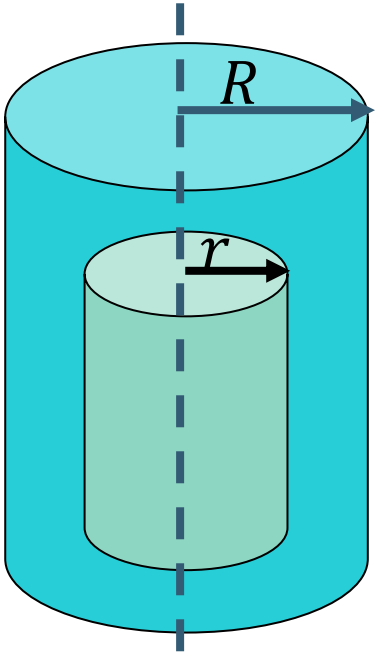
SIMPLIFICATIONS IN DETAIL

We start with $\oint \vec{E} \cdot d\vec{A}$, a charge distribution, and a Gaussian surface.



(1) E-field always points exactly parallel or perpendicular to every part of the Gaussian surface

$$\oint \vec{E} \cdot d\vec{A} = \int E dA$$

(2) E-field doesn't change on the Gaussian surface

$$\oint \vec{E} \cdot d\vec{A} = \int E dA = E \int dA \ = EA$$