

$$\frac{1}{dV} \frac{d}{dt} \int \rho \cdot \vec{v} dV = \frac{1}{dV} \int \frac{D}{Dt} (\rho \cdot \vec{v}) dV$$

$$\frac{1}{dV} \frac{D}{Dt} (\rho \cdot \vec{v} dV) = \frac{1}{dV} \left(\underbrace{\vec{v} \frac{D}{Dt} (\rho dV)}_{=0, \text{ incompressible}} + \rho dV \frac{D\vec{v}}{Dt} \right)$$

Eq. 2-98

$$= \rho \frac{D\vec{v}}{Dt}$$