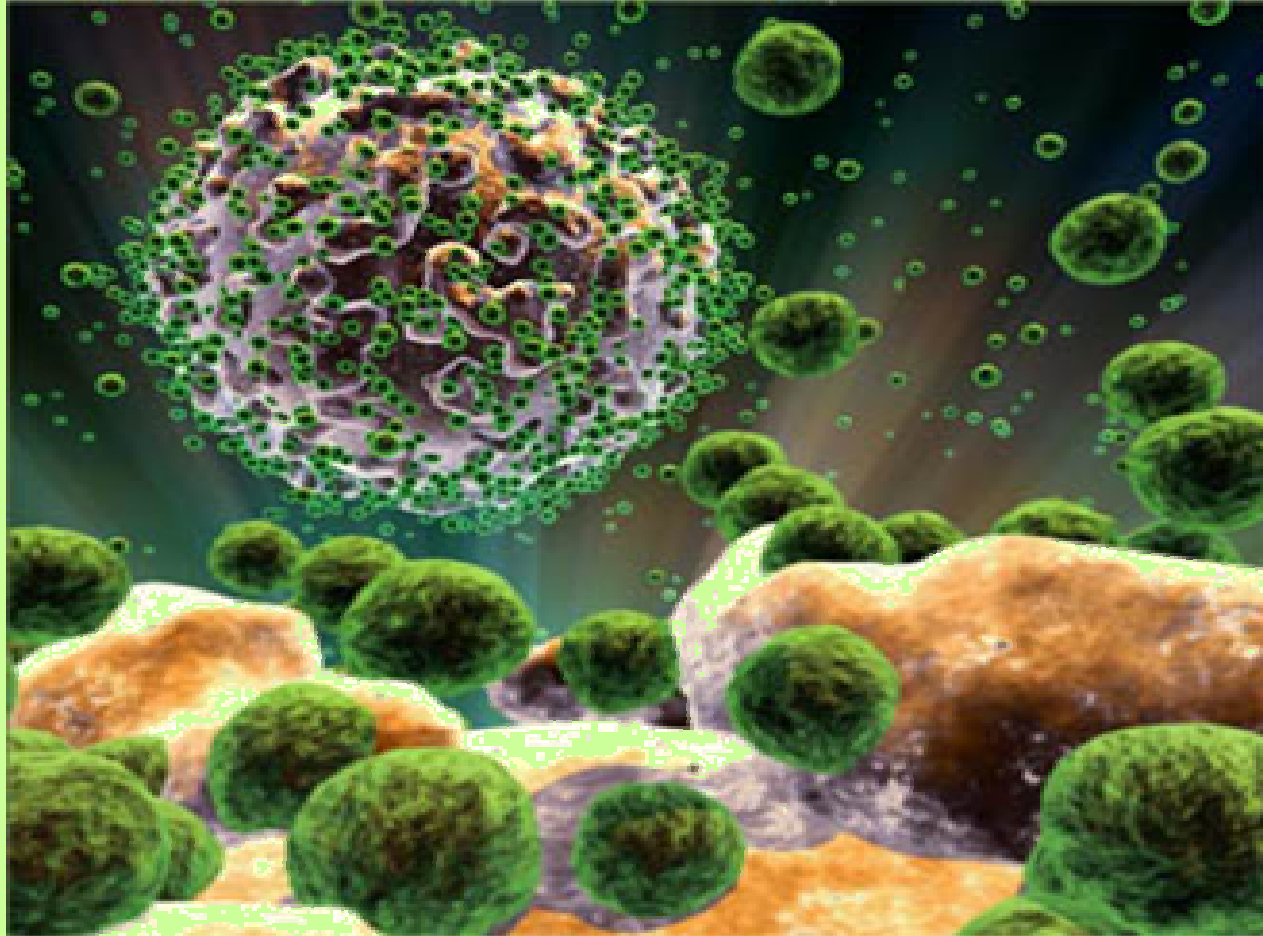


Quantum Dots for drug delivery and imaging : A promising way for therapy and diagnosis



By

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Introduction

- ❑ **Cancer, Myocardial Infarction (MI) - top “killers” in modern society.**
- ❑ **Present therapy- significant toxicities and side effects- lead to the development of new and more effective drug therapies .**
- ❑ **Nanoscale technologies has changed the foundations of disease diagnosis, treatment, and prevention.**
- ❑ **Nanobiotechnology- ability to work at the molecular level, atom by atom, combining biological materials.**
- ❑ **Goal of nanomedicines - to develop safer and more effective therapeutic and diagnostic modalities.**
- ❑ **Nanosystems- quantum dots (Qdots), silica nanoparticles, dendrimers, micelles, molecular conjugates, liposomes, and ultrasound microbubbles.**

Dream of Nanomedicine

Single Nano-sized entity which can:

➤ Target Diseased Area



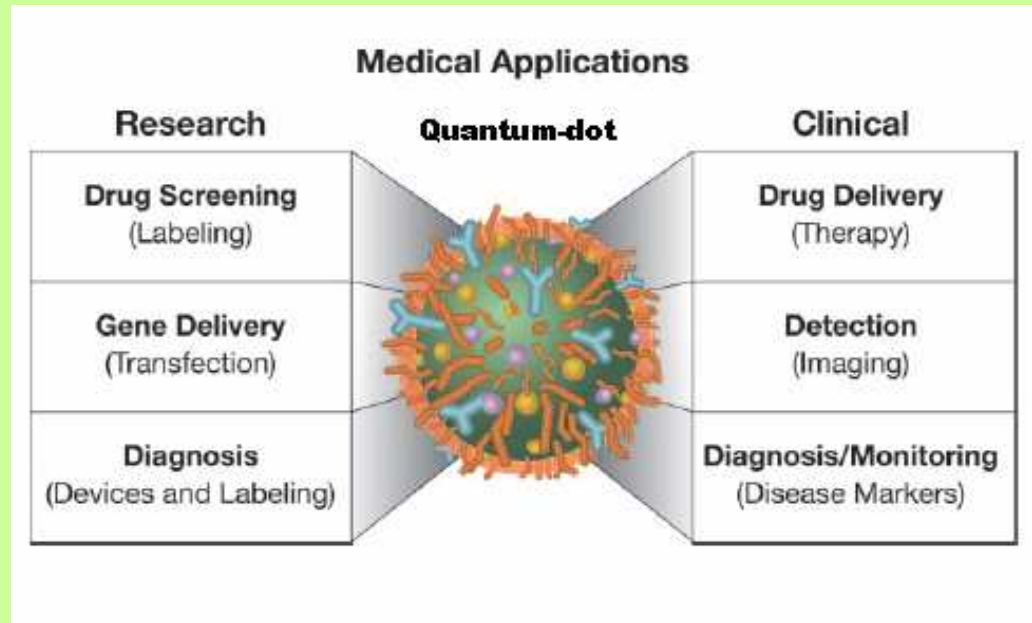
➤ Image It



➤ Deliver Drug Locally/Specifically



General features of Quantum-Dots

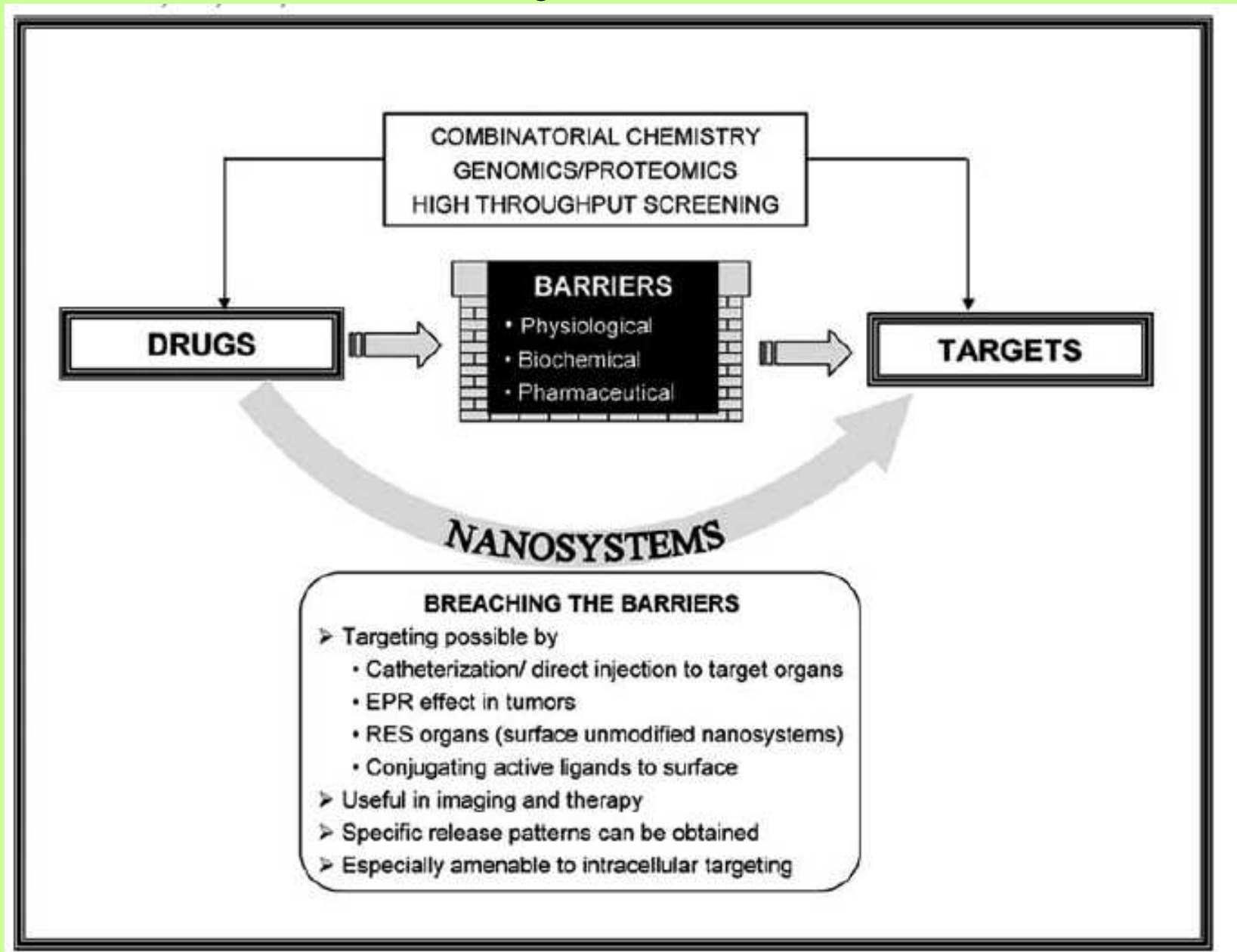


Advantages over conventional pharmaceutical agents:

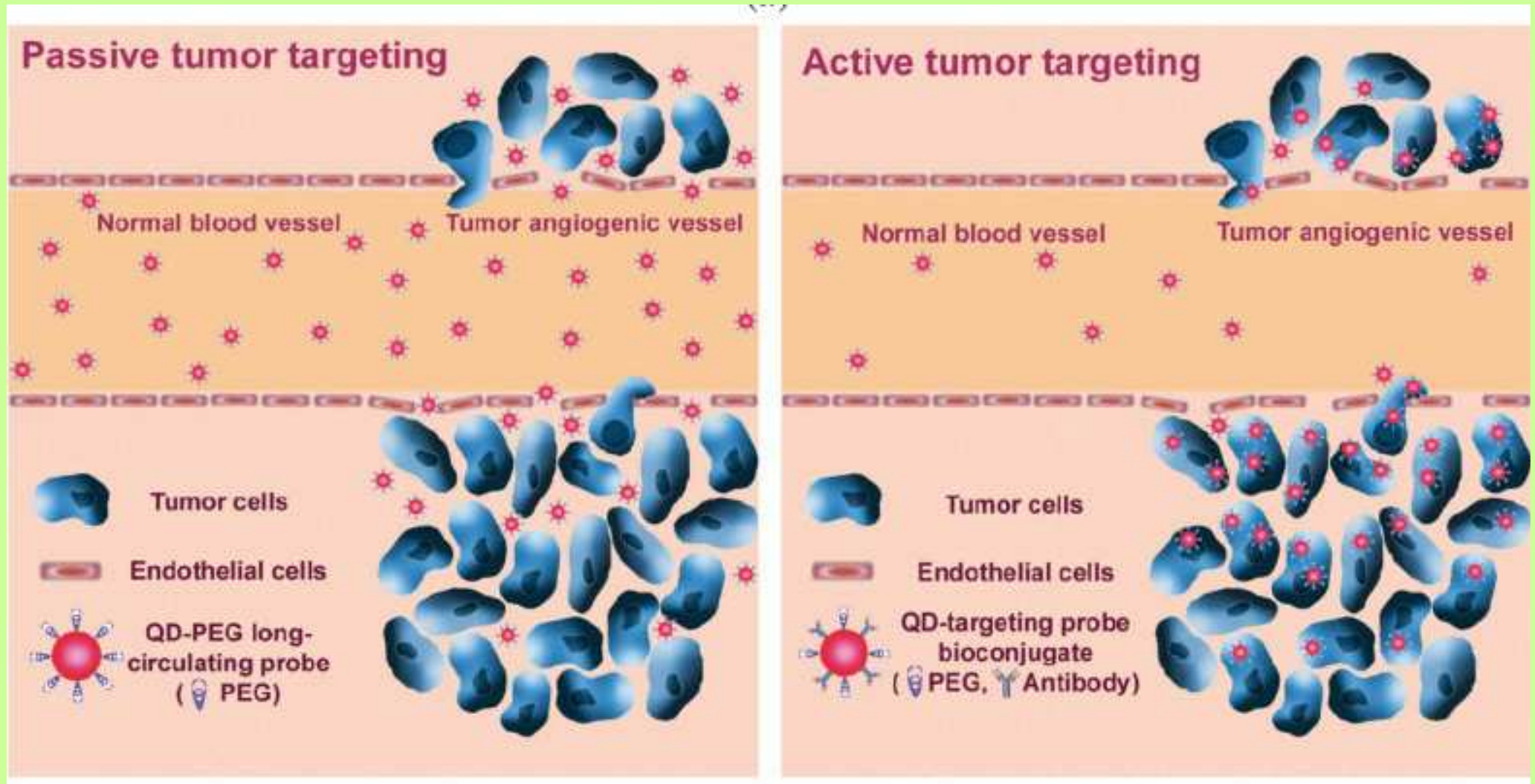
- ✓ **Smallest functional units by building groups of atoms.**
- ✓ **Small size- 1- 100nm - similar size-range – biologicals like viruses, DNA and proteins.**
- ✓ **Can overcome physiological barriers like the blood brain barrier and dermal tight junctions.**
- ✓ **Drug Carriers- carry drugs and be designed to release their contents at a site of disease.**
- ✓ **Nanoparticles may consist of an inorganic core of superparamagnetic materials coated with polymer such as dextran-contrast agents in magnetic resonance imaging for diagnostic applications and therapy monitoring.**
- ✓ **More specific tissue targeting (“functionalizing”) can be achieved by the conjugation of the nanoparticle with a ligand e.g. monoclonal antibodies.**

Quantum-dots for molecular imaging and as drug delivery carriers

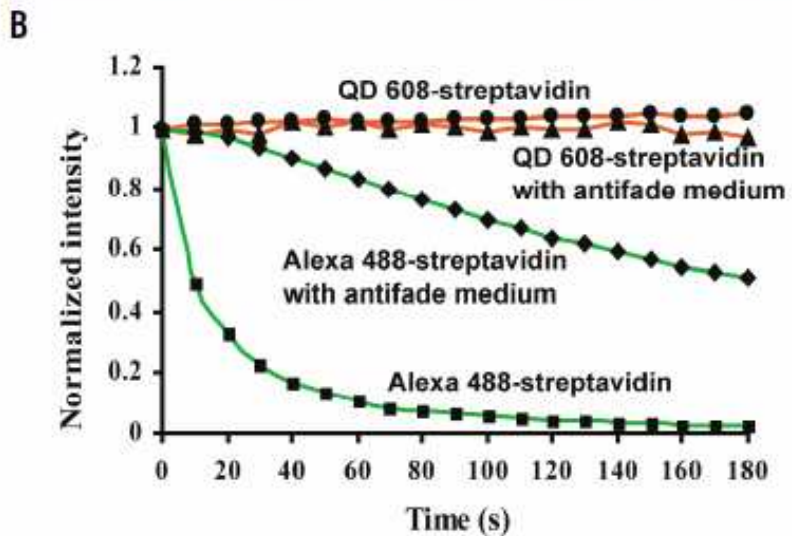
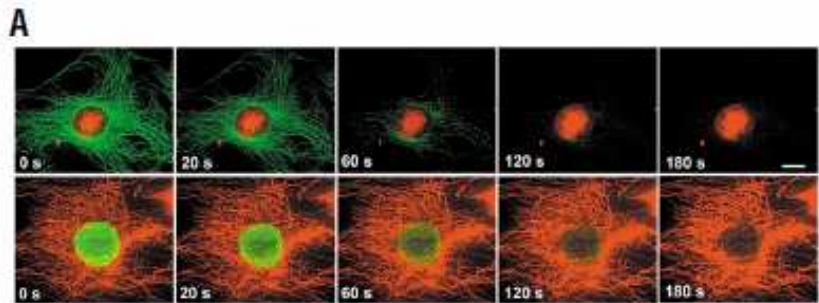
Schematic diagram describing barriers to drug targeting and the role of nanosystems in overcoming these barriers.



Active and passive targeting

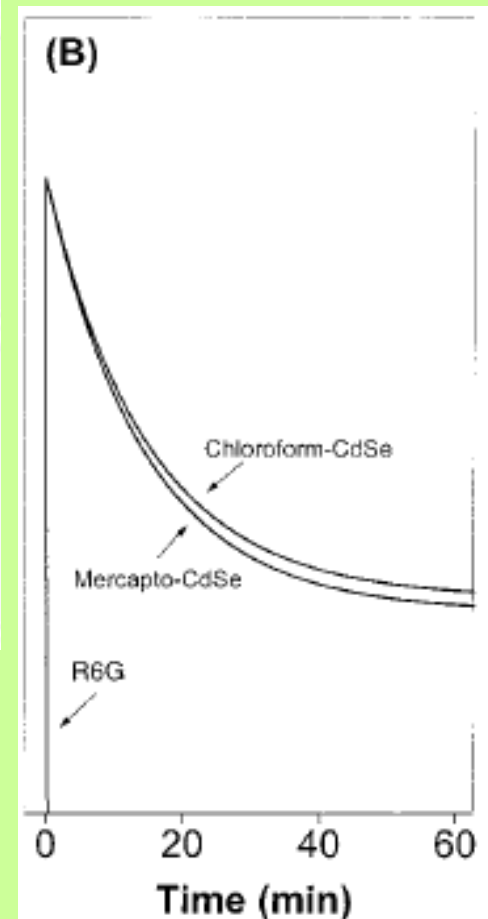
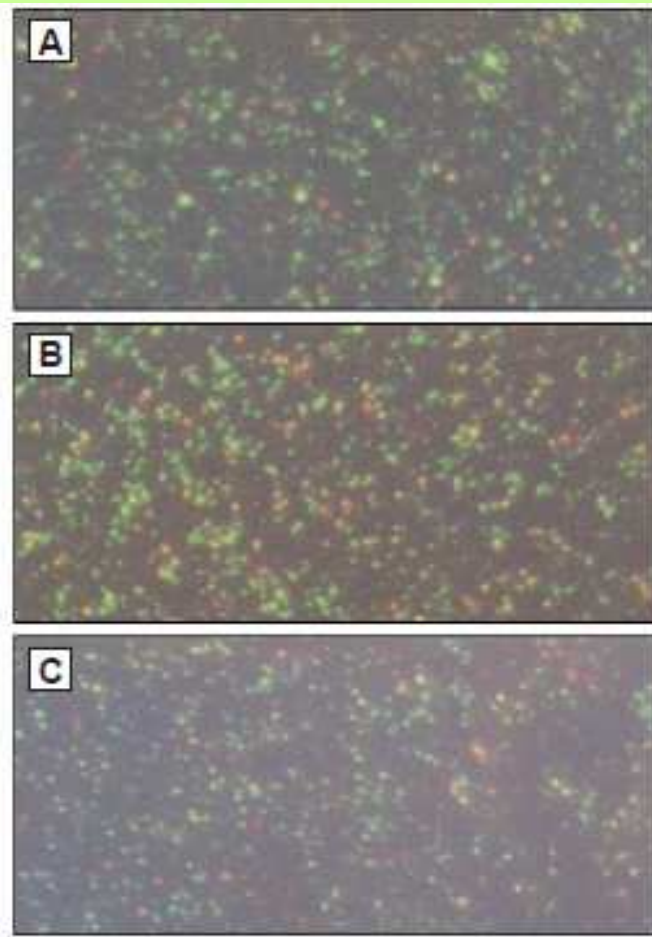


(a) Permeation and retention of Q-dot probes via leaky tumor vasculatures (passive targeting) and high affinity binding of Q-dot-antibody conjugates to tumor antigens (active targeting).



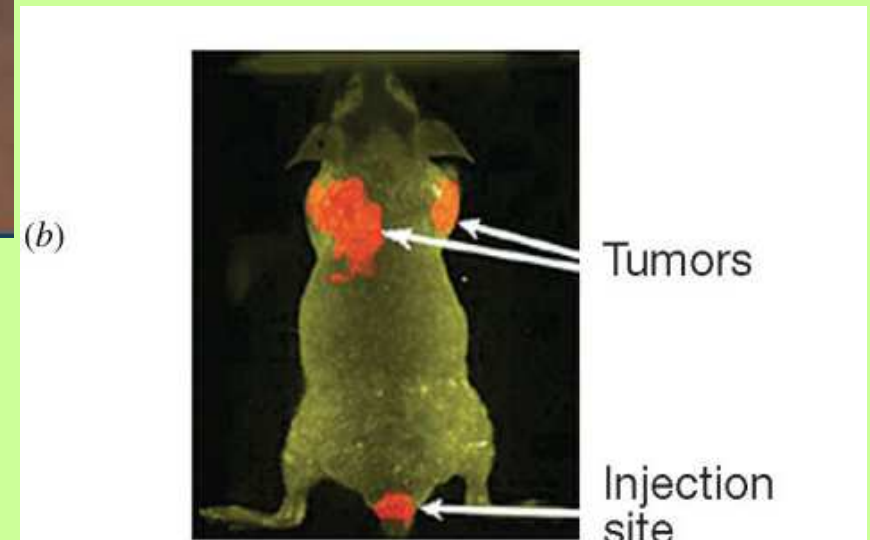
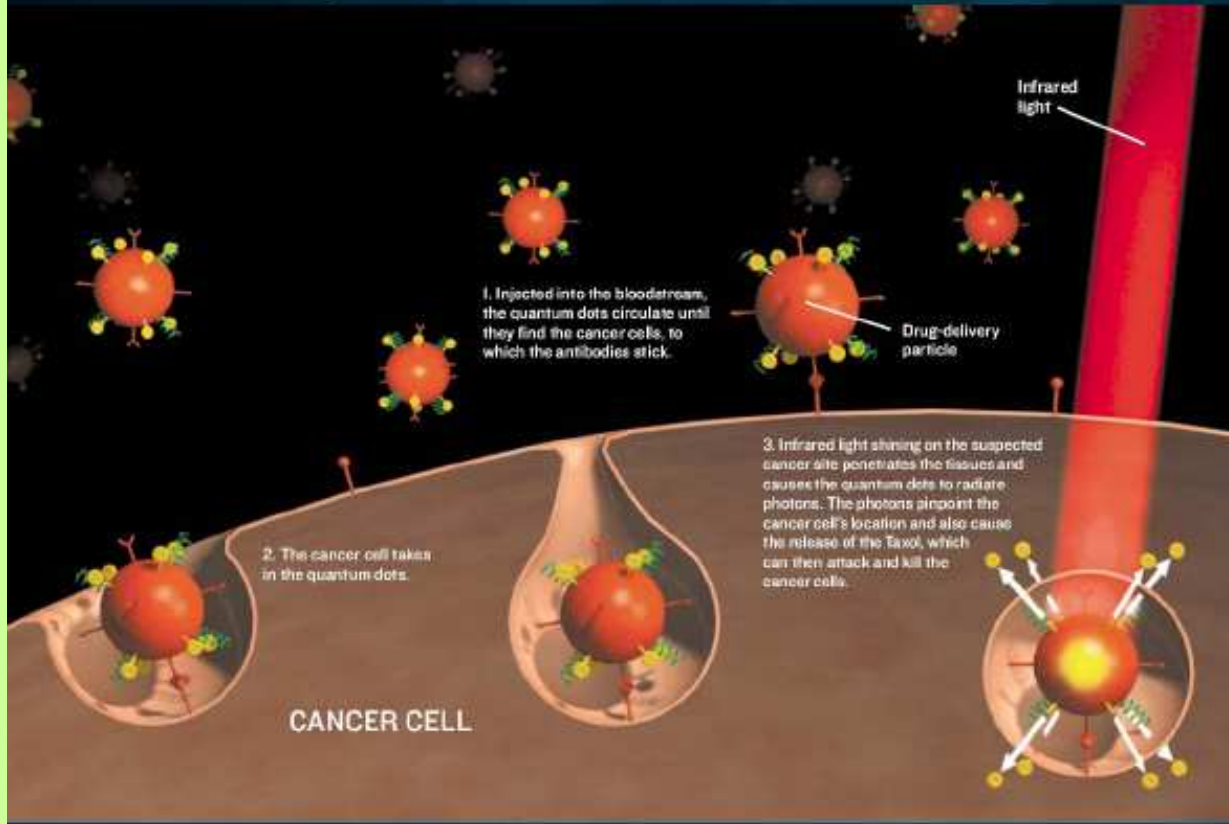
Photostability comparison between QDs and Alexa 488.

Color luminescence images obtained from (A) original QDs, (B) mercapto-solubilized QDs, and (C) QD-IgG conjugates.



(B) Time-resolved photobleaching curves for the original QDs, the solubilized QDs, and the dye R6G.

How Quantum Dots Work



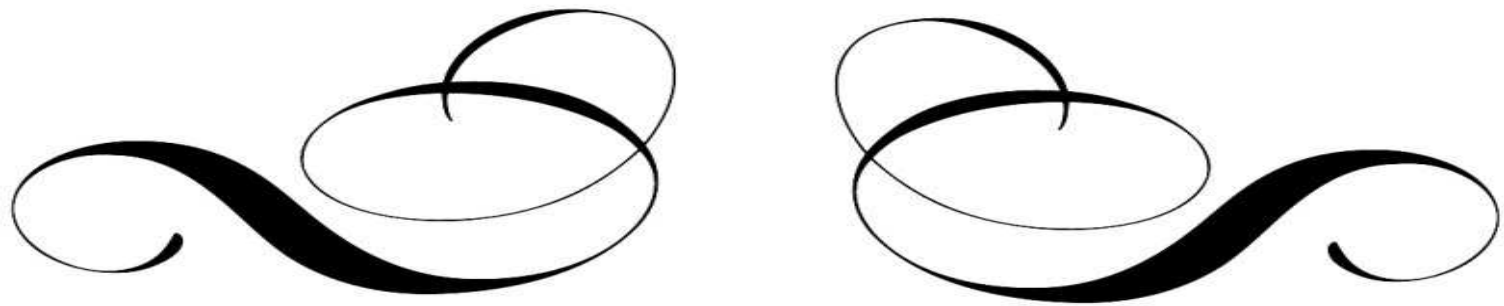
In vivo fluorescence images of tumor-bearing mice using Qdot probes with anti-PEG-PSMA antibody conjugates surface modifications in mouse cancer model

Conclusions

- ❖ Nanomedicine is still at its early stages of development; however, its development is multi-directional and rapid.
- ❖ Targeted molecular imaging is one of the important characteristics of this technology with newly discovered specific targets.
- ❖ Many challenges still remain –
 - low encapsulation efficiency for some drugs also need to be overcome
 - some nanoparticles are still toxic for clinic application.
 - Efficiency of targeting nanoparticle accumulation is not very high due to the complexity of the body and the layers of barriers
- ❖ Effective targeting would require a dual focus strategy, a better understanding of the target and a simultaneous development of the targeting system.

LIST OF PUBLICATIONS

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- “ Studies on Surface Processing and Passivation of p- Hg_{1-x}Cd_xTe” Ragini Raj Singh, **Diksha Kaushik**, Madhulika Sharma, D. K. Gupta and R. K. Pandey, *Semicond. Sci. Technol*, **23** (2008) 015016.
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Thank You

