(Bio)Nanotecnologia/nanomedicina: um mundo de oportunidades paras as ciências exatas e as engenharias

José Figueiredo

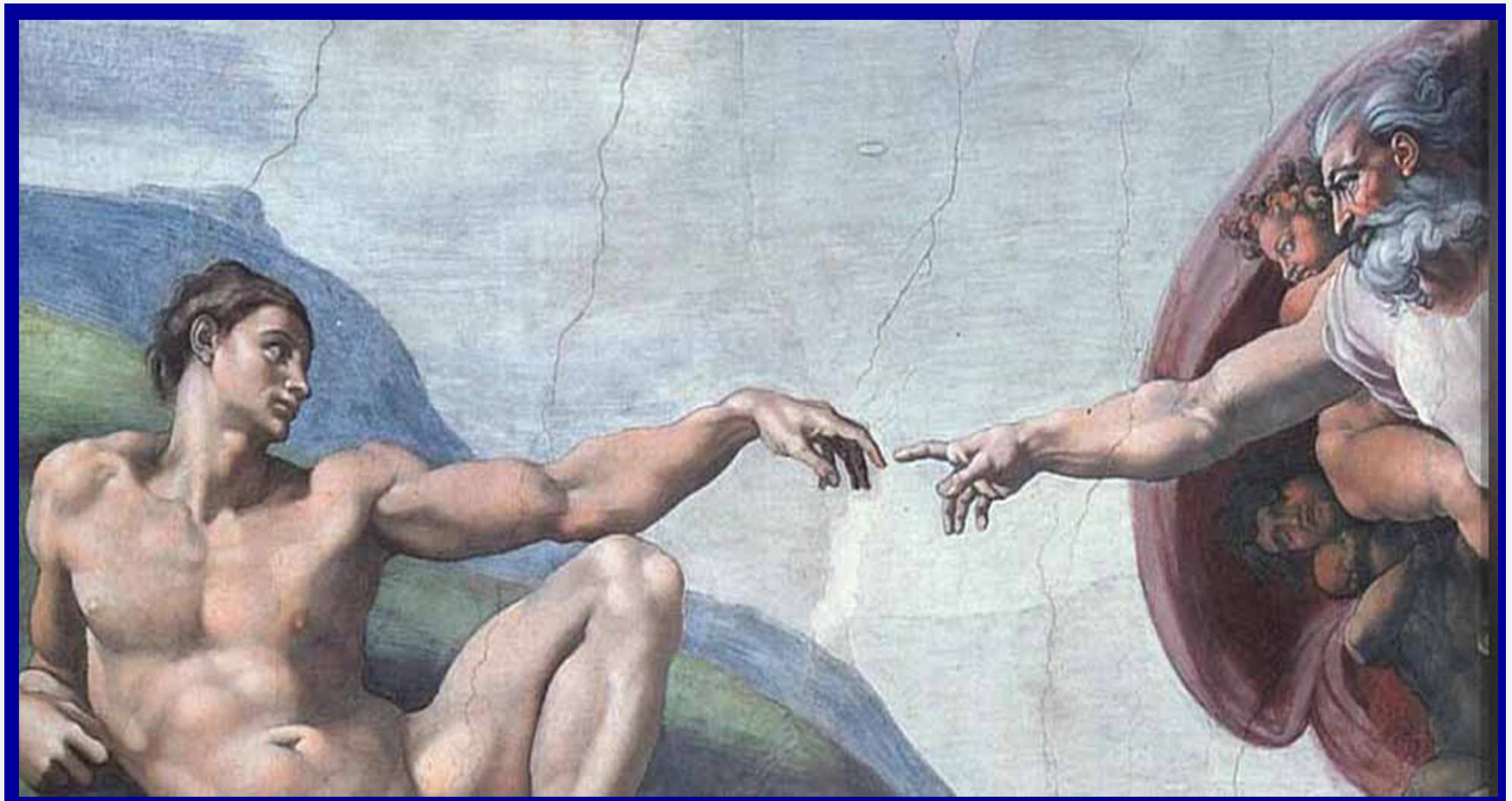
(http://w3.ualg.pt/~jlongras/)
(jlongras@ualg.pt)

Departamento de Física
Centro de Electrónica, Optoelectrónica e Telecomunicações
Faculdade de Ciências e Tecnologia

2 de outubro de 2014

https://listas.ualg.pt/wws/info/seminarios-deei

“Deus criou o mundo …”



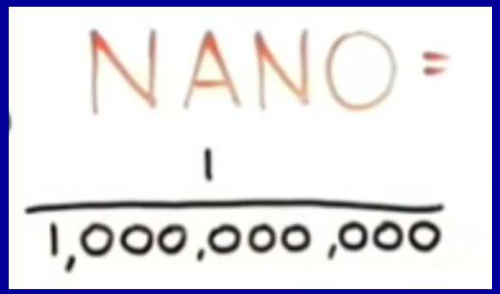
… e a nanotecnologia promete aperfeiçoá-lo

Plano da apresentação

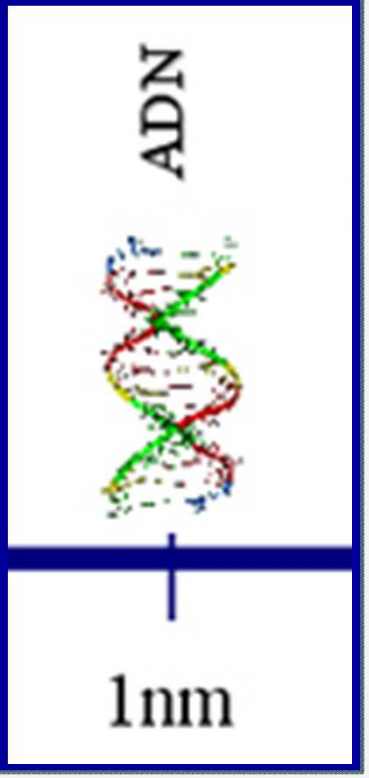
- O universo nanoscópico
- “Há muito espaço lá em baixo”
- Nanotecnologia
- Potencialidades e desafios
- Nanoferramentas
- Nanomedicina
- Nanoimplantes, nanorobôs e as comunicações sem fios

Nano-

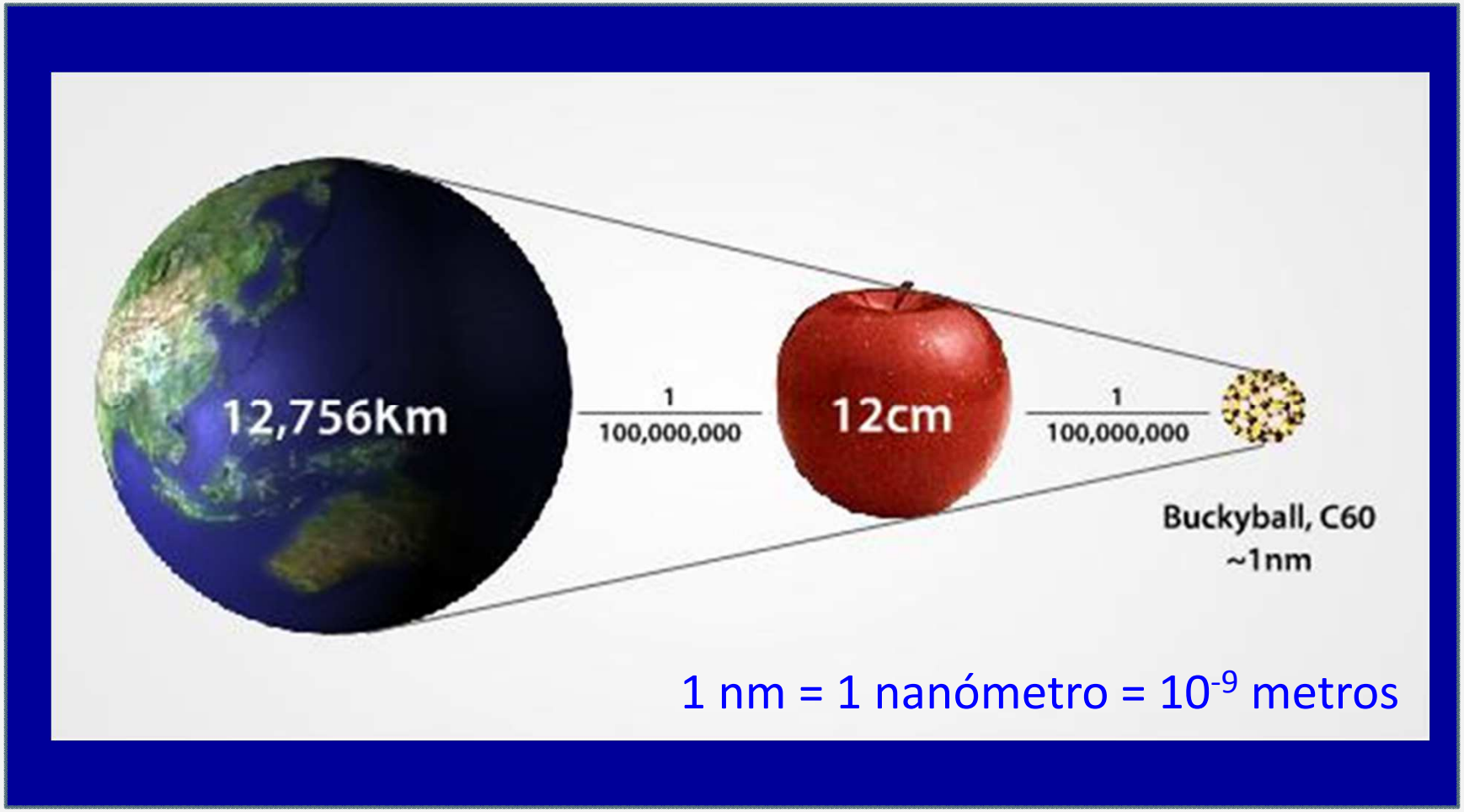
- do gr. nánnos, «anão»
- (fís.) designa um milésimo da milionésima parte



- 1 nanómetro = 10^{-9} metros = 1 nm

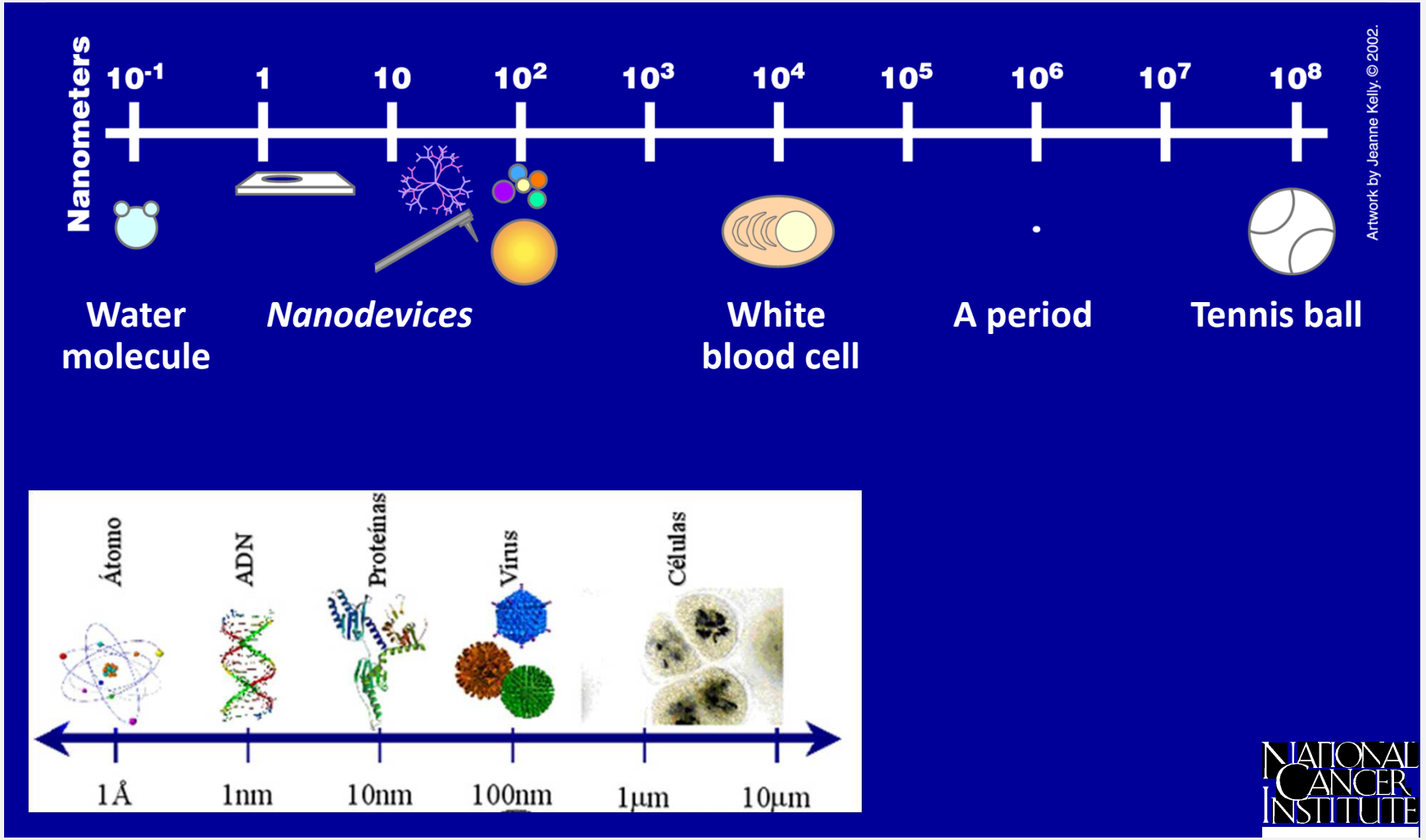


Nanómetro



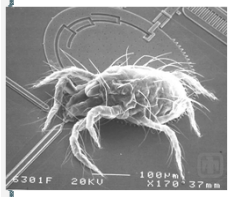
1 nm = 1 nanómetro = 10^{-9} metros

Mundo nanoscópico (< ~100 nm)



The Scale of Things – Nanometers and More

Things Natural

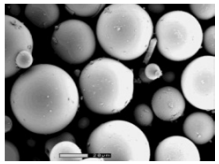


Dust mite

200 µm

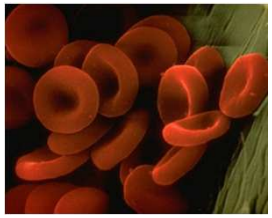
Ant
~ 5 mm

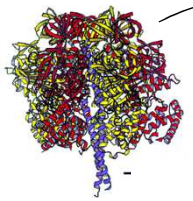
Human hair
~ 60-120 µm wide



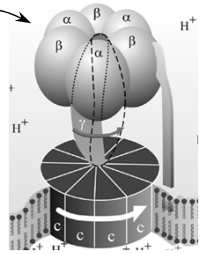
Fly ash
~ 10-20 µm

Red blood cells
(~7-8 µm)

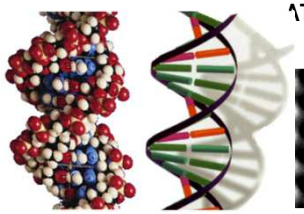




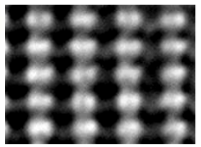
~10 nm diameter



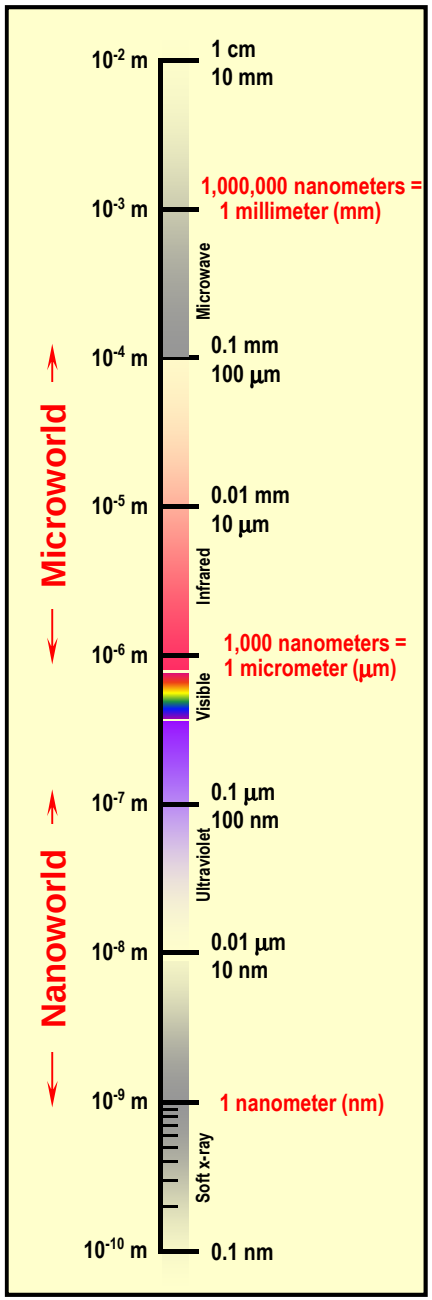
ATP synthase



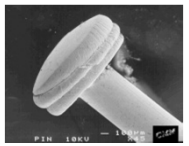
DNA
~2-1/2 nm diameter



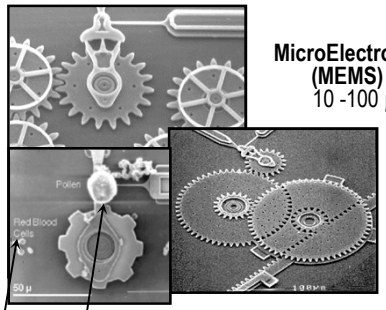
Atoms of silicon
spacing 0.078 nm



Things Manmade

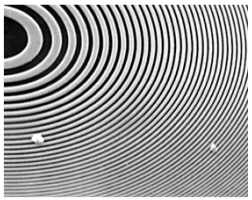


Head of a pin
1-2 mm

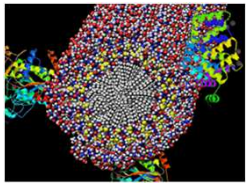


MicroElectroMechanical
(MEMS) devices
10 -100 µm wide

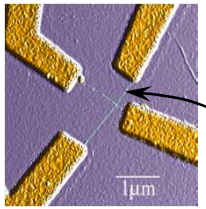
Pollen grain
Red blood cells



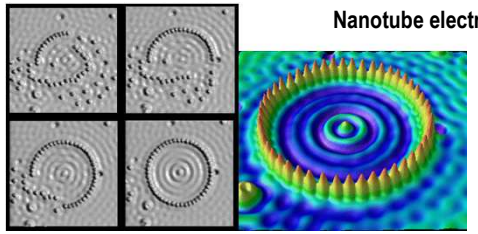
Zone plate x-ray "lens"
Outer ring spacing ~35 nm



Self-assembled,
Nature-inspired structure
Many 10s of nm

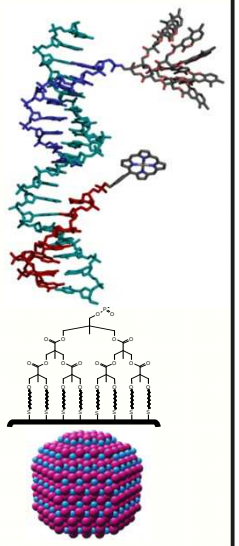


Nanotube electrode

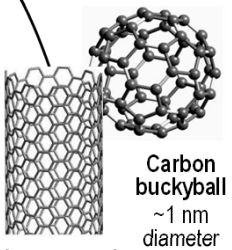


Quantum corral of 48 iron atoms on copper surface
positioned one at a time with an STM tip
Corral diameter 14 nm

The Challenge



Fabricate and combine nanoscale building blocks to make useful devices, e.g., a photosynthetic reaction center with integral semiconductor storage.

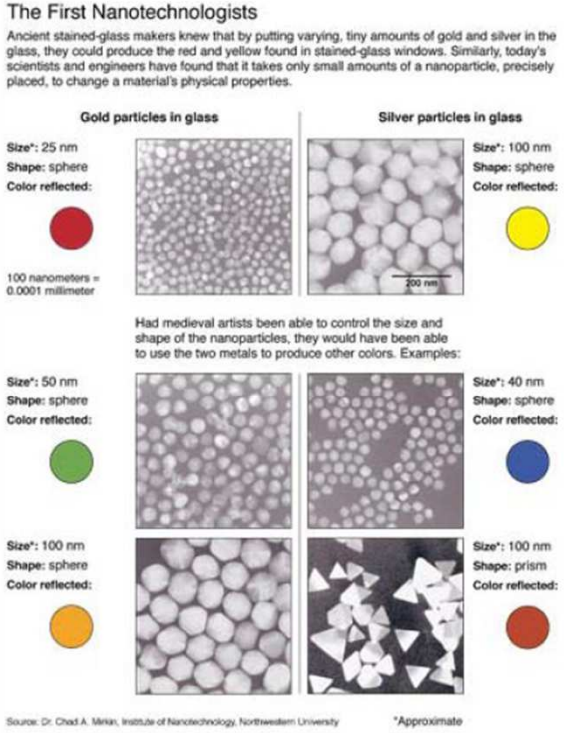


Carbon
buckyball
~1 nm
diameter

Carbon nanotube
~1.3 nm diameter

Office of Basic Energy Sciences
Office of Science, U.S. DOE
Version 10-07-03, pmd

A nanotecnologia não é nova. De fato é milenar



Chad Mirkin, Northwestern University, in NYTimes article by K. Chang - 2005

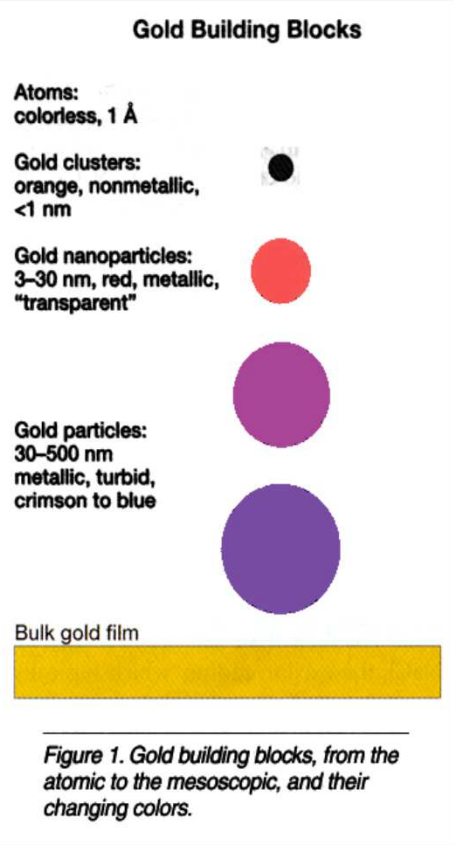


Figure 1. Gold building blocks, from the atomic to the mesoscopic, and their changing colors.

O copo de Licurgo foi criado pelos Romanos em 400 a.C.. É vermelho quando iluminado de trás e verde quando iluminado na parte dianteira.

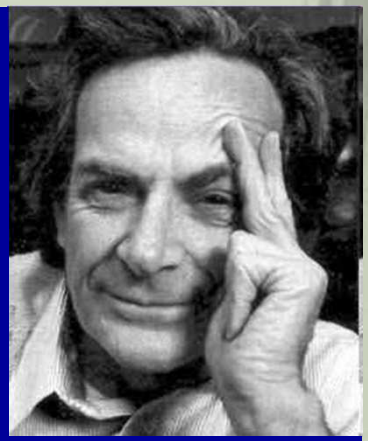
http://www.youtube.com/watch?v=u-Id3pD1vEU

Nanotecnologia: potencialidades e desafios

“Há muito espaço lá em baixo”

“There’s Plenty of Room at the Bottom”*

* Título da palestra realizada por **Richard Feynman**, 29 de Dezembro de 1959.

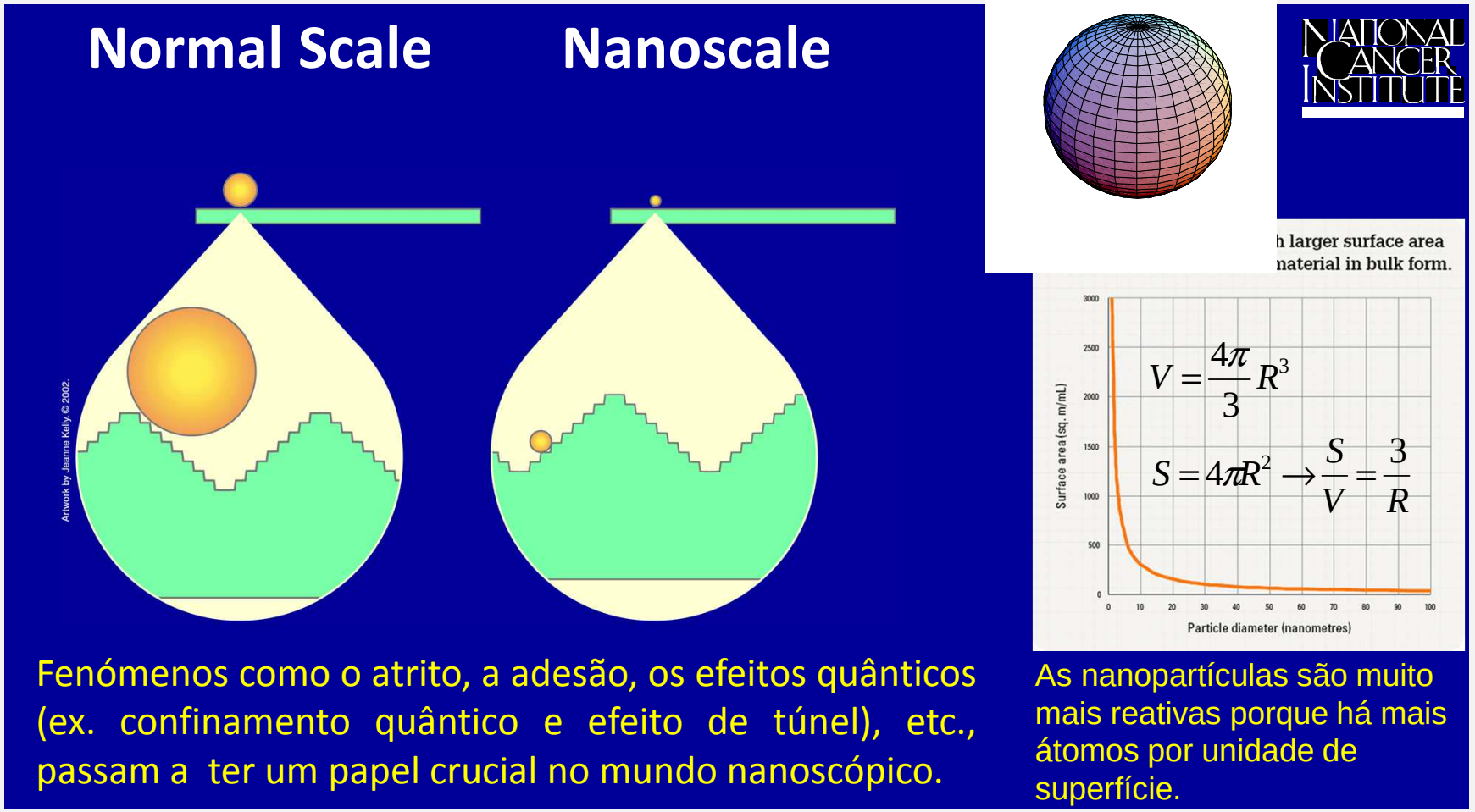


- What would happen if we could arrange the atoms one by one the way we want them (within reason, of course; you can't put them so that they are chemically unstable, for example).

- I can't see exactly what would happen, but I can hardly doubt that when we have some *control* of the arrangement of things on a small scale we will get an enormously greater range of possible properties that substances can have, and of different things that we can do.

http://www.zyvex.com/nanotech/feynman.html

À escala nano a *física* é muito diferente



O que é nano pode ser bom

Novos materiais e novos produtos

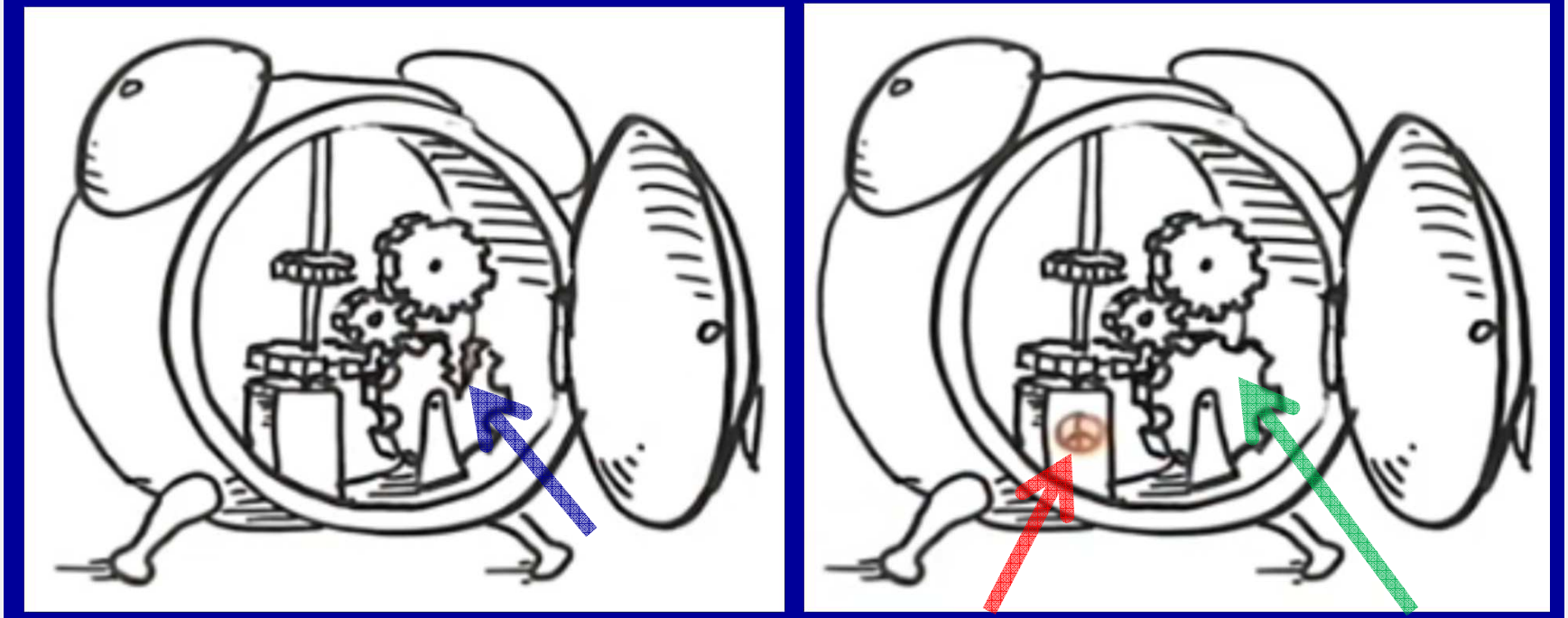
Nanociências + tecnologias = Nanotecnologias

- Novas funcionalidades
- Mais rápidos
- Mais leves
- Ocupem pouco espaço e cabe em “qualquer” lugar
- Baratos
- Energeticamente mais eficientes

http://www.youtube.com/watch?v=ITtGJUGXFKc

Dispositivos/equipamentos com novas funcionalidades

- Ex. capacidade de “autorreparação”

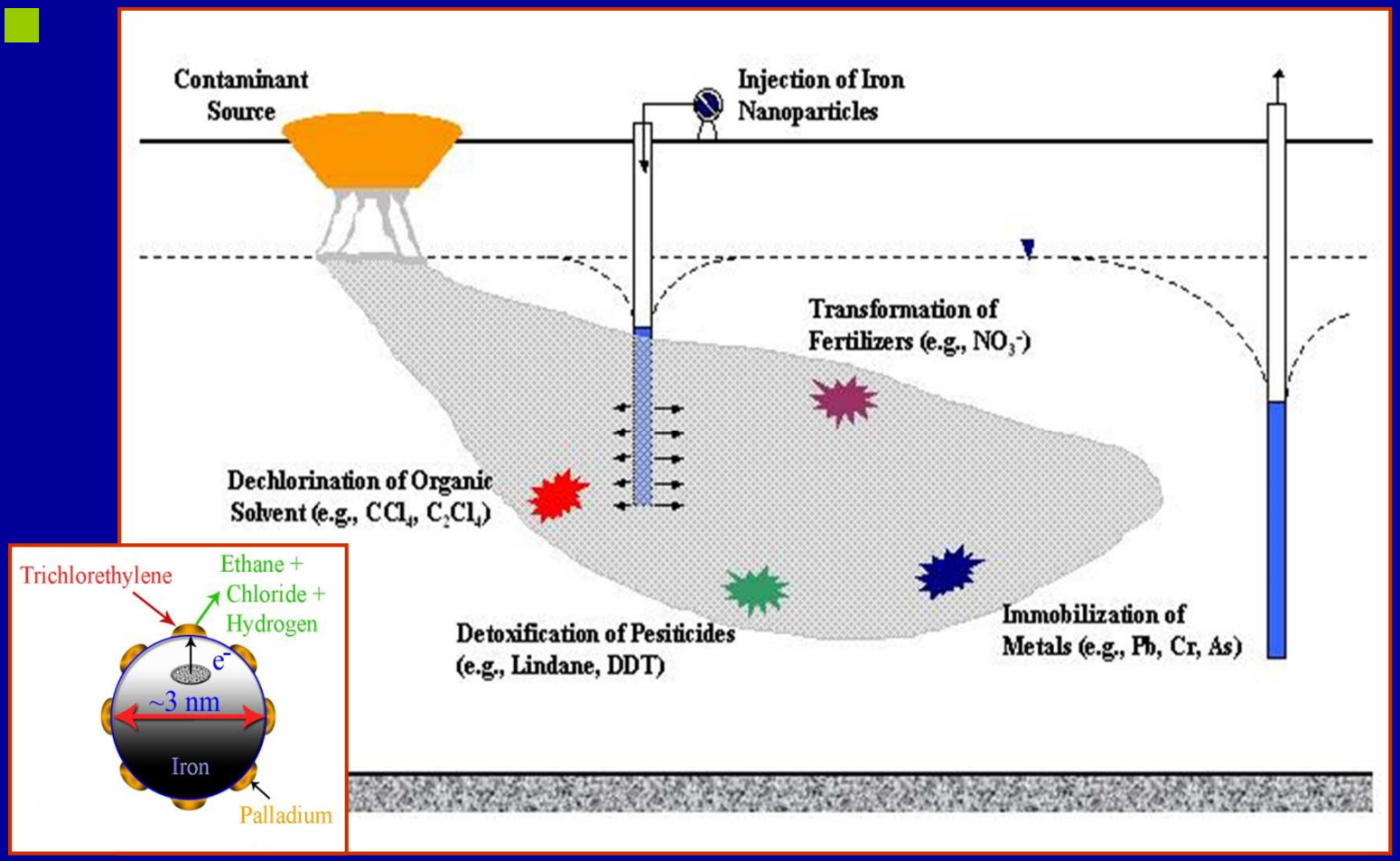


http://www.youtube.com/watch?v=ITtGJUGXFKc

Alimentos mais nutritivos e seguros

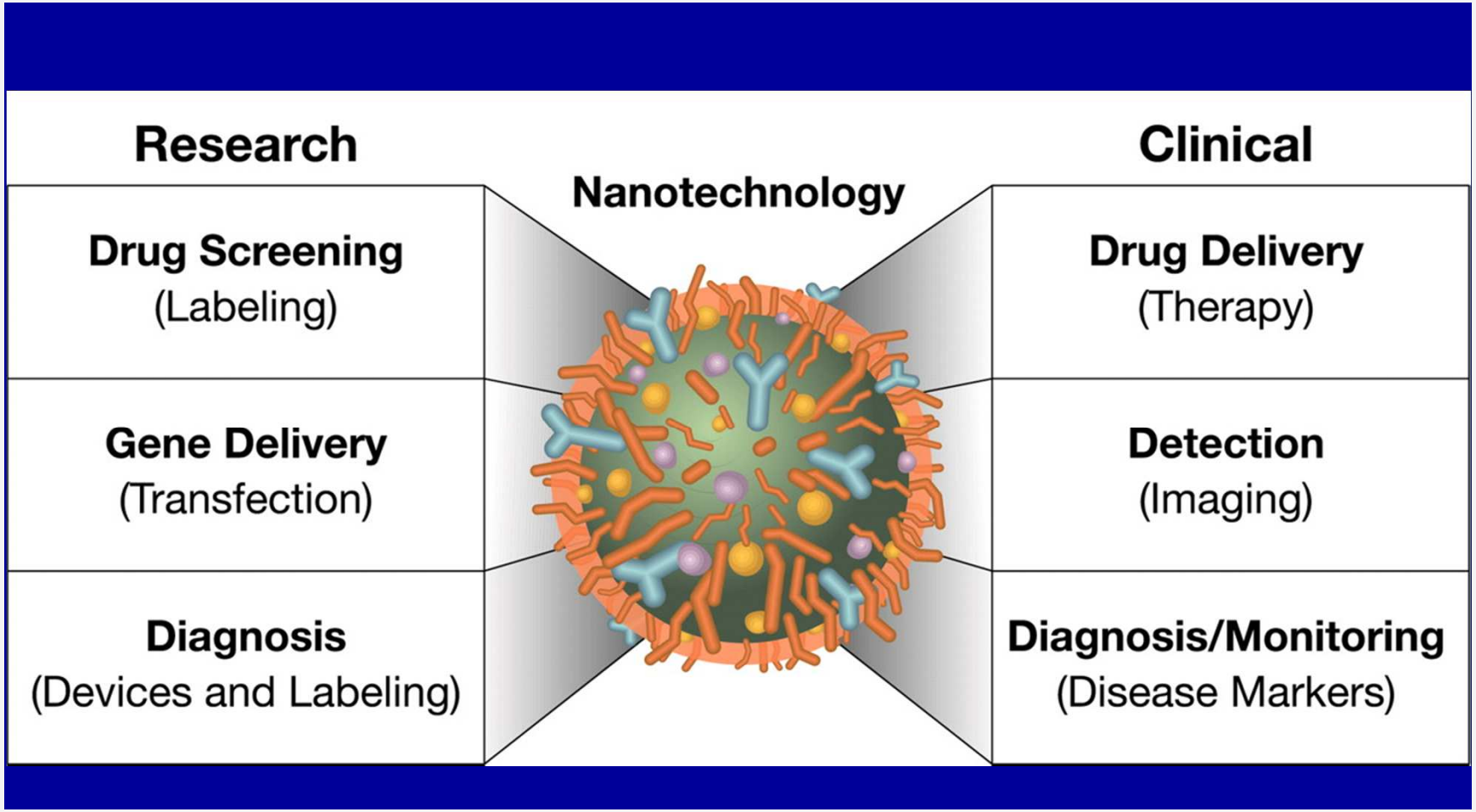
http://www.nextnature.net/2010/05/nano-product-the-food-printer/

Meio ambiente mais saudável



http://

Aplicações médicas disruptivas



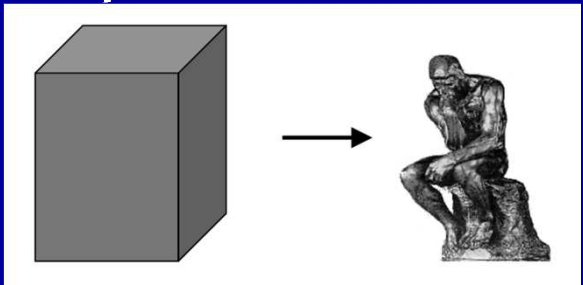
Aspetos a ter em conta

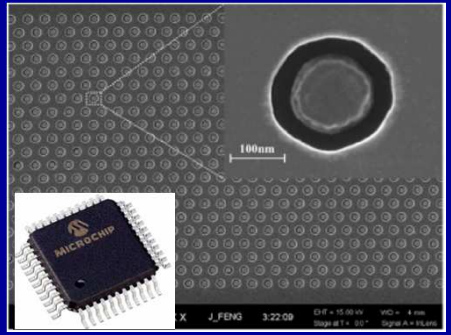
- Proteção do cérebro
- Bioincompatibilidade e toxicidade das nano-estruturas
- Segurança (pessoal, ambiental, etc.)
- Protecção do meio ambiente
- Nanopoluição/nanocontaminação (atmosférica, recursos hídricos e freáticos, cadeia alimentar, etc.)
- Implicações socioeconómicas

Abordagens e ferramentas

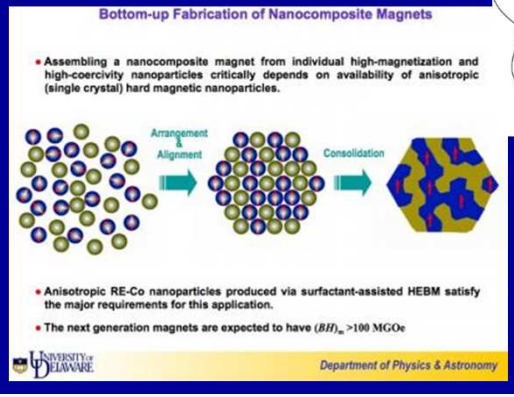
Abordagens da nanotecnologia

- "top-down"

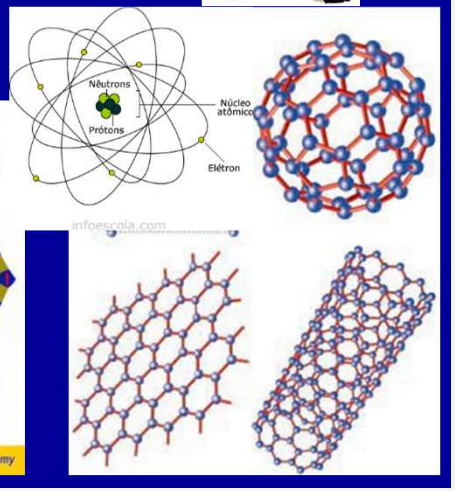




- "bottom-up"

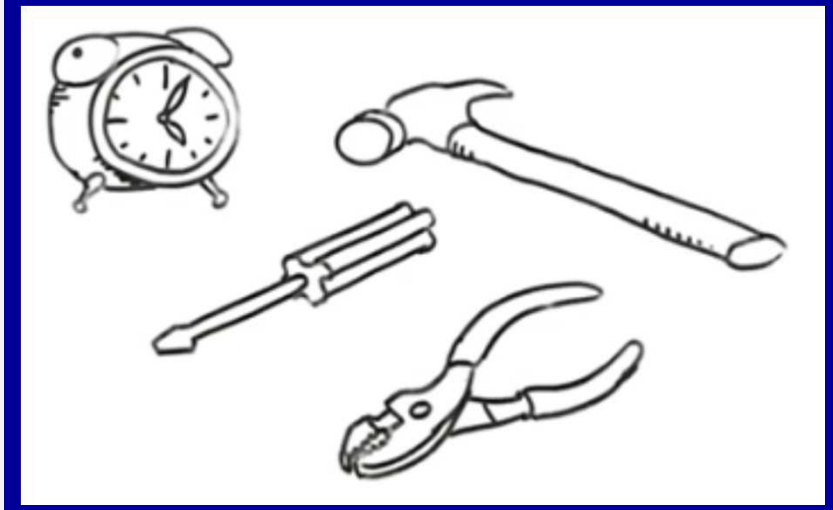


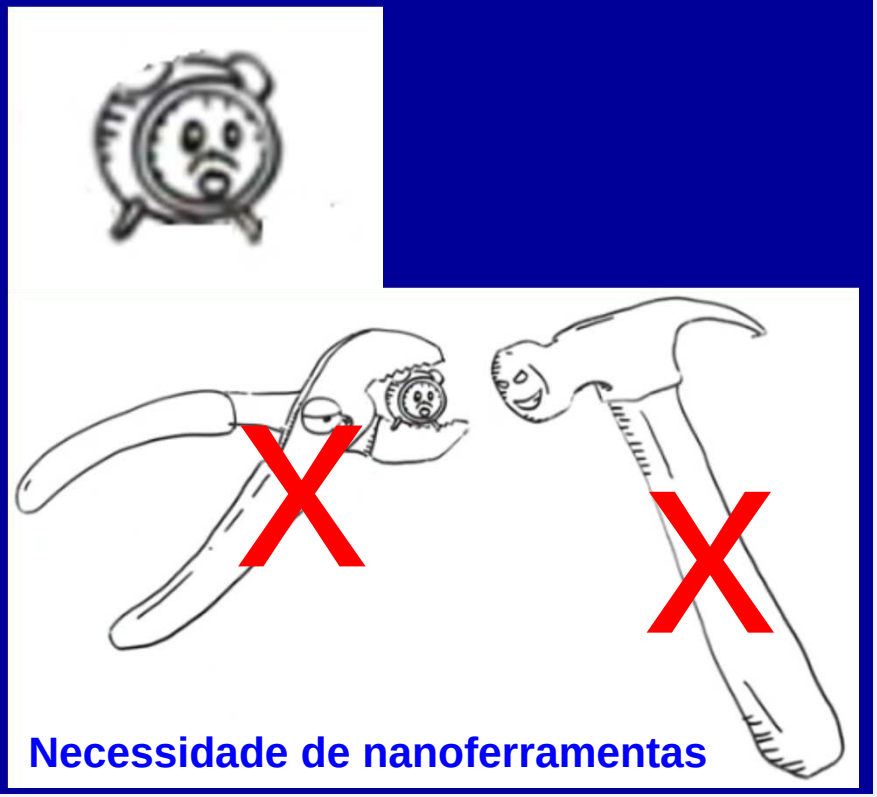
Carbono



O mundo nano exige novas ferramentas

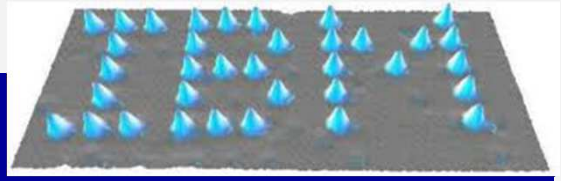
Mundo macro: ferramentas macro

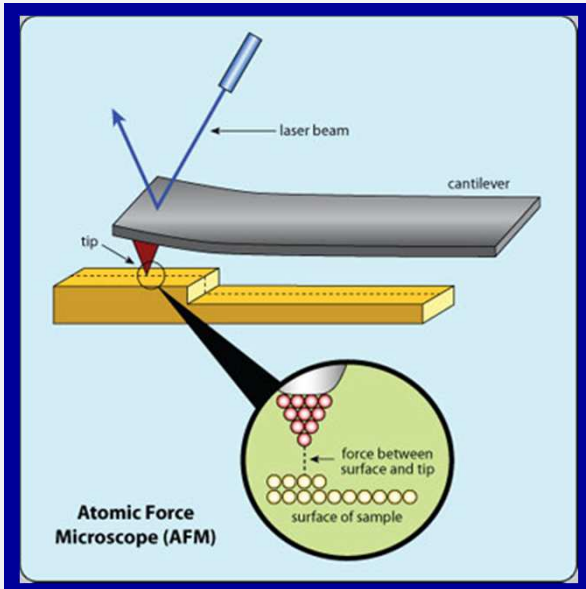


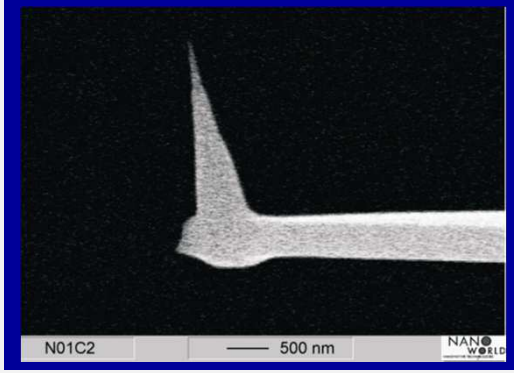


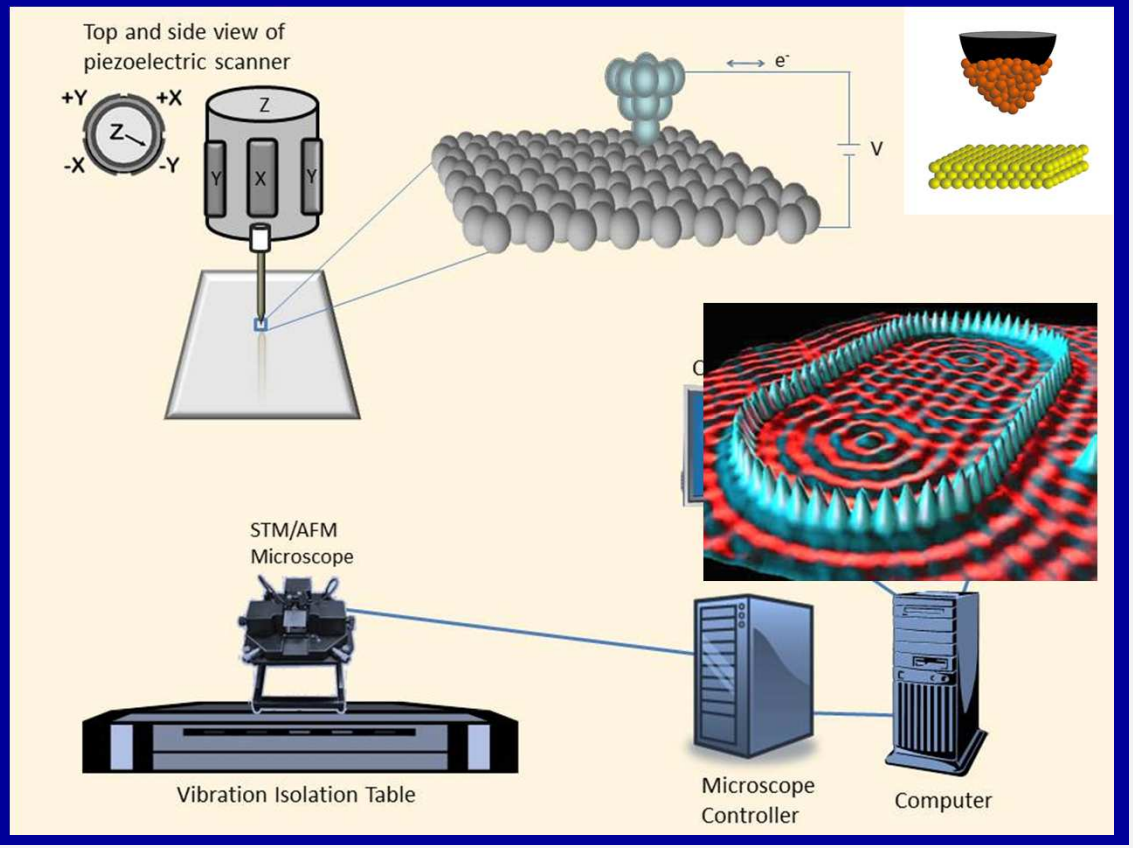
http://www.youtube.com/watch?v=ITtGJUGXFKc

Microscópio de força atómica



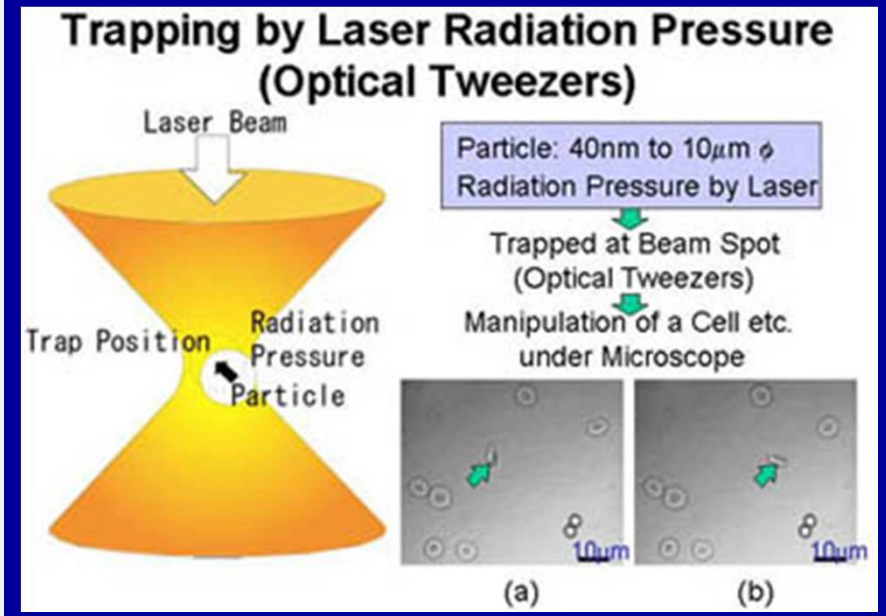


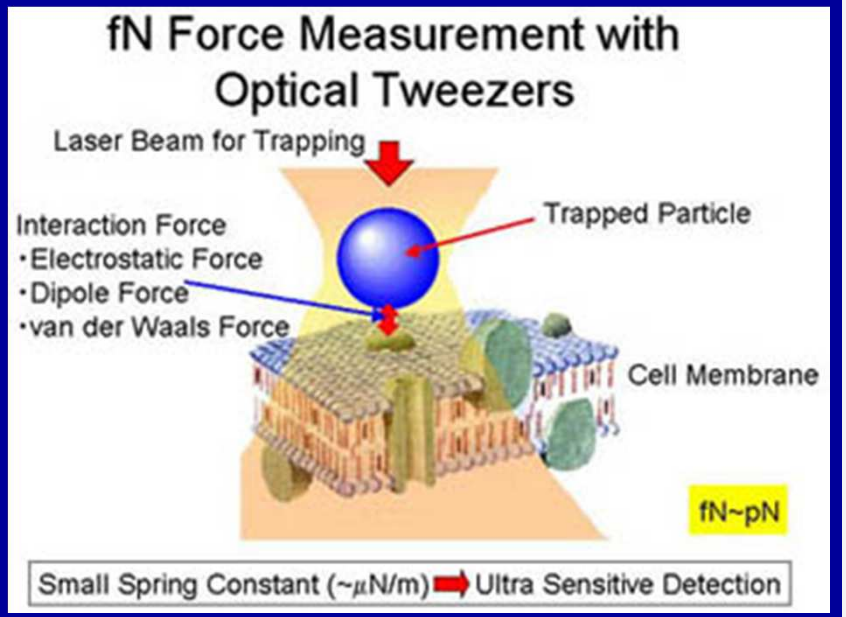




http://www.youtube.com/watch?v=ITtGJUGXFKc

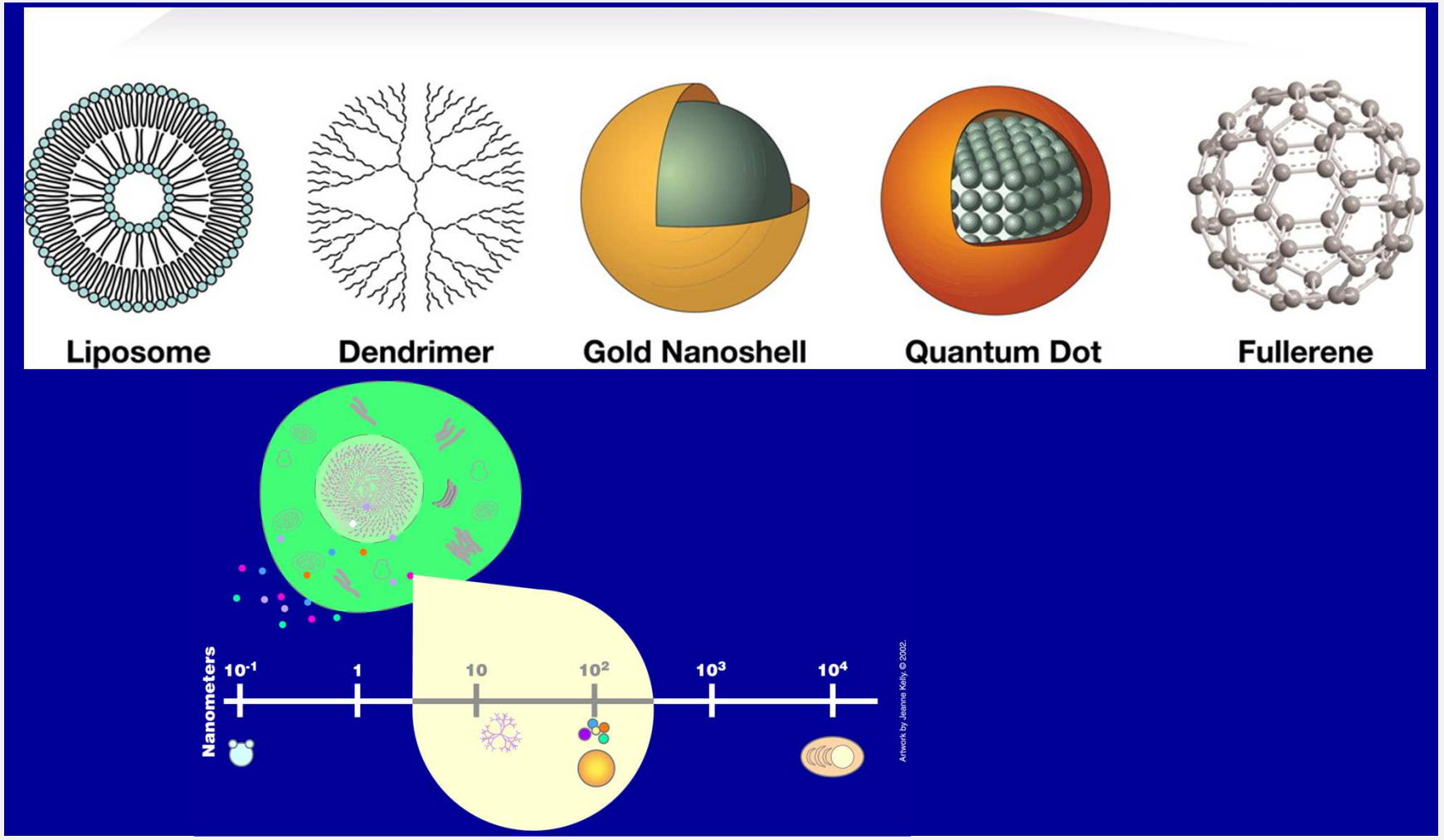
Pinças ópticas



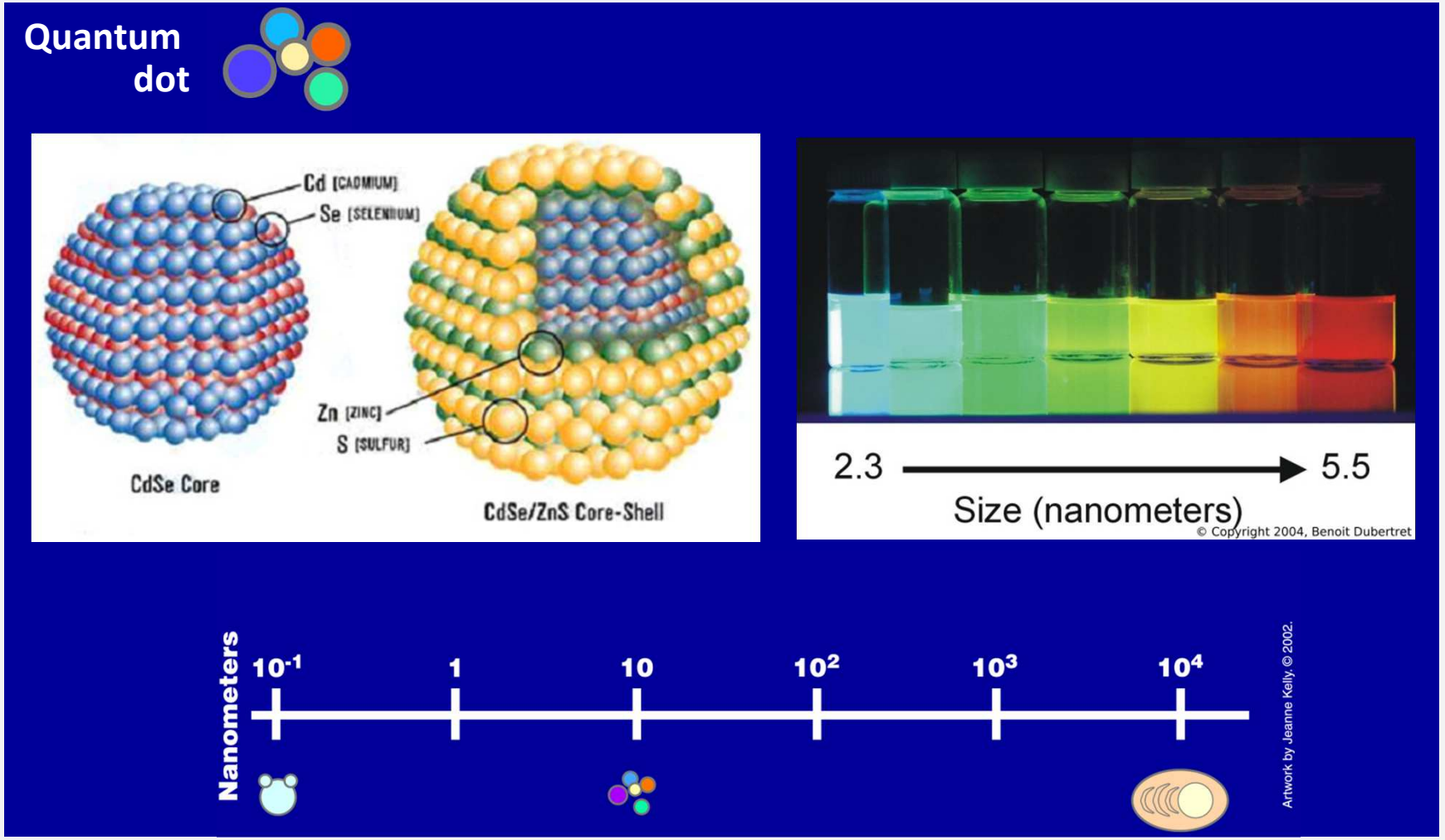


http://kotaro.naist.jp/english/research/

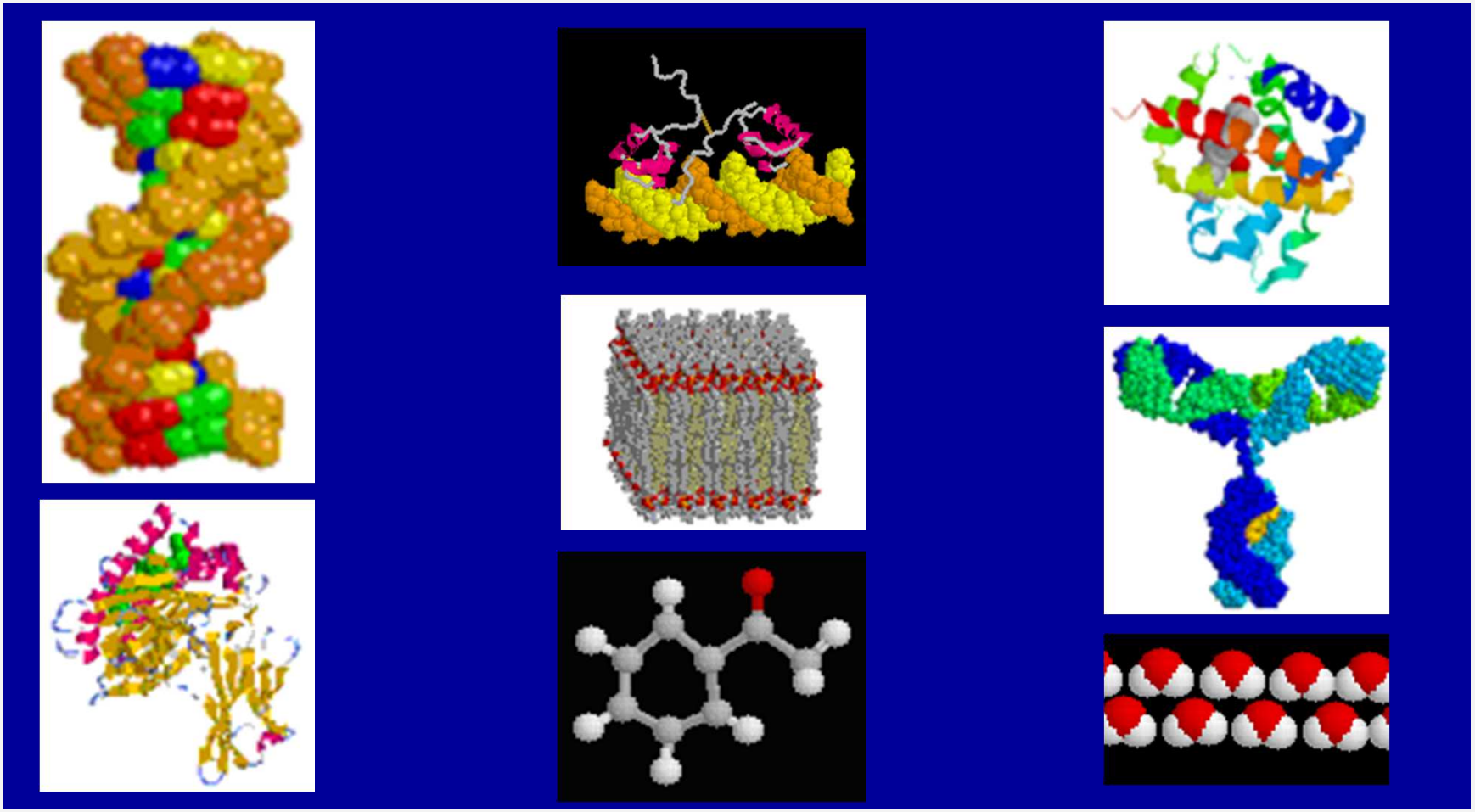
Nanopartículas



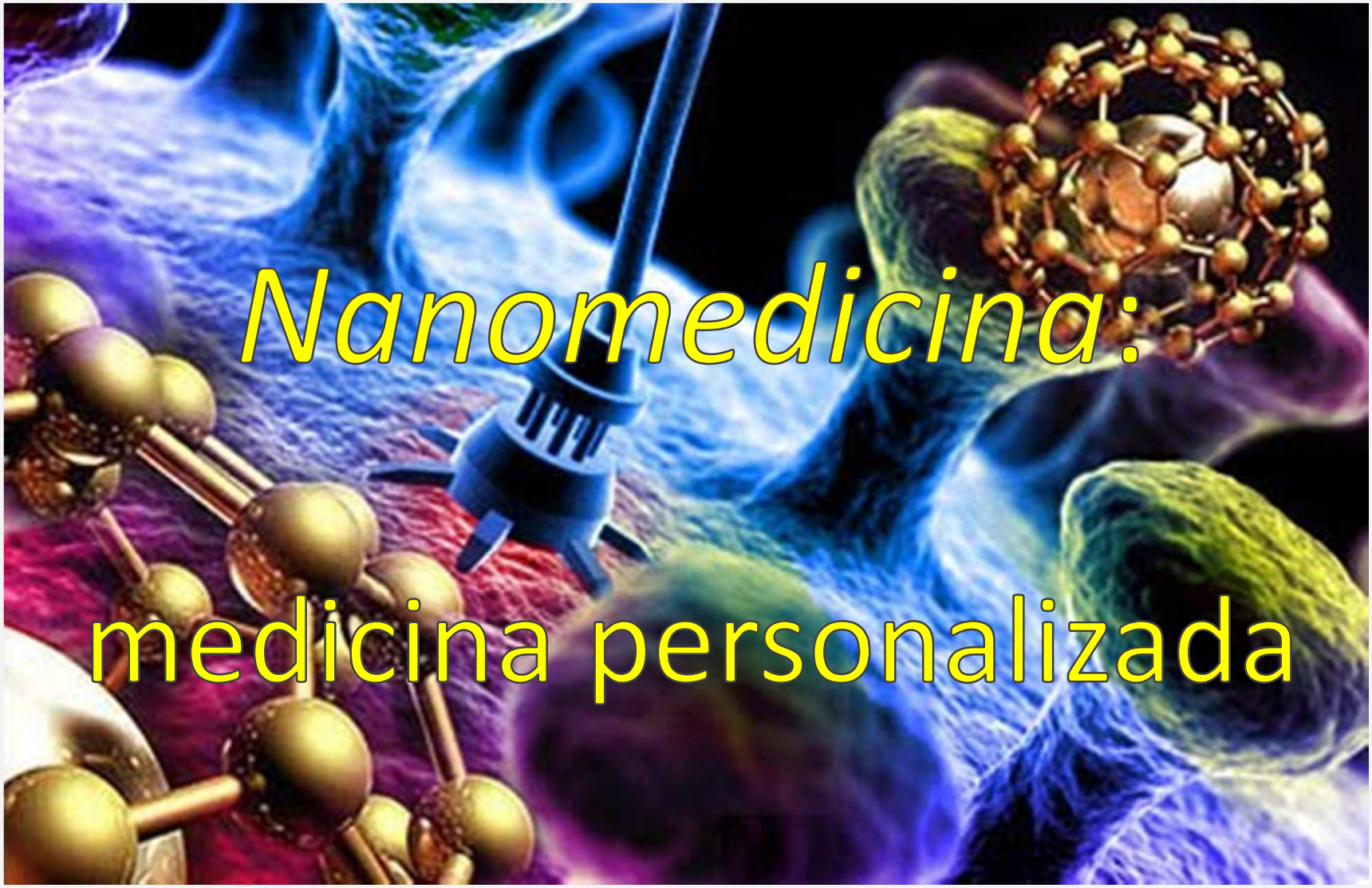
Pontos quânticos (quantum dots)



Máquinas moleculares



http://www.youtube.com/watch?v=YdjERhTczAs



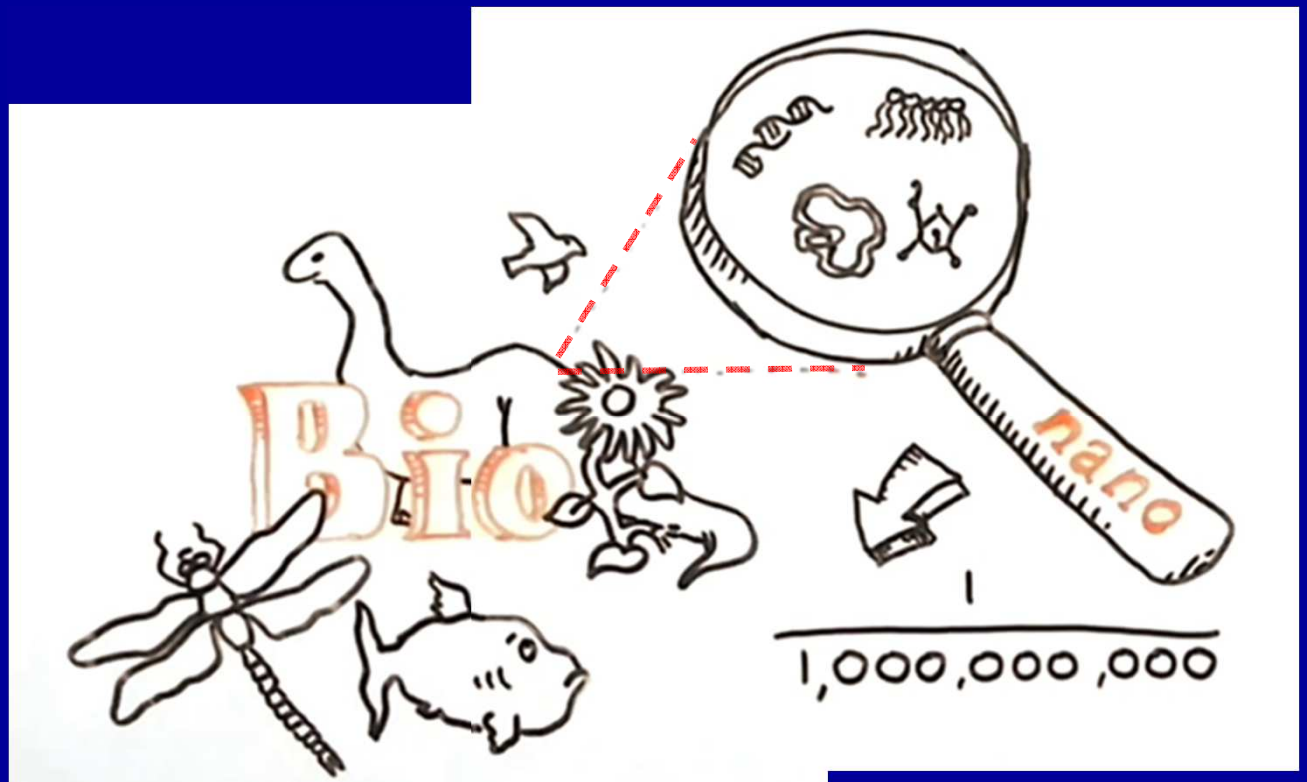
http://w3.ualg.pt/~jlongras/nanomedicina/

Matéria orgânica à escala macroscópica

Todos diferentes …

http://www.youtube.com/watch?v=ITtGJUGXFKc

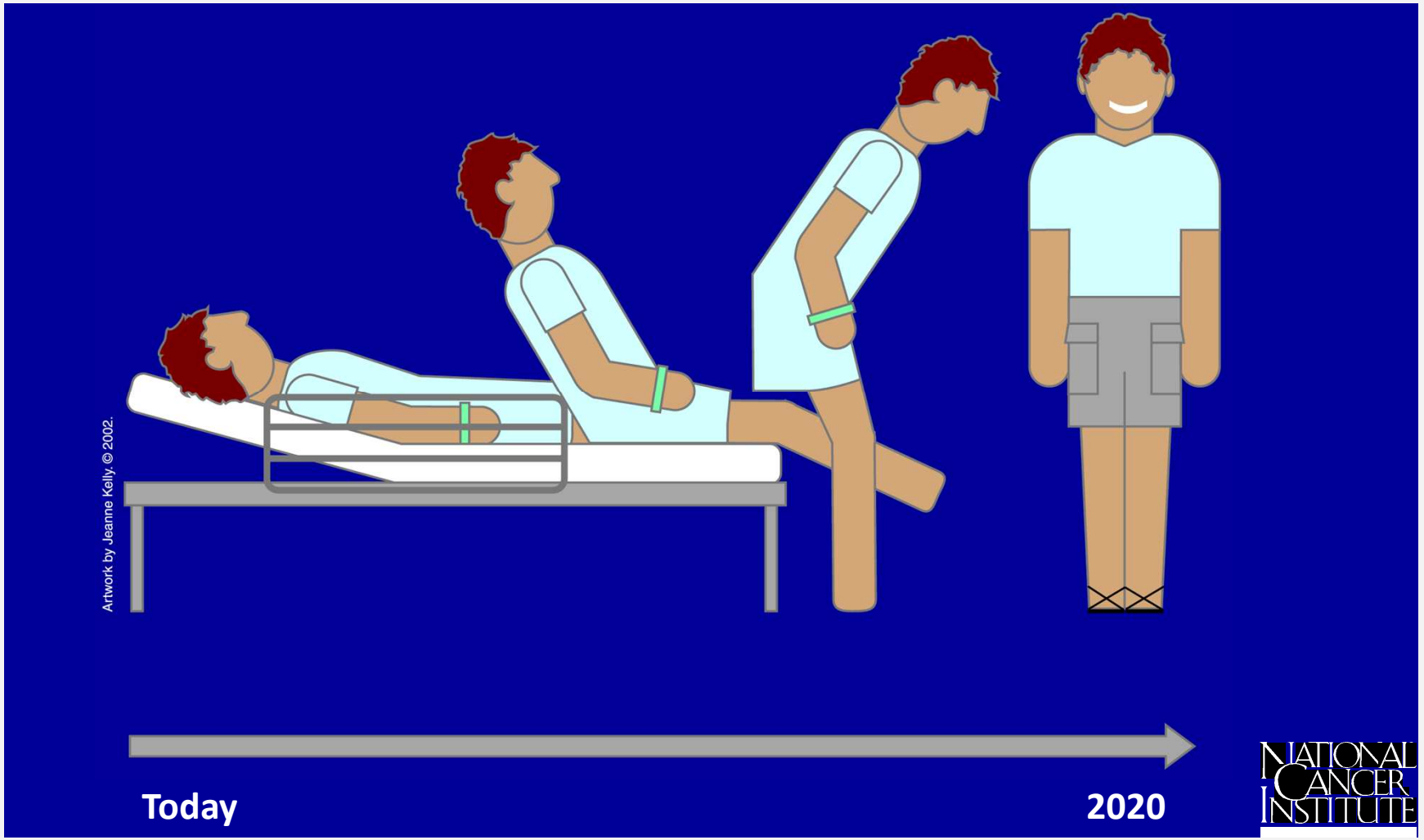
… à escala nanoscópica



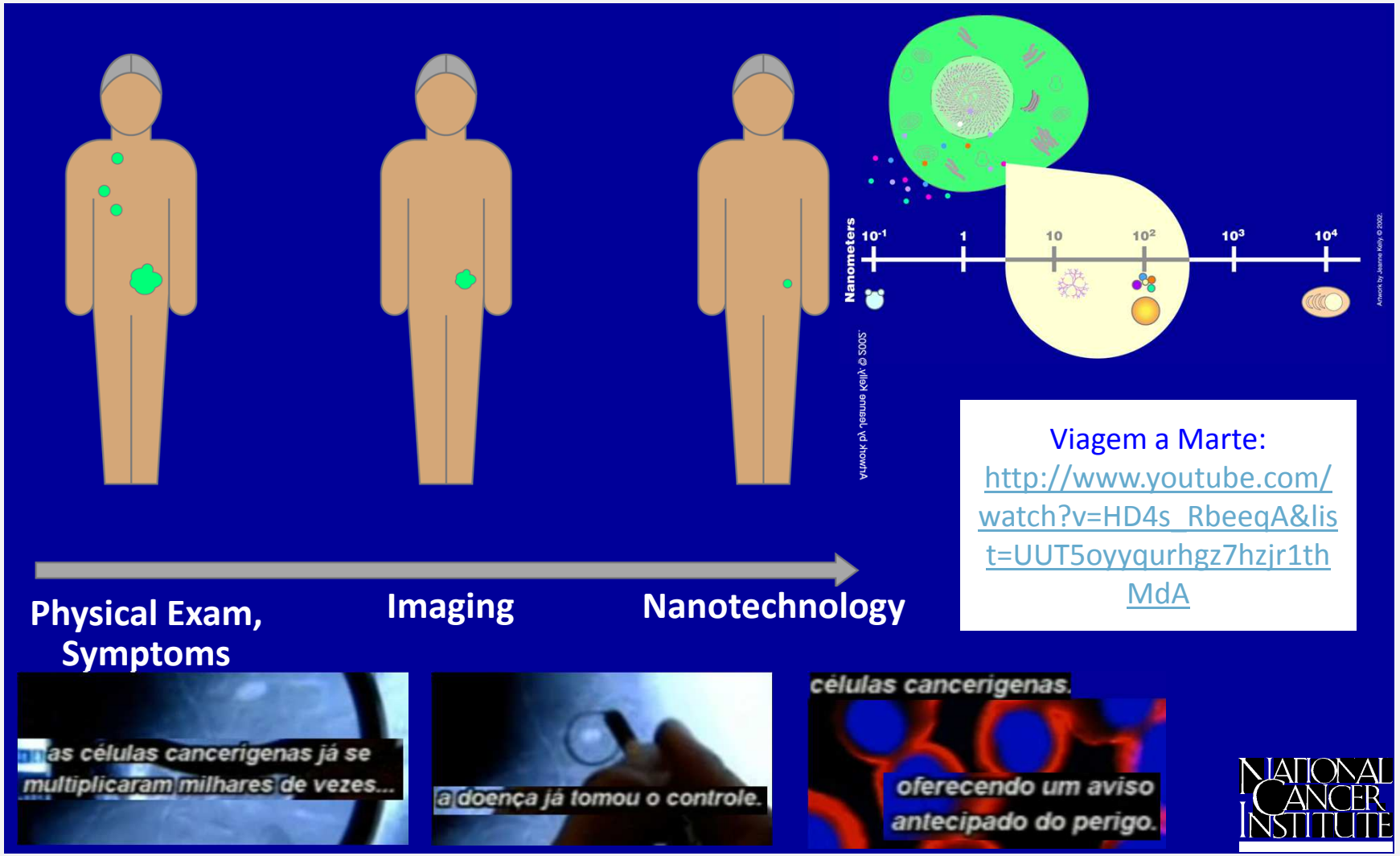
http://www.youtube.com/watch?v=ITtGJUGXFKc

… todos muito parecidos!

Objectivo: melhores níveis de saúde publica

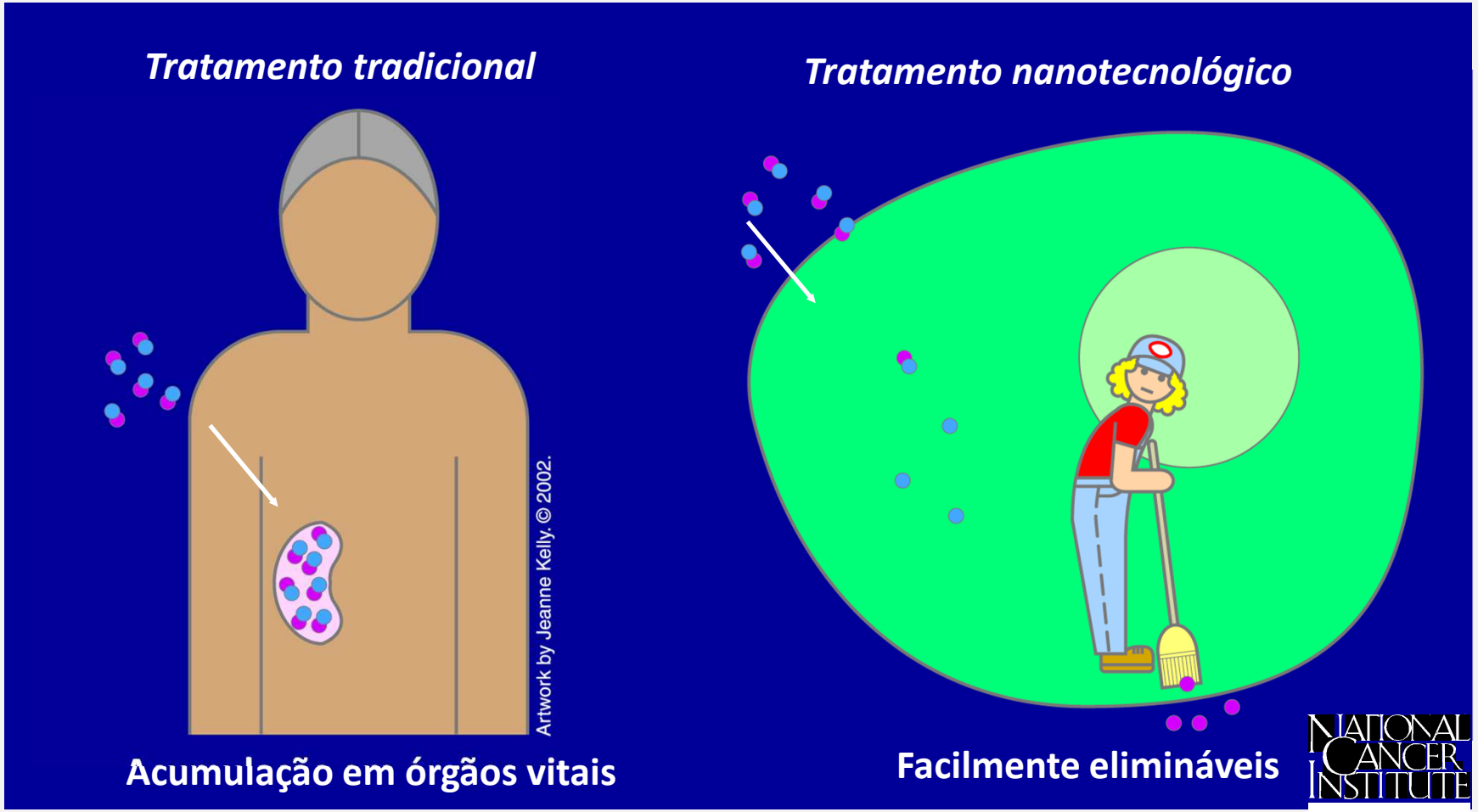


Detecção, diagnóstico e tratamento precoces

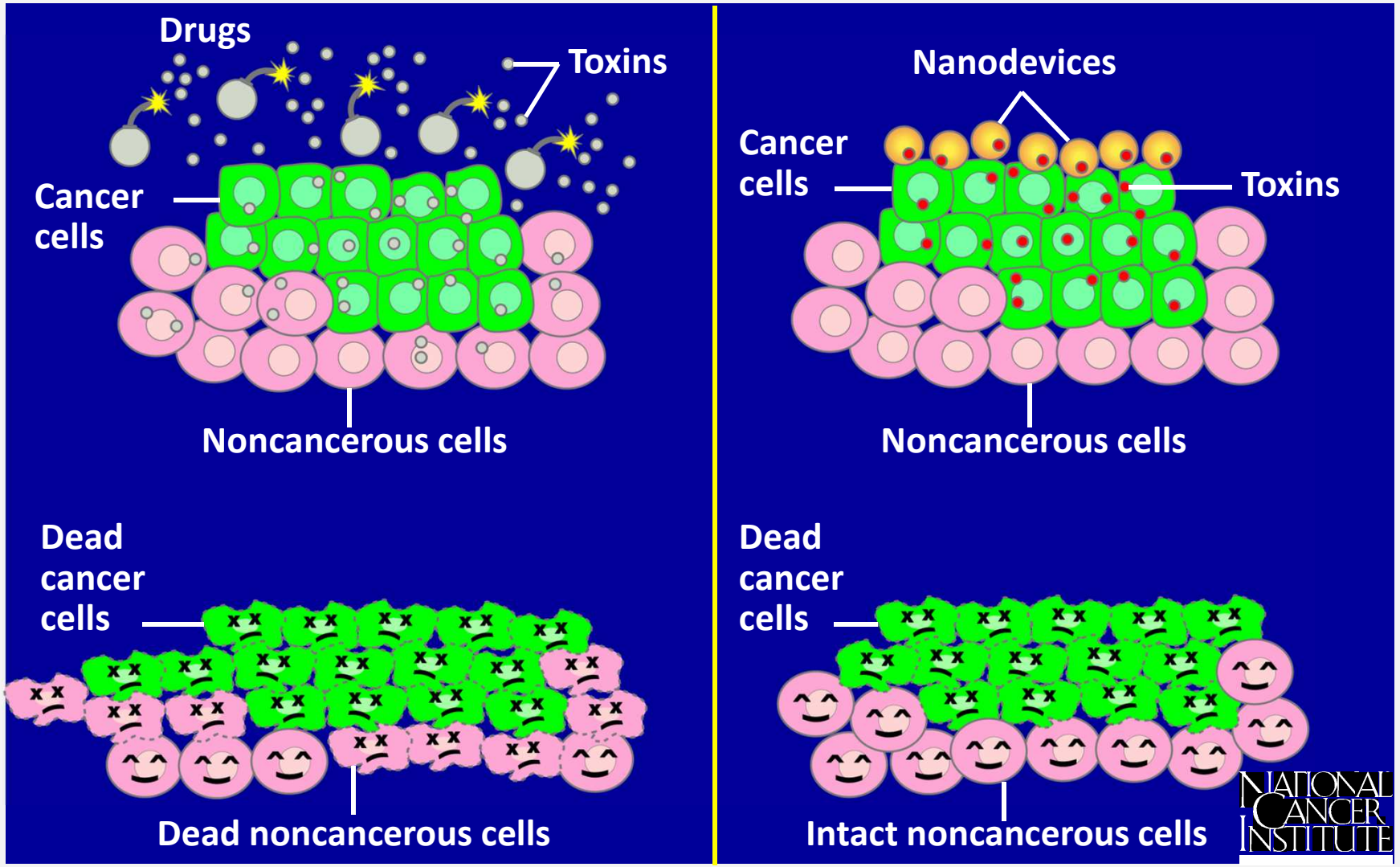


Viagem a Marte: http://www.youtube.com/watch?v=HD4s_RbeeqA&list=UUT5oyyqurhgz7hzjr1thMdA

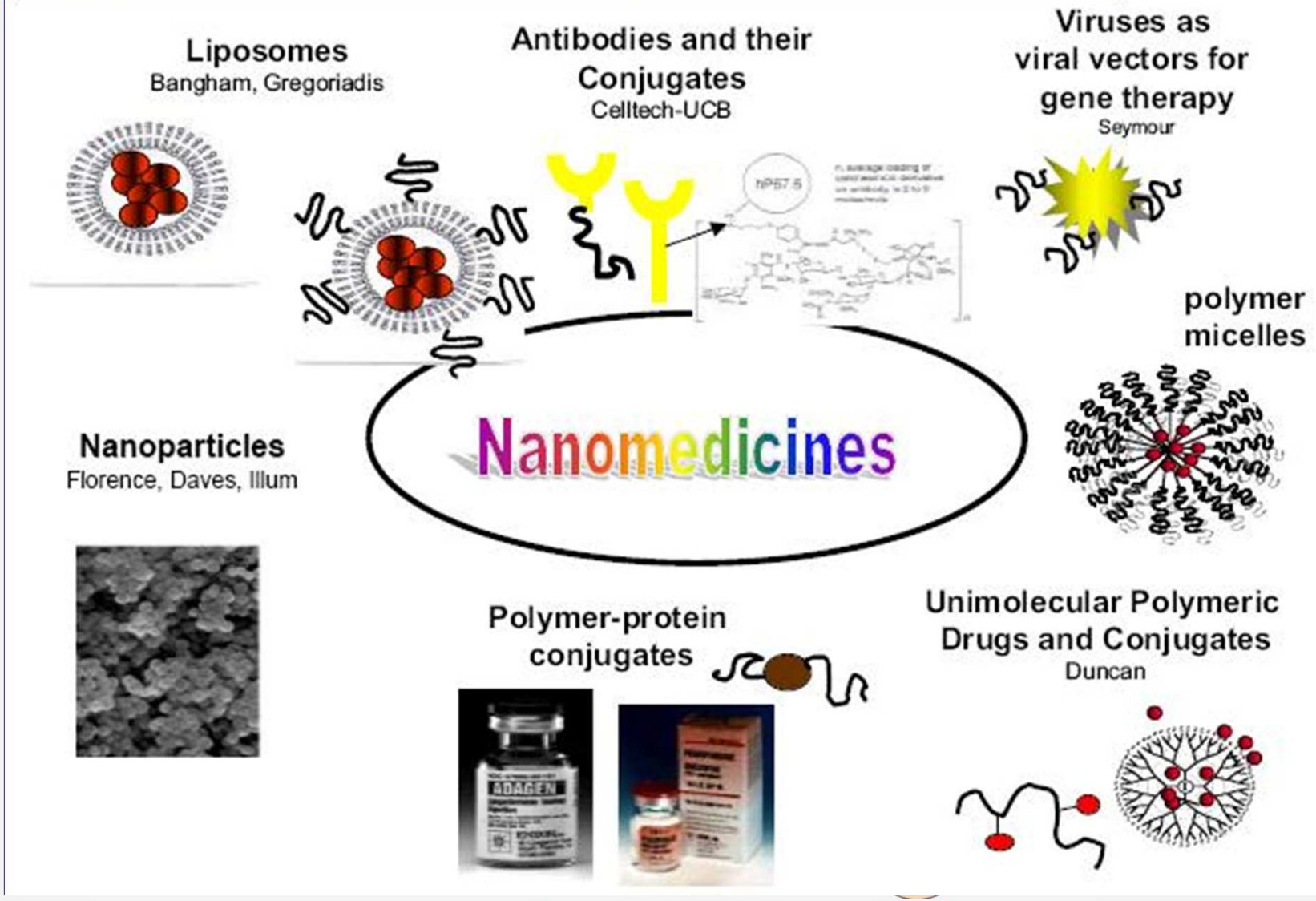
Desenvolvimento de nanofármacos



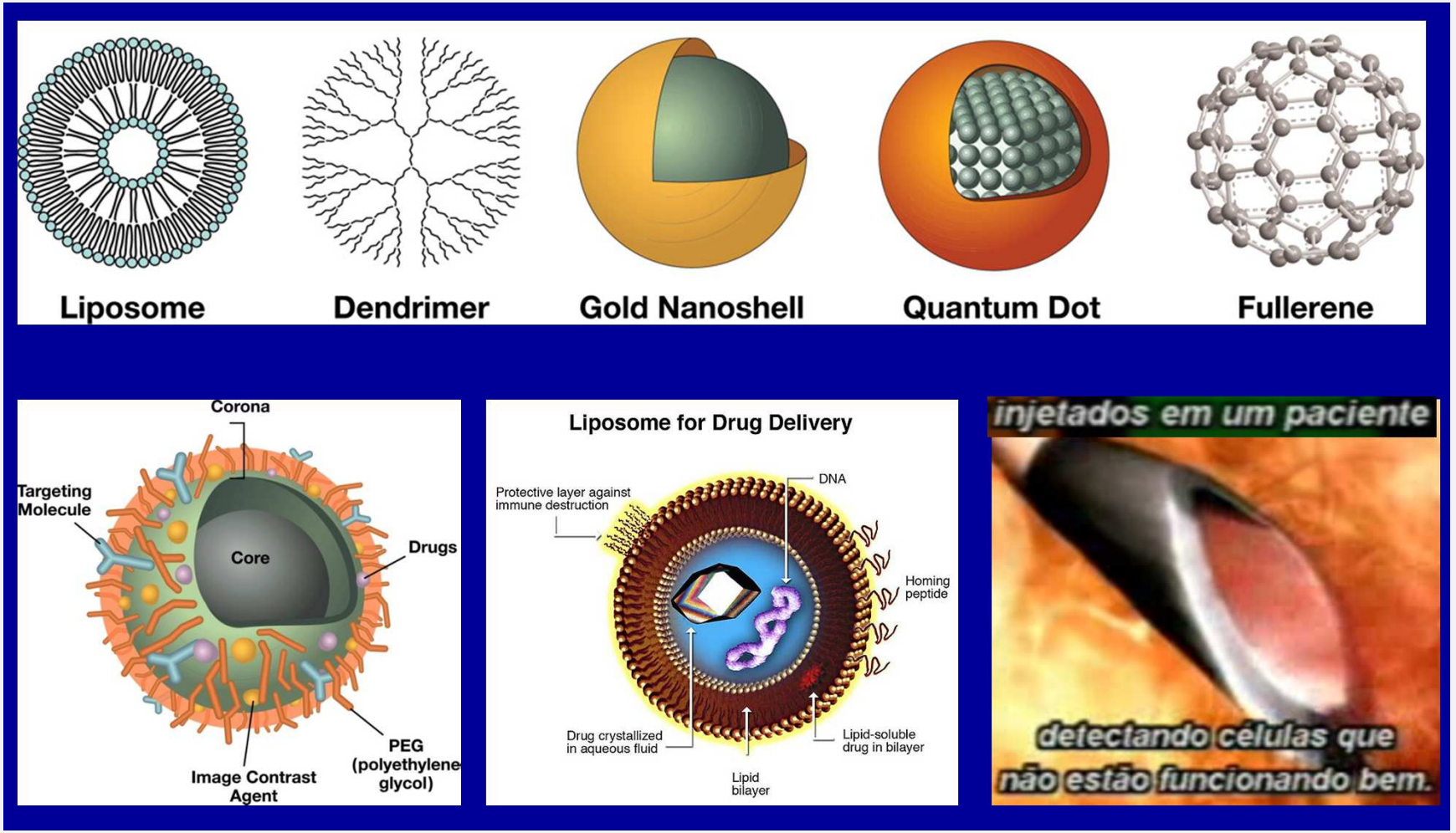
O tratamentos tradicional e o nanotecnológico



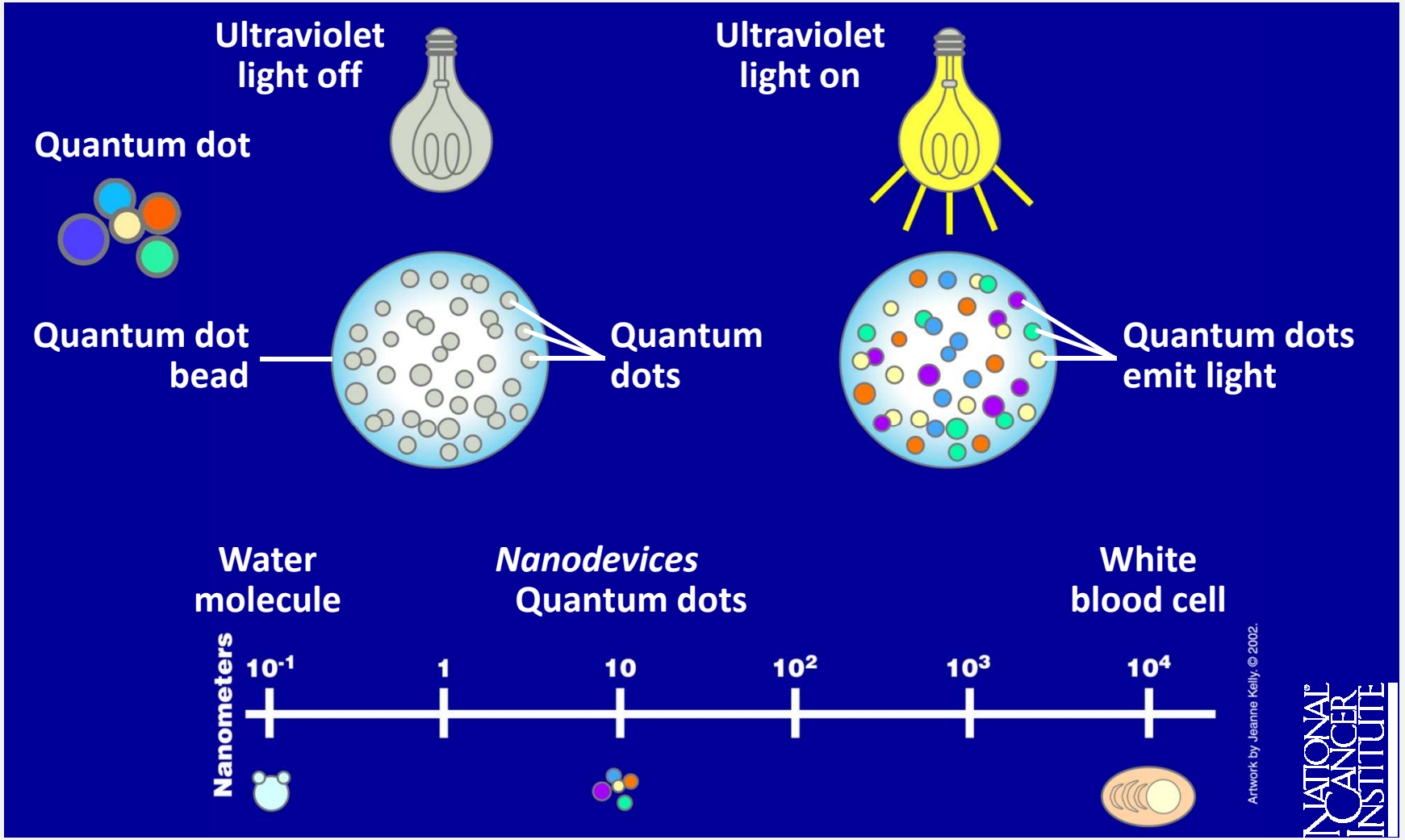
Many "Nanomedicines" are already in routine clinical use



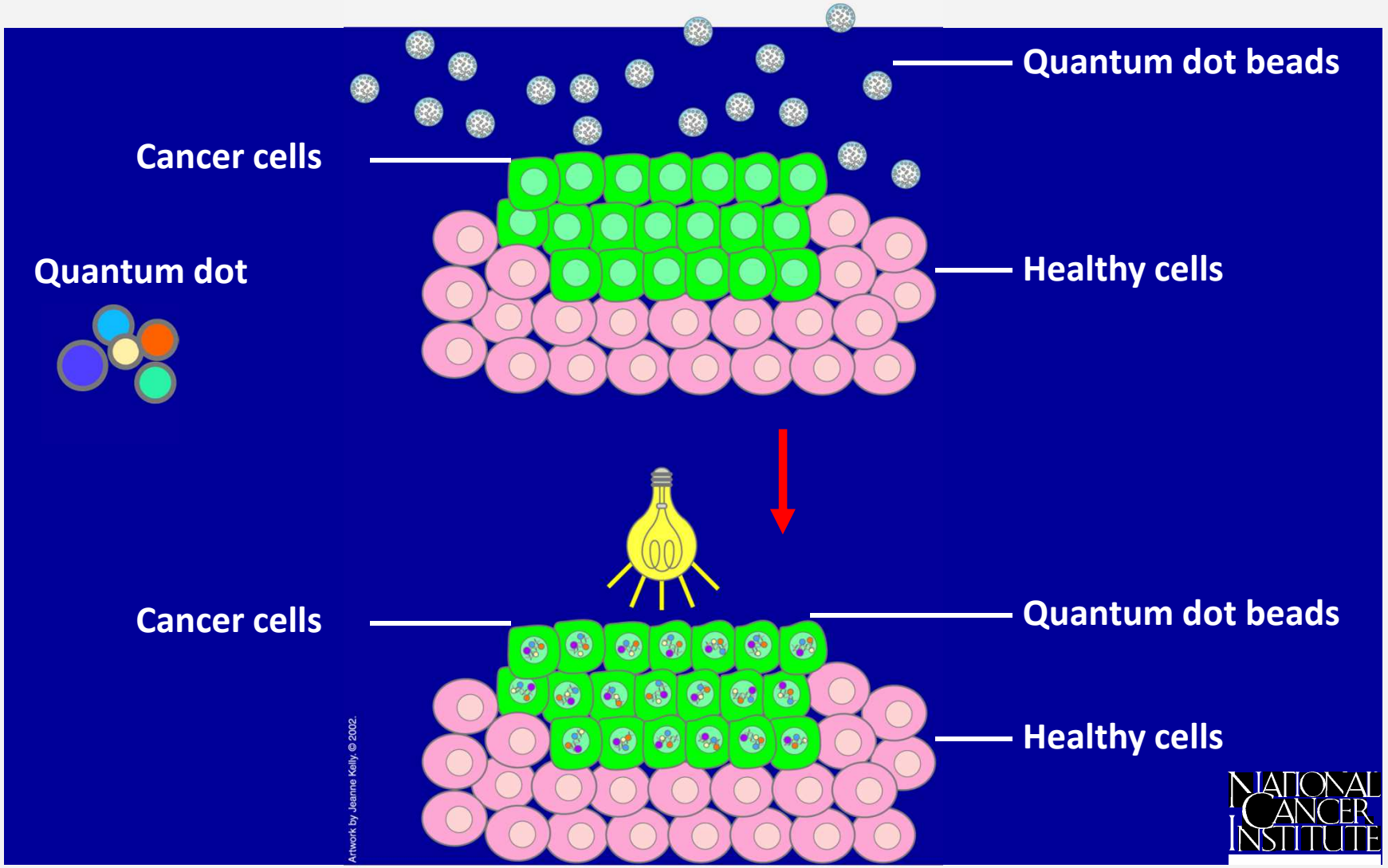
Nano-partículas *funcionalizadas*



Aplicação de pontos quânticos como fluoróforos

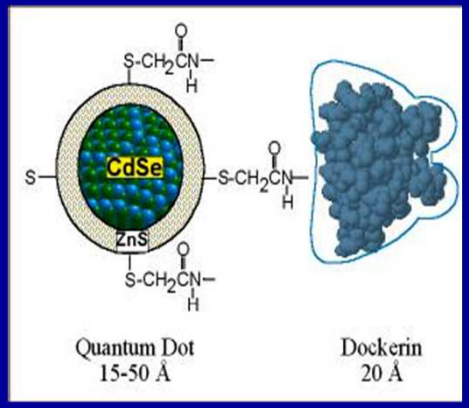


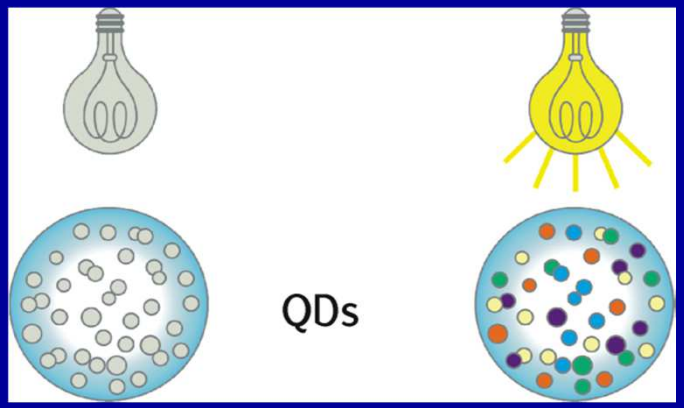
Aplicações: deteção de assinaturas de doença

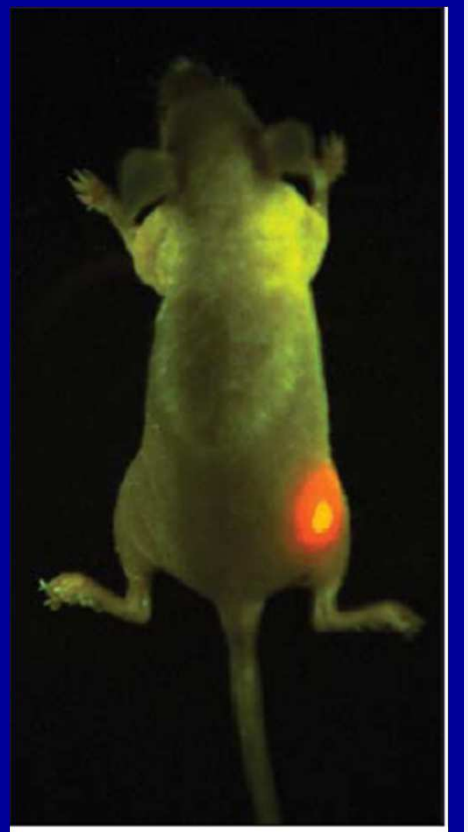


Aplicação: localização de tumores

Quantum dot





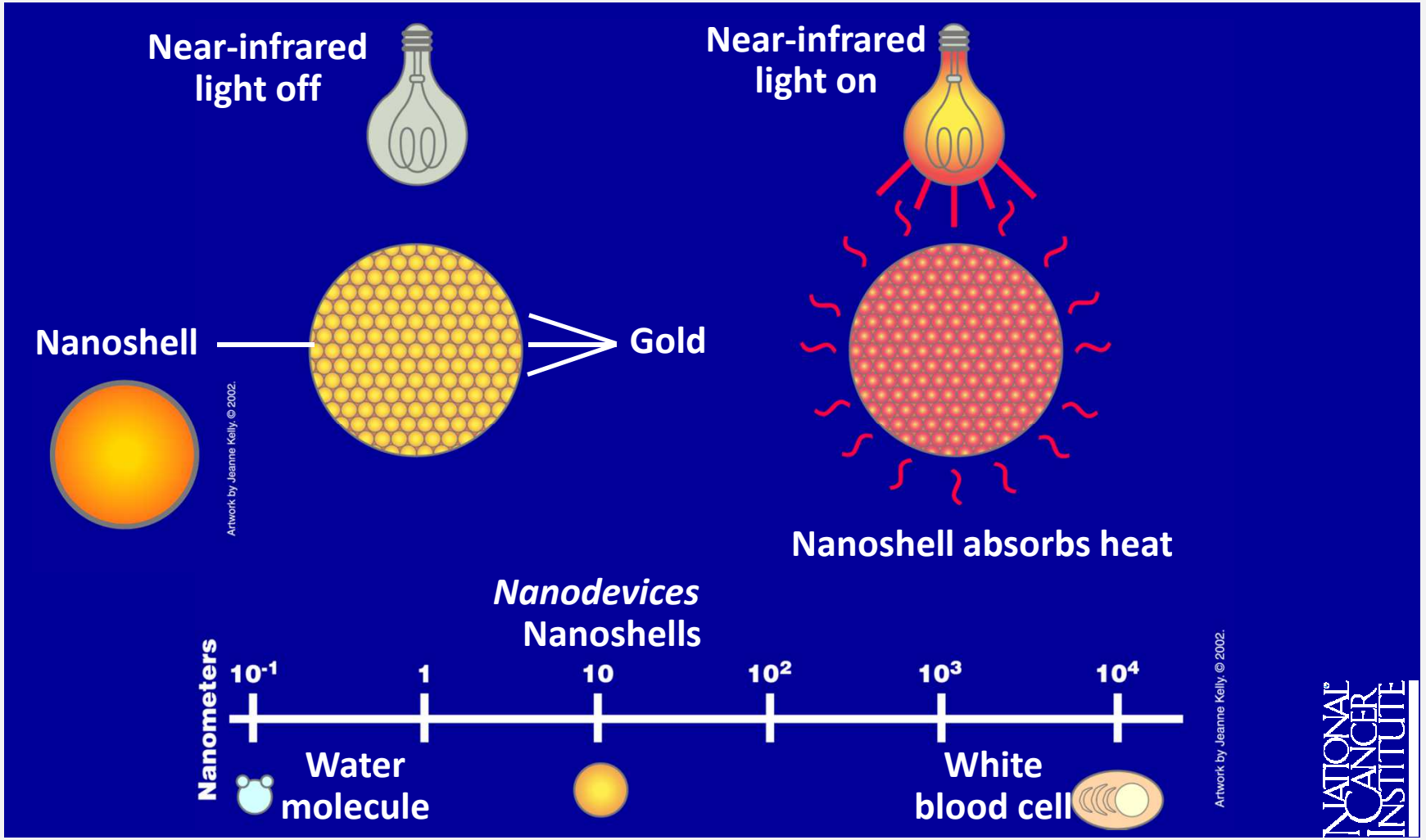


Bull's-eye. Red quantum dots injected into a live mouse mark the location of a tumor.

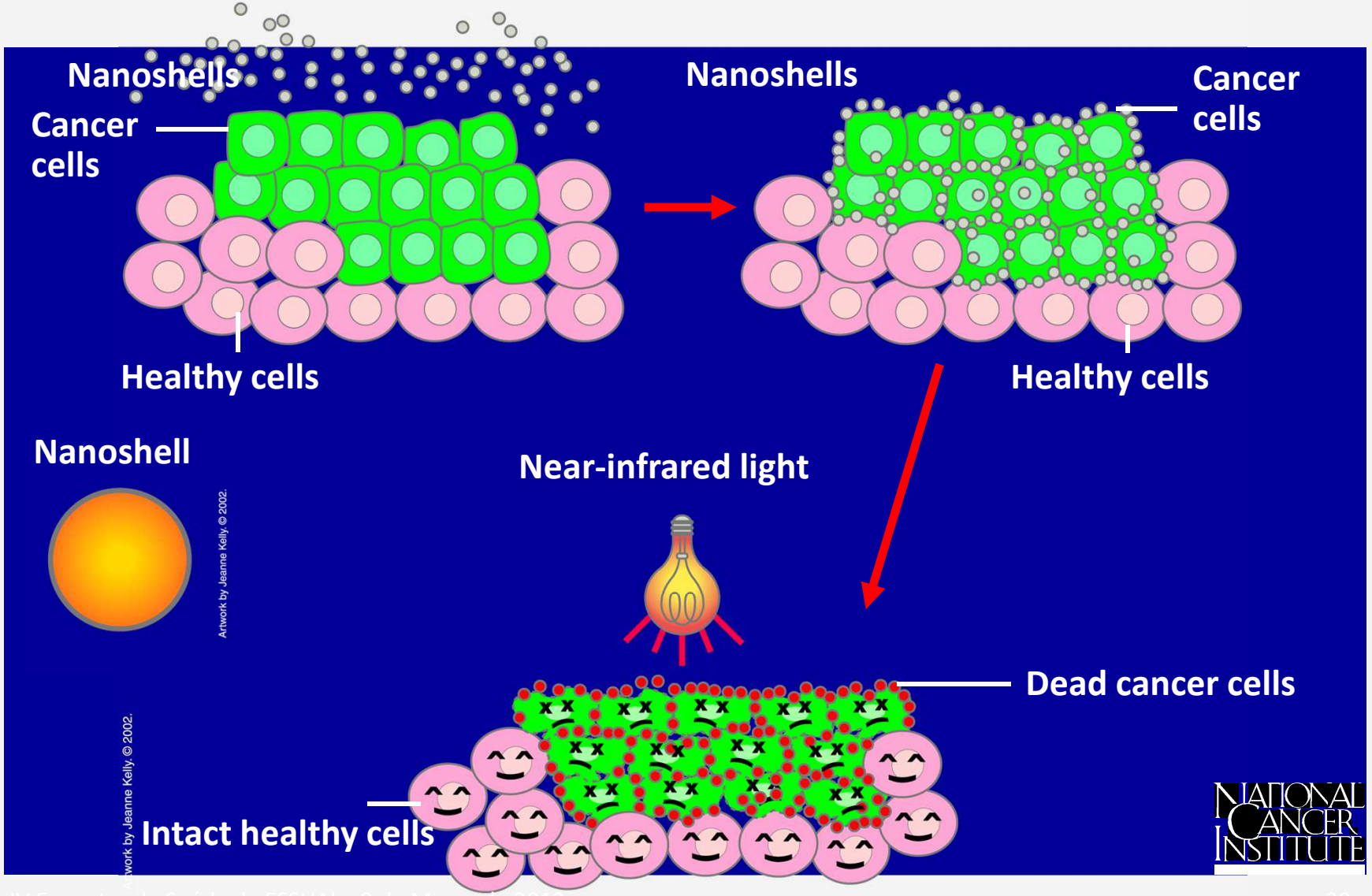
Foto: F. Fraenkel, MIT
Grupo de M. Bawendi, MIT

http://w3.ualg.pt/~jlongras/ocancro-e-quantum-dots.wmv

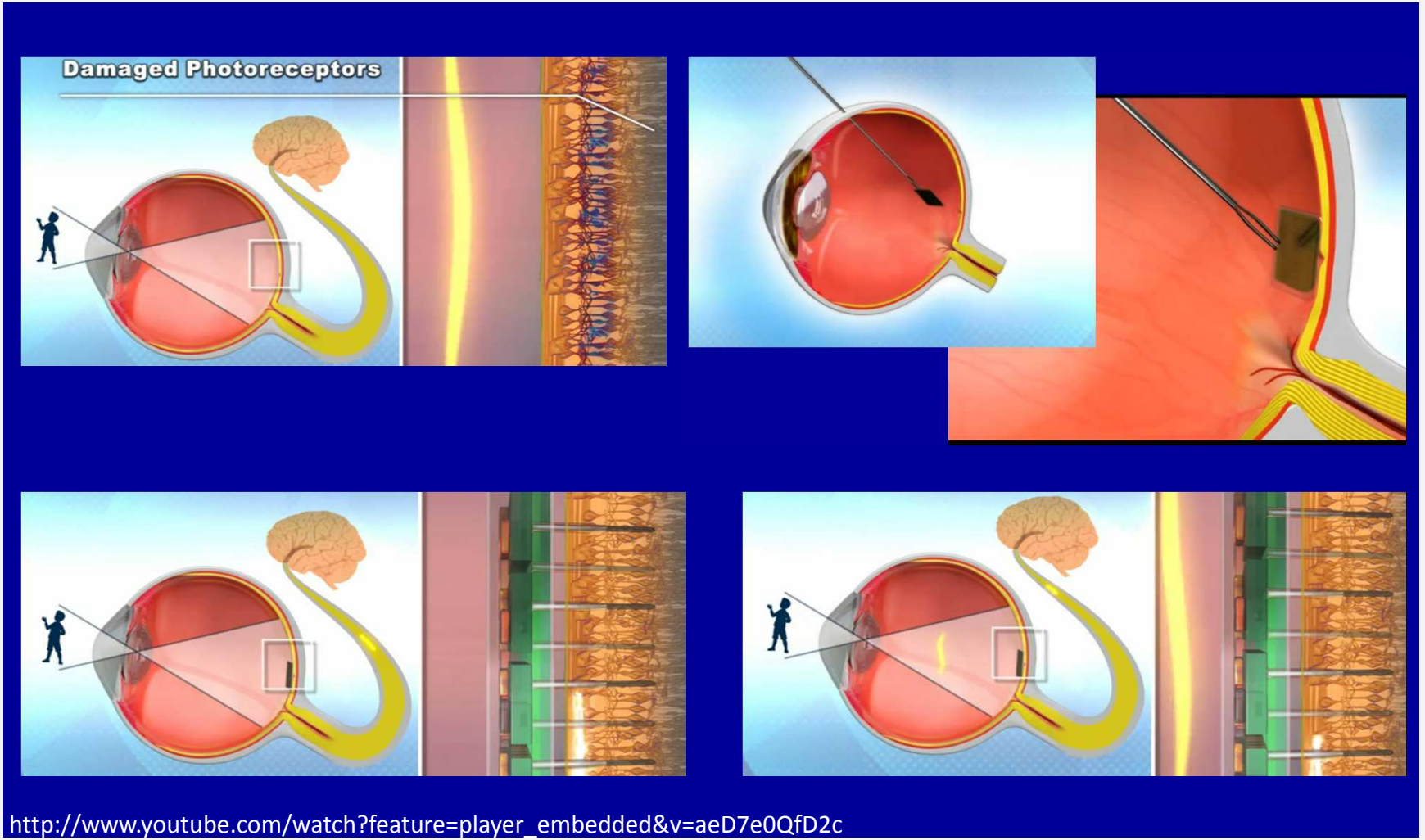
Nanopartículas metálicas



Aplicações: Eliminação de tumores

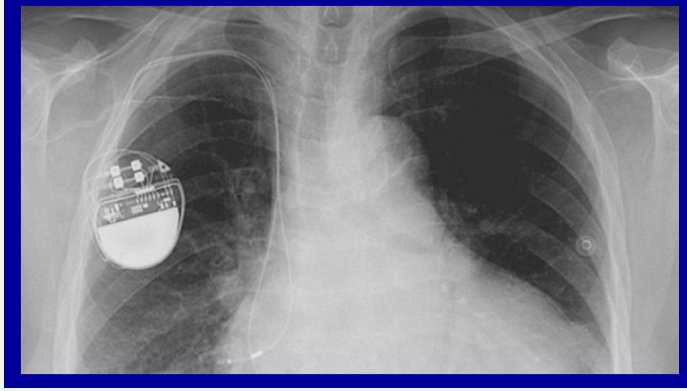


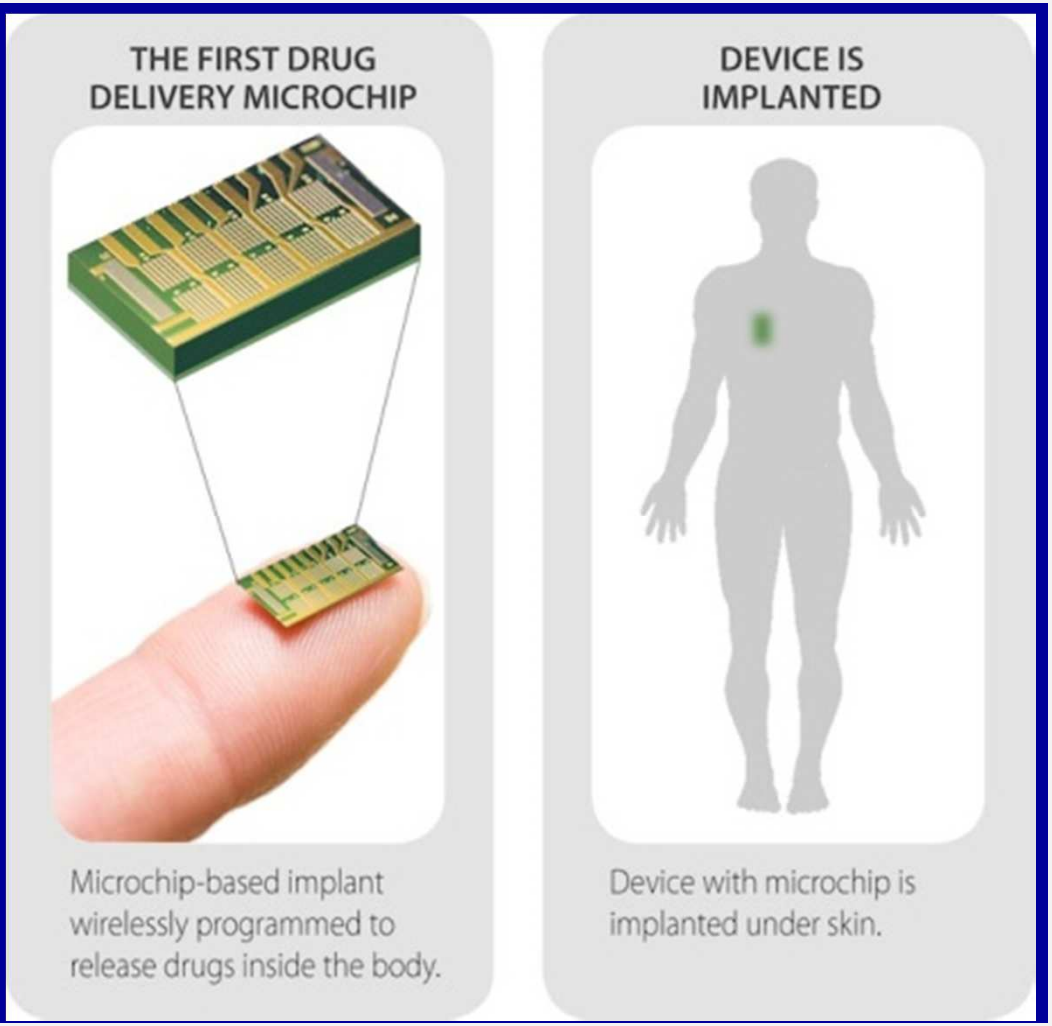
Nanoimplantes



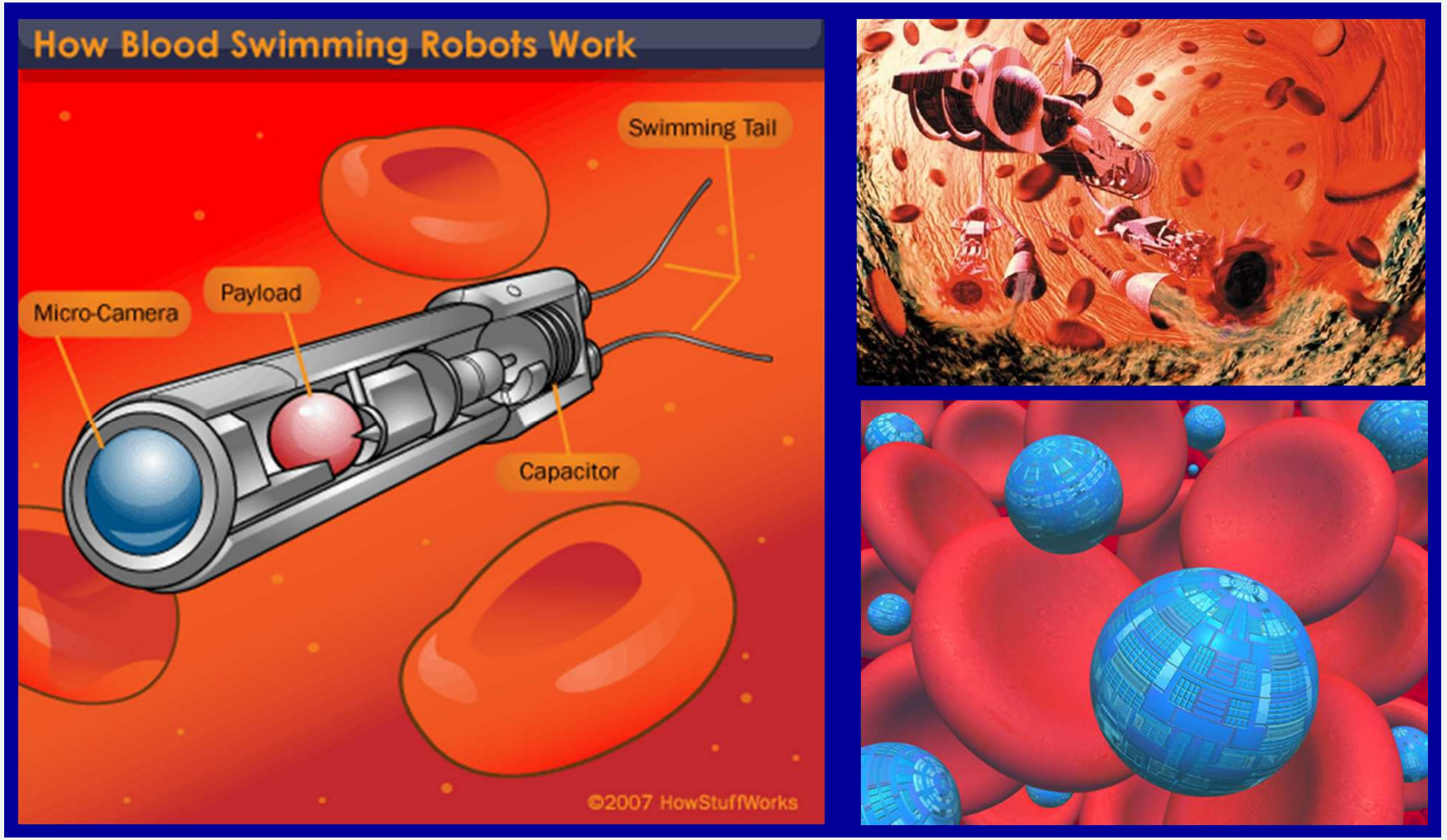
http://www.youtube.com/watch?feature=player_embedded&v=aeD7e0QfD2c

Implantes com *microchips*

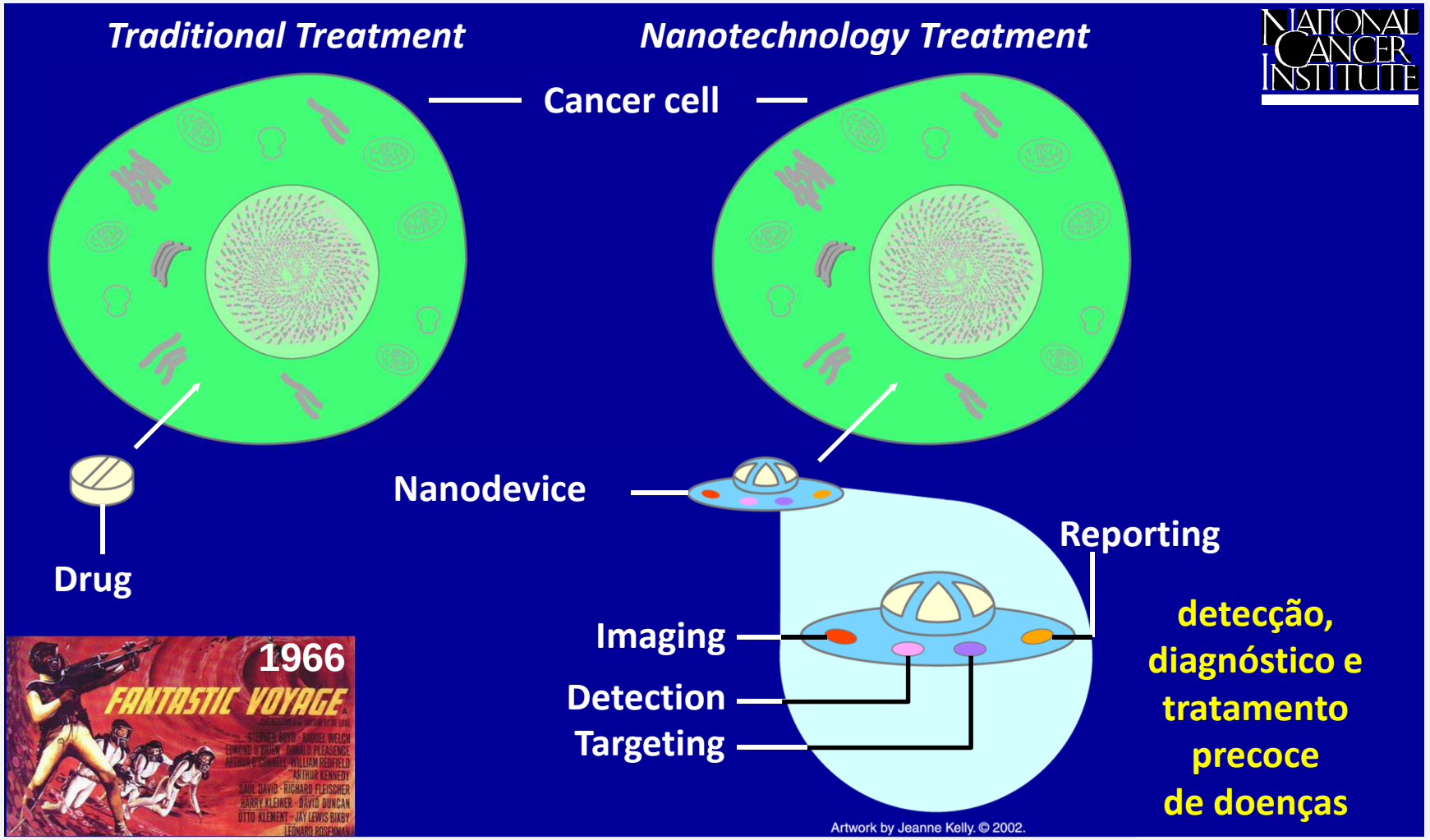




Nanorobôs

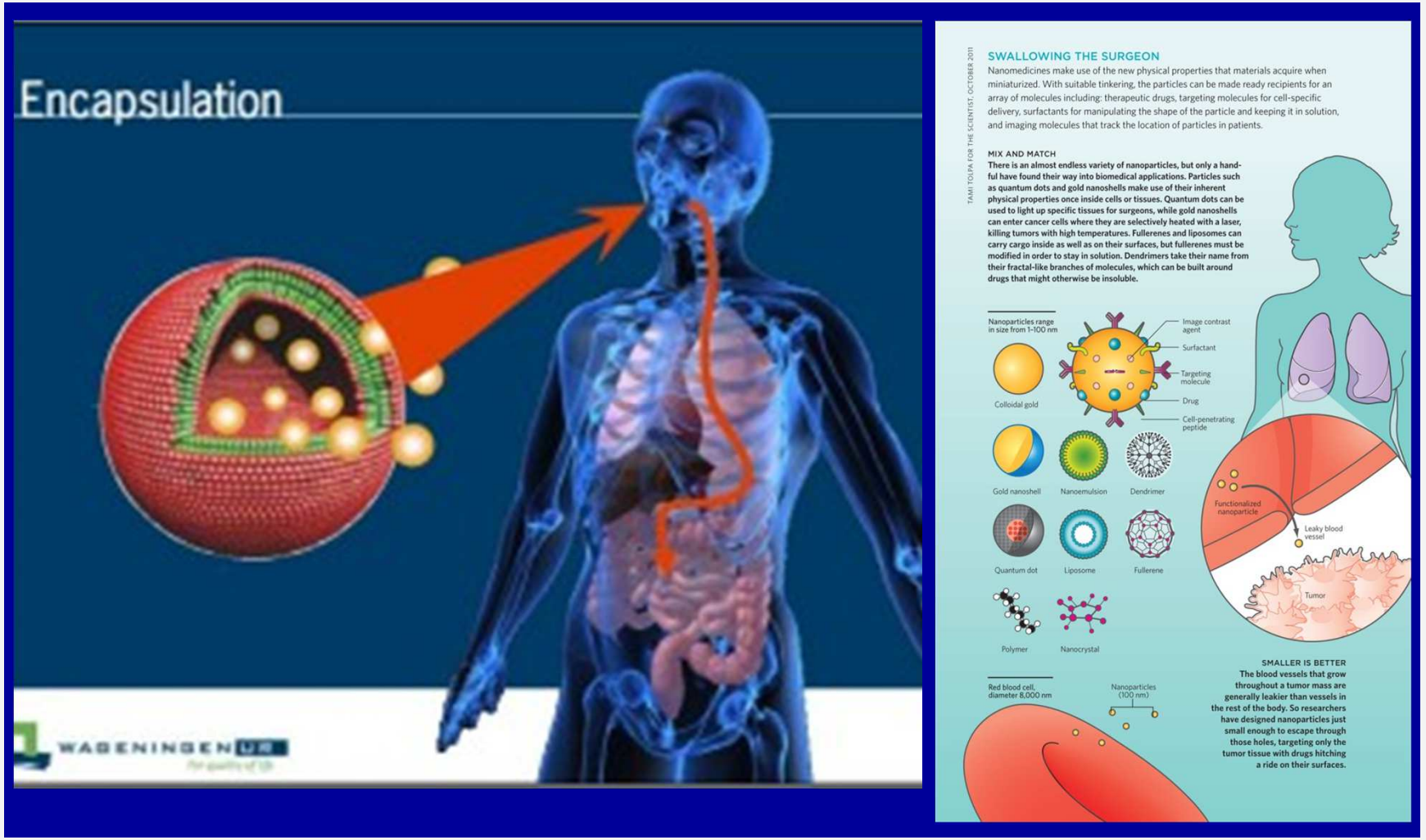

How Blood Swimming Robots Work
Swimming Tail
Payload
Micro-Camera
Capacitor
©2007 HowStuffWorks

Nanocirurgiões



http://www.youtube.com/watch?v=3o8vsU0Dw-4

Engolir o cirurgião

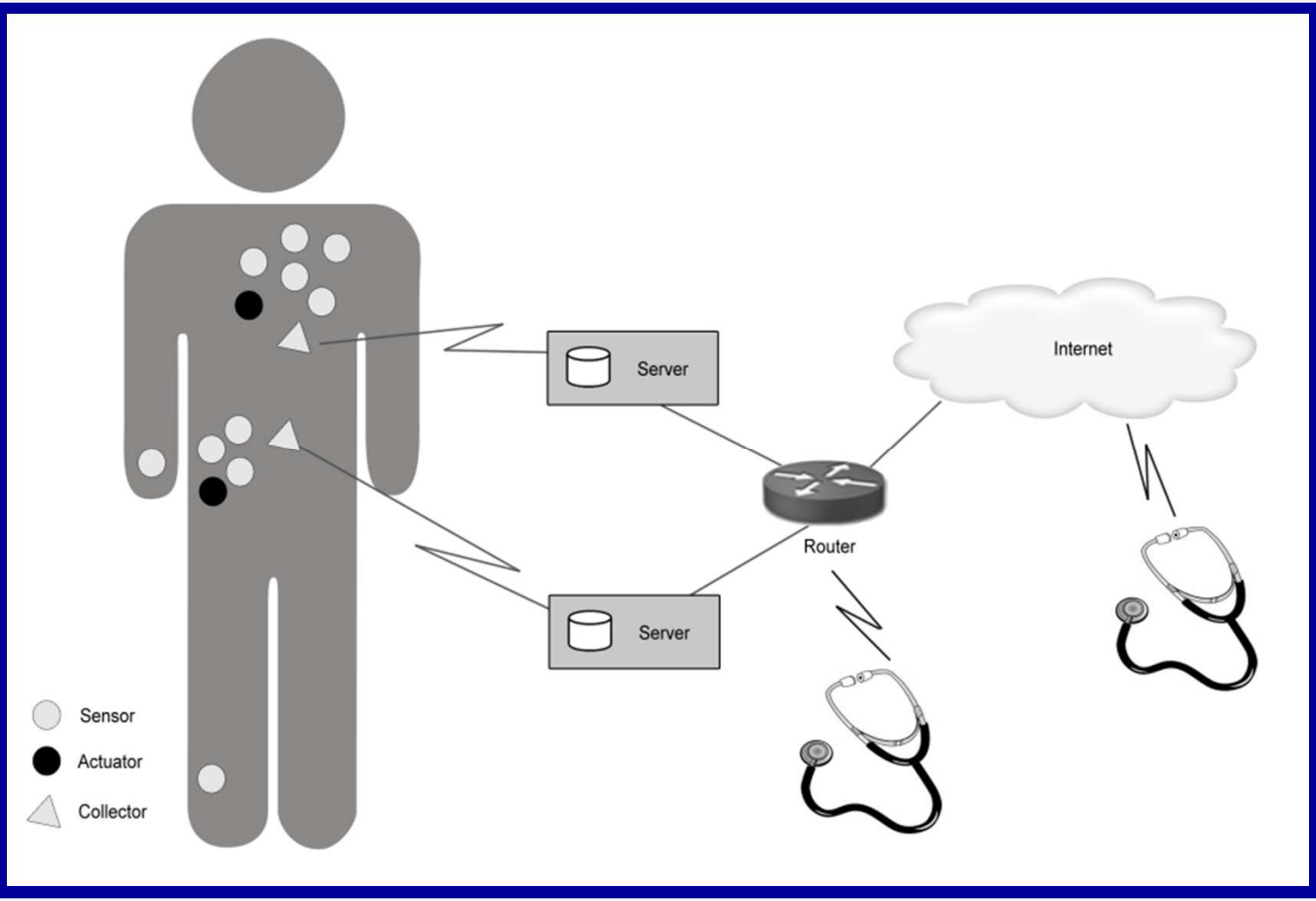


http://www.youtube.com/watch?v=YdjERhTczAs

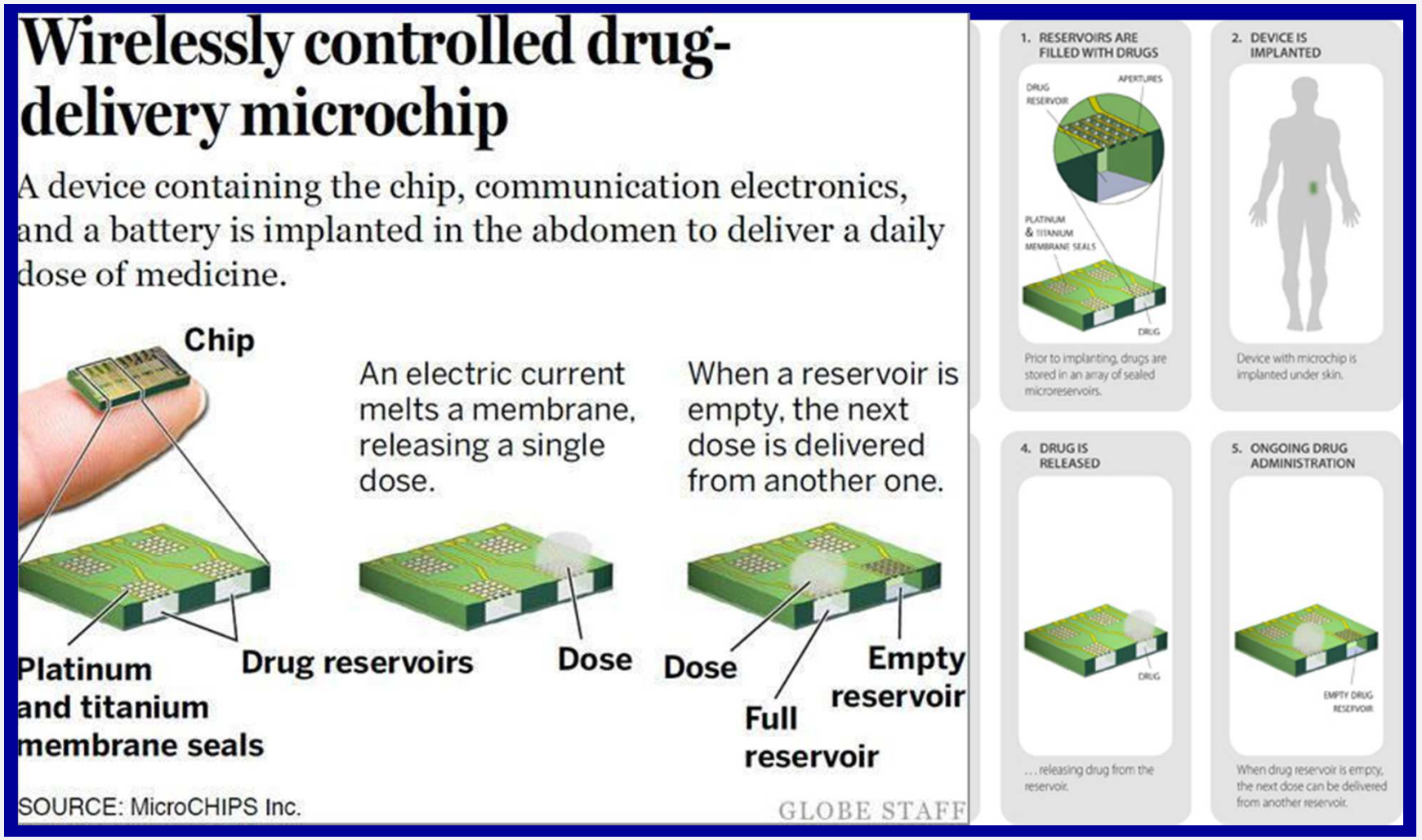
http://www.youtube.com/watch?v=FzFY5ms3AUc

Comunicações sem fios

Comunicação com o exterior



Comunicação com o exterior



Horizon 2020

Call: H2020-ICT-2014-1

Topic: ICT-06-2014

Smart optical and wireless network technologies

Innovative ultra-BROadband ubiquitous Wireless communications through terahertz transceivers

Proposal acronym: iBROW

We are pleased to inform you that the aforementioned proposal has been **favourably evaluated** by the Commission. Consequently, we wish to proceed to the preparation of the Grant Agreement based on your proposal.

(4.1) EU contribution requested in Proposal: 3,995,130.00 EUR
(4.2) Maximum EU grant amount attributed to the Action following evaluation: 3,995,130.00 EUR

Referências

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- http://pt.wikipedia.org/wiki/Nanotecnologia
- http://pt.wikipedia.org/wiki/Nanomedicina
- http://www.youtube.com/watch?v=K4PAVIWHIgw
- http://w3.ualg.pt/~jlongras/palestras.html#nano
- http://w3.ualg.pt/~jlongras/Entrevista-Mundus.pdf
- http://w3.ualg.pt/~jlongras/Nano.swf
- http://w3.ualg.pt/~jlongras/Quanta.swf
- http://w3.ualg.pt/~jlongras/nanomedicina/

Obrigado!