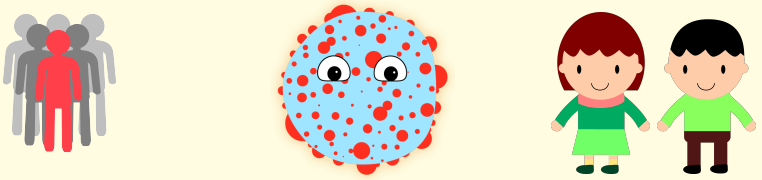


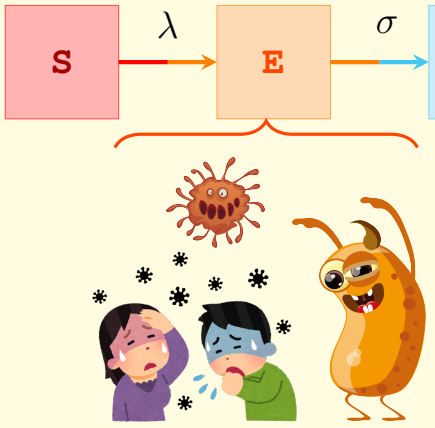
Basic **SIR** Measles Model

System of ODEs

$$\frac{d\mathbf{S}}{dt} = -\beta \mathbf{I}\mathbf{S} \tag{1.1}$$

$$\frac{d\mathbf{I}}{dt} = \beta \mathbf{I}\mathbf{S} - \gamma \mathbf{I} \tag{1.2}$$

$$\frac{d\mathbf{R}}{dt} = \gamma \mathbf{I} \tag{1.3}$$



σ is the rate of latent individuals becoming infectious.

The exposed state **E** represents people that have the infection but aren't infectious yet.

Basic **SEIR** Measles Model

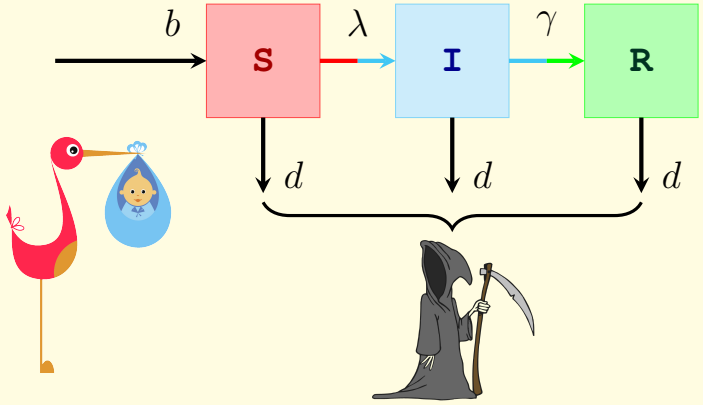
System of ODEs

$$\frac{d\mathbf{S}}{dt} = -\beta \mathbf{I}\mathbf{S} \tag{1.4}$$

$$\frac{d\mathbf{E}}{dt} = \beta \mathbf{I}\mathbf{S} - \sigma \mathbf{E} \tag{1.5}$$

$$\frac{d\mathbf{I}}{dt} = \sigma \mathbf{E} - \gamma \mathbf{I} \tag{1.6}$$

$$\frac{d\mathbf{R}}{dt} = \gamma \mathbf{I} \tag{1.7}$$



Births and Deaths **SIR** Measles Model

System of ODEs

$$\frac{d\mathbf{S}}{dt} = b\mathrm{N} - \frac{\beta \mathbf{I}\mathbf{S}}{\mathbf{N}} - d\mathbf{S} \tag{1.8}$$

$$\frac{d\mathbf{I}}{dt} = \frac{\beta \mathbf{I}\mathbf{S}}{\mathbf{N}} - \gamma \mathbf{I} - d\mathbf{I} \tag{1.9}$$

$$\frac{d\mathbf{R}}{dt} = \gamma \mathbf{I} - d\mathbf{R} \tag{1.10}$$