NHN m o i

h 0 1
6

M 6 6 6 6 0 6 7
6 6 16 :
h
M 6f 6
6 :
b :

w o o s

‘ 6 :
/ /

v Ts 6
: l
: e M
‘ :
s 6 :
s
:

h 6 : ‘
: e 6
6 : r
: h
:

u p o t i

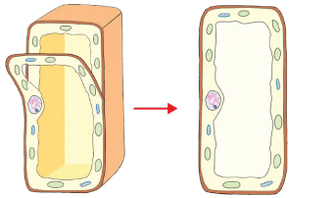
s . d 6q g 6 ?GGH:
g
0e ?:?1t g : g
6 : h 6
g :

s NHNq
g
:

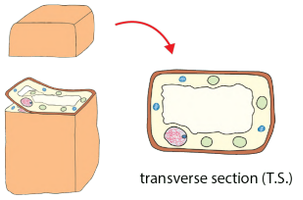
u o o i

l : v
: n
C== 6 q g ‘
k
!
?== 0 M
10e ?:A0 11t
r
A== == 0 M 1
0e ?:A0 11t
‘
: s :
:
r 7 7 6
:

s 6
0e ?:C1t



longitudinal section (L.S.)



transverse section (T.S.)

A Cb
0: :6
0k:r:1
1

A Cb
0: :6
0s:r:1
1

A C

A C

s NHO
l

s NHPv
: s 7 :

m

p o o i

‘ : h
:

v 6
: d 0f M
R O R t

o 7 : l
:

x

a

W

‘

a

n

n

a

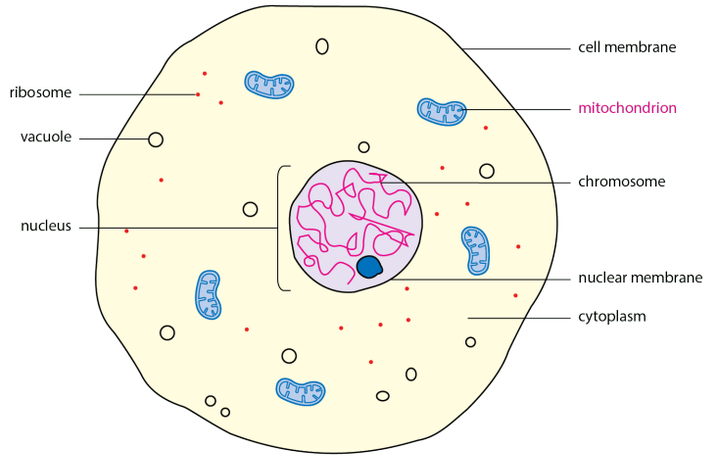
W a

E
E

a

a

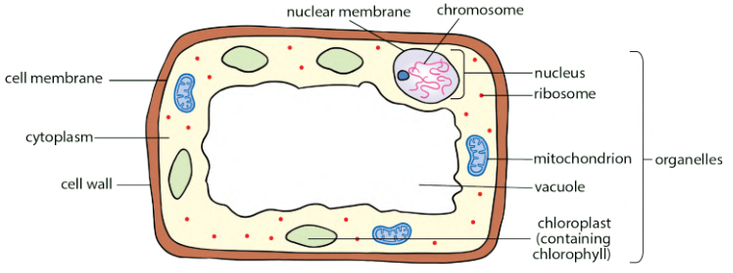
c 5
6C 5o I FOGF



cWj

F
Fs F
Fr C
F

j C
5o I F5GF
Fs
F C
F F



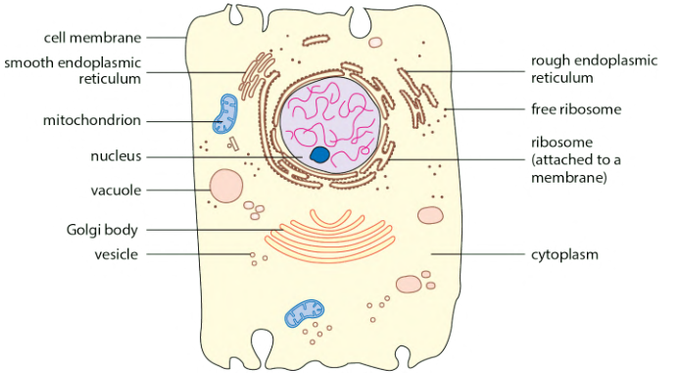
cWj

E
Fs
Fs F
Fj
F

y F
Fw C C
C
F F

w t

5o I FTGF
n Fn
C C Cp C
C F



cWy

F
F
F

c
s E F
s Fl C
C F

•

8

2k C:I 5:

y

N

WAu

f h W

x uW

x uWk u

W

I

I N

W

5

W

aRgh 2 9

k C:L

:

aRhm 2DG== 5

8 9

2k C:O5:2 R a

S a 5:

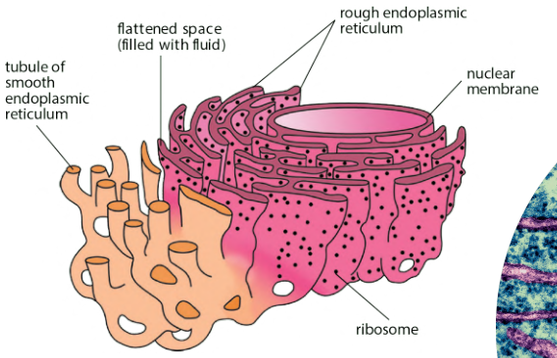
n

:•

2k C:C=5:

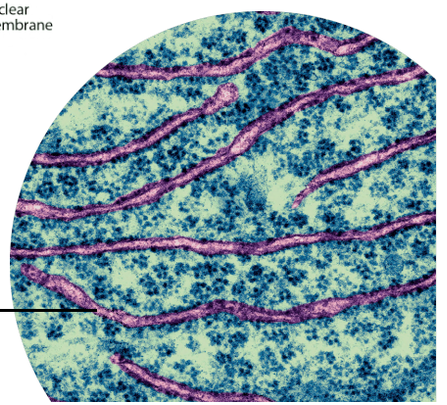
• xi x :

aRaVg



aR

• 9



:•

2xi x5

2k C:H G5:•

:

• xi x

:

•

:

oh

• xi x

l

:

mth

8 9

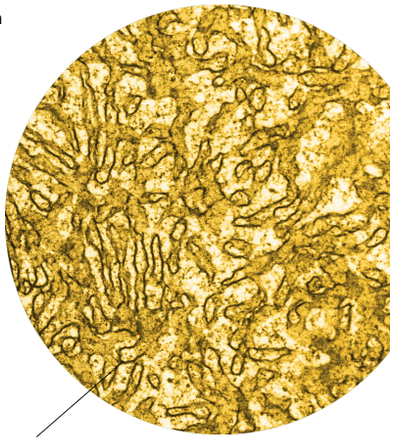
: yi x xi x 2 k C:CC5n

xi x:

• yi xR

2

5



aRaa

g

yi x

• 2 5

: n

: 2

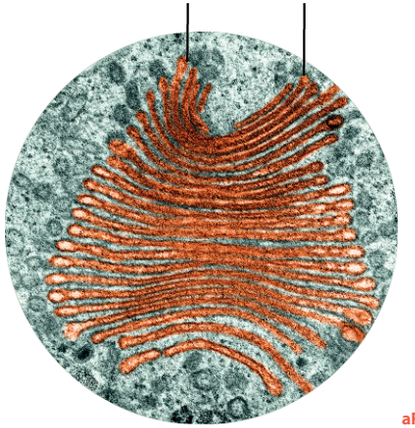
5

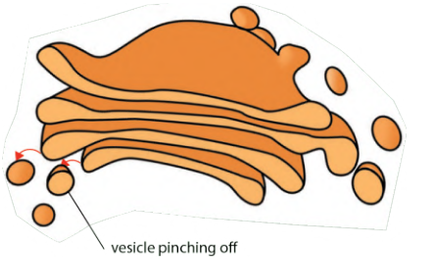
l

2k C:CD5

• l R

i x





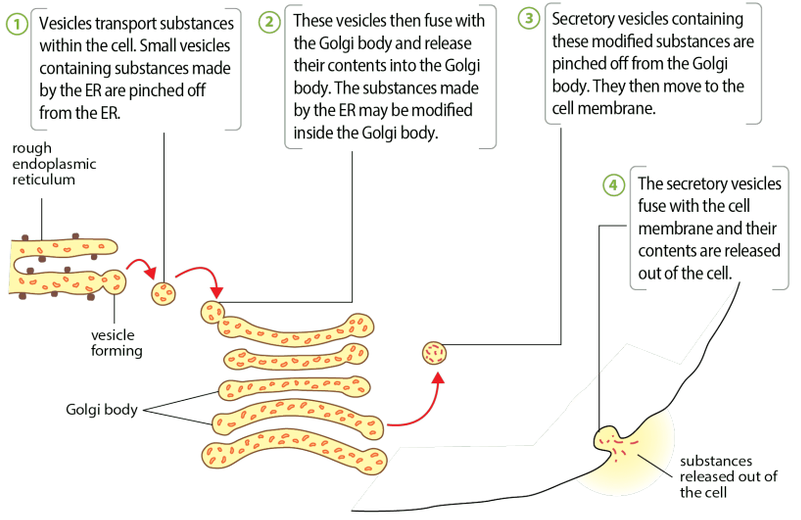
8 9• 9 l

aRbl

8 9g

l 2HDG= 5

i DIDF hv
?

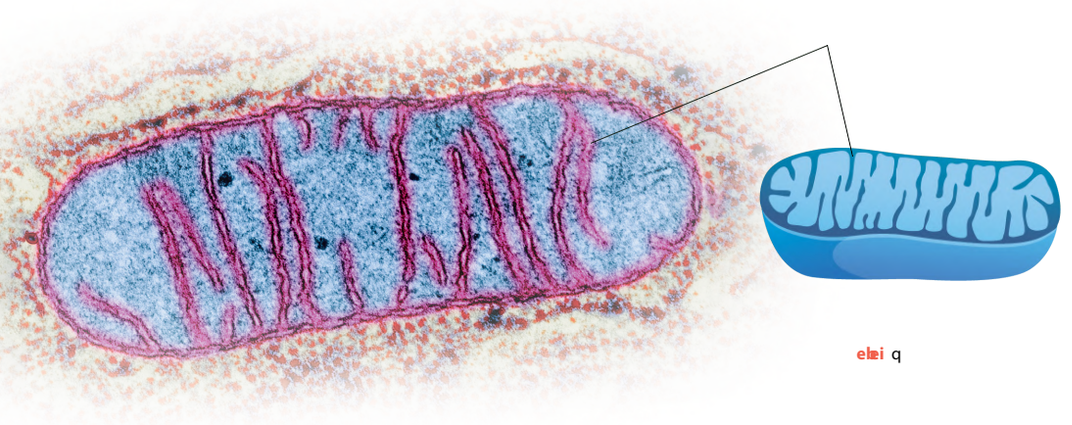


elehl

k

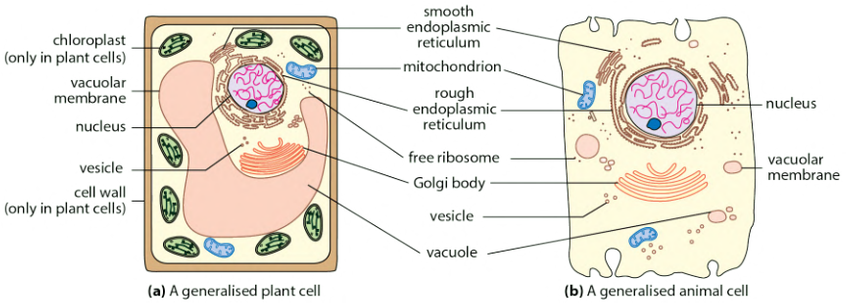
s 7
3 4 ?

3 R 4 :
3 DIDG4?d ?
g 7
3 f M4?x
?



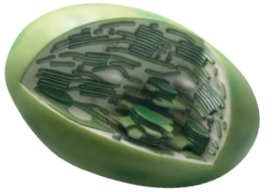
elei q

f 3 DIDH3 44
3 DIDH3 44?g 3 4
b

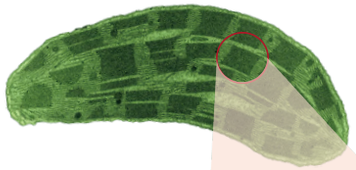


elel g

3 DIDL4?
f ?
f 7
3 f DE4?



6 Cx :



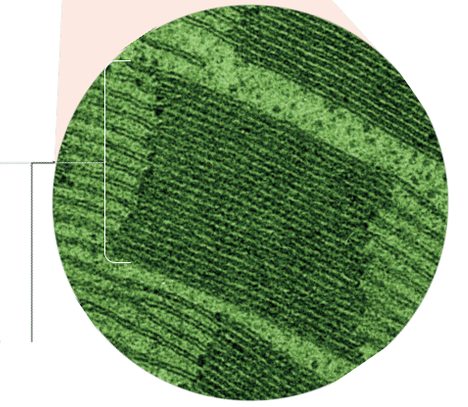
6 Cf

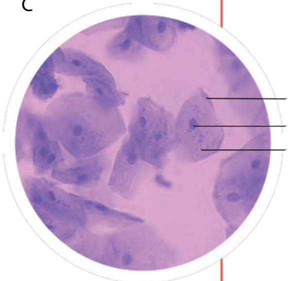
elenf

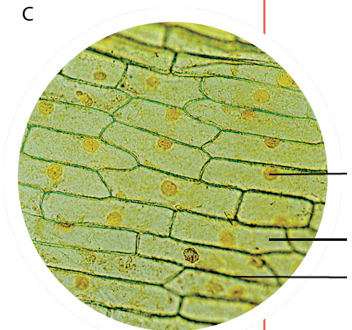
d :
?•
?

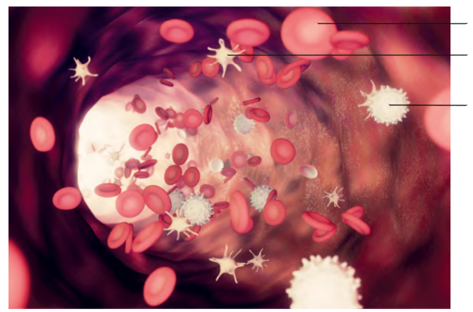
t
?
7
?

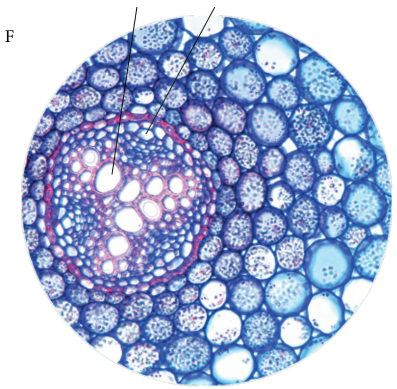
d
?x
?









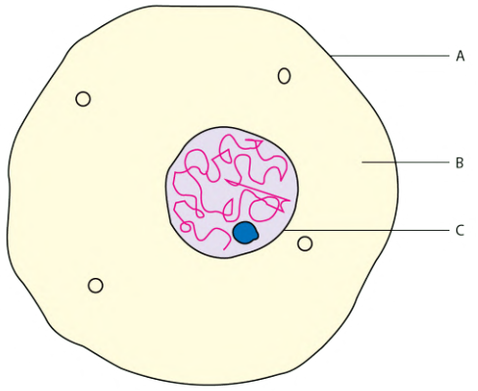


3 QIO

O e

? A ? A
? A s ? A
? A ? A
? A

P F
R r IFLI F
? A u mCn oF
? A u ks
F



t QIPO

cu

QIP w n p n t l

q : F F
C
C ?F

F
Fr e
C C
F

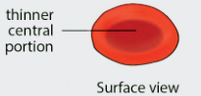
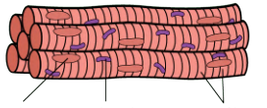
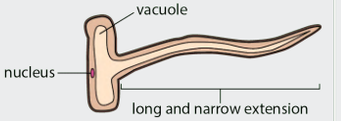
F
F

r
F

w p t l

IFL
F

QIP q

p	n t
 Surface view  Side view to show its biconcave shape	o : ? t C E E x C u
	u C t
	t E E

W

S
S
s
w dW

m
R

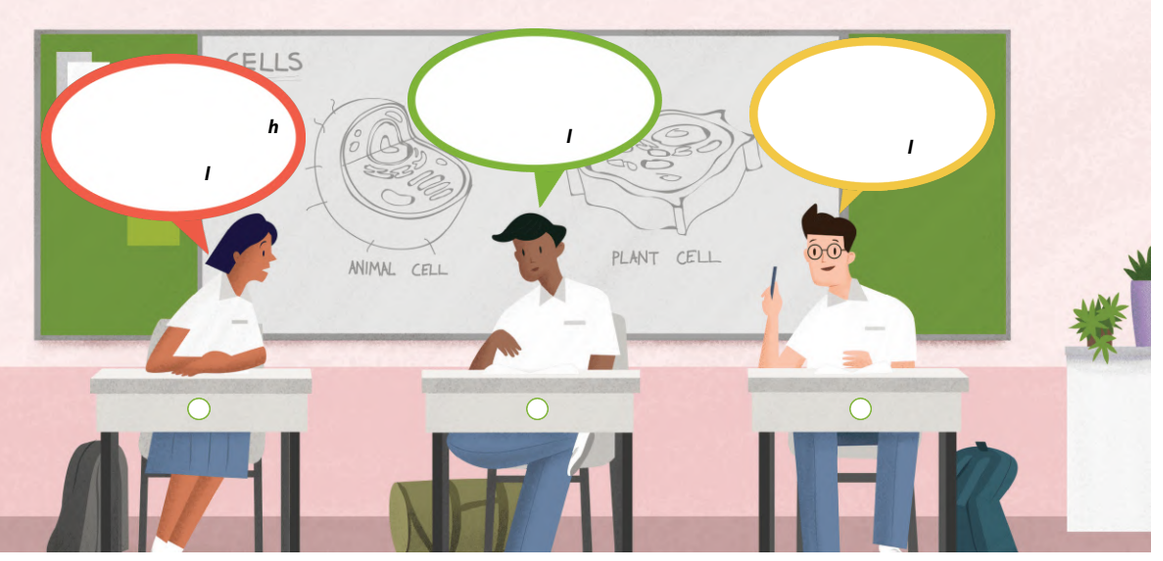
u
W
w cbW

F F
4r PISS5F
A F
C A F f
Fu A
F

t k

rht t

Aw TOvCr
o o

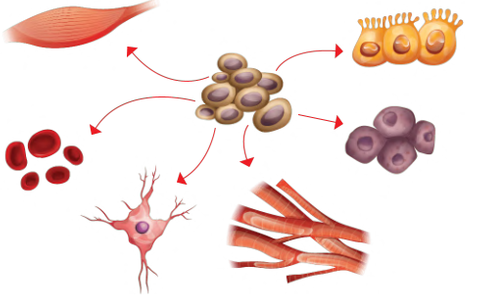


rhtu O o

4r PISWSF k
C
Ft A
F
Fm F
A
A F
r
F

rht

r A
A F
A A A
F
u A
F F
A A
4r PISa5F
Fo
Fm
F
Fu
A
F

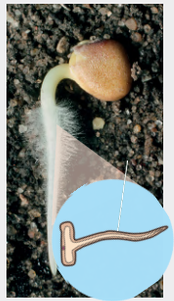


rht y
O

3 aSb

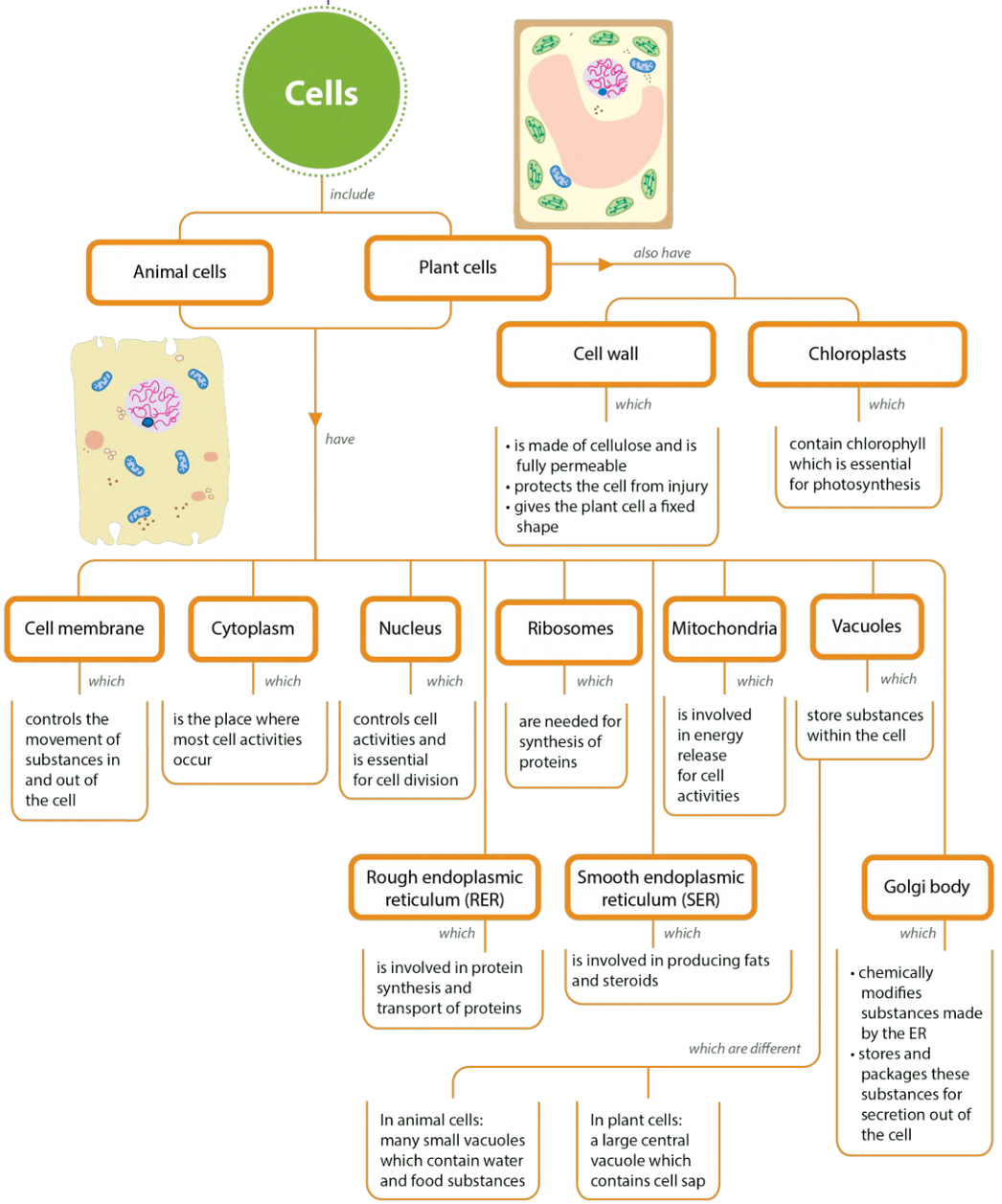
i fl f
f

aSc

		CF	
			
			

t
W
W

Let's Map It



FM

h
h
h

!
Co C
o
C
m x p
C
m x
Cm p
C
h h
h

aLW w r

l
E
l E

W

q E
Eo C
E

n LE E

aLWl

W x C C C E
a q C C
E
c E
E
d C
E E

h

v w r

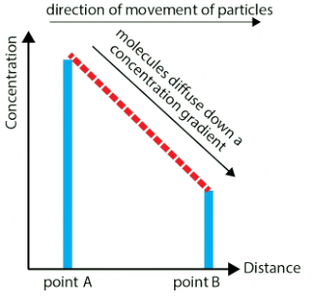
q n LE C i Ex j
C Ek
E i j E C
i j E
3n LE4 E

q n LE C
Eq i j C C
E
i j E

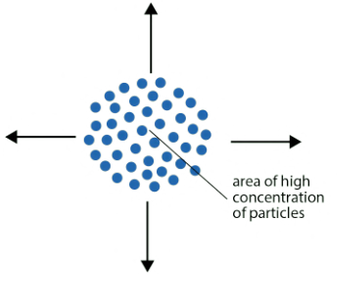
v

E

3 4 3 4
E Ei
C 3 4
3n LEM4E



ala o



alc i

h
h

h

q n LE C E
E
h
n

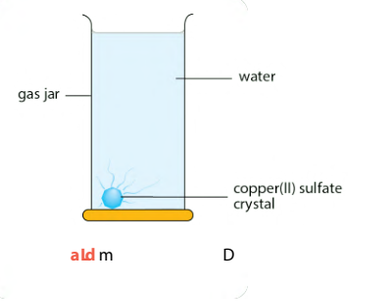
f

w

3 C 4
C C E

h
f
h

? aLW



Wl 3 4
n LE Ek
E
a w E

ald m D

f • ?
2n5
C
g d

f q 1 n GE? 2n5

Cn ?
C

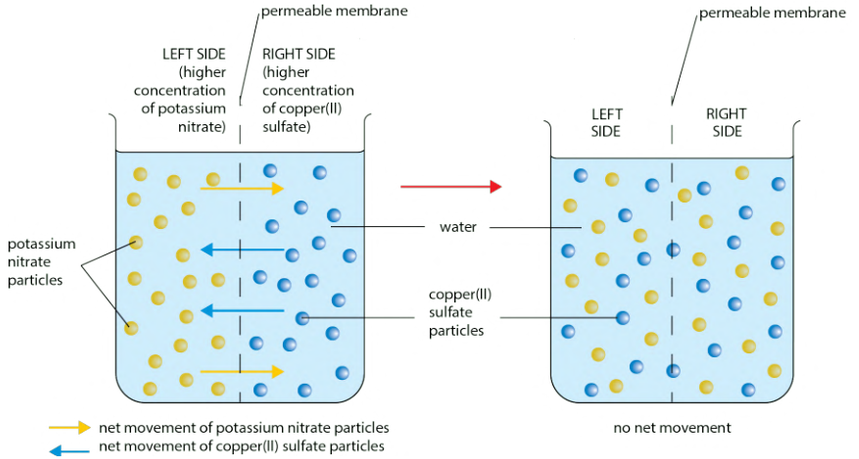
n ?
C

k GL C
f 2 5 2
5 C

f U
y 2n5
C

y
C

j ?
C



gbni 2n5

y U

A A

m
GFC

y
Cy
Cy
? ?
C

n ?
k GMCn Ck
?
C

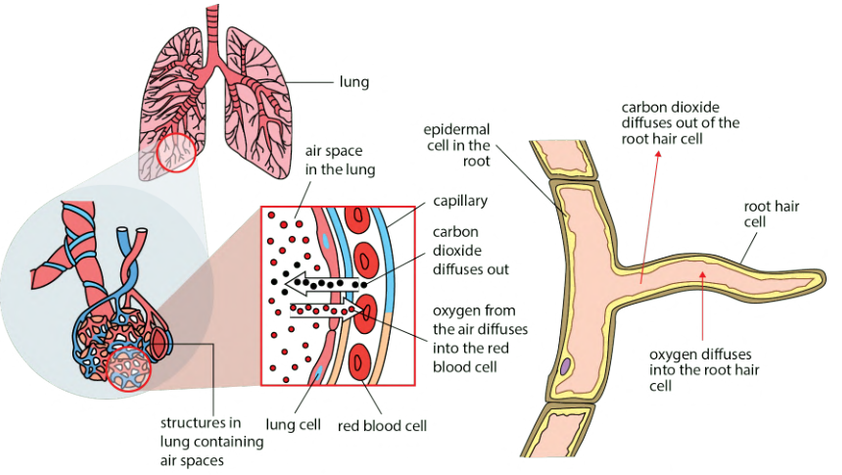
I

j
2k GM2 5Cu
2k GM2 5Cn
? ?
C

y
pe

y
hi e

e



(a) In human lungs **(b)** In plant cells

gbn l

h h

I f
C

p H H

d d

d

d

y

=h 8

=

y

2= = 3=k 8

=y

: : 8

=y : : 8

=

y : : =

7 TIT

d d

S h B 8C 8 E =

=

T h y C=B=

TIS x : :

s	1 cm 1 cm 1 cm **S**	2 cm 2 cm 2 cm **T**	3 cm 3 cm 3 cm **V**
	f b B B b B C x b b L B C b L C		
	× b B B B b B E		
H H	L C VB E		

k 8 8

=y B L C

B E =g E C C

B E =y : : =y

=y 8 8

=

q 1

k C=M=

n k C=M8 g f 8

f =y

g f =

y =f

8

=y 8

=y 8 =

j

=

X 1 cm

Y 2 cm

loss in surface area

Z 3 cm

p **r**

o

a Y a

a Y

a a

a Y x y

wa a

v TId r : :

H H n

h k C=S=j =h f g

B E =

: : f gd

Cell A

1 cm 1 cm 1 cm

Cell B

0.25 cm 2 cm 2 cm

Notice that the rectangular cell B has a larger surface area-to-volume ratio.

Cell A: Surface area = 6 cm²
Volume = 1 cm × 1 cm × 1 cm
= 1 cm³

Cell B: Surface area = 10 cm²
Volume = 2 cm × 2 cm × 0.25 cm
= 1 cm³

W

x

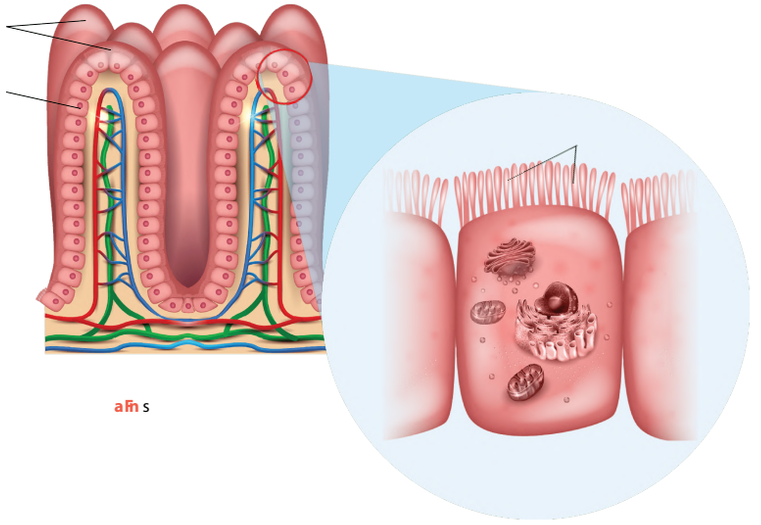
v TIe r

i

f

i

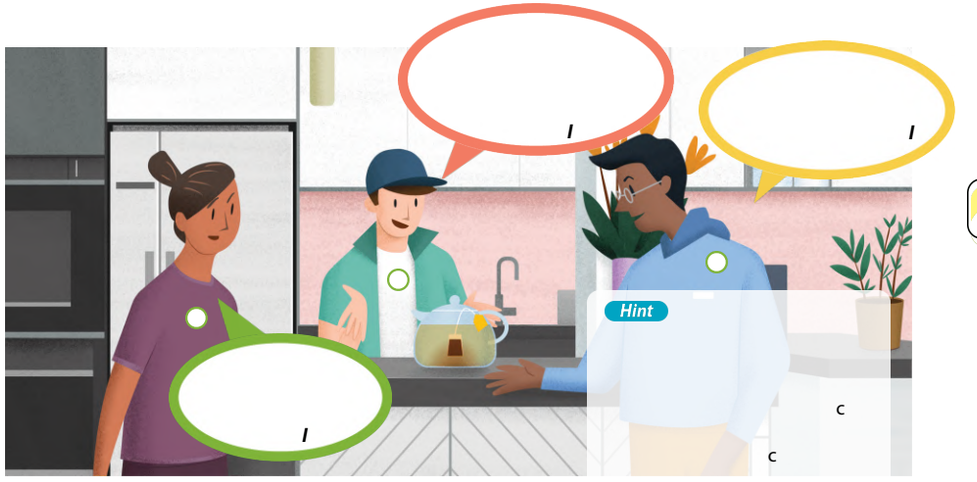
y 9 9
9 2k FA3A
y A
z ? ?
A
g MA



afn s

P ? ?
c
a m c

t 9 k FAEEA c
c g
A



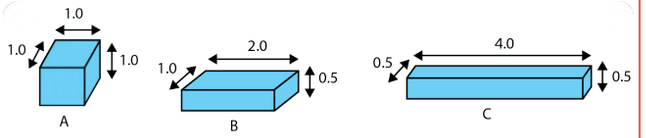
afPPz Ag A

Tt
P
T
T

2 afPb

z ? ?

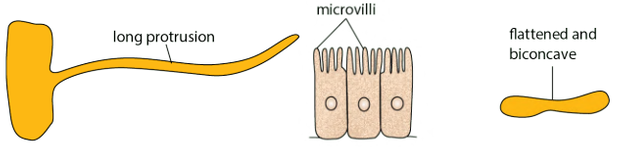
P • 2
3 2 3 k FAEDA
a g
A
b e 9
Ai Ax
A



afPLz

2 afPP

P 3 4 c
3 4 h A 2 3
c
a i A
c
b 3 4 m 2k FAEF39
2k FAEH3 2k FAEL3
c



afPa x afPb i afPc x

3 4 2 3 c

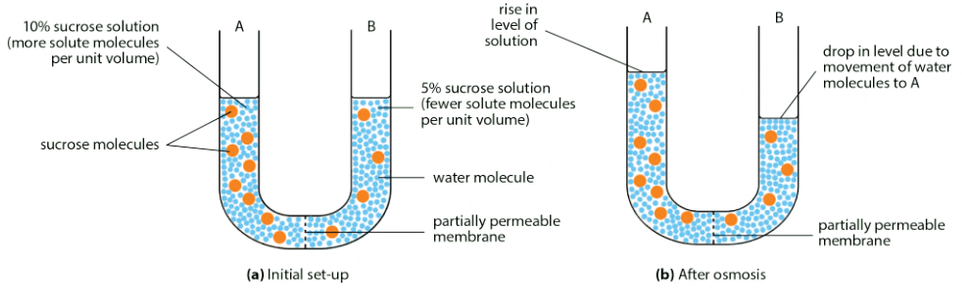
ct

x ct

RIR o

g g
?
g ?

?
i i DXCH
y : ?
x
?w 7 ?



w RIPb h :

f e7 d T
q
i

d 7 d 7 e ?

b
w d e
?
e d e
d?d

?

r Te d e 1
2?

i x
?

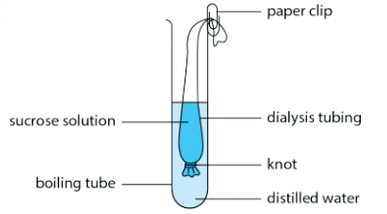
5 Rla

x

P x
?
R l : ?
Wy :
?f

?
a w
i DXCL?q
?y
?q ?
b w
?
c d DB 7
?

P bl
Lb
R : b



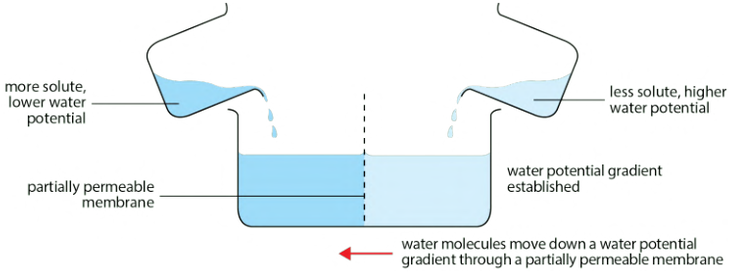
w RIPc h :

o

o

x 0 ?
?d 1
2
?l 7
?

7
1i DXCM2?
7 7
?

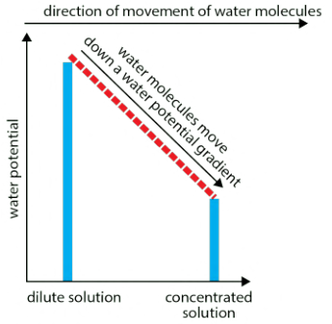


w RIPd

p MLa F

C F

SHPg r



s ? x n CF-
C
x n B ? B
Cy
x n
C ?
C
r ?

SHPh

C
Ck ?
lo I CEa2C
?
C C
x n g

C c

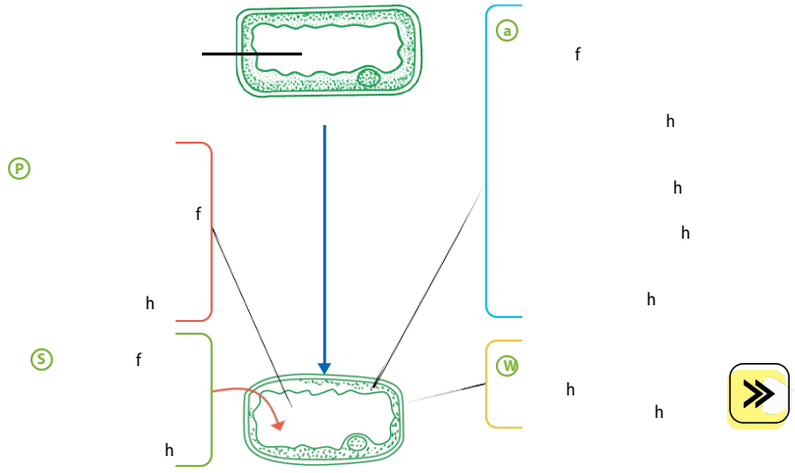
E E

v s p

k C F
o C
F

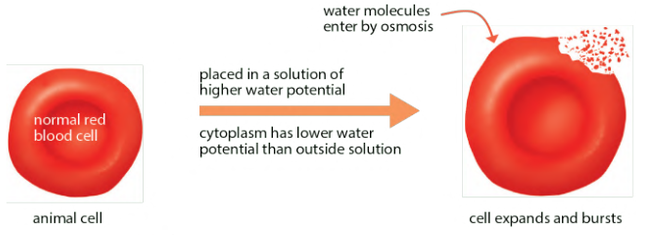
nk
F
F

u
p
C
2
8C 2 8F
k F
2p MPMH8F•
F



SHSOk

k
2p MPML8F C C
F



SHSPk

u
p
m
F
Fs C
F

r
C
l aC

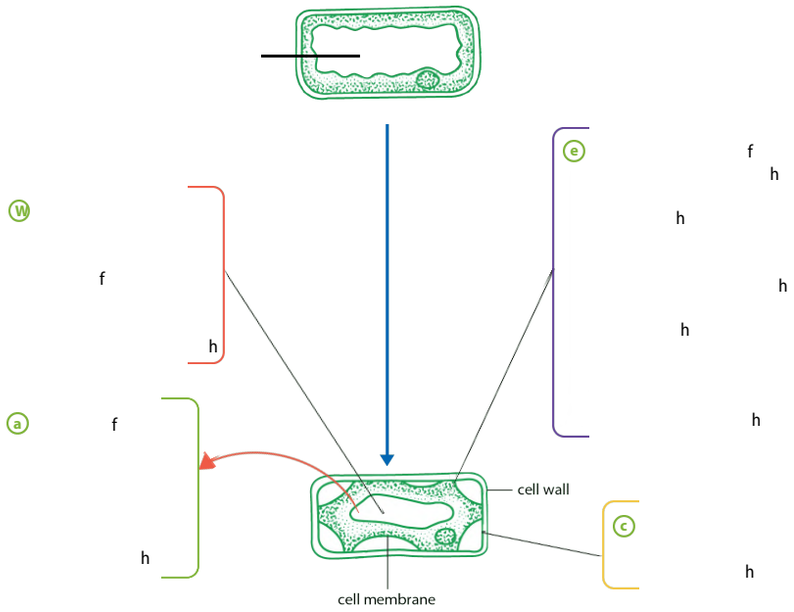
o
p

? ?

C

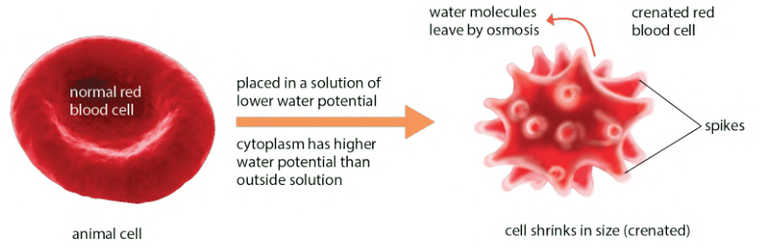
t

C C
4
5C 4 5F
l 4 PfPPSF



aRea l

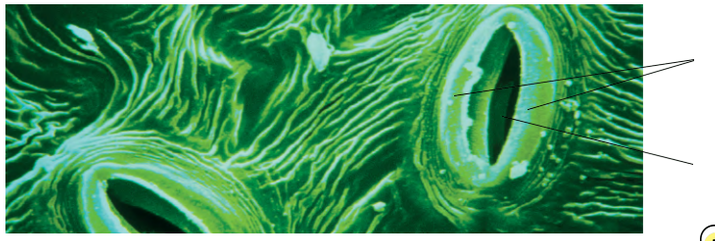
F 4 PfPSSF
Fl
F



aRec l

t

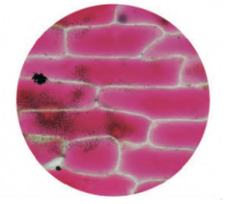
C C
F
E F
F
C F
Fr C
4 PfPTSF



aRee p

4 PfPUSFn
F C

F
u C
C F
C 4 PfPWSF



f i

f i

aReg n
4 5

f i

k

f i

k

aReh p

v 3 s **I BD**

a c

t

Bx

i FBFNBi ?

h Ff t B

m ?

bl

b

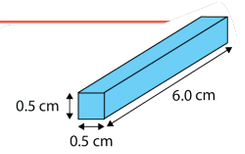


Figure 2.27 d

t

v 3 s **I BR**

a c

d 7 8? B Bf ?

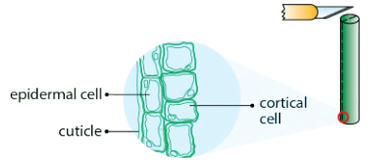
Bi FBFO7 8 Bd

T Bs

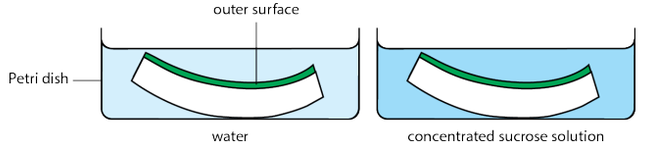
B

s

7t FBFO7 88B



o I BT4 5p



o I BT4 5f

t Bf h Fg

t B

t

v 3 s **I B5**

d?e f B ?

H ? C B

F

l

I

x

x

x 7 8 B

B

L y

g B

M

h C 7 8 S

h	i	l

O g B

l	m	m	l
w d			
w e			
w f			

7t BB

R h B

x FBF B

I B g

m	
r 7 ? ? 8	r
q ?	q ?
t	t

? a

Wn D A Du 2 3 2 3 2 3 D

a f D d d

Figure 2.29

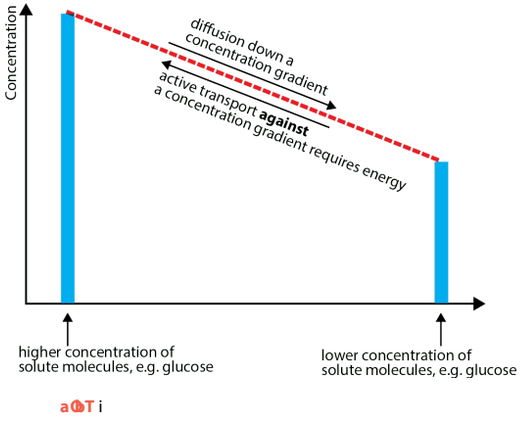
bs

a t r

i C A D

r D

t A A D



aT i

• I D

a i

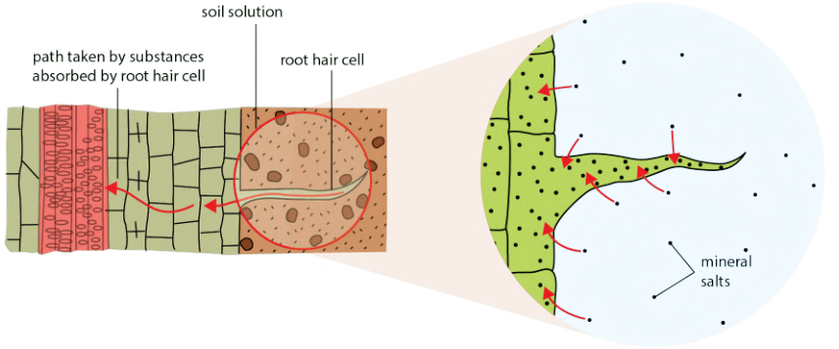
	t
t A	t A
k	k
h	h

t r

f Do A D

o A A D

o A A



aWx s A D

? a

W d a t D

D

p t e L

p t hL

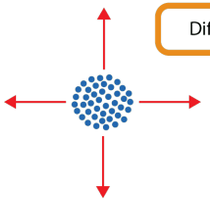
p t ab L

bt 8 r 8

Movement of Substances Into or Out of Cells

achieved by

Diffusion



which is defined as the

Net movement of atoms, molecules or ions from a region where they are of higher concentration to a region where they are of lower concentration

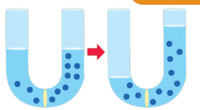
and is different from osmosis as it

- Refers to any substance, gas or liquid
- Does not require a partially permeable membrane

which share similarities as they

- Do not require energy from respiration
- Involve movement of substances down a concentration or water potential gradient

Osmosis

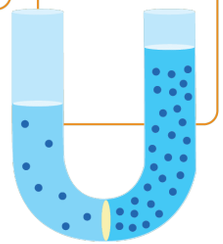


which is defined as the

Net movement of water molecules across a partially permeable membrane, from a region of higher water potential to a region of lower water potential

and is different from diffusion as it

- Refers only to water (solvent molecules)
- Takes place across a partially permeable membrane



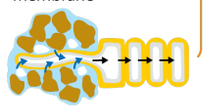
Active transport

which is defined as the

Movement of particles through a cell membrane, from a region of their lower concentration to a region of their higher concentration (against a concentration gradient), using energy from respiration

and is different from diffusion as it

- Requires energy from respiration
- Involves movement of substances against their concentration gradient
- Takes place across a partially permeable membrane



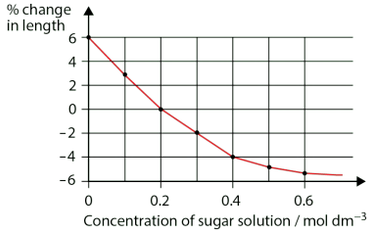
2

pe C

L

B

m HBLHB



v MDQM

e

p DBDS L r DBF L

s DBH L t DBM L

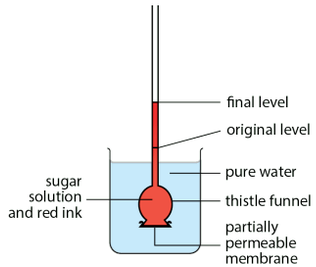
M g

m HBLBg ?

B

B

e



v MDQQ

p

r

s

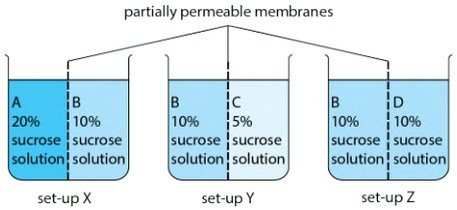
t

re

L g A ?

g?h?i k

m HBLMB



v MDQR

sev C

L k ?

B

M o e

Q

e

Z

3 4 a

3 4 B

Ta

c
c
c

h
cy
=
7
=
c

aOW r t o

p =
x 7 =
x
=
h 1 2
1 f 0 2=

y

e =y =
s 7 7 =g 7
=
=e MA, =l 7
=

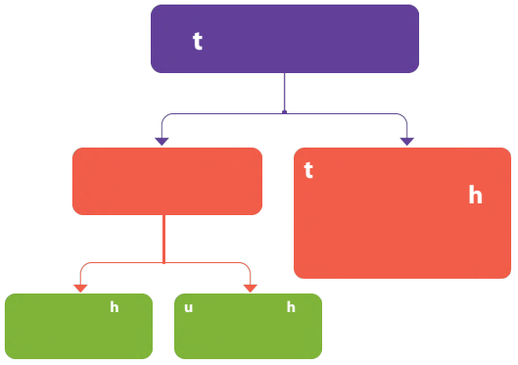
t

j D-B =

t 7 =
y CSB=

j S
$g_L l_{BC} t_L 1$
BCl SLt a Cl SBt 2
1 2 $g_{BC} l_{CC} t_{BB} 1$
CCl SBBt a Cl SBt 2

g 7
1j D€2=



y aOYg

y aOWj

i g
g
g
i g
i
i

C A
C
3n LC4C

oi

i d C

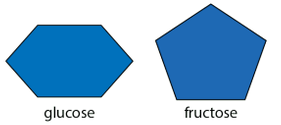
i Cq
C

3 LCH4C
Ak$_S$p$_H$w$_S$A
C
C

i cgw

o	n
n	k A

o Cn
C
n LCOC



i d

i C
k C
u 3 4 Cu
C

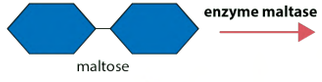
C

i
C
6

n LCOC

i cm

i
Cn A
A C



ri

s m g

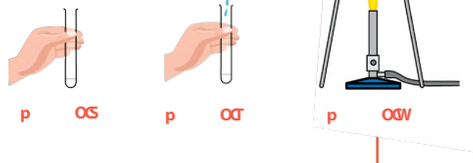
j 7 9v
e /
1 o / l G9C29w 8
9

w 4 t OCI

x
e /

I t F G 8 1i G9L29
L d F G e / 1i G9M29
O w 8 8
F G 1i G9N29
P v 9

x G9F
e /
9



p OCS p OCT p OCW

OCL f

	i
w	r
e /	x
e /	p
e / Av	o

i G9P
9

p OCa

S

x E
SS E
S
S
S

w cs

m m

i m m g

d
9

w 7
9x
7 9k 7 7
9x
x G9G9

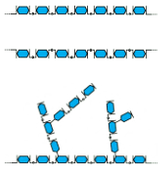
OCD x

m m			
w	d 9 9	l 9 7 9	i 7 9 9
f	d 9x 9	x 9 f 9x 9	t
j	j 9l 9	l 9 7 9	w

S

u E

lx cSaVaS



p OCH

x Sx
S E
S

w ! w p OCI w 7
S
S
E lx cSaa3S
E F S
S
S

v o v

mc

Az

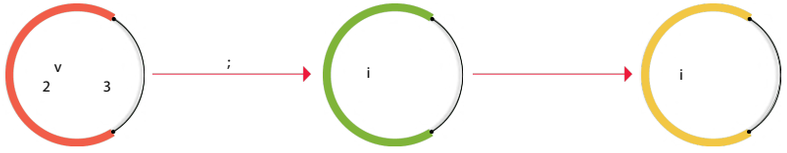
A

v i Ak ;

Al ;

2h GADF3A

R



u TIPS i

i R

w ;

A

w ;

A

w ;

; A

w ;

A

p

v Az

;

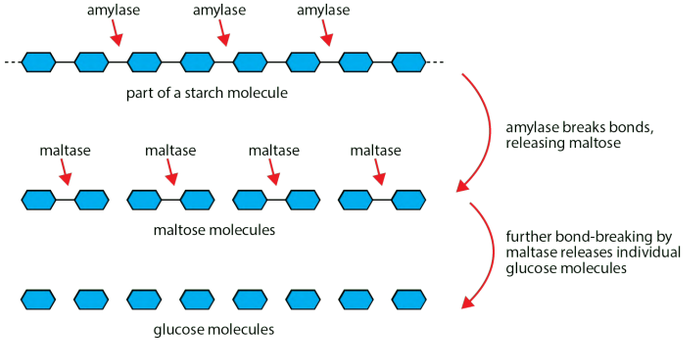
A

w Ac

Ap

; Aq

2h GADG3A



u TIPT f

r

v fR

o u r l

e R

; S

; ; S

S

; ; f q c S

; ; ;

S

A

A

w r l

v Ac

? A

? y TIS

w

P c A

S u A

I ?

2h GADH3A

u TIPWI ? A

? TIP

P f A

S f A

T r A

Wz

d 1

a

r

w t r

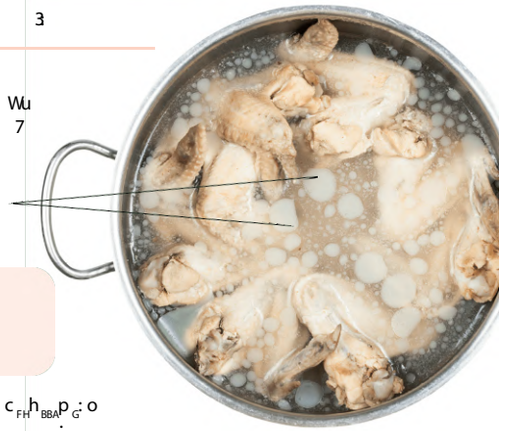
v h

be R

x dt

SDD o u m

m :
t :
t 8
:
d 1 3



h
Wu
1f DBF3 x 7
W

u
f :

u 7 7
7
: b 7
:

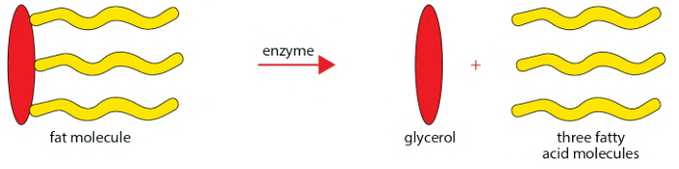
f 7 1 3 $c_{FH}h_{BBA}p_{G}$: o
:

l u SDa u
n

f : f
7 :

u r p p s u o w

f : s
f DBG:



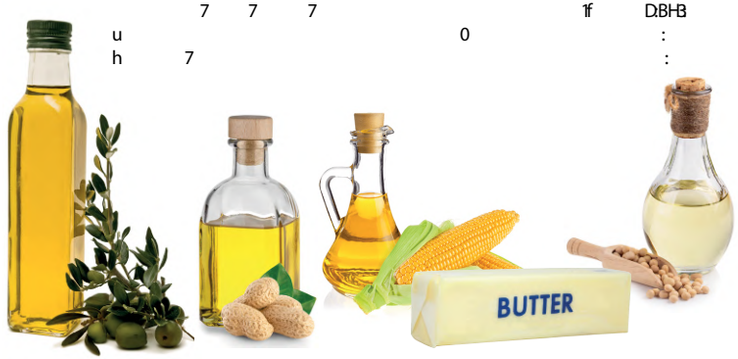
u SDc a :

u : f 7
7 N

A
1 3

o u m

f 7 7 7 7
7 7 7 1f DBH3
u 0 :
h 7 :



u SDd e

o u u m

h 7
Wk Wh
W

f N
a 8 :
u 8
:
a : f 7
1 3 7
1f DBL3
a 8
:
a 7 :
a : g
:
u 7
:
u :

u SDe t 7
:

f

f

sf

u o s k

w Bd
Bd
B

2 v PFP

w

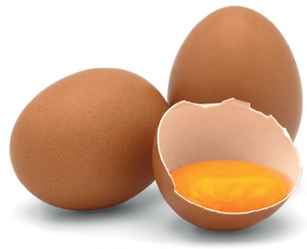
L r 2 B B 3R
3 9 d F H
A B
3 9 d F H B
3 9 u B
Or 2 B B 3R s PfLd d
3 9 f Bl :
A B B
3 9 d F H A
B
3 9 d Bf
2 3 A
F H B
3 9 u B

w 2 HEEP3B

2 PfO

L o B
O o B
P g B

y o“ H
N H
N
?w bNTAN
v H N
o“
o
or o
H H
N



s PfOl h :
oy d: g h: B
o

s

PfP m k

o B
v B
v
B
g 2 3B

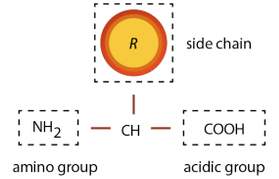
y Bl
: 2 A 3 B
w
B

: :
Bd : : B

s Bw
Bs
2 HBFE3B

m m n n

d
Bd
2 q k F 3
2 f r r k 3
u:
3Bw
R



s PfOL i B

w FD : :
Bw B
d
: FM
B

t

o m m s t C

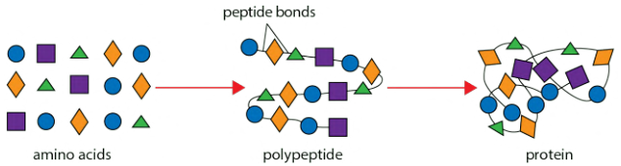
o

Br

Bc

3h HBFF4Bk ?

? A B



s PRLL c ?

B

m i

r Bo ? ?

? ?

3h HBFH4Br ? ?

h B

m s i

r S

?

A T

T

B

s PRLP g

u o i

r Bv

3k4 Bk 3 4

B

2 v PRS

v 3 B B 4

I v F H 3 B B

4?

B

L u

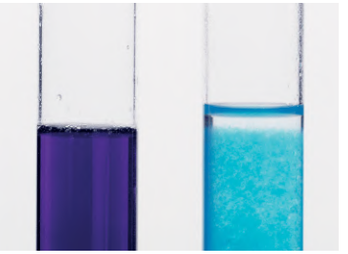
B

P t B

s PRLS c 3 4

Bk

? B



c 3h HBFI4B

y a

2 PRP

I 3 4 n B

3 4 n B

L f B

P h ? c?d eB

v v HBB

PRS t

	m	n	o
c	k	k	d A
j d 2	t	t	u
c	u	x	x

3 4 w ? B

3 4 f B

3 4 q B

' fv

fv fw

v

x

a

W

S a

s

vt

Let's Map It

Biological Molecules

Carbohydrates

Organic compounds made up of carbon, hydrogen and oxygen, with hydrogen and oxygen atoms present in the ratio 2:1.

which can be

- Single sugars
  - Include glucose and fructose
- Double sugars
  - Include maltose and sucrose

which can be identified using

Benedict's test
- Remains blue in the absence of reducing sugar
- Turns green, yellow, orange or red, depending on amount of reducing sugar present.

Note: Sucrose is a non-reducing sugar.

Complex carbohydrates
- Are made from glucose molecules (e.g. starch, cellulose and glycogen)

which can be identified using

Iodine test
- Remains brown in the absence of starch
- Turns blue-black in the presence of starch

Fats

Organic compounds made up of carbon, hydrogen and oxygen, but contain much less oxygen in proportion to hydrogen.

Fats are synthesised from fatty acids and glycerol.

which can be identified using

Ethanol emulsion test
- Remains clear in the absence of fats
- Forms white emulsion in the presence of fats

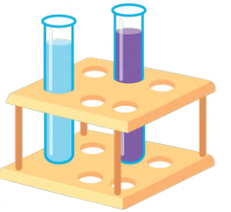
Proteins

Organic compounds made up of carbon, hydrogen, oxygen and nitrogen. Sulfur may also be present.

Proteins consist of one or more folded polypeptides, each made up of a chain of amino acids.

which can be identified using

Biuret solution test
- Remains blue in the absence of proteins
- Turns violet in the presence of proteins



u“ s w

FS

Let's Review

oc B

L m 1
B

RBTB

QCT

	r
L	
P	
R	A
S	

i

	L	M	Q	S
o	GBGT.	GBT.	LBT.	GBL.
p	LBG.	LBG.	LBT.	GBT.
r	GBT.	GBGT.	GBL.	LBT.
s	LBG.	GBT.	GBT.	GBL.

M

i

o **p**
r **s**

Q 1

i

o **p**
r **s**

pc

L l ?
A ?

B

B

3 4 l

i

3 4 s **3 4**B

M 3 4

B

3 4

B

34
3 4
3 4
3 4

3 4

B

34
3 4
3 4

r cu B

L

B

i

i

i

” ?

P p”
R” Rs

R p

hQ y v

h :
A

z

f Ar
A

e :
A

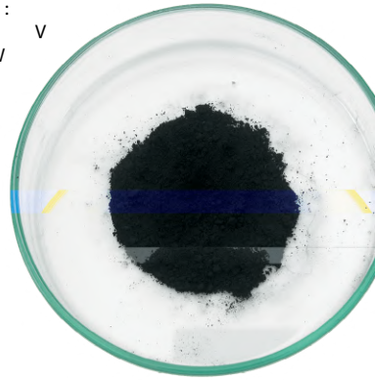
k : 2- m3 2 3
Ay A

2- m3 E

° 2- m3 ; : A
l 2- m3 A
n 2n 3 :
Ar 2n 3 V
W
A

e : 2n 3
:
Ar 2n 3
2k GAD3An
m A

n :
:
Am :
Ag
A



hQ r 2n 3
A

y z

Ay
Ay A

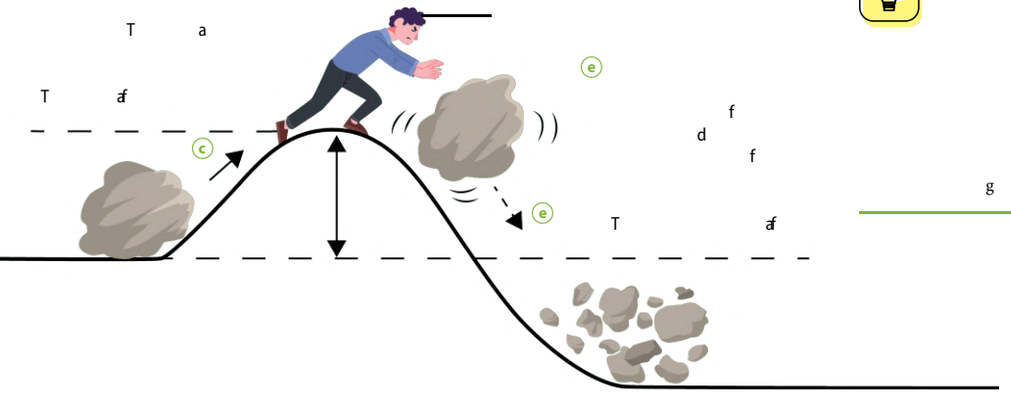
i ;
A

z
ng

y

k
Ay An
:
A

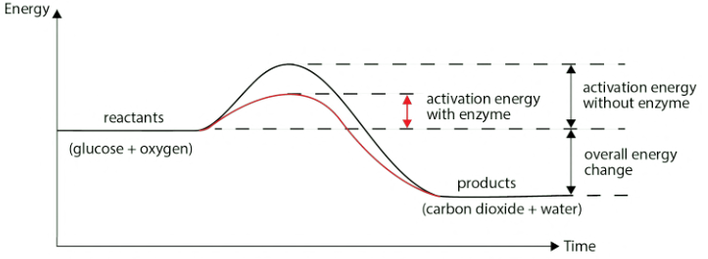
2k GAE3r



hQ e A

i
Ay 1 1A
y k GAFAi
Ay
A

k :
2k GAF3 2FL g3A



Note: If the overall energy change is negative, there is a decrease in energy content (as shown in graph). If the overall energy change is positive, there is an increase in energy content.

hQg e ;

g

g

g
g

z y u

H

H

r

f

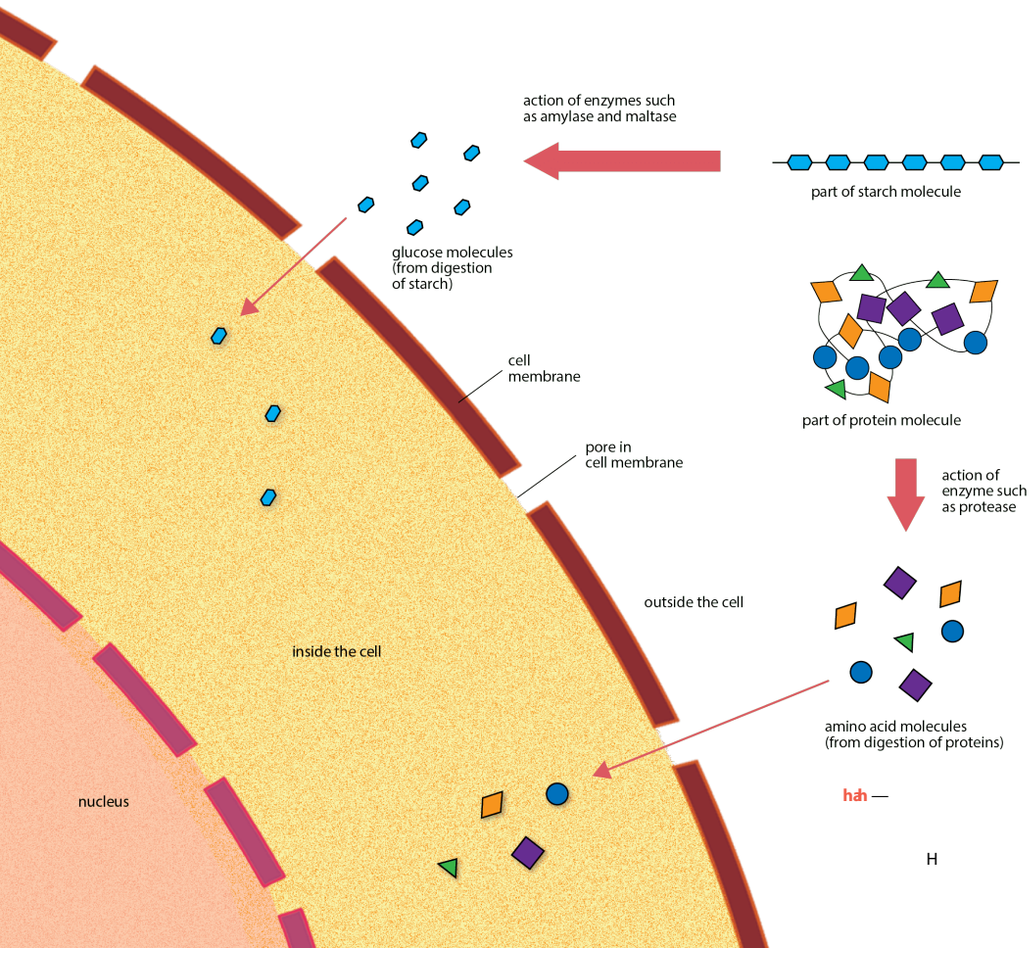
:s THA

r H

r f

um

E



hah —

H

x x z y

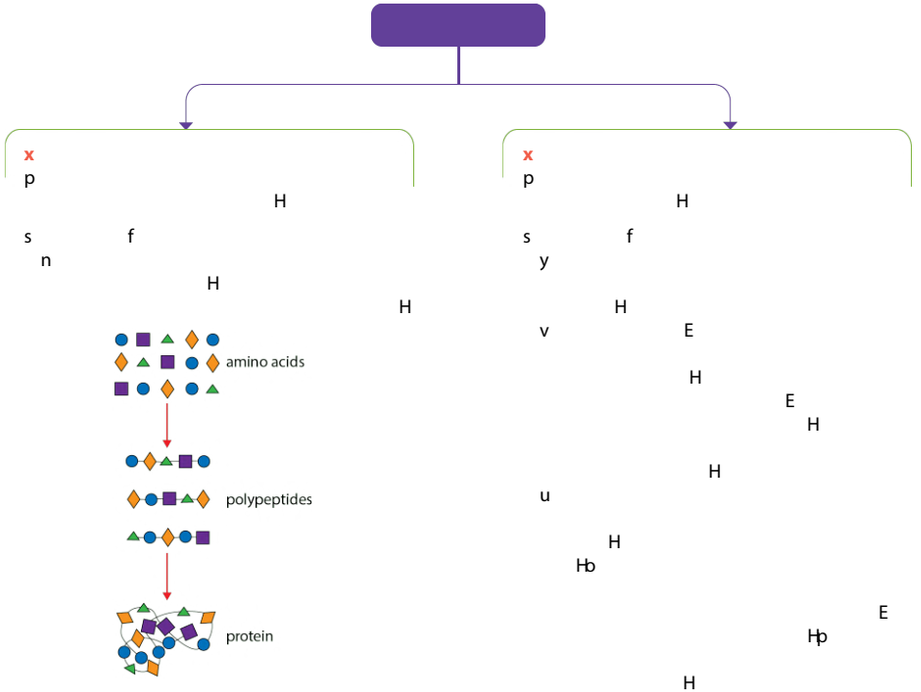
r H F

f

: A

: A

s THa H



x

p H

s f

n

H

H

x

p H

s f

y

H

v E

H

E

H

H

u

H

Hb

E

Hp

H

v E

H

H

ha F

s E

H

u E Hs E

H

r ODV. – Co

t l p i

x C
Fn C 6 7
C. –
6n PF5ZC Fx 4
4 o F

p C
Fv C
F. a

4

n C
F

t l p n i

m F
n a

6 7

z 3 ODH

H46 f
46 f
L.
F
46 q F
46 –
F
Nz F

f

ODL l
n p i

z

m C
C
E E 4 F
q p
E F

F
p C 6n PFTZC
C
F f q
F

r OBa m E

t o p i

m Fn C
C F– C
C F.

F

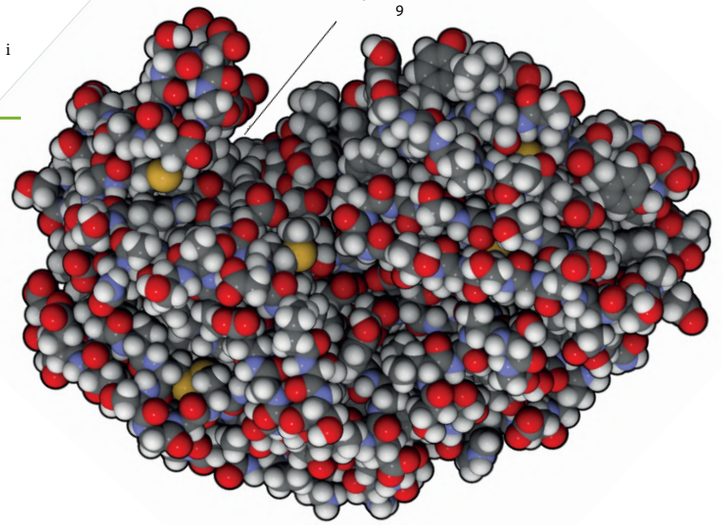
j C
E C C 4
E

F F 3z

Eo A
E

j C C 4 A
8o SEa9Ej
8 9 4
89
E A E

i g
8
9
i
i



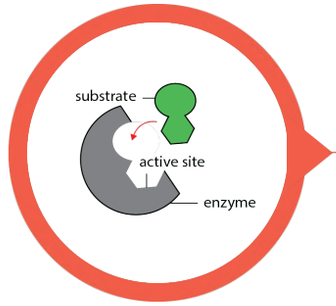
x bHy C

A
Er
E—
89 89E
89 89 E
E

c v C ⇌ v ⇌ v C

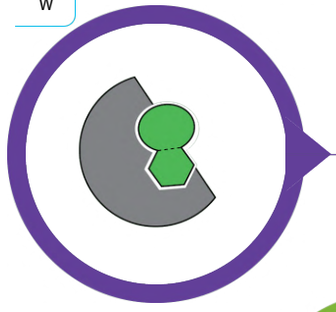
v f
f 89
f 89E

o SEbE



s
T AdTv D
W-
W
W

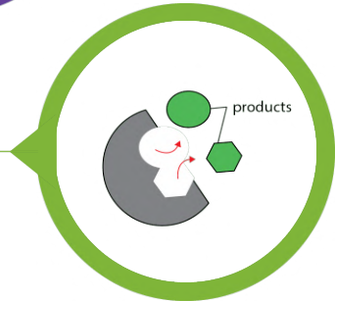
dTv
W
W
W
W
T T 3 W



a
O
W
W

I

b O
W
W
–
W



y

x bHh

y

I n

n l fi

i Ai

A

n h h

i As

A–

5 Al 5

5

A

n h fi v h fi

n fi

i Aw

5

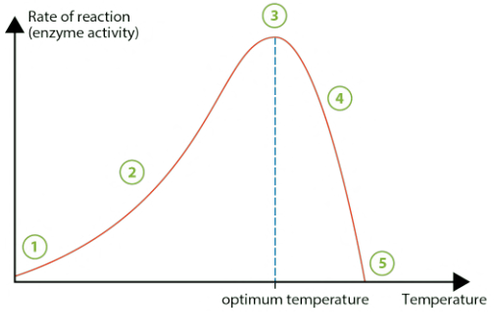
Ax 5

Aj 5

A

n h h

j HADC A



o LÆDi

E **h** **A**

e 5 Ai

Ax

A

F **h** **6** **A**

m Ax

1AA

2 Ax

7 A

I **6**

A

j 5 HC HI gA

L **r**

A

x

A

M **h**

q A

m 7

5

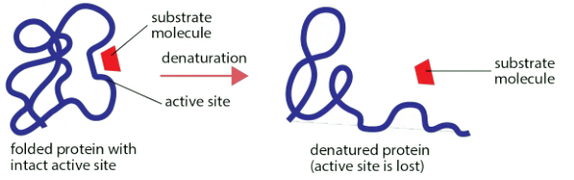
A

h 0

1j HADC2Ax 0 5

Al 5 5

A



o LÆEe

5

Ai

A

u 1 r LÆ

x

E p 7 $e_D5f_D5g_D$ h_D I F

A

F p 7 h_E F F 5 7 e_E5

f_E g_E F F A

I w 1 j HADE 2

7 7

A

7	e_D5e_E	f_D5f_E	g_D5g_E	h_D5h_E
C I	C	FM	DCC	FM

L e I 5 7 $e_E5f_E5g_E$ h_E

7 $e_D5f_D5g_D$ h_D5 Aw

7 Av 7 A

Me D 5

Ax

A1x 7

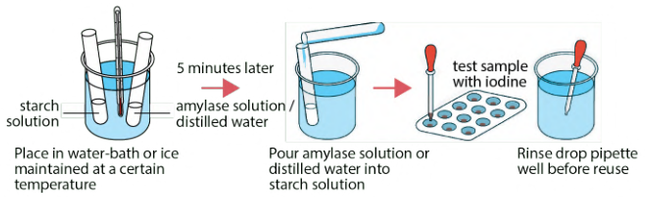
A2

R g I D7

Ax A

S v 1 2 1 2

7 A



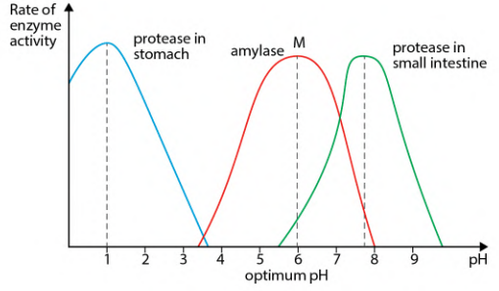
hlæf k A

e z A A f E
EA B
f z A g E
B
g z A A h E
EA B
h z A A i E
EA B

e z ? B
o ?
E 4 5B
E d

k
By 4 ?
5? 4 ?
5B n
? Bk
B

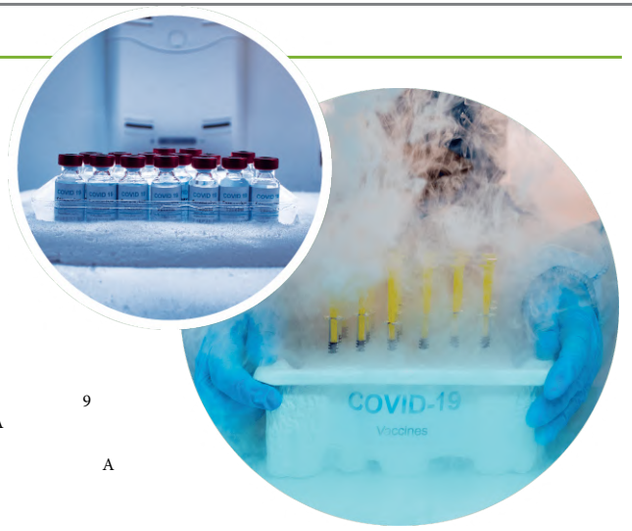
i 9
o l lBEH? s n
N4 n5Bf 4 n N L5
9 4 n N T5? Bf n l n T?
mAy B
mA



hlæg k n

x v w
m
A

x g t – rh : DR An 9
OC g A
e 9
ws e 2 4
Ax
9
: Ay
9
A
y A
i
2k HAHHA



hlæh y h ÆT

Bt l lBELB
d

hlæi z B d

z r . n E:C
0 1 : v 6
: z
m :

2 eM

z m

a r 6 d4e4f g4 :
b i 6 P

eM

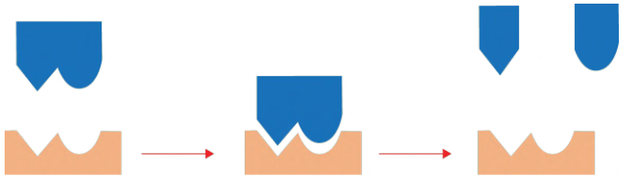
L	
d	3 BA 3 D D
e	3 BA 3 D D
f	3 BA 3 D D
g	3 BA 3 D D

a 6 b
6 b
b 6 e 6 gb

o o

2 eM

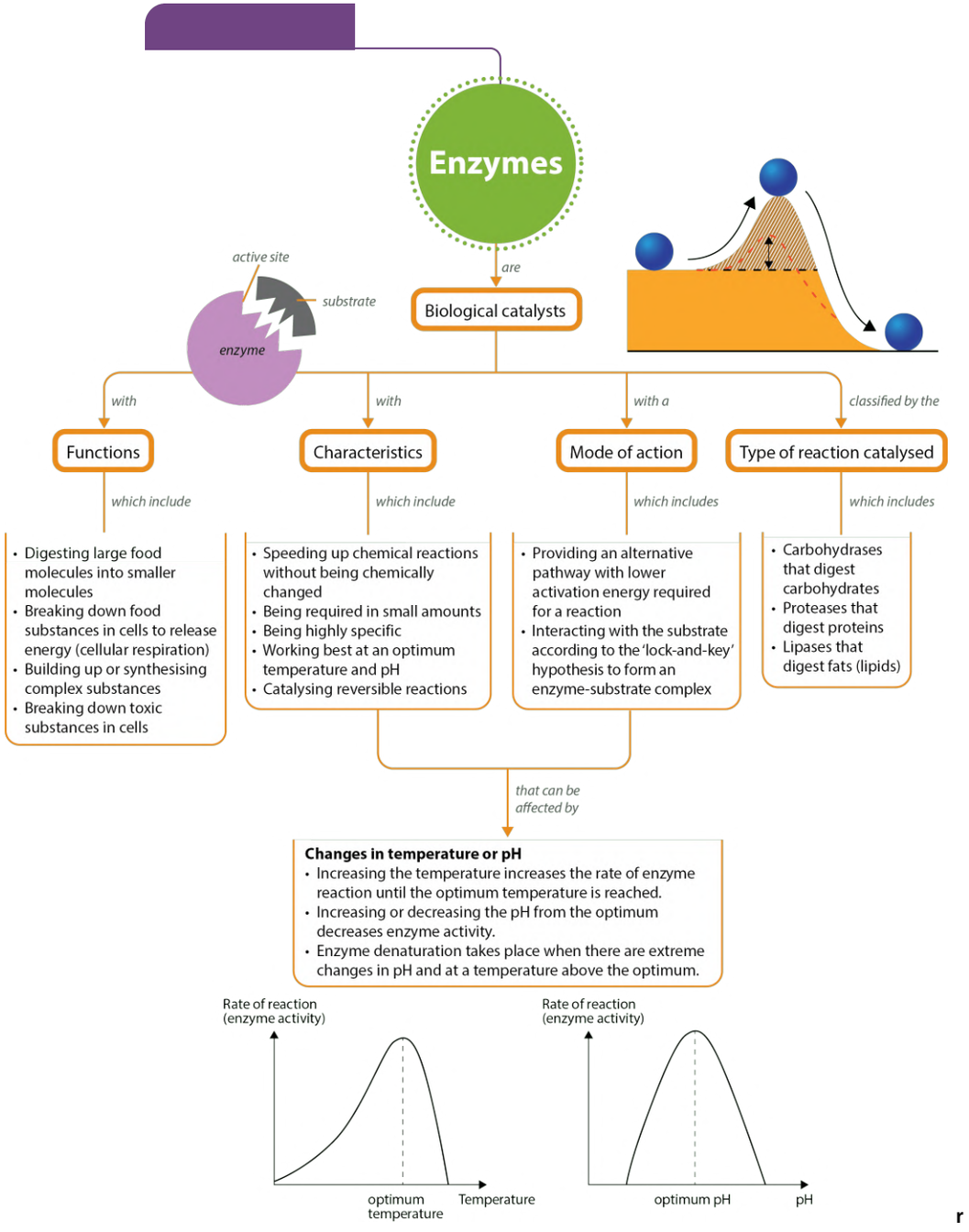
a i E:BH :
4 6 t :
4 6 y 4 :



eMh

b b

o
E
E



o r