

Unit 5: Respiration, Internal Environment, Coordination and Gene Technology

WBI15 · Issue 2 · Topics 7-8 · respiration, muscle, kidney, nerves, brain, gene tech · sheets 5.1-5.12

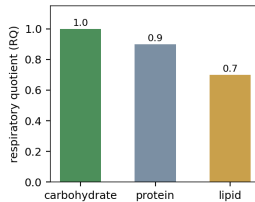
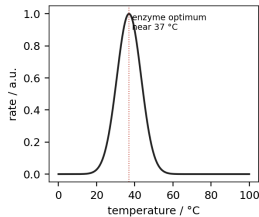
Inside the body: energy, balance and control

Respiration supplies the ATP, nerves and hormones steer it, homeostasis keeps it steady - the article question tests reading it.

Four stages, one purpose

Stage	Where	Yield
Glycolysis 糖酵解	cytoplasm	2 ATP + 2 reduced NAD
Link reaction 链接反应	matrix	CO ₂ + reduced NAD
Krebs cycle 三羧酸循环	matrix	ATP + reduced NAD + reduced FAD
Oxidative phosphorylation 氧化磷酸化	cristae	most ATP; O ₂ to water

Rate curves and the respiratory quotient



RQ identifies the substrate: 42 cm³ CO₂ for 60 cm³ O₂ gives 0.70 - this organism is burning lipid.

The sliding filament

Calcium 钙离子: binds troponin, exposes actin binding sites



Attach 结合: energised myosin head locks onto actin



Pull 拉动: the power stroke slides actin toward the centre



Detach 脱离: fresh ATP binds the head, which re-cocks for the next cycle

The heart sets its own pace

- 1 **Rest 静息** $70 \text{ cm}^3 \times 72 \text{ per minute} = \text{about } 5.0 \text{ dm}^3 \text{ per minute}$
- 2 **Exercise 运动** $120 \text{ cm}^3 \times 150 \text{ per minute} = 18 \text{ dm}^3 \text{ per minute}$
- 3 **Control 调控** medulla centres read CO_2 and pressure; sympathetic speeds, parasympathetic slows

Negative feedback holds the line

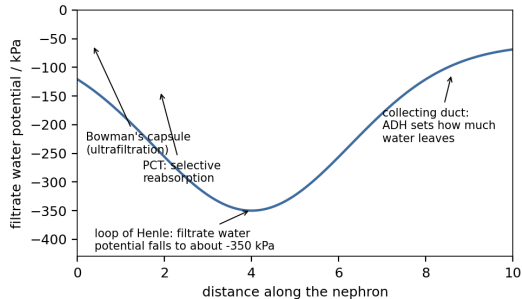
Negative 负反馈

Deviation triggers the opposite response: glucose rises, insulin lowers it - and glucagon raises it when it falls. Two-sided.

Positive 正反馈

The response reinforces the deviation - a fever climbing, depolarisation opening more channels. One-way, runaway.

One nephron, four jobs

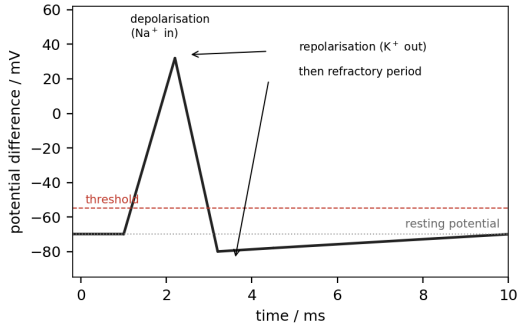


ADH present: duct walls permeable, water reabsorbed, small volume of concentrated urine - alcohol suppresses ADH and the reverse follows.

Switches without changing the sequence

The base sequence is unchanged - the damage is in the switching, which is why epigenetic drugs aim to remove methyl marks.

All-or-nothing along the axon



Below threshold nothing; at threshold everything - and the refractory period makes the impulse one-way.

Phytochrome flips with the light

- 1 **Red flash 红光闪光** Pr converts to Pfr; light-sensitive seeds germinate
- 2 **Far-red flash 远红光闪光** Pfr reverts to Pr; the effect is undone
- 3 **Last flash wins 最后一次生效** the reversal is the evidence that Pfr is the active form

Brain regions, scans and chemistry

Method	Shows	Basis
MRI	detailed structure	magnetic field + radio waves
fMRI	active regions	oxygenated blood flow
CT	fast structure	rotating X-ray
PET	metabolism	radioactive tracer

Recombinant DNA: cut, paste, select

Cut 切割: the same restriction enzyme opens plasmid and gene



Paste 连接: complementary sticky ends sealed by DNA ligase



Transform 转化: heat shock carries plasmids into bacteria



Select 筛选: antibiotic marker - only transformants survive

Check yourself

Your turn

Why is the human insulin gene made from mRNA before inserting into bacteria?

- A. bacteria cannot splice introns, and mature mRNA has none
- B. mRNA is more stable than DNA
- C. mRNA is double-stranded and easier to cut
- D. restriction enzymes only cut RNA