

Multi-functional Nanotechnology Systems for Cancer Therapy



James R. Baker, Jr. MD

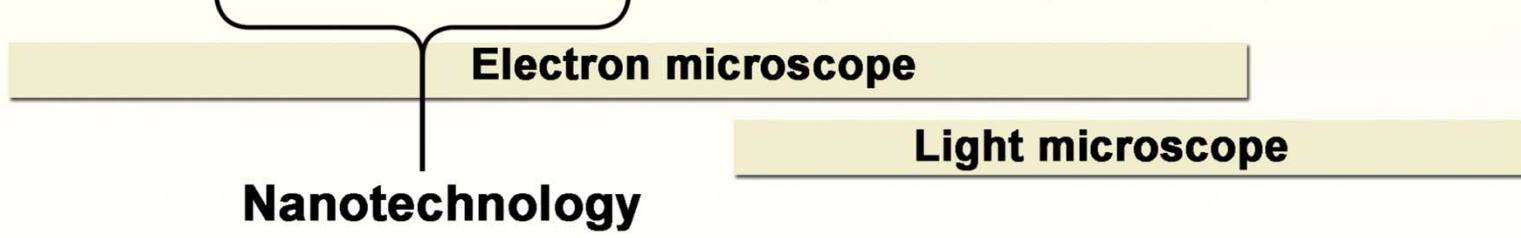
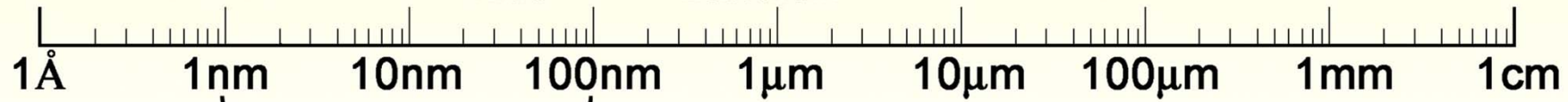
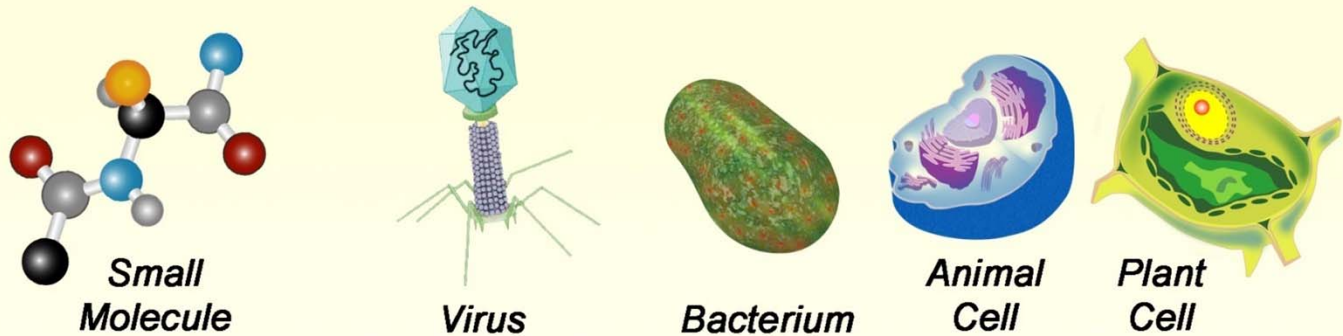
Ruth Dow Doan Professor of Medicine
and Director

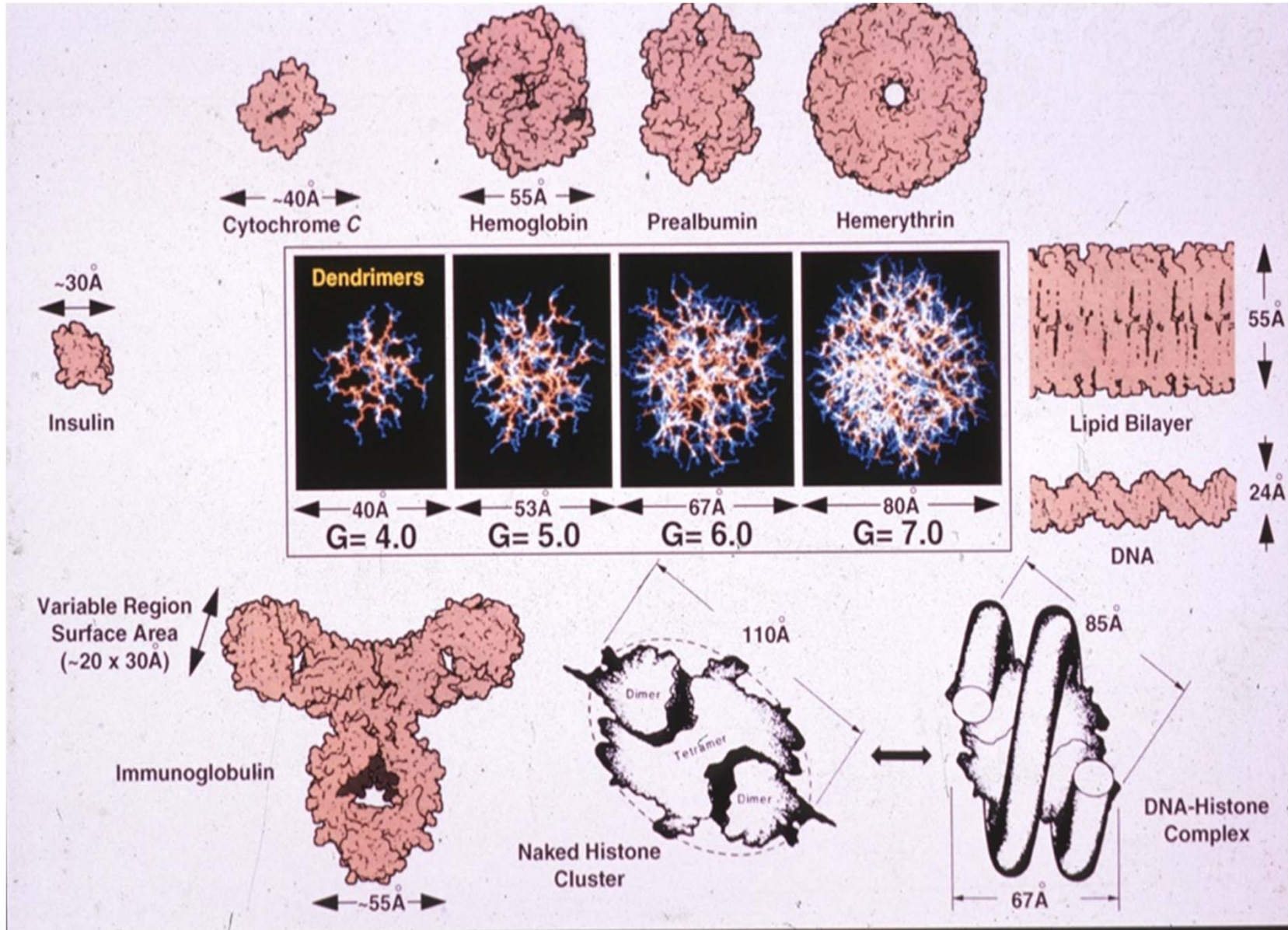
www.nano.med.umich.edu



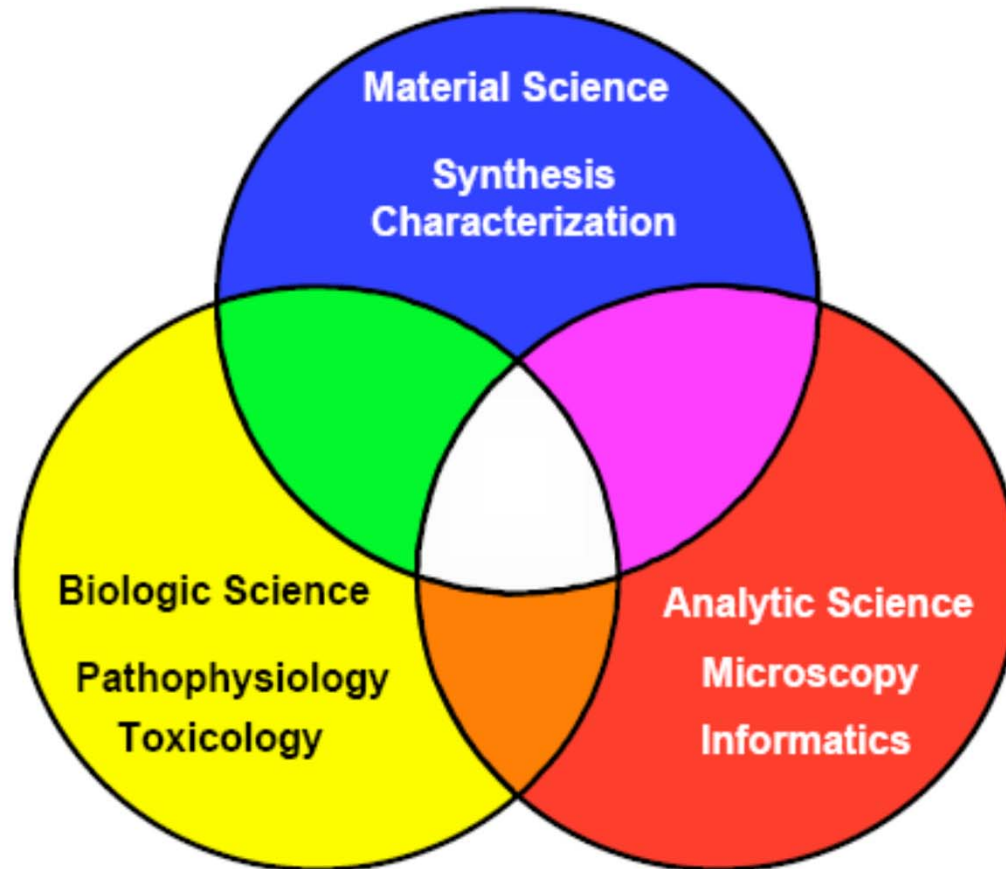
Relative sizes of cells and their components

cm = 10^{-2} m
mm = 10^{-3} m
 μm = 10^{-6} m
nm = 10^{-9} m
 \AA = 10^{-10} m



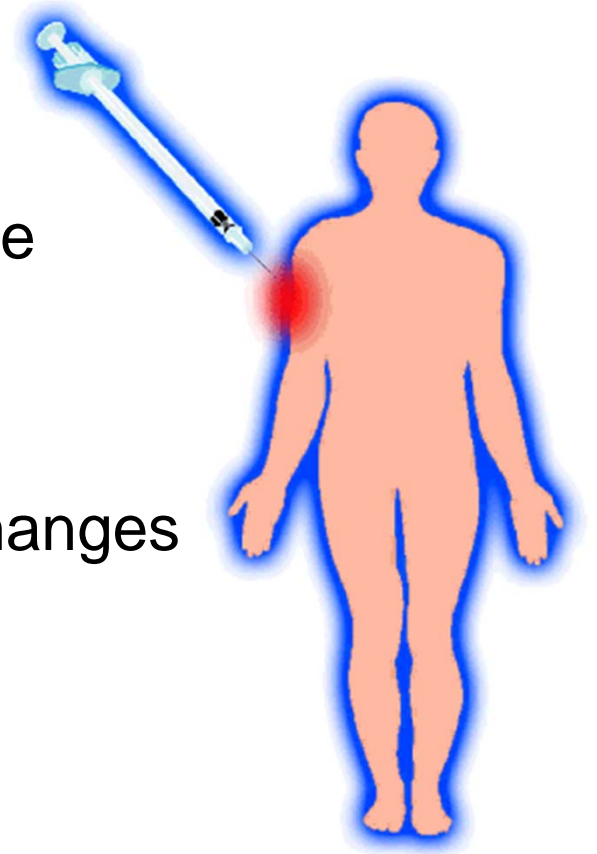


Michigan Nanotechnology Institute Scientific Organization

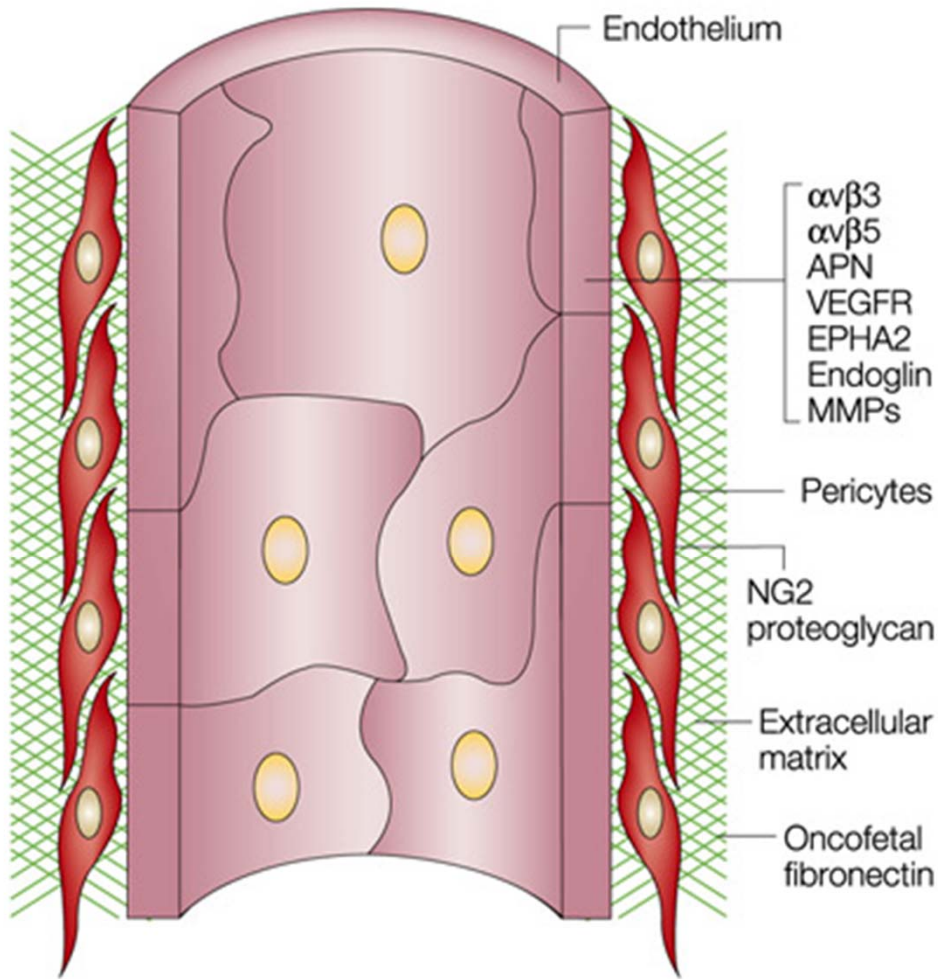


Smart Cancer Sensor/Therapeutic

- Targets to Site and Into Cells
- Imaging Capability to Document Presence
- Senses for Pathophysiologic Changes
- Selects Therapeutic Agents Based on Changes
- Non-invasive Release of Therapeutic
- Documents Response to Therapeutic

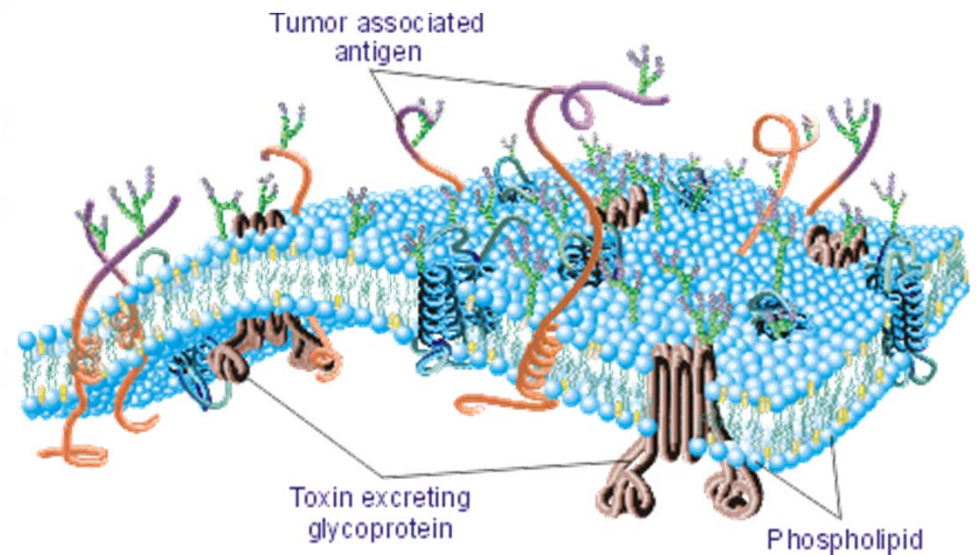
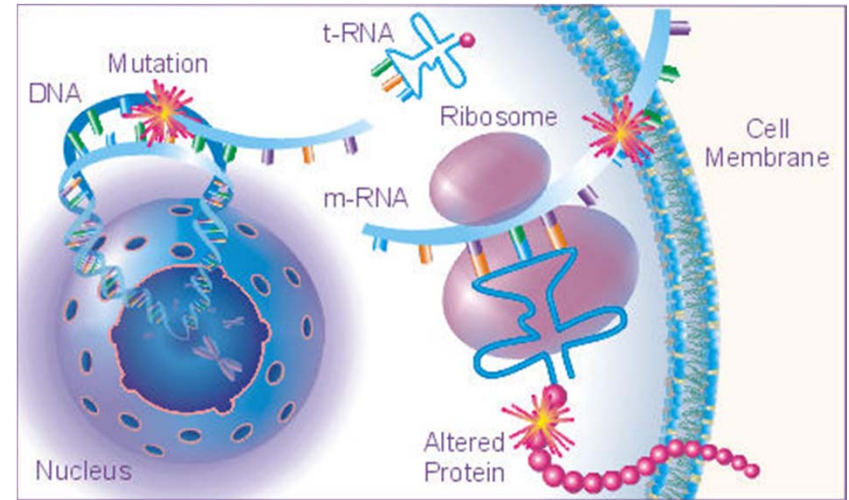


Nanoscale Barriers to Targeted Therapeutics



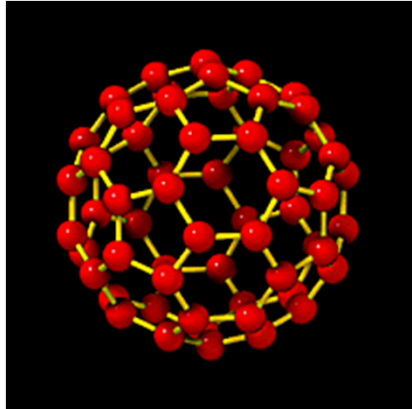
<20 nM

Nature Reviews | Cancer



<150 nM

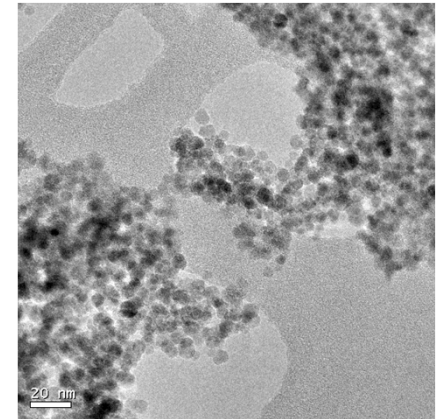
Types of Nanoparticles



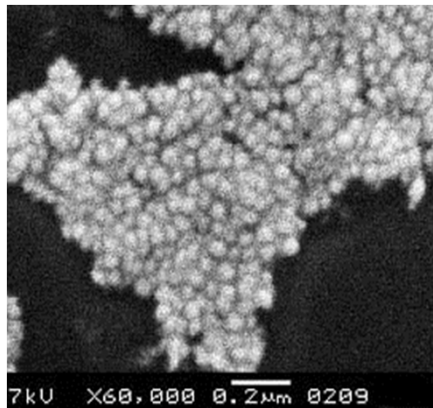
Fullerines



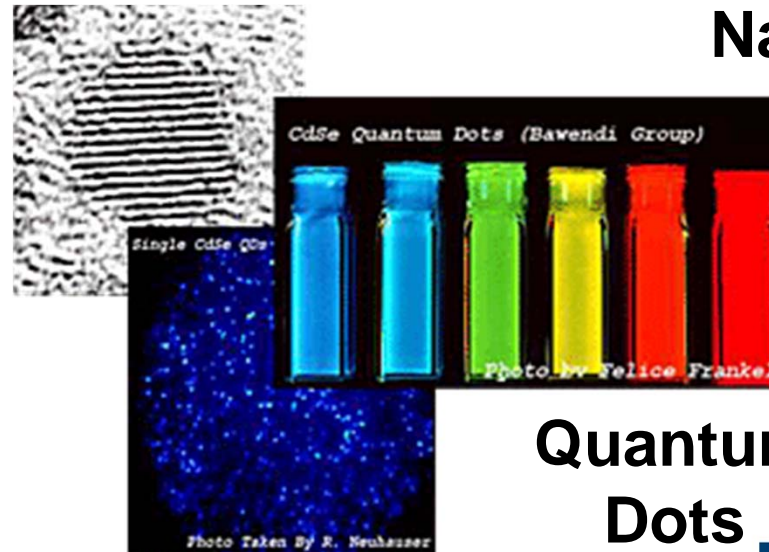
Gold Nanoshells



**Fe₃O₄
Nanocrystals**



Starch

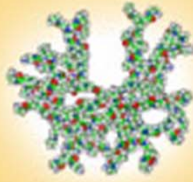


**Quantum
Dots**

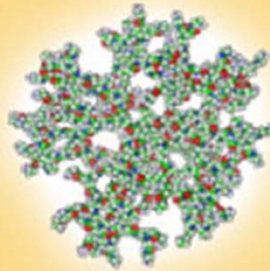
Dendrimer Size Comparison



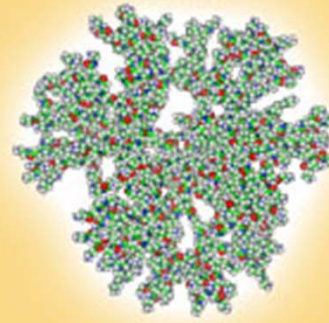
G3 Dendrimer



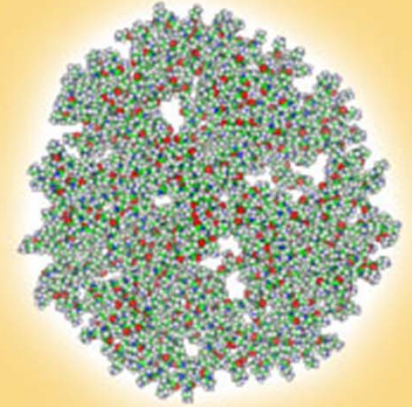
G4 Dendrimer



G5 Dendrimer



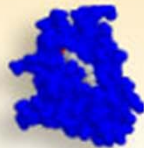
G6 Dendrimer



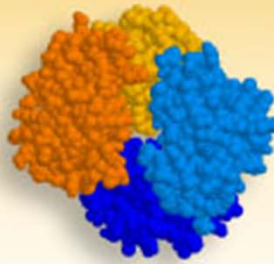
G7 Dendrimer



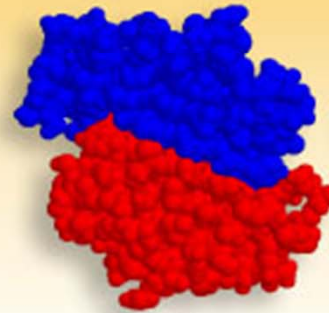
Insulin



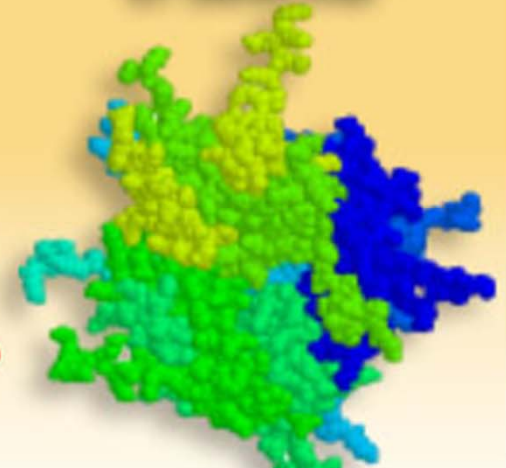
Cytochrome C



Hemoglobin

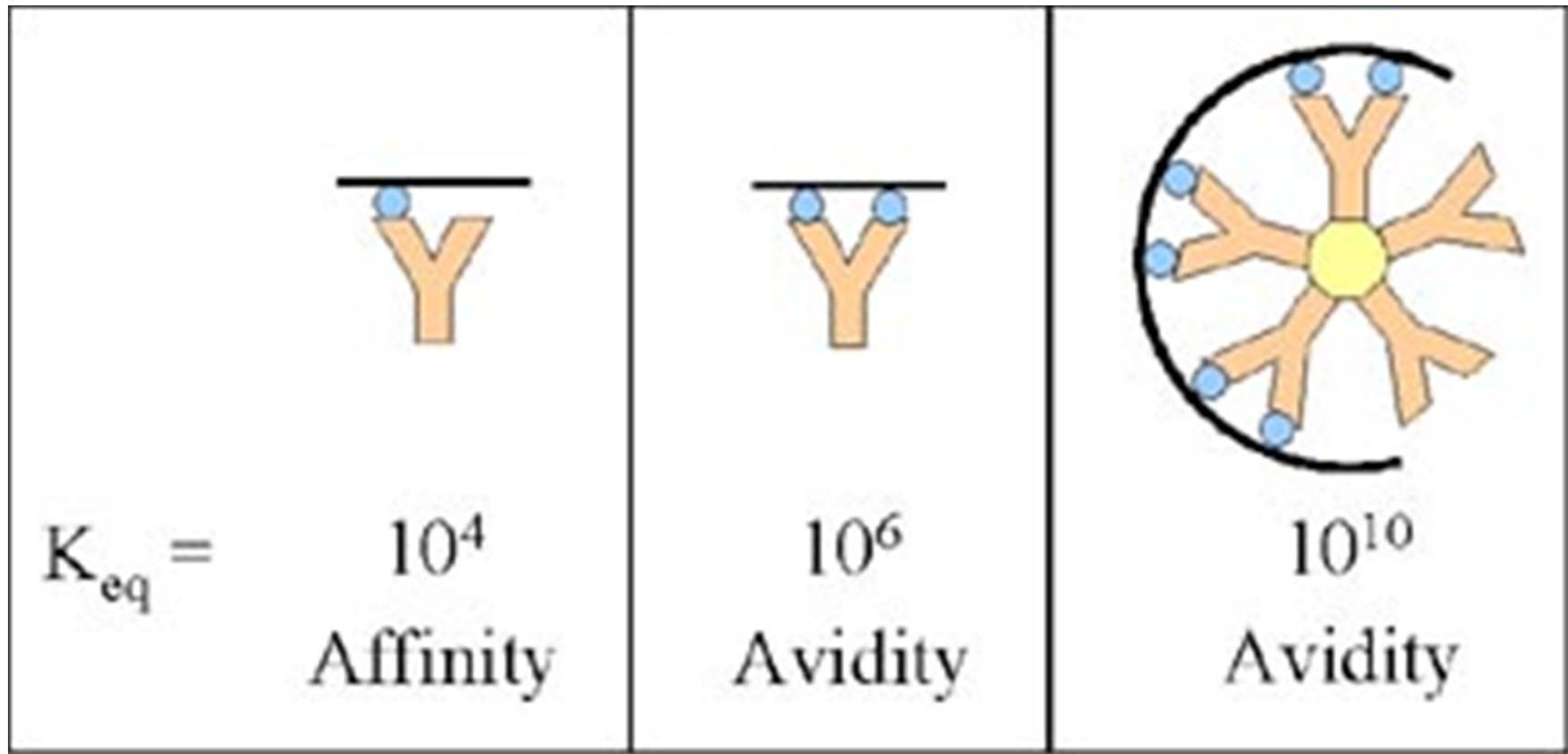


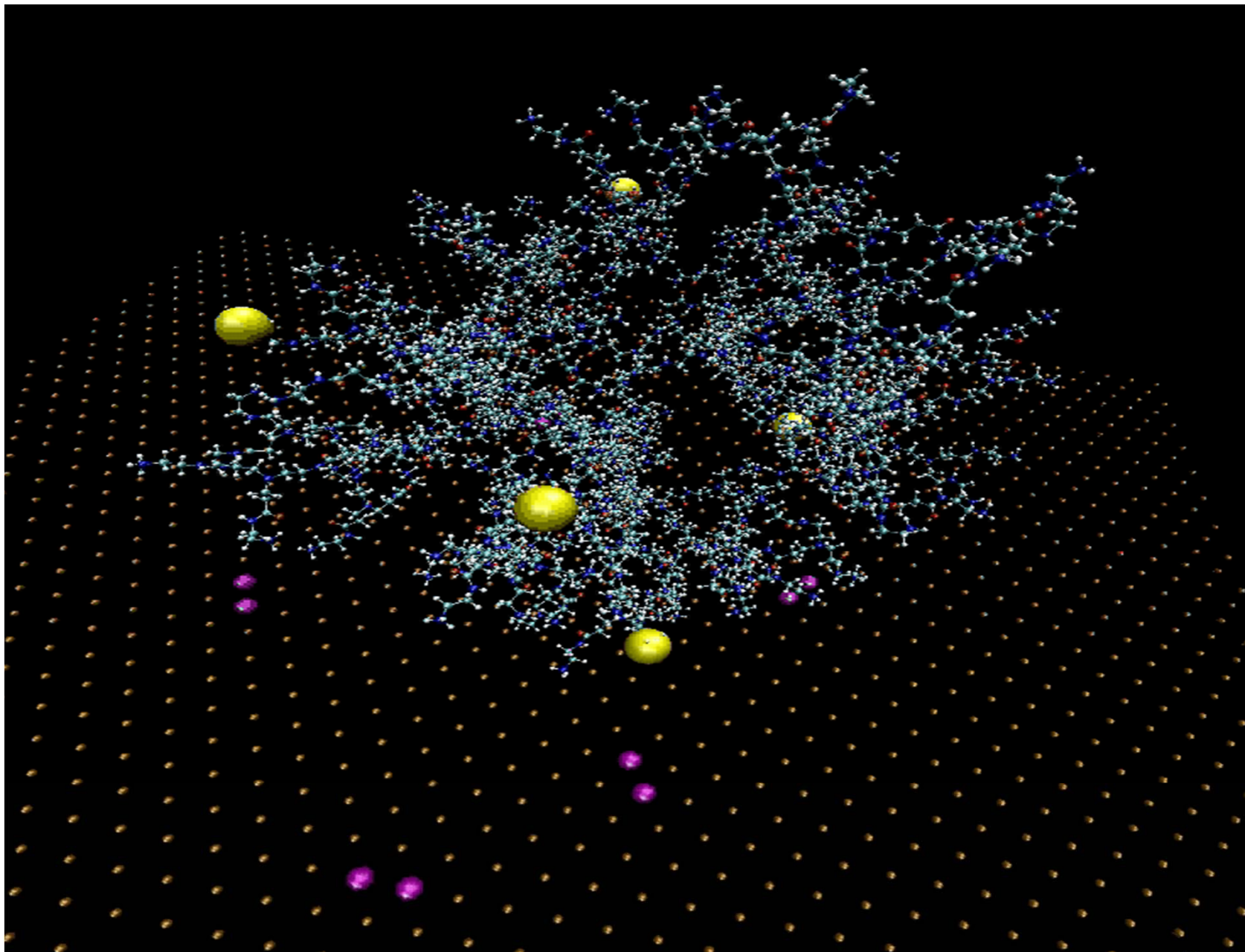
Transthyretin



Histone

Key differentiator – avidity!





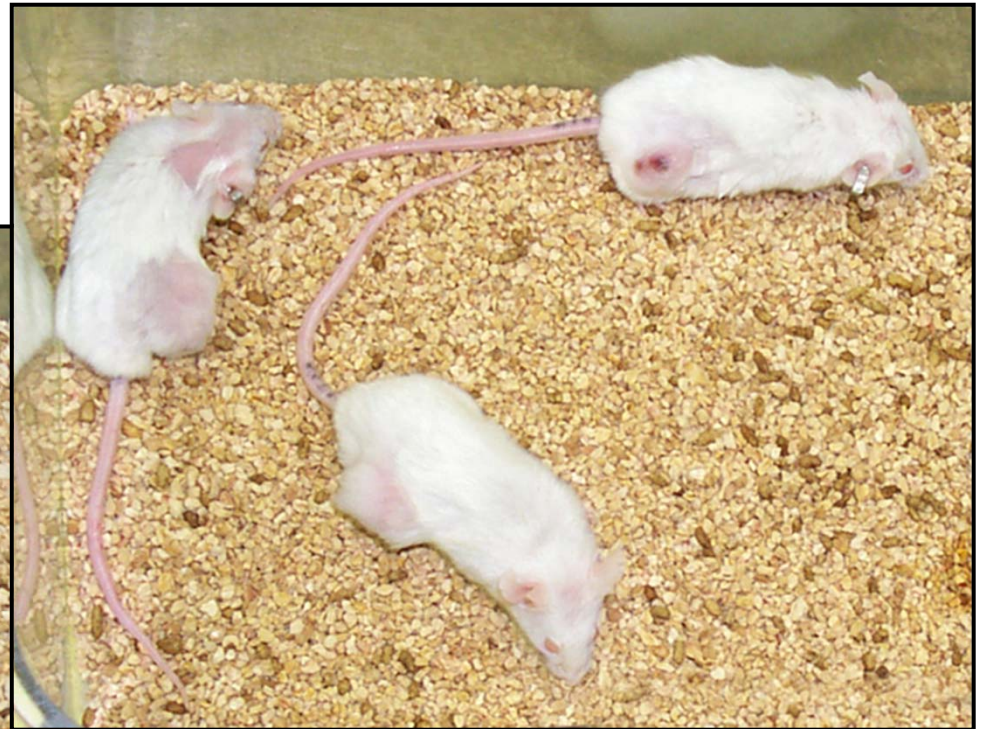
Free MTX

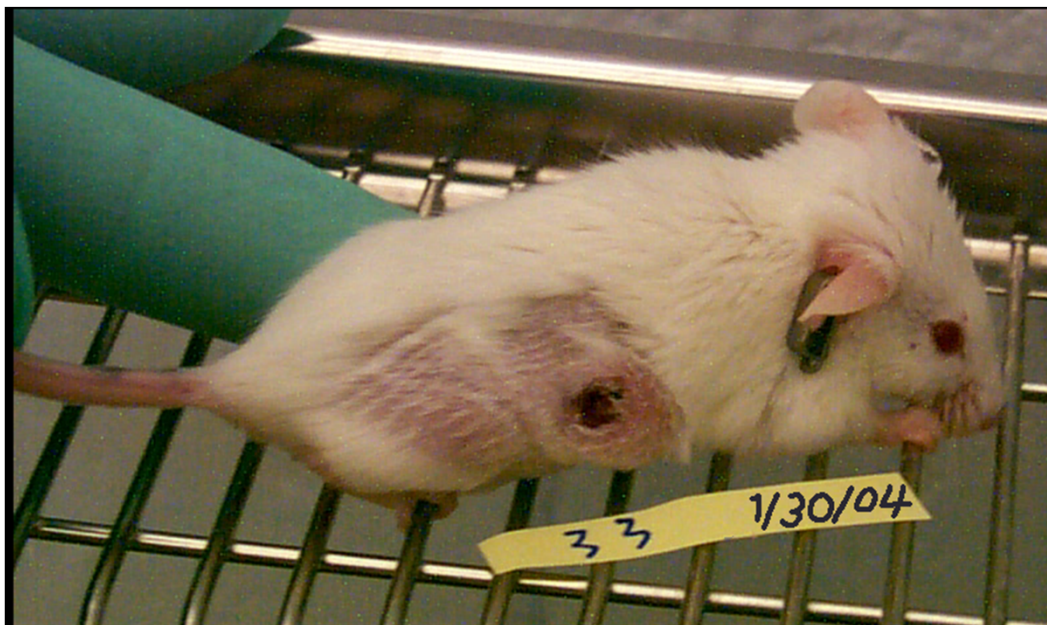
30 mg/kg total



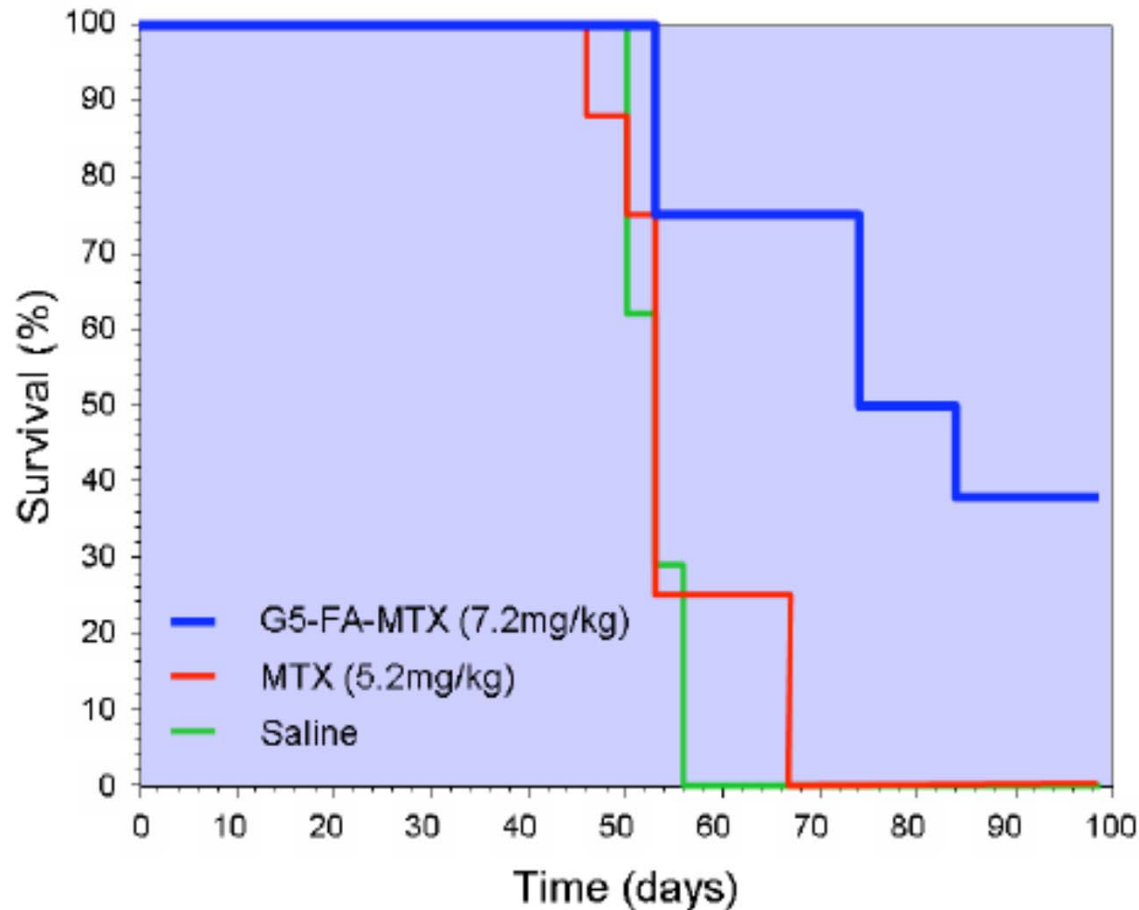
Nanodevice MTX

3 mg/kg total MTX





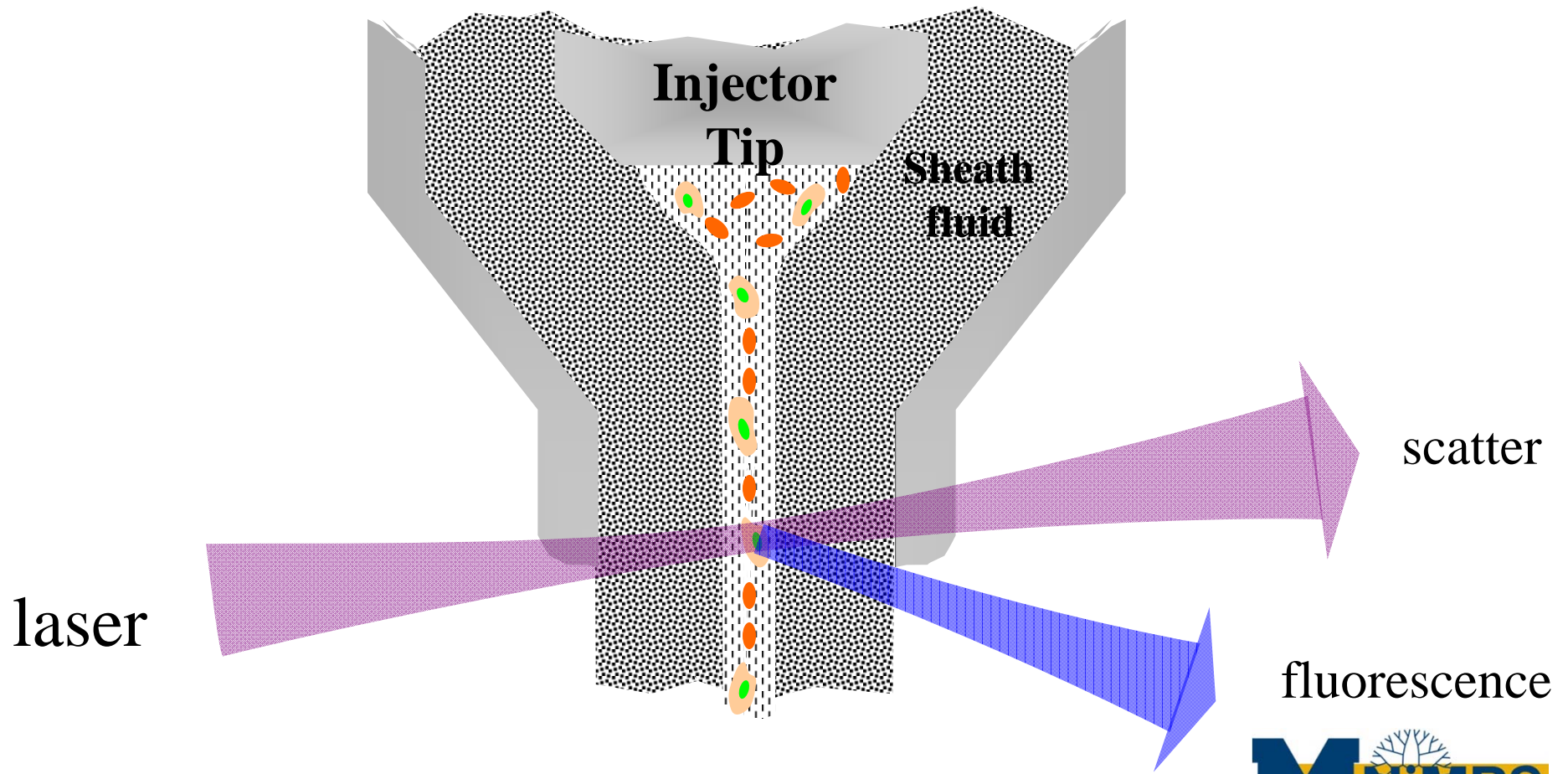
Survival of Tumor Burdened Mice (ATI-001 vs. Free Methotrexate)



Cancer Research 65 (2005): 5317-5324.

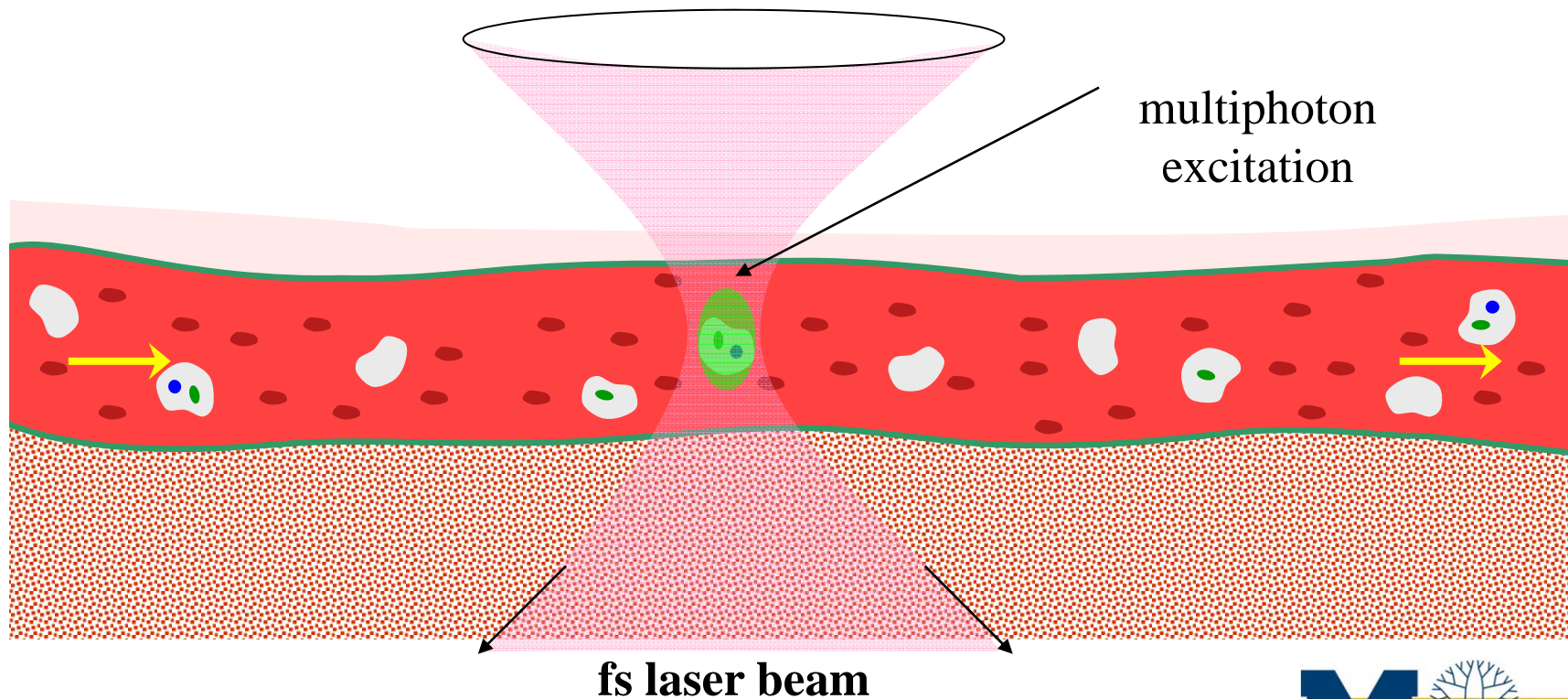
Traditional Flow Cytometry

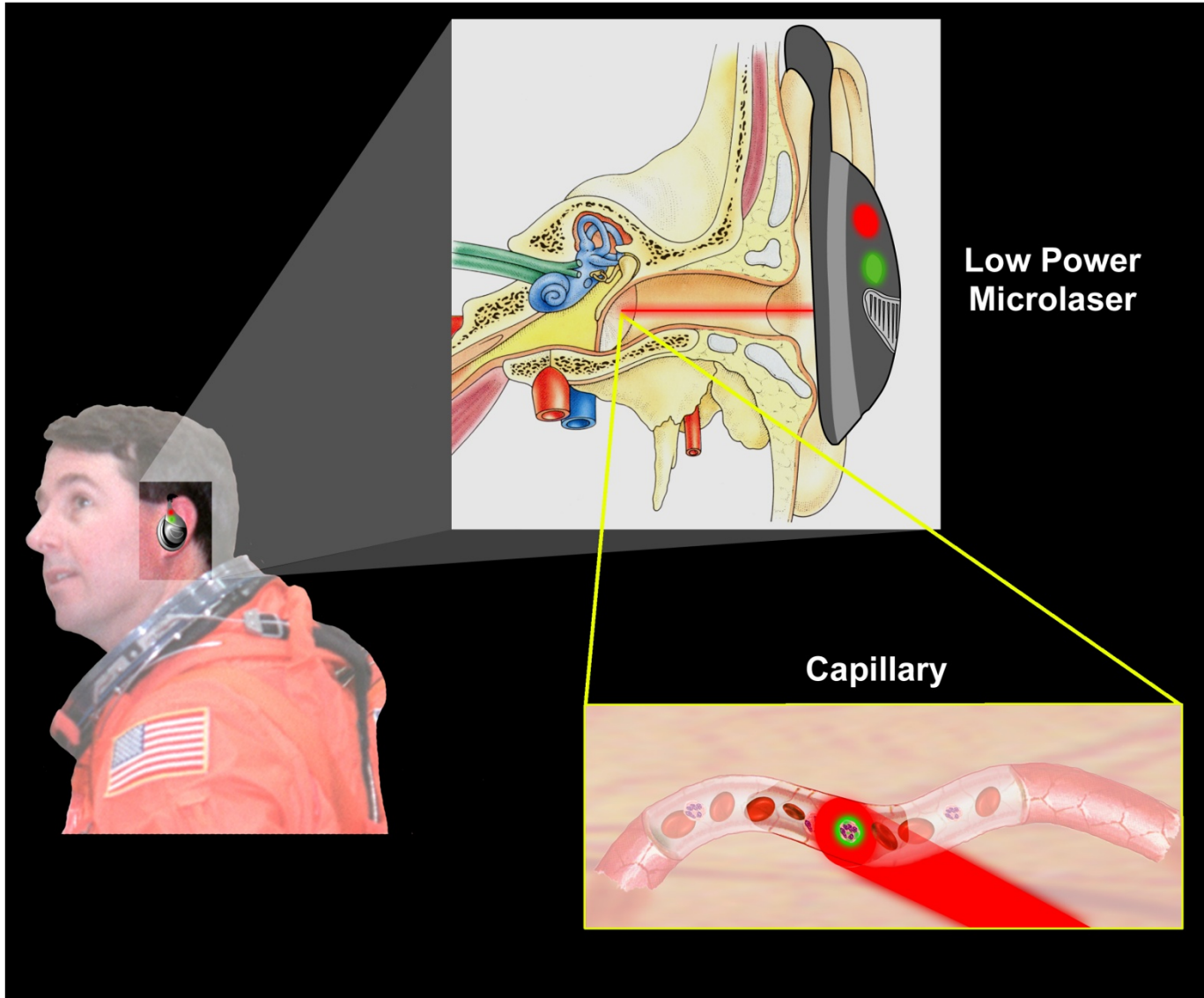
- Quantitation of fluorescence in cells



Performing Flow Cytometry *In Vivo*?

Approach : use multiphoton excitation with ultrafast laser pulses
=> match excitation volume to lymphocyte size

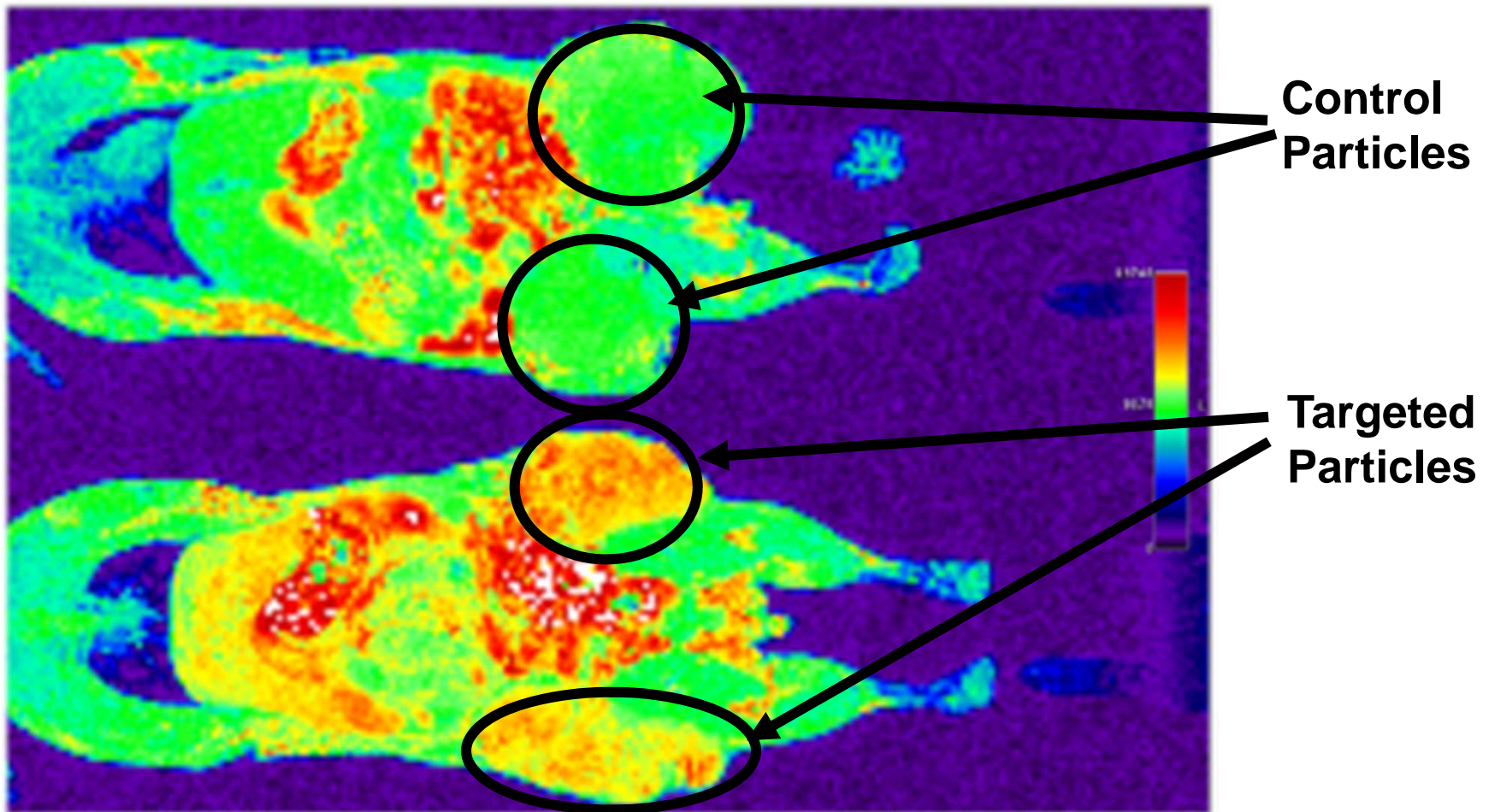


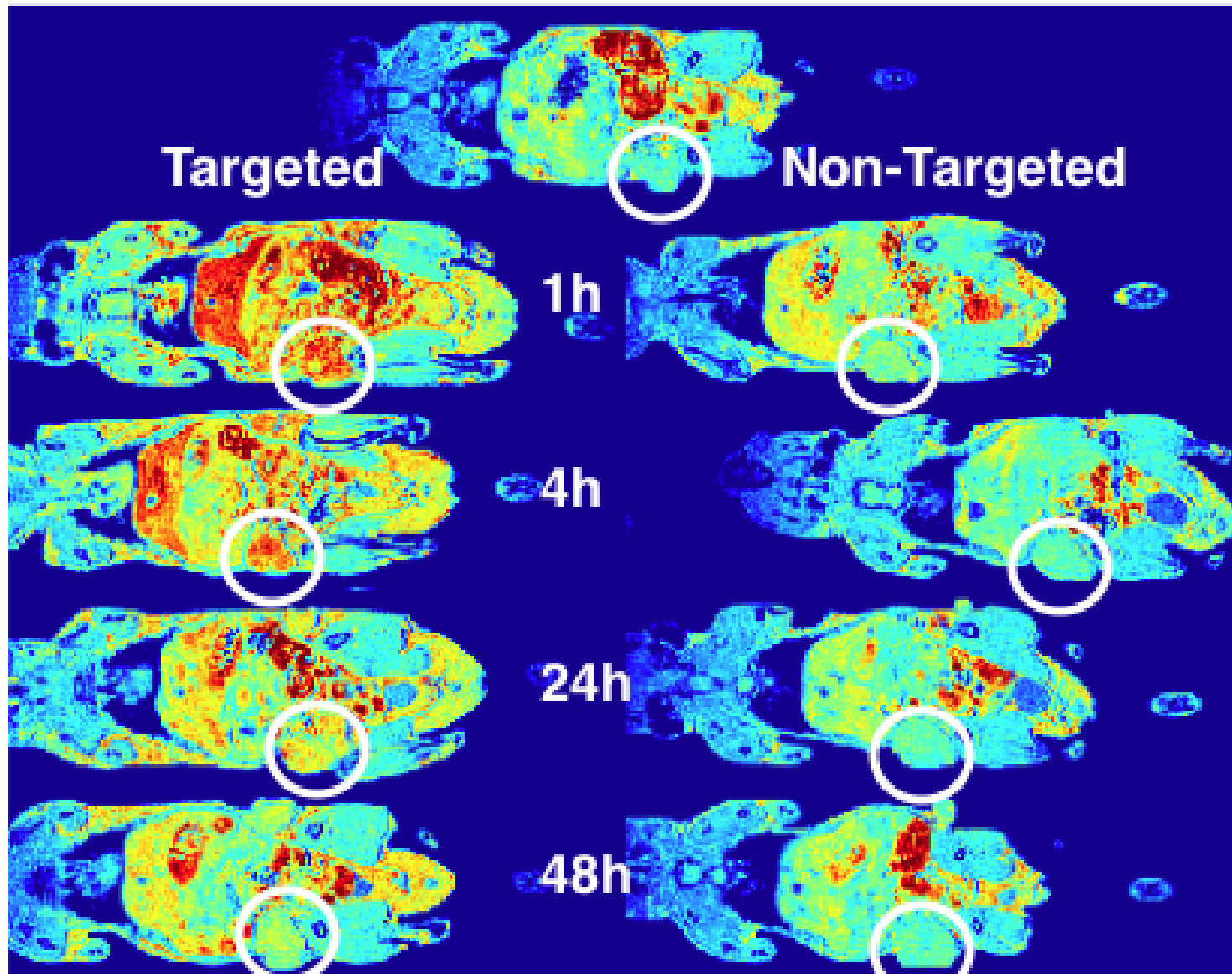


Low Power
Microlaser

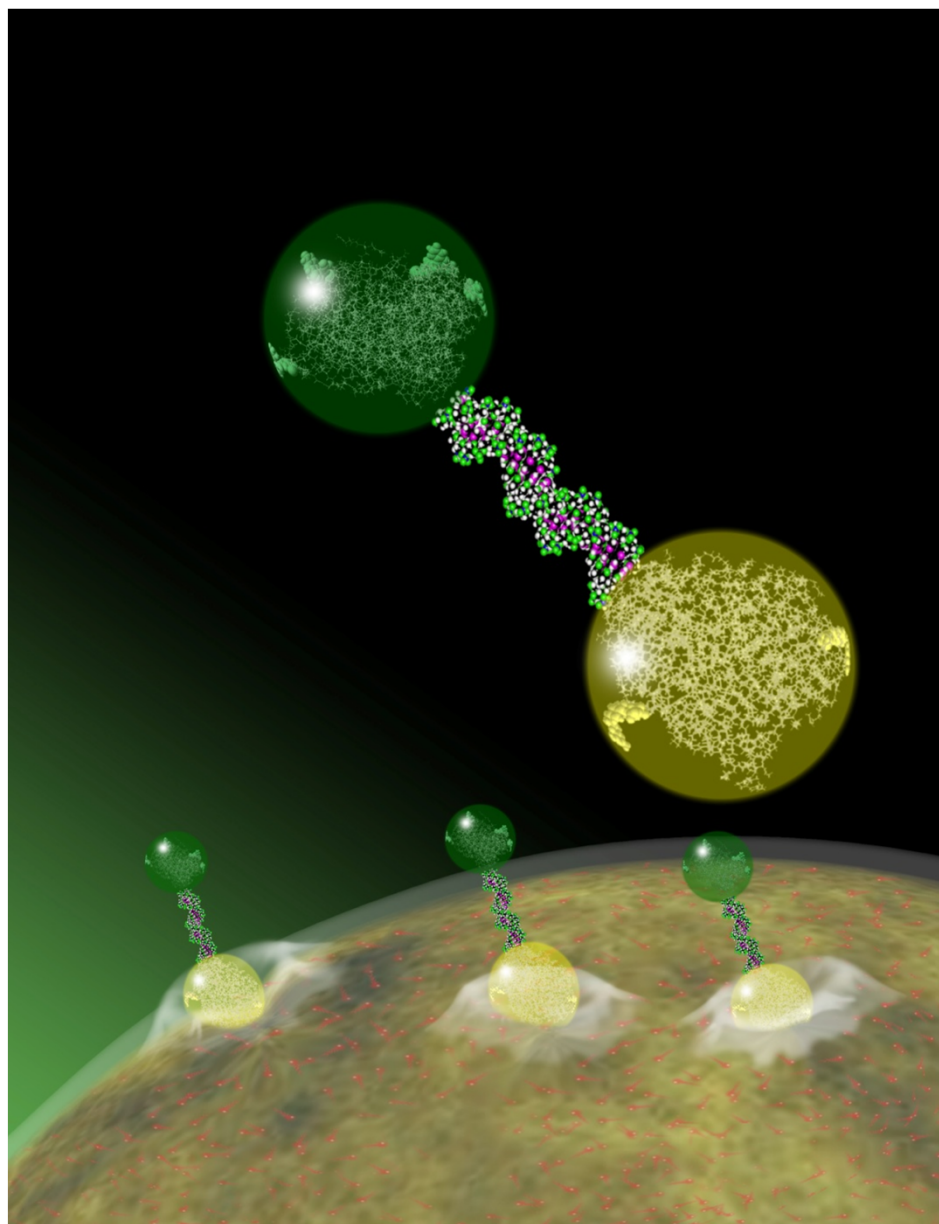
Capillary

MRI GD Contrast Nanoparticles





Targeting Cancer Cells using DNA-linked Dendrimer Nanocluster



Chemistry
and Biology

February
2005

Cancer Project Acknowledgements

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