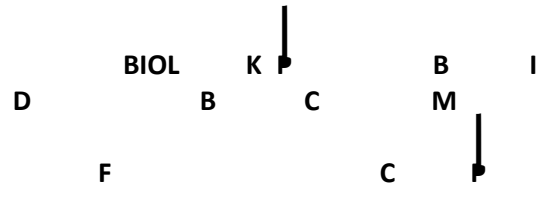

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"#$%&'#(!) *+,#-!.$+#/$#!0#/%#'1!2334!5655!7!8 9 :!;(66<;(=6!>8!

A(!02?@!;AAB;!CA!$'#D+%!E3&'FG!

H/F%'&$%3'(!I'+$!0E*4J#'F!CK'L!0E*4J#'FG!!MNN+$#(!).0!BB5O!!!PE3/#(!BBQ<BOQ<BRAS!

I4*+,(!#T$E*4J#'FUV*,D3F%*L#D&!

!

MNN+$#!W3&'F(!9#D/#FD*-!B(66<O(66!P8X!J-!*YY3+/%4#/%!

!

Z'*D&*%#!>FF+F%*/%!CZ>G(![)>! ! ! ! !

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C **D** >/!+/%'3D&$%+3/!%3!%E#!Y'+/$+Y,#F!3N!J+3,3\-!N3'!F$+#/$#!4*]3'F1!T+%E!*/!

#4YE*F+F!3/!%E#!$#,,&,*'!/*%&'#!3N!,+N#L!03/$#Y%F!$3V#'#D!+/$,&D#!%E#!3'+\+/!*/D!#*',-!#V3,&%+3/!

3N!$#,,&,*'!,+N#X!$#,,!F%'&$%&'#1!N&/$%+3/1!4#%*J3,+F41!*/D!'#Y'3D&$%+3/X!$#,,!F+\/*,+/\X!*/D!\#/#!

'#\&,*%+3/!+/!J*$%#'+*!*/D!#&^*'-3%#FL![E#'#!*'#!/3!Y'#'#_&+F+%#F!N3'!%E+F!$3&'F#L!)HM"!556R!,*J!

+F!*!$3<'#_&+F+%#!N3'!F%&D#/%F!TE3!E*V#!/3%!*,'#*D-!$34Y,#%#D!%E*%!$3&'F#!*/D!)HM"!5566!+F!*!$3<

'#_&+F+%#!N3'!:'#FE4*/!)+3,3\-!4*]3'F!C3NN#'#D!:*,,!F#4#F%#'F!3/,-G

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M

!9#!T+,,!J#!&F+/\!*!%#`%J33^!Y'3V+D#D!J-!MY#/.%*`1!*!=65C$GCAG!/3/Y'3N+%!

$E*'+%*J,#!$3'Y3'*%+3/!*FF3$+*%#D!T+%E!2+$#!a/+V#'F+%-!+/![#`*FL!![E#!\3*,!3N!%E+F!3'*/+b*%+3/!

+F!%3!4*^#!E+\E#'!#D&$*%+3/!*$$#FF+J,#!%3! !F%&D#/%FL![3!*$E+#V#!%E+F!\3*,1!%E#-!Y'3V+D#!

T+%E!*!J*$^\'3&/D!%3!J#%%#'!&/D#'F%*/D!4*/-!3N!%E#!%#$E/3,3\+$*,!+FF&#F!*/D!$E*,,#/\#F!
$3/N'3/%+/\!3&'!/*%+3/!*/D!%E#!T3',DL!!
!
[E+F!$3&'F#!T+,,!*FF+F%!-3&!+/!D#V#,3Y+/\!$34 4&/+$*%+3/!F^+,,F!*F!T#,,!*F!+/N3'4*%+3/!Y'3$#FF+/\!
F^+,,FL![E#F#!*J+,+%+#F!*'#!$'+%+$*,!N3'!*,,!F%&D#/%F1!J3%E!%E3F#!TE3!T+FE!%3!*%%#/D!Y'3N#FF+3/*,!
F$E33,!C4#D+$*,1!D#/%*,1!#%$LG!*/D!\'*D&*%#!F$E33,!*F!T#,,!*F!%E3F#!TE3!T+,,!43V#!D+'#$%,-!+/%3!
%E#!]3J!4*'^#%!N3,,3T+/\!\'*D&*%+3/L!c3&'!$'+%+$*,!%E+/^+/\!F^+,,F!T+,,!J#!#/E*/$#D!%E'3&\E!
/,-F+F!3N!,*J!#`#'$+F#F1!$,*FF!*FF+\/4#/%F1!*/D!%#F%!_&#F%+3/FL!!

E **L**

A ! ! ! ! ! ! ! P3+/%F

- a/+%!I`*4F!! ! ! ! ! =66!!
- 2*Y+D!2#FY3/F#!! ! ! ! ! 566!
- :+/*,!I`*4!C3Y%+3/*,G! ! ! ! '#Y,*$#4#/%!Y3+/%F!C566G!

iiii

T+,,!Y'3V+D#!-3&!*!$E*/$#!%3!'#$#+V#!+4 4#D+*%#!N##DJ*$^!3/!-3&'!&/D#'F%*/D+/\!*/D!
+/%#'Y'#%*%+3/!3N!+4Y3'%*/%!J+3,3\+$*,!Y'+/$+Y,#FL!P3,,+/\!_&#F%+3/F!T+,,!J#\+/!D&'+/\!%E#!F#$3/D!
T##^!3N!$,*FFL!
!
c3&!T+,,!'#$#+V#!5!Y3+/%!N3'!#*$E!Y3,,!_&#F%+3/!%E*%!-3&!*/FT#'!D&'+/\!$,*FF!CJ3%E!$3''#$%!*/D!
+/$3''#$%!'#FY3/F#F!#*'/!5!Y3+/%GL!c3&!T+,,!'#$#+V#!6!Y3+/%F!+N!-3&!D3!/3%!'#FY3/D!D&'+/\!$,*FF!3'!
+N!-3&!4+FF!$,*FFL!H%!+F!

!

?3!J33^F1!#,#$%'3/+$!D#V+$#F1!3'!/3%#J33^F!T+,,!J#!*,,3T#D!D&'+/\!#`*4F!*/D!F%&D#/%F!&F+/\!F&$E!+%#4F!T+,,!J#!*F^#D!%3!,#*V#!*/D!T+,,!'#$#+V#!*!b#'3!N3'!%E#!#`*4L!!

?3!%*,^+/\!T+,,!J#!*,,3T#D!D&'+/\!%E#!#`*41!J&%!F%&D#/%F!*'#!Y#'4+%%#D!%3!*F^!%E#!+/F%'&$%3'!_&#F%+3/FL!!

I*$E!F%&D#/%!T+,,!J#!\+V#/!*/!#`*4!%3!J#!$34Y,#%#D!*/D!E*/D#D!J*$^!%3!%E#!+/F%'&$%3'L!!

.%&D#/%F!4&F%!J'+/\!*!Y#/$+,!*/D!T+,,!%*^#!%E#!#`*4!D&'+/\!%E#!F%*%#D!,#$%&'#!%+4#!3/,-L!!

NO E c3&!T+,,!E*V#!%E#!$,*FF!%+4#!3/,-!%3!$34Y,#%#!#*$E!,#$%&'#!#`*4L!!

(!.%&D#/%F!FE3&,D!E*V#!+/!%E#+'!Y3FF#FF+3/!*%!*,,!%+4#F!%E#+'!e.a!F%&D#/%!+D#/%+N+$*%+3/!$*'DL!)#$*&F#!3N!%E#!,*'\#!F+b#!3N!%E#!$,*FF!%E+F!F!F#4#F%#'!T#!T+,,!J#!$E#$^+/\!F%&D#/%!HK!3'!*/3%E#'!N3'4!3N!Y+$%&'#!HK!D&'+/\!#`*4FL!!

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A FE A [E#!:*4+,-!ID&$*%+3/*,!2+\E%F!*/D!P'+V*$-!>$%!C:I2P>G!Y'3E+J+%F!%E#!Y&J,+$!Y3F%+/\!3N!\'*D#F!J-!F3$+*,!F#$&'+%-!/&4J#'!3'!+/!*/-!4*//#'!Y#'F3/*,,-!+D#/%+N+*J,#!%3!%E#!+/D+V+D&*,!F%&D#/%L!?3!\'*D#F!$*/!J#!\+V#/!3V#'!%E#!%#,#YE3/#!3'!3V#'!#4*+,!J#$*&F#!Y3F+%+V#!+D#/%+N+$*%+3/!$*/o%!J#!4*D#L!!

A .%&D#/%F!T+%E!D+F*J+,+%+#F!TE3!*'#!#`Y#'+#/$+/\!J*''+#'F!+/!%E+F!$3&'F#!4*-!$3/%*$%!%E#!>$$#FF!MNN+$#!N3'!*FF+F%*/$#!+/!D#%#'4+/+/\!*/D!+4Y,#4#/%+/\!'#*F3/*J,#!*$$344 3D*%+3/FL![E#!>$$#FF!MNN+$#!+F!,3$*%#D!+/!:*'J*'!W*,,L![E#!YE3/#!/&4J#'F!*'#!BBQ<BO=<BOQ;!CeG1!BBQ<AR=<=;R5!CeP6!*/D!BBQ<B5Q<5AO;!C[[cGL!:3'!43'#!+/N3'4*%+3/1!Y,#*F#!V+F+%!e.aoF!>$$#FF!MNN+$#!3'!#4*+,(!*$$#FFUV*,D3F%*L#D&L!!

I e*,D3F%*!.%*%#!a/+V#'F+%-!Ce.aG!+F!$344 4+%%#D!%3!$'#*%+/\!*!D+V#'F#!*/D!+/$,&F+V#!T3'^!*/D!,#*'/+/\!#/V+'3/4#/%!N'##!N'34!D+F$'+4+/*%+3/!*/D!E*'*FF4#/%L!e.a!+F!D#D+$*%#D!%3!$'#*%+/\!*/!#/V+'3/4#/%!TE#'#!*,,!$*4Y&F!$344&/+%-!4#4J#'F!N##,!V*,&#D1!'#FY#$%#D1!*/D!+/$,&D#DL!e*,D3F%*!.%*%#!a/+V#'F+%-!Y'3E+J+%F!D+F$'+4+/*%+3/!3/!%E#!J*F+F!3N!'*$#1!$3,3'1!#%E/+$+%-1!/*%+3/*,!3'+\+/1!F#`!C+/$,&D+/\!Y'#\/*/$-!F%*%&F1!F#`&*,!E*'*FF4#/%!*/D!F#`&*,!V+3,#/$#G1!F#`&*,!3'+#/%*%+3/1!\#/D#'!+D#/%+%-1!'#,+\+3/1!*\#1!/*%+3/*,!3'+\+/1!D+F*J+,+%-1!\#/#%+$!+/N3'4*%+3/1!3'!V#%#'*/!F%*%&F1!+/!%E#!a/+V#'F+%-qF!Y'3\'*4F!*/D!*$%+V+%+#F!*F!'#_&+'#D!J-!*YY,+$*J,#!,*TF!*/D!'#\&,*%+3/F!F&$E!*F![+%,#!HrL![E#!+/D+V+D&*,!D#F+\/*%#D!T+%E!'#FY3/F+J+,+%-!N3'!$33'D+/*%+3/!3N!$34Y,+*/$#!#NN3'%F!*/D!'#$#+Y%!3N!+/_&+'+#F!$3/$#'/+/\!/3/D+F$'+4+/*%+3/!Y3,+$+#F!+F!%E#!a/+V#'F+%-qF![+%,#!HrI033'D+/*%3'(!8*\\+#!e+V#'#%%#!!K+'#$%3'!3N!%E#!MNN+$#!3N!.3$+*,!I_&+%-1!%+%,#+`UV*,3F%*L#D&1!5B6;!?L!P*%%#'F3/!.%L1!e*,D3F%*!.%*%#!a/+V#'F+%-1!e*,D3F%*1!Z#3'\+*!A5S6;1!BBQ<AAA<=0SAL!!

!

C G C HB !HN!-3&!$E33F#!%3!$*''-!*!$3/$#*,#D!T#*Y3/!3/!$*4Y&F1!-3&!*'#!'#FY3/F+J,#!N3'!^/3T+/\!*/D!N3,,3T+/\!%E#!,*TL!2#N#'!E#'#!N3'!:>h(!E%%YF(ddTTTLV*,D3F%*L#D&d*D4+/+F%'*%+3/dN+/*/$#<*D4+/dY3,+$#d$*4Y&F$*''-d

L BIOL K A F

D		C
>&\&F%!5S!	.-,,*J&F!	.-,,*J&F!
>&\&F%!5;!	[E#!.$+#/$#!3N!)+3,3\-!	5L5!
>&\&F%!B6!	[E#4#F!*/D!03/$#Y%F!3N!)+3,3\-X!a/D#'F%*/D+/\!IV3,&%+3/!	5LBX!5;L5!
>&\&F%!BA!	>%34F1!+F3%3Y#F1!+3/F1!*/D!43,#$&,#F!	
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>&\&F%!BR!		