

NANOTECHNOLOGY

TRANSPORT TO A NEW UNIVERSE



SERIES: NANOTECHNOLOGY
IN COMICS...
NUMBER 1

MINISTÉRIO
DO TRABALHO E EMPREGO



FUNDACENTRO

FUNDAÇÃO JOSÉ DUPRAT FIGUEIREDO
DE SEGURANÇA E MEDICINA DO TRABALHO

ZF6

Nanotechnology

Transport to a new universe

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Script: Antonio Gracias Vieira (Tonico) - IIEP
Concept: João Antonio Garcia (Jão)

Nanotechnology

Transport to a new universe



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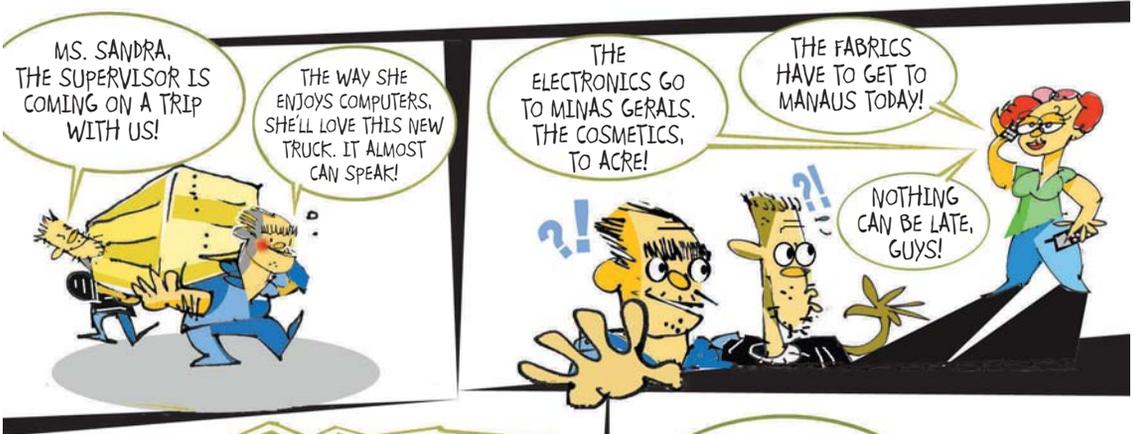
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NANO TECHNOLOGY: TRANSPORT TO A NEW UNIVERSE



SOMETIME LATER,
LEAVING THE GARAGE...

LET'S PLAY
MUSIC TO KEEP
US AWAKE!

GAS LAMP
GAS LAMP

IT'S A WASTE
OF TIME LISTENING
TO AN OLD SONG ON
A NEW RADIO...

OK, I'LL
TURN IT OFF!

IT'S GOING
TO BE A LONG
TRIP...

SOMETIME LATER...

SO, LET'S SEE...
ACCORDING TO THE TRAFFIC
AND THE COMPANY MANUAL, IT'S
ABOUT TIME TO SLOW DOWN
AND TURN ON THE
WINDSHIELD
WIPERS.

TRANSPORTADORA
NOVO UNIVERSO

KA-BRUM...

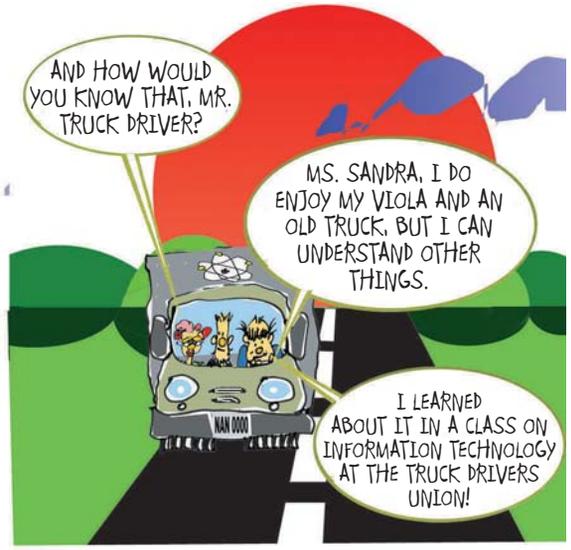
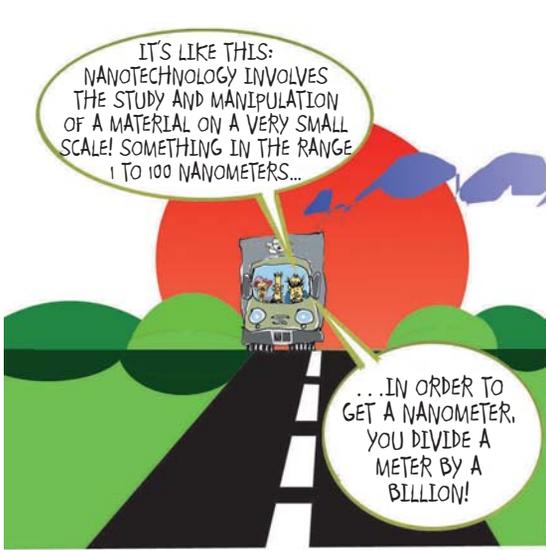
WE DON'T
NEED WINDSHIELD
WIPERS FOR THIS
TRUCK!

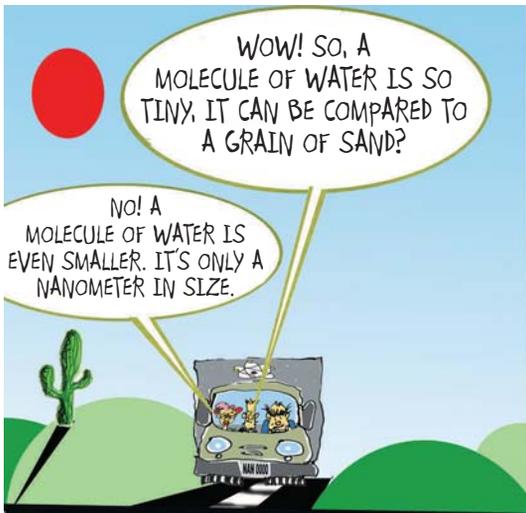
REALLY?
WHY?

BECAUSE THIS
TRUCK WAS MADE WITH THE
LATEST IN INNOVATIVE MATERIALS!
WITH NANOTECHNOLOGY! THE
GLASS IS COVERED WITH A
NANOSTRUCTURED FILM.
ISN'T THAT AWESOME?

BUT... WHAT
EXACTLY DOES
NANOTECHNOLOGY
MEAN?

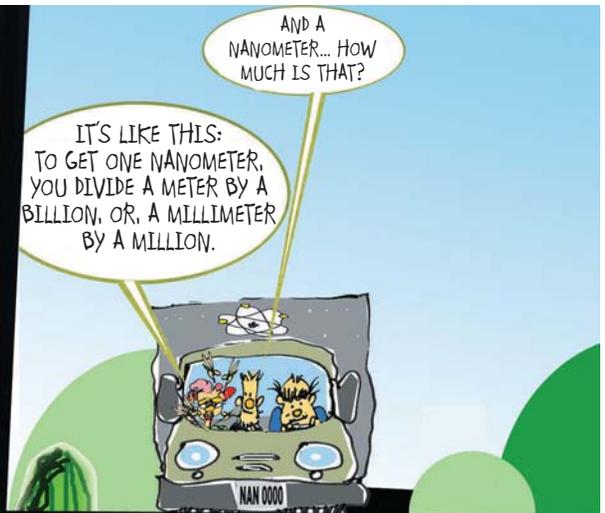
OH, BOY! IT'S
VERY COMPLICATED... IT
DEALS WITH VERY TINY
MATERIALS... YOU
WOULDN'T UNDERSTAND!





WOW! SO, A MOLECULE OF WATER IS SO TINY, IT CAN BE COMPARED TO A GRAIN OF SAND?

NO! A MOLECULE OF WATER IS EVEN SMALLER. IT'S ONLY A NANOMETER IN SIZE.



AND A NANOMETER... HOW MUCH IS THAT?

IT'S LIKE THIS: TO GET ONE NANOMETER, YOU DIVIDE A METER BY A BILLION, OR, A MILLIMETER BY A MILLION.



THINK OF THAT TRIP WE TOOK TO THE NORTH, TO DELIVER BANANAS. THE DISTANCE BETWEEN NATAL AND SALVADOR, IS ABOUT 700 MILES (1,126 KM). IMAGINE A GRAIN OF SAND IN ALL THIS DISTANCE AS A NANOMETER IS TO A METER!



HOLD ON! SO, NANOTECHNOLOGY DEALS WITH THESE ULTRA-SUPER TINY THINGS?

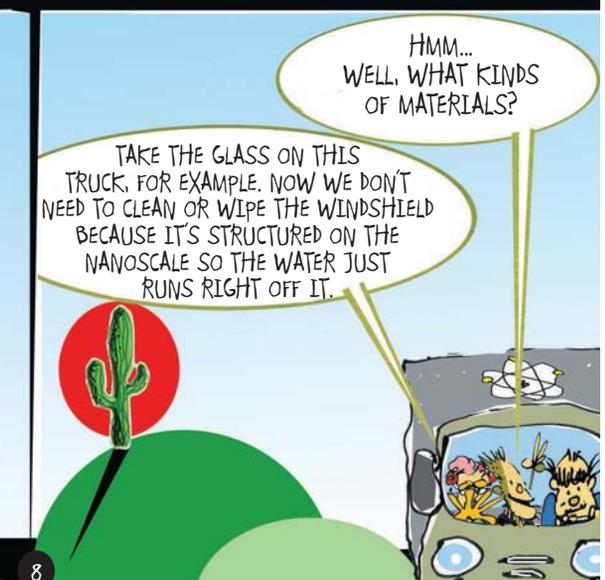
YES...

LET ME TELL YOU. COMPANIES AND SCIENTISTS ARE ALREADY WORKING WITH MATERIALS ON THE NANOSCALE! MANIPULATION MOLECULES, ISN'T THAT AMAZING?



THAT'S CRAZY MRS. SANDRA! ARE THESE THINGS GOING TO BE SOLD ON THE MARKET?

YES, THERE ARE ALREADY SOME PRODUCTS MADE FROM NANOSCALE MATERIALS.



HMM... WELL, WHAT KINDS OF MATERIALS?

TAKE THE GLASS ON THIS TRUCK, FOR EXAMPLE. NOW WE DON'T NEED TO CLEAN OR WIPE THE WINDSHIELD BECAUSE IT'S STRUCTURED ON THE NANOSCALE SO THE WATER JUST RUNS RIGHT OFF IT.

AND THERE IS STAIN RESISTANT
FABRIC THAT DOESN'T WRINKLE!
ANTIBACTERIAL DUST!

NANO GLUE THAT STICKS ANY
MATERIAL TO ANOTHER!

GLASS COATING AND
ANTI-CORROSION MATERIALS!

ELECTRONIC EQUIPMENT!

THE COSMETICS WE'RE
DELIVERING!...



SO, THIS
NANOTECHNOLOGY THING IS
REALLY GOOD! RIGHT NOW I AM
REMEMBERING A MOVIE THAT
SHOWED EXACTLY THAT...
SOMETHING TO DO WITH VERY
SMALL MACHINES...
GROOVY!

BUT WAIT A MINUTE!
MS. SANDRA FORGOT TO
EXPLAIN THE PROBLEMS
WITH NANOTECHNOLOGY.



WELL, ARE
THERE ANY
PROBLEMS?

OH, YES!!!
THERE ARE LOTS
OF PROBLEMS!



AT THE NANO LEVEL,
PROPERTIES OF MATERIALS CAN
CHANGE. WHAT IS STABLE IN BIGGER
SIZES CAN BE VERY REACTIVE. WHAT
IS INSULATING CAN BE CONDUCTIVE.
WHAT IS OPAQUE CAN TURN
TRANSPARENT...

HELLO
LITTLE
FRIENDS!!!

WHAT ARE
YOU LOOKING AT,
"BRO"?



GOLD, FOR INSTANCE.
WHEN WE HAVE A GOLDEN
RING, IT'S GOLD, ISN'T IT? BUT
ON THE NANO SCALE, GOLD
CAN EVEN CHANGE
COLOR!

NOOOO!
GOLD THAT'S NOT
GOLDEN?!

JUST BECAUSE
IT CHANGES COLOR,
DOESN'T MEAN
THAT'S A
PROBLEM...!

THAT'S TRUE,
BUT IT'S NOT
JUST THAT!



THINKS ABOUT THIS:
JUST BECAUSE IT WORKS IN A
REGULAR SIZE, DOESN'T MEAN IT
WILL WORK THE SAME WAY ON
THE NANO SCALE.

WHAT A
PROBLEMATIC
WOMAN...

RIGHT!



MATERIALS THAT ARE
SAFE IN A REGULAR SIZE, CAN GET
UNDER THE SKIN AS NANOPARTICLES,
OR THEY CAN GO AEROSOL AND GET INTO
THE RESPIRATORY SYSTEM.

WOW...
THAT'S
FRIGHTENING!



BUT THINK ABOUT
THE ADVANTAGES! NANOTECHNOLOGY
IS REALLY GOOD! IT CAN HELP IN
AGRICULTURE, MEDICINE, WATER
PURIFICATION, COMPUTERS...
MY COSMETICS!

NOW, SHE'S GOT
US! I BET THEY DIDN'T
EXPLAIN THAT AT THE
TEAMSTERS UNION
COURSE.



SO,
NOW WHAT,
MR. KNOW-IT-ALL?

HERE'S THE THING:
THIS IS ALL VERY NICE, BUT
HOW CAN WE USE IT, IF WE
DON'T KNOW IT WON'T HARM
HUMAN HEALTH?



COMPANIES SPEND A LOT OF
MONEY RESEARCHING MATERIALS
THAT WORK ON THE NANO SCALE,
AND ALMOST NOTHING STUDYING
WHETHER THEY ARE HARMFUL
TO HEALTH.

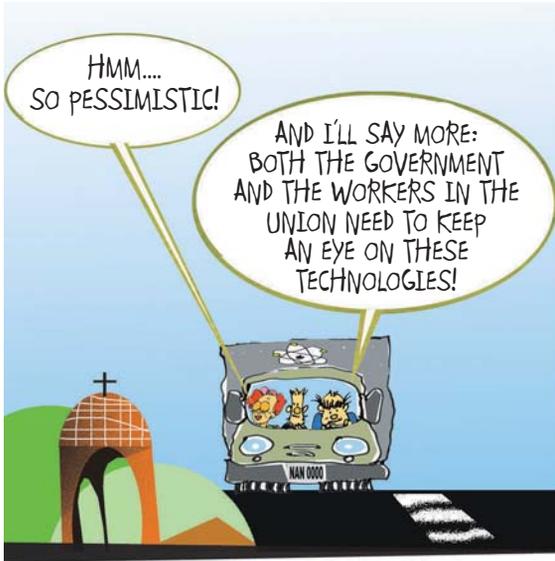
BLAH, BLAH BAH!
THERE ARE ALWAYS
COMPLAINTS... WHAT DO
YOU SUGGEST?



I WOULD SUGGEST THAT
THESE FOLKS STUDY WHETHER
NANOMATERIALS, BECAUSE OF THEIR SIZE OR
THEIR COMPOSITION COULD POSSIBLY DO HARM
TO PEOPLE. THAT SOMEONE BE ABLE TO SAY,
THIS IS GOOD OR THIS IS BAD.

I GOT IT!





HMM....
SO PESSIMISTIC!

AND I'LL SAY MORE:
BOTH THE GOVERNMENT
AND THE WORKERS IN THE
UNION NEED TO KEEP
AN EYE ON THESE
TECHNOLOGIES!



MR. ANTONIO, I THINK
MS. SANDRA'S RIGHT! AREN'T YOU
OVERREACTING? IF THEY WERE AS
DANGEROUS AS YOU SAY, NO ONE
WOULD HANDLE THEM!

THAT'S RIGHT, GABRIEL!
THESE PEOPLE ARE JUST AFRAID
OF NEW TECHNOLOGIES,
ANYTHING NEW!



YOU'RE WRONG MS. SANDRA!
IT'S NOT FEAR; YOU JUST HAVE TO BE
CAREFUL! THERE ARE LOTS OF DANGEROUS
PRODUCTS ON THE MARKET, AND PEOPLE ONLY
FIND OUT ABOUT THE DANGERS WHEN IT'S TOO
LATE. THERE ARE STILL LOTS OF DANGEROUS
PRODUCTS ON THE MARKET!



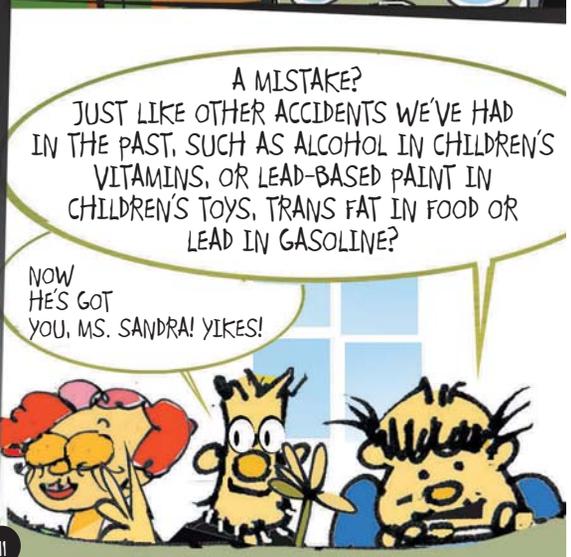
LIKE WHAT,
MR. ANTONIO?

ASBESTOS-LINED
VEHICLE BRAKES, FOR
EXAMPLE. THEY HAD TO TAKE THE
ASBESTOS OUT OF THE BRAKES
BECAUSE IT WAS PROVEN
PARTICLES WERE RELEASED
BY THAT, AND CAUSED
CANCER!



OH,
THAT'S SILLY
MR. ANTONIO! THE
INDUSTRY JUST MADE
A MISTAKE!

THAT'S TRUE,
MR. ANTONIO! IT WAS
JUST AN ACCIDENT!

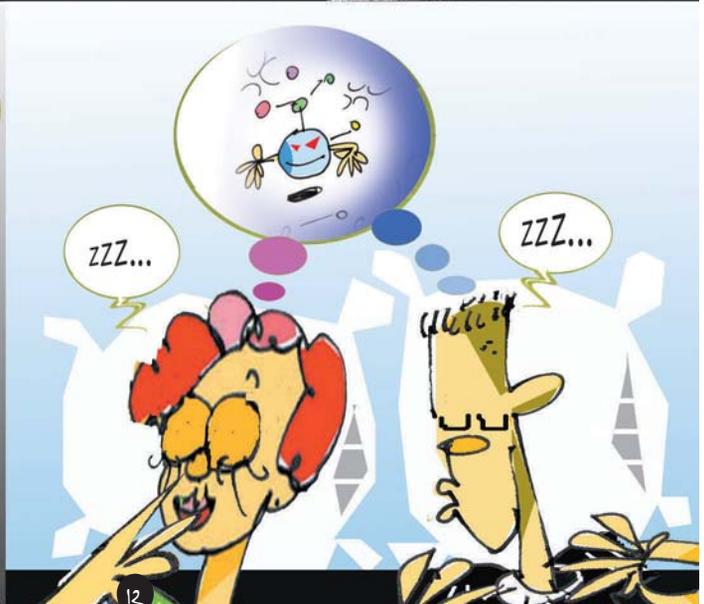
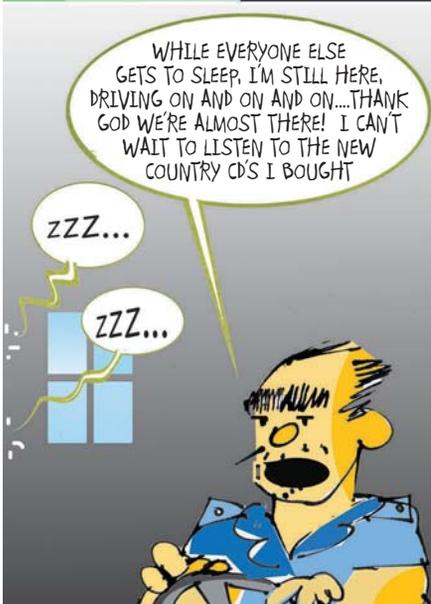


A MISTAKE?
JUST LIKE OTHER ACCIDENTS WE'VE HAD
IN THE PAST, SUCH AS ALCOHOL IN CHILDREN'S
VITAMINS, OR LEAD-BASED PAINT IN
CHILDREN'S TOYS, TRANS FAT IN FOOD OR
LEAD IN GASOLINE?

NOW
HE'S GOT
YOU, MS. SANDRA! YIKES!



TIMES GOES BY AND NIGHT FALLS OVER THE HIGHWAY...



LET'S TAKE A LOOK AT MS. SANDRA'S DREAM...

O GREAT ENLIGHTENED CELL PHONE, FORGIVE THE MISTAKES OF YOUR DEVOTED SERVANT!

YOU'LL BE FORGIVEN, AS SOON AS YOU SEND 30 TEXT MESSAGES TO 30 DIFFERENT CELL PHONE NUMBERS... O LAZY SERVANT!



...AND GABRIEL'S DREAM...

ALL THESE NANO THINGS SEEM TO BE PRETTY CRAZY! TOO BAD I DON'T UNDERSTAND ANYTHING ABOUT THEM...



NANOTECHNOLOGY

NANOPARTICLES

NANO

MANOESTRUCTURED

BUT... THAT CRAZY DREAM! WHO ARE YOU?

WE ARE NANOPARTICLES! WE HAVE BEEN MAGNIFIED NEARLY A BILLION TIMES TO LET YOU SEE US!

THAT ONE IS FLIP AND I AM FLOP. HOW ARE YOU DOING, BUDDY?



YIKES! MS. SANDRA AND MR. ANTONIO SAID YOU WERE INVISIBLE!

WE ARE INVISIBLE! WE DON'T HAVE PERSONALITIES AND WE AREN'T DIVIDED INTO MALE AND FEMALE!

WELL... WE ARE PRODUCTS OF YOUR IMAGINATION! THAT'S WHY WE ARE PART OF YOUR DREAMS!

THAT'S CRAZY!

THAT'S ALL HE CAN SAY??? CRAZY, CRAZY, CRAZY...

OH, FLIP, LEAVE HIM ALONE. AFTER TELLING HIM ALL ABOUT IT, WE'LL TEACH HIM SOME NEW WORDS!

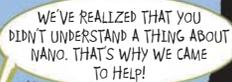




SMART ASSES!
WHAT DO YOU WANT
TO TELL ME?



WE CAME TO
DO A BIT OF REVIEWING! YOU
DON'T DESERVE... BUT WE
WOULD LIKE TO SHOW UP IN
THIS STORY!



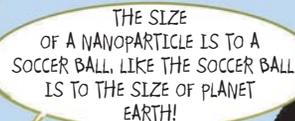
WE'VE REALIZED THAT YOU
DIDN'T UNDERSTAND A THING ABOUT
NANO. THAT'S WHY WE CAME
TO HELP!



WOW... COOL!



SO, SMART GUY... LET'S
GET BACK TO THE SIZE OF MATTER
INSTEAD OF THE BANANA DELIVERY.
THINK OF IT LIKE THIS...



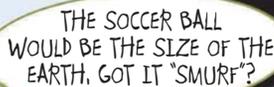
THE SIZE
OF A NANOPARTICLE IS TO A
SOCCER BALL, LIKE THE SOCCER BALL
IS TO THE SIZE OF PLANET
EARTH!



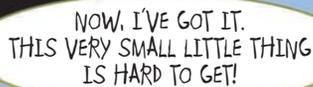
BALL?... EARTH?...
NANOPARTICLES?
AAUGH! ...



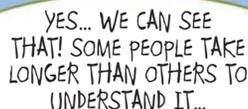
IF A NANOPARTICLE
WERE THE SIZE OF A
SOCCER BALL...



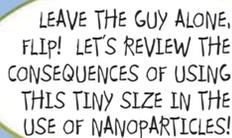
THE SOCCER BALL
WOULD BE THE SIZE OF THE
EARTH, GOT IT "SMURF"?



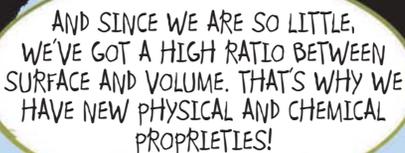
NOW, I'VE GOT IT.
THIS VERY SMALL LITTLE THING
IS HARD TO GET!



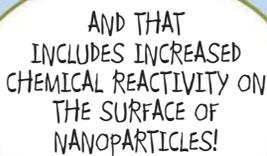
YES... WE CAN SEE
THAT! SOME PEOPLE TAKE
LONGER THAN OTHERS TO
UNDERSTAND IT...



LEAVE THE GUY ALONE,
FLIP! LET'S REVIEW THE
CONSEQUENCES OF USING
THIS TINY SIZE IN THE
USE OF NANOPARTICLES!



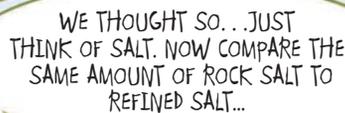
AND SINCE WE ARE SO LITTLE,
WE'VE GOT A HIGH RATIO BETWEEN
SURFACE AND VOLUME. THAT'S WHY WE
HAVE NEW PHYSICAL AND CHEMICAL
PROPERTIES!



AND THAT
INCLUDES INCREASED
CHEMICAL REACTIVITY ON
THE SURFACE OF
NANOPARTICLES!



WOW...
YOU LOST ME
AGAIN!



WE THOUGHT SO... JUST
THINK OF SALT. NOW COMPARE THE
SAME AMOUNT OF ROCK SALT TO
REFINED SALT...



WHICH ONE TAKES UP
MORE SPACE? VOLUME?
WHICH ONE DISSOLVES
MORE EASILY?

REFINED? THE ONE WE USE ON FOOD, IS THAT IT?

THAT'S RIGHT! IT'S THE SAME IDEA WITH US -- SINCE WE ARE SO LITTLE, WE REACT MORE!

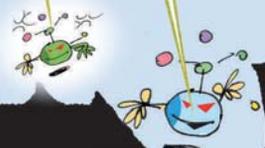
BUT NOTICE 'LITTLE SMURF': THIS ISN'T A NEW PROPERTY, BUT IT SHOWS THE IMPORTANCE OF THE SIZE OF NANOPARTICLES, AND THE SIZE OF PARTICLES IN THE PROPERTIES OF SUBSTANCES.



HOW ABOUT YOU? WILL YOU CHANGE THE WORLD?

NANOTECHNOLOGIES DON'T NEED MUCH WORK, SPACE OR MAINTENANCE!

WE ARE GOING TO MEAN MAJOR CHANGES IN SOCIETY, THE ECONOMY, THE ENVIRONMENT AND THE MILITARY!



THAT'S COOL, MAN!

AND NOW... TA-DA! LET'S INTRODUCE SOME MEMBERS OF OUR FAMILY TO YOU!

CARBON NANOTUBES, FULLERENES AND NANOLAYERS! OUR RELATIVES ARE GORGEOUS, AREN'T THEY?



CARBON NANOTUBES ARE STRUCTURED IN CYLINDRICAL SHAPES MADE OF CARBON ATOMS WHOSE DIAMETERS ARE FROM ONE TO 20 NANOMETERS, AND WHOSE LENGTH CAN BE 18,000 NANOMETERS. THEY ARE ALMOST 100,000 TIMES THINNER THAN A HAIR. RESEARCHERS HAVE BEEN STUDYING THEIR USE IN STRUCTURES BY REPLACING STEEL, IN CONDUCTING MATERIALS AND SEMICONDUCTORS, OR EVEN CHIPS FOR COMPUTERS.

I AM VERY LITTLE, BUT VERY STRONG!



FULLERENES ARE PURE CARBON SPHERES COMPOSED BY 60 ATOMS OF CARBON (C60). THEY ARE ABOUT A NANOMETER IN DIAMETER, ARRANGED IN 20 HEXAGONS AND 12 PENTAGONS, LIKE A SOCCER BALL. THEY CAN BE USED IN A PROCEDURE CALLED DRUG DELIVERY, WHICH CONSISTS OF CARRYING DRUGS TO SPECIFIC PARTS OF THE BODY. THEY REACT DIFFERENTLY FROM CURRENT MEDICATIONS, SUCH AS ANTIBIOTICS, FOR EXAMPLE, THE ONES THAT KILL BAD BACTERIA, AS WELL AS GOOD BACTERIA.

NANOLAYERS ARE PRODUCED BY ENGINEERED NANOSCALE SURFACES AND LAYERS. THEY MAY GENERATE A WIDE RANGE OF FUNCTIONALITIES AND NEW PHYSICALEFFECTS. EXAMPLES OF THEIR USE ARE: SELF-CLEANING SURFACES, LIKE WINDSHIELDS OF THE TRUCK DRIVEN BY ANTONIO, CORROSIVE PROTECTION FOR MACHINES AND EQUIPMENTS, AND EVEN BANDAGES FOR WOUNDS...

MS. BACTERIA I'VE BROUGHT YOU A SURPRISE!



HEAVEN!

HO, HO, HO, WE ARE VERY CLEAN!



AS YOU'VE SEEN, WE AND OUR RELATIVES ARE ALREADY SOLD IN THE MARKET.

I MEAN, NOT BOTH OF US, RIGHT FLIP? WE ARE JUST PRODUCTS OF YOUR IMAGINATION... NANOPARTICLES CAN'T TALK!

THIS IS ALL COOL! BUT MR. ANTONIO HAS SAID THAT NANOPARTICLES HAVEN'T BEEN STUDIED ENOUGH IN ORDER TO LEARN ABOUT THEIR EFFECTS ON HEALTH! HOW ABOUT THE RISKS TO WORKERS? HOW ABOUT OTHER PRODUCTS ALREADY AVAILABLE ON THE MARKET AND SOMETIME LATER WERE FOUND TO BE DANGEROUS?

THAT GUY IS SMART!

THAT'S TRUE. INVESTMENTS IN RESEARCH AND DEVELOPMENT OF NEW MATERIALS IN NANOTECHNOLOGY ARE 100 TO 1000 TIMES GREATER, DEPENDING ON THE COUNTRY, THAN IN STUDIES OF THEIR IMPACT ON HEALTH AND THE ENVIRONMENT!

IT'S TIME TO GO, FLOP!

OK FLIP! THIS BOY ASKS A LOT OF DIFFICULT QUESTIONS!

IT'S ALWAYS LIKE THAT! THEY SEEM SOME PEOPLE THAT VANISH WHEN IT'S TIME TO TALK ABOUT THE OWN FAULTS!

PUF!

TUF!

ON THE HIGHWAY, LIFE GOES ON...

U-U?

ZZZ...

ZZZ...

NICE MUSIC!

TRANSPORTADORA
NOVO UNIVERSO

LÂMPIÃO DE GÁS, LÂMPIÃO DE GÁS...

FOR A WHILE DEAR READER, THIS IS THE END! BUT YOU WON'T HAVE TO WAIT TOO LONG FOR MORE ADVENTURES OF MS. SANDRA, ANTONIO AND GABRIEL!

AUTHOR'S HOME

TONICO ,
ANTHROPOLOGIST
AND WRITER

SCRIPT,
ALEXANDRE,
TEACHER.

JAO,
JOURNALIST AND
CARTOONIST.



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Other documents on the subject can be found at:

- > <http://blog.iiep.org.br/nanotecnologia>
- > <http://nanotecnologia.incubadora.fapesp.br/portal>

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