

Pattern formation; brain and other topics



1 m

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



5 cm

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

Production of material and reaction diffusion leads to patterns



1 m

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

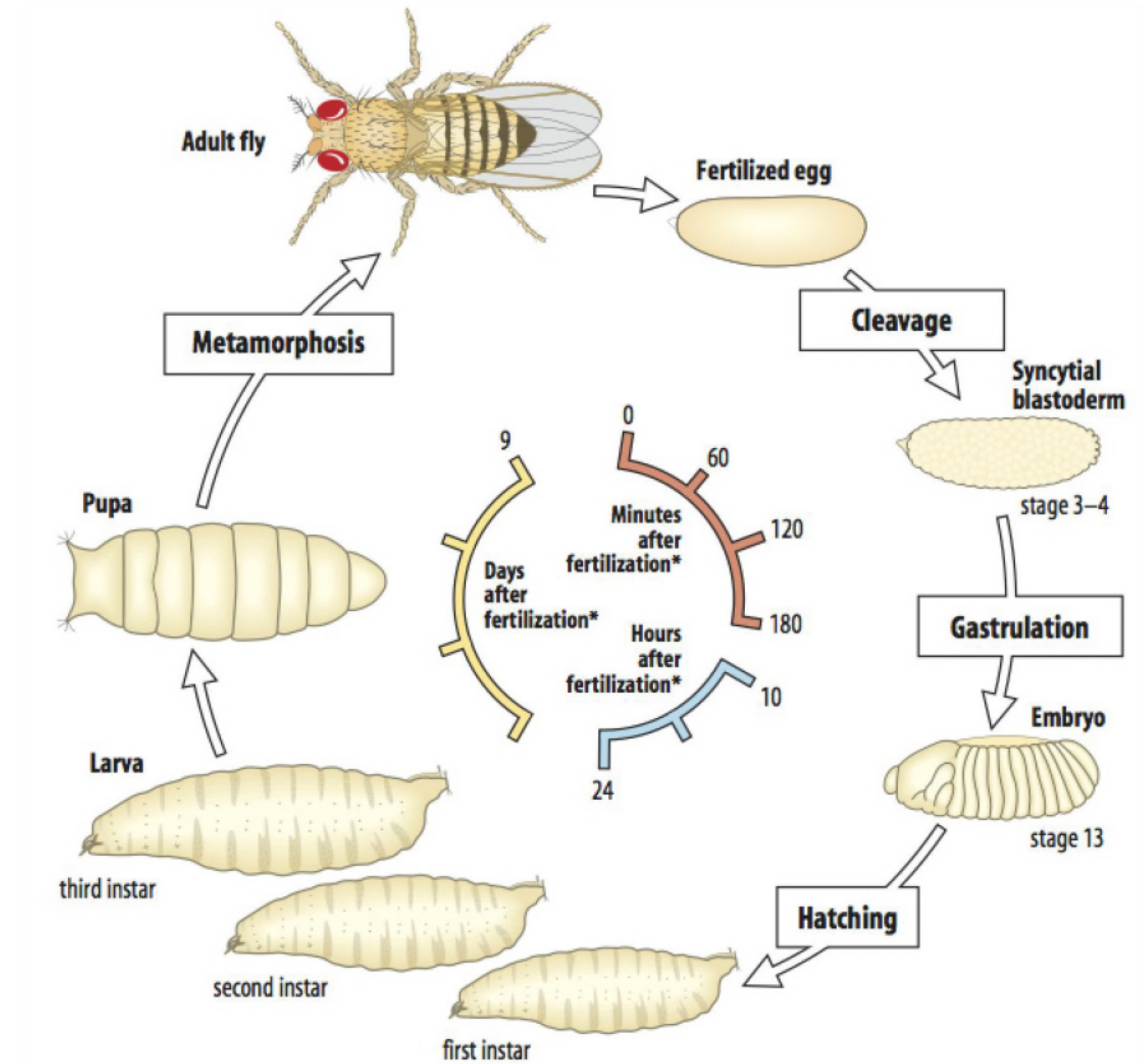
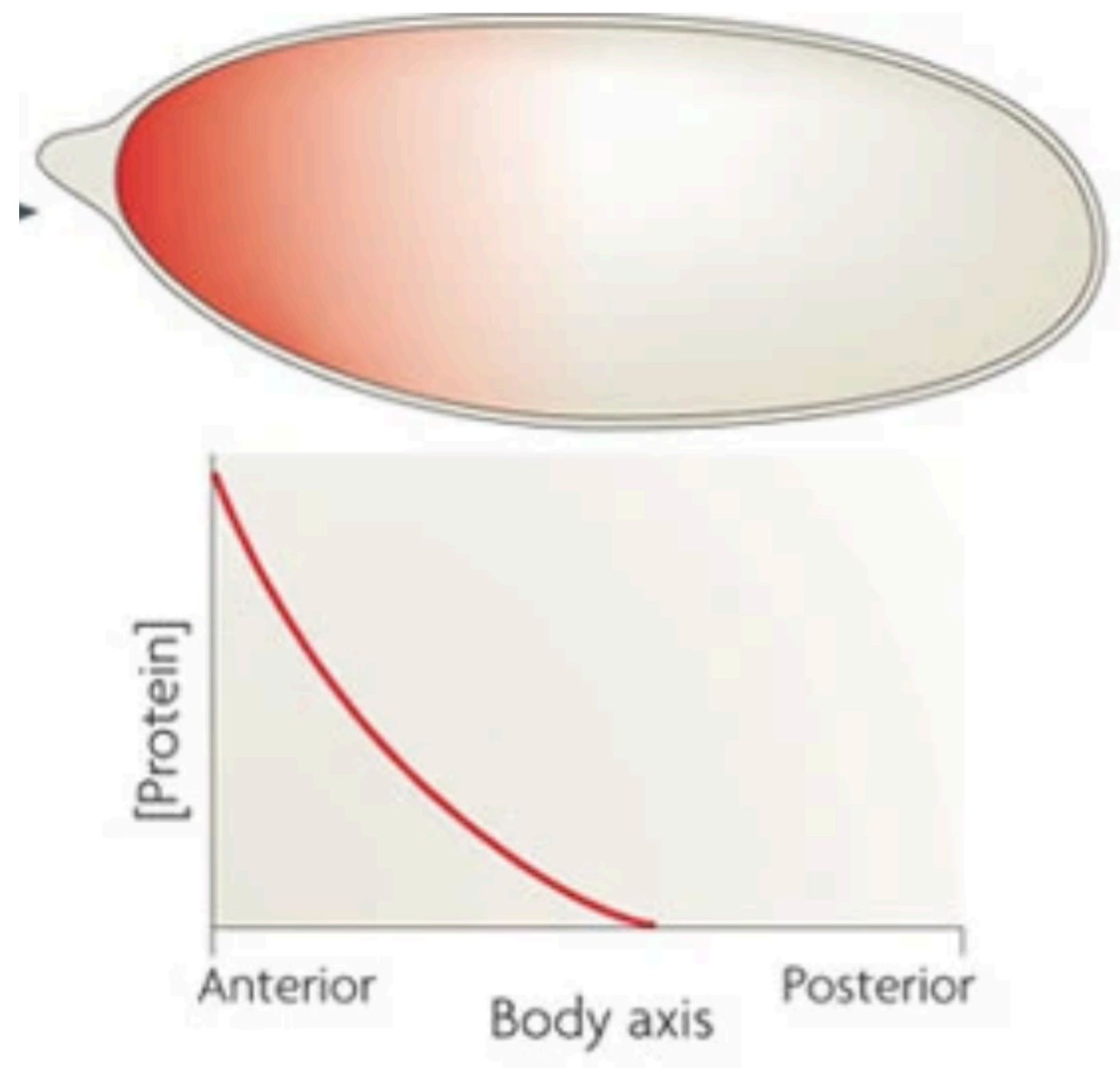


5 cm

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

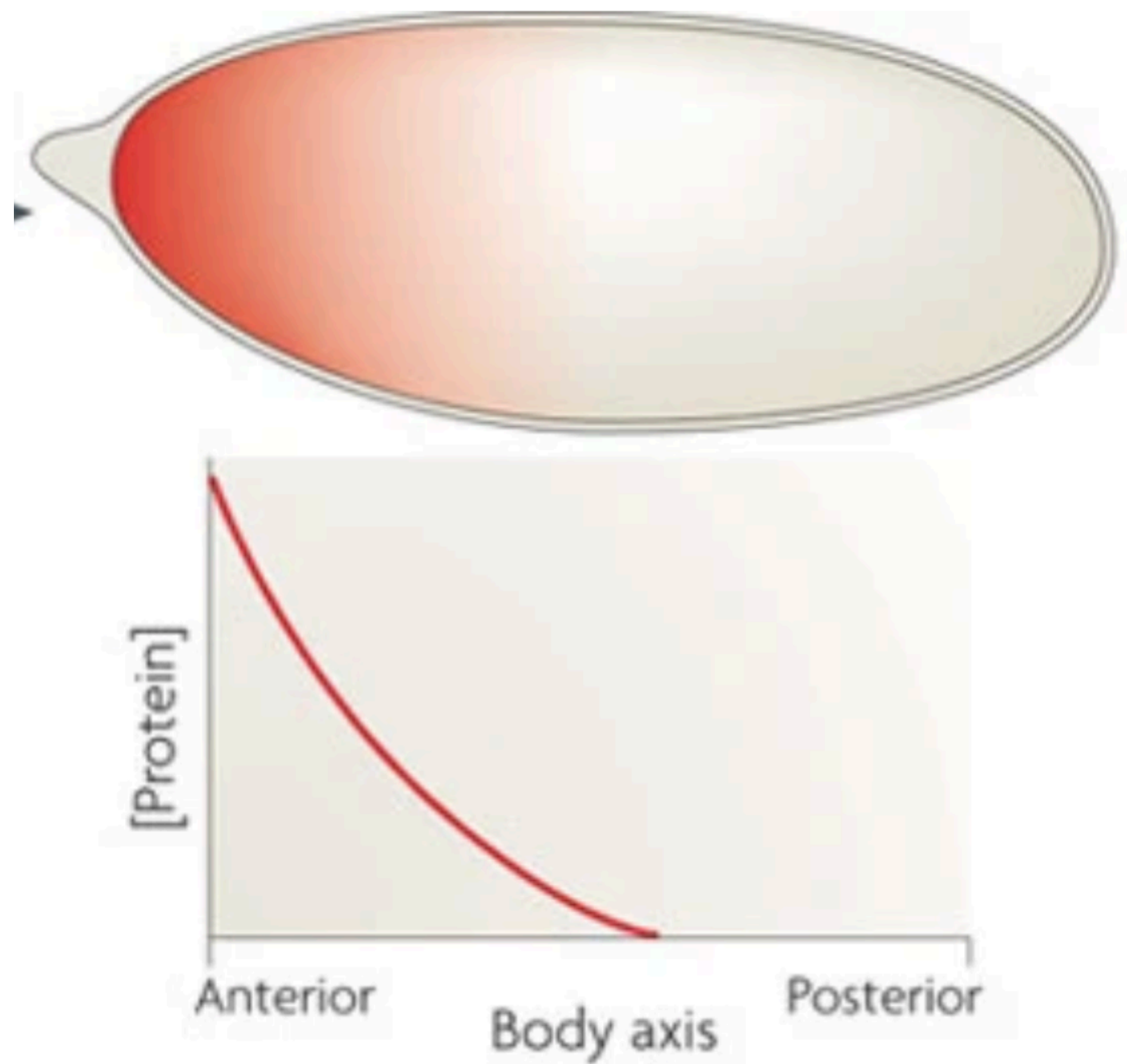
**Reaction diffusion: emergence
of length scale**

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



*At 25°C incubation

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

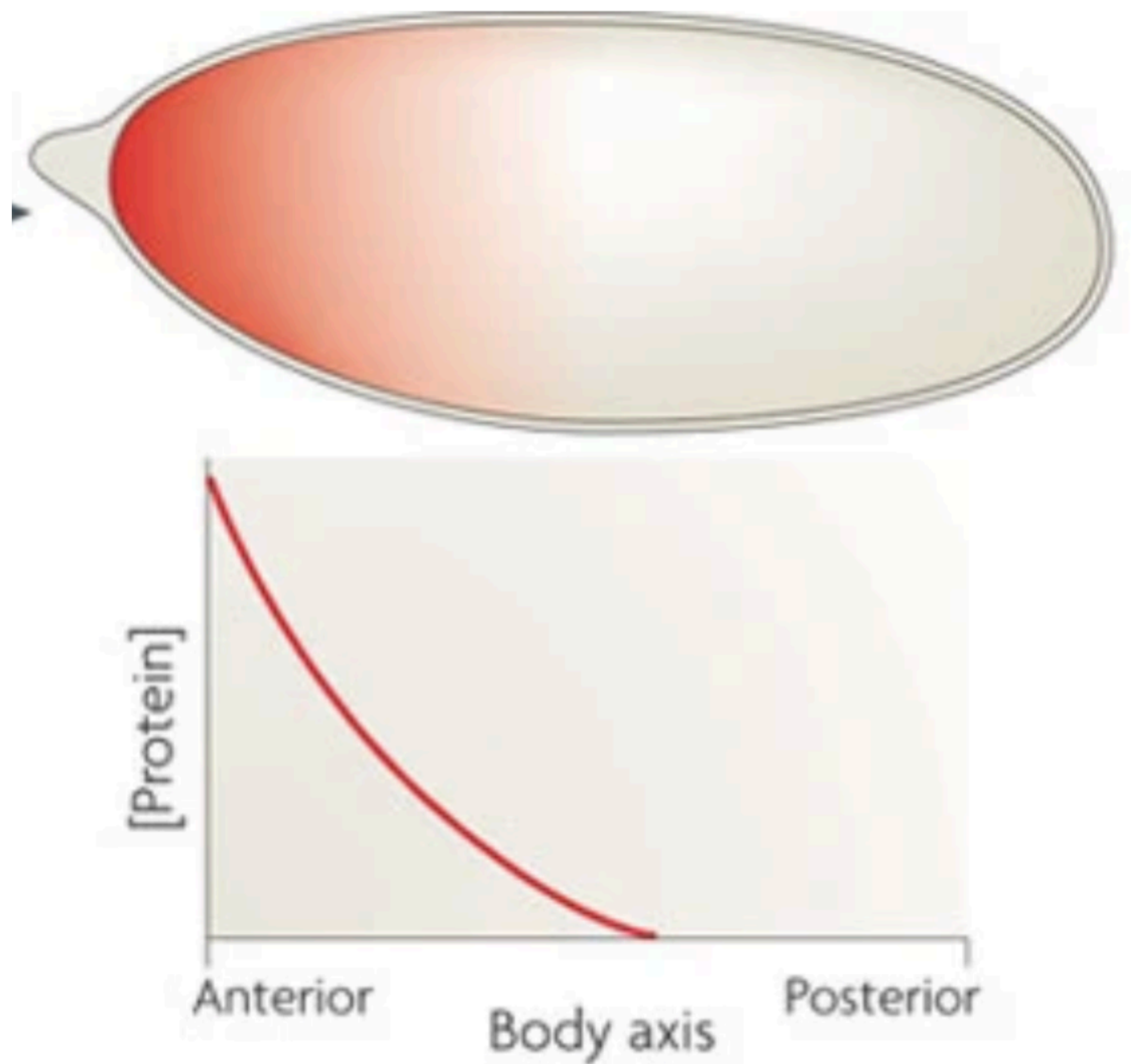
K_d = degradation rate

D = diffusion constant

At steady-state, concentration is time-independent

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

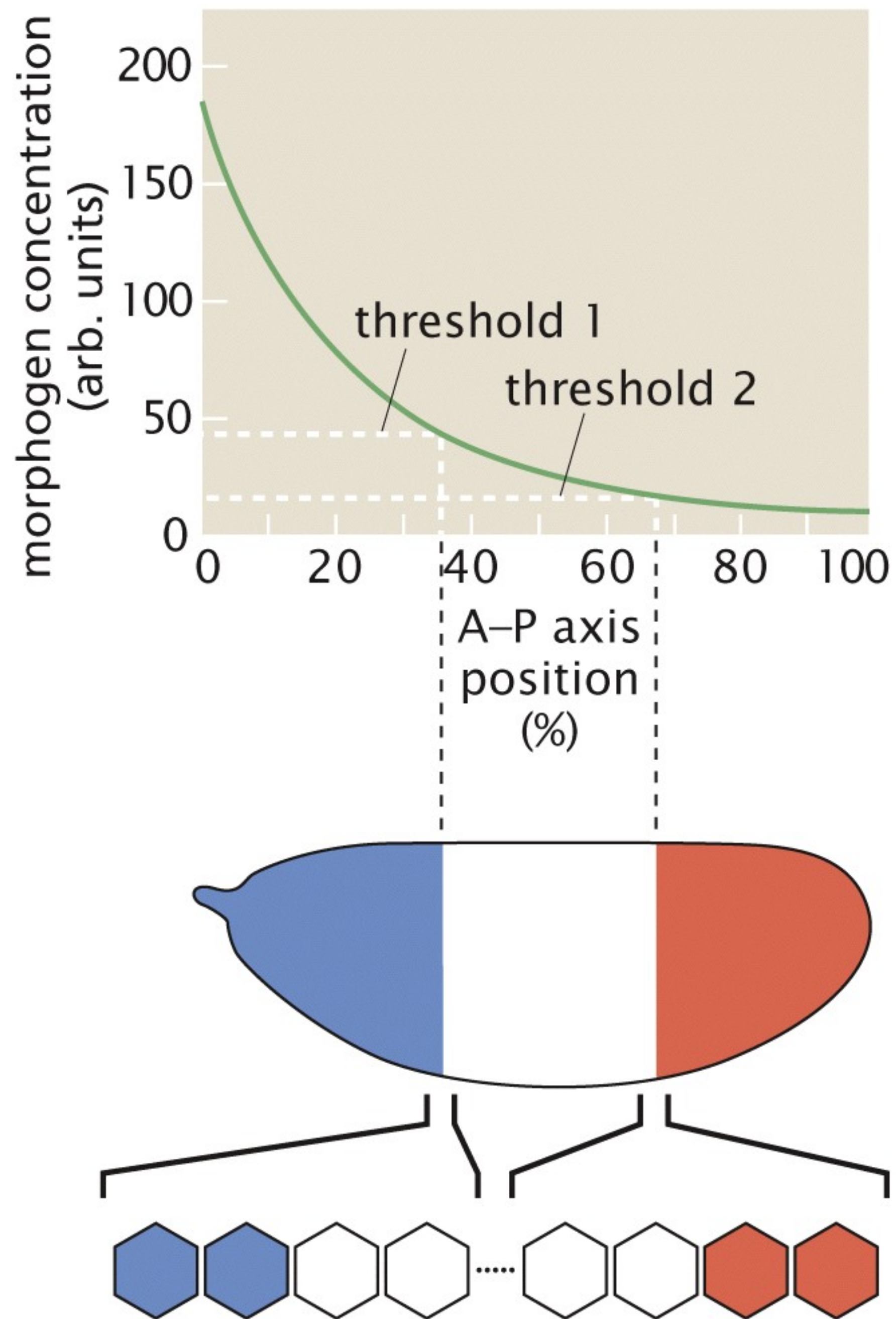
Length-scale emerges



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

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

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



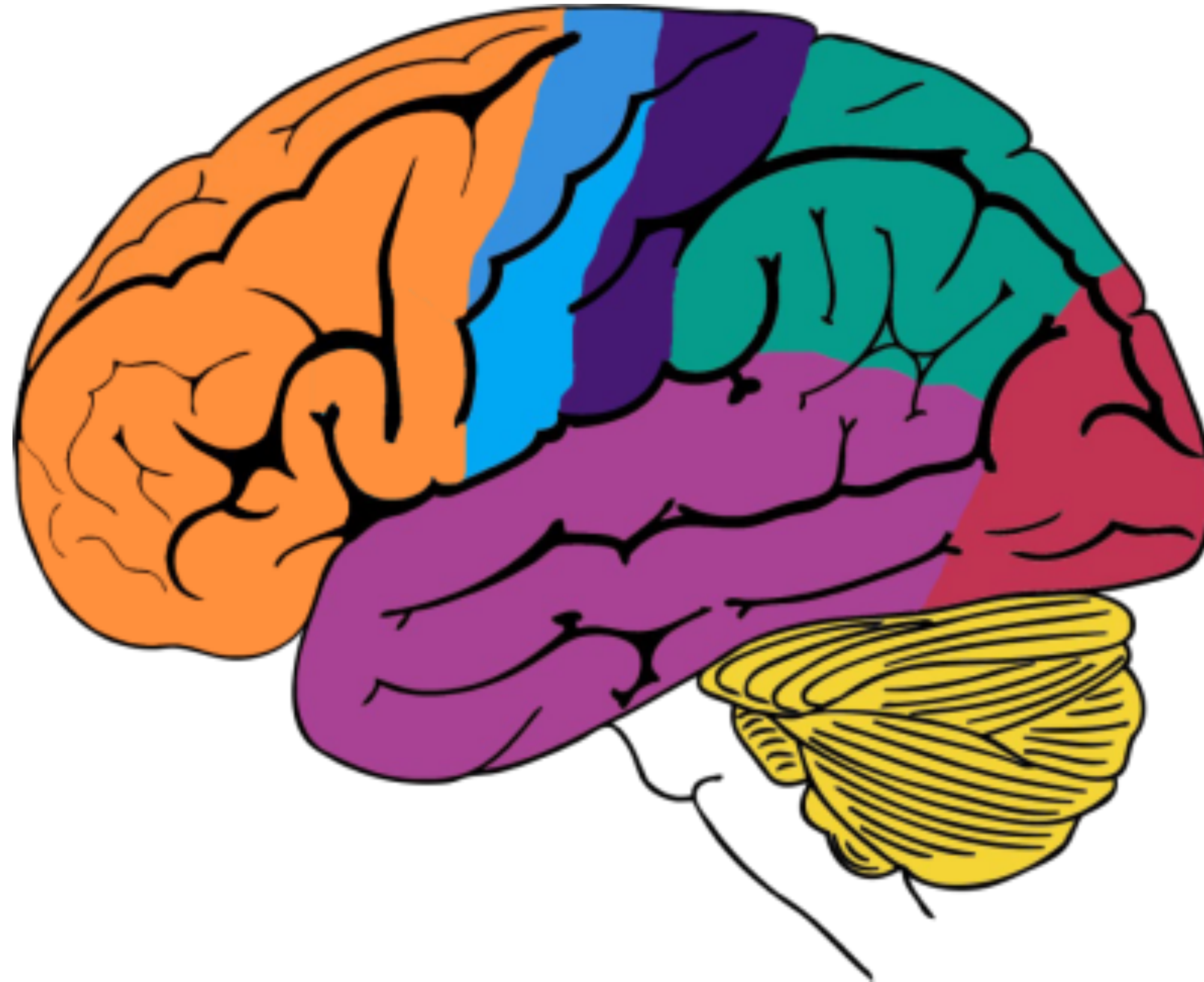
Reactions based on threshold of concentration leads to pattern

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

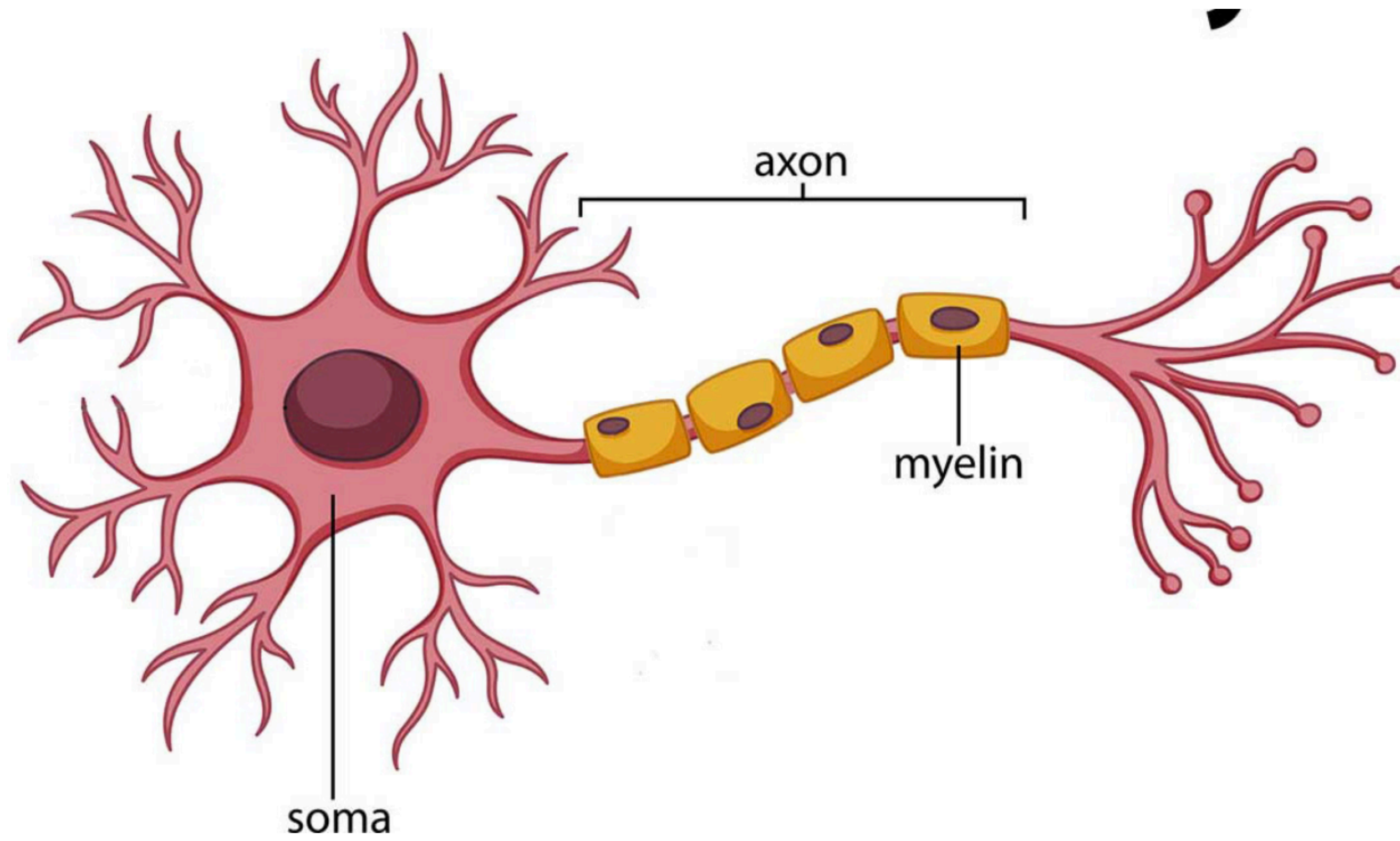
**Length-scale and time-scales
emerge from such active chemical
processes**

Bit about brain

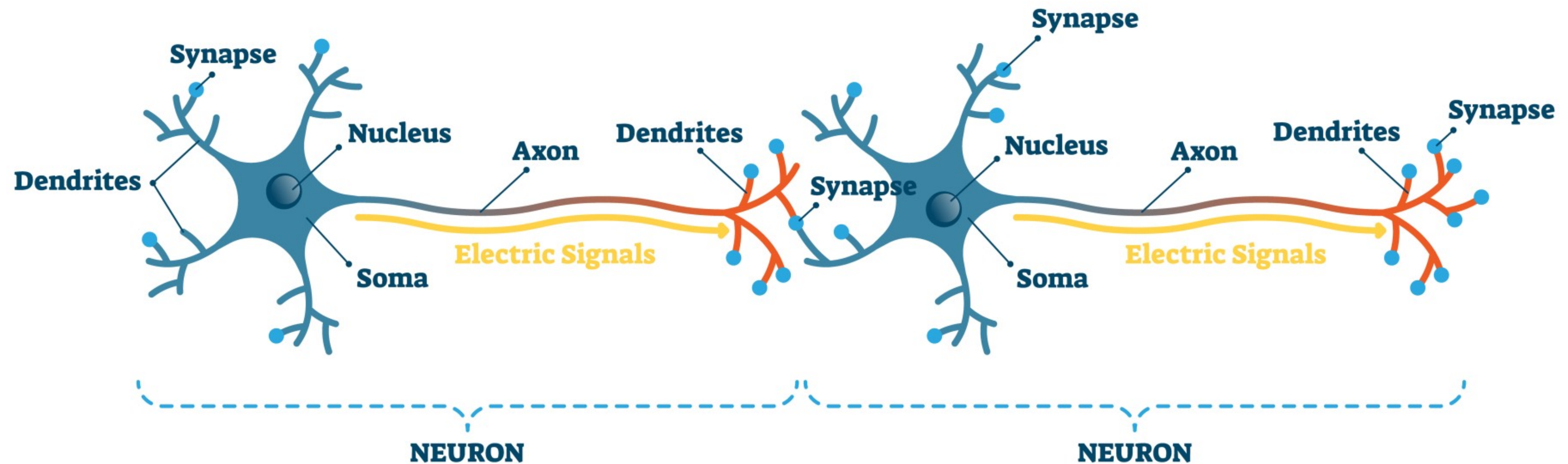
Brain has some structure. Different parts do different things



Made of neuronal cells

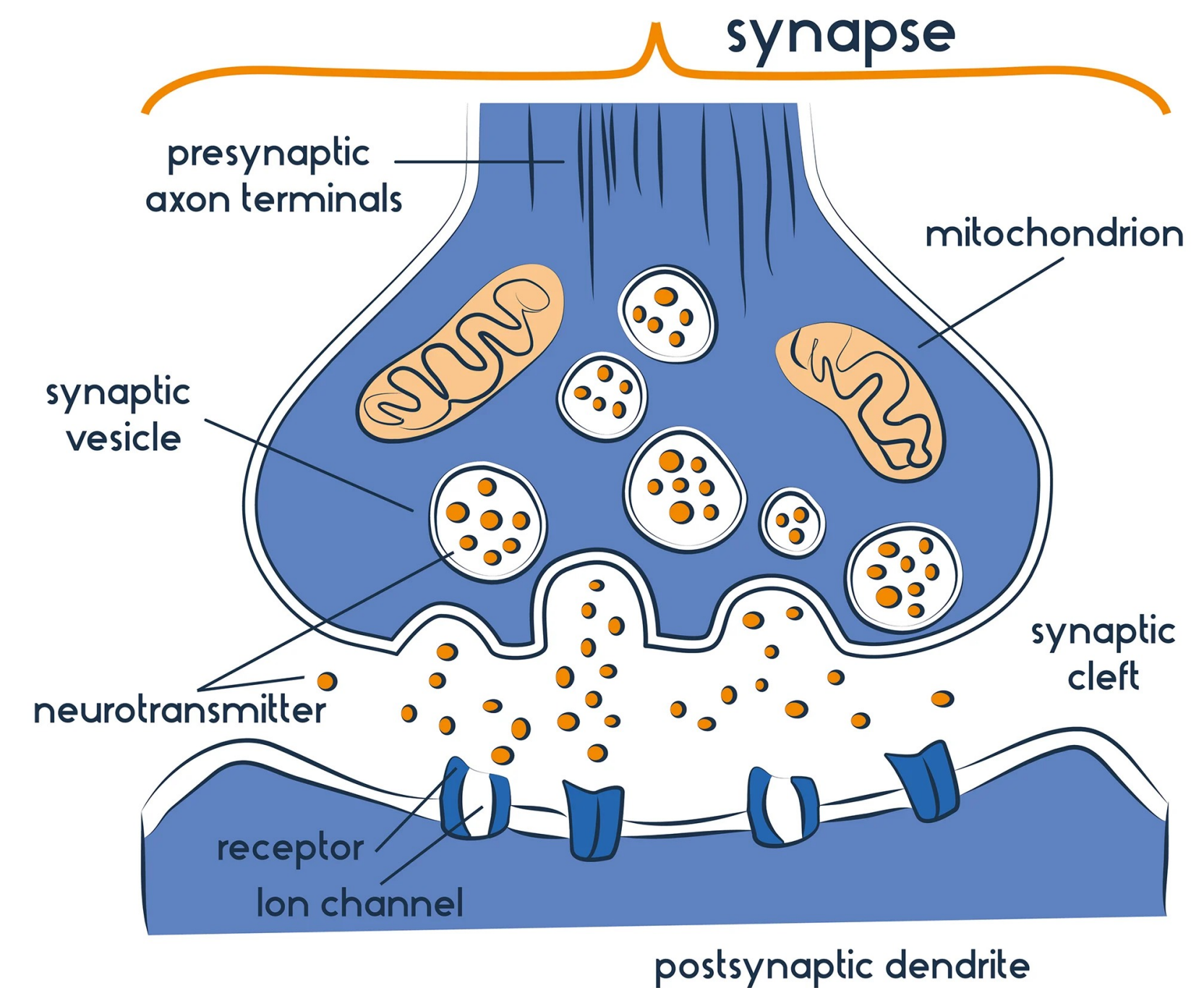
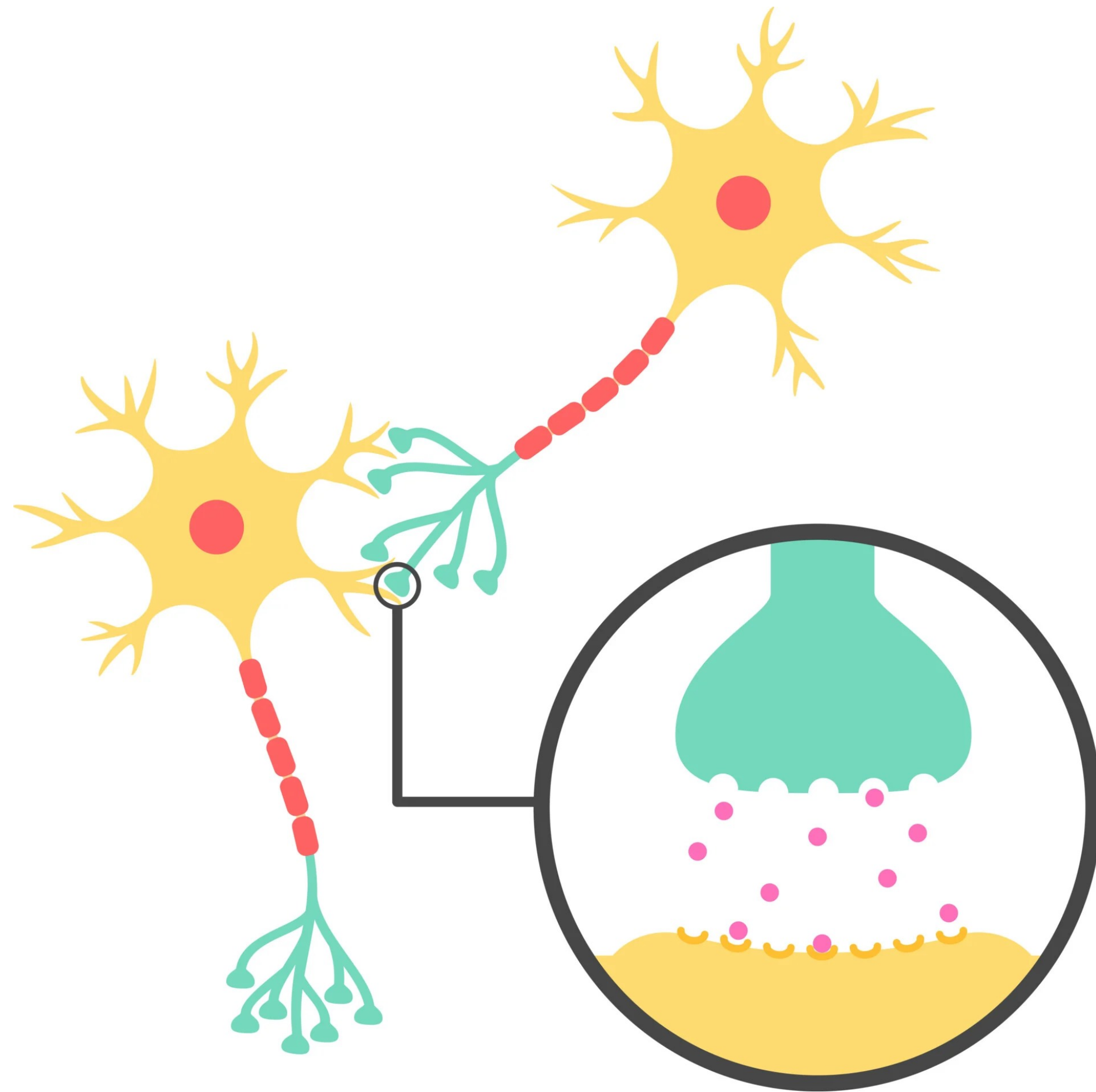


Network of neurons



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!

WHAT IS LIFE?

*The Physical Aspect of the
Living Cell*

BY

ERWIN SCHRÖDINGER

SENIOR PROFESSOR AT THE DUBLIN INSTITUTE FOR
ADVANCED STUDIES

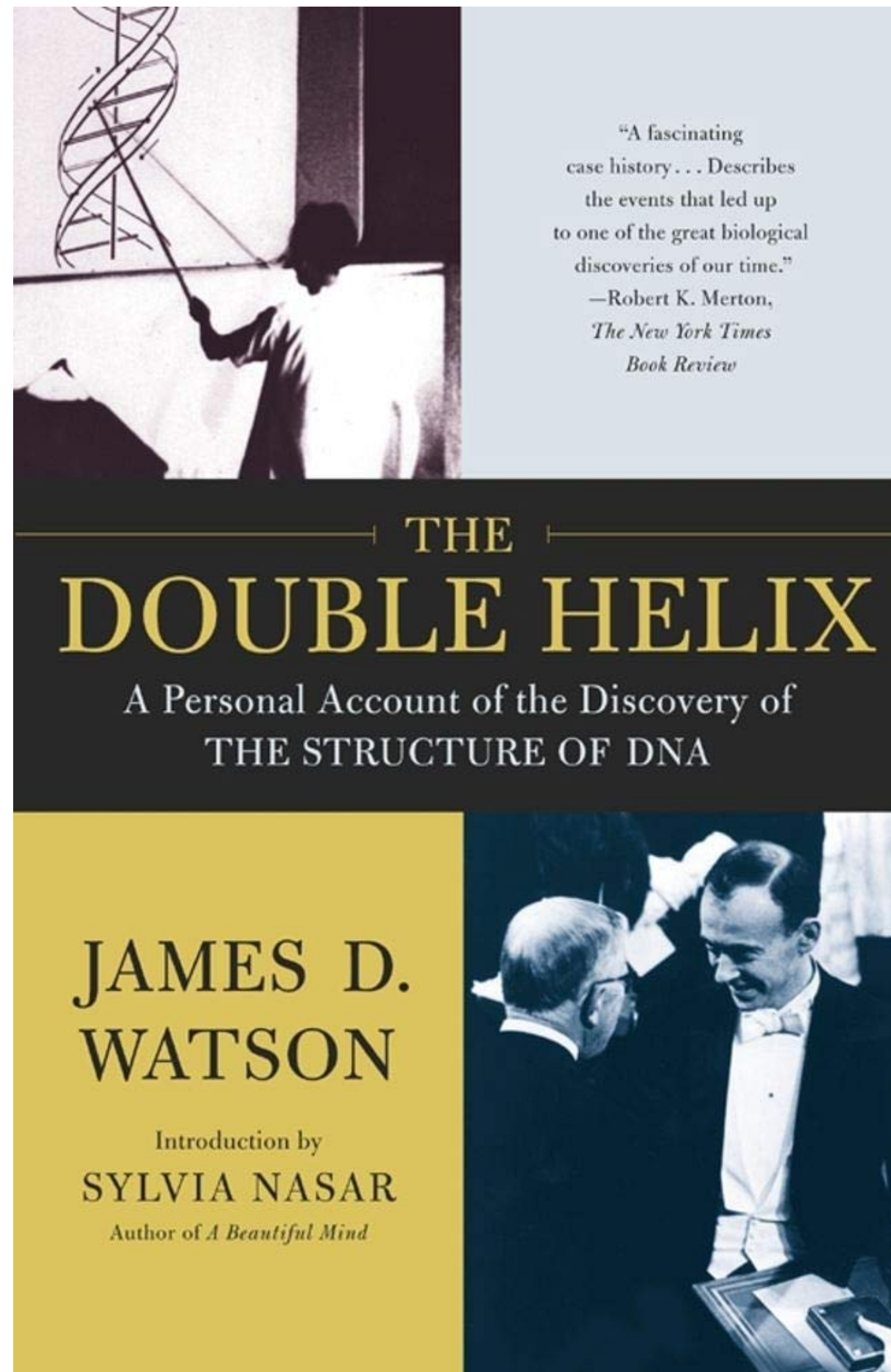


ON GROWTH AND FORM

The Complete Revised Edition



D'Arcy Wentworth Thompson



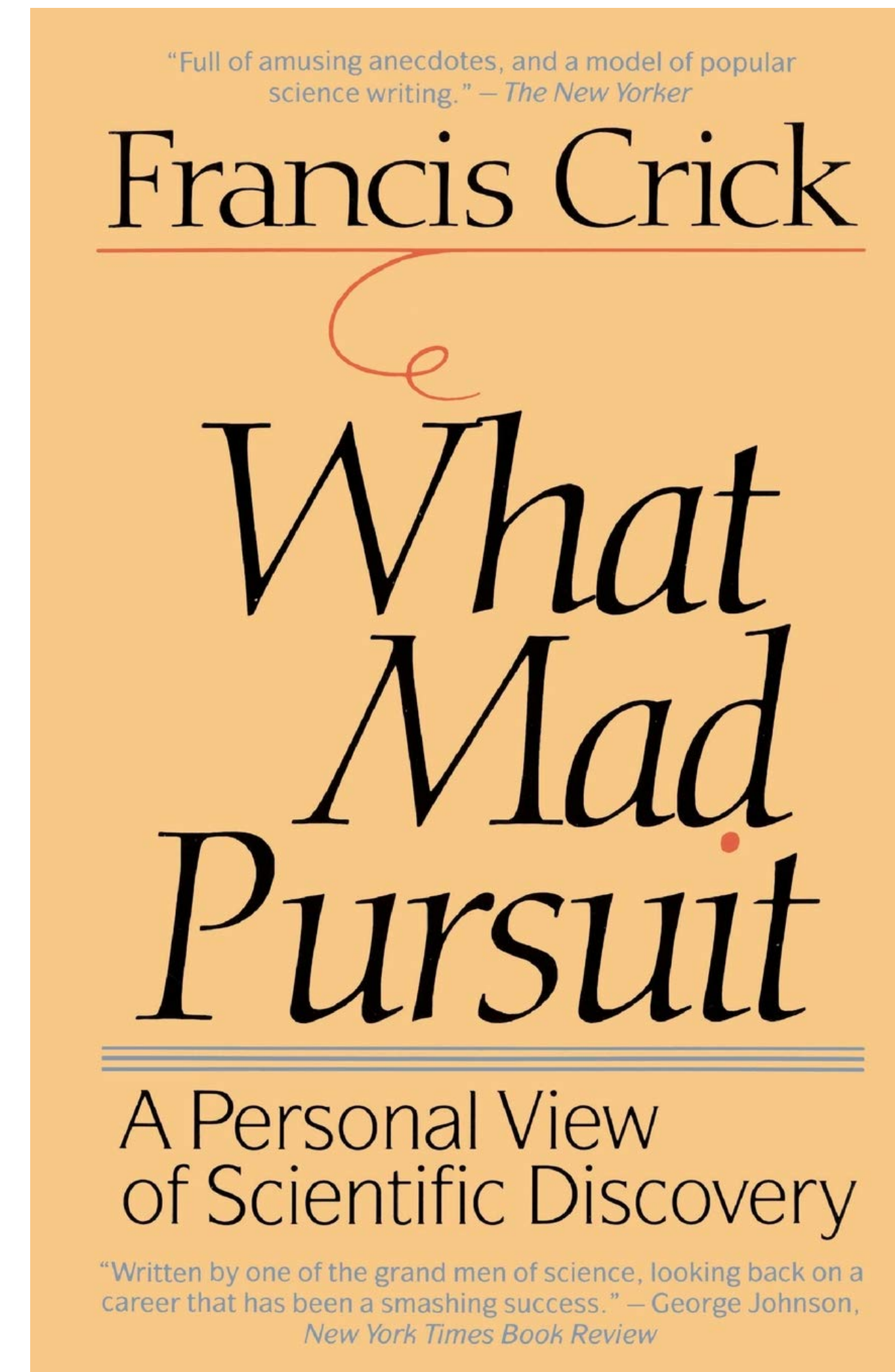
"A fascinating case history . . . Describes the events that led up to one of the great biological discoveries of our time."
—Robert K. Merton,
The New York Times
Book Review

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WATSON

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Francis Crick

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New York Times Book Review

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'A page-turner' *INDIAN EXPRESS*

THE GENE

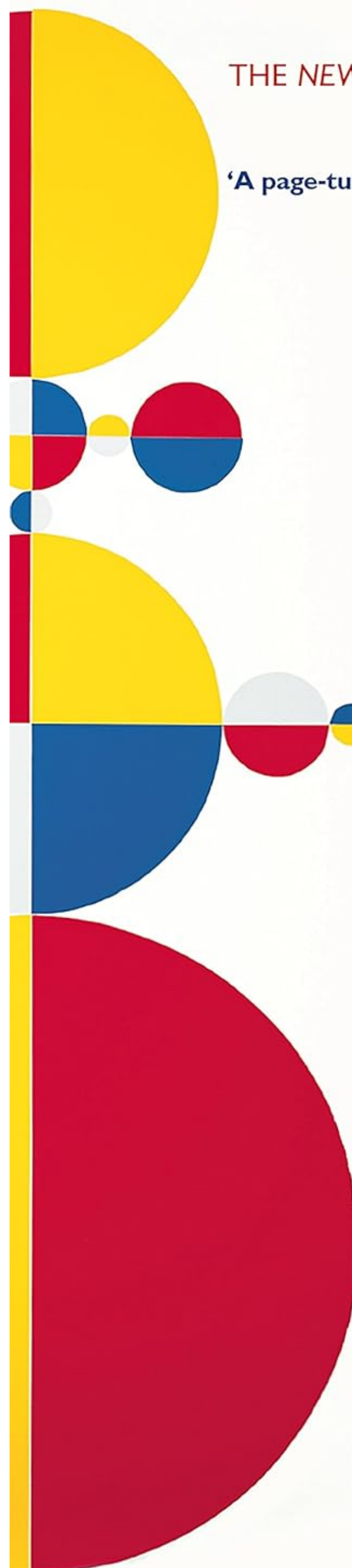
AN INTIMATE HISTORY

SIDDHARTHA
MUKHERJEE

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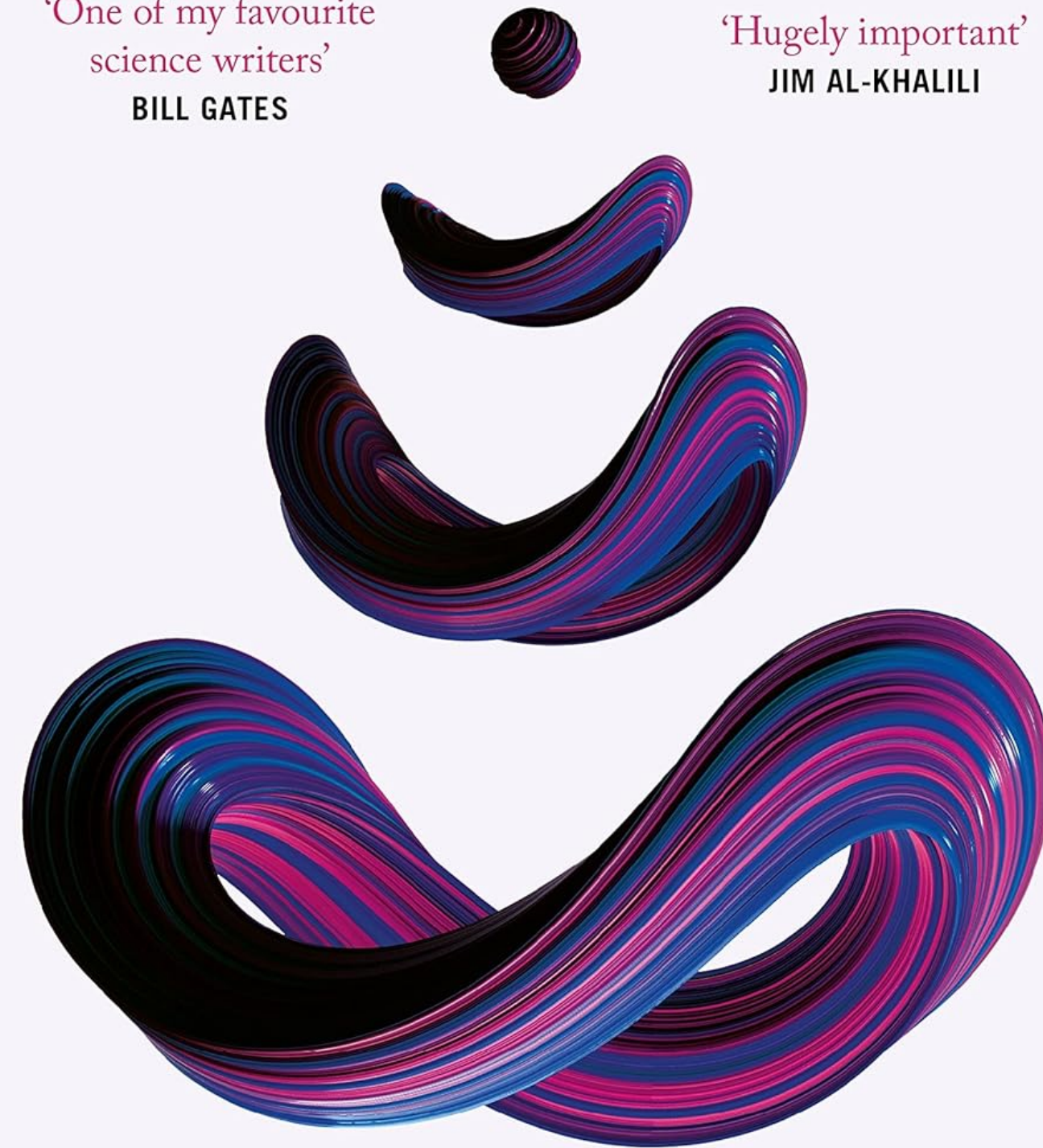


THE
CODE
BREAKER

JENNIFER DOUDNA,
GENE EDITING, AND THE
FUTURE OF THE HUMAN RACE

‘One of my favourite
science writers’
BILL GATES

‘Hugely important’
JIM AL-KHALILI



TRANSFORMER

The Deep Chemistry of Life and Death

NICK LANE

The test: 24 April, Wednesday

- The test will be for 2 hours.
- Content: only what is taught by me (no questions from Prof. Srivastava)
- You can bring one A4-sized sheet with whatever hand-written on it.
- You **CANNOT print** anything on it; you **CANNOT bring a photocopy.** Prepare your own hand-written sheet.
- My part of the course will have 50% weightage.
 - 35 Marks (out of 50) end see
 - 15 Marks from weekly tutorial quizzes