- Loop rule: $\mathcal{E} - IR - L\dfrac{dI}{dt} = 0$

- Differential equation: $L\dfrac{dI}{dt} = \mathcal{E} - IR \quad \Rightarrow \quad \dfrac{dI}{dt} = \dfrac{\mathcal{E}/R - I}{L/R}$

$$\int_0^I \frac{dI}{\mathcal{E}/R - I} = \int_0^t \frac{dt}{L/R} \quad \Rightarrow \quad -\ln\left(\frac{\mathcal{E}/R - I}{\mathcal{E}/R}\right) = \frac{t}{L/R} \quad \Rightarrow \quad \frac{\mathcal{E}/R - I}{\mathcal{E}/R} = e^{-Rt/L}$$

- Current through inductor: $I(t) = \dfrac{\mathcal{E}}{R}\left[1 - e^{-Rt/L}\right]$

- Rate of current change: $\dfrac{dI}{dt} = \dfrac{\mathcal{E}}{L}\,e^{-Rt/L}$