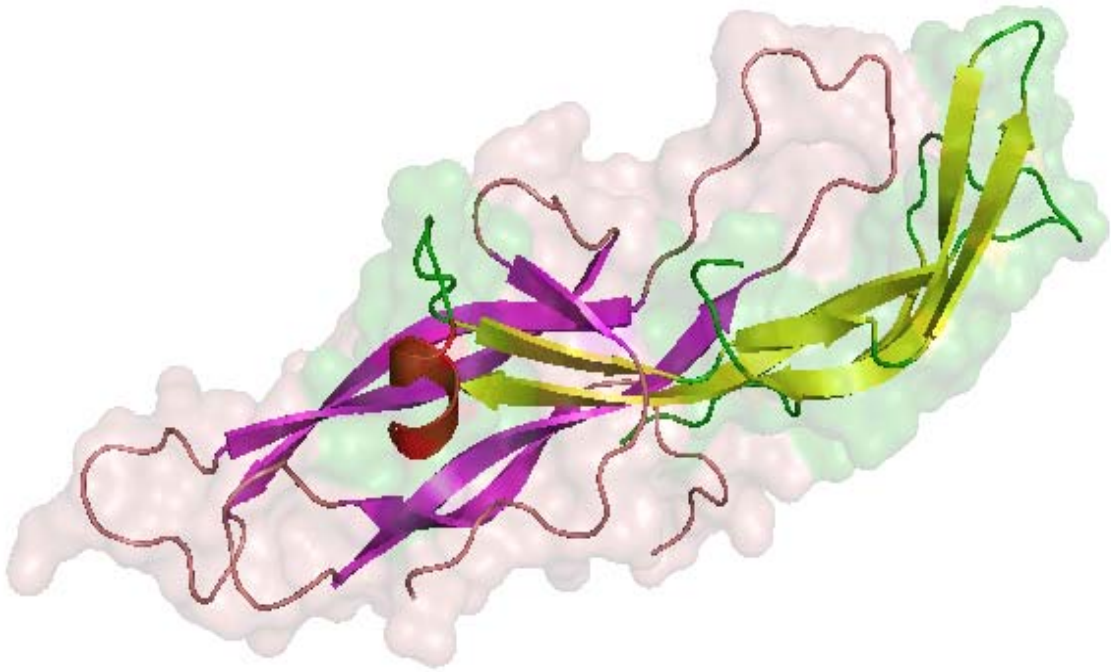
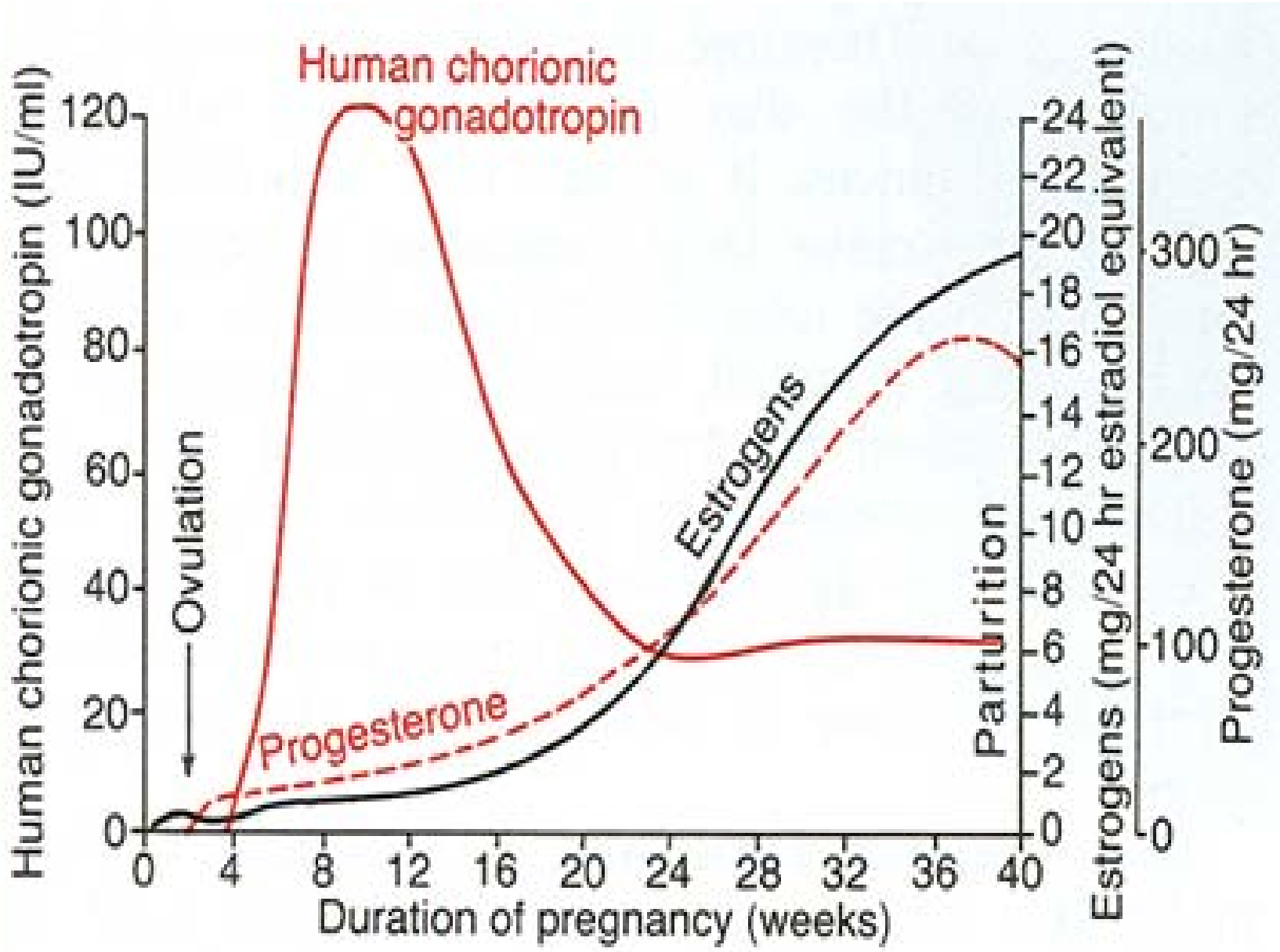
Gold Nanotechnology for Medical Diagnostics

Department of Chemistry
University of Liverpool

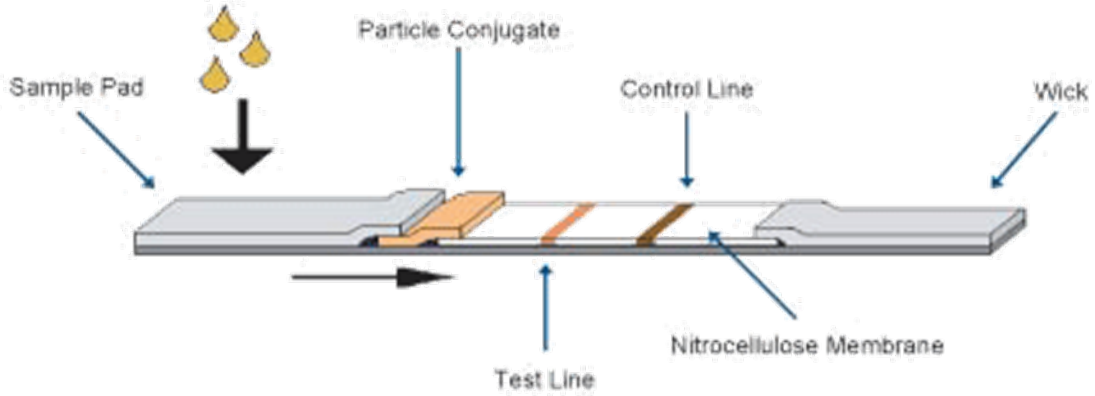
Pregnancy tests



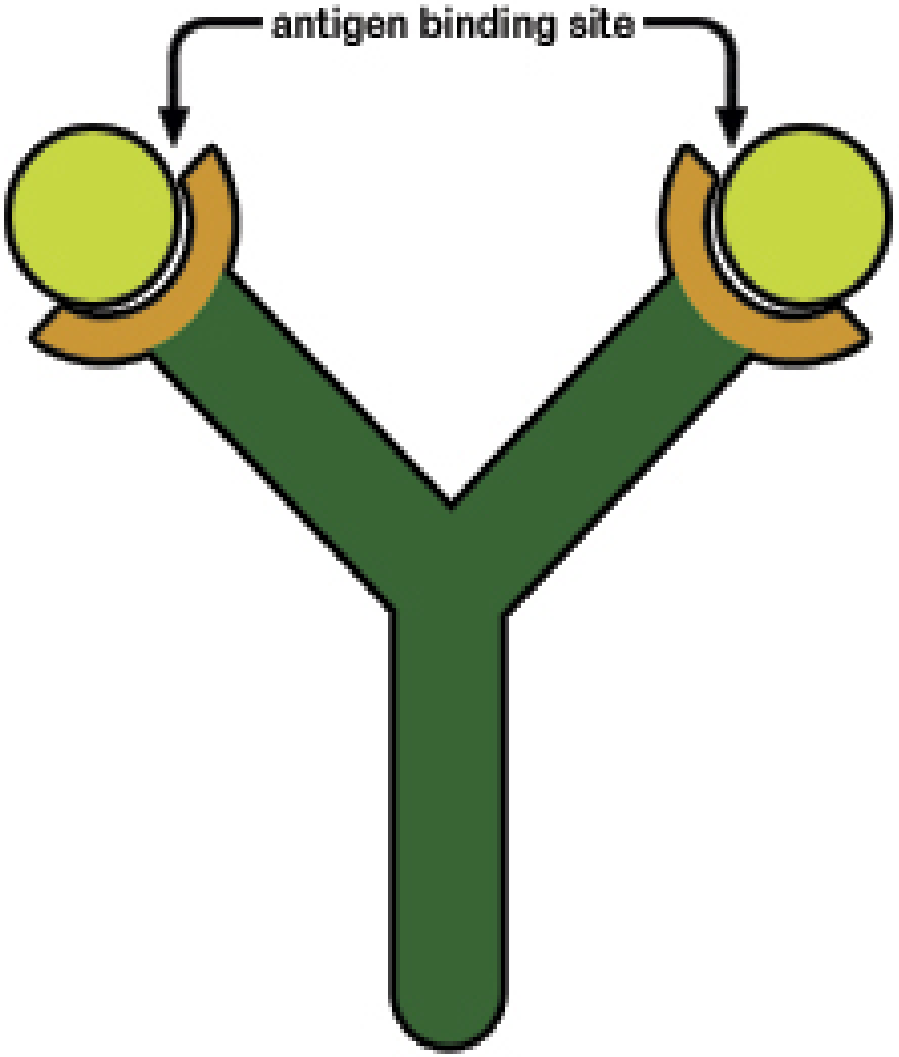
Human Chorionic Gonadotropin (hCG)


Human chorionic gonadotropin
Human chorionic gonadotropin (IU/ml)
120
100
80
60
40
20
0
Ovulation
Progesterone
Estrogens
Parturition
24
22
20
18
16
14
12
10
8
6
4
2
0
Estrogens (mg/24 hr estradiol equivalent)
300
200
100
0
Progesterone (mg/24 hr)
0 4 8 12 16 20 24 28 32 36 40
Duration of pregnancy (weeks)

Typical Lateral-Flow Assay Format

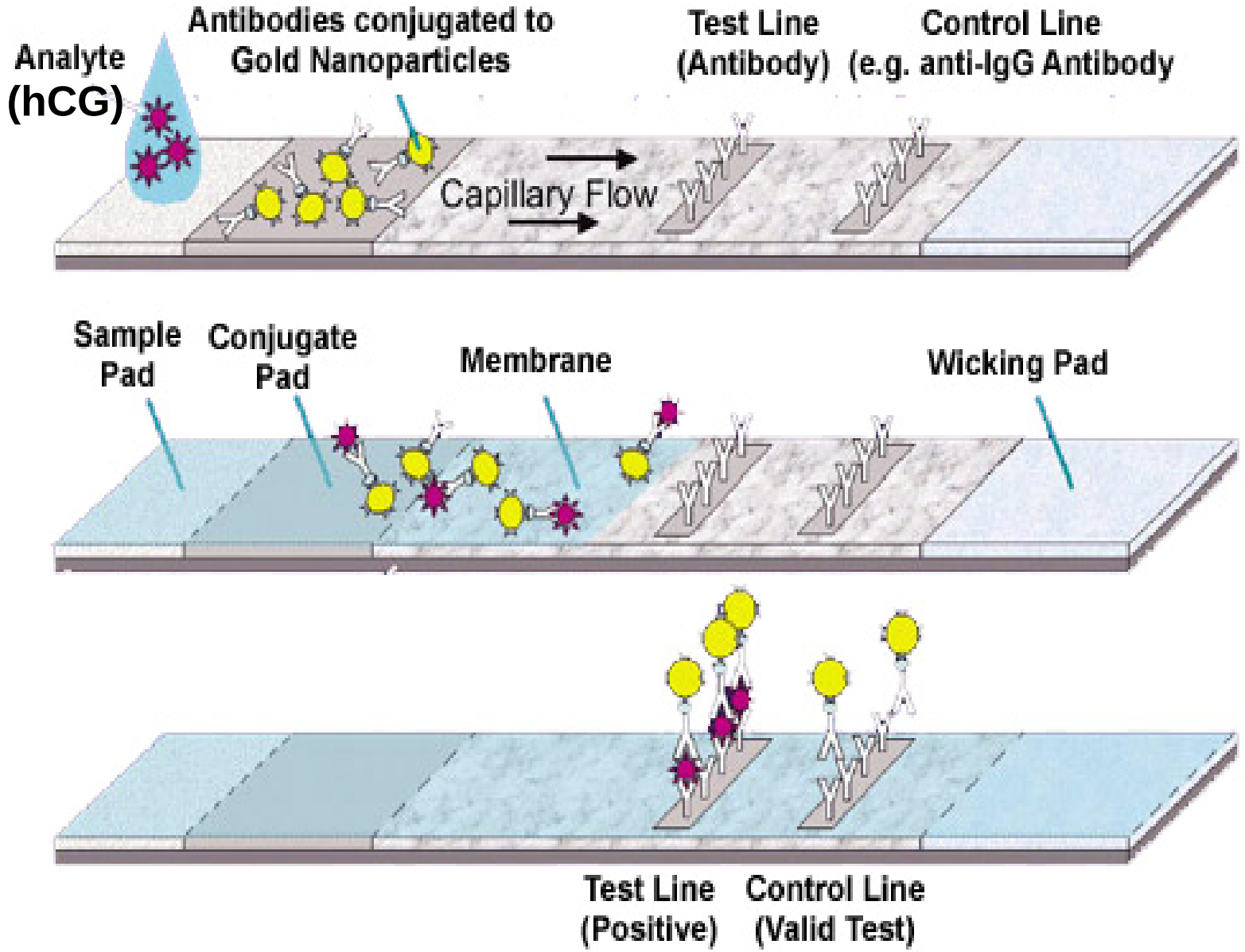


Antibody Molecule



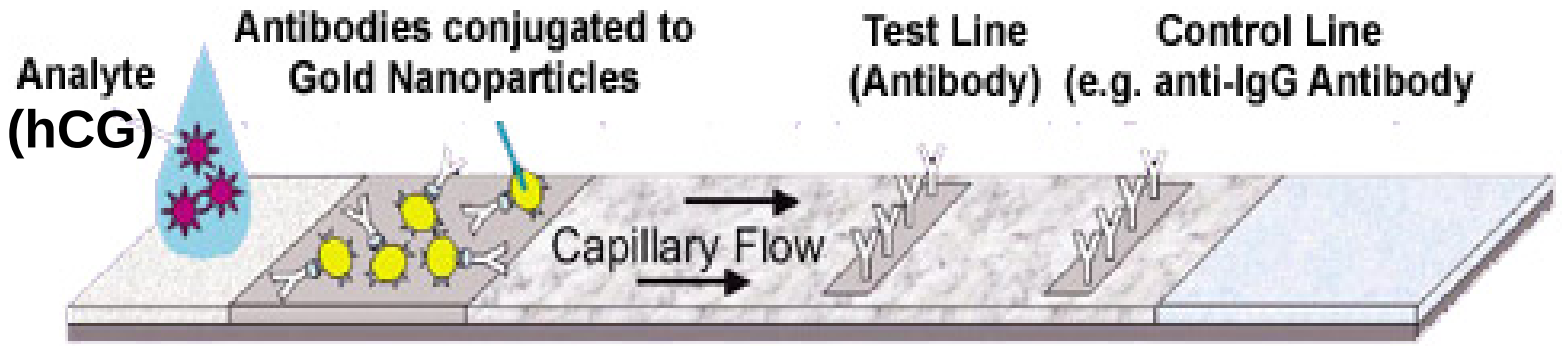
Antibodies are proteins that are produced by the body to fight the intrusion of foreign molecules, such as toxins or other poisons. The antibodies are designed to bind very tightly to their target molecules (i.e., the antigens).

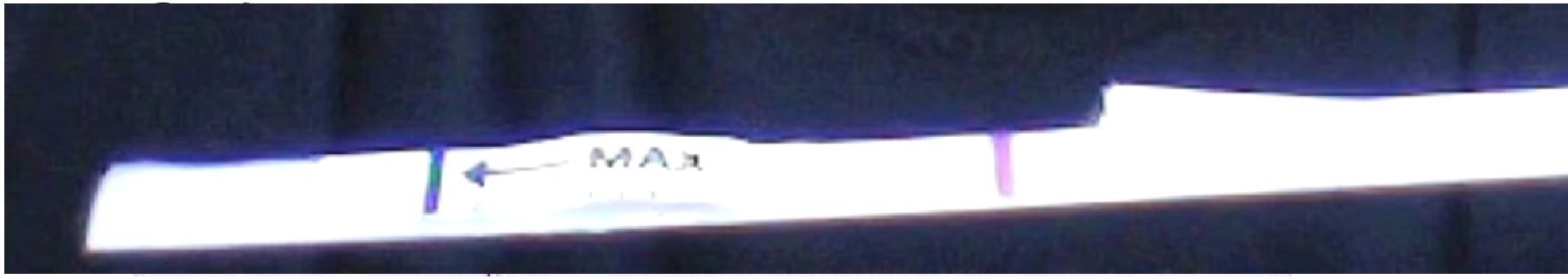
Lateral Flow Assay Architecture

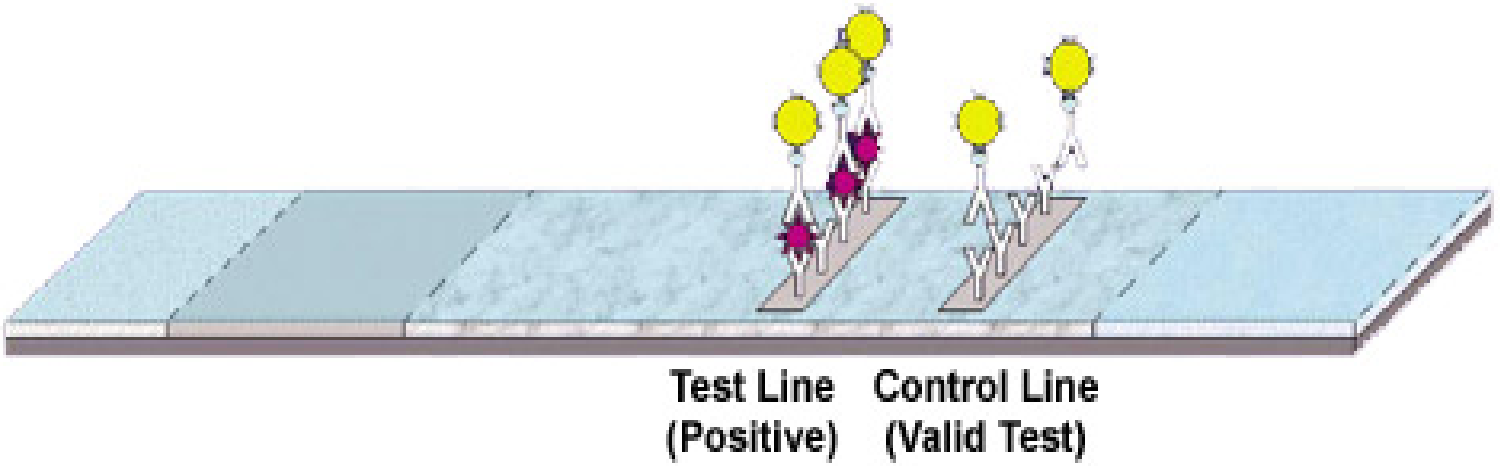


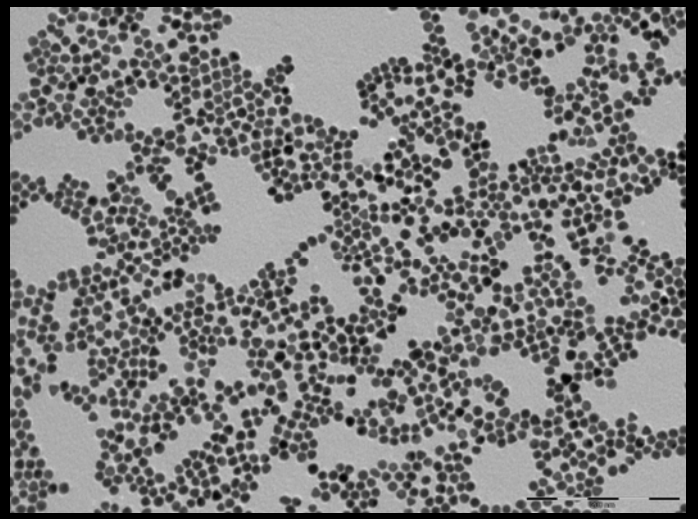

MAX

Lateral Flow Assay Architecture









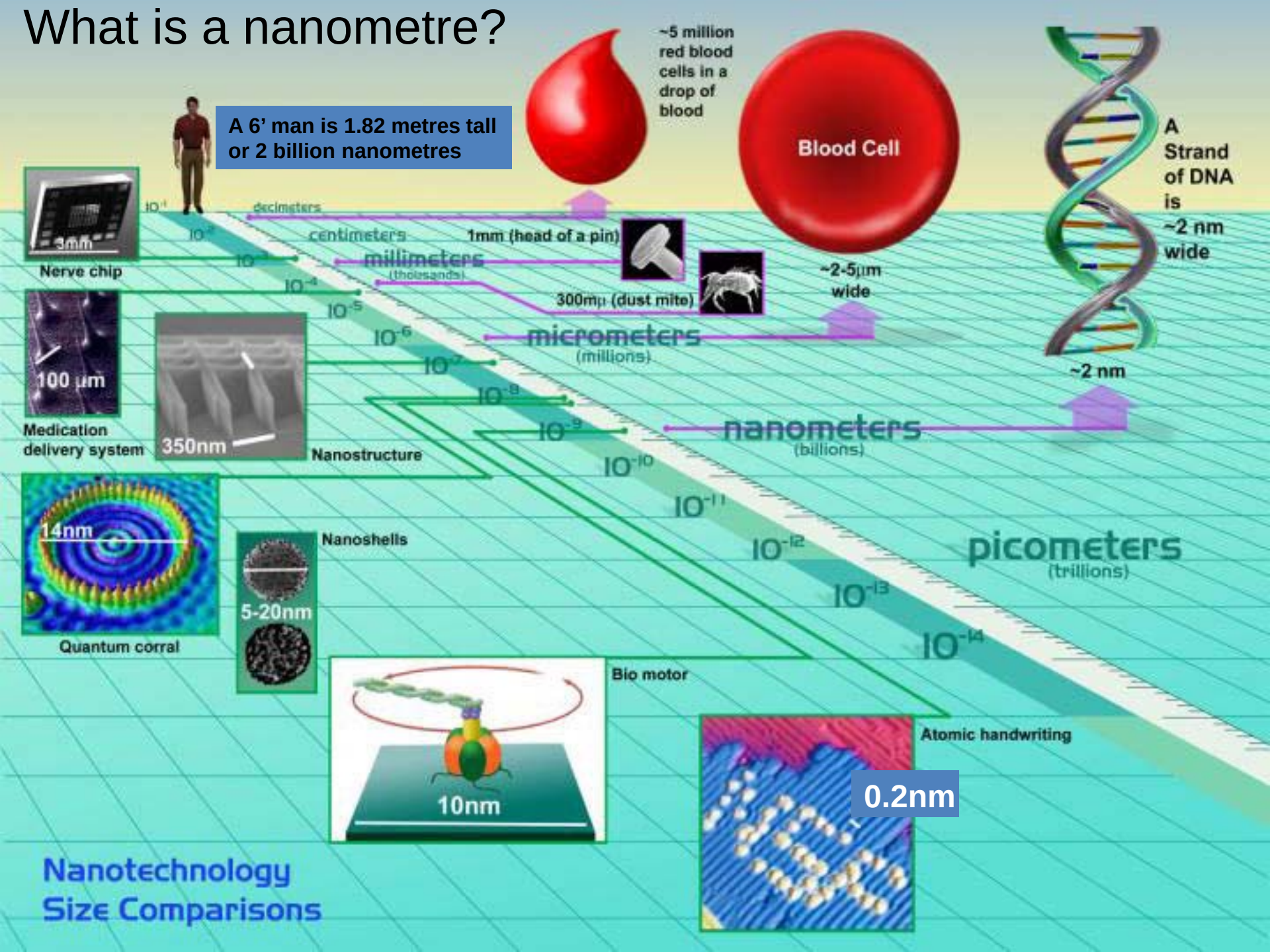
What are gold nanoparticles?

How can they be made?

Why can we not use a much cheaper metal instead?

What else can be done with these particles?

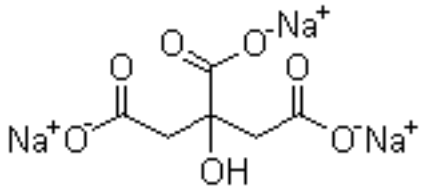
What is a nanometre?



How are gold nanoparticles made?

Aqueous Solution $HAuCl_4$

Aqueous Solution Trisodium Citrate



Turkevich, J.; Stevenson, P. L. ; Hillier, J. Discuss. Faraday Soc. **1951**, 11, 55.

Why is gold used?


Optical Properties

Plasmon Resonance

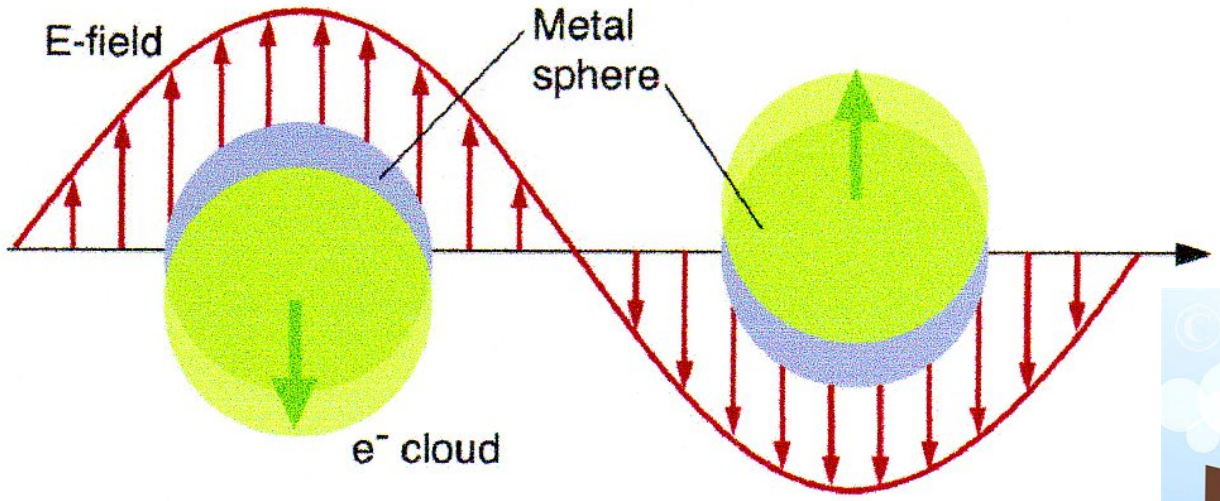
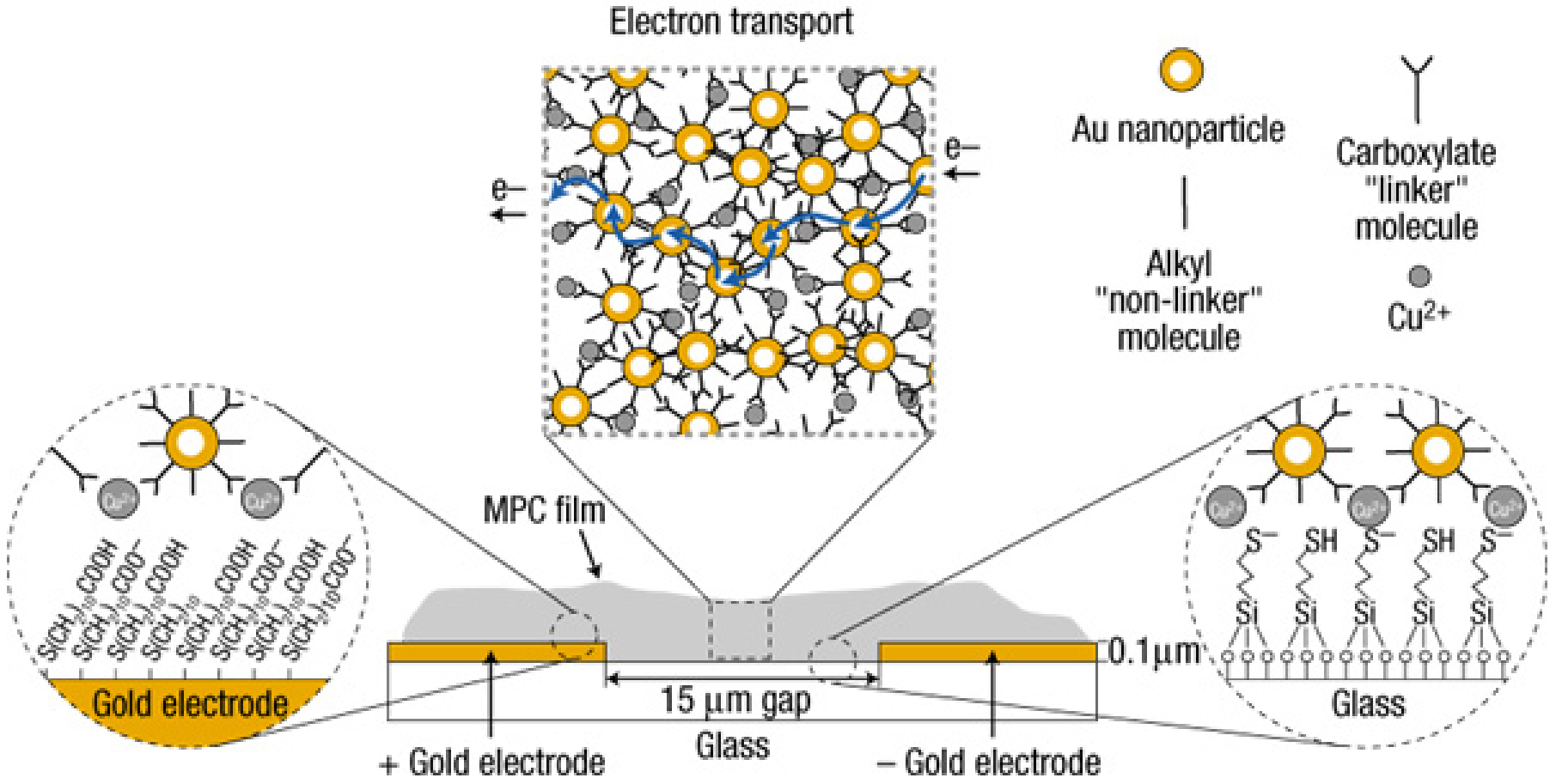
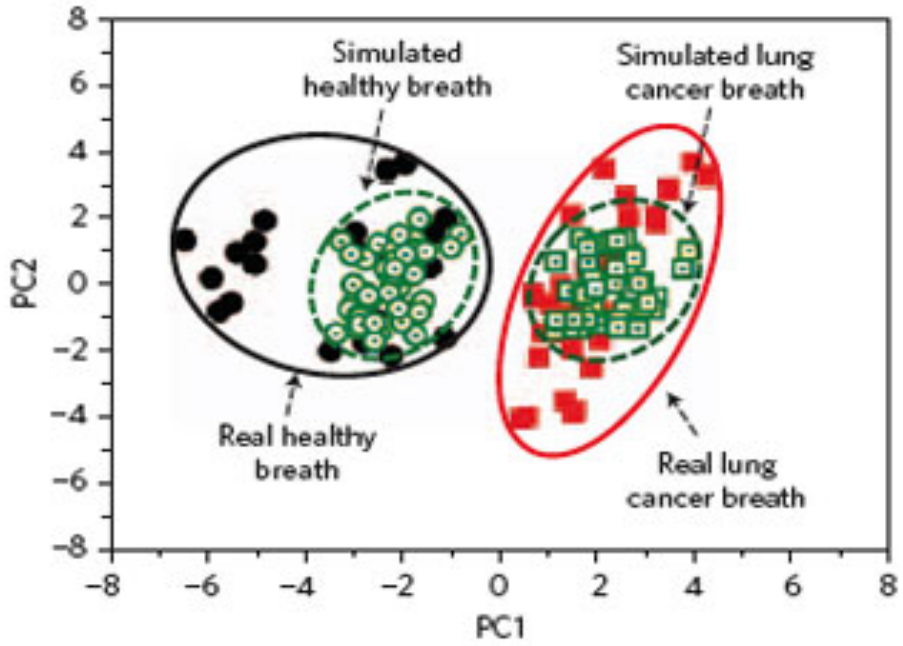


Fig. 1 Schematic of the interaction of a metal nanosphere with light. The electromagnetic field of the light induces a coherent dipolar oscillation of th metal conduction electrons across the nanoparticle. (Reprinted with permiss from[25]. © 2003 American Chemical Society.)

What else can gold nanoparticles do?

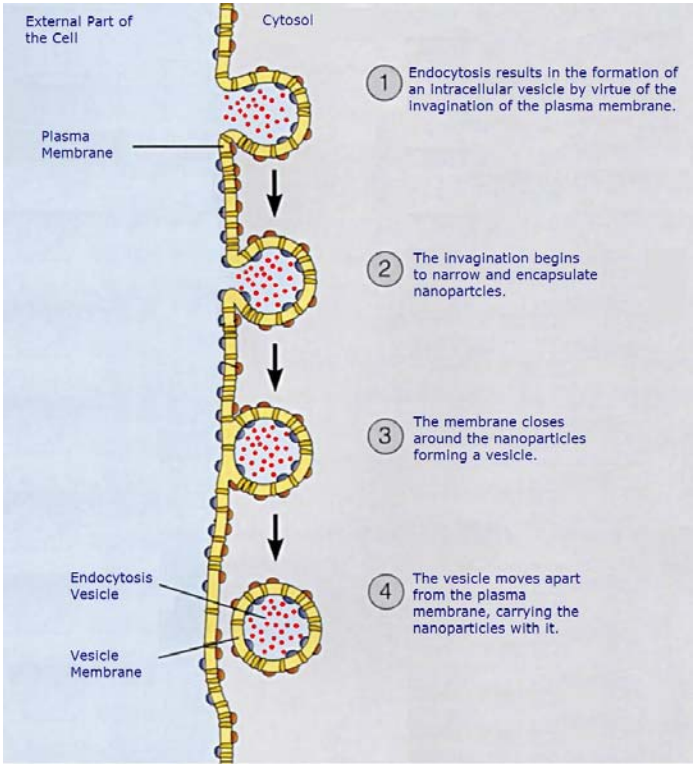


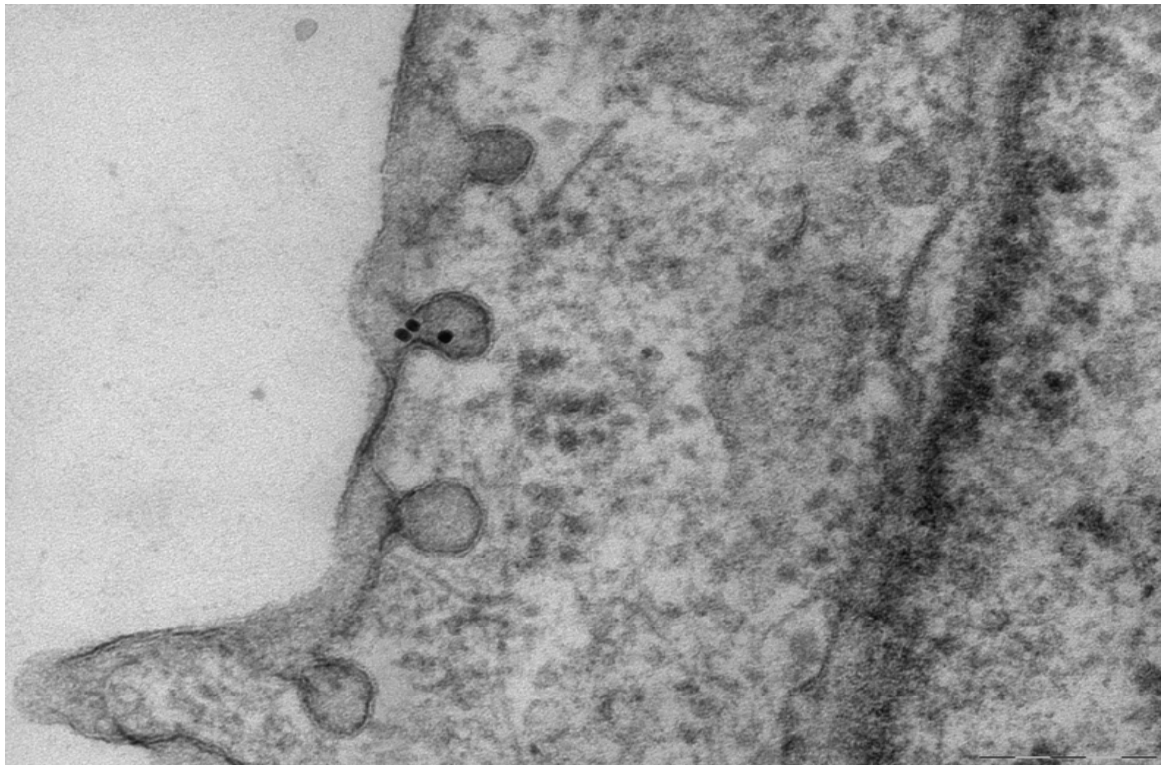
Artificial nose for lung cancer diagnostics



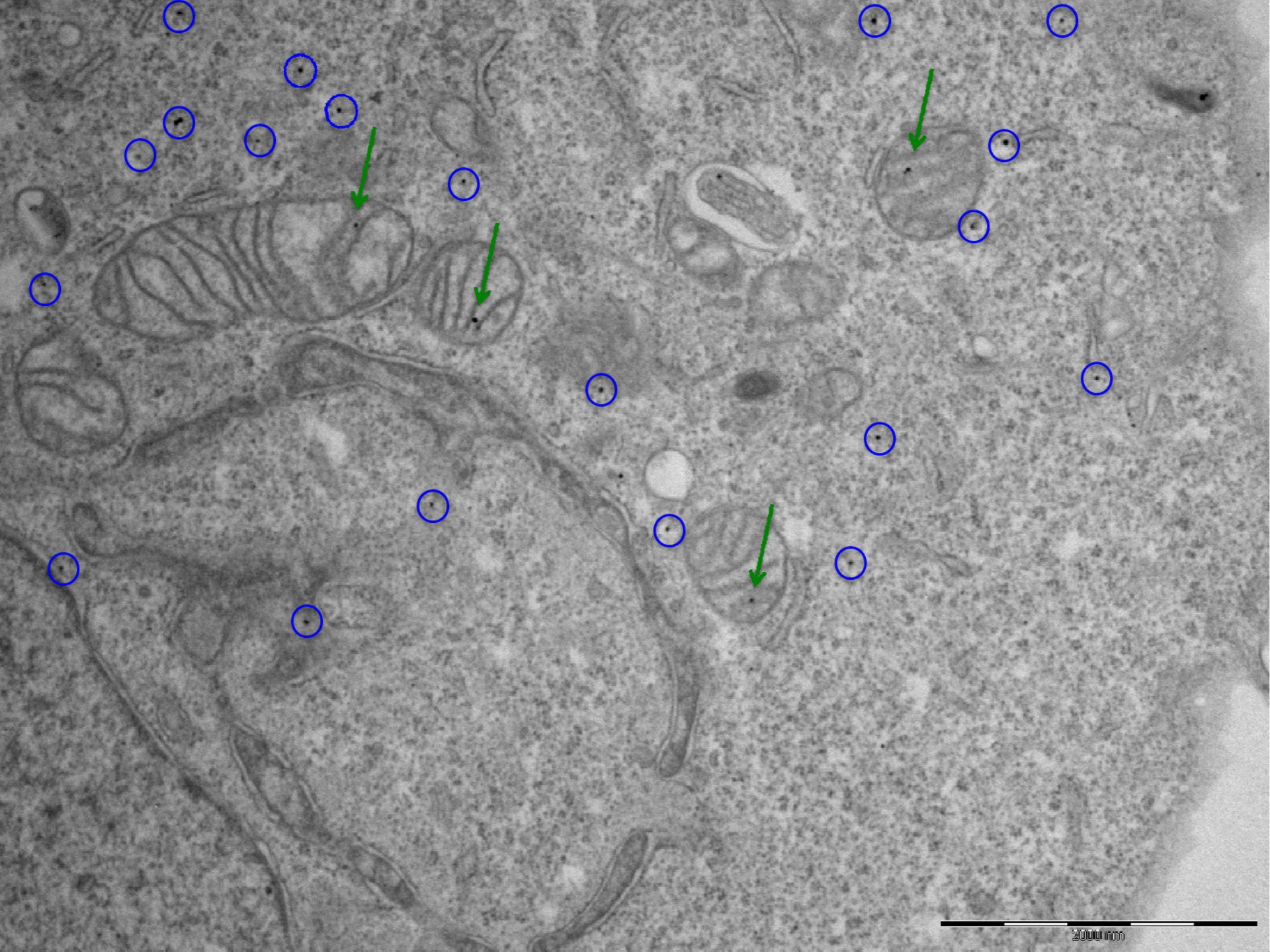
Hossam Haick *et al. Nature Nanotechnology* ***4, 669 - 673 (2009)***

Can they also be used to treat cancer?

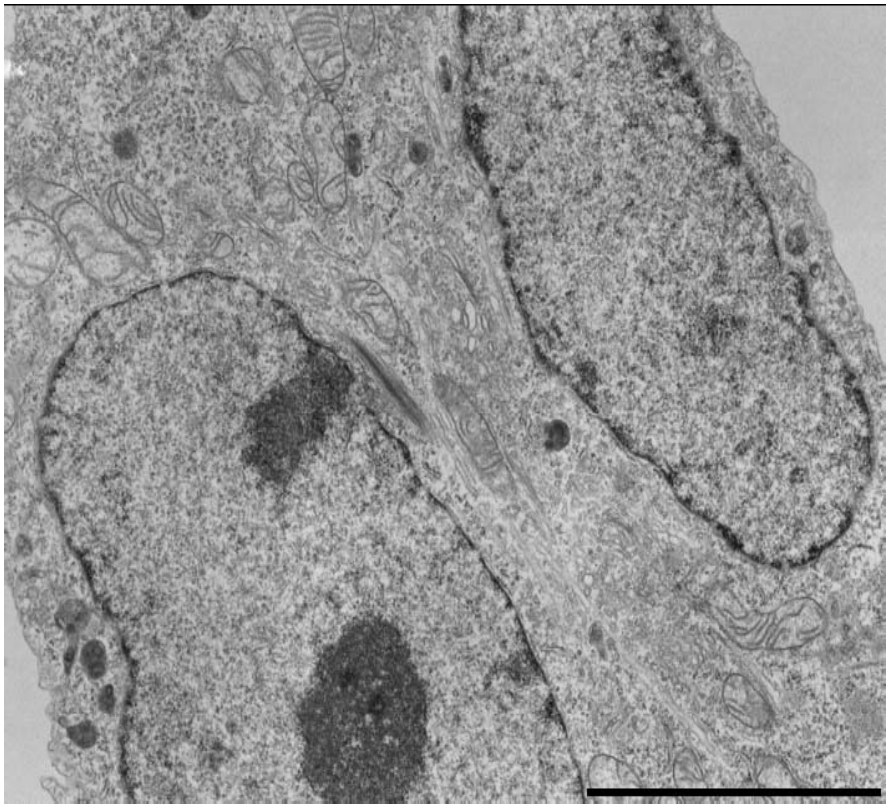


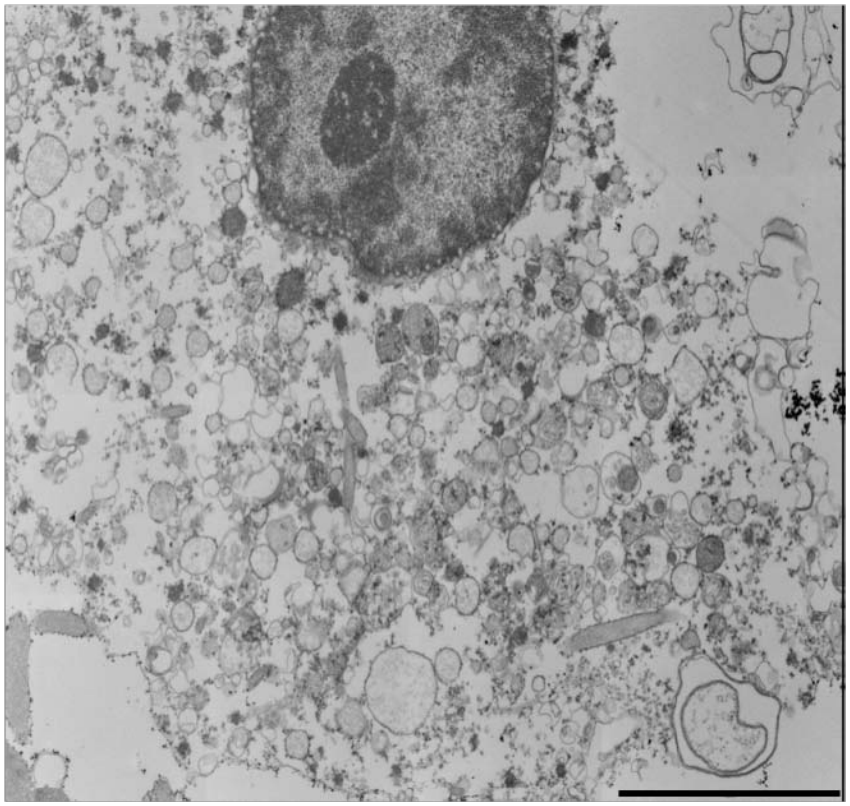


Endocytosis


200 nm

Photodynamic therapy





Intact cancer cells (left) and completely obliterated ones (right) after exposure to a laser beam that interacts with gold nanoparticles inside the cell.

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Thank you for your attention