Calculating $\vec{E}$ from Gauss's Law: Point Charge

- Consider a positive point charge Q.
- Use a Gaussian sphere of radius R centered at the location of Q.
- Surface area of sphere: $A = 4\pi R^2$.
- Electric flux through Gaussian surface: $\Phi_E = \oint \vec{E} \cdot d\vec{A} = E(4\pi R^2)$.
- Net charge inside Gaussian surface: $Q_{in} = Q$.
- Gauss's law $\oint \vec{E} \cdot d\vec{A} = \dfrac{Q_{in}}{\epsilon_0}$ becomes $E(4\pi R^2) = \dfrac{Q}{\epsilon_0}$.
- Electric field at radius R: $E = \dfrac{1}{4\pi\epsilon_0}\dfrac{Q}{R^2} = \dfrac{kQ}{R^2}$.