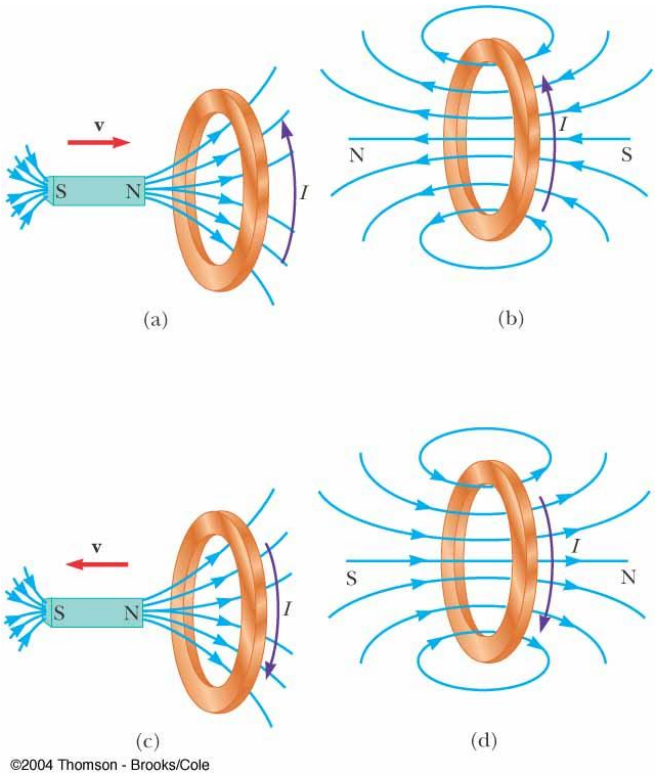
LENZ'S LAW

So far we haven't worried about the direction of the induced EMF and induced current. However, their direction follows mathematically from the negative sign in Faraday's Law which is due to Lenz's Law.

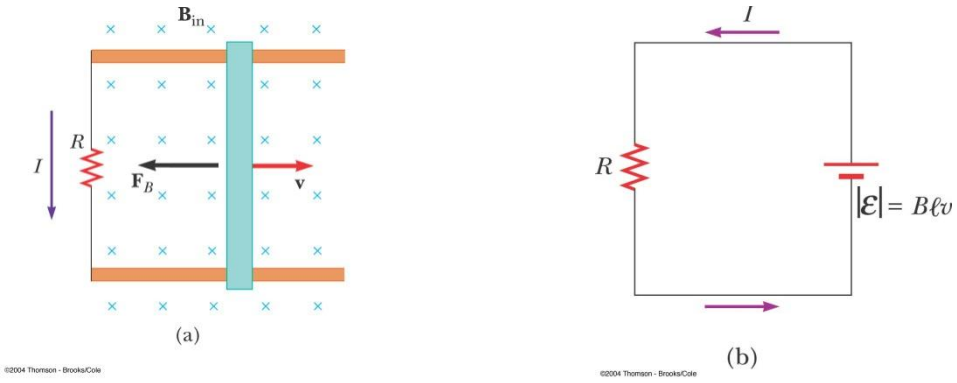
THE DIRECTION OF THE INDUCED EMF AND INDUCED CURRENT IS SUCH THAT THE MAGNETIC FIELD CREATED BY THE INDUCED CURRENT OPPOSES THE CHANGE IN THE MAGNETIC FLUX.

In other words, the induced current tends to keep the original flux through the circuit from changing. As we shall see, this is a consequence of the law of Conservation of Energy.



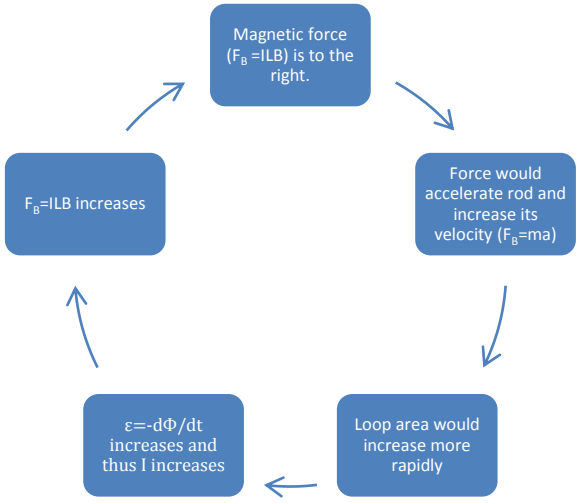
(a) When the magnet is moved toward the stationary conducting loop, a current is induced in the direction shown. (b) This induced current produces its own magnetic field directed to the left that counteracts the increasing external flux. (c) When the magnet is moved away from the stationary conducting loop, a current is induced in the direction shown. (d) This induced current produces a magnetic field directed to the right and so counteracts the decreasing external flux.

In order to obtain a better understanding or Lenz's Law from an energy approach, let's consider the case in which a conducting rod moves along two parallel conductors with a resistor R connecting the conductors.



A conducting rod is given an initial velocity **v** to the right along two fixed conducting rails. As the conducting bar slides on the two fixed conducting rails, the magnetic flux due to the external magnetic field into the page through the area enclosed by the loop increases in time. By Lenz's law, the induced current must be counterclockwise so as to produce a counteracting magnetic field directed out of the page. The upward current in the rod results in a magnetic force $\mathbf{F_B}$ that opposes the motion.

What would happen if the current was in the clockwise direction???



The result is that the system would acquire an infinite amount of energy without any input of energy! The would clearly violate the Law of Conservation of Energy. Thus, we must conclude that the current must be in the CCW direction.