

# BIOM9640

6]ca YX]WU`']bgrfi a YbhU]cb

HYfa " z&\$&&



7ci fgY`Cj Yfj ]Yk

GHJZ 7cbHJW`8YHU]`g

7cbj Ybcfg

BUa Y	9a U]`	5j U]`UV]`]m	@W]h]cb	D\cbY
8f`8Uj ]X`HgU]	<a href="#">X"hgU]4 i bgk "YXi "Ui</a>	H65	F a %\$\$' ž@]` %ž6]cgW]YbVW Gci Ĥ`fĐ&*Ł	-\$*)` , &' \$

@YW]i fyfg

BUa Y	9a U]`	5j U]`UV]`]m	@W]h]cb	D\cbY


## 7ci fgY'8YHJ`g

I b]hg'cZ7 fYX]h\*`

Gi a a UfmicZ'h\Y'7ci fgY

H\]g'W'ci fgY'gYf] Yg'Ug'Ub' ]b]fcXi W]cb'hc'd\mg]c'c[ ]W]`a YUgi fYa YbhcZV]cY'YWf]Wd\Ybca YbU'UbX bYi fcgh]a i `U]cb" H\]g'W'ci fgY'XYU'g'df]a Uf]mk ]h [ U]b]b[ `Ub'i bXYfg]UbX]b[ `cZ'h\Y'd\mg]W]`df]bW]d'Yg k \]W [ c] Yfb'h\Y'a YUgi fYa YbhcZU'V]c'c[ ]W]`j Uf]UV'Y'cf'gmghYa žVmiU'fUbgXi Wf'k \]W' W'cbj Yf]g'h\Y j Uf]UV'Y' ]b]c'Ub'Y'YWf]W]`g][ bU'"6miH\Y'YbX'cZ'h\Y'W'ci fgY'mci `g\ci `X'i bXYfg]UbX'j Uf]ci g'a YUgi fYa Ybh XYj ]W]g'UbX'UddfcUW]Yg ]bW] X]b[ `h\Y'i bXYf]m]b[ `V]c'c[ ]W]`dfcW]gg'h\U]h[ YbYfU]hYg'h\Y'ei Ub]h]m]c'VY a YUgi fYX'cf'W'cb]fc`YX" H\Y'VUg]Wa YX]W]`j]b]gf]a Yb]U]cb'i gYX'W]b]W]`m]c'dYfZ'fa `h\YgY'Z' bW]cb]g]g U`gc'Yi Ua ]bYX" H\]g'W'ci fgY'\Ug'U'Z'W'g'cb'V]cY'YWf]Wd\Ybca YbUžV]cY'YWf]cXYgž'a YX]W]`Y'YWf]cb]W]g UbX'bYi fcgh]a i `U]cb" H\Y'W'ci fgY' ]bW] XYg'U'fYj ]g]cb'cZ87 `UbX'57 `W]fW ]h'h\Ycfmž`UbXg!cb'dfUW]W]`j]b h\Y'i gY'UbX'h]g]h]b[ `cZ'a YX]W]`fUbgXi W]fg'UbX'Y'YWf]ca YX]W]`Yei ]da Ybh]b'W'ca a cb'i gY' ]b'\cgd]h]U'g UbX'fYgYUfW'`UVcfU]c]f]Yg'hc'a U\_Y'a YUgi fYa Ybh]cZV]ca YX]W]`j Uf]UV'Yg'cZV]b]W]`g][ b]Z]W]bVW"

## 7ci fgY'5]a g

H\Y'U]a g'cZ'h]g'W'ci fgY'UfY'hc.

- ]b]fcXi W'g]h XYb]hg'hc'h\Y'Z' bXUa Yb]U'g'cZY'YWf]W]`Yb[ ]bYf]b[ `Ug:]h]fY'U]hYg'hc'i bXYfg]UbX]b[ V]cY'YWf]Wd\Ybca YbU'UbX'bYi fU'g]h]a i `U]cb
- i bXYfg]UbX'h\Y'd\mg]W]`df]bW]d'Yg'k \]W [ c] Yfb'h\Y'a YUgi fYa YbhcZU'V]c'c[ ]W]`j Uf]UV'Y'cf'gmghYa `VmiU'fUbgXi Wf'k \]W' W'cbj Yf]g'h\Y j Uf]UV'Y' ]b]c'Ub'Y'YWf]W]`g][ bU`

hlyfy'k j''vy'u'' \ci f'dyf]cX'wta df]g]b[ 'u''ywhi fy'ubx'ga u'' [ fci d'yi yfW]gYg#i hcf]U'gž [ fci d'X]gW gg]cbg  
ubx'chlyfa yhcXg'hc'ZUW]fUHy'ghi XYbh'YUfb]b[ ''-b hly''uhyf'\u'ZcZhy'hyfa 'U'gyhcZ'UVcfUhcfm  
YI dYf]a Ybhtg'k j''vy'wcbxi wYX'hc'fy]bZcfW' dfUW]WU''UgdYW]g'cZV]ca YX]WU'' ]bghfi a YbhU]cb'ubX  
V]cY'YW]f]Wd\Ybca YbU''DfcV'Ya 'gc'j ]b[ ' ]g'ub'YggYbh]U''wta dcbYbhczh]g'gi V'YWh'5'A ccX'Y'wta fgYk UfY  
a cxi 'Y'\Ug'vYyb'YghU'V]g\YX'Zcf'h]g'gi V'YWh'f'h'd.##a ccX'Y''hy'hi bgk ''YXi ''Ui 'E''I dWta ]b[ 'hi hcf]U''fUg\_gž  
X]gW gg]cb[ fci dg'ubx''ywhi fy'bchYg'ubX'fygci fW'a Uhyf]U'g'k j''vy'a UXY'Uj U]UV'Y'cb'h]g'g]h'X'i f]b[ 'hly  
hyfa ''D'YUgY''cc\_UhUbbci bW'a Ybhtg'cb'A ccX'Y'Zcf''Ugha ]bi hy'W'ub[ Yg''5ggYgga Ybhtg'ubX'ZYXVUW'cb  
hi hcf]U''k cf\_k j''vy'fy[ i 'Ufmdfcj ]YX'hc'hly'ghi XYbhtg''

H\]g'wta fgY'fyei ]fyg'mci 'hc'i bXYfghubX'hly''ywhi fy'a Uhyf]U''ubX'hlyb'Udd'm'hly'\_bck 'YX[ Y'hc'VUg]W  
V]c]bghfi a YbhU]cb'Udd']W]h]cbg''-h]g]a dcfUbh'hc'i bXYfghubX'hly'Z bXUa YbhU''wcbW'dhtg'Ug'gccb'Ug  
dcgg]V'Y'ubX'hc'Ug'\_Zcf'\Y'd']Zmci 'Xc'bhci bXYfghubX''5'hly'bx'U''hly''ywhi fyg'ubX']Zgca Yh]b[ ' ]g'i bWYUfz  
d'YUgY'Ug'\_ei Ygh]cbg''A U\_Y'gi fy'mci 'fy] jYk 'U''hly''ywhi fy'bchYg'ubX'fyUX'U''a Uhyf]U''h.Uh]g'gi [ [ YghYX  
cf'\ubXYX'ci h'7'Ugg'dUfh]W]dU]h]cb'h'fci [ \ 'Uhy'bx'ubW'U'h'ywhi fyg'ubX'dUfh]W]dU]h]cb' ]b'WUgg'YI YfW]gYg'ubX  
[ fci d'k cf\_k j''vy'fy'YI dYWYX'ubX'k ]''U'ck 'Zcf'U'hy'f]U'h]g'Y'a YhcXg'cZUVgc'f]b[ 'hly'fy'Yj Ubh]bZcf'a U]h]cb''

Hly'a Uhyf]U'' ]g'X]j YfgY'ubX'bchUg'h] [ \hm'' ]b\_YX' ]bhc'ub'c'j YfU''ub'nt]WU''g'fi whi fy'Ug' ]b'gca Y'chlyf  
gi V'YW]g''Mci 'k j''bYXX'hc'vY'dfydUfYX'hc'Ugg]a ]'Uhy'ZUW]g'fy'U]h]b[ 'hc'U''Uf[ Y'bi a VYf'cZ]Z]ZYfYbh  
a YUgi f]b[ ' ]bghfi a Ybhtg'ubX'a YUgi fYa Ybhdf]bW]d'Yg''-Zmci 'hfyUhh]g'Ugg]a ]'U]h]cb'g]a d'mUg'ub'YI YfW]gY  
]b'fchY''YUfb]b[ ž'hly'j'c'i a Y'cZa Uhyf]U''k j''a U\_Y' ]h'UfX''-Zmci 'VYwta Y'gi Z]M]Ybh]m]bj'c'j YX'ubX  
]bh'fyghYX' ]b'hly'a Uhyf]U''Zmci 'k j''Z]bX' ]h'YUgm]hc'wta dfY\YbX/] Yfma i W''Ygg'fchY''YUfb]b[ 'k j''vy  
bYXX'Y'VYWhi gY'mci 'k j''i bXYfghubX'hly'df]bW]d'Yg'ubX'vY'UV'Y'hc'k cf\_'ci h'hly'wcbgYei YbW]g''

### 5XX]h]cbU''7ci fgY' -bZcfa U]h]cb

Dfygi a YX'\_bck 'YX[ Y

Gca Y'a Uhy'Ya U]h]g'VUW' [ fci bx' ]g'YggYbh]U''Mci 'g\ci 'X'\Uj Y'df]cf'YI dcgi fy'hc'wta d'YI 'bi a VYfg  
ubX'U' [ YVfU'fYei ]j 'U'Ybh'hc'wta d'Y]h]cb'cZ%ghm]Uf'a Uhy'Ya U]h]g' 'A Uhg' %5'ubX' %6' -h]g'\Y'd'Z'  
Vi h'bhYggYbh]U''h'Uhmci '\Uj Y'gca Y'\_bck 'YX[ Y'cZY'YW]f]WU''W]fW ]rg'ubX'gm]gh'a g''Hly'YggYbh]U''W]fW ]rg  
a Uhyf]U''k j''vy'fy] jYk YX'Xi f]b[ 'hly'wta fgY''

F Y'U]h]cbg'hc'chlyf'6-€A 'wta fgYg

6-€A - \* ( \$'wcbg]gh]cZ]bh]f] fUhyX''ywhi fyžhi hcf]U''ubX'dfUW]WU''k cf\_'ubX' ]bWi XYg'U'a U'cf'fy] ]g]cb'cZ  
Y'YW]f]WU''Yb[ ]bYYf]b[ '\_bck 'YX[ Y'Ug'k Y''Ug'U'ZcW'g'cb' ]bghfi a YbhU]cb'ubX'a YUgi fYa Ybhfy'U]h]b[ 'hc'  
V]cY'YW]f]Wd\Ybca YbU''6-€A - \*) \$'f6]cgYbgc'fg'ubX'hfUbgXi W'fg'f'fi bg' ]b'h%'ubX'ZcW'gYg'cb'chlyf  
gYbg]b[ 'ubX'hfUbgXi W]h]cb'a YW'ub]ga g'fX]gd'UV'Ya Ybhž'ZcfW'ž'c'i a YždfYggi fyžZck žYhW'ei gYX'Zcf  
W]b]WU''a YUgi fYa Ybhtg''Gca Y'cZhy'VUg]WY'YW]f]WU''Yb[ ]bYYf]b[ 'Z' bXUa YbhU'g' ]b'f'cXi W'X' ]b'6-€A - \* ( \$  
k j''vy'Uggi a YX'\_bck 'YX[ Y' ]b'6-€A - \*) \$''

Hly'wta fgY'6-€A - \*\* \$'fha d'ubhUV'Y'6]cb]W]g]ž'YI d'ubXg'cb'UgdYW]g'cZY'YW]f]WU''Yb[ ]bYYf]b[ 'W]fW ]hgž  
V]cY'YW]f]cXYgžV]cdchYbh]U'g'ubX'byi fU'gh]a i 'U]h]cb'Zca 'hly'dYfgdYW]j'Y'cZXYg][b]b[ 'ubX'a Ubi ZUWh'f]b[  
ub' ]a d'ubhUV'Y'hly'fUdYi h]WXYj ]W''Hly'wta fgY'6-€A - +%'fA cXY'' ]b[ 'C'f[ Ubgž'H]ggi Yg'ubX'8Y] ]W]g'k  
dfcj ]XYg'U'dfUW]WU''c'j Yf] jYk 'cZwta di h]h]cb'U'a cXY'' ]b[ ' ]b'V]cYb[ ]bYYf]b[ ž'ZcW'g]b[ 'cb'U'fub[ Y'cZ  
Udd']W]h]cbg' ]bWi X]b[ 'Y'YW]f]WU''gh]a i 'U]h]cb'cZbYi fU''ubX'W]fX]UW]h]ggi Yg''Hly'\_bck 'YX[ Y' [ U]bYX' ]b  
6-€A - \* ( \$'k j''Ugg]gh]b' i bXYfghubX]b[ 'hly'gy'dfcW]ggYg''

# 5ggYgga Ybh

5ggYgga YbhUg_	K Y][ \h	8i Y'8UH	7ci fgY'@YUfb]b[ Ci hWta Yg'5ggYggYX
%`Hi hcf]U`gž < UbX'jb E i Yghcbg	%)	GYd!&&žGYd!&- žC Wł * ž C Wł%	%ž &ž'

F Y`UhrX`[ fUXi UHr`WUdUV`])hYg`]bWl XY.

- I bXYfghUbX]b[ `cZkY`X]gWd`]bY`]b`]hg`]bhYfX]gWd`]bUfmVc`bhYI h
- F ][ cfcI`g`]b`UbU`mg]gZ`W]h`ei Y`UbX`fYZYW]cb
- 5V`Y`hc`Udd`mi`\_bck`YX[ Y`UbX`g\_]`g`hc`gc`j`]b[ `dfcV`Ya`g
- 7 UdUV`Y`cZ]bXYdYbXYbZ`gY`ZX]fY`WYX`dfUW]W

5ggYgga Ybh(. :A U`c`f`@UVcfUhc`fmF Ydcfh

8i Y`XUhr. :H65`fUZhYf`k`\_`%\$Ł

CbY`UVcfUhc`fmk`j`VY`WcgYbZ`UbX`hY`gh XYbhk`j`VY`YI`dY`WYX`hc`dfYdUFY`U`Zcfa`U`UVcfUhc`fmfYdcfh`h`Uh



!% 'Bcj Ya VYf



F Ygci fWg

DfYgW]VYX F Ygci fWg

# Gi Va ]gg]cb'cZ5ggYgga YbhiHUg\_g

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

5gg][ ba Ybht'g\ci 'X'VY'gi Va ]H'X'cb'h'a 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'h'Y'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'f'W'a g'fUb'W'g''

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

D@5; 5F 6A

6Yk UfY`5b`Ugg][ ba Ybh\Uh]bWl XYg`d`U[ ]Uf]gYX`a UHf]U`k ]`fYW]j Y`U`\$i : U]žUbX`gh XYb]k`k \c

## 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'dUfhcZl BGK 'g'Ug'dUfhcZl BGK 'g'a m9l 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'hck UfX'hY'YbX'cZHYfa "': YYXVUW\\_UbX'gi [ [ Ygh]cbg  
dfcj ]XYX'k ]"VY'ja dcfhUbh]b]ja dfcj ]b[ 'hY'Wci fgY'Zf'Z hi fY'gh XYbthg"

85H9G'HC'BC H9

FYZf'hc'A m BGK 'Zcf'æ dcfhUbh8UH'gžUj U]UV'Y'Uh  
[\hfdg.##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'cb'UggYgga Ybthg'UbX'd'U[ ]Uf]ga ž
- ""GdYWU"7 cbg]XYfU]cbgž
- ""GW'cc" Gh XYbh9h ]Vg'C Z]W'fz'UbX
- ""69GG

fYZf'hc'hY'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 YbhUfm9l Ua ]bUh]cbg.

Gi dd`Ya YbhUfm9l Ua ]bUh]cbg'Zcf'HYfa '%&\$&&'k ]"VY'\Y'X'cb'fH67E'g\ci 'X'mci 'VY'fYei ]fYX'hc'g]hcbY"

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

⇒a U[ Y'7 fYX]h

fW'G\i H'Yfg'hcW\_ ⇒a U[ Yg

7F ⇒CG

7F ⇒CG'Dfcj ]XYf'7cXY.'\$\$\$- ;

5W\_bck `YX[ Ya YbhicZ'7ci bhfm

K Y'UW\_bck `YX[ Y'hY'6YXY[ U'dYcd'Y'k \c'UfY'hY'fUx]h]cbU'W'g'hcX]Ubg'cZ'hY'UbXg'cb'k \]W' l BGK

? Ybg]b[ hcb`Wla di g`lg`cWJHYX"