We'll make a rectangular loop  $\Delta x$  wide by  $\ell$  high, and evaluate Faraday's law:

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

$$\oint \vec{E} \cdot \vec{ds} = -\frac{\partial \Phi_B}{\partial t}$$
and counter-clockwise, starting on left leg:
$$E(x) \ell + 0\Delta x + E(x + \Delta x) \ell + 0\Delta x = -\frac{\partial (B\Delta x \ell)}{\Delta x}$$

Go around counter-clockwise, starting on left leg: 
$$-\underbrace{E(x)}_{-E(x)}\ell + 0\Delta x + \underbrace{E(x + \Delta x)}_{-E(x)}\ell + 0\Delta x = -\frac{\partial(B\Delta x\ell)}{\partial t}$$

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

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

$$-E(x)\ell + \frac{\partial E}{\partial x}\Delta x \text{ (Holli your care class)}$$

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

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

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

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

Call this equation (1)