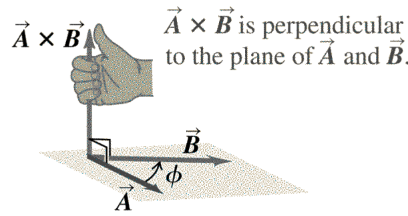
Various Right-Hand Rules Involved in Magnetism

General Vector Multiplication

Occasionally, we need to do a cross product between two vectors, so can just fall back on the definition.
If $\vec{C} = \vec{A} \times \vec{B}$, then the components of $\vec{C}$ will be:
$C_x = A_y B_z - A_z B_y \quad C_y = A_z B_x - A_x B_z \quad C_z = A_x B_y - A_y B_x$
Note $\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$ (anti-commutative).



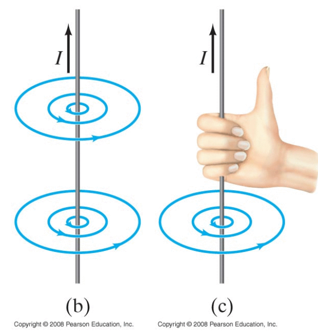
(Magnitude of $\vec{A} \times \vec{B}$) $= AB \sin \phi$

We encounter this process in a couple of places:

- Magnetic force on current-carrying wire: $\vec{F} = I\vec{L} \times \vec{B}$
- Magnetic force on a moving charge: $\vec{F} = q\vec{v} \times \vec{B}$

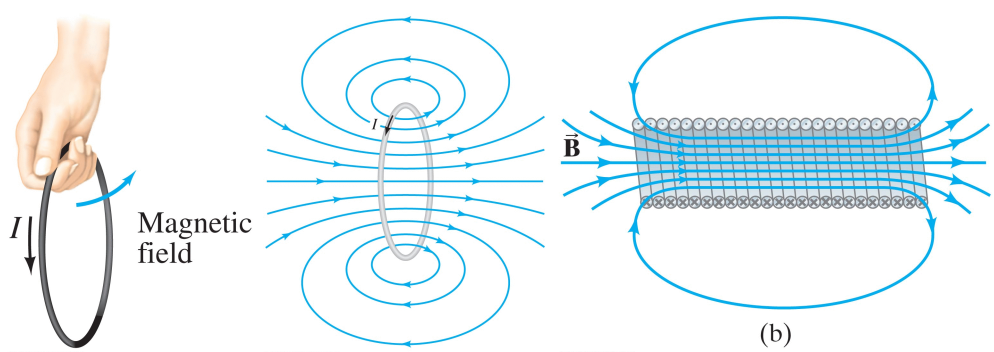
Magnetic Field Around A Current-carrying Wire

Current flowing in wire produces a magnetic field that swirls or curls around the wire as shown in the left figure. If you point your thumb (on your right hand) in the direction of the current flow, then your fingers 'curl around' in the direction of the magnetic field around the wire that the wire's current is creating.



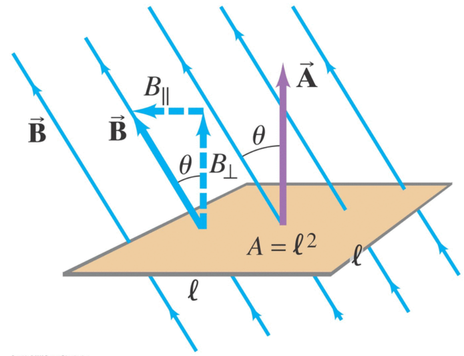
Magnetic Field At Center of a Current Loop

This is basically an extension of the previous example, but if you have current flowing around a loop in some direction, this right-hand rule provides the direction of the magnetic field within the loop. The middle figure is a reminder that magnetic field lines are themselves closed loops: they don't start or stop anywhere, but rather form continuous loops. The right figure shows a related geometry where we have a long solenoid instead of just a single loop. If you look closely, you'll see that in this cross section through the solenoid, the current is coming up out of the page towards you at the top of the coil and going into the page away from you at the bottom of the coils, so basically the same as in the left and middle figures.



Faraday's Law

Faraday's law relates the EMF generated around a loop due to changes in magnetic flux through the area defined by that loop: $\boxed{\xi = -N\frac{d\Phi_B}{dt}}$ where $\boxed{\Phi_B = \int \vec{B} \cdot d\vec{A}}$.



The loop in the first equation is the 'edge' of the area (vector) from the second equation. Here, we basically choose a direction to walk around the loop and if we curl our fingers in that direction, our thumb points in the direction associated with $\vec{A}$.

In this figure, apparently they chose to define the loop in a counter-clockwise direction, which resulted in $\vec{A}$ pointing the way it does.