1 Growth

	With	Without
V_1	$\frac{4\pi}{3\times 2^k}R^3 = \frac{4\pi}{3}\left(\frac{R}{2^{k/3}}\right)^3$	$\frac{4\pi}{3}R^3$
V	$\frac{4\pi}{3}\left(\frac{R}{2^{k/3}}\right)^3 \times 2^k = \frac{4\pi}{3}R^3$	$\frac{4\pi}{3}R^3$
S_1	$4\pi\left(\frac{R}{2^{k/3}}\right)^2$	$4\pi R^2$
S	$4\pi\left(\frac{R}{2^{k/3}}\right)^2 \times 2^k = 4\pi R^2\, 2^{k/3}$	$4\pi R^2$

Table 1. Growth with/without reproduction 2^k offspring. Offspring have the same overall volume as the progenitor.

2 Population models

$$y' = ry \Rightarrow y(t) = e^{rt}\,y(0) = \left(1 + rt + \frac{1}{2}(rt)^2 + \cdots + \right)y_0$$

$$y_{t+1} - y_t = \rho y_t \Rightarrow y_t = (1+\rho)^t y_0 = \left(1 + \rho t + \frac{t(t-1)}{2}\rho^2 + \cdots + \right)y_0$$

2.1 Ordinary versus delay differential equations

- Ordinary differential equation

$$\text{IVP: } y'(t) = f(t, y(t)),\, y(0) = y_0$$

- Delay differential equation

$$\text{IVP: } y' = f(t, y(t-\tau)),\, y(t) = f_0(t) \text{ for } -\tau \leqslant t \leqslant 0$$