

BIOM1010

9b[]bYYf]b[']b'A YX]W]bY'UbX'6]c`c[m

HYfa &Z&\$&&



7 ci fgY`Cj Yfj]Yk

GHJZ`7cbHJW`8YHU]`g

7cbj Ybcfg

9a U]`	BUa Y	9a U]`			

7 ci fgY'8YHJ`g

I b]hg'cZ7 fYX]h*`

Gi a a UfmicZ\hY'7 ci fgY

H\]g'Wci fgY']bfcXi W'g'hY'Z]Y'X'cZV]ca YX]WU'Yb[]bYYf]b['k \YfY'hY'df]bW]d'Yg'cZYb[]bYYf]b['UFY'i gYX
lc'gc'j Y'dfcV'Ya g']b'a YX]W]bY'UbX'V]c'c[m' Hcd]Wg'Wc'j YfYX']bW' XY'U'VUg]W]bfcXi W]cb'lc'V]c'c[]WU'
gmghYa g'zhY'Yb[]bYYf]b['UddfcUWX'lc'V]c'c[]WU'gmghYa g'UbX'hY'Udd']W]h]cb'cZVUg]WYb[]bYYf]b[
W'cbW'dhg'lc'gc'j]b['V]ca YX]WU'dfcV'Ya g'k]h'YI Ua d'Yg'Z'ca 'W' h]b['YX[Y'hY'W'bc'c[]Yg']bW' X]b['hY
Ufh]Z]WU' \YUfz'V]cb]WYm'Z'a U[bYh]WfYgcbUbW']a U[]b['UbX'h]ggi Y'Yb[]bYYf]b["

7 ci fgY'5]a g

7 ci fgY'5]a g

%`' bfcXi W' hY'ghi XYbhlc'gca Y'VUg]W'W'cbW'dhg']b'gY] YfU'VfUbW'Yg'cZYb[]bYYf]b['k]h'Udd']W]h]cbg']b
a YX]W]bY"
&"" bfcXi W' hY'ghi XYbhlc'gY'Y'W'X'Udd']W]h]cbg'cZYb[]bYYf]b['UbX'hY'W'bc'c[m]b'a YX]W]bY"
' "" bfcXi W' hY'ghi XYbhlc'gY'Y'W'X'UFYUg'cZd'm]c'c[n'z'k \]W' W]b'VY'j]Yk YX'Ug'Yb[]bYYf]b['gc'i h]cbg
lc'dfcV'Ya g'cZ'Z'
("8Yj Y'cd'hY'ghi XYbh]UV])m]lc'UbU'm]gY'UbX'gc'j Y'dfcV'Ya g']b'hY'V]ca YX]WU'Yb[]bYYf]b['UFYU"
)"" a dfcj Y'hY'ghi XYbh]k'f]h]b['g_]`g"
*""9b\UbW' hY'ghi XYbh]g_]`Uhi g]b[']bZ'ca U]cb'fYgci fW'g"

7 ci fgY'@YUfb]b['Ci hW'ca Yg

%`' Ghi XYbh]k]`VY'UV'Y'lc']XYbh]ZmUbX'XYgW'VY'gY] YfU'Udd']W]h]cbg'cZYb[]bYYf]b['UbX'hY'W'bc'c[m
lc'a YX]W]bY#]c'c[m'
&"" Ghi XYbh]k]`VY'UV'Y'lc'Udd'mVUg]Wa U'hYa U]h]W'g'z'd'm]g]W'g'UbX'Yb[]bYYf]b['a Y'h'cXg'lc'gc'j Y
V]ca YX]WU'dfcV'Ya g"
' "" Ghi XYbh]k]`VY'UV'Y'lc'Z]bX']bZ'ca U]cb'cb'UbX'Yj U'i U'h'gdYW]Z]WUdd']W]h]cbg'cZ'hY'W'bc'c[m]lc
a YX]W]bY#]c'c[m'
(" Ghi XYbh]k]`VY'UV'Y'lc'k'f]h]U'W'cbW]gY'UbX'dfcZ'gg]cbU'fYdcfhXYHJ]]b['U'gdYW]Z]WUdd']W]h]cb'cZ
hY'W'bc'c[m]b'a YX]W]bY#]c'c[m]i g]b['hY'Ub[i U[Yg'cZYb[]bYYf]b['UbX'a YX]W]bY#]c'c[m'z'UbX
dfYgYbh]h]g']bZ'ca U]cb'cfU'm'

HYUWX]b['GhfUH[]Yg'

D'YUgY'fYZf'lc'hY']bZ'ca U]cb']b'A ccX'Y

5XX]h]cbU'7 ci fgY' bZ'ca U]cb

@YW' fYg'UFY']bW' XYX'g'c'f'cb']bY'Yggcbg'UbX'Z]W]h]lc'Z]W'g'Ygg]cbg'c'j Yf'hY'Z]fgh'ci f'cZYUWX
h'lc'f]U' "H\Ym]bW' XY'W'cbW'dhXY] Y'cda Yb'h'z'dfcV'Ya]gc'j]b['UbX'X]gW'gg]cb'gYgg]cbg" H\YgY'k]`W'c'j Yf
hY'hY'cfmigi ddcf]h]b['YI dYf]a Yb]U'`a Y'h'cXg'UbX'hY'dfUW]W] fYgYUfW' d'fcV'Ya g"" Hi'lc'f]U'g'UFY'XYg][bYX
lc'YI d'U]b'hY'W'cbW'dhg']bfcXi W'X']b'hY'Y'W' fYg'i g]b['dfUW]W]UddfcUWX'Yg' H\YgY'ghfUH[]Yg'UFY
]b]h'X'YX'lc'gi ddcf]h]c']b'U'h]U]b]b['hY'Y'Ufb]b['ci hW'ca Yg""7 cb'h]b'h]]bW' X]b['bc'hYg'UbX'j]XYcgz'k]`VY
Uj U]UV'Y'j]U'A ccX'Y'UbX']b'hY'W'Ugg""5ggYgga Ybh]UbX'Z'YXVUW'k]`VY'dfcj]XYX'lc'lc'ci 'fY[i 'Uf'm'

5ggYgga Ybh

: i f\Yf]bZcfa Uh]cb`fY`UhYX`hc`h\Y`UggYgga Ybhk]`VY`dfcj]XYX`]b`h\Y`A ccX`Y`UbX`ZJW`!hc!ZJW`WUggYg"

5ggYgga YbhUg_	K Y][\h	8i Y`8UH`	7ci fgY`@YUfb]b[Ci hW`a Yg`5ggYggYX

Gi Va]gg]cb'cZ5ggYgga YbhiHUg_g

@UVcfUhcfmfYdcfng'UbX'a U'cf'Ugg][ba Ybht'k]''fYei]fY'U' [Bcb'D'U\[\]Uf\]ga '8YWUfU\]cb'7cj Yf'G\YYH'](#)

5gg][ba Ybht'g\ci 'X'VY'gi Va]H'X'cb'hja Y''5'XU]mdYbU'micZ) i 'cZhY'a Uf_g'Uj U]'UV'Y'Zcf'hUh
Ugg][ba Ybhk]''Udd'mZcf'k cf_'fYW'j YX'UZ'Yf'hY'Xi Y'XUH''5bmiUgg][ba Ybhia cfY'h'Ub') 'XUmg''UH'k]''bch
VY'UW'W'dh'X''H\Y'cb'mYI Ya dh]cb'k]''VY'k \Yb'df]cf'dYfa]gg]cb'Zcf''UH'gi Va]gg]cb'\Ug'VYYb'[fUbh'X'Vm
h'Y'7ci fgY'W'cfX]bUhc'f''9I h'bg]cbg'k]''VY'[fUbh'X'cb'mcb'a YX]W'cf'W'ca dUgg]cbUH'[fci bXg'i bXYf
YI hfYa Y'W'fW'a g'fUb'W'g''

5 WUXYa]W< cbYgmiUbX`D`U[]Uf]ga

D@5; ≠F ≠GA

6Yk UFY`5b`Ugg][ba YbhUUh]bWi XYg`d`U[]Uf]gYX`a UHYf]U`k]`fYW]j Y`U`\$i : U]žUbX`ghi XYbhtg`k \c d`U[]Uf]gY`a UmZ]j`hY`Wci fgY`Ghi XYbhtg`k \c`d`U[]Uf]gY`k]`Uj Y`hY]f`bUa Yg`YbHYfYX`cb`U`d`U[]Uf]ga fY[]ghYf`UbX`k]`VY`]UV`Y`hc`X]gW]d`]bUfmiUW]cbž]bWi X]b[`YI Wi g]cb`Zca `Ybfc`a`Ybh`
#]g`YI dYWYX`hUUhU`ghi XYbhtg`a i ghUUhU`h]a Yg`gi Va]hY]f`ck`b`k`cf`_`Zcf`UggYgga Ybh`Gi Va]h]b[`hY`k`cf`_`cf`]XYUg`cZgca YcbY`Y`gY`k]h]ci hWYUfmiUW_bck`YX[]b[`hY`gci fW`cZVcffck`YX`a UHYf]U`cf`]XYUg`]g d`U[]Uf]ga "

5`UggYgga Ybhtg`k \]W`mci `UbX`]b`a i gh`Uj Y`U`[B`cb`D`U\[\]Uf\]ga`8YWUfU\]cb`7cj`Yf`G`YYh`H\\]g`\]g`Zcf`Vch`\]bX\]j`\]Xi`U`UbX`\[fci`d`k`cf`_`5hUW\]`\]h\]ci`f`Ugg\]\[ba YbhVYZcfY`gi Va \]h\]b\[`\]h\]ci`hY`7`ci`fgY`7`ccfX\]bUhc`f`cf`UhihY`GVX`cc`C`Z\]W"](#)

D`U[]Uf]ga `]g`hY`i`gY`cZUbchYf`dYfgcb`g`k`cf`_`cf`]XYUg`Ug`]ZhYmik`YfY`mci`f`ck`b`K` \Yb`]h]g`bYW]ggUfmicf`XYg]fUV`Y`hc`i`gY`chYf`dYcd`Y`g`a`UHYf]U`mci`g`lci`X`UXYei`UH`m`UW_bck`YX[Y`k` \cgY`k`cfXg`cf`]XYUg`hYm

5WUXYa]W=Zcfa Uh]cb

7CI FG9'9J5@! 5H€B'5B8'89J9@CDA 9BH

Gh XYbhZYXVUW_ \Ug\YdYX'hc'g\UdY'UbX'XYj Y'cd'h.]g'Wci fgYž]bWi X]b['ZYXVUW_cVHU]bYX'Zca'cb!
]bY'Yj U'i Uh]cbg'Ug'dUfhcZI BGK 'g'Ug'dUfhcZI BGK 'g'a m9I dYf]YbW' dfcW'gg"Mc'i 'UfY'\][\`m
YbWci fU[YX'hc'Wca d'YH'gi W\ 'Ub'cb!]]bY'Yj U'i Uh]cb'hc'k UfX'h'Y'YbX'cZHYfa "': YYXVUW_UbX'gi [[Ygh]cbg
dfcj]XYX'k]"VY'ja dcfh]bh]b]ja dfcj]b['h'Y'Wci fgY'Zf'Z hi fY'gh XYbng"

85H9G'HC'BC H9

FYZf'hc'A m BGK 'Zcf' a dcfh]bh8UH'gžUj U]UV'Y'Uh
[\hfd.##a m'i bgk "YXi "Ui #gh XYbh#fYgci fW'g#? Ym8UH'g"\ha`](#)

57589A ⇒ '58J ⇒9

: cf]bZcfa Uh]cb'UVci h

- ""B cH'g'icb'UggYgga Ybng'UbX'd'U[]Uf]ga ž
- ""GdYWU'7 cbg]XYfUh]cbgž
- ""GW'cc'Gh XYbh9h]Vg'C Z]W'fz'UbX
- ""69GG

fYZf'hc'h'Y'GW'cc'k YVg]h'Uj U]UV'Y'Uh
[\hfd.##k k k "Yb\[\]bYYf\]b\["i bgk "YXi "Ui #/\]ca YX\]WU'!Yb\[\]bYYf\]b\#

Gi dd`Ya YbhUfm9I Ua]bUh]cbg.

Gi dd`Ya YbhUfm9I Ua]bUh]cbg'Zcf'HYfa '&\$\$&&'k]"VY'\Y'X'cb'fH67 E'g\ci 'X'mci 'VY'fYei]fYX'hc'g]hcbY"

H\]g'Wci fgY'ci h]bY'gYhg'ci hXYgW]dh]cb'cZUggYg'Uh'h'Y'XUH'h'Y'7 ci fgY'Ci h]bY']g'di V']g\YX" H\Y
bUh fY'cZUggYg'a UmVXUb[Y Xi f]b['h'Y'HYfa 'UZf'f'h'Y'7 ci fgY'Ci h]bY']g'di V']g\YX" A ccX'Y'g\ci 'X'VY
W'cbgi 'h'X'Zcf'h'Y'i d'hc'XUH' WUgg'XYgW]dh]cbg" 'Z'h'YfY']g'Ubm]bW'cbg]gh'bw]b'h'Y'XYgW]dh]cb'cZ
UW]j]h]Yg'VYhk YYb'h'Y'I b]j Yfg]m]h]a YHUV'Y'UbX'h'Y'7 ci fgY'Ci h]bY'fUg'i dXUH'X']b'A ccX'Y'Udd']Yg"

⇒a U[Y'7 fYX]h

GmbYf[]Yg']b'Gci bX'&\$%*

7F ⇒CG

7F ⇒CG'Dfcj]XYf'7 cXY. '\$\$\$- , ;

5W_bck `YX[Ya YbhcZ'7 ci bhfm

K Y'UW_bck `YX[Y'h'Y'6YXY[U'dYcd'Y'k \c'UfY'h'Y'fUX]h]cbU'W'g'hcX]Ubg'cZ'h'Y'UbXg'cb'k \]W'I BGK
? Ybg]b[hc'b'W]a di g']g'c'W]h'YX"