Engineering Nanoparticle Shape to Deliver to 3D Tumor

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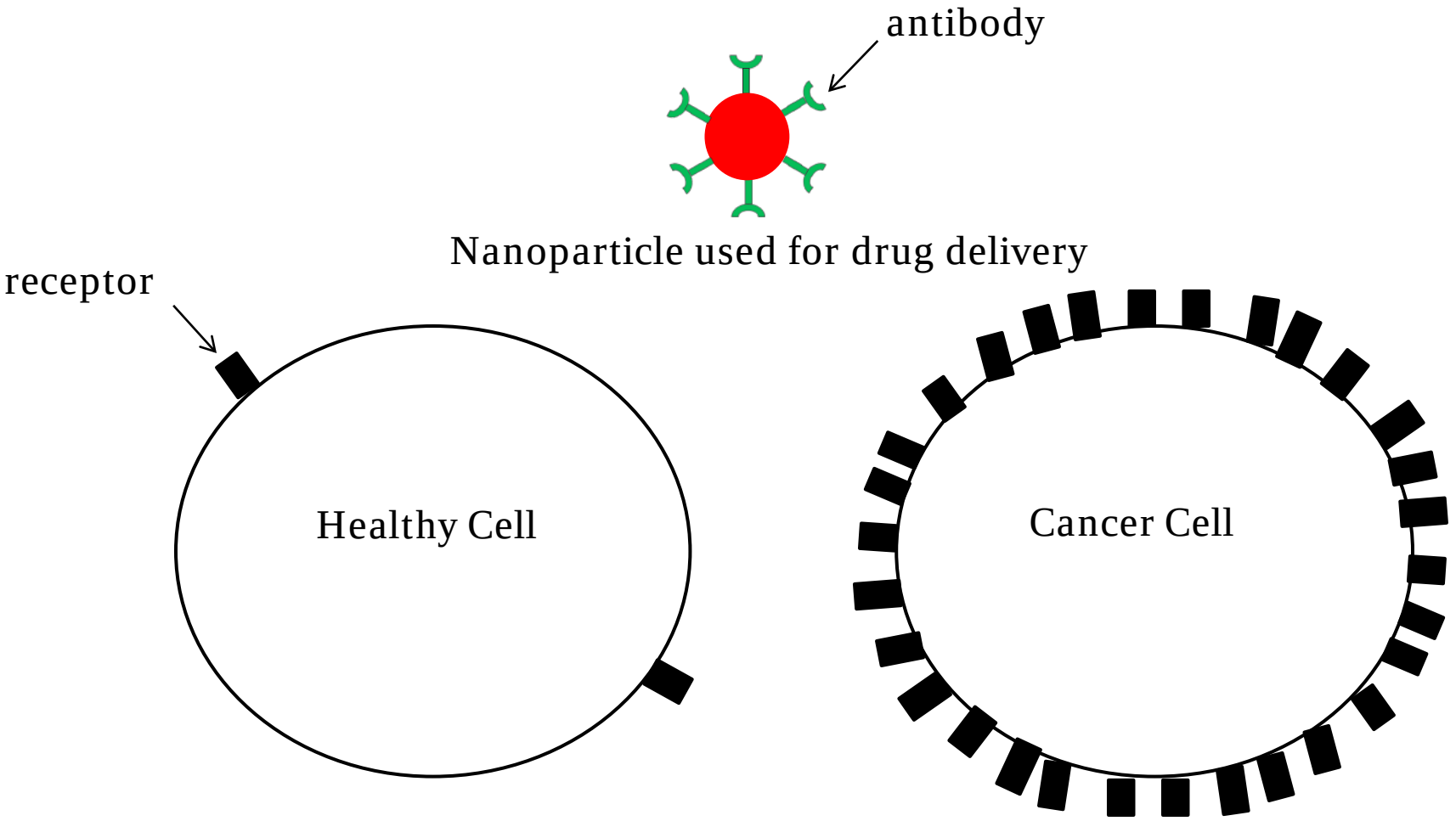
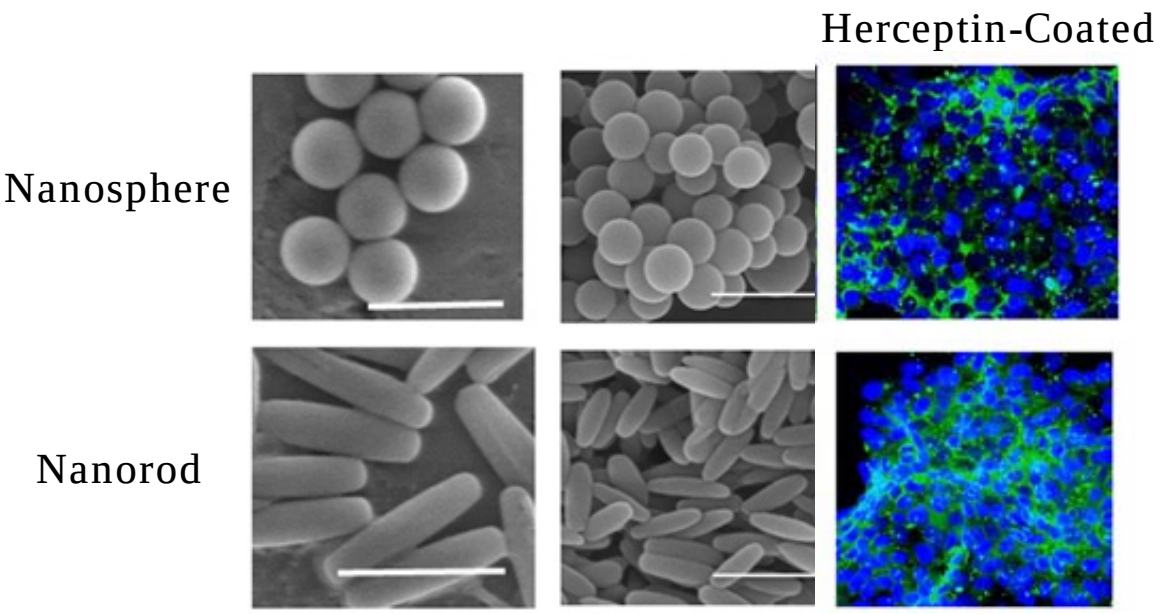
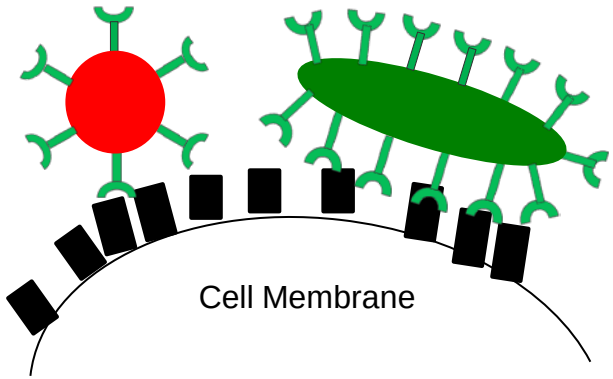
Targeted Therapy for Cancer Treatment

Targeted Therapy



Previous Study: Nanorods Target Better than Nanospheres



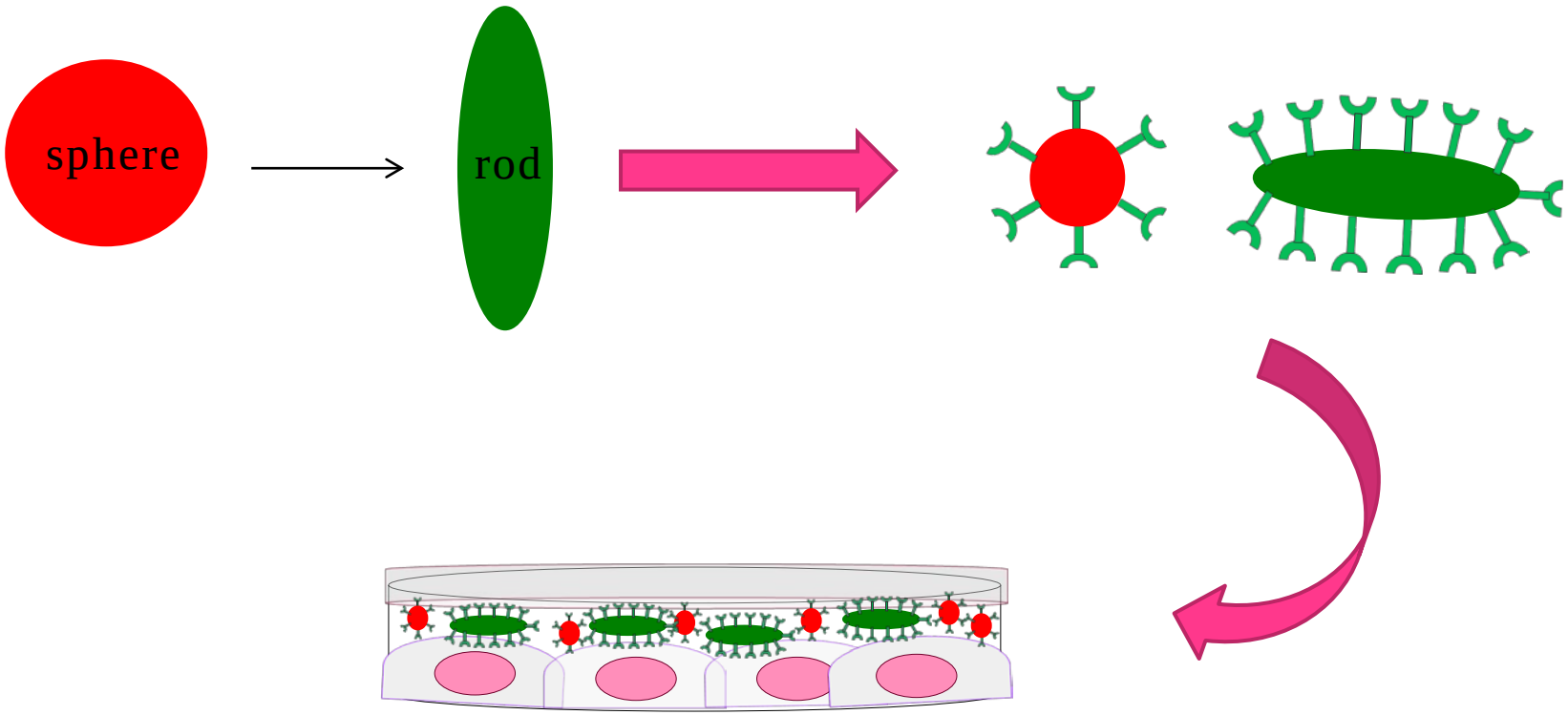


Nanorods have greater bonding to cancer cell surfaces than nanospheres

Barua et al.; PNAS, 2013

Objectives

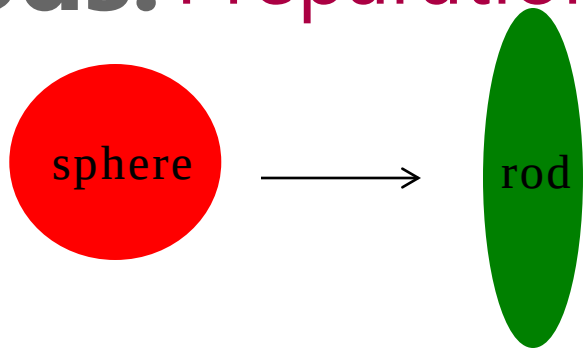
Improving Therapeutic Efficiency of Anti-Cancer Drugs



Hypothesis: Rods penetrate cells more than spheres

Methods: Preparation of Nanoparticles

Polystyrene Particles



Spherical shaped nanoparticles in a polyvinyl alcohol (PVA) film

Spheres

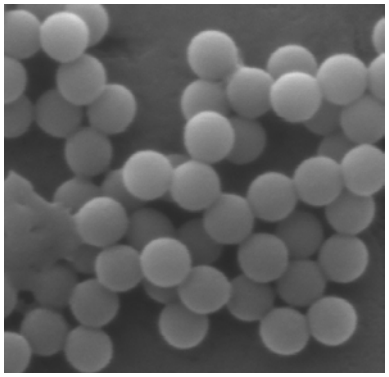
PVA film is allowed to set for 18 hours

Place PVA film in metal stretcher and heat

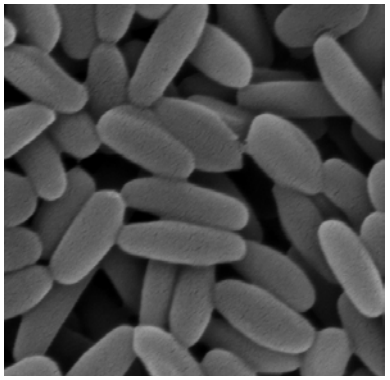
Stretch PVA film; Prepare nanorods

Nanosphere and Nanorod Images

Scanning Electron Microscopy (SEM)



Nanosphere
(200 nm)

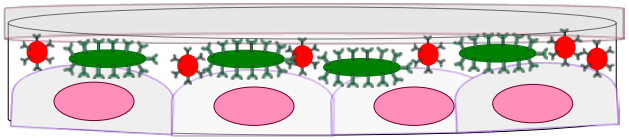


Nanorod
(300 nm x 100 nm)

Nanoparticles were coated with a targeting antibody, Herceptin

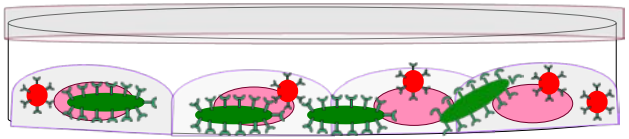
Barua et al.; PNAS, 2013

Methods: In vitro 3-D Tumor Growth and Imaging



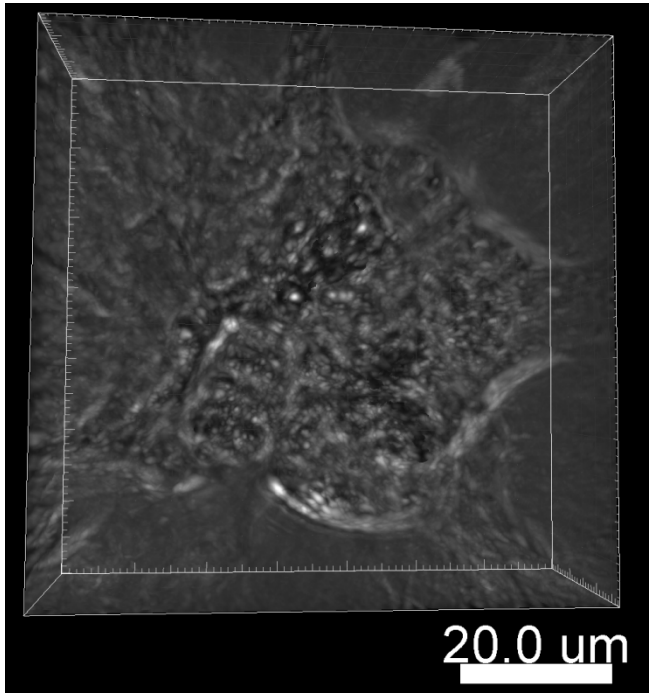
3-D Breast cancer cells treated with
Herceptin-coated nanospheres and nanorods

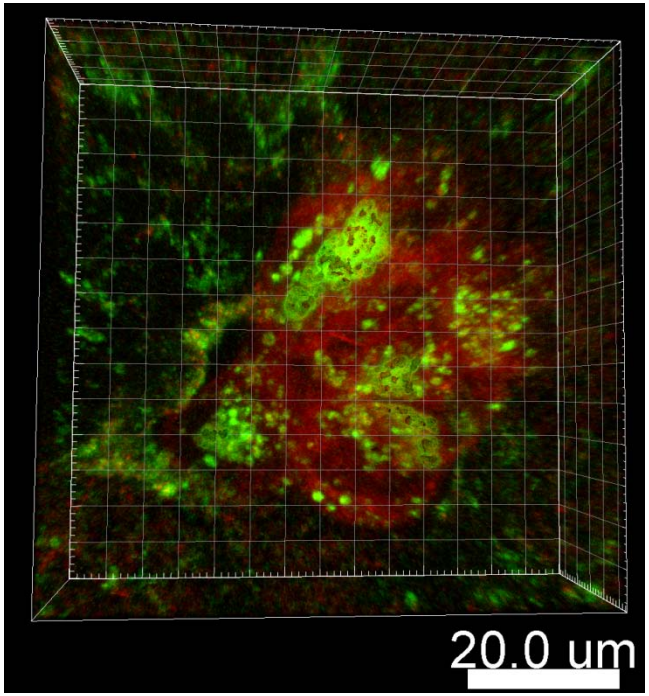
24 Hour Incubation



Visualize the nanoparticle penetration and quantify the differences

Visualizing Nanoparticles in 3-D Breast Cancer Cells





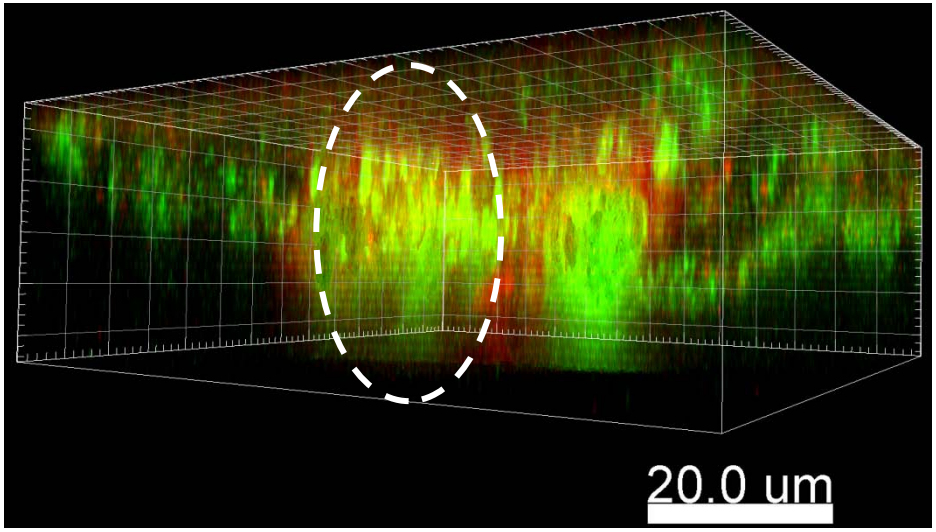
Key:

nanosphere

nanorod

Confocal microscopy allows analysis of nanoparticle penetration in 3-D cells

Comparing Nanorod vs. Nanosphere Penetration in 3-D Cells



Key:

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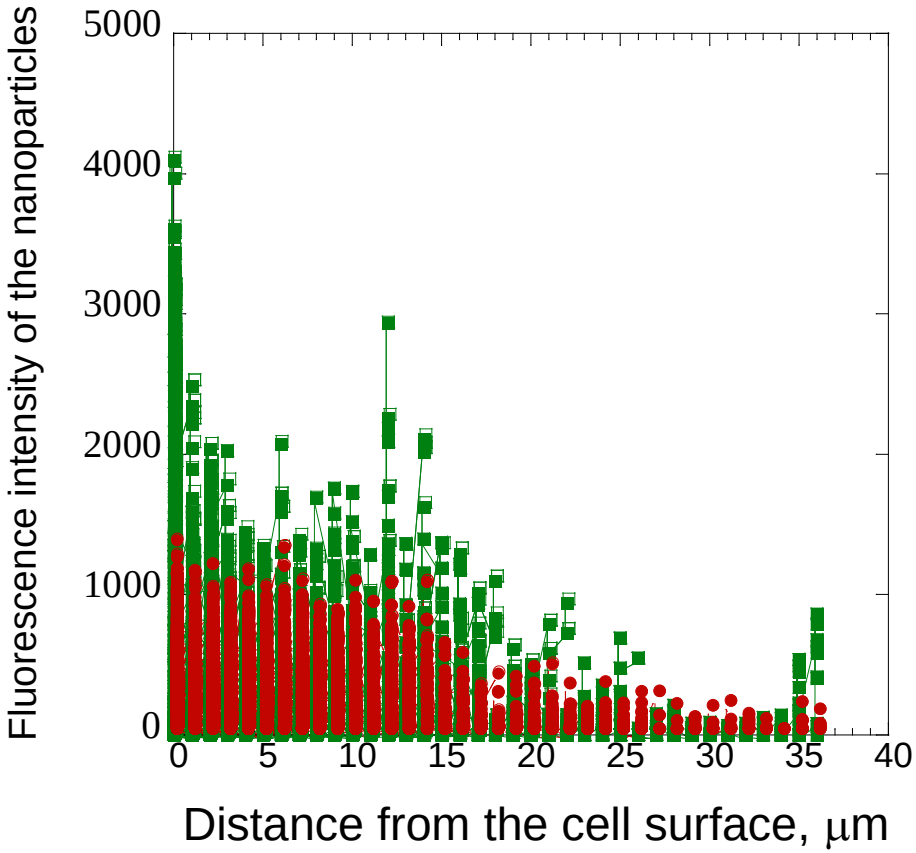
nanorod

We used a 3D imaging software to measure the penetration of the nanoparticles into cells

Quantitative Measurements of Nanoparticle Fluorescence Intensity



Key:

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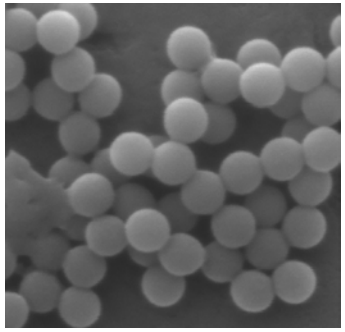
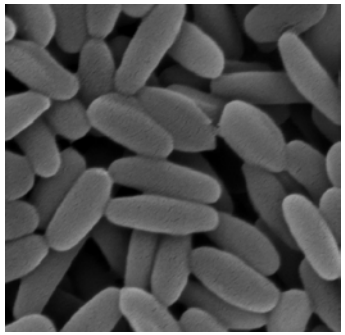
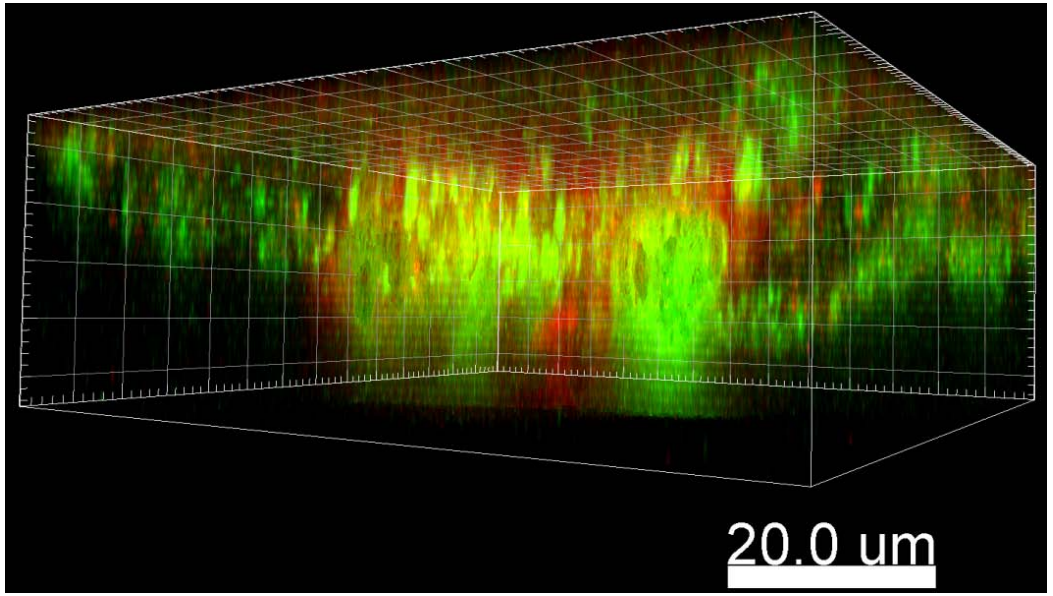
Nanorods penetrated deeper into the cells than nanospheres

Summary

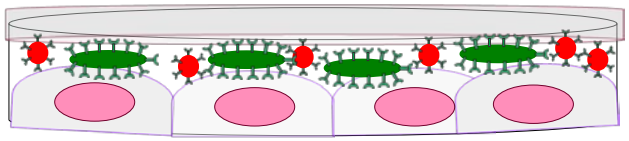


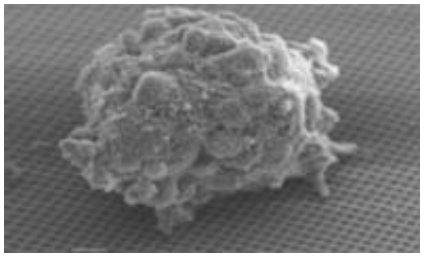




Application in drug delivery to complex tissues

Future Work





Thank you!

- Samir Mitragotri, my mentor Sutapa Barua, and Maarten Bakker
- Arica, Ofiela, Maria, Kevin and the CSEP Staff

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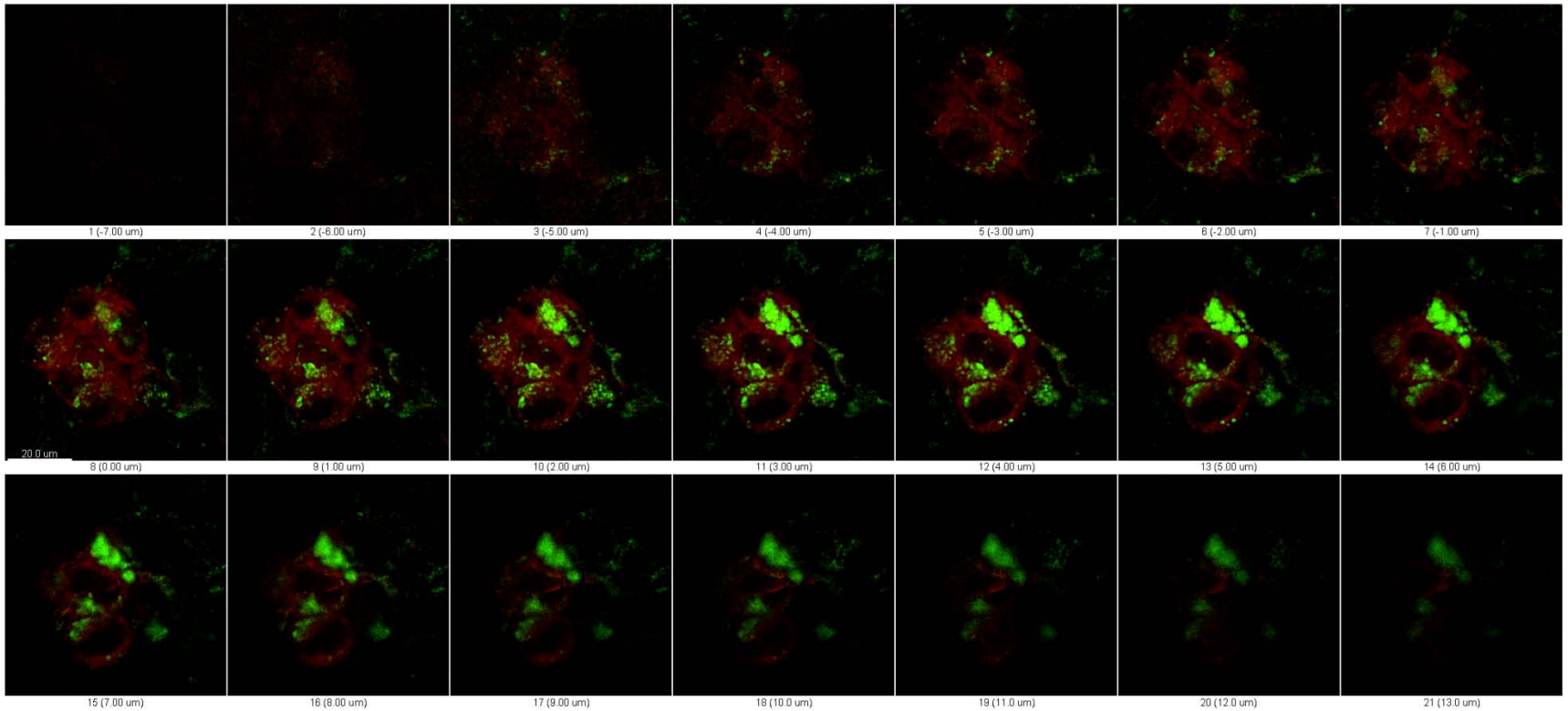
...and the audience for listening!

Sliced view into the cells