Physics You Learned

Physics Concepts	Is there an Equation?
Magnets always have a north and a south pole. Like poles repel and opposite poles attract.	
Magnets attract iron and induce iron to act as a temporary magnet.	
A compass can be used to detect and map the presence and direction of a magnetic field.	
A **magnetic field** spreads throughout all of space but gets weaker with increasing distance from the magnet causing it.	
The "north seeking" (north) pole of a compass points toward Earth's geographic north pole, which is a south magnetic pole.	
The units for magnetic field strength are called teslas (T) or newtons per ampere-meter.	
Electric currents generate magnetic fields. A current-carrying wire is surrounded by a magnetic field. The magnetic field has a circular shape about the wire, and the direction of the field is determined by the direction of the current in the wire.	
Active Physics Plus — Magnetic field strength (B) equals a constant (μ_0) times the current (I) divided by 2π times the distance (d). The strength of the magnetic field surrounding a current-carrying wire varies directly with the current flowing in the wire and inversely with the distance from the wire.	$B = \frac{\mu_0 I}{2\pi d}$
The magnetic field surrounding a current-carrying coil of wire (a **solenoid**) is very similar to that surrounding a bar magnet.	
The strength of a solenoid's magnetic field varies directly with the current in the coil, the number of turns comprising the coil, and the magnetic permeability of the core material.	
A wire carrying a current in a magnetic field experiences a force if the current is perpendicular to the magnetic field lines.	
Active Physics Plus — The force (F) on a current-carrying wire in a magnetic field equals the current in the wire (I) times the length of the wire in the field (l) times the magnetic field strength (B) when the current is perpendicular to the field. The direction of the force on the charge is perpendicular to both the magnetic field and the current.	$F = IlB$
An electric motor consists of a rotating solenoid interacting with either a permanent magnet or an **electromagnet**.	
A DC motor uses a **commutator** to change current direction.	
Active Physics Plus — The force on a charge moving perpendicular to a magnetic field is proportional to the velocity and magnitude of the charge, and the strength of the field. The direction of the force on the charge is perpendicular to both the magnetic field and the velocity of the charge.	$F = QvB$

When there is relative motion between a coil of wire and a magnetic field, a voltage is induced in the coil. The direction of the current in the coil depends upon the polarity of the magnetic field and the direction of its relative motion.	
A **generator** is a device that moves a coil of wire in a magnetic field to create a current. A generator induces maximum voltage when the coils of wire are moving perpendicular to the field lines, and zero voltage when the coil is moving parallel to the field lines.	
The voltage induced when a coil is moving in a magnetic field depends upon the length of the wire in the field, and the speed with which the coil is moved.	
Active Physics Plus A current induced by the relative motion between a magnet and a wire coil is always in a direction that sets up a magnetic field which exerts a force to oppose that motion. This is an example of the conservation of energy.	
When a coil of wire is rotated in a magnetic field, an **alternating current** is established, which changes direction each half cycle. This current can be changed by a commutator into a **direct current**, which travels only in one direction.	
Changes in magnetic fields cause changes in electric fields, and changes in electric fields induce changes in magnetic fields.	
Oscillating electric and magnetic fields which constitute electromagnetic waves propagate at the speed of light.	
The velocity (v) of an electromagnetic wave equals the wave's frequency (f) times its wavelength (λ). The electromagnetic spectrum is composed of waves formed by changing electric and magnetic fields. All these waves travel at the speed of light, but have different frequencies of vibration and wavelengths.	$v = f\lambda$
The speed of light in a vacuum is 3×10^8 m/s.	
Waves that compose the electromagnetic spectrum include radio waves, microwaves, infrared, visible light, and ultraviolet waves, X-rays and gamma rays.	
Transformers are used to raise or lower voltage. Transformers work only with AC electricity.