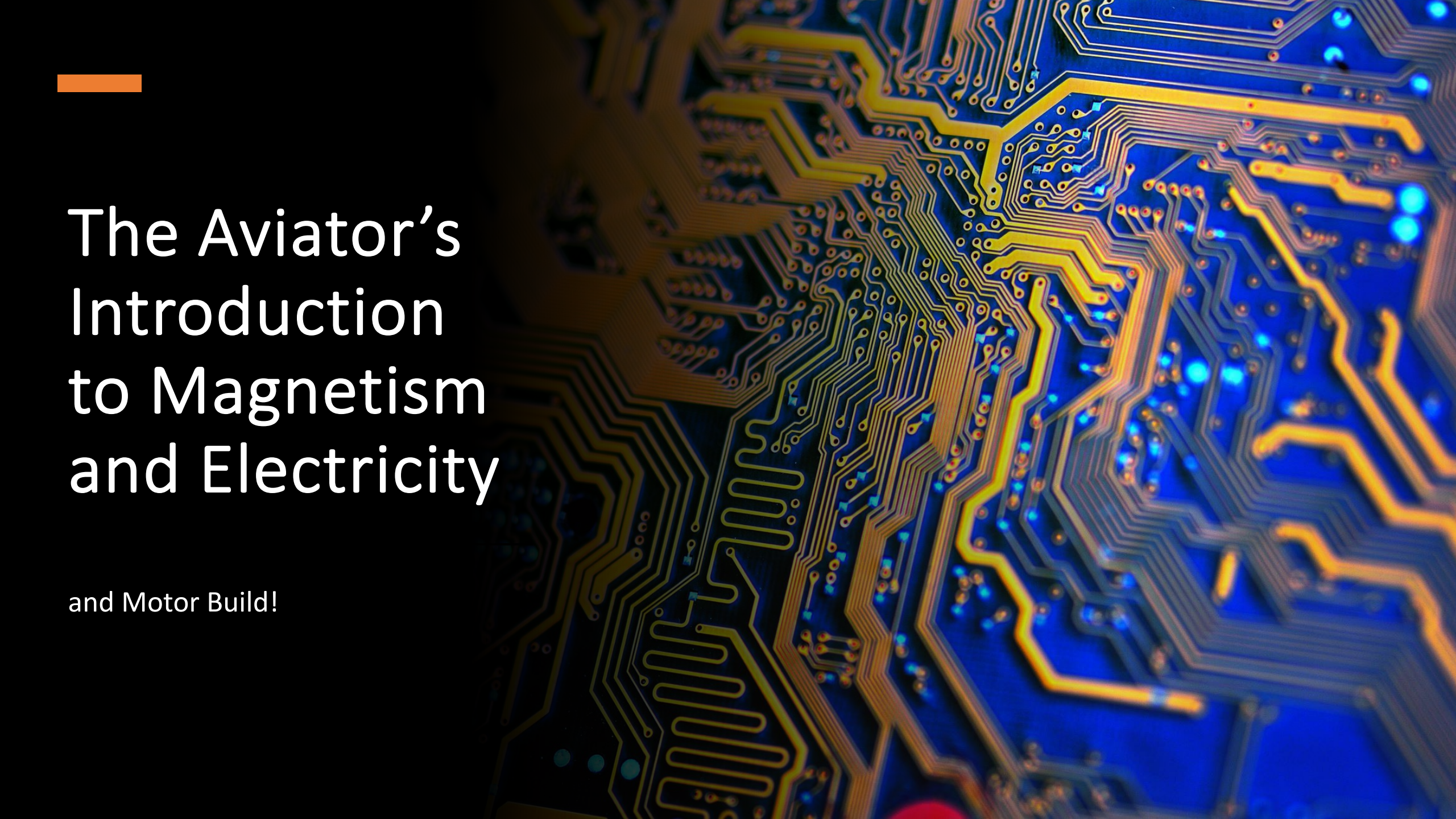
The Aviator's Introduction to Magnetism and Electricity

and Motor Build!

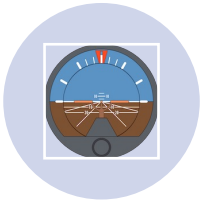


The largest cause of fatal accidents is loss of control in-flight.

KEEP
CALM
AND
AVIATE, NAVIGATE,
COMMUNICATE

Aviate Navigate Communicate

Fly the plane!



Wings Level

Prop turning!

Fuel Level

Tach RPM

Oil Temperature

Aviate Navigate Communicate

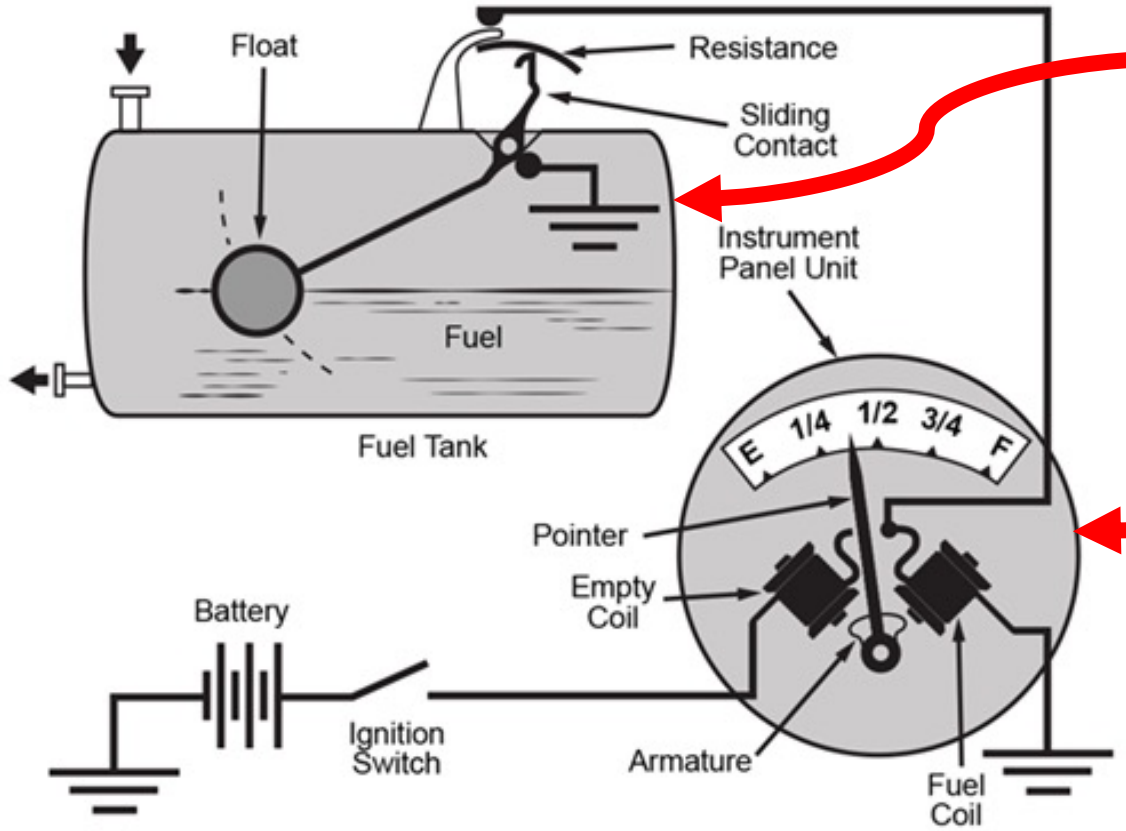
Aviate Navigate Communicate

A TOMATO  FLAMES!!!

Aviate Navigate Communicate

- Airspeed Indicator
- Tachometer (for each engine)
- Oil Pressure (for each engine using a pressure system)
- Manifold pressure gauge (for each altitude engine)
- Altimeter (high to low, hot to cold, look out below)
- Temperature gauge (for each liquid cooled engine)
- Oil temperature gauge (for each air cooled engine)
- Fuel gauge
- Landing gear position indicator (if equipped)
- Anticollision lights (for airplanes certified after 3-11-96)
- Magnetic Compass
- ELT
- Safety Belts

Fuel Level

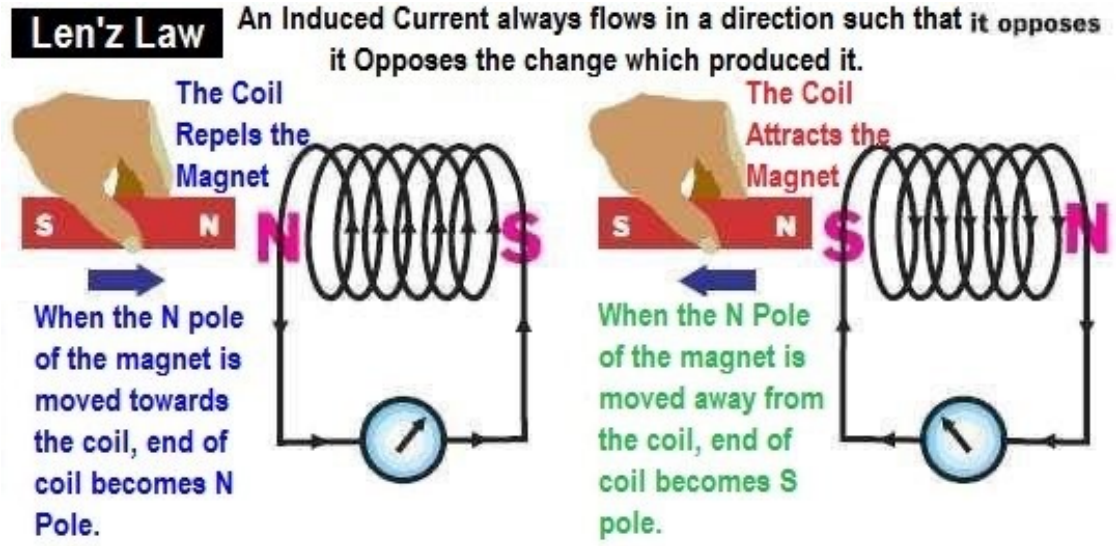


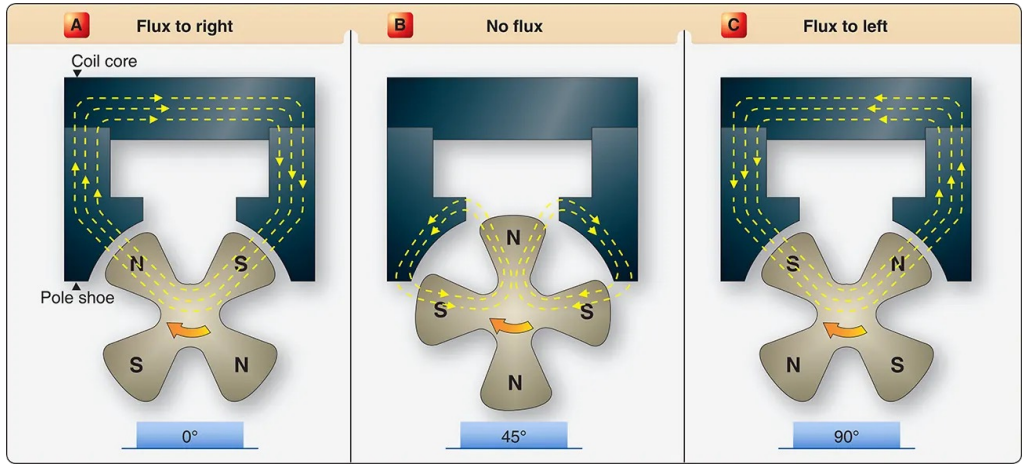
Sensor on tank

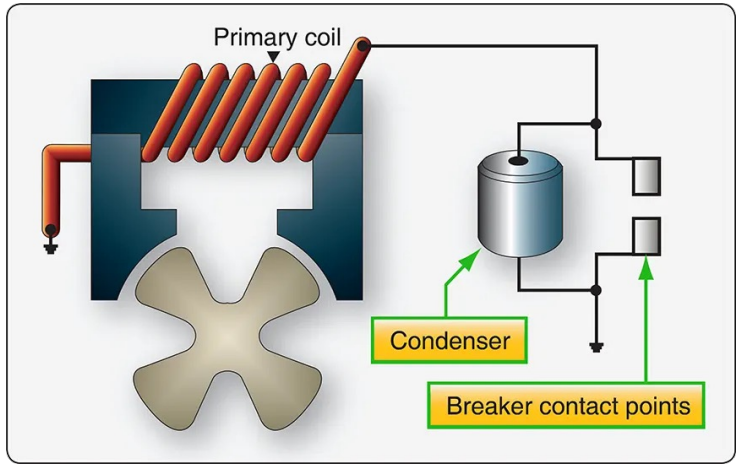
Gauge on dash

Simplest Electrical System in an Airplane - Magneto

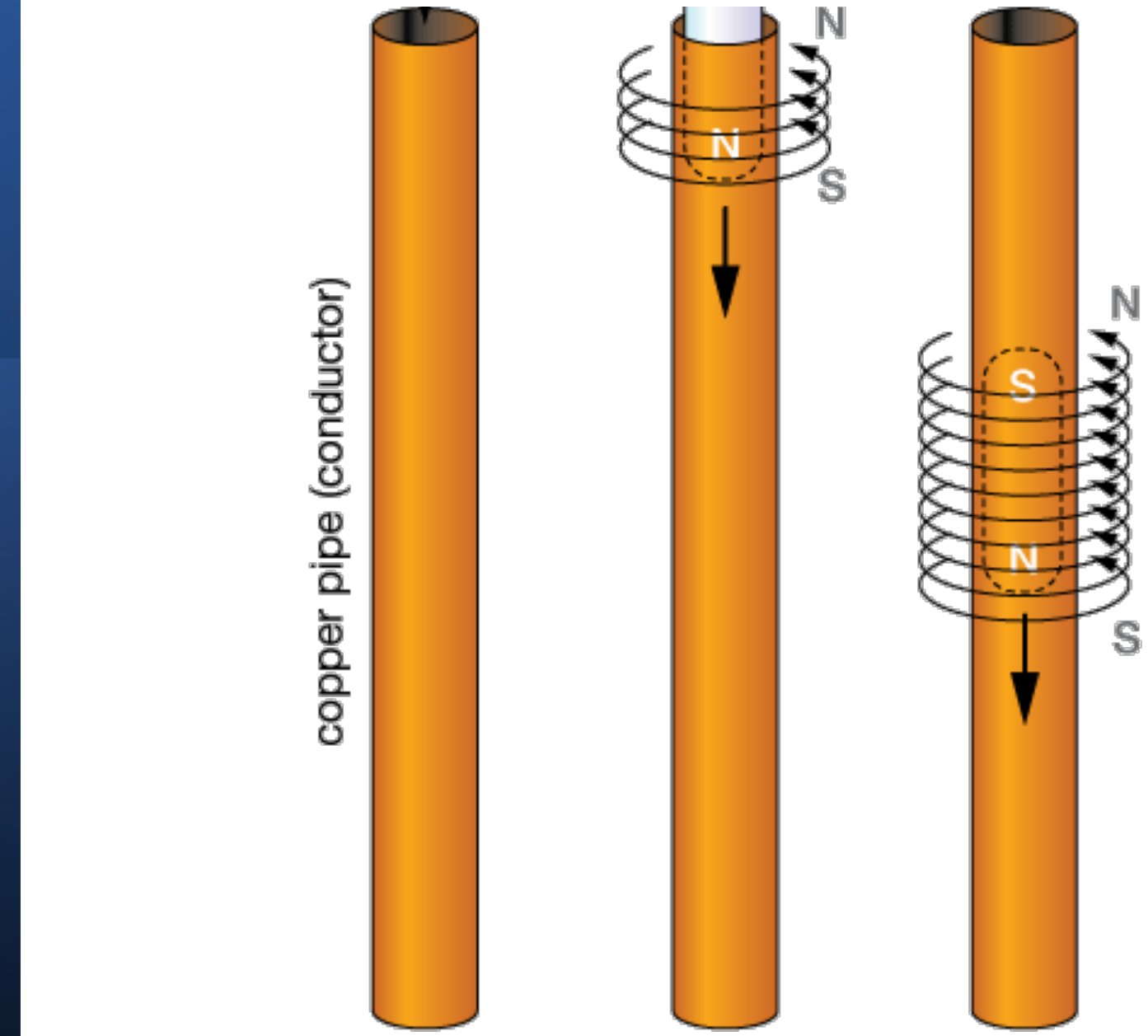
Lenz's Law that states: "An induced current always flows in such a direction that its magnetism opposes the motion or the change that induced it."



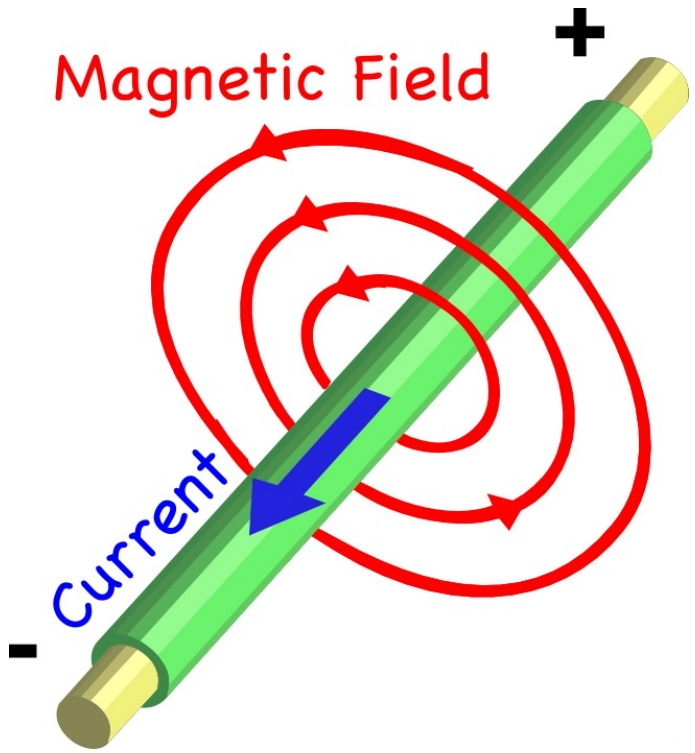


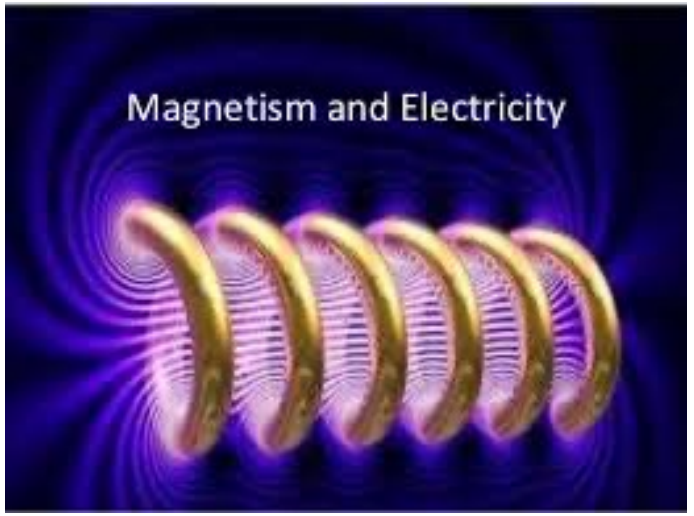


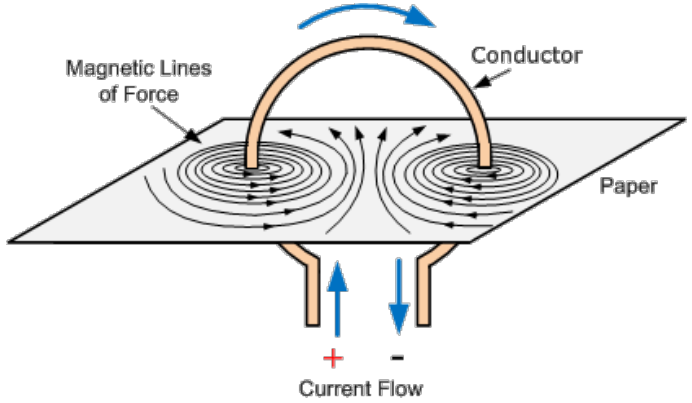
Magnet in a tube demo



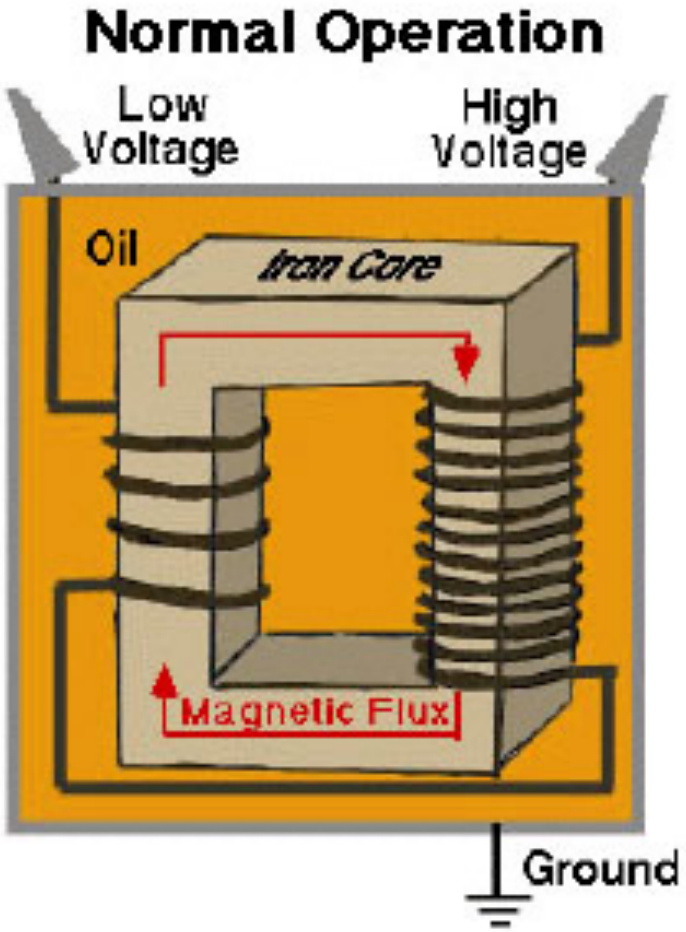
Magnetic Field Strength - Coils

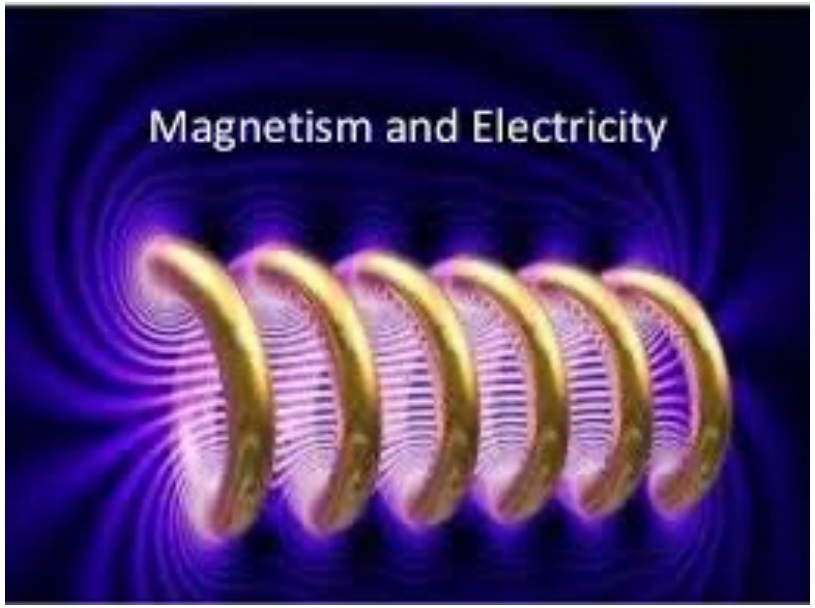


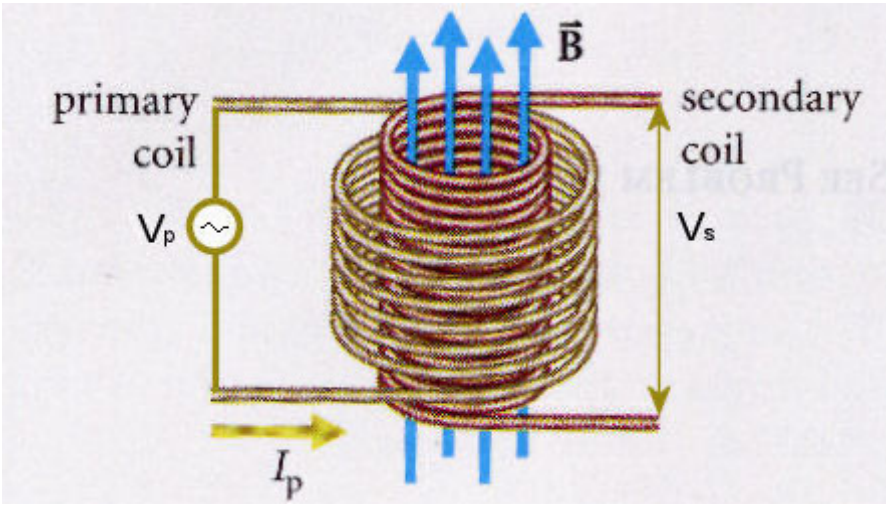




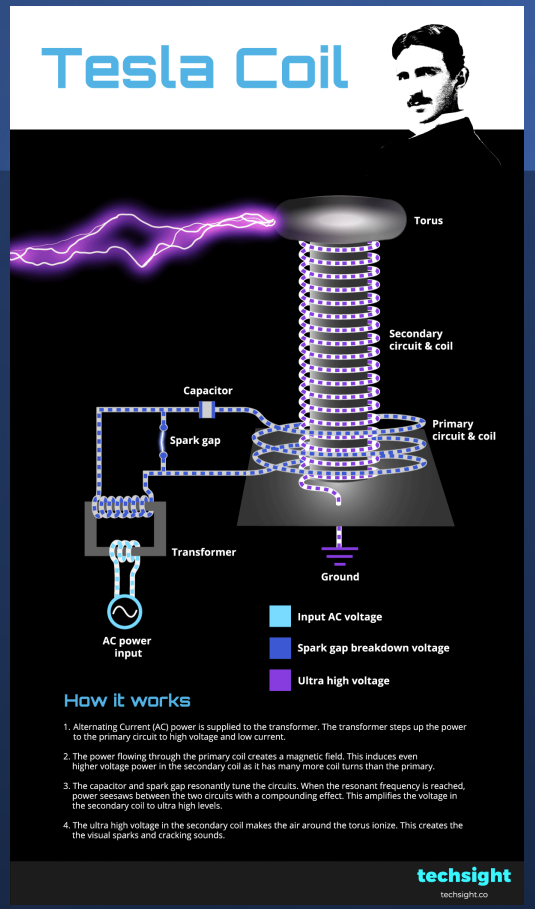
Increasing Voltage



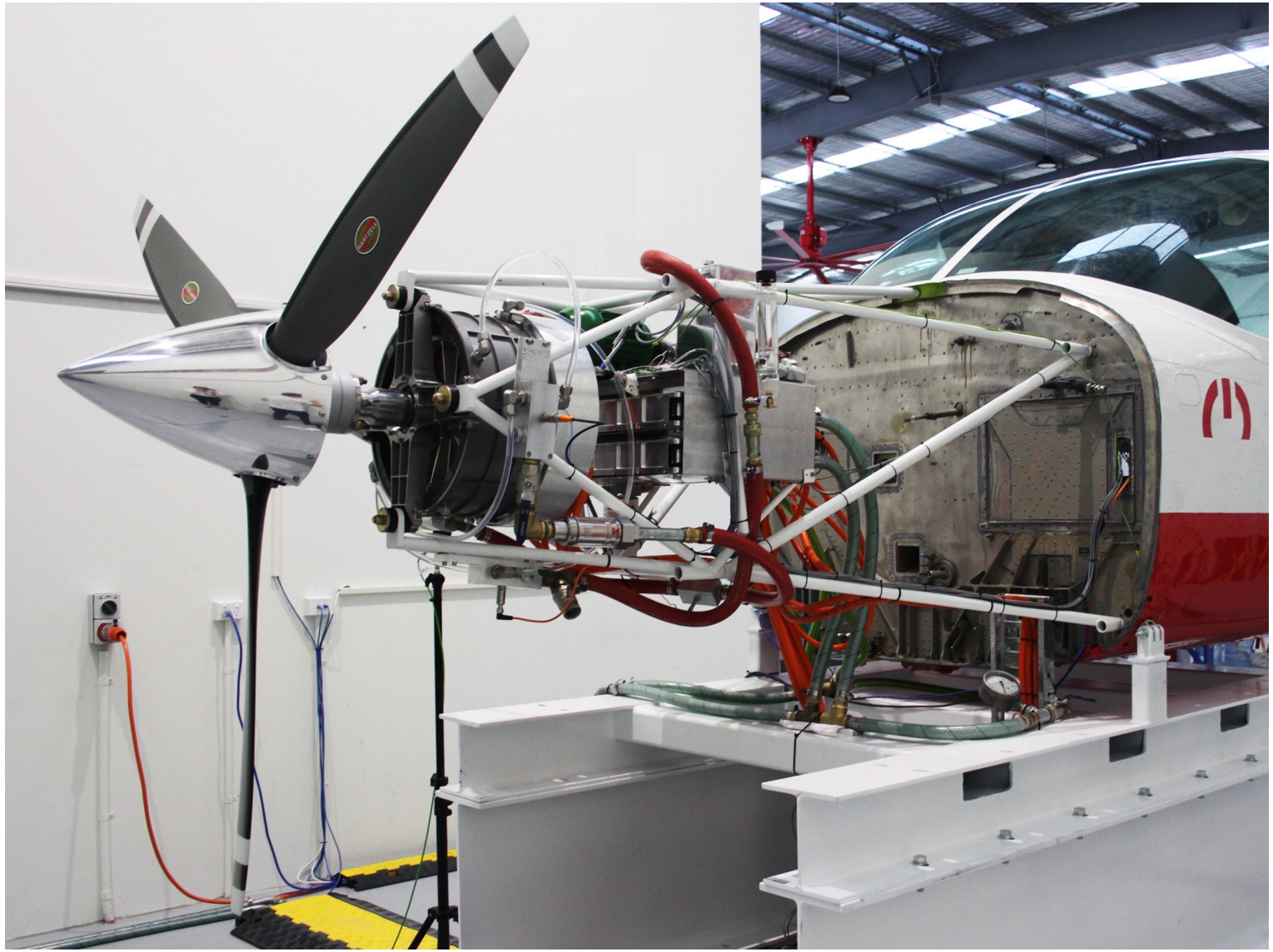




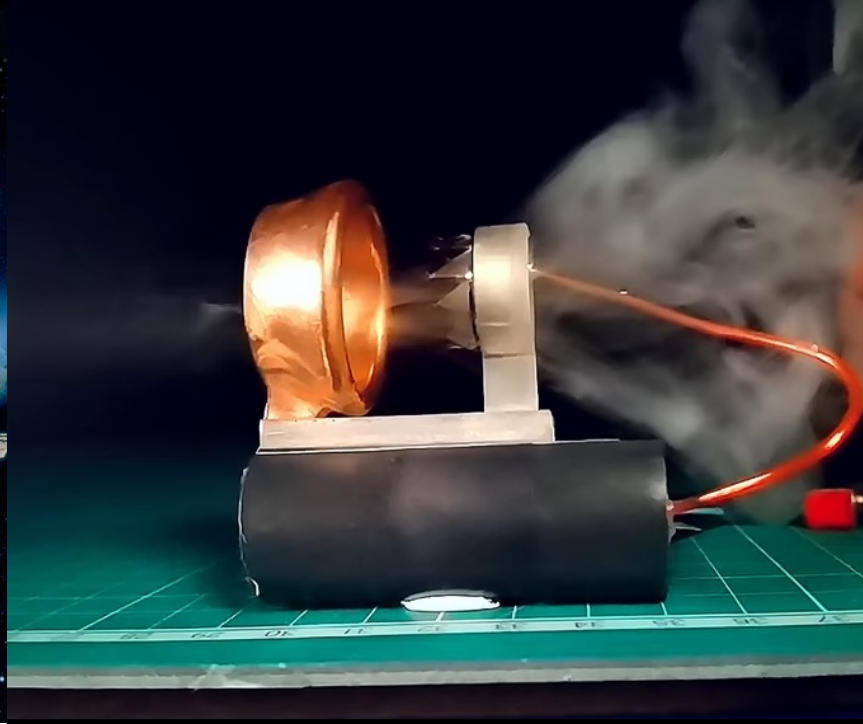
Tesla Coils – Even greater voltage

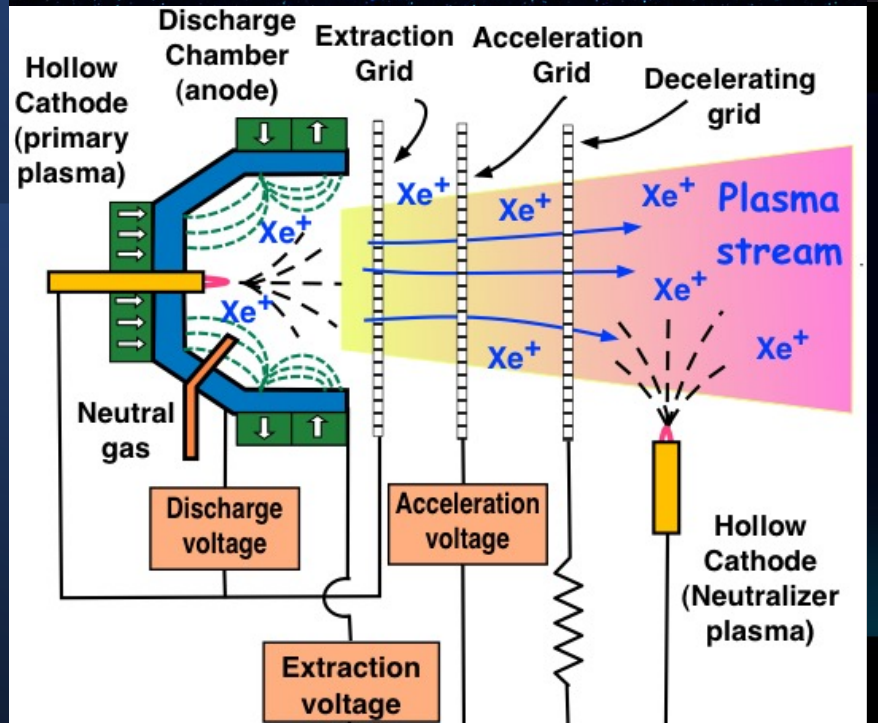


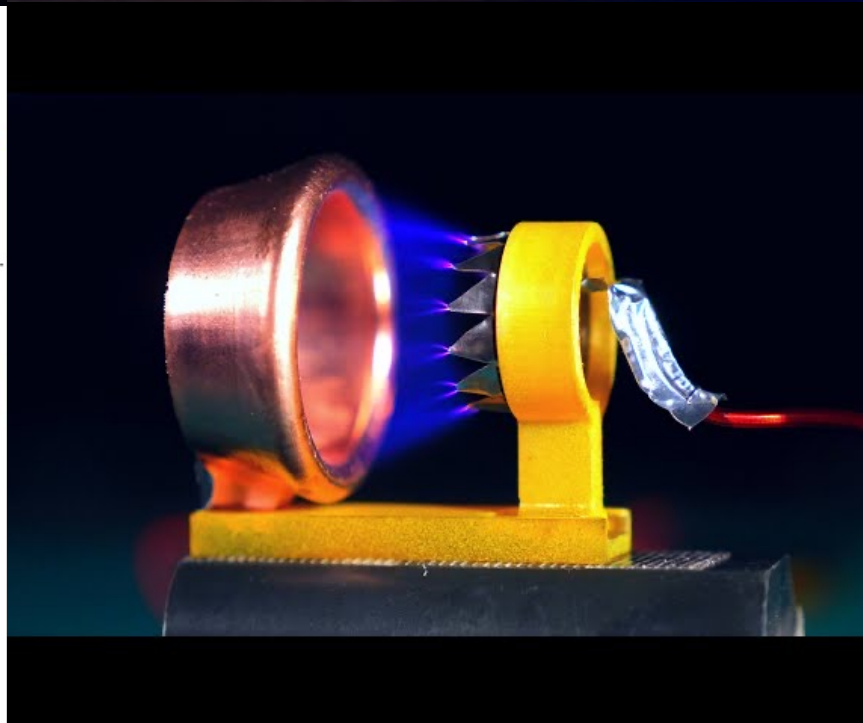
Electric Airplane



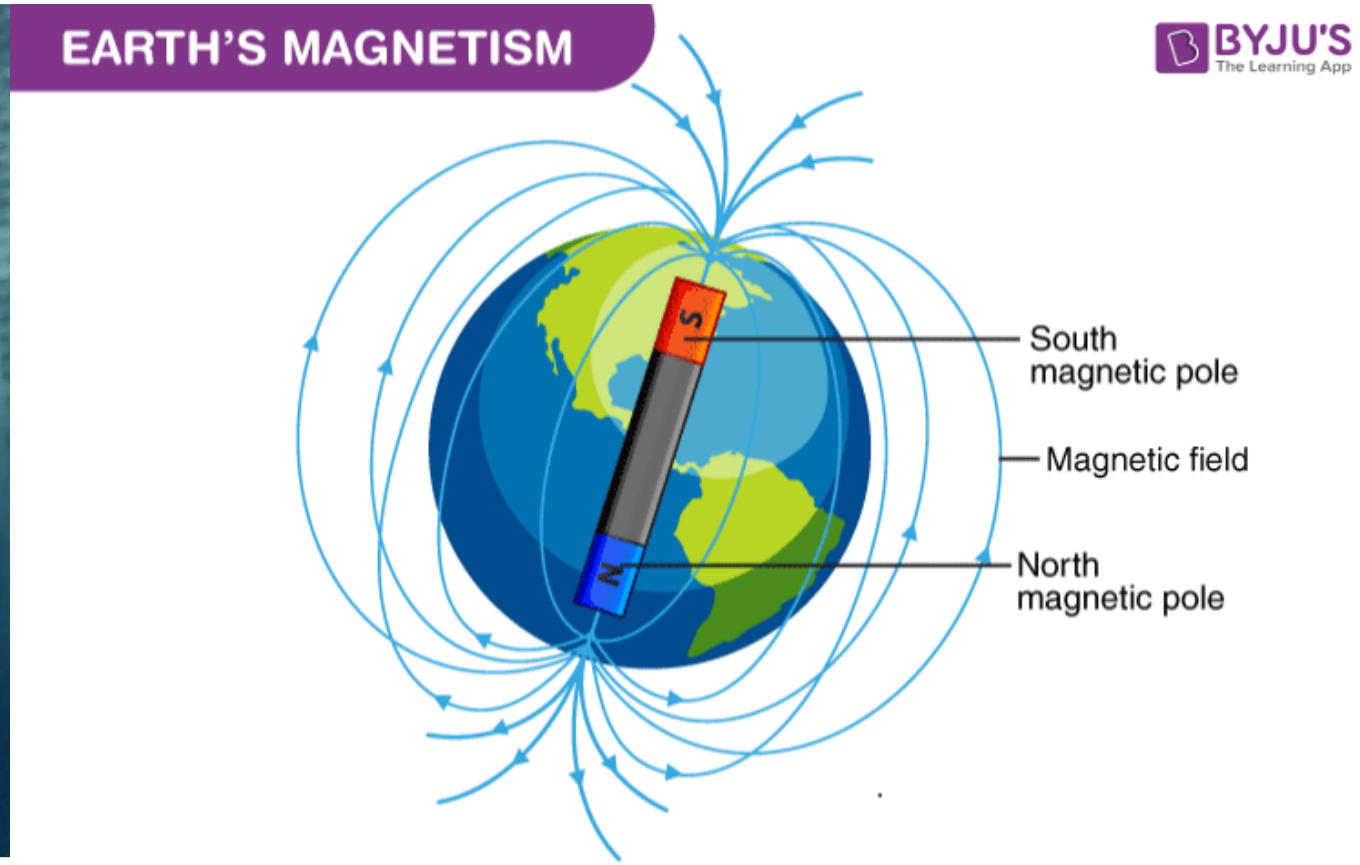
Ion Thrust Propulsion





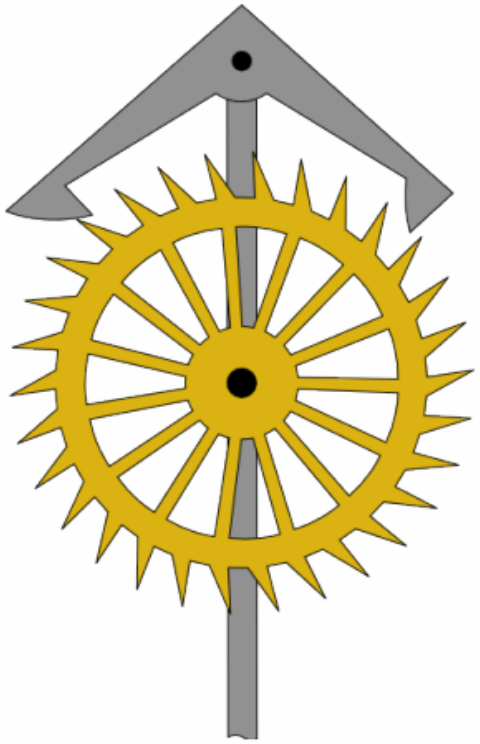


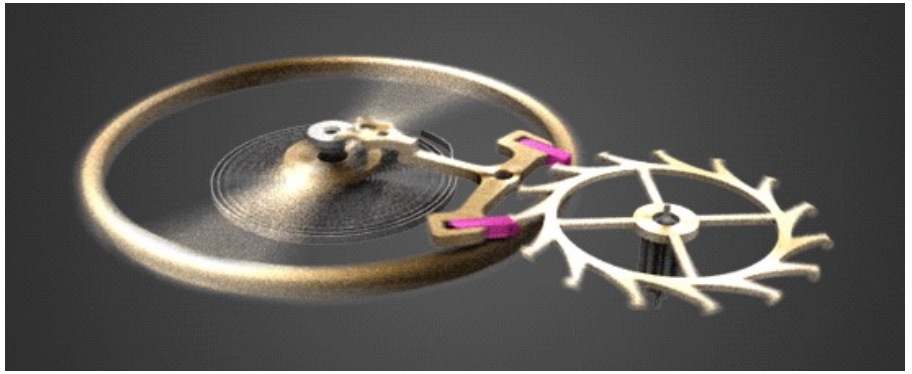
Aviate Navigate Communicate



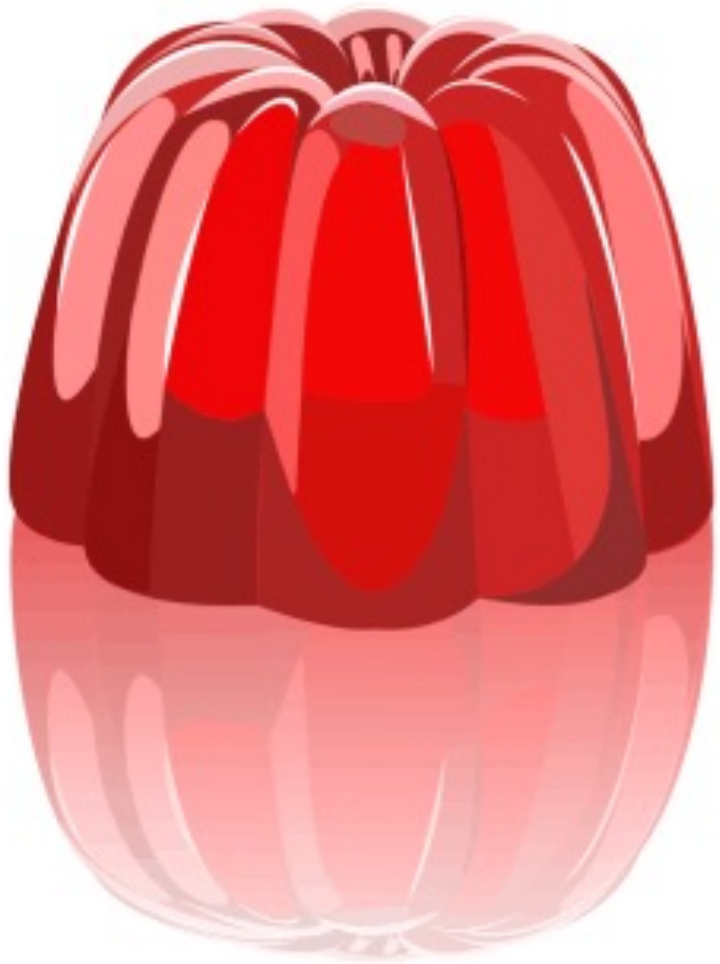
DIRECTION

TIME KEEPING AT SEA (AND IN THE AIR)

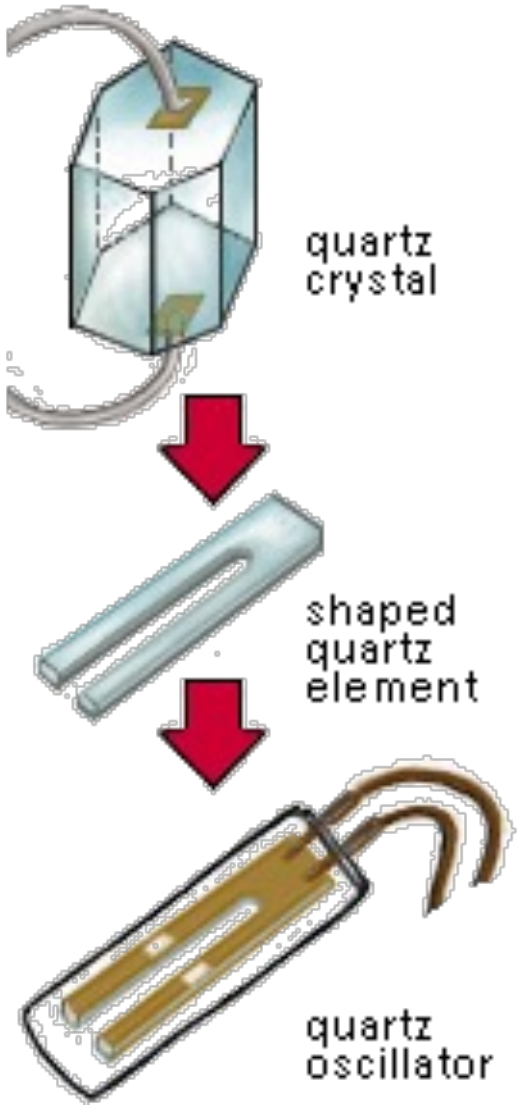




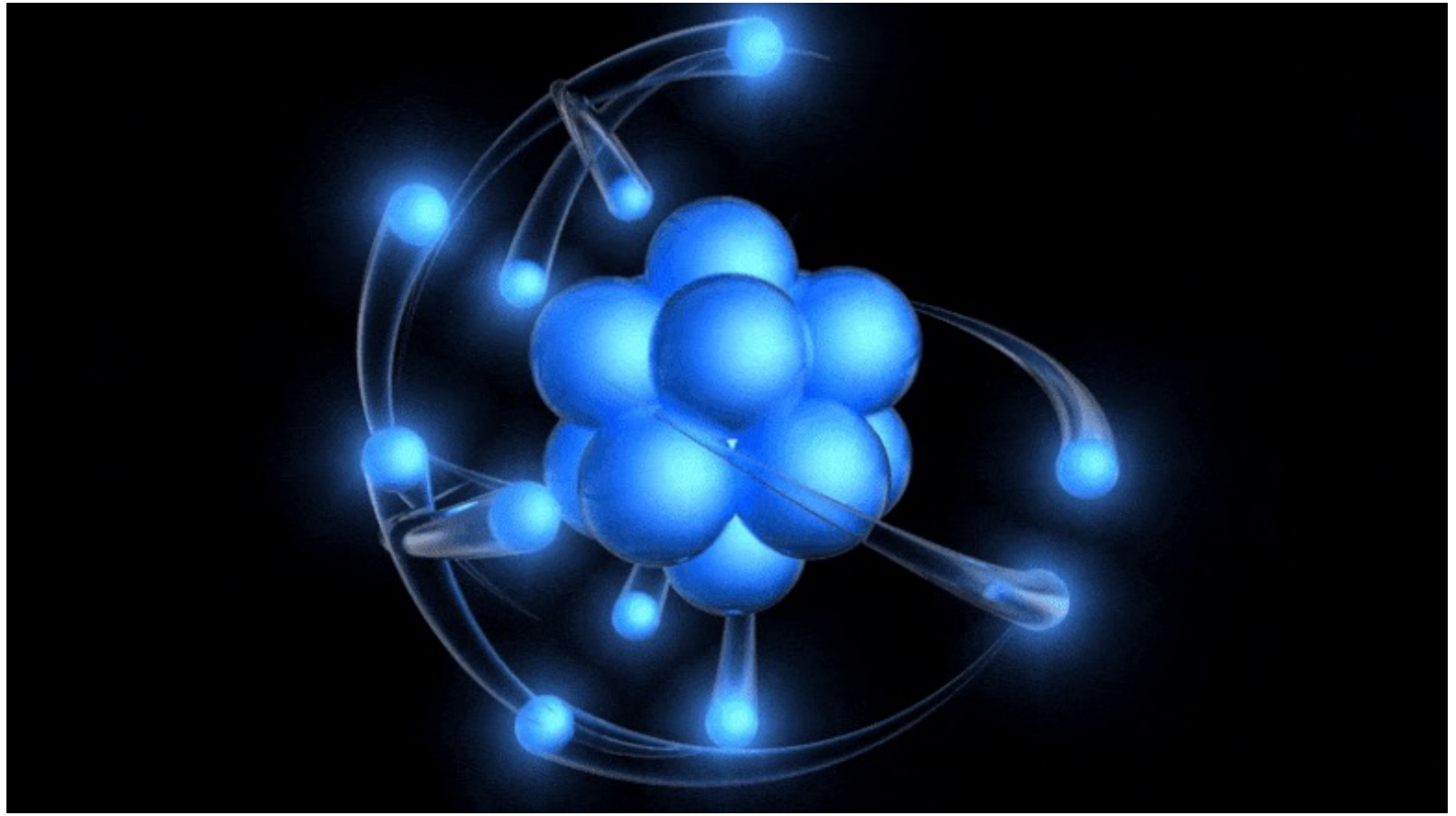
PRECISION TIME KEEPING



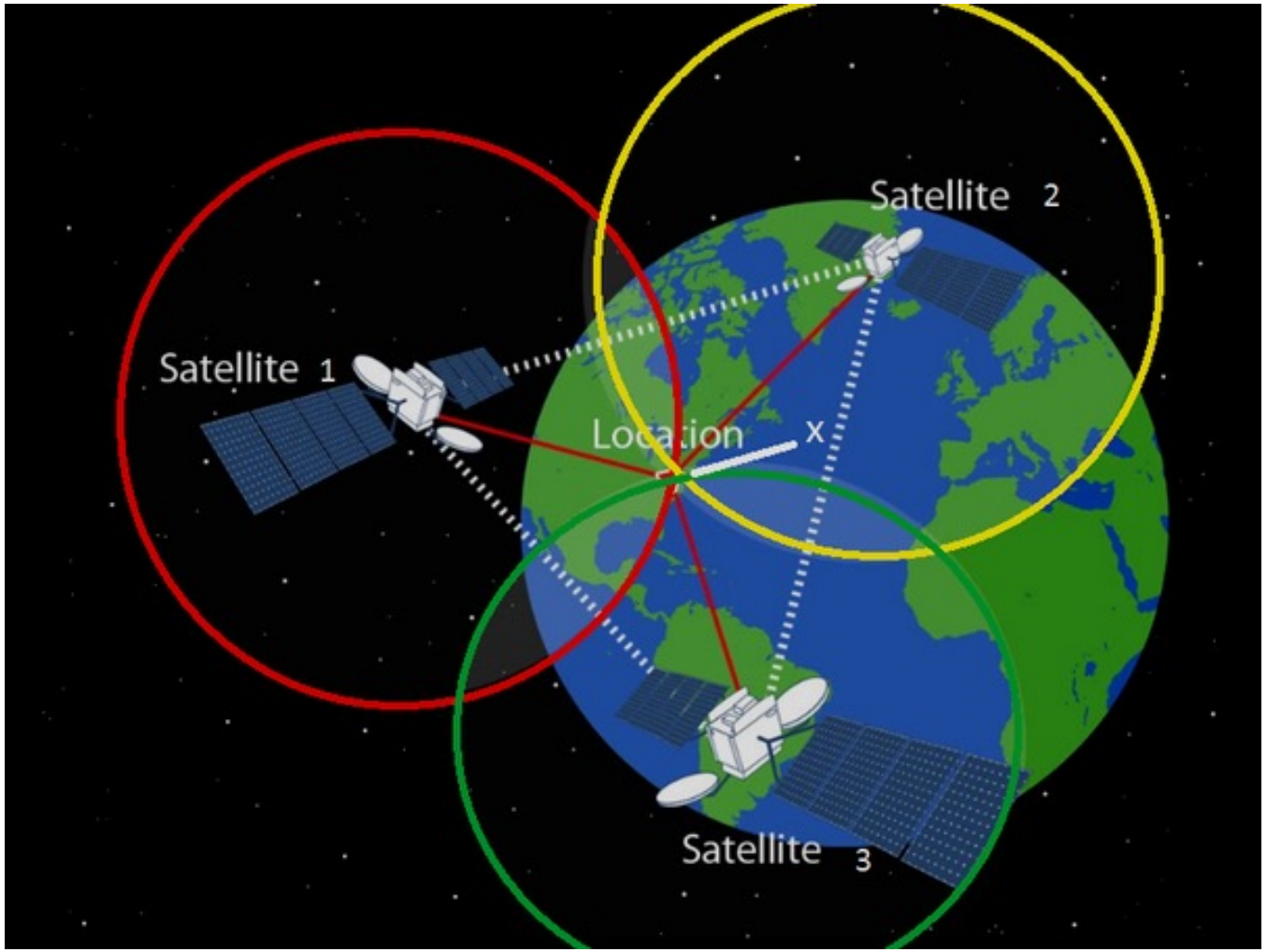
PRECISION TIME KEEPING



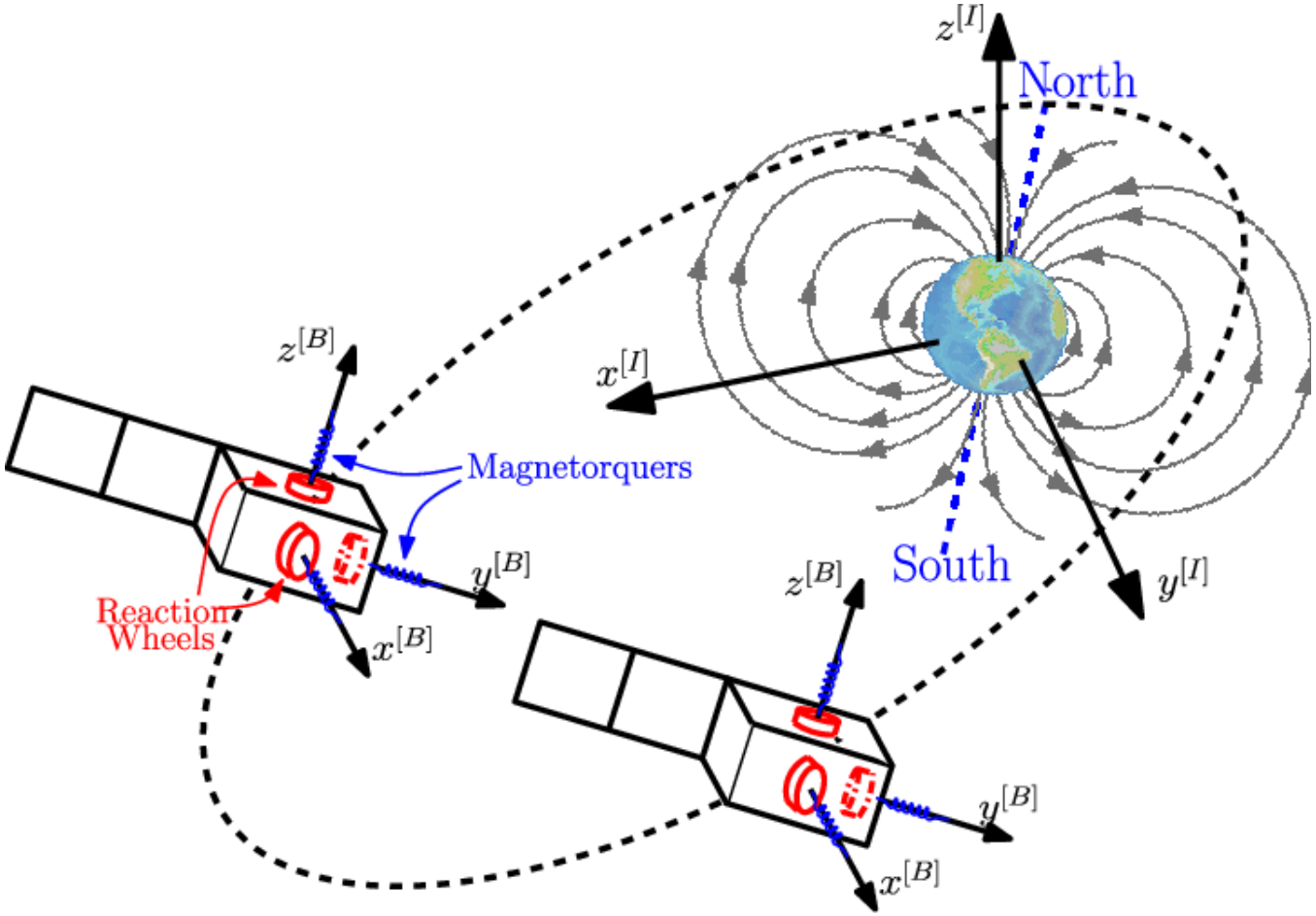
REALLY PRECISION TIME KEEPING

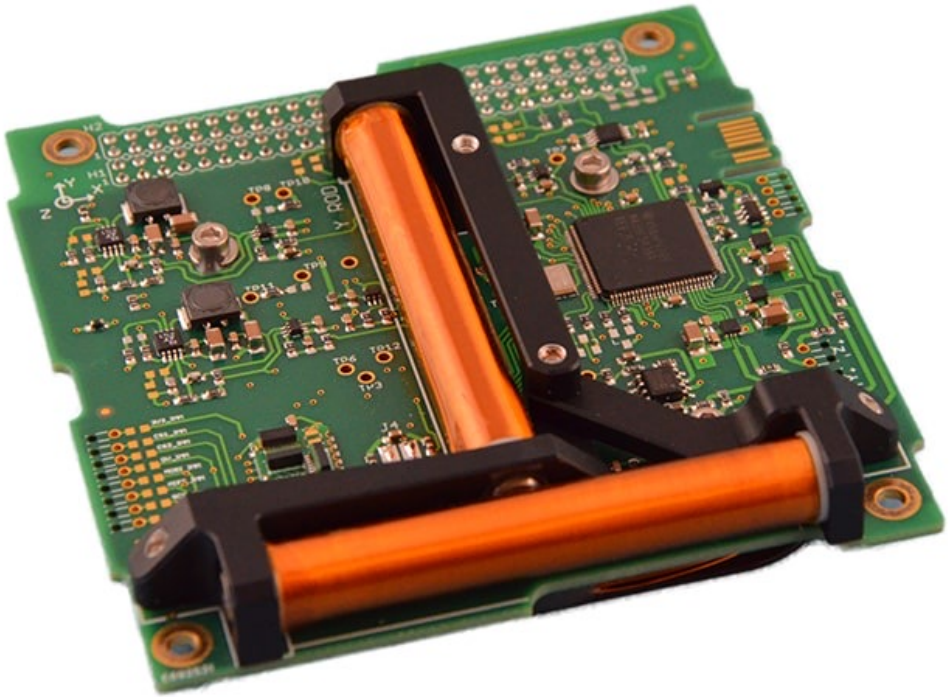


GPS Satellites

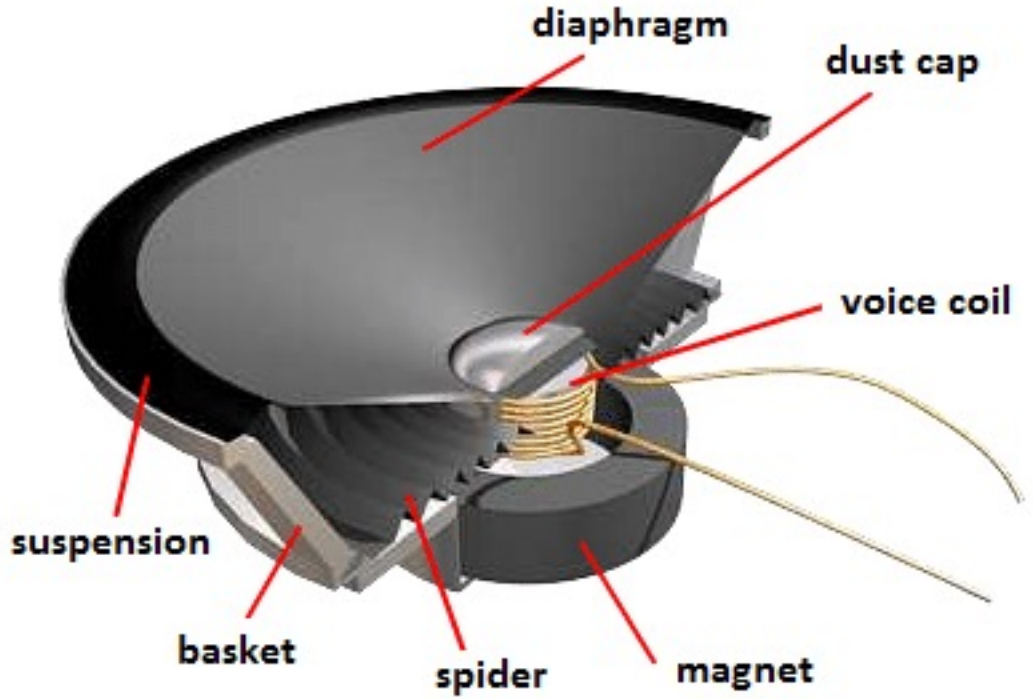


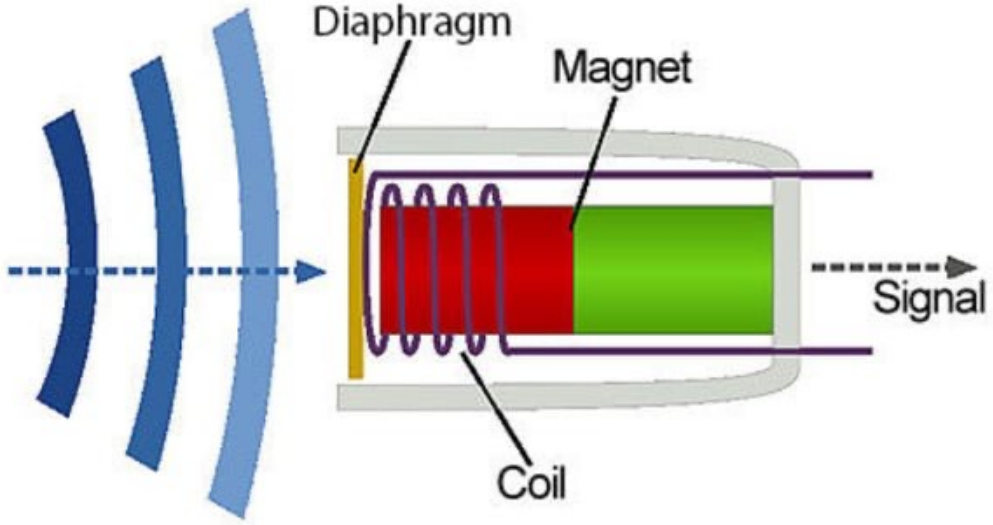
Satellite Navigation - Magnetorquers





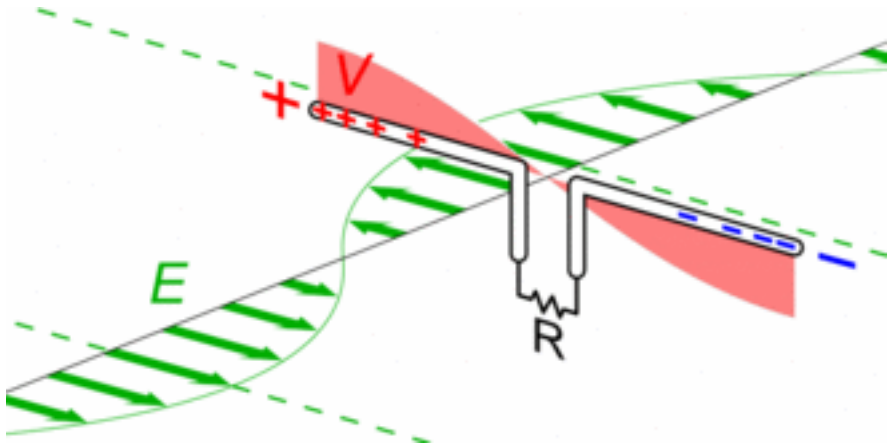
Speaker and Microphone



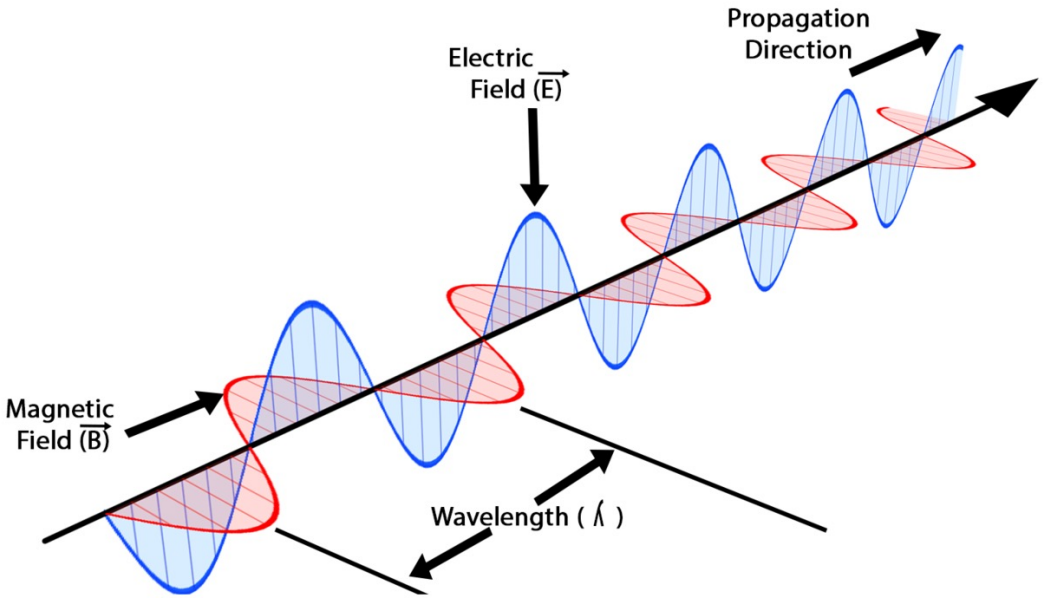


Aviate Navigate Communicate

Antenna

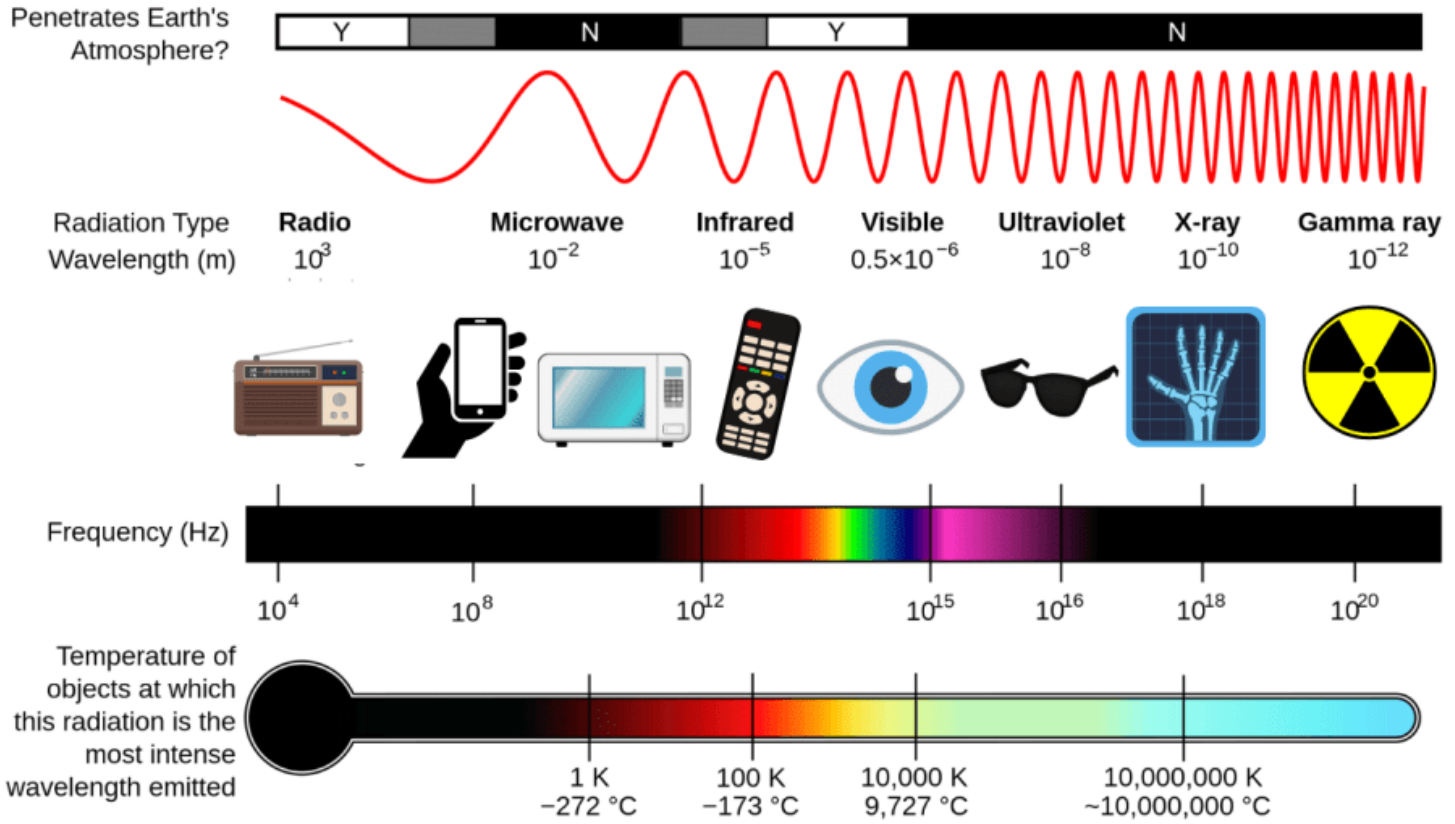


Electromagnetic Wave



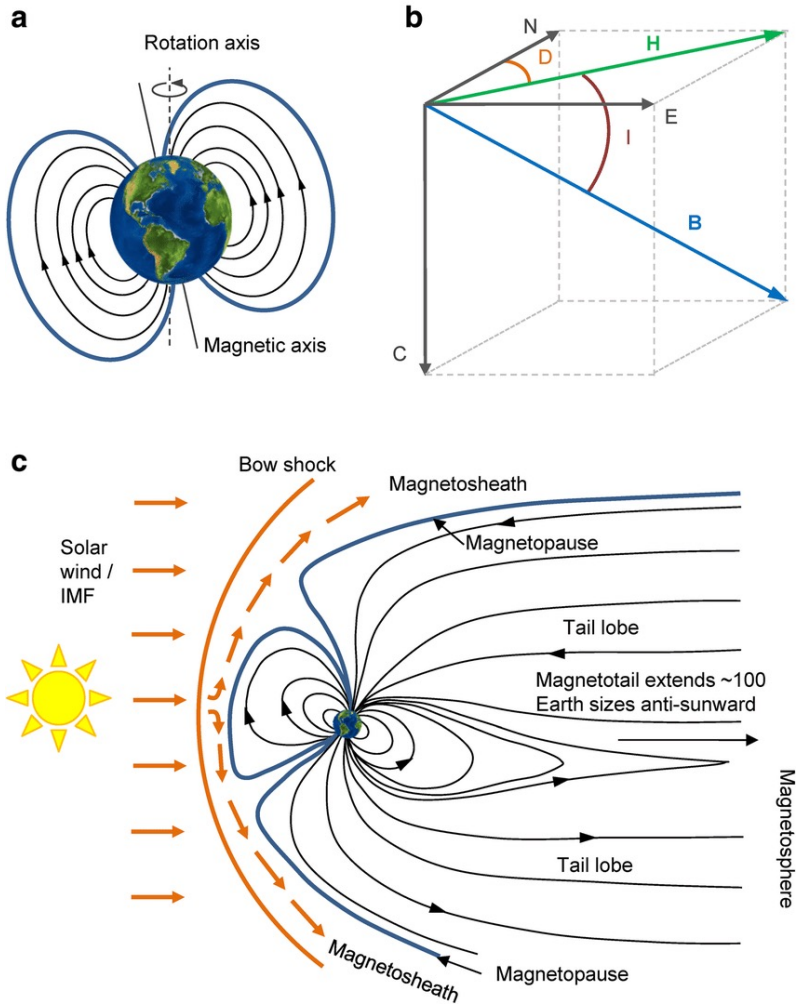
Electromagnetic Spectrum

The electromagnetic spectrum is the range of all frequencies of electromagnetic radiation.



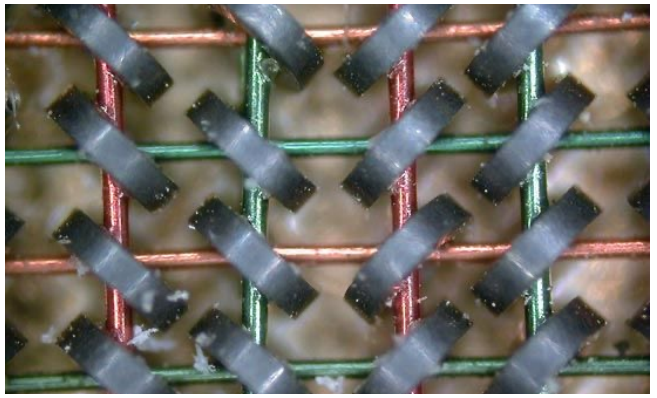
sciencenotes.org

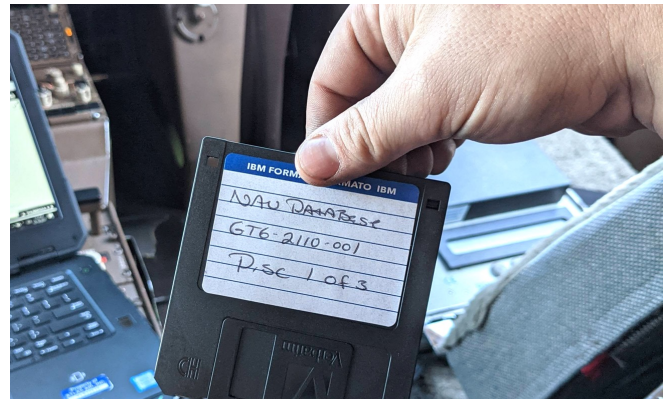
Aviate Navigate Communicate



Storing Information Magnets and Wire

- Cassette Tape – Long-Term Storage
- Core Memory (Apollo, Gemini) – fast RAM and ROM
- Hard Drive Platter
- Floppy Disk
- Flight Recorder

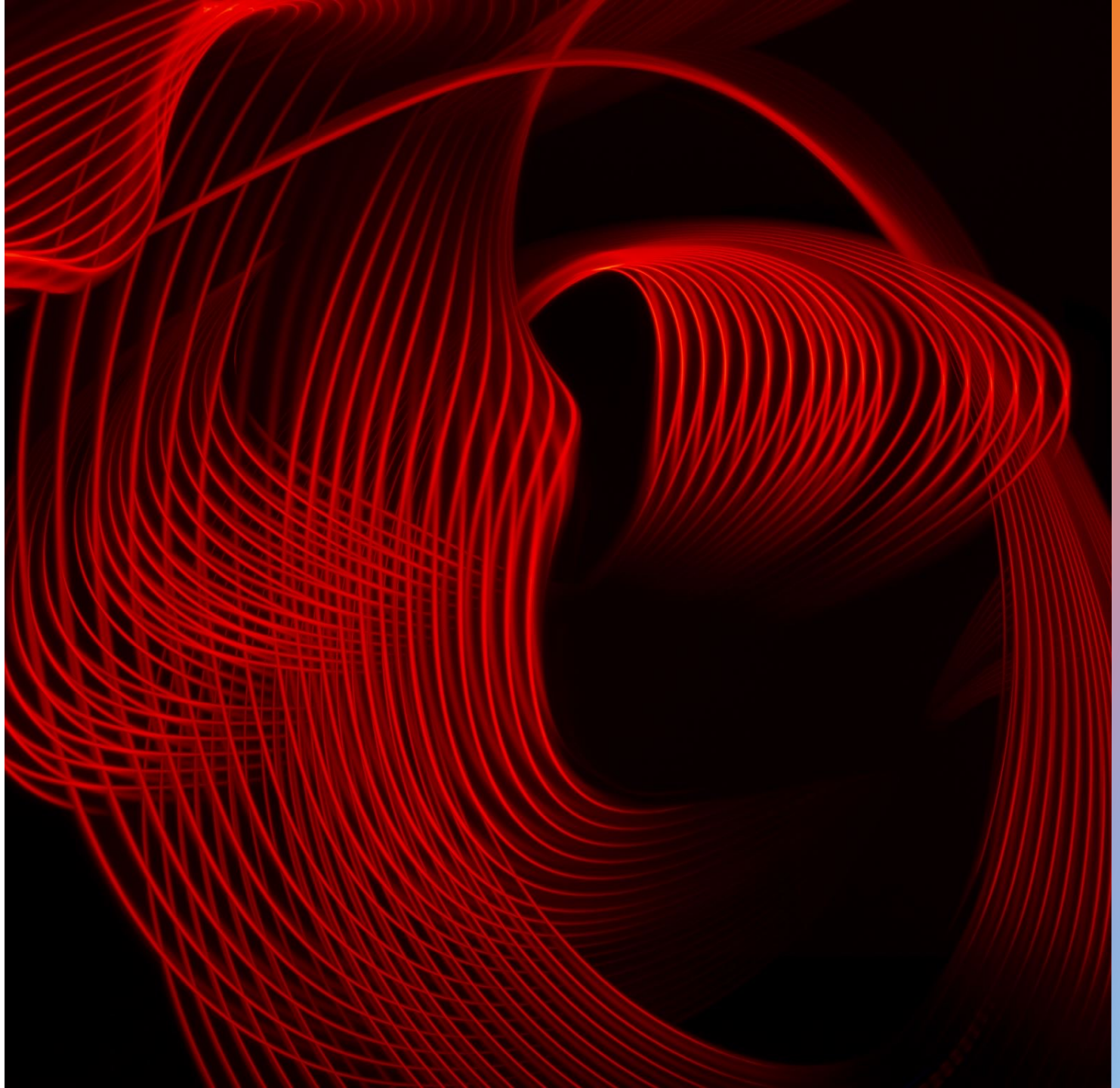




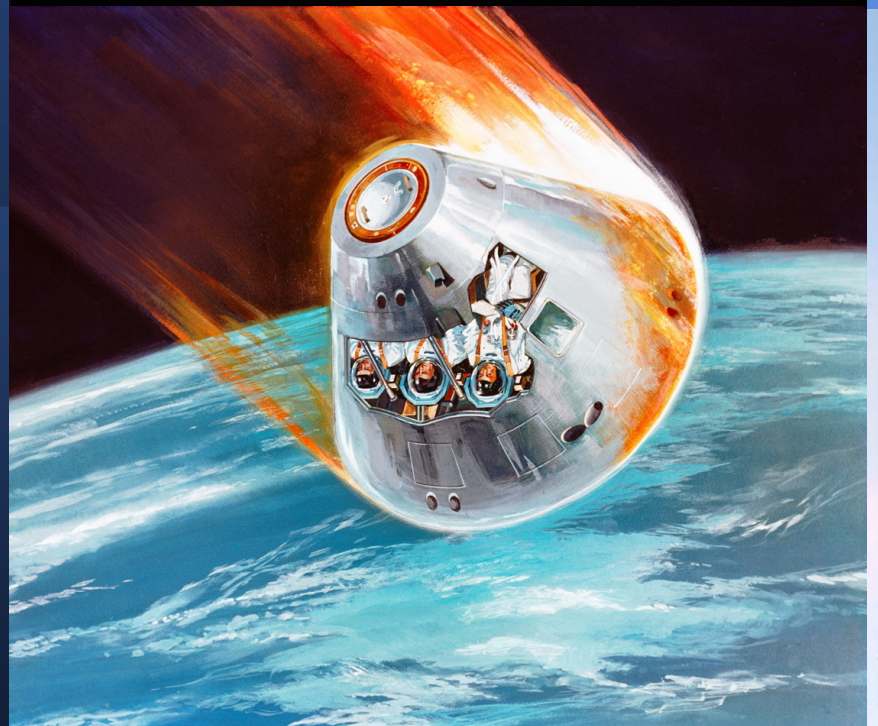

What else are sparks used for?

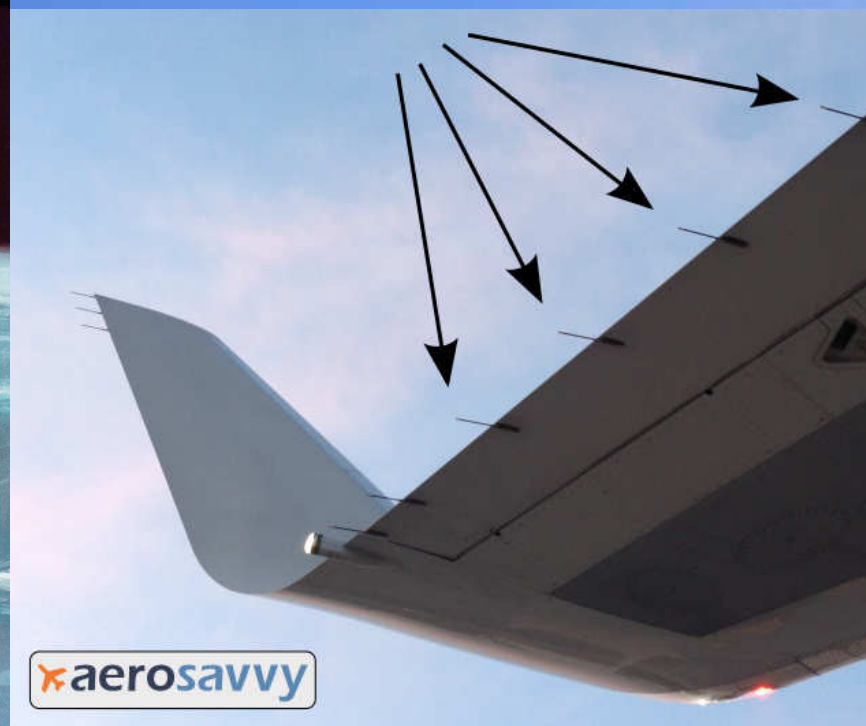
What is being emitted from the Tesla Coil?

- Light
- Heat
- Plasma - Ionization
- Sound waves
- Smell - Chemistry
- Electric Field
- Magnetic Field

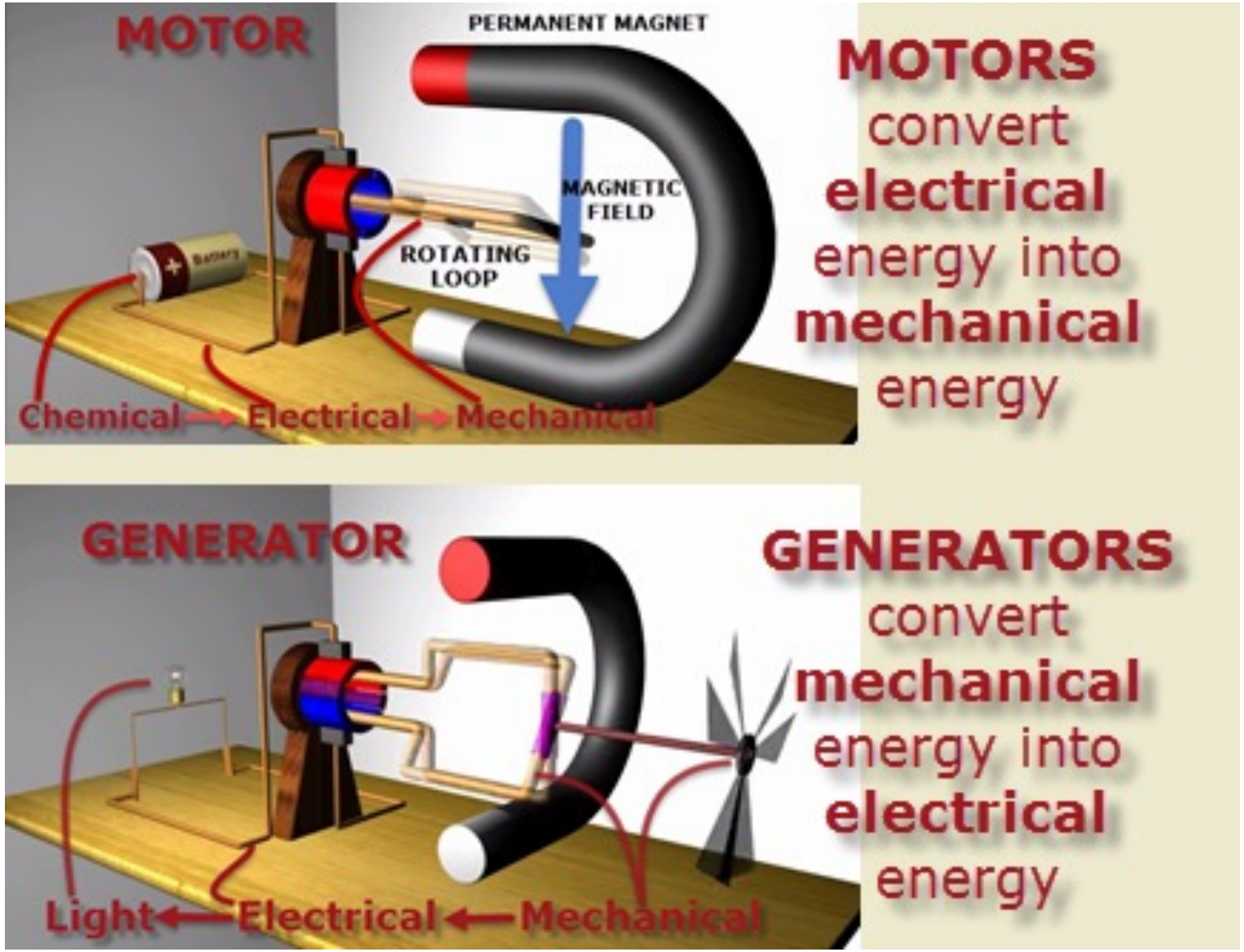


Interference





MOTORS vs GENERATORS



Motor Build

3D PRINTED PARTS (4 parts, one each)

- Motor platform: https://www.thingiverse.com/thing:4704606 “motor_platform.stl” by license https://creativecommons.org/licenses/by/4.0/
- Motor armature: https://www.thingiverse.com/thing:6450820
- Battery holder: https://www.thingiverse.com/thing:456900 “flexbatterAAx1.stl” by license https://creativecommons.org/licenses/by-sa/3.0/
- Propellor

AND STUFF

- Qty 1: Battery “AA”
- Qty 10 ft: Enamel coated wire, 22awg, 20 turns per armature. 1 ft left for battery and brush connections
- Qty 1: Sandpaper, 2 square inches, fold in half – removal enamel on ends of wire
- Qty 4: Neodymium magnets, diameter 32mm x 2mm thick (approx. 1.26" x 0.08") https://www.amazon.com/Neodymium-Double-Sided-Adhesive-Permanent-Scientific/dp/B075WV5HPH/

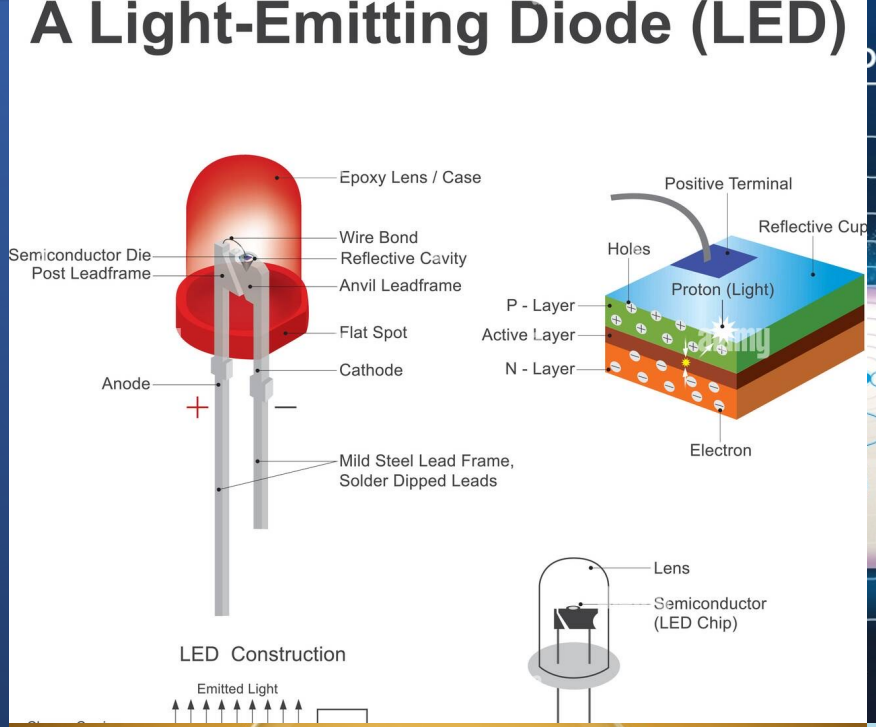
https://youtu.be/vz3DLgWqSBY?si=dOaM1Z6tY89u9np1
Instructions https://docs.google.com/document/d/10RfJQUC75f35oriDNkn3UcM94wlSgQMLpBUgYVlsIuU/edit?usp=sharing

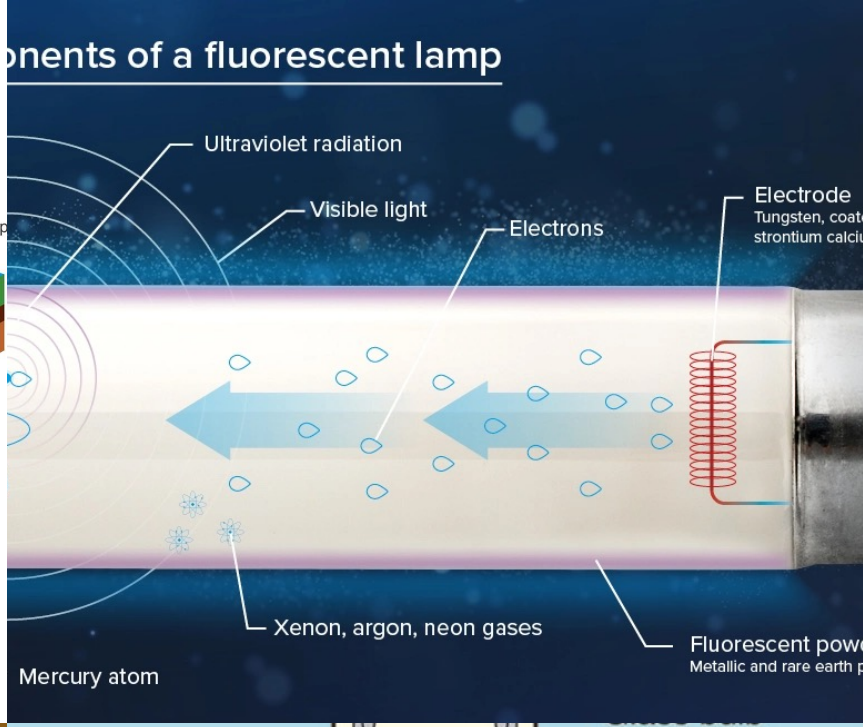
References

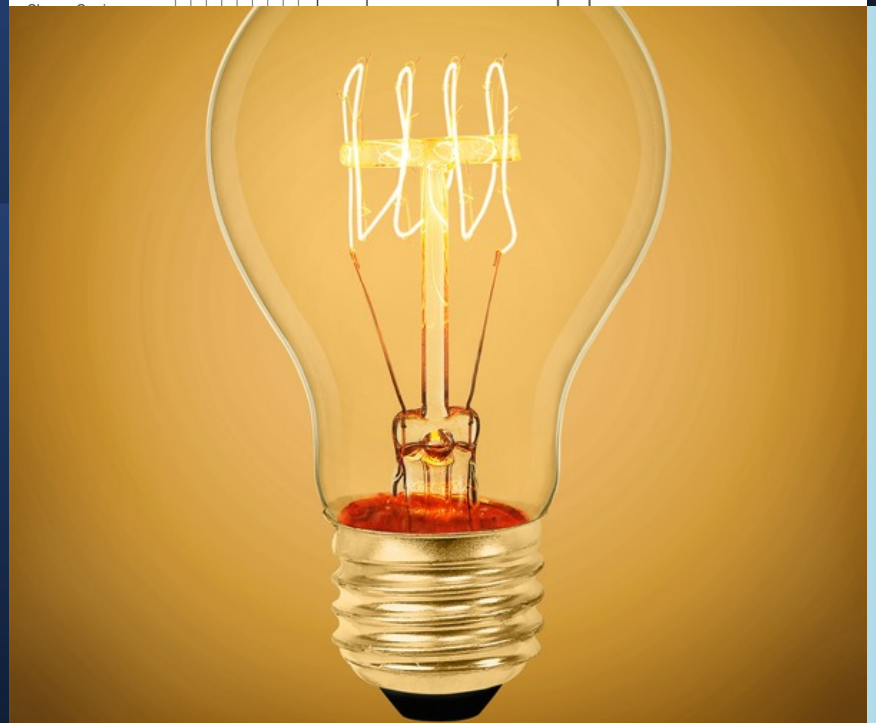
- https://www.youtube.com/watch?v=vz3DLgWqSBY
- https://www.thingiverse.com/thing:4704606
- https://docs.google.com/document/d/10RfJQUC75f35oriDNkn3UcM94wlSgQMLpBUgYVlsIuU/edit
- 32mm magnets, 22g wire,

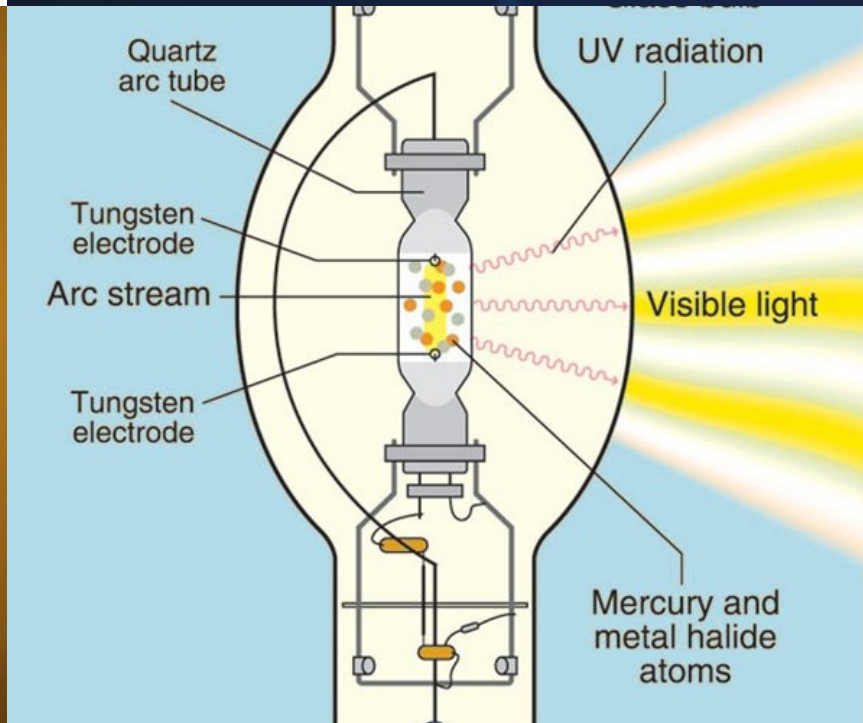
- https://www.youtube.com/watch?v=RdaIvgGQQlo&list=PLXb3r5ny8_1VefkQsdcSvP5u5w6CVrnwX

Other ways to Communicate





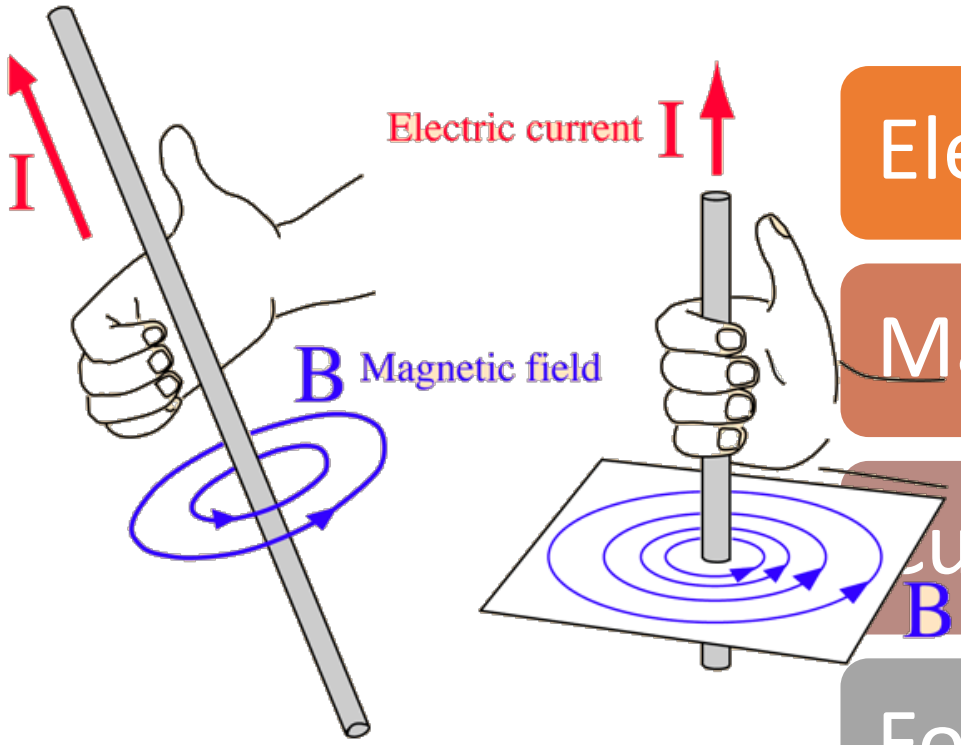




Learn more about motors

This is another concept which takes the learning much further. Good "exercise for the user" to pursue.
https://www.youtube.com/watch?v=RdalvgGQQlo&list=PLXb3r5ny8_1VefkQsdcSvP5u5w6CVrnwX

Physi

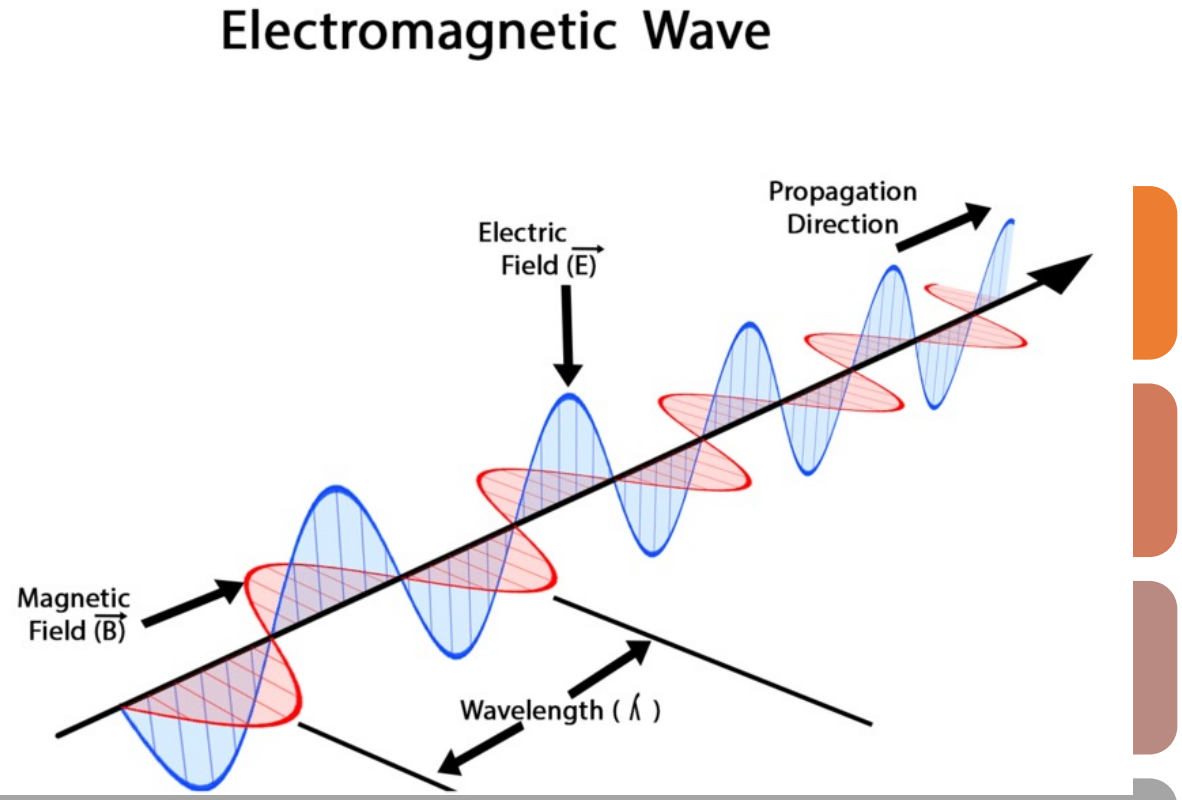


Elect

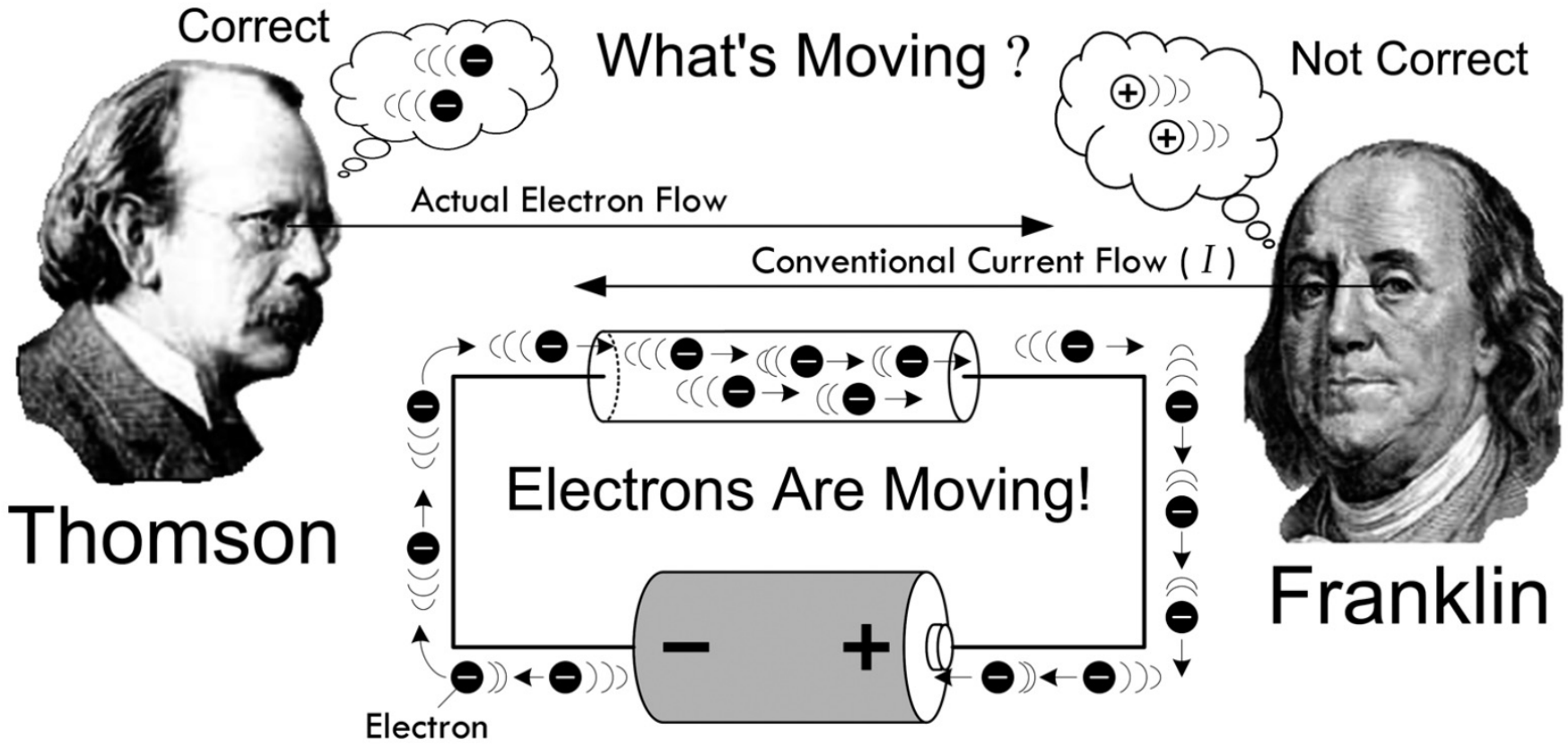
Magr

urre

Force



Conventional vs Real Current Flow

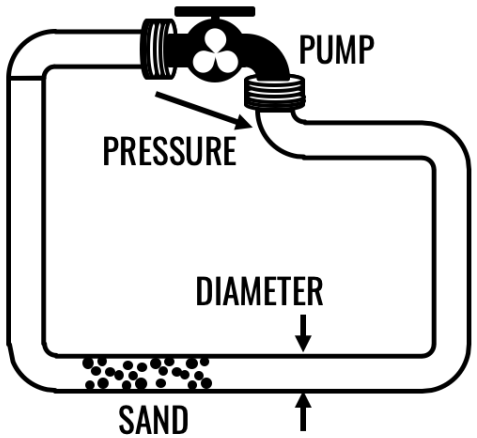


Electricity analogy to water flow

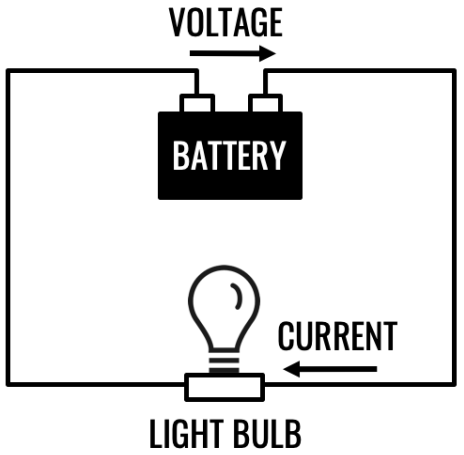
Voltage = Current x Resistance

(V = I x R)

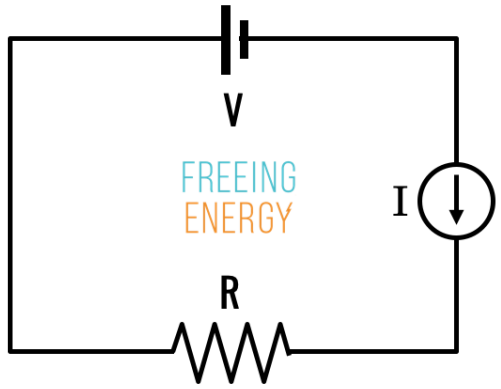
Water



Electricity



Circuit Diagram



Antennas

Electric Field (far field)

Magnetic Field (near field)

AM antenna (loop – magnetic field)

FM antenna (whip – electric field)

Electricity as a field

https://www.youtube.com/watch?v=bHIhgxav9LY

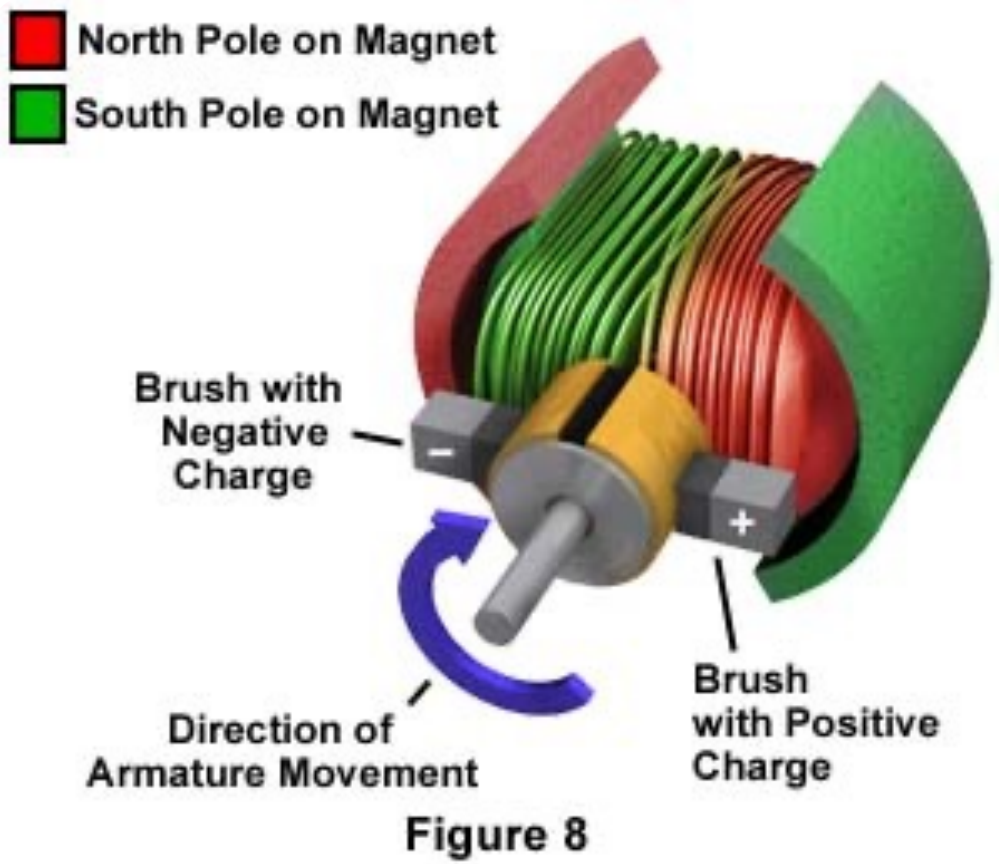


Figure 8