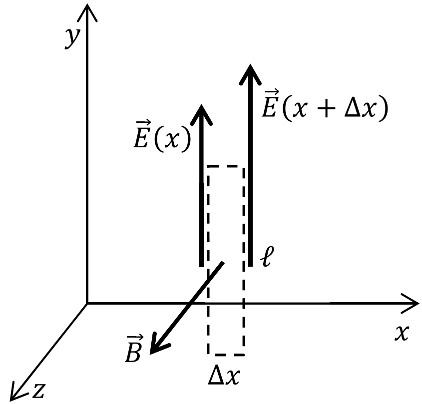
First, let's see how a change in $\vec{B}$ will affect $\vec{E}$.

We'll make a rectangular loop Δx wide by ℓ high, and evaluate Faraday's law:



$$\oint \vec{E} \cdot \overrightarrow{ds} = -\frac{\partial \Phi_B}{\partial t}$$

Go around counter-clockwise, starting on left leg:

$$-\underbrace{E(x)}\,\ell + 0\Delta x + \underbrace{E(x + \Delta x)}\,\ell + 0\Delta x = -\frac{\partial (B\Delta x \ell)}{\partial t}$$

"*E of x*," not "*E times x*"

$$E(x + \Delta x) = E(x) + \frac{\partial E}{\partial x}\Delta x \quad \text{(from your calc class)}$$

$$-E(x)\ell + \overbrace{\left(E(x) + \frac{\partial E}{\partial x}\Delta x\right)}\ell = -\frac{\partial (B\Delta x \ell)}{\partial t}$$

$$-E(x)\ell + E(x)\ell + \frac{\partial E}{\partial x}\Delta x \ell = -\Delta x \ell \frac{\partial B}{\partial t}$$

$$\boxed{\frac{\partial E}{\partial x} = -\frac{\partial B}{\partial t}}$$

Call this equation (1)