

JSC 5778: Nanotechnology

Nanotechnology in Medicine:

- Many nature's "nanomachines" inside cells
- Video: Harvard Microbiology: The Inner Life of the Cell
- Two fiber networks inside cells:
 - Actin: cellular "skeleton" (cytoskeleton)
 - Microtubules: really nanotubes, cellular "highway"
↳ 24 nm
- Protein-based nanomachines:
 - Kinesin: Motor protein
 - Ribosomes: "Protein Fabricators" ← RNA

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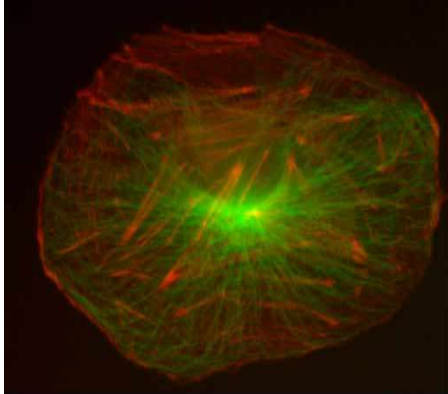
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Nanotechnology in Medicine:

- Video: Harvard Biochemistry: The Inner Life of the Cell
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A Real Picture of Microtubules and Actin in a Cell



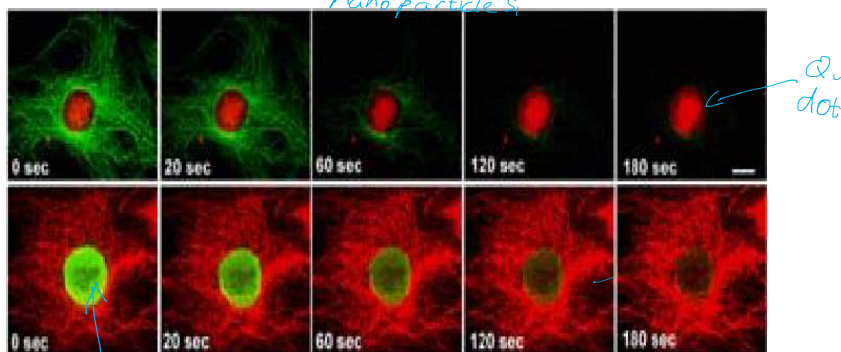
[University of Illinois at Urbana-Champaign](#)
The Imaging Technology Group

- Actin filaments (red) and Microtubules (green)
- Dyed with Fluorophores – molecules which fluoresce, (give off light)

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Problem: Fluorophores quickly become bleached – lose their ability to give off light.

Solution: Quantum dots also fluoresce, but don't bleach!

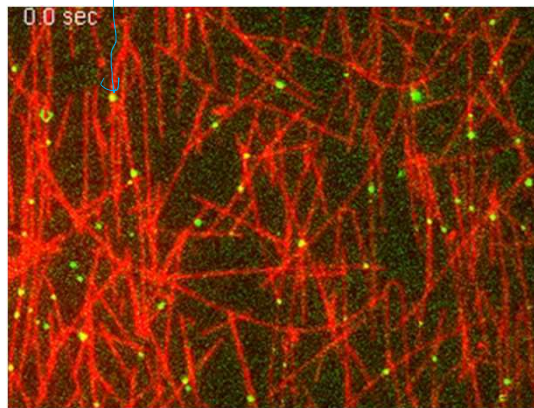


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Using Nanotechnology to Watch Cell Nano-machinery:

- Movie: A real picture of kinesin moving on microtubules.
- Kinesin (green) and microtubules labelled with quantum dots



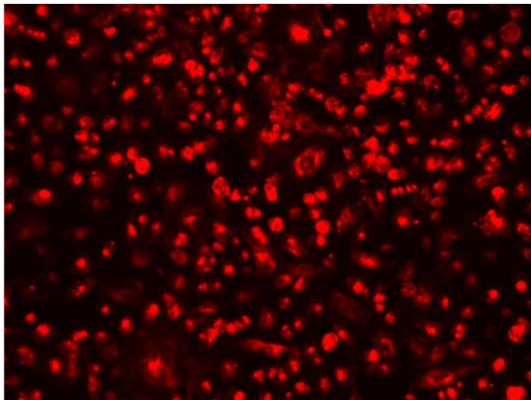
Arnold Seitz & Thomas Surrey
European Molecular Biology Lab

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Using Nanotechnology to Study Cancer Cell Multiplication

- Since quantum dots don't bleach, can use them to make observations for a long time.
- Like these cancer cells, watched over a period of 3 hours to see how they multiply.

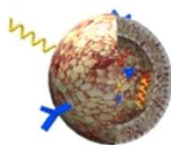


Lagerholm, B.C., et al. *Nano Letters* 2004, 4

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Nanoparticles can be functionalized by attaching molecules to them, e.g. so they only stick to cancer cells:



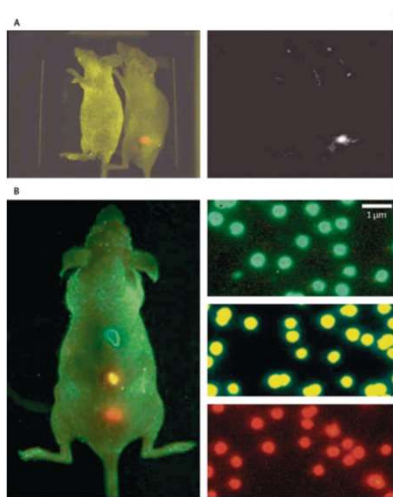
From Dr. R. Rezka, MDC, Berlin

3D Model of a Functionalized Nanoparticle

- Such functionalized nanoparticles can be used for quantum dot fluorescence imaging of tumors

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Each functionalized to attach ("stick") to a different type of tumor.

Yezhelyev, Emerging use of nanoparticles in diagnosis and treatment of cancer

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