Patterns; brain and other topics

Production of material and reaction diffusion leads to patterns

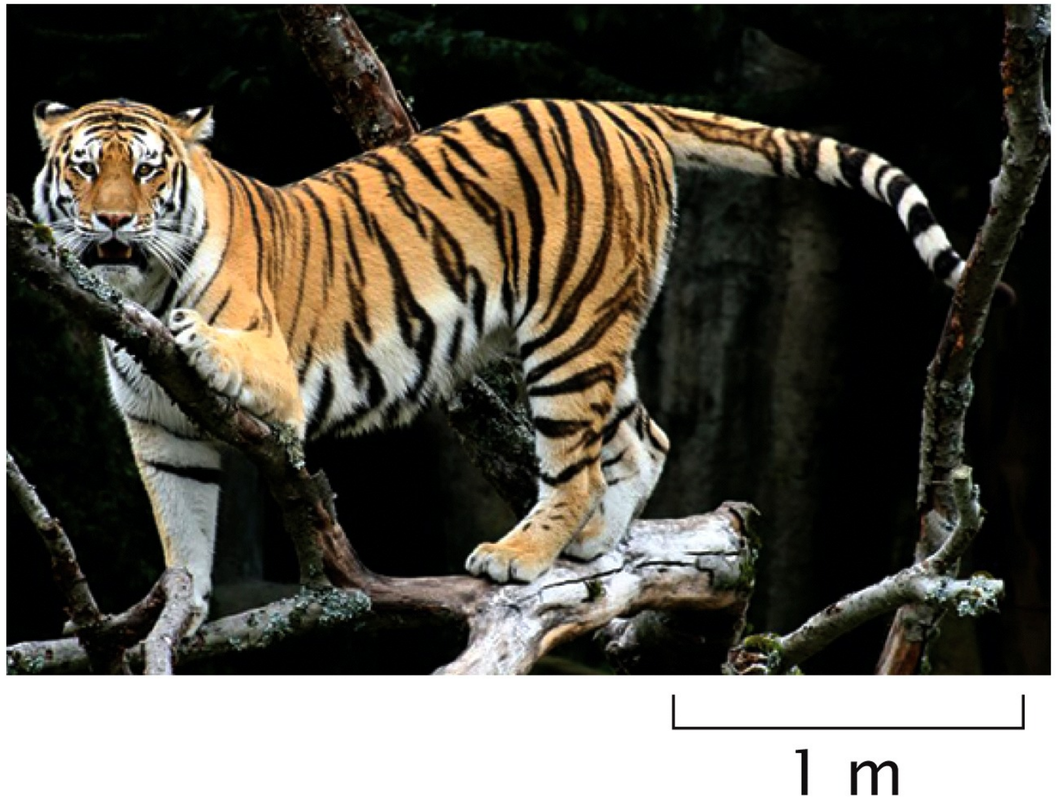
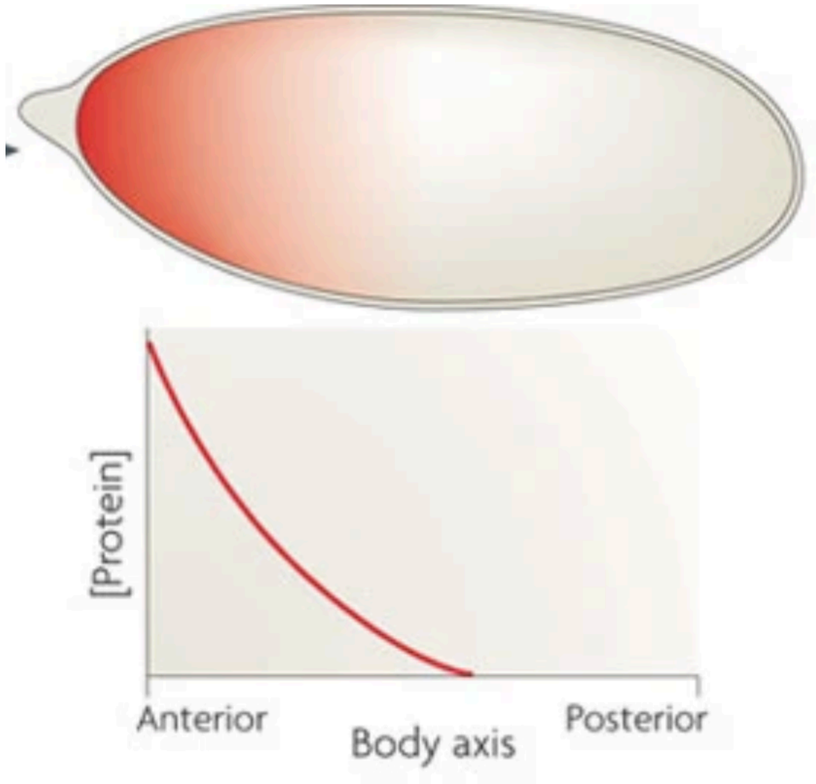


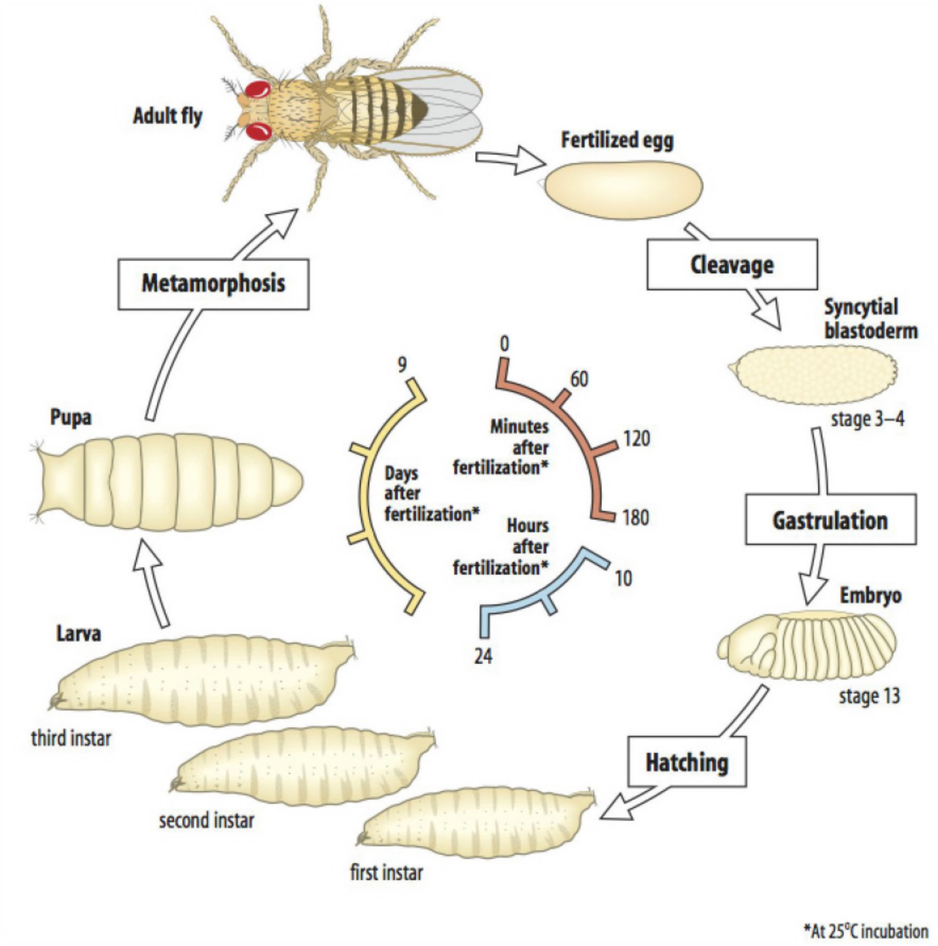
Figure 20.1d Physical Biology of the Cell, 2ed. (© Garland Science 2013)

Figure 20.1e Physical Biology of the Cell, 2ed. (© Garland Science 2013)

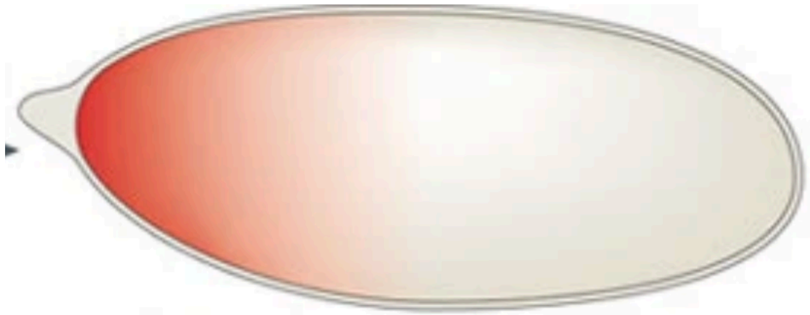
Reaction diffusion: emergence of length scale

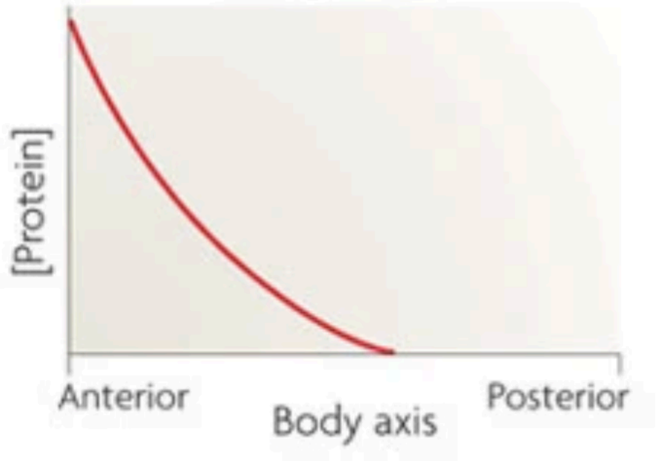
Bicoid protein diffusion in drosophila determines the anterior-posterior (front-back or head-tail) axis





What sets the length scale?





What equation will you write?

$$\frac{\partial[B]}{\partial t} = D\frac{\partial^2[B]}{\partial x^2} - k_d[B]$$

[B] = concentration of Bicoid

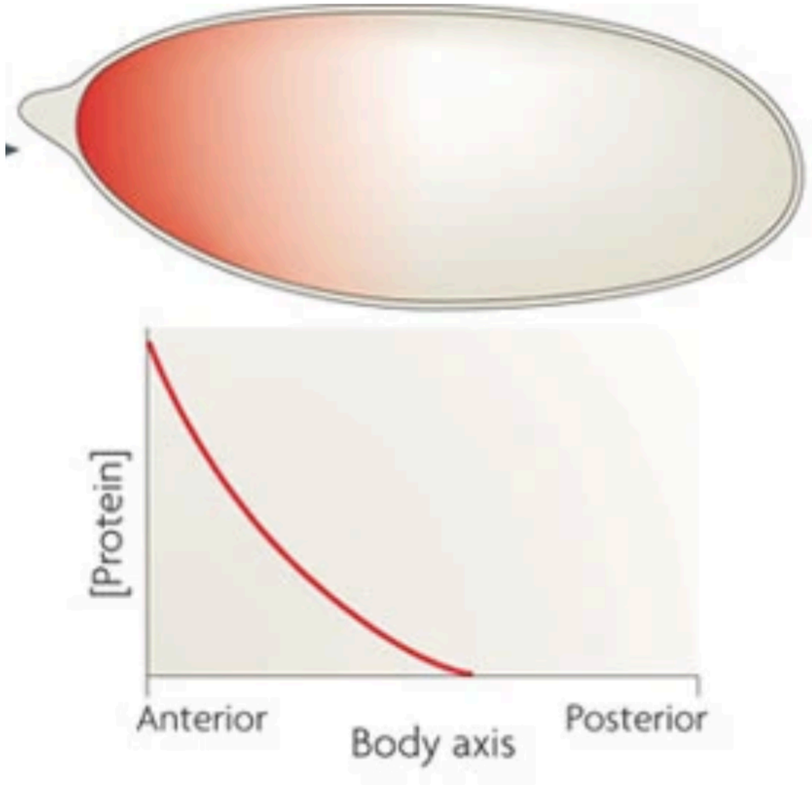
Kd = degradation rate

D = diffusion constant

At steady-state, concentration is time-independent

$$0 = D\frac{\partial^2[B]}{\partial x^2} - k_d[B]$$

Length-scale emerges



$$[B] = B_m \exp\left(-\frac{x}{l_0}\right)$$

$$l_0 = \sqrt{D/k_d}$$

Estimate length assuming typical protein diffusion in water, and degradation timescale of ~ 1 hour

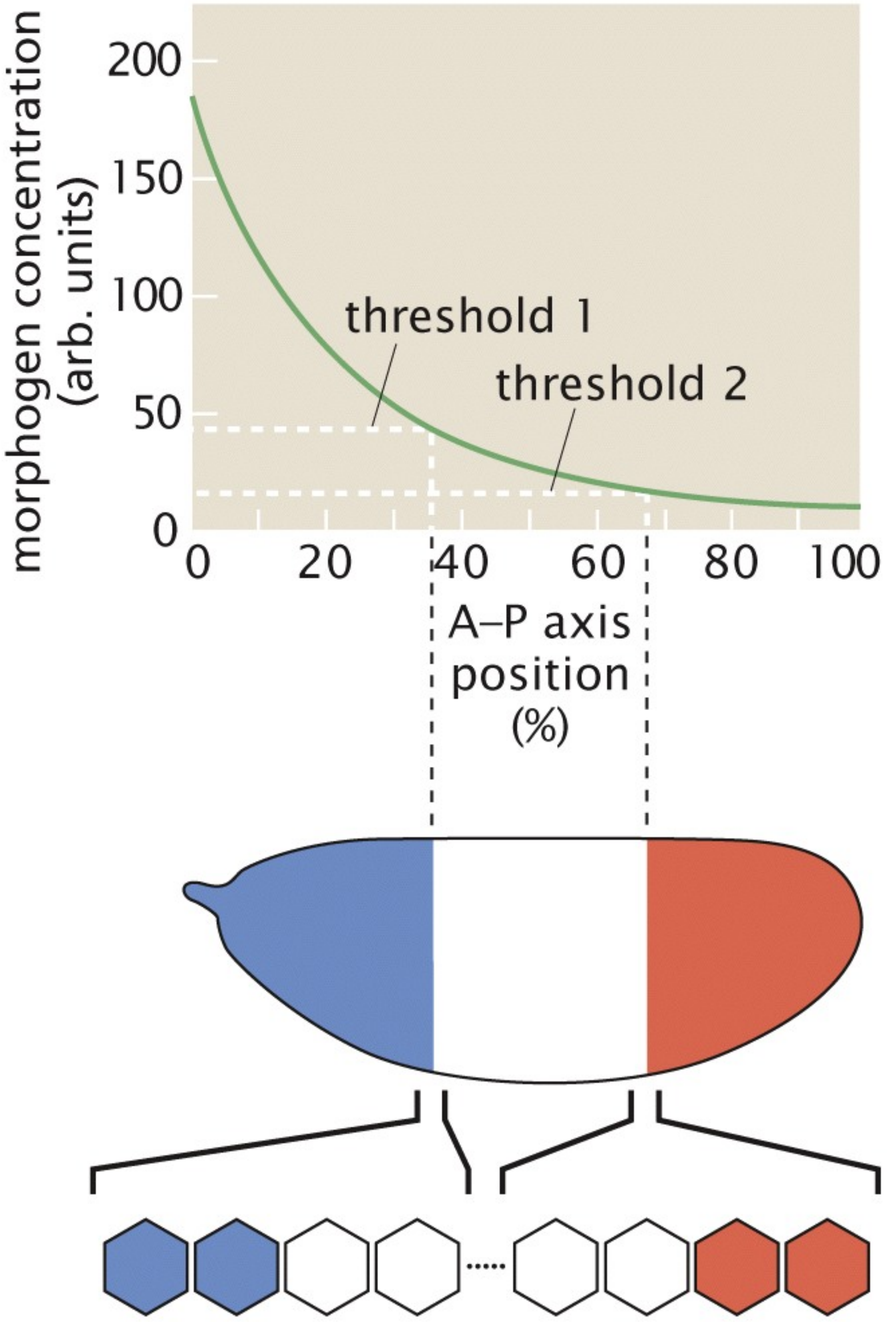


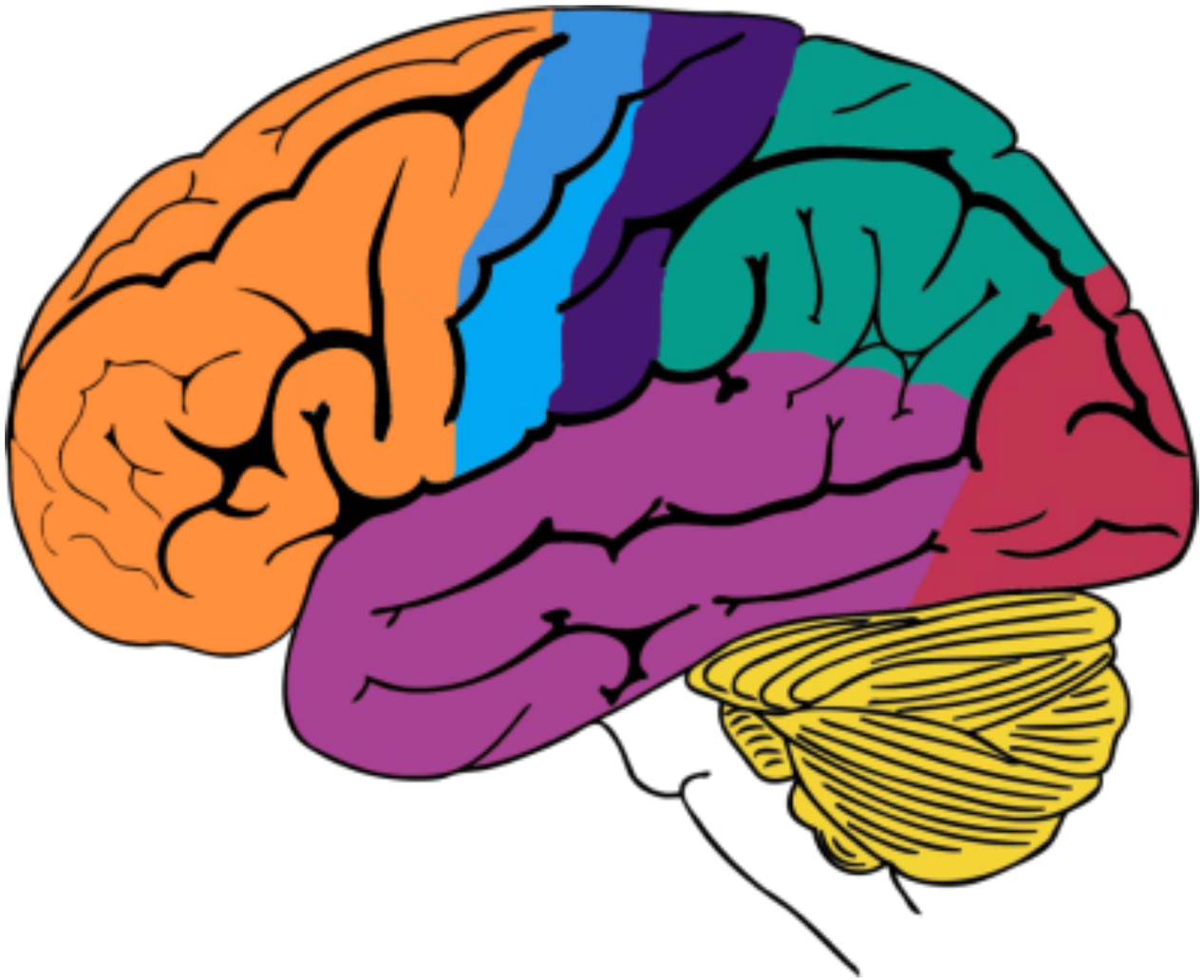
Figure 20.3 Physical Biology of the Cell, 2ed. (© Garland Science 2013)

Reactions based on threshold of concentration leads to pattern

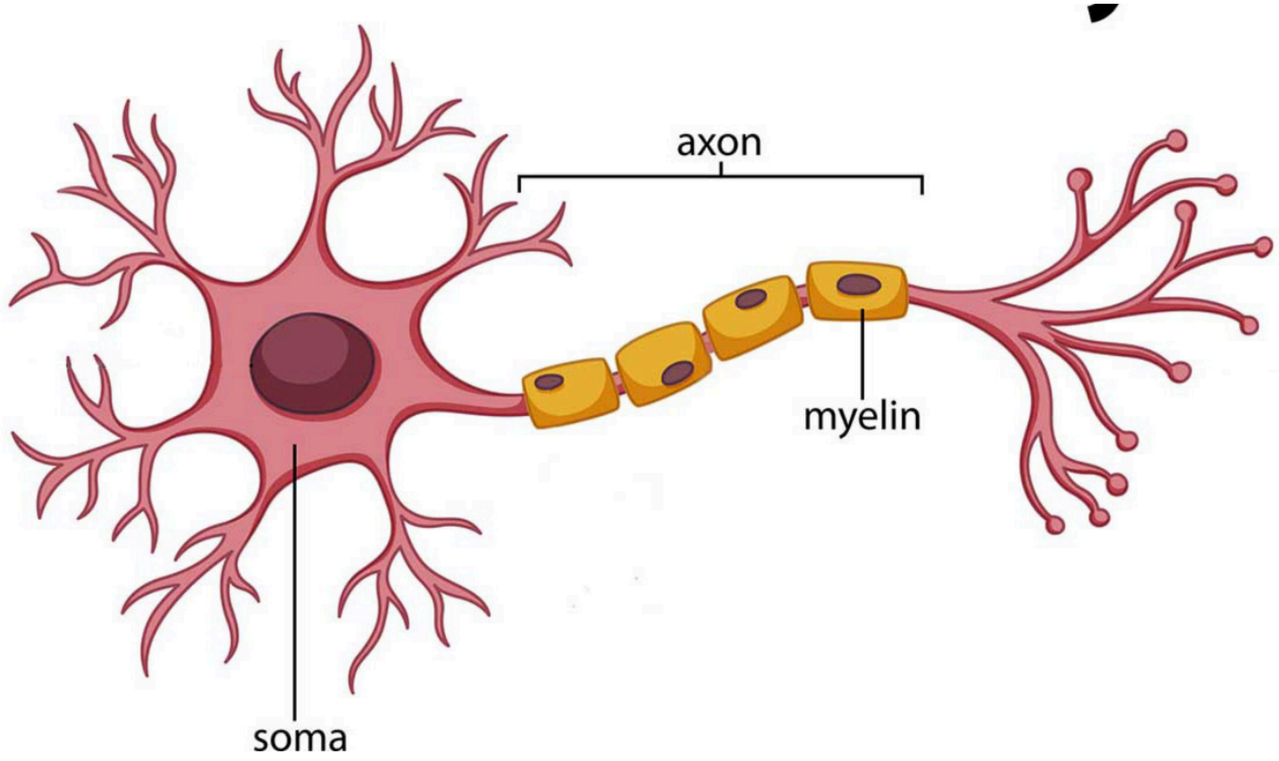
Length-scale and time-scales emerge from such active chemical processes

Bit about brain

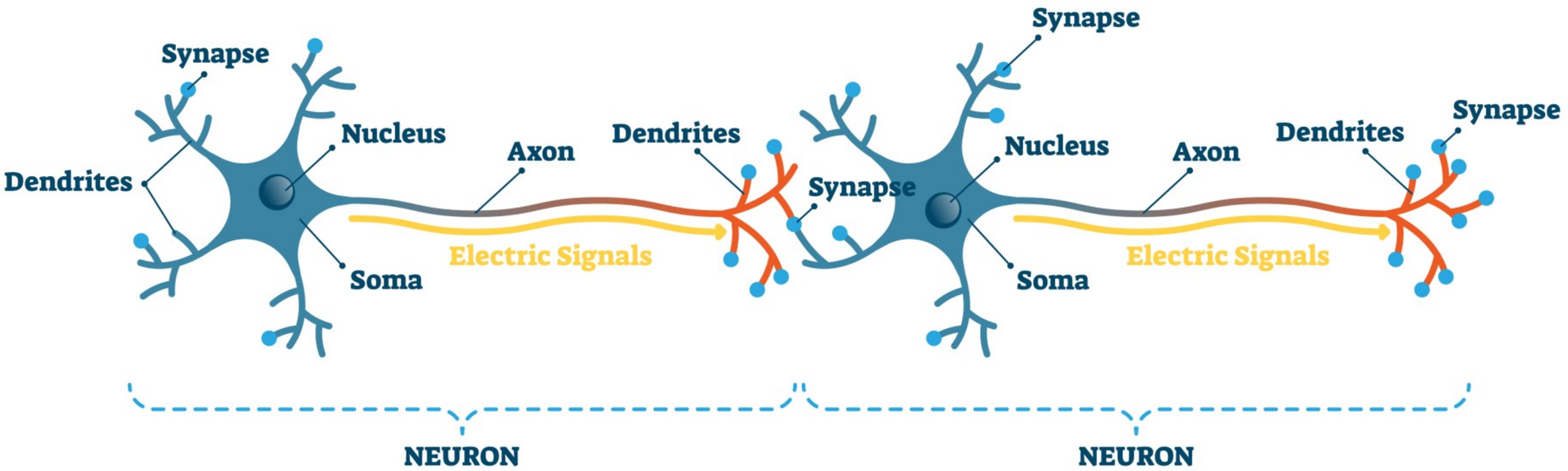
Brain has some structure. Different parts do different things



Made of neuronal cells

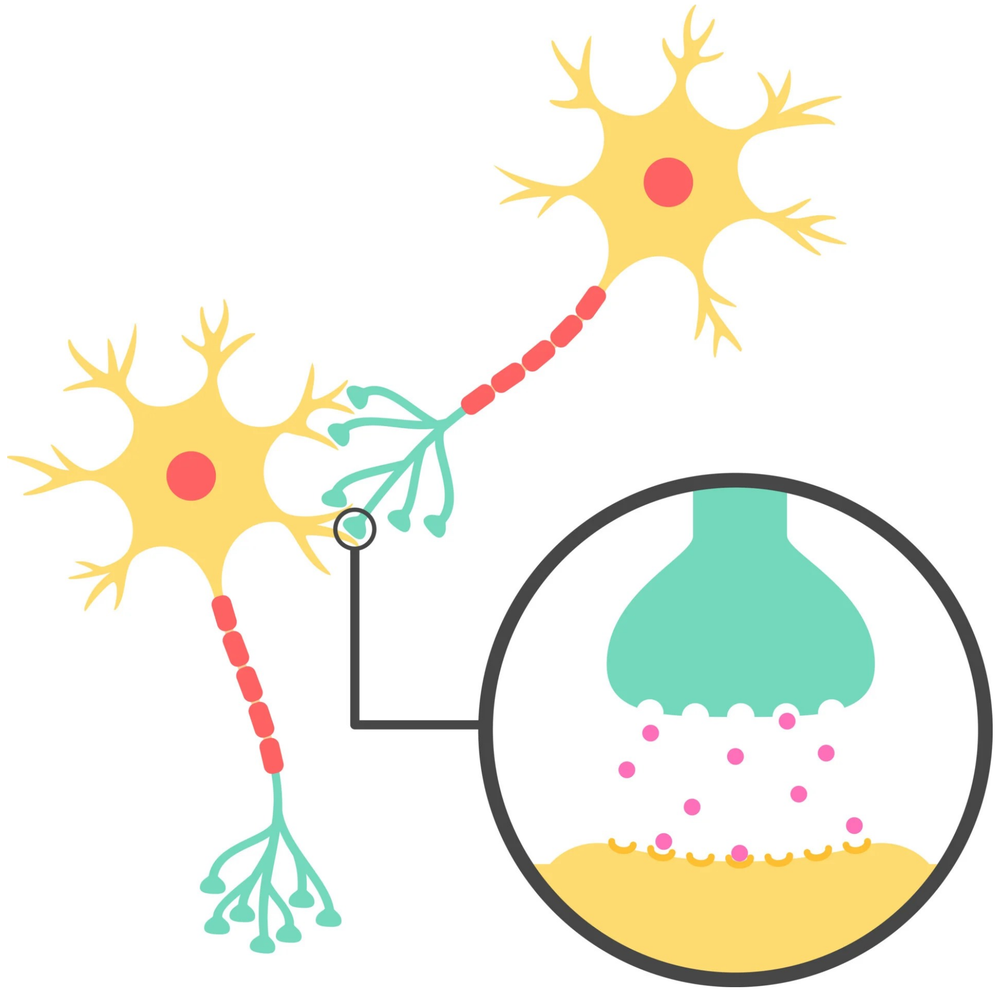


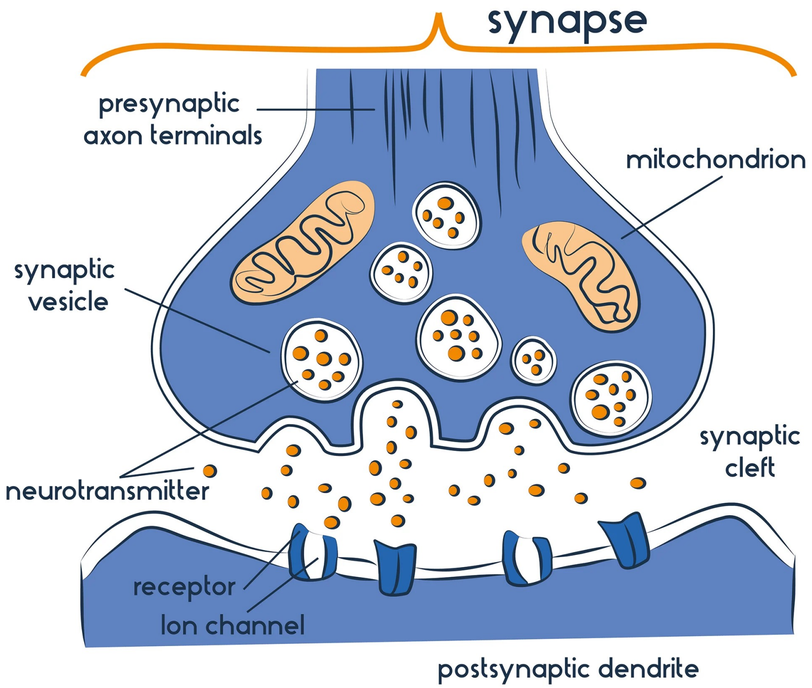
Network of neurons



Electric signals within the cell

Junctions: synapse => chemical signals





Memory storage is related to connection between neurons.

100 billion neurons; many different connections and arrangements

Biology is a super-thrilling and interesting subject.

Think of the length scales and timescale it spans!

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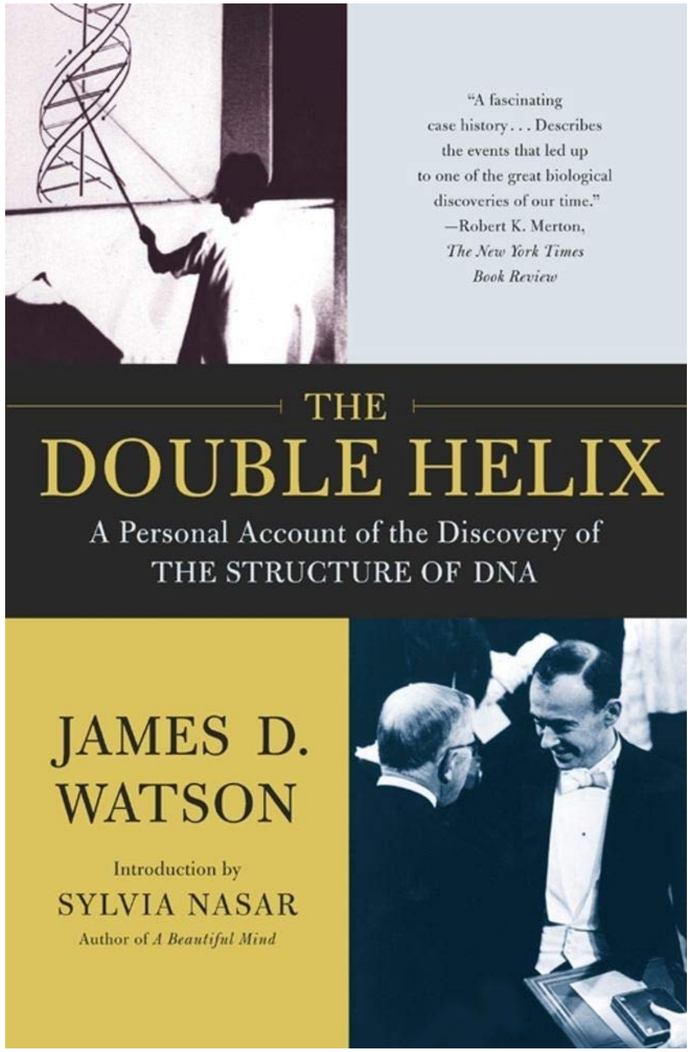
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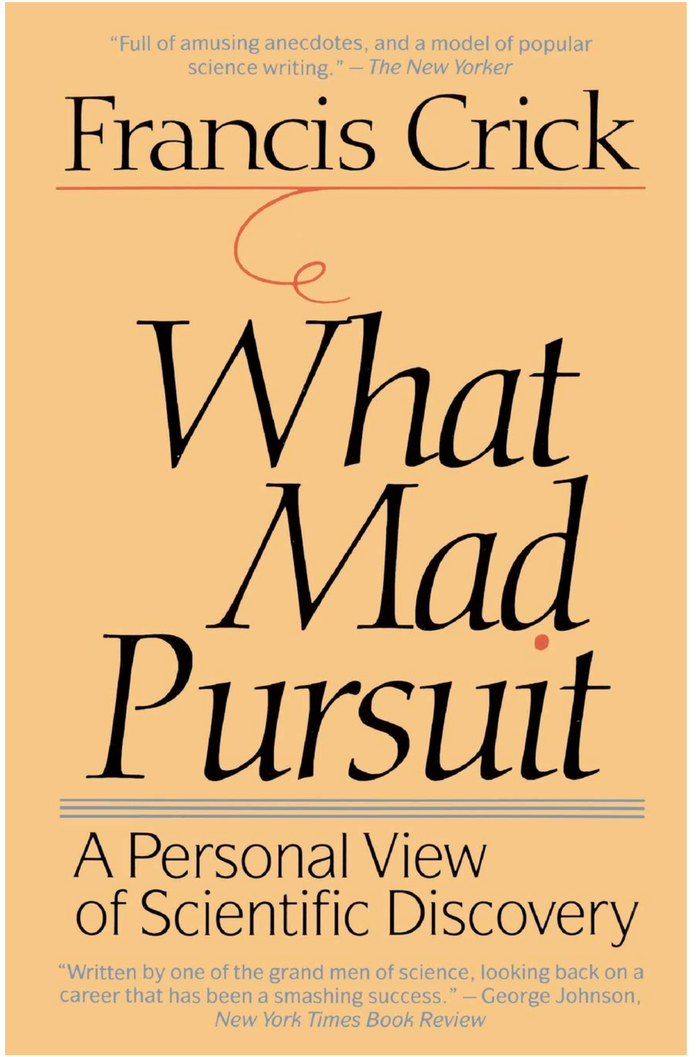
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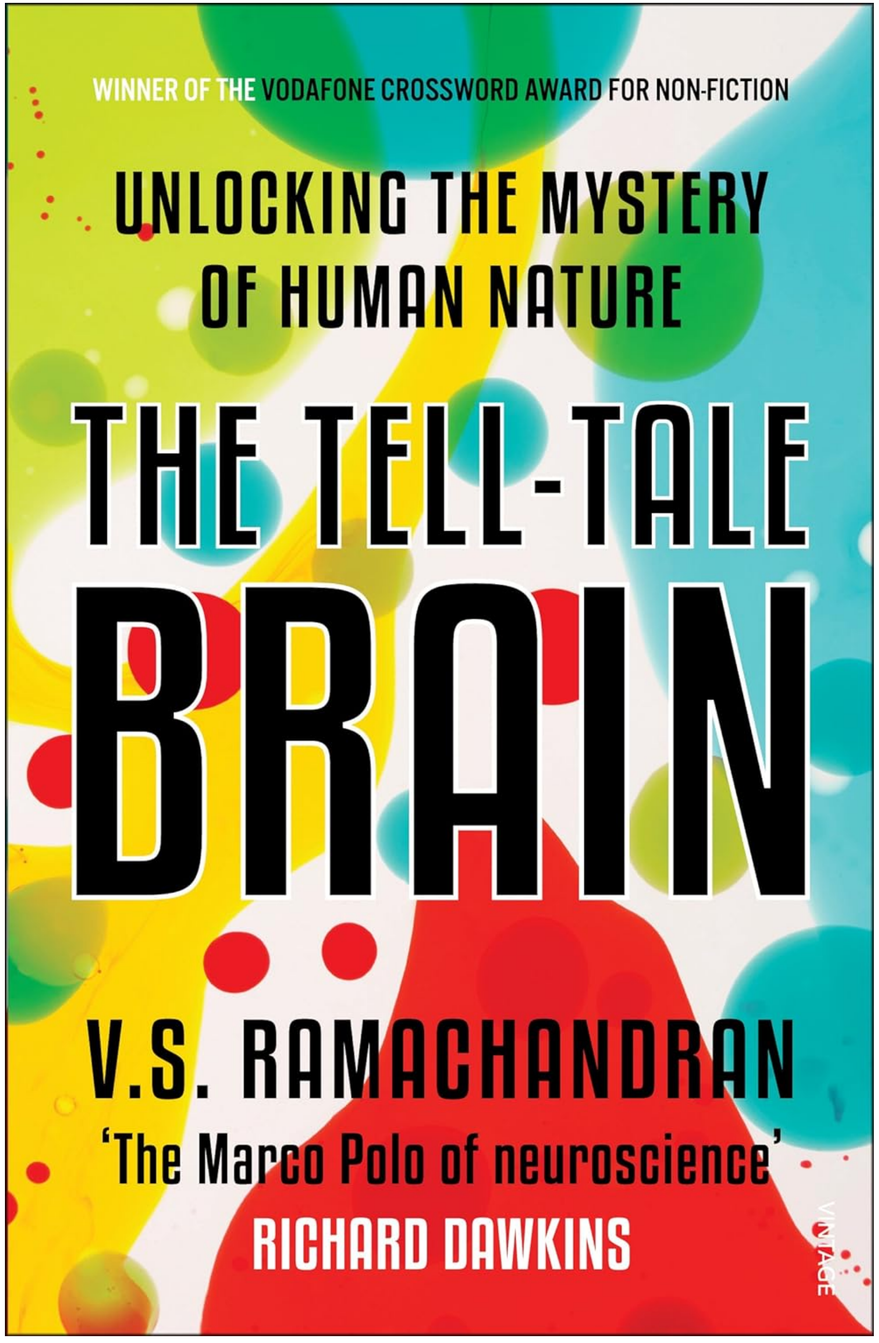
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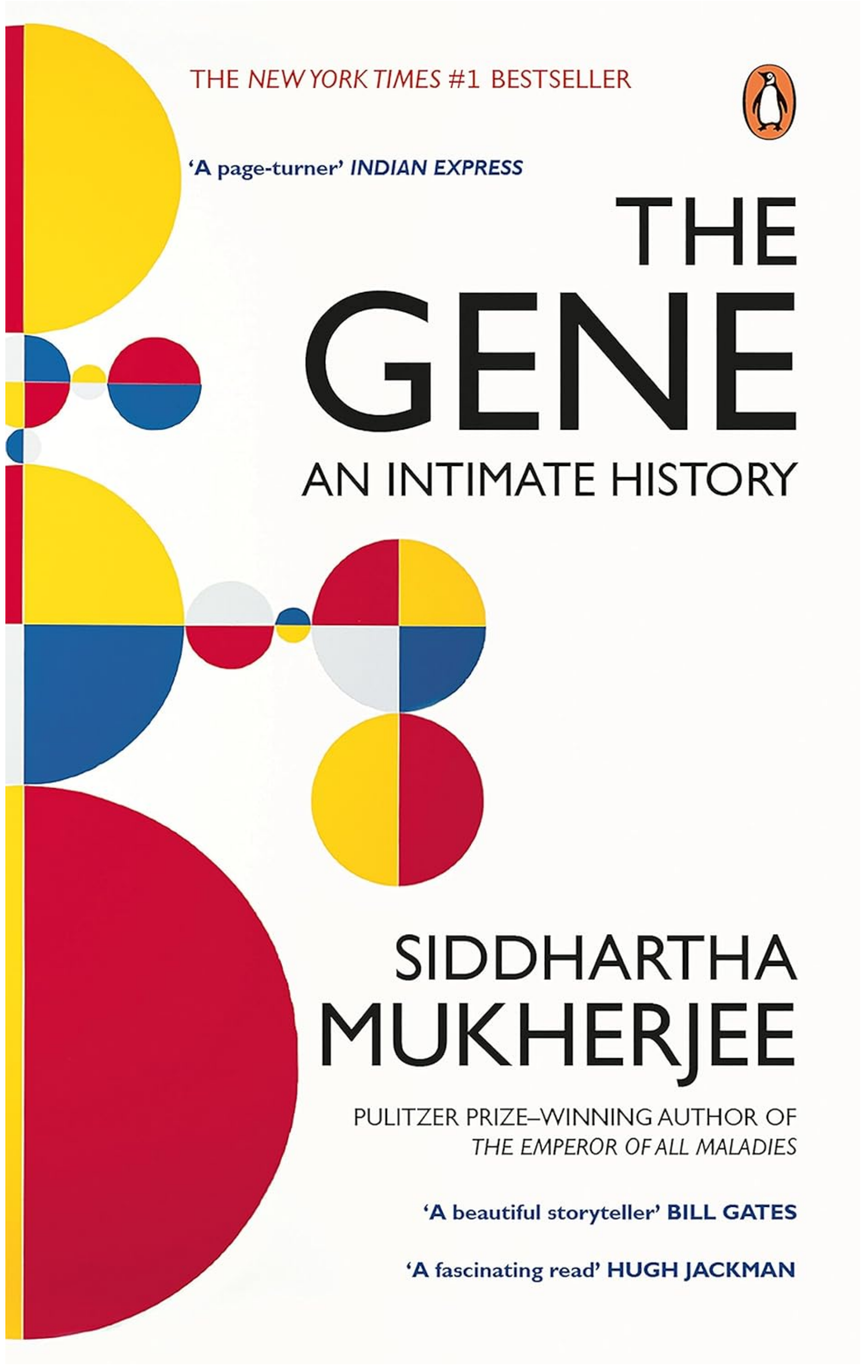
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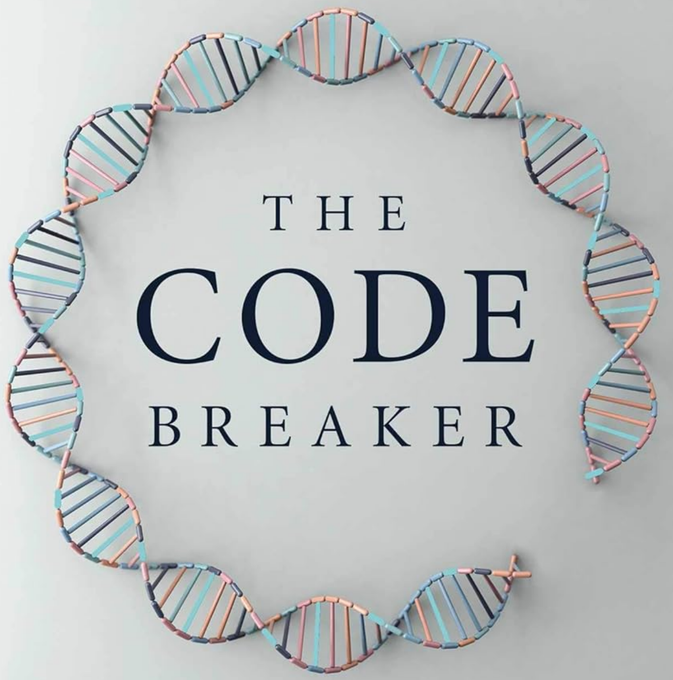

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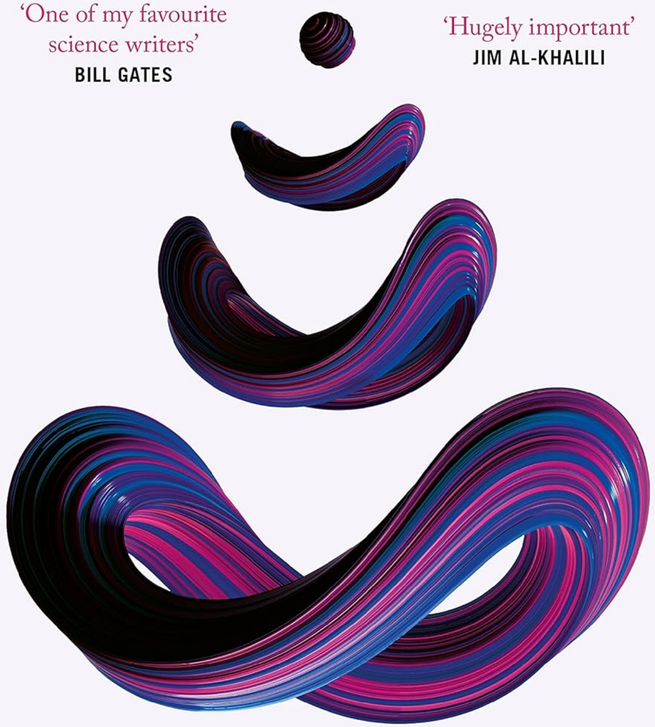

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