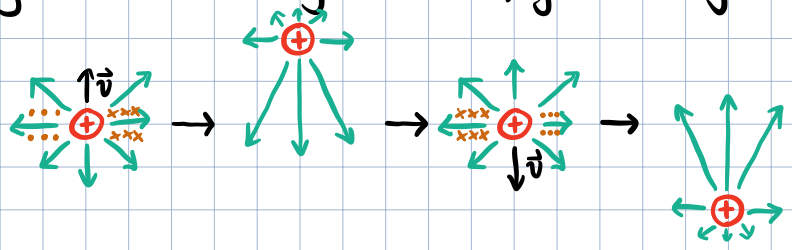
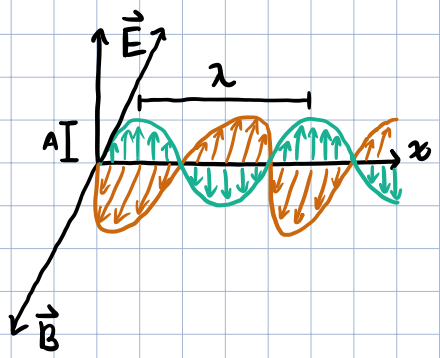
# Speed of Light

- Recall Maxwell's equations:
  - $\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\varepsilon_0}$
  - $\oint \vec{B} \cdot d\vec{A} = 0$
  - $\int \vec{E} \cdot d\vec{s} = -\frac{d}{dt} \oint \vec{B} \cdot d\vec{A}$
  - $\int \vec{B} \cdot d\vec{s} = \mu_0 \left[ I_{encl} + \varepsilon_0 \frac{d}{dt} \left( \oint \vec{E} \cdot d\vec{A} \right) \right]$
- Light is an electromagnetive wave, generated by oscillating charge



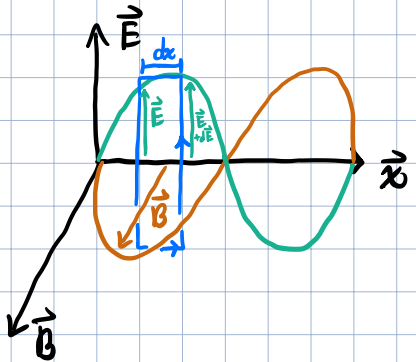

  - In 1800s, this was model:




$\Psi = A\sin(kx - \omega t)$
$k$ = wave number / conversion factor $= \frac{2\pi}{\lambda}$
$\omega$ = angular frequency $= 2\pi f$

$v_{light} = f\lambda = \frac{\omega}{2\pi} \times \frac{2\pi}{k} = \frac{\omega}{k}$

- Closer examination:




I have no idea what he did but we get $E_0 k = B_0 \omega \rightarrow \frac{\omega}{k} = \frac{E_0}{B_0}$

So $v_{light} = \frac{E_0}{B_0}$

He did more funky stuff and got $\frac{\omega}{k} = \frac{B_0}{\mu_0 \varepsilon_0 E_0} = \frac{k}{\mu_0 \varepsilon_0 \omega} \rightarrow c = \sqrt{\frac{1}{\mu_0 \varepsilon_0}}$
$= 3 \times 10^8 \text{ m/s}$