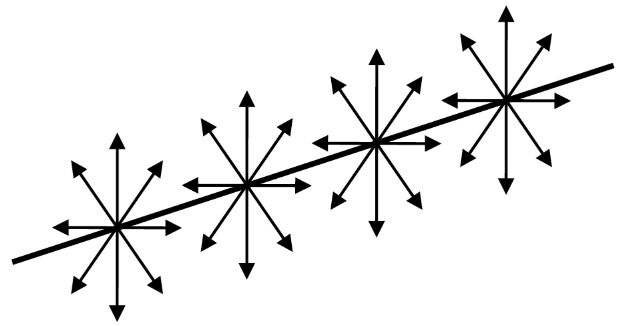
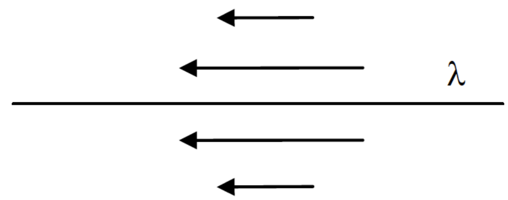
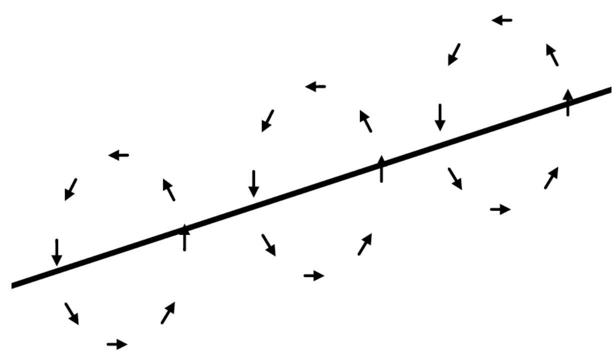
A. Symmetries: Consider a long straight wire with uniform charge per unit length λ. We will use Gauss' law to determine the electric field around the wire. Usually, we begin by assuming that the electric field around the charged wire is entirely in the *radial* direction.



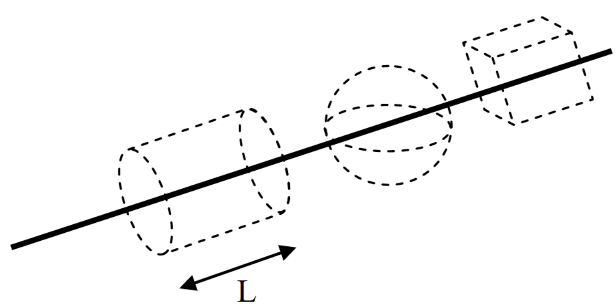
Give a brief <u>symmetry</u> argument for why the electric field should *not* have a *longitudinal* component (parallel with the wire).



Give a brief <u>symmetry</u> argument for why the electric field should *not* have a *tangential* component (circling around the wire).



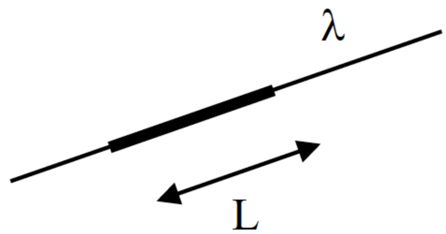
Assuming the electric field *is* purely radial, why would we choose an imaginary *cylinder* as our Gaussian surface? Why not a *sphere* or a *cube*?



B. Here is Gauss' law in *differential* form: $\vec{\nabla}\cdot\vec{\mathbf{E}} = \rho/\varepsilon_0$

Now, write down Gauss' law in *integral* form.

Consider an infinitely long wire, with uniform charge density λ. What is the total charge on a small *section* of this wire of length **L**?



Use Gauss' law in integral form to solve for the electric field at any point around the wire. Briefly define any symbols you use.

Challenge Question (for really fast teams!) If the wire was not infinite, but in fact was ONLY a segment of length L, would the formula you found above still hold, assuming you only want to know the E field around the exact midpoint of the wire segment?
Why/why not?