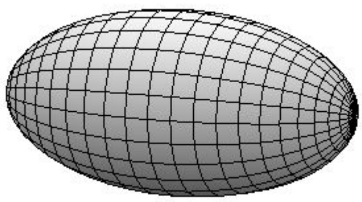
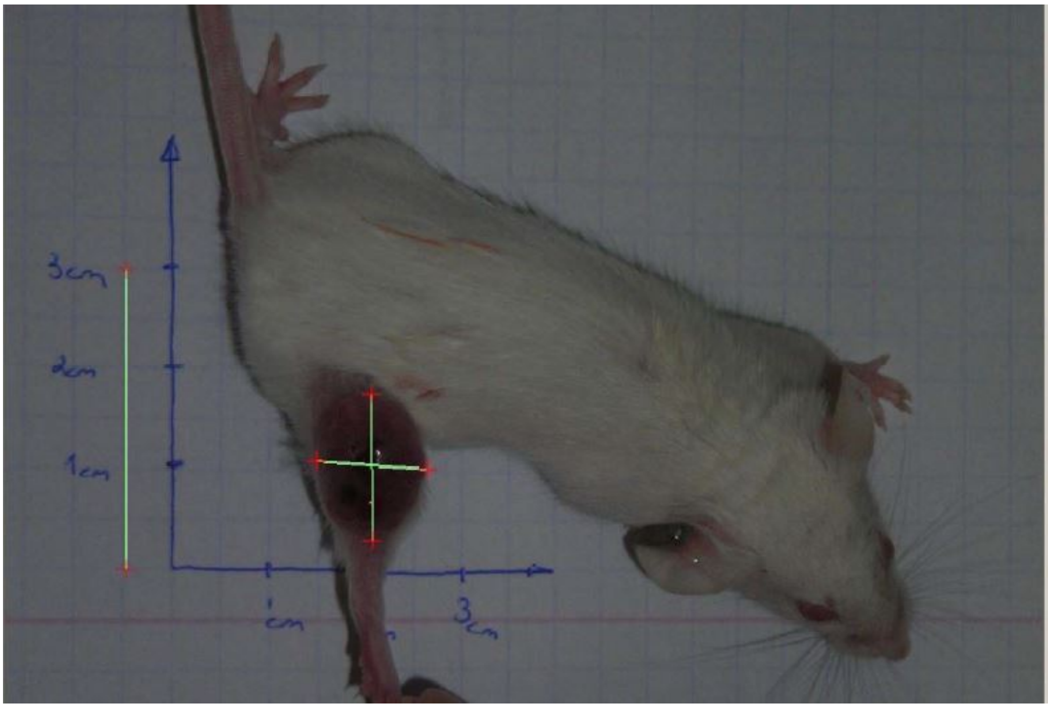
$$V = \frac{4\pi}{3}ab^2$$




3cm
2cm
1cm
1cm
3cm

Suppose we measure a tumor to be 2.00 cm along the major axis and 1.00 cm along the minor axis.

$$a_1 = 1.00 \qquad\qquad b_1 = 0.50$$

Two months later, the tumor is measured to be 2.08 cm along the major axis and 1.10 cm along the minor axis.

$$a_2 = 1.04 \qquad\qquad b_2 = 0.55$$

How long will it take for the mass of the tumor to double?

The Malthusian Law

$$\frac{dM}{dt} = \lambda M$$

$$M(t) = M_0 e^{\lambda t}$$

If $\tau$ is the doubling time then:

$$2M_0 = M_0 e^{\lambda \tau}$$

$$\tau = \frac{\ln 2}{\lambda}$$

$$\frac{M}{V} = \rho \quad (\text{density in gm/cm}^3)$$

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$$M = \rho V$$

Let $M_1$ be the mass of the tumor at volume $V_1$
Let $M_2$ be the mass of the tumor at volume $V_2$

$$\frac{M_2}{M_1} = \frac{\rho V_2}{\rho V_1} = \frac{V_2}{V_1}$$

$$\frac{M_2}{M_1} = \frac{\rho V_2}{\rho V_1} = \frac{V_2}{V_1}$$

$$\frac{M_0 e^{\lambda t_2}}{M_0 e^{\lambda t_1}} = \frac{\frac{4}{3}\pi a_2 b_2^2}{\frac{4}{3}\pi a_1 b_1^2}$$

$$e^{\lambda(t_2 - t_1)} = \frac{a_2 b_2^2}{a_1 b_1^2}$$

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$$t_2 - t_1 = 2 \text{ months}$$

$$a_1 = 1.00 \qquad b_1 = 0.50$$

$$a_2 = 1.04 \qquad b_2 = 0.55$$

$$e^{2\lambda} = \frac{(1.04)(0.55)^2}{(1.00)(0.50)^2}$$

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$$\lambda = \frac{1}{2}\ln\left(\frac{(1.04)(0.55)^2}{(1.00)(0.50)^2}\right)$$

$$\tau = \frac{\ln 2}{\lambda} \approx 6.03 \text{ months}$$