+U(Ÿ • œ F ¸º m ÷ l =

)Á •!Y

c 30 œL˜"j+U+U(Ÿ.J0¬ v

< Æ#•B c ù

2020.08.22

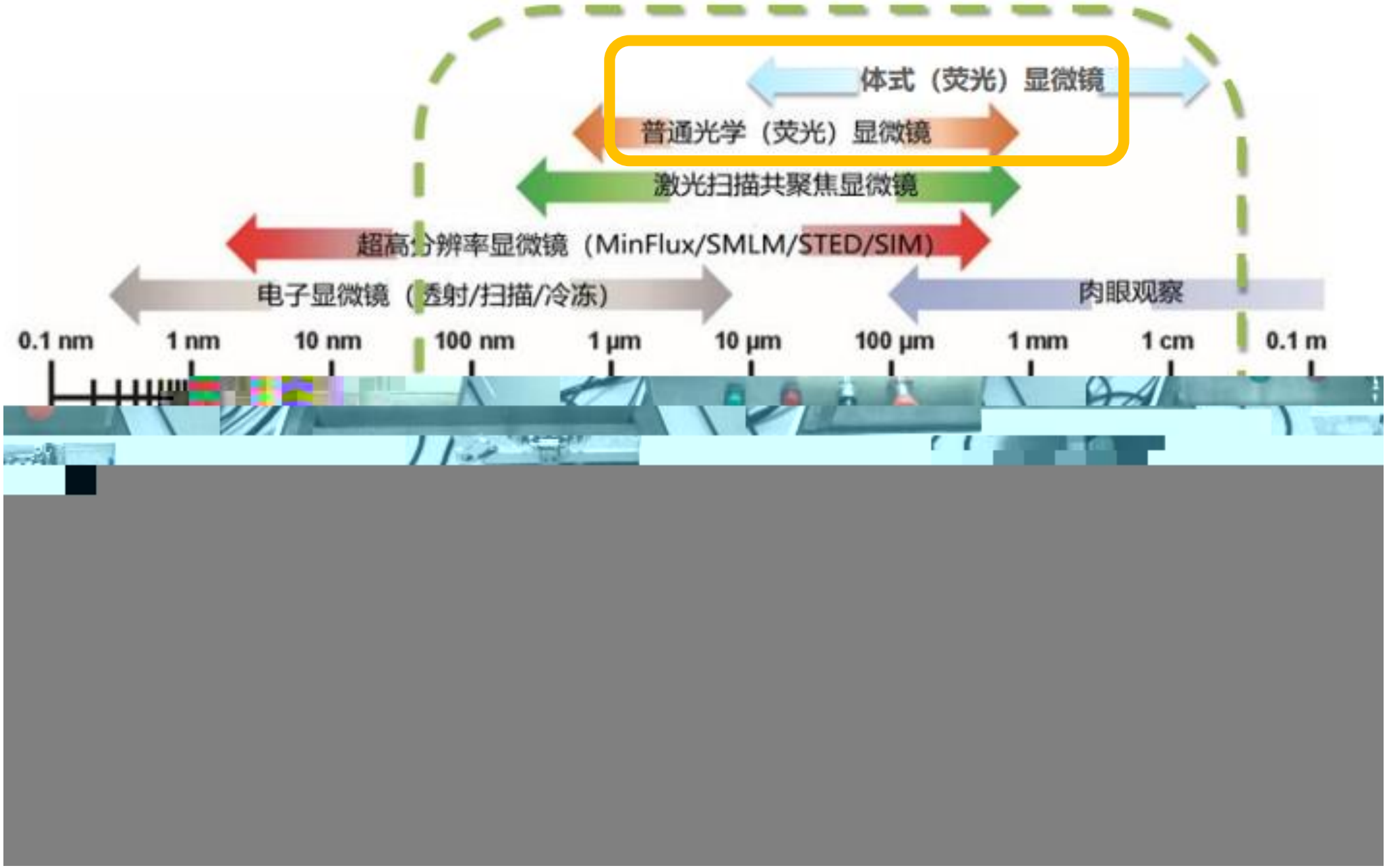
q?· » ï

1 = • œ F © &1¶

2 = F l m,º 0 b SD% Â n?÷ ï#

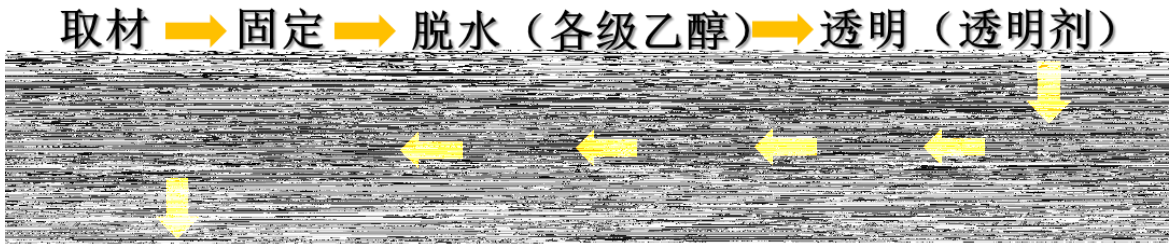
3 = n?÷+U(Ÿ m ÷,º :*< ï#

4 = Ê+^ ~ Á


体式（荧光）显微镜
普通光学（荧光）显微镜
激光扫描共聚焦显微镜
超高分辨率显微镜（MinFlux/SMLM/STED/SIM）
电子显微镜（透射/扫描/冷冻）
肉眼观察
0.1 nm
1 nm
10 nm
100 nm
1 μm
10 μm
100 μm
1 mm
1 cm
0.1 m

4ô4÷ 7(w

.#=Q 7(w



¾ F 5 7 2 ï …,ú´(w È(w €;´6< w 0 È ,á?f

¾4ô4÷ * ÊE³ - È Ç Ï Ê } ö.ž È Ô$Y ; K¯ O ˆ n

¾+X ¾ }+Û4ô F,´.#=Q 7(w Ä ƒ XE³ ~,´$Y Ö ;F >|

7 7a"d ÃF? >1yE÷0; Ä X4 ł ;F >|

8 4ô4÷ u 67a"d ÃF? > Ã#¨=Q È ~$Y.#=Q 5 û Ä60 ł ; Å

9 37 ł ,$Y1áE÷ L' È ÿ A7a(w

¾ ý Œ4q*@ È é CFP @ô4÷ µ Ç Ï W,´ W a

¾ 1 •/ë4ô4÷,´4ß Ö È"Ñ 972%$ Ã rCX1y"‘

¾.#=Q8 9— yE³ j

4ô4÷ 7(w

_ Ø 7(w

¾ Y+X 0(w _ Ø Ï*6 È 6 àRÌ,´#k ƒ4ô4÷ F * ÊE÷,´4ô4÷ 7 @

î ì …;ú(w ~1mm : Ê(w

¾ 08\ Ê Ö2î Ö × f W4Ö j í … Ŀ ² Ì Š9— y 8¢ *AÞ 7 @;´(w

¾ àRÌ4ô4÷ = * Ê = à ë

¾7-E³ - ` +‰72$æ W(™CX ¼4ö7 7Ì Ç Ï

Ä1 Å > à ë 7(w-(" È =M0?±)4ô4÷ ç ë È = J ’ @ à ¦ F

FP @4ô4÷ Ç Ï,´.d •

Ä2 Å >.#=Q 7(w-(" È =M0?±7a"d ÃF? > Ã#¨=Q1yE÷0; ÈF¯

}) Ç Ï,´ • ã

¾ k?±+X ¾7A4ô4÷ Ã7:Q Ã6Í7? Ã-l-‹ ú ¦ E³EŸ ˜ È4ô4÷

k?±#q0;

1. g
2. * Ê
3. 4ô4÷7(w
4. 8¢ / }+Û4ô F/ Ï } r Ô
5. 1(w
6. ^

HE 8¢

8ÿ X2î v :4Ò 8¢# (hematoxylin-eosin staining)

1°0 HE 8¢# È.#=Q 7(w ° _Gü h+X,´ 8¢# { 0 Ä8ÿ X2î #â j.á W È k?± ¯ 4ö7 h µ,´

8¢CX >7 CX µ,´ hG¨-p 3[; 8¢ × :4Ò jG¨ W É È k?± ¯ 4ö7 CX¼4ö7 F *CX],´ @ 6-p 4Ò8¢Ä

#k ƒ g ñ

#k4ö7 / 7 6þ

¾GFP/EGFP/RFP1y9— y=½ 8<û,->˜EîE- ƒ,´ ´ *

7 4ö7 Ö F$À * +GFPCX2Â ÈEœ

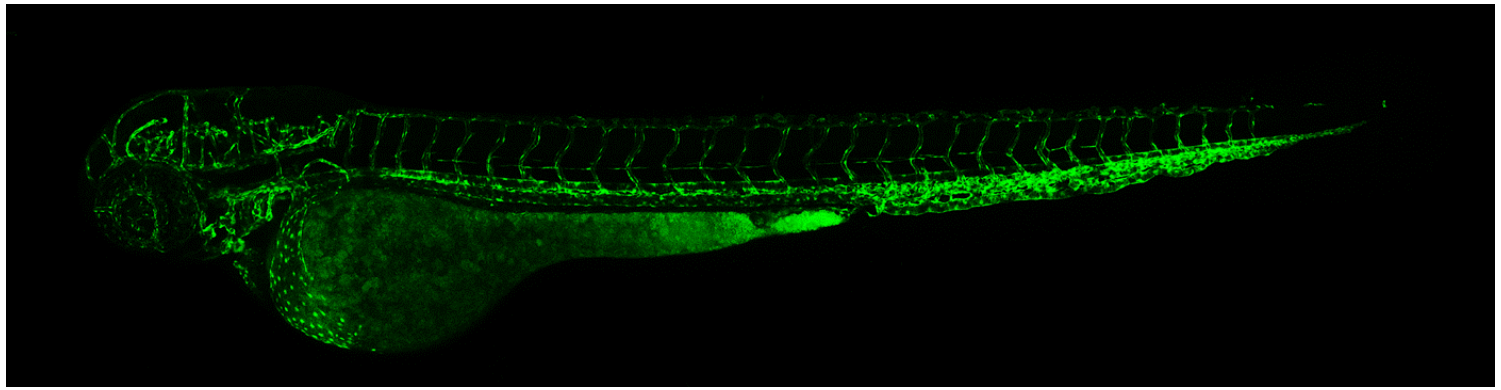
8 ÁPœR¬ŒÖGFPEœ * R¬ È n Þ# 4

4ö7 y" W•T

y%2,- ,8$,´9— y$ &•

¾E- ƒ,´Eœ ˆ X x)·L NÈ

¾ 9,´ g \9— y<û,- X#k ƒ!« Ñ > j Ö ÿ a



#k ƒ g ñ

4ö7 ˜ ú DNA

4ï2Â ƒ ÖMitoTracker F?E÷4ö7 7Ì Ä X+X * Ê r.d •7Ì+e } { > • = J

>Û#G ¹ Ä

$æG¦ ƒ ÖLysoTracke**È**+X ¾$æG¦ ƒF-DZ È F >|#k4ö7 7Aà ×LysoSenso**È**

9— y Þ Ö fPHl F ¡ ý È+X ¾ ð#{$æG¦ ƒ ’ @ Ä

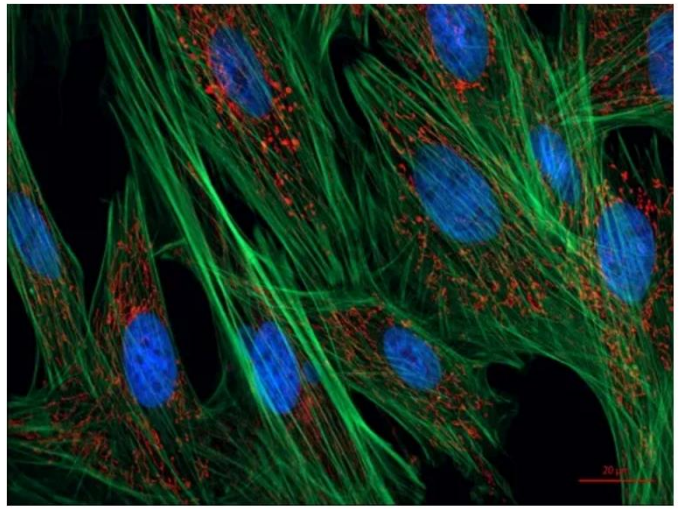
µCX5• ÖDIOC6**È**MŽ(© 2 W È**E³Q #ƒ** Ö 7Aà µCX5• È**E³** ~#**ƒ** Ö 7Aà**4ï2Â ƒ** Ä

Q D * ƒ Ö ¯+X NBD C6ceramide¼BODIPYFL C5ceramide1y9— y É) ¦

F >| 7Aà Ä

4ö7 h ÖDAPI7Aà zFJF?4ö7 È7- O0¯F?4ö7 7Ì È +X ¾ * Ê ¼#k4ö7

{] × Hochest 8¢ r" W-( )E³ ~ È" E³F2 8 7Aà#k4ö7 Ä



▲ 蓝色为DAPI标记细胞核，绿色为

<+#â

f(w

¾ àRÌ<+2« g ñ 08\ )à j f(w

¾M0?± 6<+#â i ƒ 6 “ x w 0,´ Ã Ü#ž(æ

¾ § 94Ô" ,´<+4ö7 F ØE³ È +X 0.05%´ ~'Ä&é*l72

* Ê X-)ë(w :

¾ } f(w &# ? 1(w ÈF¯ }<+4ö7 a"d ’

&5/3P

¾8 9— y)àB‘

¾%ð yBa ¼ Õ f yBaE³ í È 9 & J ¢ - ,´9— y ',´ ð#{

7 Ð j- ,´ ',´9— y j Ö

8 B3 ¤- ,´ ',´ Õ f# !å È ÿ A &5/3P,´ ',´Gý Õ f Ä

¾ ëL” &5/3P Ö 6<+4ö7 * Ê X-)ë(w : È# X+bG·$æ#â È -20 ; 20min

8 9— y

9 4Ò4ö7 >p4Ò<û,-],´ • y Ä !“ h õ å ; È • y ¼Jñ/ë €-(5 8 È Á f ¶9— y Œ

+X × ² X>p#â] ÐG¨ ¯Jñ/ë €$h/ë È F5jJñ WC[>p È>p4ö7 • x4Ò8¢9— y Ä

9 Ë6ï,T4ö7 X3[F F; y%ð x)à > n,´8 9— y Ä

9 5$+O3Ƥ § 95/8¢8 W9— y Ä

9 Ë9Ÿ(™ • x)àNÌ8¢9— y È ² ~ ± È)ß3P 1y Ä

Aî5ž0ª,-)'— ¼ ÎP¼)'—

q?· » ï

1 = • œ F © &1¶

2 = F l m,º 0 b SD% Â ï#

3 ="j+U+U(Ÿ m ÷ :*< ï#

4 = Ê+^ ~ Á

1 ;OÙOÍ%ù*™o!1è# _ 4õ6 Eƒ4•ikk{"to -%"tP›%ù*™15mino 4%PFA

2 ;_ " o! PBS< 5minpd3: o ~D' Triton-100_ " 30-40min

3 ;+ dìo! ~D'+ dì<± (Triton-100 0.2% +BSA 1% +DMSO 1% in PBSTopo H7.3 pd10mino 5ÿ# ÿ: 1h ä <

4 ; ÿ1–*tO±o! 4 ł o ^Æ(<o (•6› ÿ1– Jdó v6 >[&'EƒIÝ ˆo Š(• p*™ Lo h• G*t" à"ö^,.0Eƒ1– Ro

5. ~D'+ dì<±= < <OÙOÍ"ÐO± \„^Æ 24ho 15minpd4: o" 24h-48ho 15minpd8: <

6. ‹1–*tO±o!*£=(_~ Ho 1h <

7. .~D'+ dì<±= < < 15minpd3: <

8.C;P KÕ%ù*™o!!d"º"t'òo D' 1%M@“?¸C;P KÕ%ù*™

9.Rf H1–<ë?l!Ao 4 ł Ü*W <

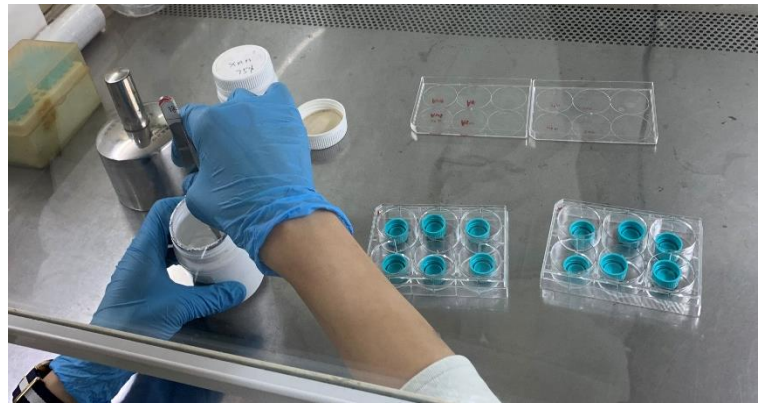
1.2Ï!L Å(

X TúMÅOÝo!MÅOÝ≤ÌR^¥~10^6 cells/mL≤

Y ^|BºAF#‹EÕBºAFo! GD';3 ±< -q ¿o Œ<w;à • 75%X`† ,o (D'

Z + 50%ŒƒPlo OY X?î ™Oùo D'?lRëdH2CHÿ`ÉPà1%<

PI'î ä6 4GEƒ ~MÅOÝ\3eCo E5.OY X?î ™Où ^ v6 .‡.9Eƒ:Ñ/& <



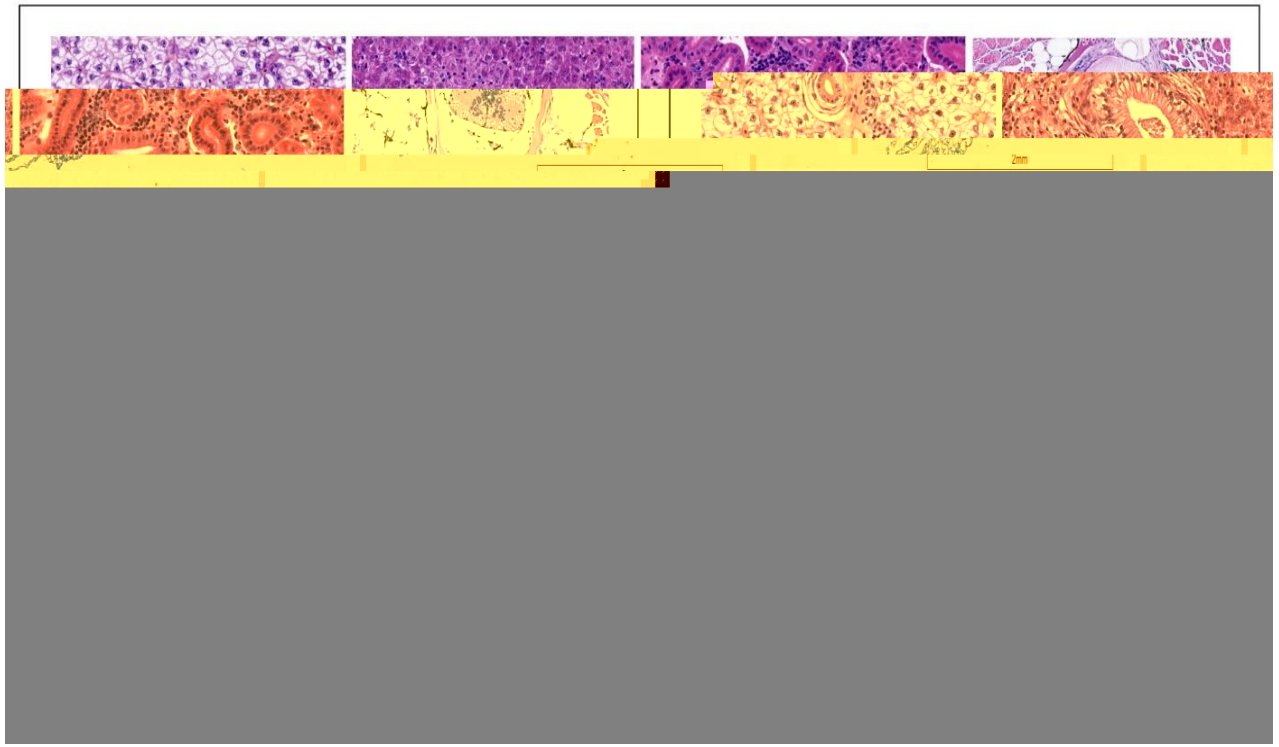
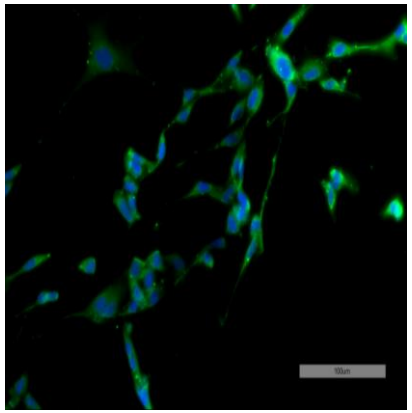
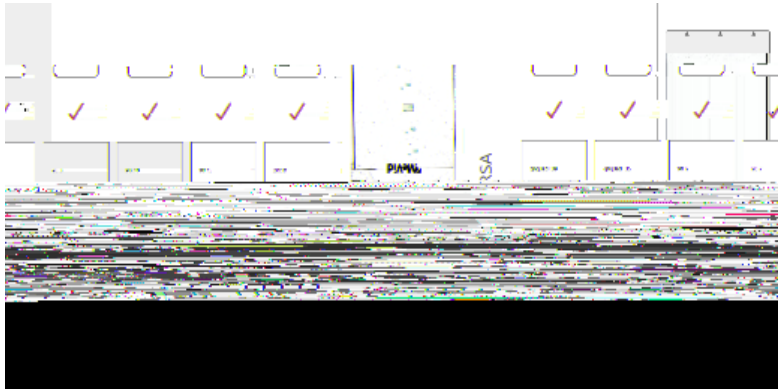
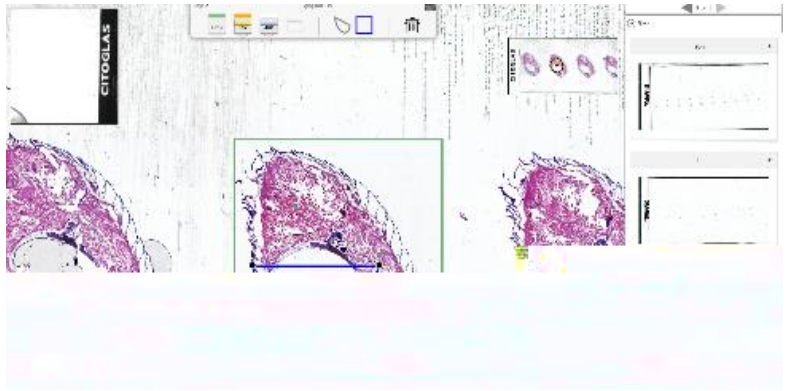
2.EÕBºAF(C o!

X + 6*S6~< -q ¿o ,dó4= d 15mLHº.ÂJ EƒEÕ*O <D'-q ¿EƒdI*O+ .Â

"Õ ùEÕBºAFo Nm1•5mLHº.ÂJ EƒEÕ*O o &'\„ ¿"ï ,#8-q

Y "Õ í ì ì • î ì ì … >EƒP9=µ<±=ó&'EÕBºAF o ^z^z5B!§ ~Pl&'EÕBºAF

3I-ro @5# IÊ&'4ß+ M· #72ˆ(X<± Ro 4=Nm 1-2min# 1þ!/\„ ¿"ï

,#8-qo M¥ 30min~1ho

4ú4ý =() l m =() ¡