



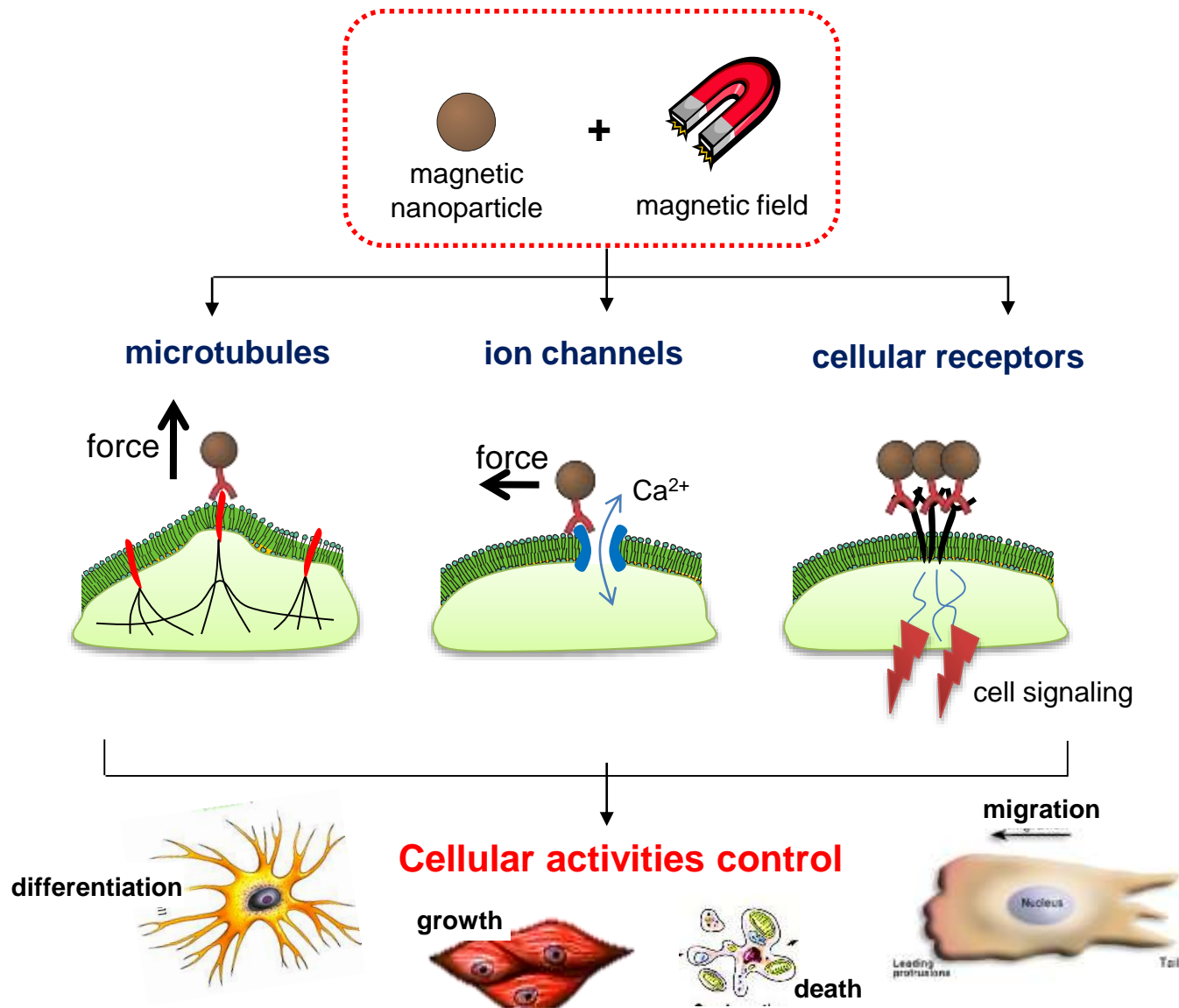
A Magnetic Switch for the Control of Cell Death Signaling

2015. 06. 04.

Jungkuk Lee

image from © Hybrid Medical Imaging Inc.

Magnetic Nanoparticle for Artificial Control of Cellular Activity



J. Dobson, *Nat. Nanotech.* **2008**, 3, 139.;
J. Cheon et al. *Angew. Chem. Int. Ed.* **2010**, 49, 5698.

Apoptosis (Programmed Cell Death)

eliminating cells that are misplaced, no longer needed, or irreparably damaged

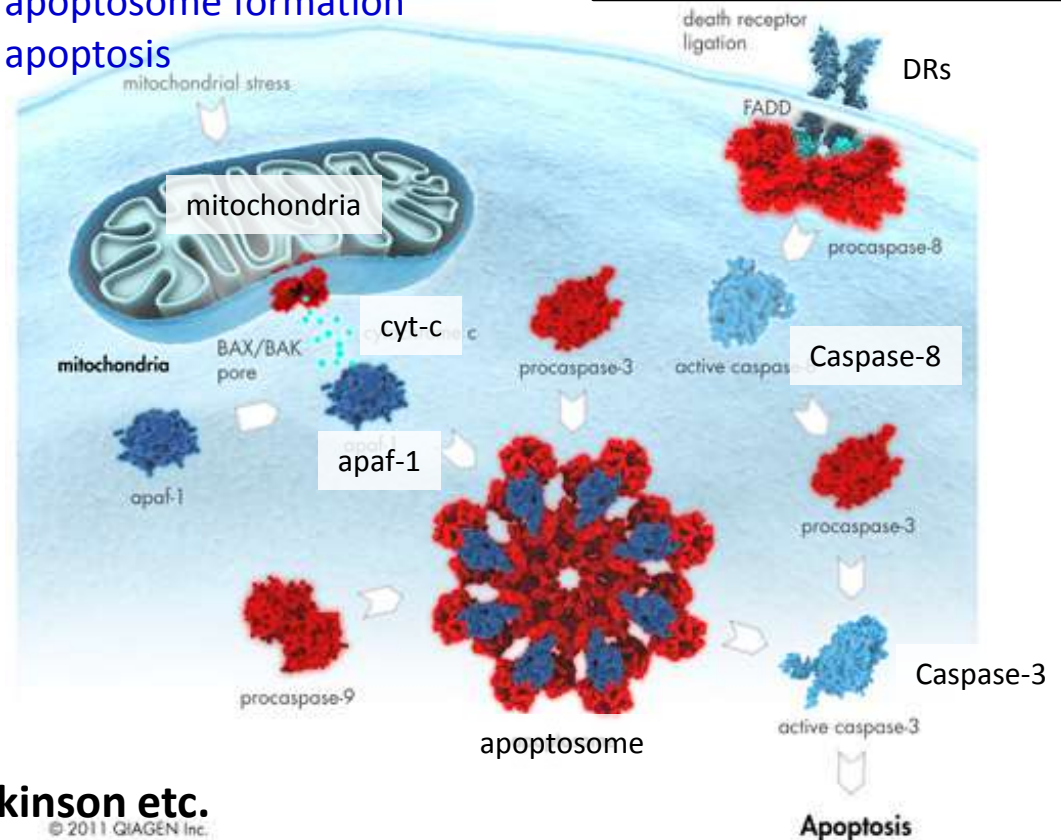
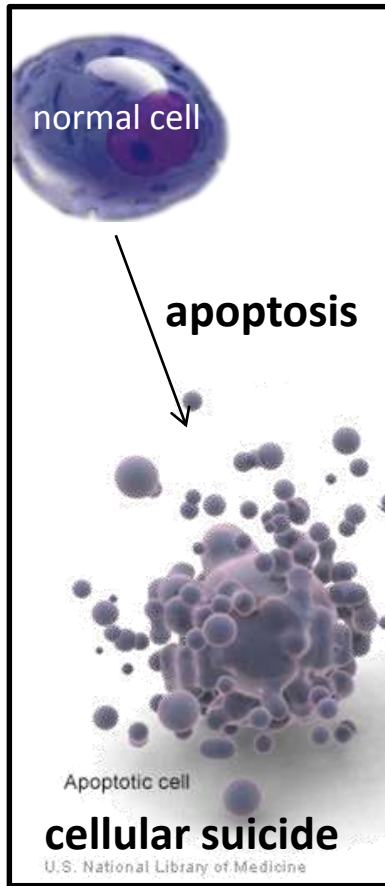
apoptosis signaling pathways

intrinsic pathway

1. mitochondria stress
2. cytochrome c release
3. apaf-1 activation
4. apoptosome formation
5. apoptosis

extrinsic pathway

1. death receptor (DR) clustering
2. caspase-8 activation
3. caspase-3 activation
4. apoptosis

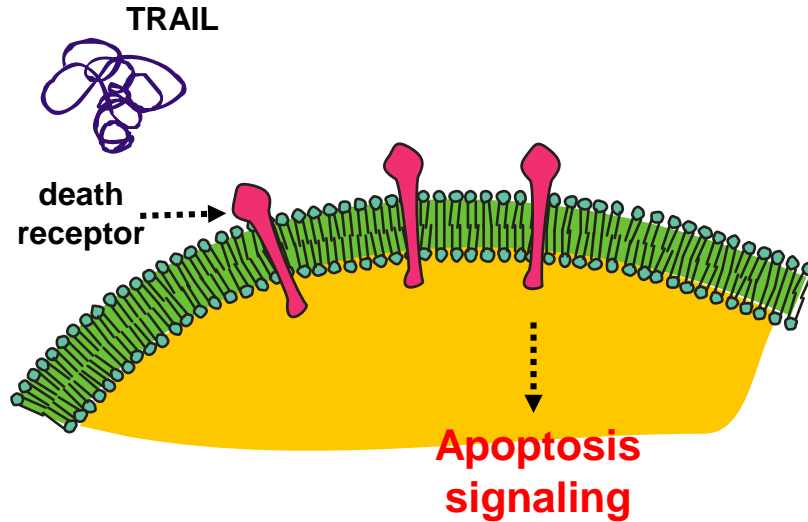


related disease: cancer, Alzheimer, Parkinson etc.

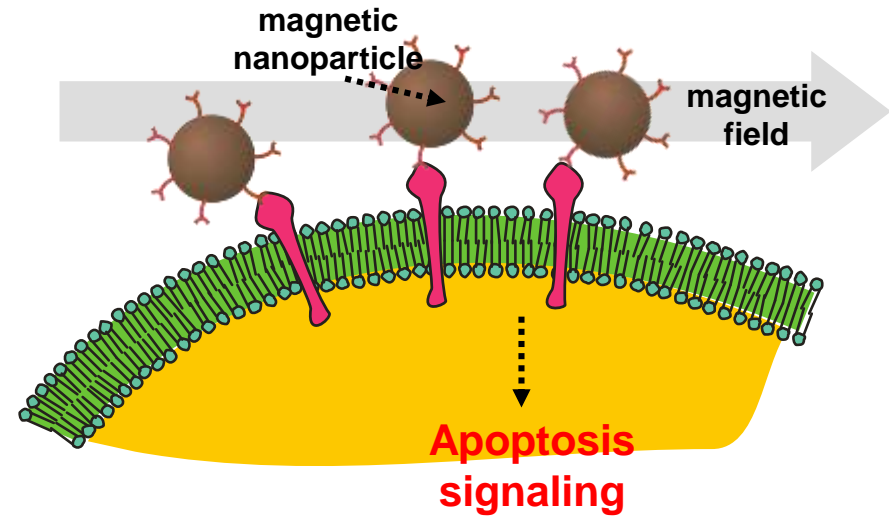
images from QIAGEN Inc. and US National Library of Medicine

Control of Cell Signaling by Targeting the Cell Surface Receptor

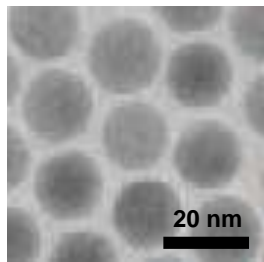
Native



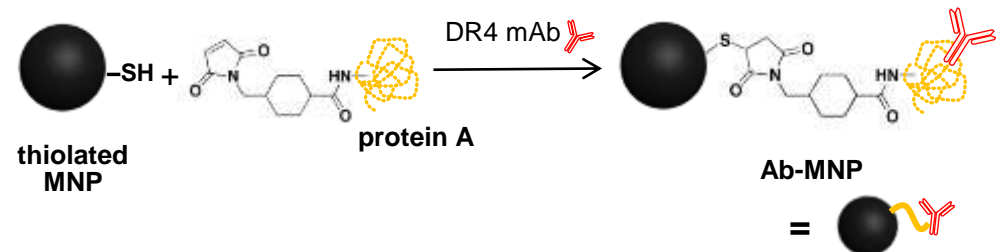
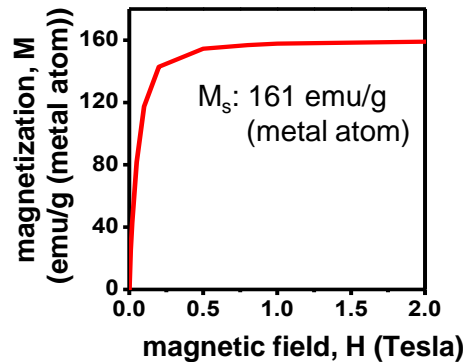
Magnetic Actuation



• Magnetic nanoparticles & Conjugation scheme of MNP to the DR4 antibody (DR4 Ab)

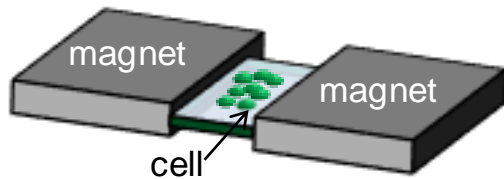


15 nm
Zn-doped iron oxide
($\text{Zn}_{0.4}\text{Fe}_{2.6}\text{O}_4$)

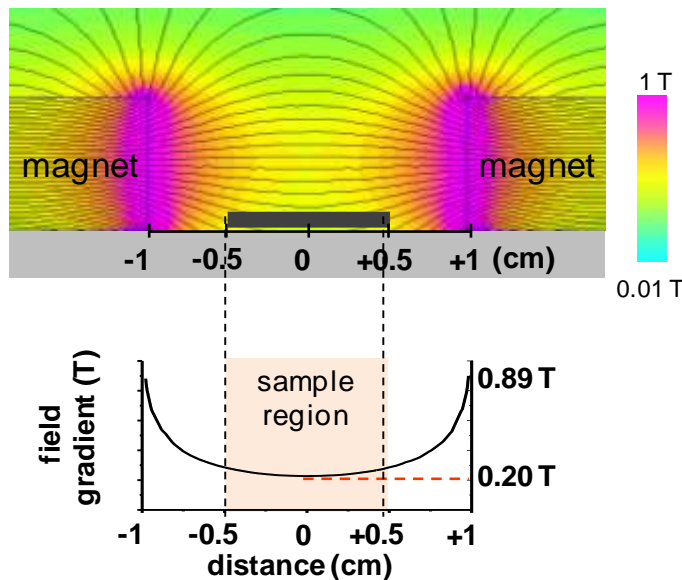


Magnetic Switch Activating Apoptosis Extrinsic Pathway

magnetic switch set-up



side view

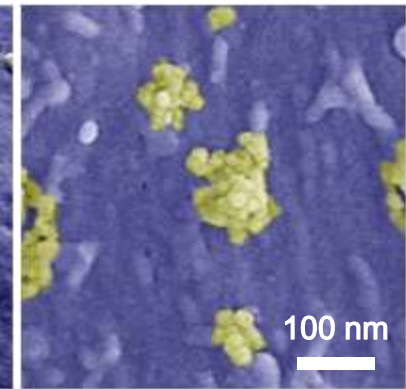
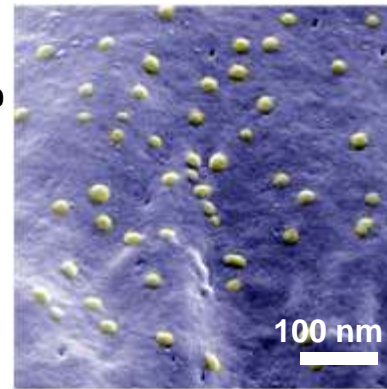


(Cell : DLD-1 colon cancer cell)

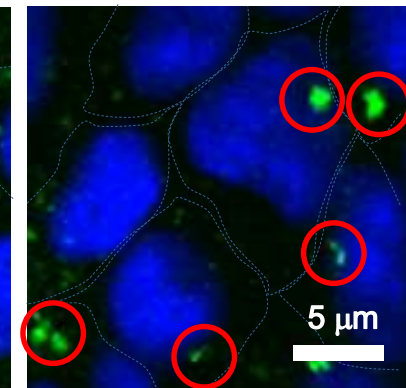
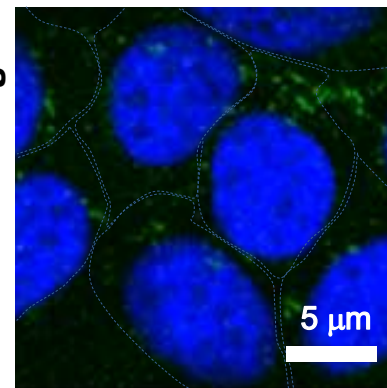
before magnetic field

after magnetic field

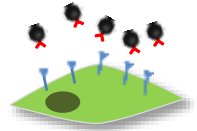
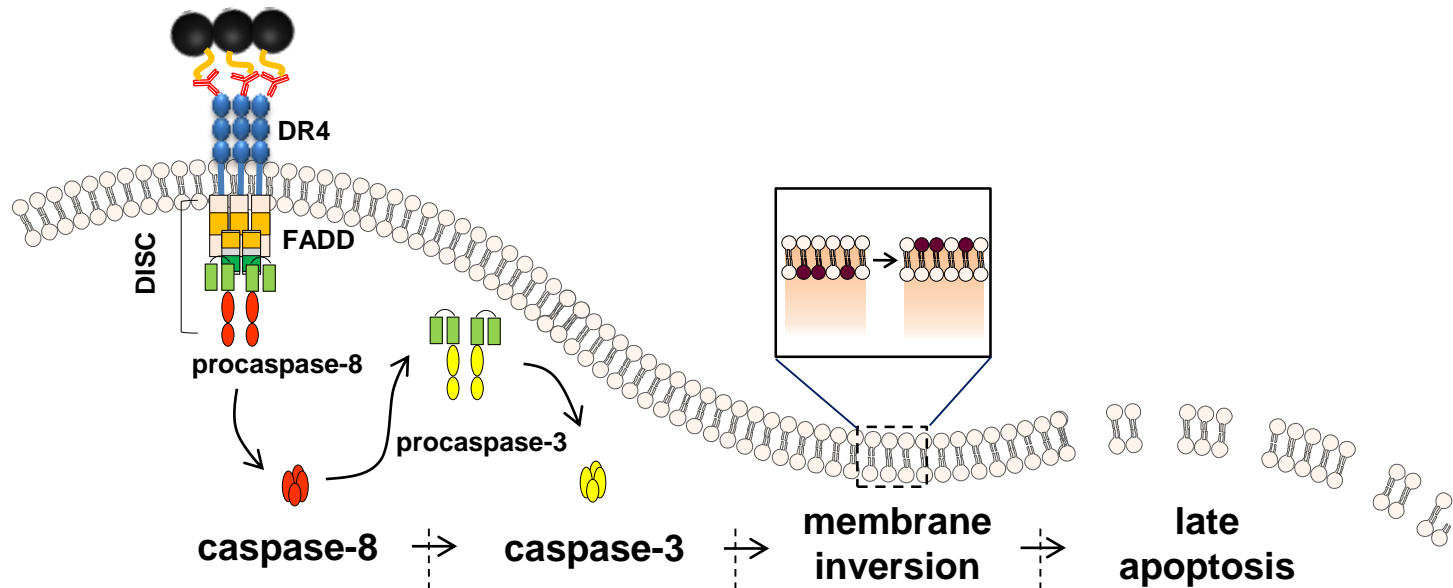
SEM image



confocal image

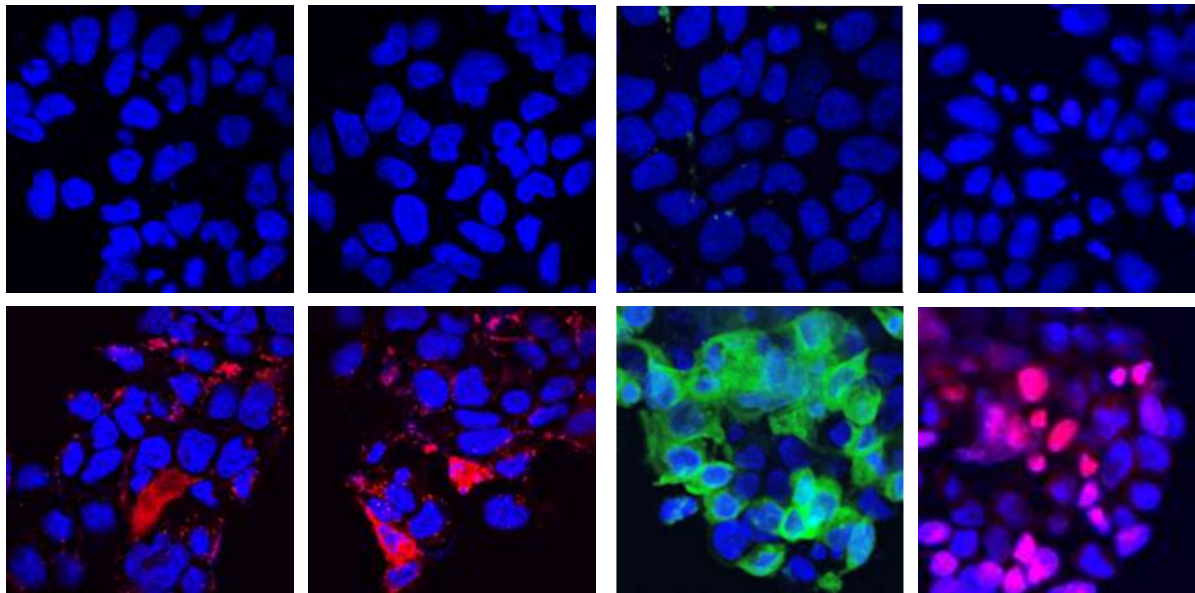


Magnetic Switch: In Vitro Apoptosis Induction



non-activated

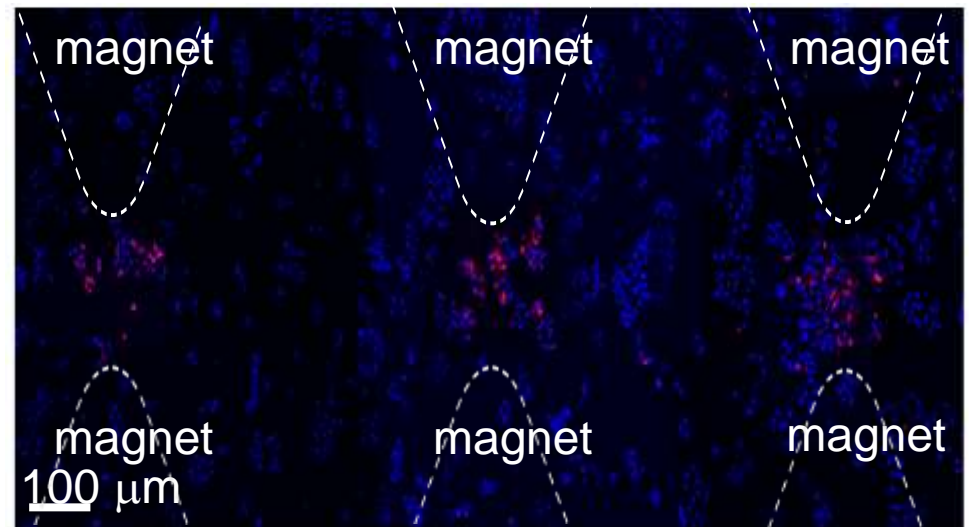
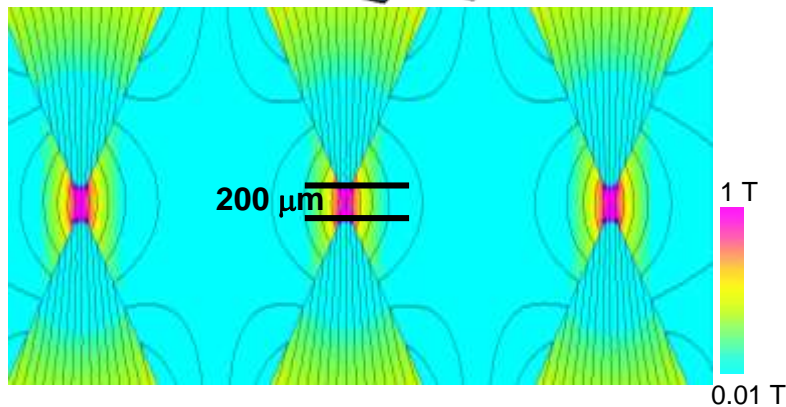
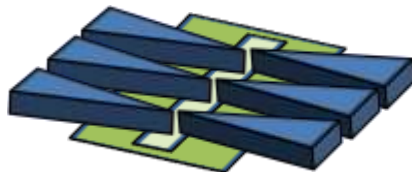
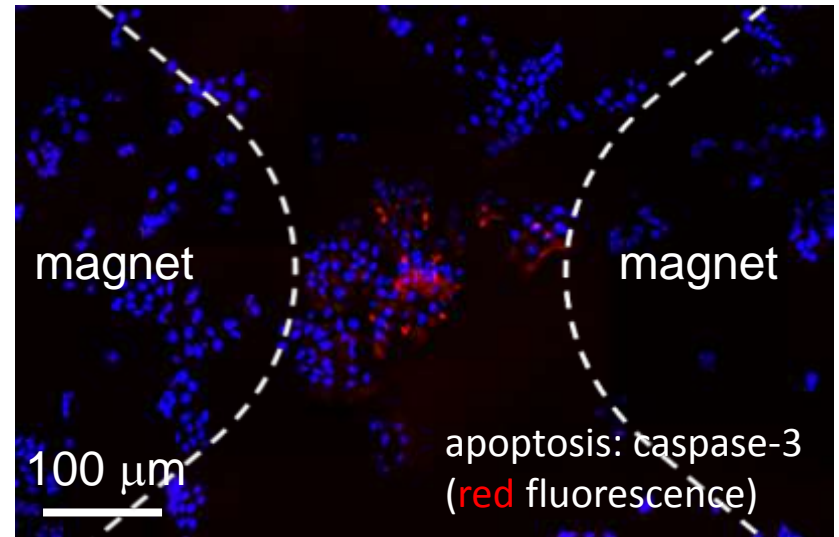
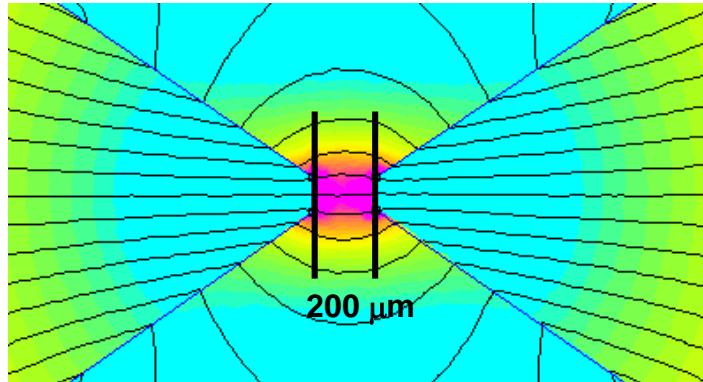
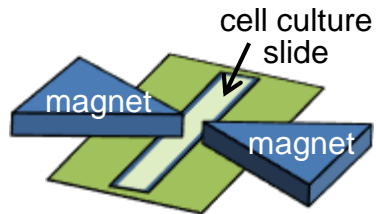
magnetically
activated



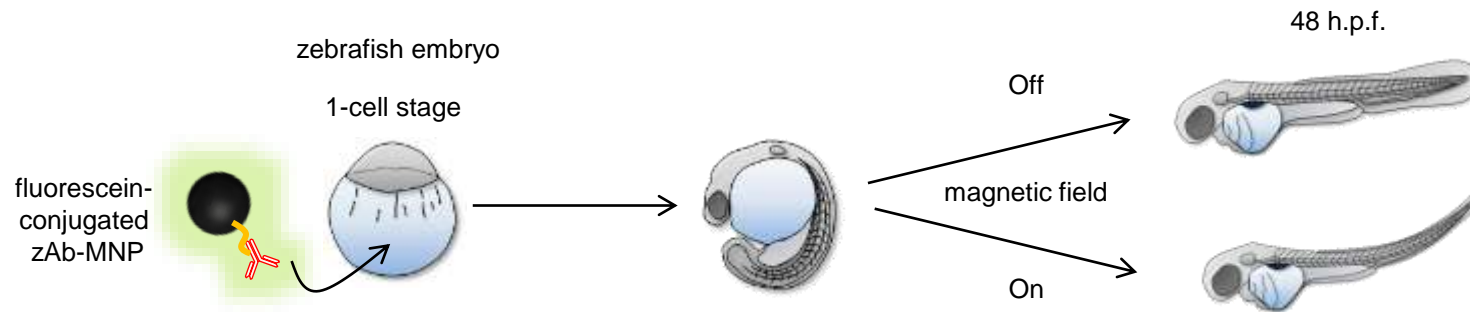
0 h

24 h

Spatial Control of Apoptosis Signaling



Magnetic Switch: In Vivo Apoptosis Induction (Zebrafish)



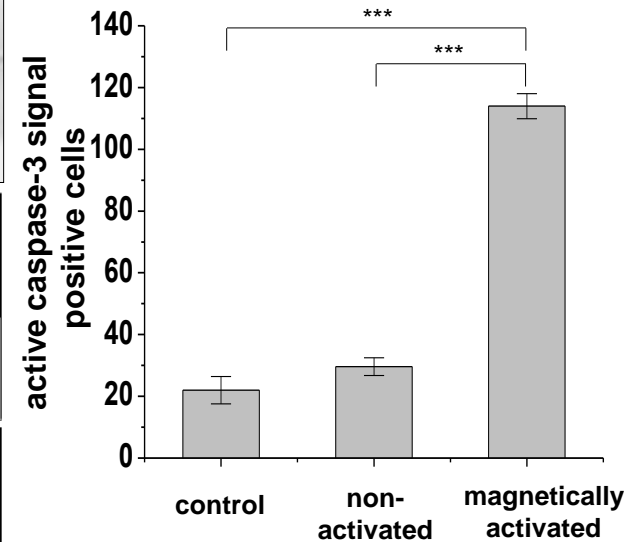
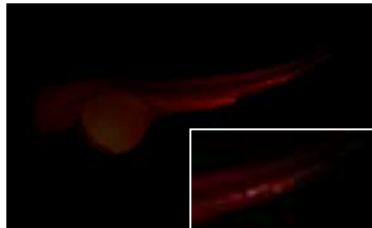
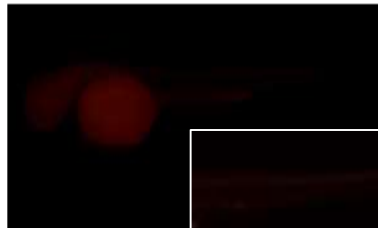
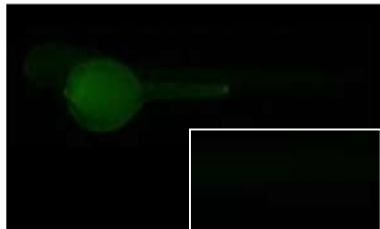
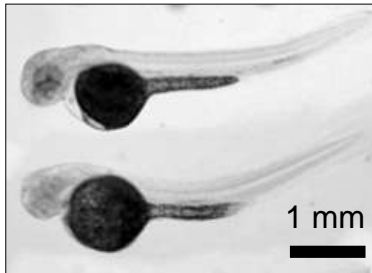
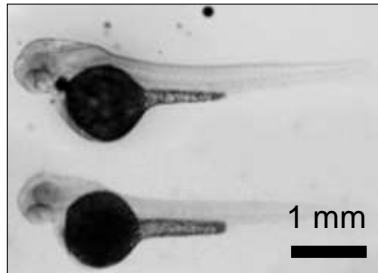
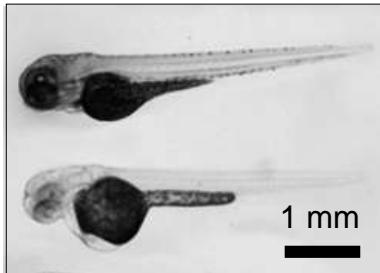
zAb-MNP (-)

zAb-MNP (+)

control

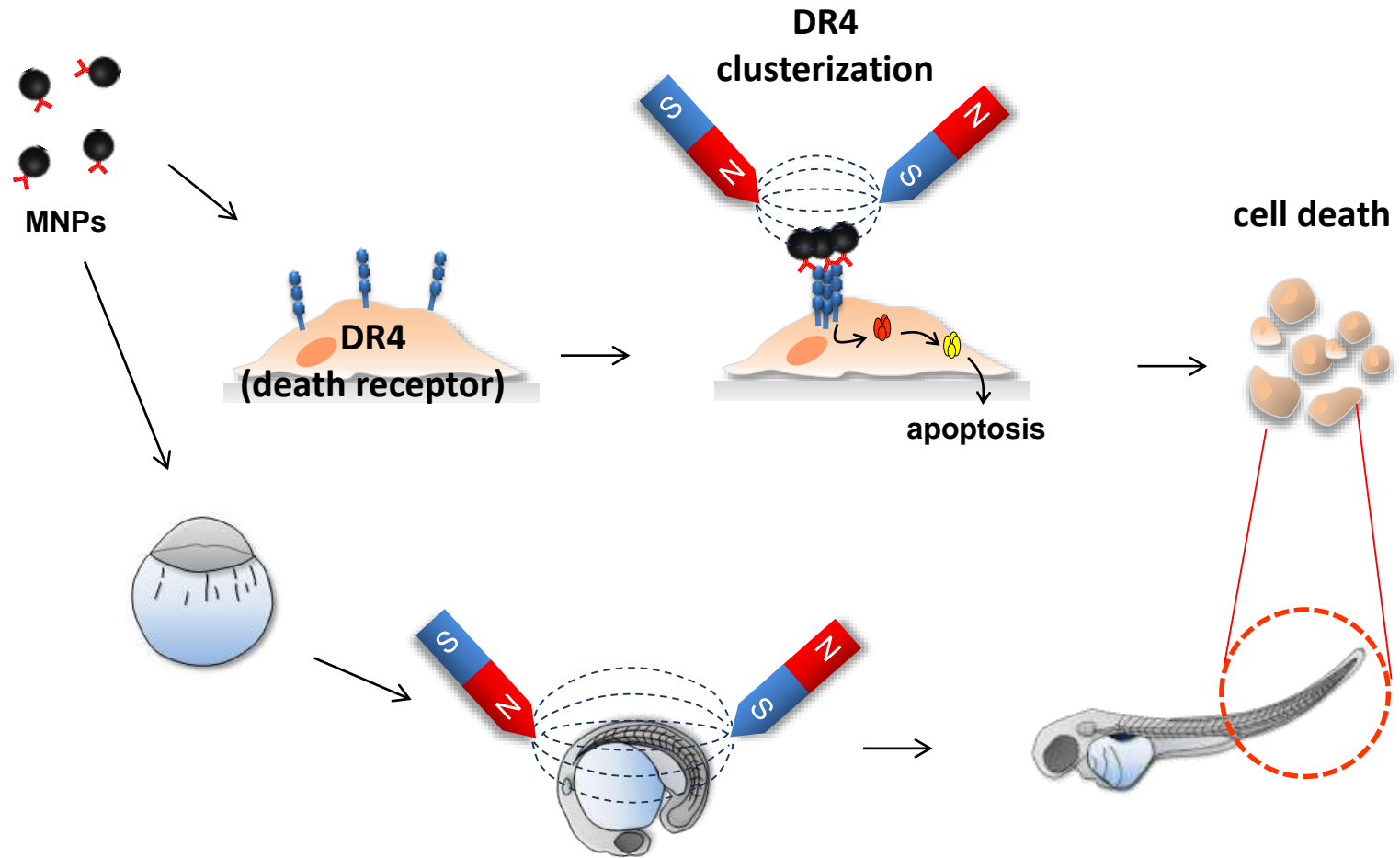
non-activated

magnetically
activated



Magnetic Switch for Apoptosis Signaling

remotely triggered cell death by using external magnetic field



In Unity There is Strength!

