

PLANEAMENTO DAS AULAS

AULA 1 (02.03) – INÍCIO DOS TESTES DE ECOTOXICOLOGIA

AULA 2 (09.03) – EFEITOS DO BEZAFIBRATO NA GERMINAÇÃO DOS ORGANISMOS TESTE (TAXAS DE INIBIÇÃO E CONSTANTES DE INIBIÇÃO IC50)

AULA 3 (16.03) – MARCADORES BIOFÍSICOS DE TOXICIDADE I

AULA 4 (23.03) – MARCADORES BIOFÍSICOS DE TOXICIDADE II

AULA 5 (06.04) – ANÁLISE ESTATÍSTICA MULTIVARIADA E ÍNDICES FOTOQUÍMICOS (TEÓRICO-PRÁTICA)

AULA 5 (13.04) - MARCADORES BIOQUÍMICOS DE TOXICIDADE I – PIGMENTOS VEGETAIS

AULA 6 (20.04) – MARCADORES BIOQUÍMICOS DE TOXICIDADE II – PIGMENTOS VEGETAIS II

AULA 7 (27.04) - MARCADORES BIOQUÍMICOS DE TOXICIDADE III – DANO MEMBRANAR

AULA 8 (04.05) – MARCADORES BIOQUÍMICOS DE TOXICIDADE IV – DANO MEMBRANAR

AULA 9 (11.05) – OCEAN METAGENOMICS

AULA 10 (18.05) - NANOTOXICOLOGIA

random][pLasatd

NANOTECHNOLOGY VS NANOTOXICOLOGY

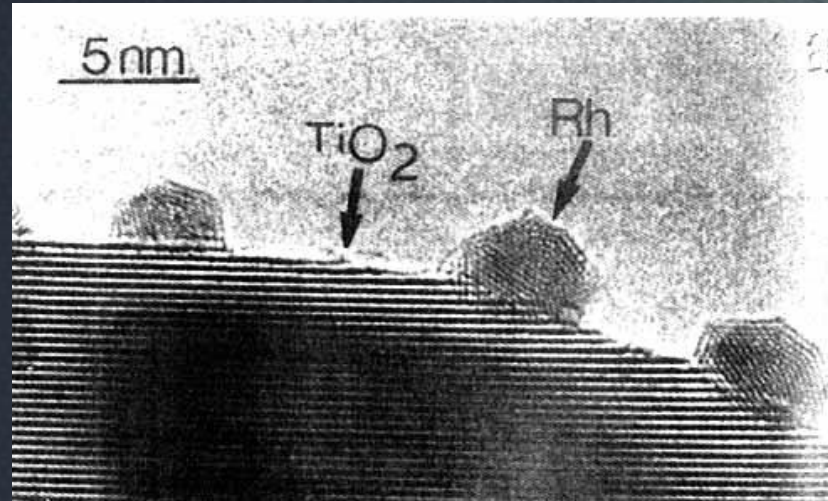
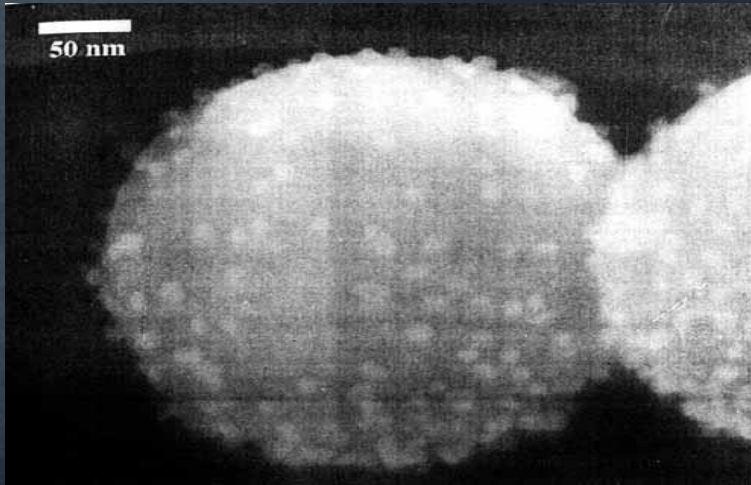
NANOTECHNOLOGY IS THE UNDERSTANDING AND CONTROL OF MATTER AT DIMENSIONS BETWEEN APPROXIMATELY 1 AND 100 NANOMETERS (NM), WHERE UNIQUE PHENOMENA ENABLE NOVEL APPLICATIONS.

NANOTOXICITY RESEARCH IS INTENDED TO DETERMINE WHETHER OR NOT NANO PARTICLES ARE HARMFUL TO THE ENVIRONMENT AND TO HUMANS.

random][pLasatd



TiO₂ AND SiO₂ ARE NANOPARTICLES FOUND IN SUNSCREEN. TESTING THESE TWO NANOPARTICLES COULD HELP KEEP PEOPLE SAFE.



Chemically, DNA consists of two complementary strands of opposite polarity. Each strand is a long polymer of nucleotides, which are the building blocks of DNA. The two strands are held together by hydrogen bonds between the nitrogenous bases of the two strands. The sequence of these bases is the genetic information. The information is passed on to the next generation by the process of DNA replication. The process of DNA replication is a complex process that involves many steps. The first step is the unwinding of the DNA double helix. This is done by an enzyme called DNA helicase. The next step is the synthesis of a new strand. This is done by an enzyme called DNA polymerase. The final step is the proofreading of the new strand. This is done by an enzyme called DNA proofreading. The process of DNA replication is a highly accurate process. The error rate is very low. This is because the DNA polymerase has a built-in proofreading mechanism. If an error is made, the polymerase will stop and correct the error. This is how the genetic information is passed on to the next generation.

Chemically, DNA consists of two complementary strands of opposite polarity. Each strand is a long polymer of nucleotides, which are the building blocks of DNA. The two strands are held together by hydrogen bonds between the nitrogenous bases of the two strands. The sequence of these bases is the genetic information. The information is passed on to the next generation by the process of DNA replication. The process of DNA replication is a complex process that involves many steps. The first step is the unwinding of the DNA double helix. This is done by an enzyme called DNA helicase. The next step is the synthesis of a new strand. This is done by an enzyme called DNA polymerase. The final step is the proofreading of the new strand. This is done by an enzyme called DNA proofreading. The process of DNA replication is a highly accurate process. The error rate is very low. This is because the DNA polymerase has a built-in proofreading mechanism. If an error is made, the polymerase will stop and correct the error. This is how the genetic information is passed on to the next generation.

random][pLasatd

Within cells, DNA is organized into long, thin structures called chromosomes. These chromosomes are made up of DNA and proteins. The DNA is wrapped around proteins called histones. This wrapping is called chromatin. The chromosomes are made up of many chromosomes. Each chromosome is a long, thin structure. The chromosomes are made up of DNA and proteins. The DNA is wrapped around proteins called histones. This wrapping is called chromatin. The chromosomes are made up of many chromosomes. Each chromosome is a long, thin structure. The chromosomes are made up of DNA and proteins. The DNA is wrapped around proteins called histones. This wrapping is called chromatin. The chromosomes are made up of many chromosomes. Each chromosome is a long, thin structure.



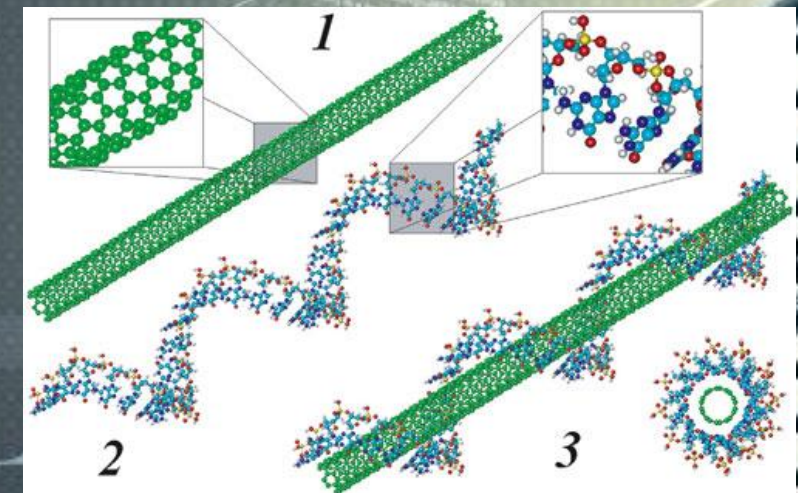
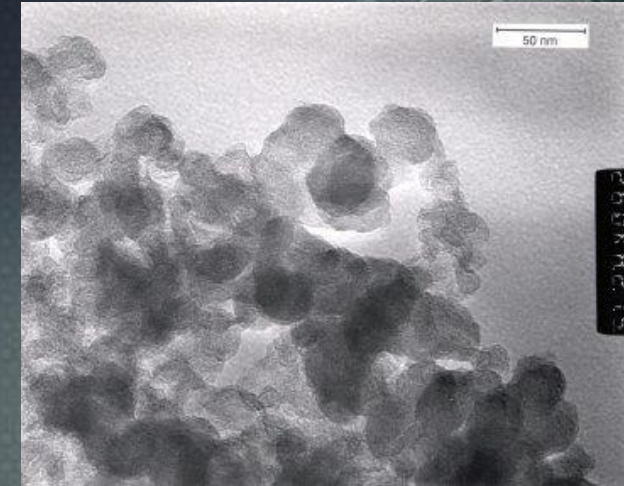
WHY HAVE SPECIAL CONCERNS WITH NANOPARTICLES?

ANALOGY TO FINE PARTICLE POLLUTION

ABILITY TO MOVE AROUND THE BODY

POSSIBLE SHARED MECHANISMS OF TOXICITY

SIZE IS UNIQUELY SUITED TO INTERACT WITH BIOLOGICAL MACHINERY



CLOTHING COVERED IN NANO-ZINC OXIDE WIRES COULD POWER DEVICES.

(NATURE, FEB 2008)

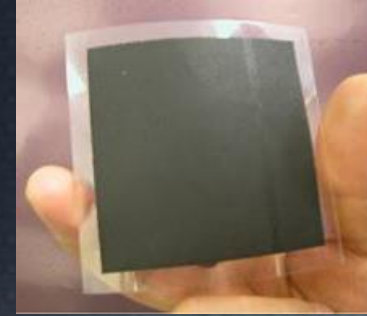
*IRON NANOPARTICLES CAN DECONTAMINATE SOLVENT-SOAKED SOIL UP TO
1,000 TIMES FASTER THAN A CONVENTIONAL IRON MIXTURE.*

*IMPROVED HYDROGEN-FUEL CELLS, LITHIUM-ION BATTERIES, AND SOLAR CELL
SEMICONDUCTORS*

random][pLasatd



STAIN-RESISTANT CLOTHING (NANO-PERFLUORINATED COMPOUNDS)



CLEAR SUNSCREEN (TiO2)

THE NANOSOLAR UTILITY PANEL CARRIES 5-10 TIMES MORE CURRENT THAN TYPICAL PANELS



NANOSILVER ANTIBIOTIC CLOTHING, FOOD PACKAGING, AND TEDDY BEARS



CARBON NANOTUBE LIGHTER STRONGER BUILDING MATERIALS

random][pLasatd

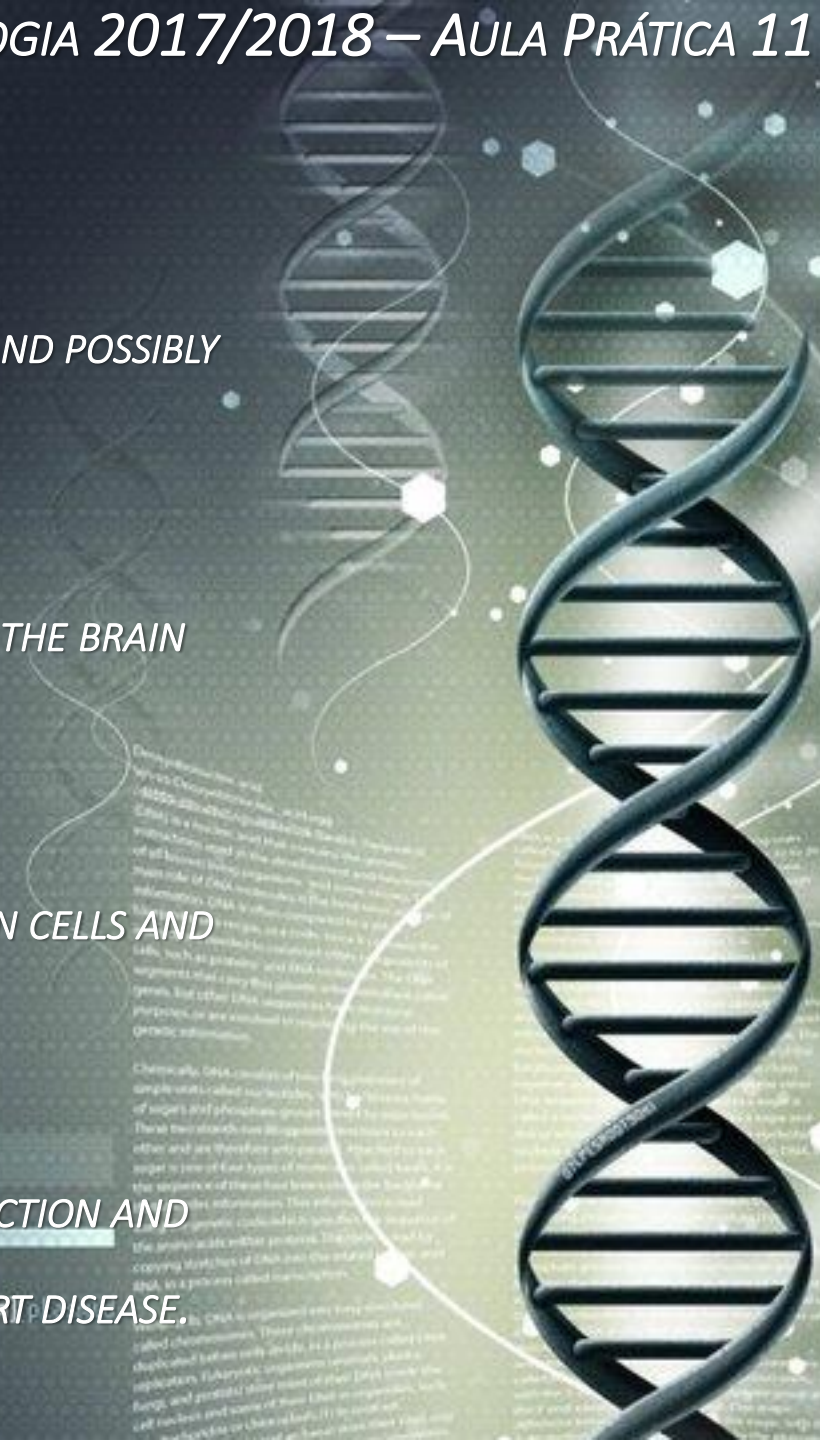
NANOTOXICOLOGY: BASIC ASSUMPTIONS

SMALL SIZE FACILITATES EASIER ACCESS TO THE LUNGS, PASSAGE THROUGH CELL MEMBRANES, AND POSSIBLY SKIN PENETRANCE.

ONCE INSIDE THE BODY, THEY SEEM TO HAVE ACCESS TO ALL TISSUES AND ORGANS, INCLUDING THE BRAIN AND FETAL CIRCULATION.

ANIMAL STUDIES SUGGEST THAT SOME NANOMATERIALS CAUSE INFLAMMATION, DAMAGE BRAIN CELLS AND CAUSE PRE-CANCEROUS LESIONS.

ULTRAFINE (NANO) AIR POLLUTION, IS ASSOCIATED WITH SIZE-DEPENDENT REDUCED LUNG FUNCTION AND INCREASED LIKELIHOOD OF ASTHMA, RESPIRATORY DISEASE, AND DEATHS FROM LUNG AND HEART DISEASE.



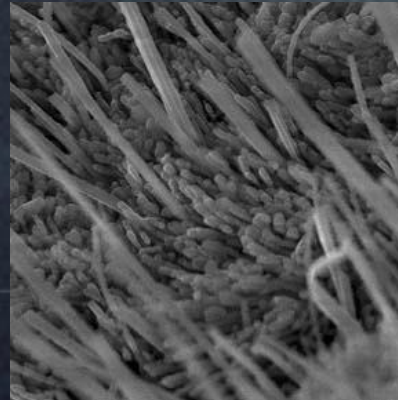
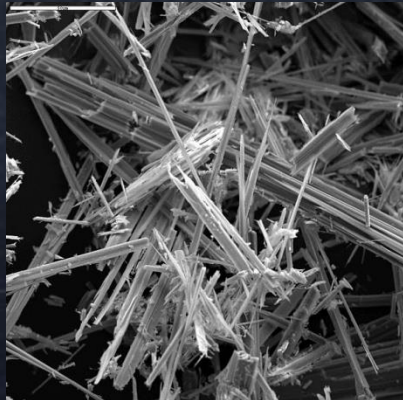
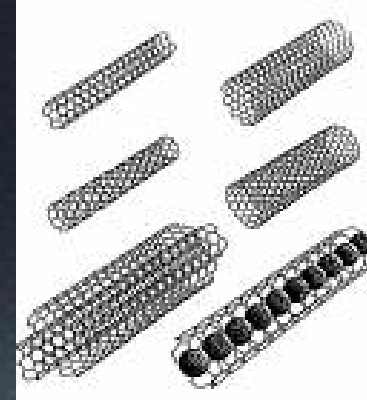
CARBON NANOTUBES: the new asbestos?

Both are long, rigid, fiber-like tubes.

Both have a diameter of about 100-200 nm.

Both cause cytotoxicity, DNA damage, mutation.

Both cause size-dependent inflammation, granulomas, fibrosis



NANOSILVER: ANTIMICROBIAL

Silver is a priority pollutant whose discharge is regulated by EPA under the Clean Water Act

100's of consumer products claim to use nanosilver;

Nanosilver, like silver, kills both harmful and beneficial microbes. The nanoscale version is more toxic than regular silver, and releases free ions.

In cultured mouse sperm stem cells, a 48 hr treatment of nanosilver (15 nm diameter) was 45-fold more toxic than silver carbonate (EC50 of 8.75 v 408 ug/ml).

NANOCHEMICALS IN MEDICINE

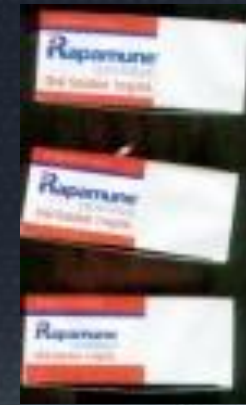
Emend® (Merck, USA) approved by FDA in 2003 as an anti-nausea drug for chemotherapy patients. Nanocrystals.

Doxil® (ALZA Corp, USA) approved by FDA in 2005 to treat ovarian cancer and Kaposi's sarcoma. Lipid nanoparticles.

Estrasorb™ (Novavax, Inc, USA) approved by FDA in 2003 as topical estradiol lotion to treat menopause. Micellar nanoparticles.

Rapamune® (Wyeth, USA) approved by FDA in 2000 as an immunosuppressant for renal transplant patients. Nanocrystal form.

Zirconium Oxide® (Altair Nanotechnologies, Inc, USA) commercially available since 2003 for dental fillings



NANOCHEMICALS IN FOOD AND BEVERAGES

Nanoceuticals™ Slim Shake Chocolate (RBC Life Sciences, USA). Pure cocoa is added to a nano-cluster

Canola Active Oil (Shemen Industries, Israel). Uses Nano-sized self assembled structured lipids, NSSL, to deliver insoluble vitamins through the cellular membrane

Nanotea (Shenzhen Become Industry&Trade Co., China)



NANOCHEMICALS IN FOOD CONTACT MATERIALS

Kitchen cutting board (S Korea) nanosilver

Home and garden spray (ABL, USA) nanosilver

Aluminum foil (Melitta, Germany). With non-stick coating. “Put simply, is that the black coating material to carbon, in a glass matrix is embedded. The black area reached up to 100 degrees Celsius higher surface temperatures when cooking ... the food is prepared quickly.”



NANO TITANIUM DIOXIDE

When TiO₂ nanoparticles were fed to mice in drinking water (300-3,000 µg/day for five days), they showed DNA damage. (Trouiller et al, 2009)



When pregnant mice were injected under the skin with TiO₂ (0.1 mg at 3, 7, 10, and 14 days postcoitum) the nanoparticles were found in the offspring and caused reduced sperm production and brain cell death in the male offspring. (Takeda et al, 2008).

Quantum dots vary in toxicity

Studies have shown cellular toxicity, DNA damage (Hardman, 2007, Green 2005)

Longer exposure times more likely to show toxicity

Use of cadmium raises concerns

Long-term stability of caps not certain

Widespread applications may lead to environmental loading

