

# BIOM9311

A Ugg'HfUbgZYf'jb'A YXJWjby

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7ci fgY`Cj Yfj JYk

GHJZZ7cbHJW`8YHJ]`g

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GcWUhg`8c_cg	<a href="#">g"Xc_cg4 i bgk "YXi "Ui</a>	6mUddc]bfa Ybh fj ]U`Y!a U]t	F cca `) \$*z GUa i Y`g 6`X[ `f! &) t	- ' , ) ` - ( \$*

8Ya cbghfUhc fg

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8\mYmG\U\	<a href="#">X\mYm`g\U\4 gh XYbfi bgk "YX i "Ui</a>	6mUddc]bfa Ybh fj ]U`Y!a U]t		

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5XX]h]cbU`7ci fgY`bZcfa Uh]cb

: cfYUW\`ci f'cZWcbUWz]h]g'YI dYW\X'hUhmc i`k ]`di h]b'Uh`YUgh%)`ci fg'cZdfj] UhY`gh Xm'Mci`k ]`  
bYYX'hc'gdYbX'gi VghUbh]U`h]a Y`ja d`Ya Ybh]b[ `Wca di hYf!VUgYX'Ugg][ ba Ybhg`]b`7CA GC@`H\Y`Zc`ck ]b[  
XYgW]VYg'h\Y`YUfb]b[ `UddfcUWYg'fYWca a YbXYX'Zcf'h]g`Wci fgY.

Df]j UhY`Gh Xm

- K UhW`h\Y`dfY!fYWcfXYX`YWhi fY`UbX`fyj ]Yk`h\Y`YWhi fY`bchYg`YUW`k YY`fA ccX`YE"

# 5ggYgga Ybh

H\Y'UggYgga YbhUg\_g'Zcf'6€A -' %A Ugg'HfUbgZyf'j'b'A YX]WbY'\Uj Y'VYYb'XYg][ bYX'hc'a YUgi fY'mci f UWX]Yj Ya YbhcZHY'YUfb]b[ 'ci hWca Yg"H\Y'ZbU' fUXY'Zcf'h]g'Wci fgY'k ]'bcfa U'mVY'VUgYX'cb'h\Y'gi a cZHY'gWcfYg'Zca 'YUWX'cZHY'UggYgga YbhUg\_g"

E i ]nnYg'k ]'Wcbg]ghcZa i 'hd'Y'Wc]W'UbX'g\cfhUbgk Yf'ei Ygh]cbg'UbX'Ufy'XYg][ bYX'hc'YbWci fu[ Y 'YUfb]b[ 'h'fci [ \ci h\Y'gYa YghYf'UbX'dfydUfy'ghi XYbhg'Zcf'h\Y'hmdYg'cZei Ygh]cbg']b'h\Y'ZbU'Yi Ua " H\Yfy'k ]'VY'hk c'ei ]nnYg'YUWX'k YY\_žWcbg]h]h]b[ 'Ub']b!WUgg'Yi YfW]gY'UbX'U'ca Yk cf\_'Ugg][ ba Ybh'H\Y'hk c'ei ]nnYg'Ufy'k cfh '+' ) i 'YUWX'ž'hc[ Y'h\Yf'hc'U'%) i 'cZHY'Wci fgY'UggYgga Ybh'

H\Y'a U'cf'Ugg][ ba Ybh]g'k cfh '&\$i 'cZHY'hc'U'Wci fgY'UggYgga Ybh'5'gi Vg'hUbh]U'dfcV'Ya 'cZgca Y Wca d'Yi ]mk ]'VY'XYZbYX"H\Y'WcbWdh U'a Uhf]U'fYei ]fYX'hc'gc'j Y'jhk ]'\Uj Y'VYYb'Wcj YfYX']b'YW'i fYg Vi hUdd'm]b[ 'hUha Uhf]U'hc'h]g'dfcV'Ya 'k ]'bchVY'hf] ]U' " #k ]'bchVY'U'a Uhf'f'cZg]a d'mZbX]b[ 'h\Y'f][ \hYei Uh]cb"'7 YUf'h]b\_]b[ 'UbX'k cf\_]b[ 'i d'Zca 'h\Y'VUg]Mg'k ]'VY'fYei ]fYX'" # UXX]h]cbž'j U'i Yg'cZgca Y fYei ]fYX'a Uhf]U'dfcV'f]Yg'k ]'\Uj Y'hc'VY'Zci bX'Zca 'h\Y'']hfU'h fY" H\]g'k ]'bchVY'hf] ]U'Y'h\Yf' #]g YI dYWX'hUh\Y'fYdcfhk ]'WYUf'mXYhU]'h\Y'a YhcX'cZgc'i h]cbž']bW'i X]b[ 'U'g]a d']h]b[ 'Uggi a dh]cbg" H\Y'UVcfUhc'fmfYdcfhk ]'VY'Ub'cddcfh]b]mZcf'gh XYbhg'hc'UbU'mgY'YI dYf]a YbhU'XU'U'UbX'dfYgYbh ZbX]b[ g']b'h\Y'Zcfa 'cZU'UVcfUhc'fmfYdcfh'H\Y'UVcfUhc'fmfYdcfh]g'k cfh '&\$i 'cZHY'hc'U'Wci fgY UggYgga Ybh'

H\Y'ZbU'Yi Ua 'k ]'VY'\Y'X'Xi f]b[ 'h\Y'Zcfa U'Yi Ua 'dYf]cX'UbX']g'k cfh'() i 'cZHY'hc'U'Wci fgY UggYgga Ybh'

5ggYgga YbhUg_	K Y][ \h	8i Y'8UH	7ci fgY'@YUfb]b[ Ci hWca Yg'5ggYggYX
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&"@UVcfUhc'fmF Ydcfh	&\$i	%, #/%#&\$&%\$). \$\$'DA	&ž( ž)
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8i Y'XUHy. &&#/%#&\$&%\$) .\$\$'DA  
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Gh XYbtg'UfY'fYei ]fYX'hc'g]a i 'UHy'U'Wca d'YI 'a Ugg'fUbgZ'f'gmghYa ' ]b'a YX]W]bY'cf'V]c'c[ mžgi Va ]h]b[  
U'XYHJ]YX'fYdcfhXYgW]V]b[ 'a YhcXgž'Uggi a dh]cbgž'fYgi 'hg'UbX'g][ b]Z]WbVW'cZ]bX]b[ g"

5ggYgga Ybh(. : ]bU`YI Ua ]bUh]cb

GhUfhXUHy. 'H65

H\]g'UggYgga YbhWcbg]h hYg'hY'Z]bU`YI Ua 'Zcf'hY'Wci fgY" "k ]`VY'cdYb'Vcc\_'UbX'cb`]bYž'Wcbg]gh]b[ 'cZ  
U'Wca V]bUh]cb'cZg\cfhUbgk Yfgž'a i 'h]d'Y'V\c]Wž'W'W'Uh]cbg'UbX'g]a i 'Uh]cbg'i g]b[ '7CA GC@gcZk UfY"






# F Ygci fWg

## DfYgWf]VYX`F Ygci fWg`

- 6Ug]WHfUbgdcfhD\Ybca YbU`]b`6]ca YX]WU`9b[ ]bYYf]b[ `fl fX`9X]h]cbE`Vm: ci fb]YfzF cbU`X`5"@`7 F 7`DfYgg`&\$\$&`f5j U]UV`Y`Zca`h`Y`@]VfUfm`) +%\*( # 5ž) +%\*( # 6ž`d`i`g`cbY`W`dmcZUb`YUf]Yf`YX]h]cbE`"

## F YWca a YbXYX`F Ygci fWg

H\Y`YW`fY`bchYg[ ]j Yb`U`cb[ `k ]h` ]bZfa Uh]cb`dcg`h`X`cb`A`ccX`Y`k` ]`VY`h`Y`df]a Ufmigci fW`cZ ]bZfa Uh]cb`5XX]h]cbU`cdh]cbU`fYgci fWg`UFY [ ]j Yb`VY`ck`."

5`h`I`hk` \]W`d`fcj` ]XYg`i` gYZ` `WUgY`gh` X]Yg`]b`V]ca YX]WU`Yb[ ]bYYf]b[ `a` Ugg`hfUbgZyf`d\Ybca YbUž`Ug`k`Y` Ug`U`i`gYZ` `fYgci fW`]b`7`C`A`GC`@`a`cXY`]b[ `]g.

- 8UfU`5žF`U`Yg` \ `j` .`5b`-`hfcXi` W]cb`h`c`A`cXY`]b[ `cZHfUbgdcfhDfcW`ggYg. `5dd`]W]h]cbg`h`c`6]ca YX]WU`Gmg]h`a`gž`Ua`Vf]X[ `Y`I` b]j`Yfg]mDfYgg`f&\$\$&E`"

5`h`I`hk` \]W`]g`cf[ `Ub]gYX`ei` ]h`X]ZYfYbhmZ`ca`h`Y`W`ci`fgY`Vi`hk` \]W`a` ][ `h`VY` \`Y`dZ` `cb`g`Y`W`h`X`h`cd]Wg.

- Hfi`g`\_mi; `5ž`M`Ub` :` Ubž?`Ulm`8` :` .`HfUbgdcfhD\Ybca YbU`]b`6]c`c[ ]WU`Gmg]h`a`gž`DYUfgcb`DfYbh]W` <U`f`&\$\$(`E`";`G6A`9`]VfUfm`@Yj`Y`+ž`A`U]b`@]VfUfmf) +%\*( #&\*`E`Q`"

5`VUg]Wa`Ugg`hfUbgZyf`fYZYfYbWf.

- 7`i`gg`Yf`9@`8]Z]`g]cb.`A`Ugg`hfUbgZyf`]b`Zi`]X`gmg]h`a`g`7`Ua`Vf]X[ `Yž`7`Ua`Vf]X[ `Y`I` b]j`Yfg]mDfYgg`f%`-` ,`(`E`@Yj`Y`-`ž`A`U]b`@]VfUfmfD`\*\*`\$`&` ,`(`&`#&`E`Q`"

5`fYZYfYbWf`h`Uh[ ]j`Yg`U`g]a`d`Y`X]gW`gg]cb`cZX]Z]`g]cb`Ug`k`Y`Ug`h`Y`dfcV`Ya`cZX]Z]`g]cb`h`c`U`fYW`drcf`fUg`cb`U`W``E`"

- 6Yf[ `<7` .`F`UbXca`k`U`\_g`]b`6]c`c[ `m`Df]bWf`h`cbž`Df]bWf`h`cb`I` b]j`Yfg]mDfYgg`f%`-` -` `E`@]VfUfm@Yj`Y` +`A`6` )`+`("\$%)`%`&` ,`&#%Q`"

5`fY`Uhj`Y`mig]a`d`Y`fYZYfYbWf`cb`Zi`]X`Zck`UbX`X]U`mg]g.

- `?`Y`Yf`?`<` .` :` `i` ]X`a`YW]Ub]Wg`UbX`a`Ugg`hfUbgZyf`]b`Ufh]Z]WU`c`f[ `Ubg`" `f%`-` +` `E`5`g]a`d`Y`]b]hfcXi` W]cb`h`c`Zi`]X`Zck`UbX`X]U`mg]gž`Vi`hU`V]h`]a` ]h`X`"

## 7ci fgY`9j`U`i`Uh]cb`UbX`8Yj`Y`cda`Ybh

Gh`XYbhZYXVUW` \Ug` \`Y`dYX`h`c`g`UdY`UbX`XYj`Y`cd`h`]g`W`ci`fgYž`]b`Wi`X]b[ `ZYXVUW`c`VHU]bYX`Zca`c`b[ ]bY`Yj`U`i`Uh]cbg`Ug`dUfhcZ]`B`G`K`'g`a`m9]`dYf]YbWf`dfcW`gg`"M`ci`UFY` \] [ `m`YbW`ci`fU[ `YX`h`c`W`ca`d`Y`h`gi`W`Ub`cb[ ]bY`Yj`U`i`Uh]cb`h`ck`UfX`h`Y`YbX`c`ZHYfa` " :`YYXVUW`UbX`gi` [ [ `Ygh]cbg`dfcj`]YX`k` ]`VY`]a`dcffUbh]b`]a`dfcj`]b[ `h`Y`W`ci`fgY`Zcf`Z`h`fY`gh`XYb]g`"

Gi Va ]gg]cb`cZ5ggYgga YbhiHUg\_g

@UVcfUhcfmifYdcfhg`UbX`a U`cf`Ugg][ ba Ybhg`k ]`fYei ]fY`U`[Bcb`D`U\[ \]Uf\]ga`8YWUfU\]cb`7cj`Yf`G`YYh`](#)

@UH`gi Va ]gg]cbg`k ]`VY`dYbU`]gYX`%\$i`cZ`h`Y`a Uf`\_`Zcf`YUW`W]`YbXUf`XUm`UH`" `Z`mci`ZcfYgYY`U`dfcV`Ya  
]b`a`YYh]b[ `h`Y`bca ]bUH`X`gi Va ]gg]cb`XUH`d`YUgY`W`b`h`U`W`h`h`Y`7`ci`fgY`7`cbj`Ybcf`h`a`U`\_`Y`Ub`Uddc]bha`Ybh  
h`c`X]gW`gg`mci`f`g]h`Uh]cb`Ug`gccb`Ug`dcgg]V`Y"

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

D@5; =F =GA

6Yk UfY`5b`Ugg][ ba YbhUUh]bWl XYg`d`U[ ]Uf]gYX`a UHf]U`k ]`fYW]j Y`U`\$i : U]žUbX`gh XYbhtg`k \c d`U[ ]Uf]gY`a UmZ]`hY`Wci fgY`Gh XYbhtg`k \c`d`U[ ]Uf]gY`k ]`Uj Y`hY]f`bUa Yg`YbHYfYX`cb`U`d`U[ ]Uf]ga fY[ ]ghf`UbX`k ]`VY`]UV`Y`hc`X]gW]d`]bUfmiUW]cbž]bWl X]b[ `Yl Wl g]cb`Zca `Ybfc`a`Ybh`  
#]g`Yl dYWYX`hUUhU`gh 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 UHf]U`cf`]XYUg`]g d`U[ ]Uf]ga "

5`UggYgga Ybhtg`k \]Wl`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`\[ fci`d`k`cf`\\_`5HUVW`\]h\]c`mci`f`Ugg\]\[ ba YbhVYZcfY`gi Va \]h\]b\[ `\]h\]c`hY`7`ci`fgY`7`ccfX\]bUhc`f`cf`UhhY`GVXcc`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`UHf]U`mci`g`ci`X`UXYeI`UH`mUW\_bck`YX[ Y`k`cgY`k`cfXg`cf`]XYUg`hYm`UfY`UbX`k` \YfY`mci`Zci`bX`hY`a`f`]j`]b[ `hY`Wca`d`YH`fYZYfYbW`XYH]`gž]bWl X]b[ `dU[ Y`bi`a`VYffg]H`Y`@YUfb]b[ `7`YbHY`dfcj`]XYg`Z`fHYf`]bZcfa`U]cb`cb`k` \UhWcbgh]h`hYg`D`U[ ]Uf]ga `Uh` \Hdg`#gh XYbhi`bgk`"YXi`"Ui`#d`U[ ]Uf]ga

## 5WUXYa ]WbZcfa Uh]cb

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Gh XYbhZYXVUW\_\Ug\Y'dYX'hc'g\UdY'UbX'XYj Y'cd'h]g'Wci fgYz]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 Wk'Ub'cb!]bY'Yj U'i Uh]cb'hck UfX'hY'YbX'cZHYfa "': YXVUW\_UbX'gi [ [ Ygh]cbg  
dfcj ]XYX'k ]`VY'ja dcfhUbh]b]ja dfcj ]b[ 'hY'Wci fgY'Zc'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 Ybth'UbX'd'U[ ]Uf]ga ž
- ""GdYWU'7 cbg]XYfUh]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'Zc'f'HYfa " '&\$%&'k ]`VY'\Y'X'cb'A cbXUm%\$h'>Ubi Ufm--: f]XUm%( h  
>Ubi Ufmf]bWi gj Yl'g\ci `X'mci `VY'fYei ]fYX'hc'g]hcbY"

⇒a U[ Y'7 fYX]h

<c`ck 'ZVfY'X]U'mgYf'g]a i 'Uh]cb'i g]b[ '7CA GC @A i 'hd\mg]Wg

7F ⇒CG

7F ⇒CG'Dfcj ]XYf'7cXY. '\$\$\$- , ;

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

K Y'UW\_bck `YX[ Y'hY'6YXY[ U'dYcd'Y'k \c'UfY'hY'fU]h]cbU`W g'hcX]Ubg'cZ'hY`UbXg'cb'k \]W'! BGK  
? Ybg]b[ hc'b'W]a di g'g`cW]hYX"

