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# NANOTEHNOLOGIJA Z EKSPERIMENTI IN NANOVARNOST V IZOBRAŽEVANJU

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**Zavod RS za šolstvo**

8. Posvet KEMIJSKA VARNOST ZA VSE, Izola, 2016

# Namen prispevka

## KAJ IN KAKO Z NANOVARNOSTJO V ŠOLI?



Predstavili bova:

- možnosti za vključevanje nanotehnologije in nanovarnosti v pouk glede na UN naravoslovnih predmetov v OŠ in SŠ,
- dejavnosti, ki spodbujajo razvijanje razumevanja, kritičnega mišljenja učencev in ozaveščajo o nanovarnosti,
- primere projektov in gradiv za dejavnosti skupnosti Scientix...
- ...



# Kaj nam je lahko v pomoč v „gozdu nanotehnologije“?

**Informacijska grafika** *ali* info-grafika = grafični vizualni prikaz informacije, podatkov ali znanja z namenom predstaviti kompleksno informacijo hitro in pregledno.

poenost. = predstavitev podatkov na zanimivejši (zabavnejši) in hitrejši način

**Info-grafike in njihova priprava** lahko izboljšajo kognicijo in vizualizacijske sposobnosti (prepoznavanje vzorcev in trendov).

Ref. „data visualization“, „information design“ ali „information architecture“



Zelo uporabne infografike za naravoslovje, kemijo najdete na:  
[www.compoundchem.com](http://www.compoundchem.com)



# EVERYDAY USES OF NANOTECHNOLOGY

National Nanotechnology Day (Oct. 9) is a yearly event in the U.S. to celebrate the tiny tech. Here, we take a look at various consumer products that utilize nanotechnology and the chemistry behind them.

## WHAT IS NANOTECHNOLOGY?



SALT GRAIN = 100,000 nm



NANOPARTICLES = 1-100 nm

Nanotechnology involves the applications of nanoparticles, which are collections of atoms or molecules less than 100 nm across. Because of their small size, the particles have properties that can differ from those of larger amounts of the same material.

## ANTIMICROBIAL USES



Products such as bandages, soaps, and surgical implements use silver nanoparticles for their antimicrobial effects. However, the particles' effectiveness in some applications has been questioned, and the materials may cause environmental problems.

## SUNSCREENS



Many sunscreens contain titanium dioxide and/or zinc oxide nanoparticles because the materials can absorb UV radiation. Titanium dioxide also finds use in some foodstuffs as a whitening agent.

## CLOTHES



SILVER ANTIMICROBIAL

SILICA WATER-REPELLENT



TiO<sub>2</sub>/ZnO UV-ABSORBING

ANTIMONY-DOPED TIN OXIDE ANTISTATIC

UV-absorbing titanium oxide and zinc oxide nanoparticles can be incorporated into clothes to prevent sunburn and sometimes to act as antistatic agents. Silicon dioxide nanoparticles can prevent stains and help clothing repel water.

## SPORTS EQUIPMENT



CARBON NANOTUBES

100 TIMES AS STRONG AS STEEL

ONE-SIXTH THE WEIGHT OF STEEL

AS STIFF AS DIAMOND

Sports equipment such as tennis rackets and bicycles are sometimes built using nanomaterials including carbon nanotubes. The nanotubes improve strength and durability and decrease weight. Titanium nanoparticles can also be used.

## QUANTUM DOTS



Quantum dots, which are nanoparticles of semiconductors such as cadmium selenide, absorb light of one color, such as blue light, and emit it as another depending on particle size. The particles are more energy-efficient than light-emitting diodes.

# Nanotehnologija in nanovarnost v učnih načrtih

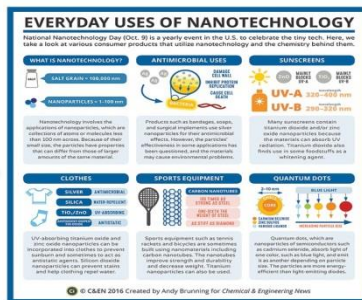
## Kje so možnosti v OŠ?

### BIOLOGIJA

- *Biologija kot veda*
- *Zgradba in delovanje človeka*
- *Biotehnologija*
- *Vpliv človeka na naravo in okolje*

### NARAVOSLOVJE, NARAVOSLOVJE IN TEHNIKA

- *Onesnaževanje zraka*



### KEMIJA

- *Kemija je svet snovi*
- *Elementi v periodnem sistemu*

### FIZIKA

- *Področja fizike in njen pomen*
- *Fizikalna dognanja nam lajšajo življenje*

### Izbirni predmetni

- *Poskusi v kemiji (osnove toksikologije) itd.*

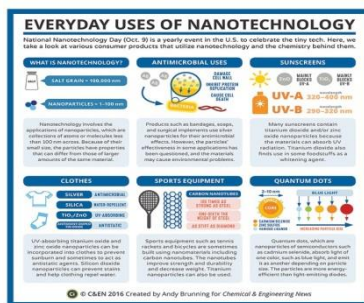
# Kje so možnosti v SŠ?

## BIOLOGIJA

- Življenje na Zemlji
- Zgradba človeka in drugih živali
- Ekologija
- Izbirni program
- Biološke osnove zdravega življenja
- Biotehnologija in mikrobiologija

## FIZIKA

- Izbirna poglavja polprevodniki



## KEMIJA

- Uvod v varno eksperimentalno delo (osnove toksikologije)
- Lastnosti izbranih elementov in spojin v bioloških sistemih in sodobnih tehnologijah
- Izbirni program
- Kemija in hrana

## STROKOVNI MODULI

- Npr. Kemija v stroki





# Kaj od „nano“ najdemo v skupnosti Scientix?

Še prej vprašanje, kaj je že Scientix?

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# „Nano“ projekti in gradiva v skupnosti Scientix



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The community for science education in Europe

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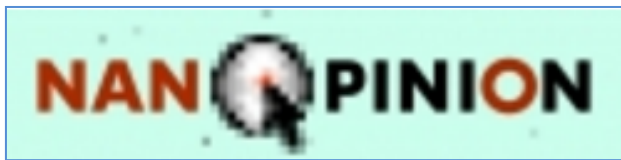
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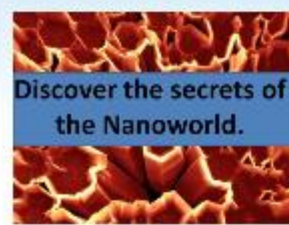
## NANOYOU Posters



NANOYOU has prepared some posters to introduce you to Nanoscience and to the applications of nanotechnologies in medicine, environment and ICT. You can download them below. NANOYOU posters by NANOYOU are licensed under a Creative...

★★★★☆ 3.0/5 (2085 votes) Thursday, 28 January 2010 46098 hits

## NANOYOU Power Point Presentations



NANOYOU has prepared some power point presentations to introduce you to the Secrets of the Nanoworld and to the Benefits and Risks that nanotechnologies can represent for the developed and the developing countries. You can download them below....

★★★★☆ 2.9/5 (1895 votes) Wednesday, 27 January 2010 43294 hits

## NANOYOU film



Do you want to know more about Nanoscience and Nanotechnologies? Watch NANOYOU's video and discover the secrets of the Nanoworld. You can download Podcast and iPod/iPhone versions of the video below, as well as the transcript of the film.

★★★★☆ 3.0/5 (3113 votes) Thursday, 14 January 2010 81577 hits

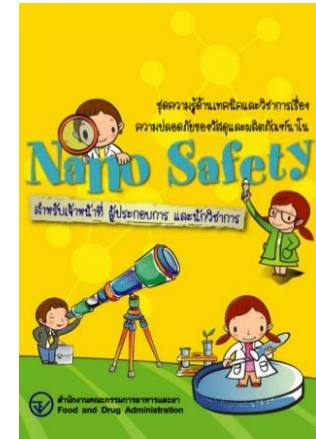
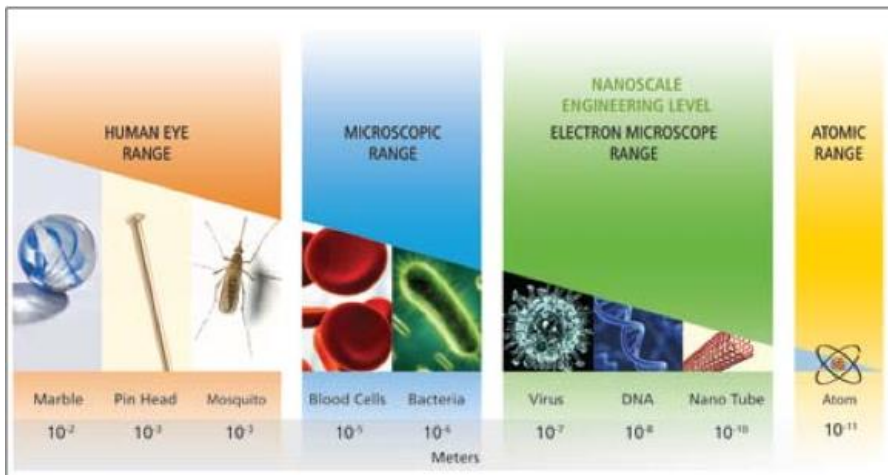
### Become a member of the NANOYOU Schools' Community!

Schools from all over Europe are already teaching NT in their classrooms and sharing their experience and best practices in the NANOYOU Schools' Community.

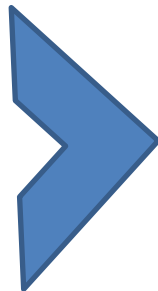


Click [here](#) for more information on the Schools' Community and on how to register.

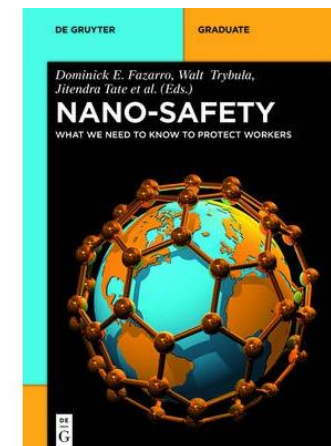




**Svet „škratov“ ni enak našemu ...**  
**Nove lastnosti → nove (varnostne) vsebine**



**NANOVARNOST**





**KAJ JE VARNOST ?**

**... = nasprotno od tveganja...**

**Kaj se nam zdi tvegano?**



**SAFETY**



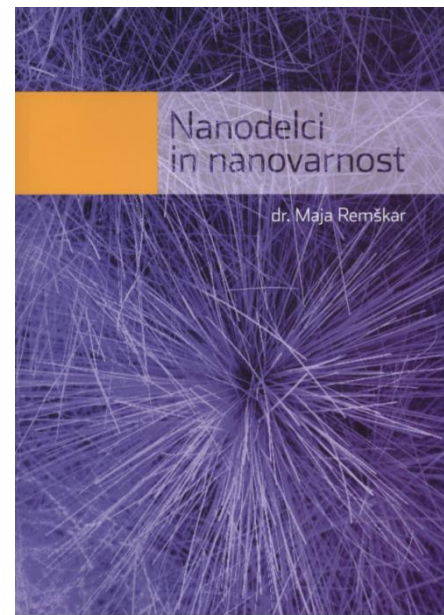
**Praktična varnost  
naslavlja učinke,  
ki se **NE bodo pojavili**,  
če določeno snov  
uporabljamo  
**v KOLIČINI in NA NAČIN**,  
ki je predlagan za uporabo !?**

**Vemo dovolj o nano, smo dovolj previdni ?**



## Zakaj je velikost tako pomembna?

- 70 nm delci prodrejo v pljučne mešičke
- 50 nm delci prodrejo v celice
- 30 nm delci prodrejo v celično jedro
- ni podatkov o potovanju delcev, ki so < od 20 nm

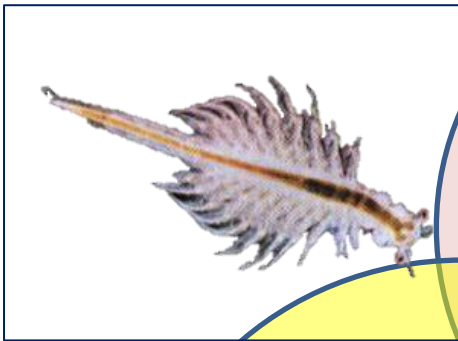


# Didaktični pristopi

**Eksperimentalno delo**



**Učenje z raziskovanjem**



**Projektno delo – avtentični problemi**

**Onesnažen zrak ubija**

Objavljeno: 30.03.2014 15:00 | Posodobljeno: 30.03.2014 15:00  
Avtor: U.S.  
Ključne besede: z smog, z onesnaženje

Svetovna zdravstvena organizacija opisuje onesnažen zrak kot največji okoljski dejavnik tveganja za zdravje. Strokovnjaki ga ne povezujejo samo z boleznimi dihalnih poti, ampak tudi z boleznimi srca ter možgansko kapjo.



**Različne dejavnosti**

**NANOYOU: Memory Game**



Test your memory with this memory game: find nanoscience and the

There are different definitions of nanoscience, nanotechnology and nanomaterials. Select a definition and a time!

You can download the cards and the instructions on how to play the game.



# EKSPERIMENTI z NANO

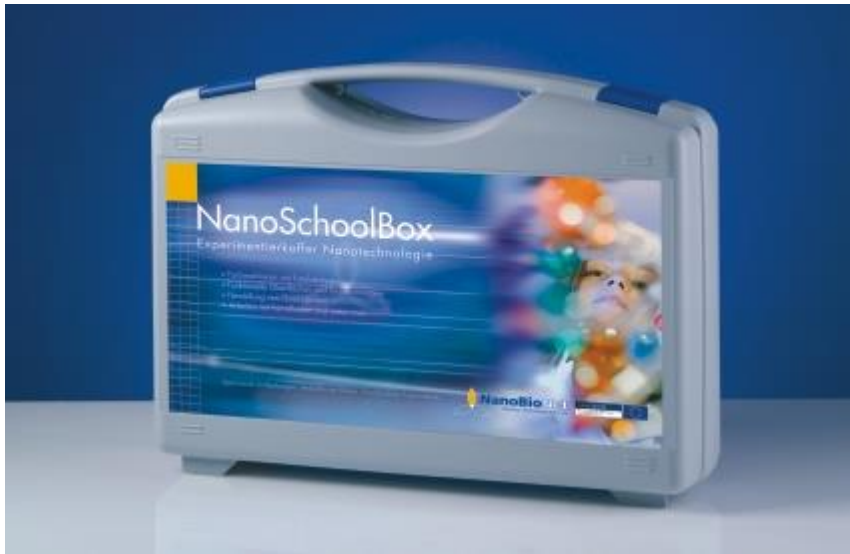
**EKSPERIMENT** ali **poskus** (*nlat. experimentum iz lat. experiri – izkusiti, poskusiti, preiskati*)

je znanstveni postopek in temelj pouka naravoslovnih predmetov.

Z eksperimenti otroci/učenci/dijaki spoznavajo osnovne naravoslovne pojme in pojave, poglobljajo razumevanje, povezujejo znanje in razvijajo eksperimentalno raziskovalne veščine. Z eksperimenti ugotavljamo, raziskujemo, dokazujemo, potrjujemo ali zavračamo hipoteze in teorije.



# EKSPERIMENTALNI KOVČKI/ KOMPLETI ZA NANO





# Zbirka eksperimentov NanoSchoolBox

## *Od lotosovega efekta do tehničnih aplikacij nanoslojev*

- 1. Opazovanje lotosovega efekta
- 2. Hidrofozna površina na lesu ali na kamnih
- 3. Hidrofozna površino na tekstilnem materialu
- 4. Nevidno črnilo za steklo – tvorba hidrofilne površine (anti fog)

## *Funkcionalnost z nanotehnologijo*

- 5. Les odporen na praske
- 6. Zaščita pred ognjem
- 7. Povečanje električne prevodnosti skozi ITO (indij kositrov oksid)

## *Uporaba titanovega dioksida v nanotehnologiji*

- DEMO: Polobla s flip-flop efektom
- 8. Fotokataliza s titanovi dioksidom

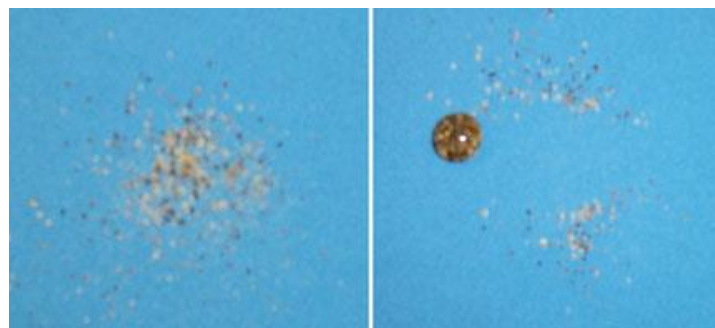
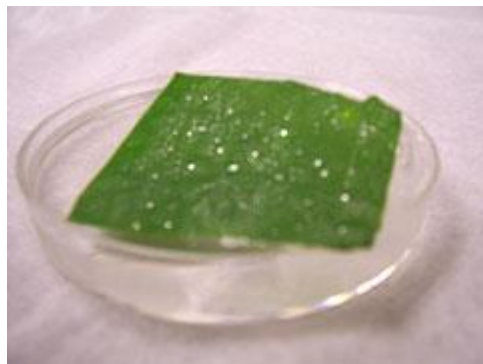
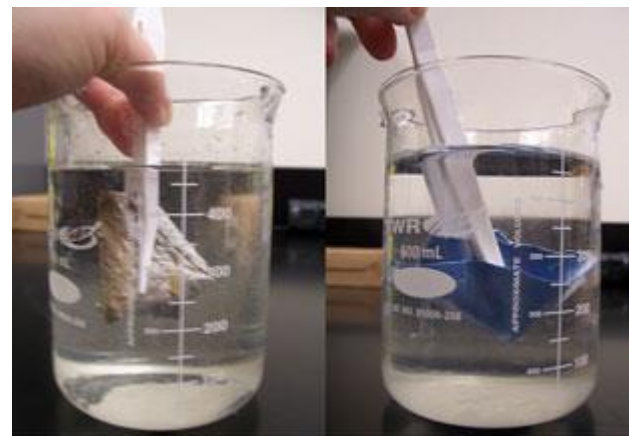
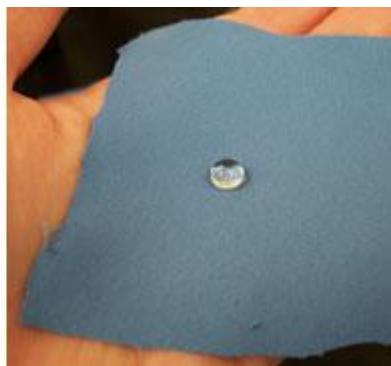
## **Ferofluidi**

- 9. Magnetno polje
- 10. Ločevanje na osnovi gostote s ferofluidi

Itd. → npr. 13. Spominska kovina...



# Eksperiment 1: Opazovanje lotosovega efekta

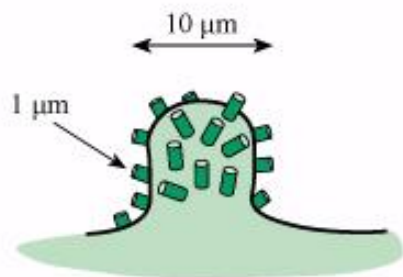
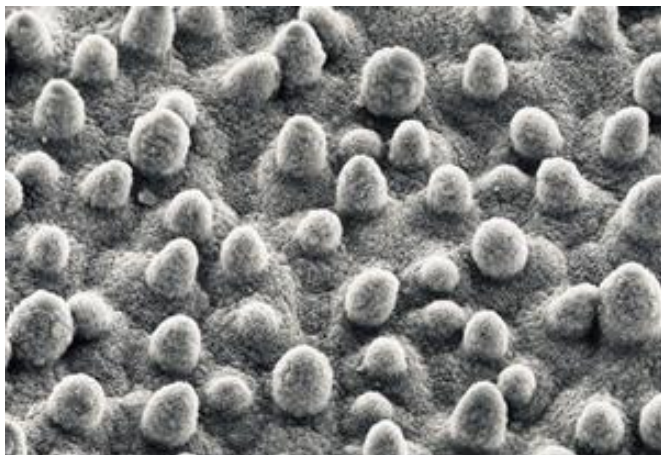


## Nadgradnja: vpliv površinsko aktivnih snovi na lotosov efekt

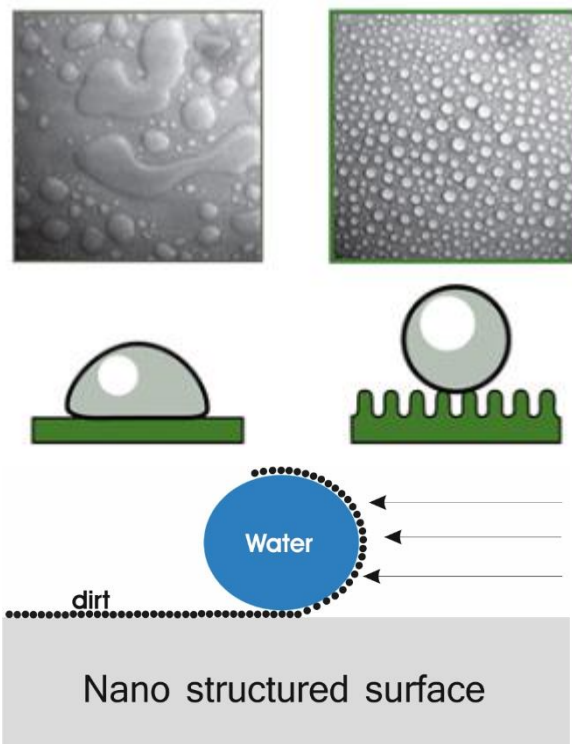




# Lotusov efekt - samočistilna sposobnost površine lista



Voščena površina lotusovega lista je pokrita z drobnimi izrastki, na katerih so od nekaj nm do  $\mu\text{m}$  velike cevaste tvorbe iz voska.



Lotusov učinek omogočajo mikrostrukture na listni površini in v njih ležeči voščeni kristali. Na vodoodbojni površini se ne moreta obdržati ne voda, ne prah.

# Možnosti vključevanja v vsebinske sklope:

## Osnovna šola

- Naravoslovje: Zgradba in delovanje rastlin
- Biologija: Biologija kot veda, Biologija in družba
- Kemija: Maščobe, Mila

Medpredmetno  
povezovanje

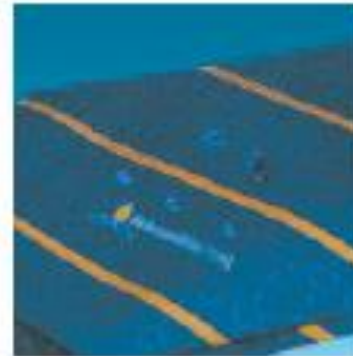
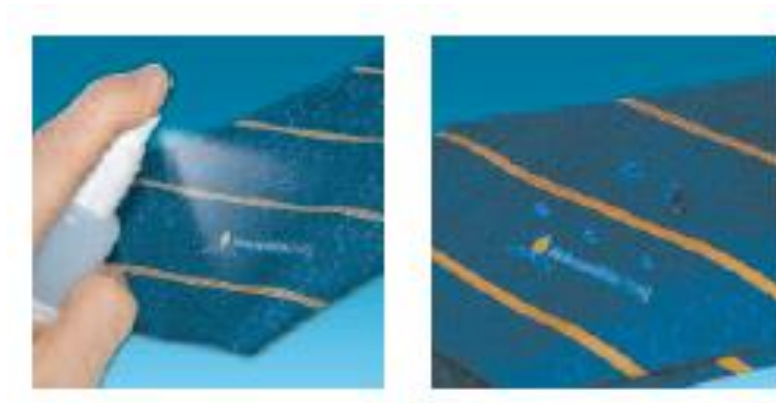
## Srednja šola

- Biologija: Zgradba in delovanje rastlin
- Kemija: Lipidi

Medpredmetno  
povezovanje



# Eksperiment 2 in 3: Hidrofobna površina na lesu ali mineralnih materialih ter tekstilnem materialu



## Eksperiment 4: Nevidno črnilo za steklo – tvorba hidrofilne površine (anti fog)



## Eksperiment 5 : Zaščita pred ognjem

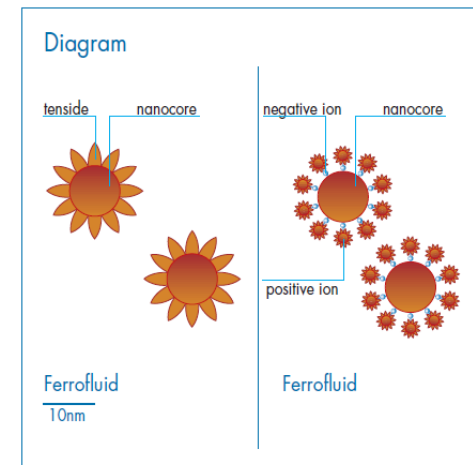




# DEMO: Polobla s flip-flop efektom



## Eksperiment 9 : Magnetno polje





## About Nano

## Nano Lab

## Nano Dialogue

## Play Nano

## Nano Educators



### NANOYOU Posters

**The Nanoscale**

### NANOYOU Power Point

**Discover the secrets of the Nanoworld.**

### NANOYOU film

### Virtual Nano Lab - Construct an electronic nose!

Would you like to experience how it is like to be a nanoscientist? Would you like to construct your own electronic nose? Enter the virtual lab and do the research yourself!

★★★★☆ 2.9/5 (4001 votes) Monday, 08 February 2010 68635 hits

### Experiment with Superhydrophobic materials

In this experiment you will analyse some innovative materials that are highly water repellent, stainless and require less cleaning thanks to their surface nano-engineering. Those materials have been developed using nature as an inspiration, since...

★★★★☆ 3.0/5 (2443 votes) Friday, 05 February 2010 58691 hits

### Experiment with Colorimetric Gold Nanosensor

Think of gold as you know it. Gold (Au, atomic number 79) is the most malleable and ductile metal of all; it can be beaten to very thin sheets of material and rolled or bent as desired. This has been known and done for centuries. In this...

★★★★☆ 3.0/5 (2081 votes) Friday, 05 February 2010 50151 hits

### Experiment on Natural Nanomaterials

We have many natural nanomaterials around us and in this experiment you will learn that two very common materials, milk and gelatine, are indeed two of these. The properties of these materials are directly connected to their molecular...

★★★★☆ 2.9/5 (2683 votes) Friday, 05 February 2010 56348 hits

### Experiment with Liquid Crystals

Liquid crystals are an example of self-assembled molecules that are sensitive to external factors, such as temperature, and that change their assembly as a consequence of variations in these factors. In this experiment you will see how some liquid...

★★★★☆ 2.9/5 (2485 votes) Friday, 05 February 2010 51051 hits

## Become a member of the NANOYOU Schools' Community!

Schools from all over Europe are already teaching NT in their classrooms and sharing their experience and best practices in the NANOYOU Schools' Community.

**Attachments:**

Teacher document (age 11-13)	501 Kb
Teacher document (age 14-18)	751 Kb
Appendix I for teachers	104 Kb
Student background reading	452 Kb
Student laboratory worksheet (age 11-13)	398 Kb
Student laboratory worksheet (age 14-18)	319 Kb
Power point presentation	2208 Kb
Video 1 Superhydrophobic materials	40740 Kb
Video 2 Superhydrophobic materials	38083 Kb

Click [here](#) for more information on the Schools' Community and on how to register.







## About Nano

## Nano Lab

## Nano Dialogue

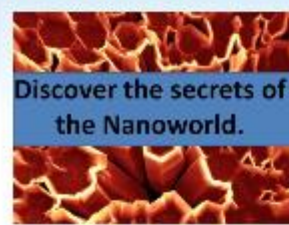
## Play Nano

## Nano Educators

### NANOYOU Posters



### NANOYOU Power Point



### NANOYOU film



### Virtual Nano Lab - Construct an el



### Experiment with Superhydrophob



### Experiment with Colorimetric Gold



### Experiment on Natural Nanomater



### Experiment with Liquid Crystals



### NANOYOU: Virtual dialogue



Engage in a discussion on the different NT dilemmas that NANOYOU is presenting you and try to find solutions using your knowledge on NT. You'll be able to share your opinions with other NANOYOU participants. Click on the images below to select...

★★★★☆ 3.0/5 (2131 votes) Tuesday, 19 January 2010 44064 hits

### NANOYOU picture contest



The Nanoyou picture contest "My intelligent environment" ran from December 7th, 2009 till July 1st, 2010 and was open to people aged 18-25. Youngsters were invited to portrait how nanotechnologies are becoming part of our lives and to discuss...

★★★★☆ 3.0/5 (2081 votes) Friday, 27 November 2009 70219 hits

### NANOYOU: Role Play



Is it right to sell antibacterial socks containing silver nanoparticles while is not known yet if they are entirely safe for the environment? Should nanosensors be used to diagnose medical conditions in the early stages when there are still no...

★★★★☆ 2.9/5 (3119 votes) Monday, 23 November 2009 53597 hits

### NANOYOU Video Contest



On the 5-6 December 2009 six teams of youngsters took part in the NANOYOU video contest and spent a weekend working on the production of short videos on "Living a 2.0 city". Now you can watch the finalist videos and enjoy the results of that...

★★★★☆ 2.9/5 (1529 votes) Friday, 20 November 2009 37727 hits

### ENSAG video contest



In the context of NANOYOU, students from ENSAG (École Nationale Supérieure d'Architecture de Grenoble) took part in the workshop "Big Scale, Small Objects", where they produced videos on the theme of the communication networks in the city....

the Community!  
are already and sharing their

- 501 Kb
- 751 Kb
- 104 Kb
- 452 Kb
- 1-13) 398 Kb
- 4-18) 319 Kb
- 2208 Kb
- 40740 Kb
- 38083 Kb

n on the Schools' ter.

# Diskusija: Antibakterijske nogavice ... „nano“ zobne ščetke

Home >> Dilemmas 1 Grade 11 - 13

## The antibacterial socks - Grade 11 - 13

Silver nano-particles placed into socks eliminate the bacteria which cause smelly feet and fungal infections. Using these socks might make sport's players life much more pleasant ...

1. Click on the buttons to watch the different stages of the animation.
2. Answer the questions related to the animation you have watched by filling in the boxes.
3. Press send to share your answers with other participants.

**The Problem** [Click for the solution](#) [Click for the effect](#) [Summa](#)



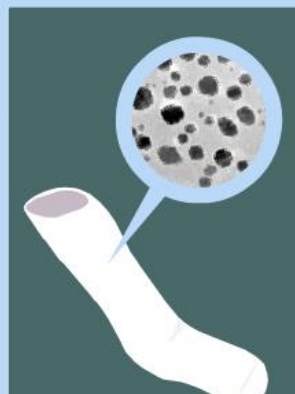
### The problem

After playing tennis my socks smell.



### The solution


Silver nano particles placed in socks eliminate the bacteria which cause smelly feet.




### The effect


Silver nano particles can get washed out into the water systems and pollute the environment.



Name:    
School:    
Country:  

Is it right to buy antibacterial socks?

What is your opinion? 

Please justify your opinion: 

!?

### The problem

When you brush your teeth, you leave millions of germs on your brush.



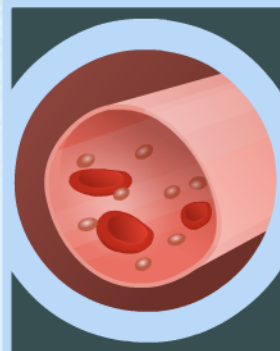
### The solution

Nano antibacterial toothbrush are made of nano silver nanoparticles that kills 99.7 percent of those germs within six hours after the brush has been used.



### The effect

There is a lack of information on the effects of nano particles entering our body.





# Diskusija: „Nano“ sončne kreme

NANO



## The problem

It is important to use something to protect our skin from the sun, but using regular sunscreen makes us ridiculously white.

## The solution

sunscreens containing nanoparticles of titanium oxide are excellent at absorbing the sun's harmful UV rays while leaving us looking natural.

## The effect

Some nanoparticles may be absorbed through the skin.

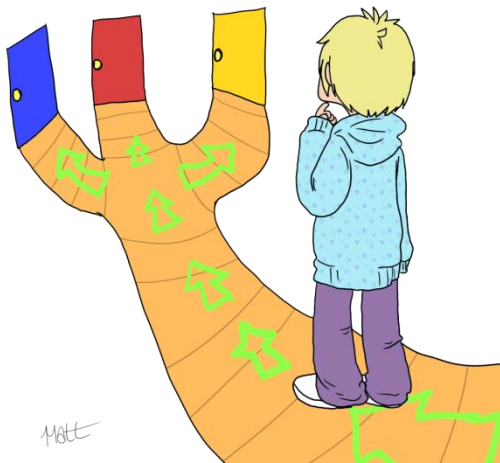


!?



# POZOR: ČAS ZA KRITIČNO MIŠLJENJE!

Kritični mislec se vplete v dogajanje z **razmišljujočim skepticizmom**, usmerjenim v odločitev o tem, v kaj verjeti ali kaj storiti. (Ennis → Halonen v Rupnik Vec, 2011)



“Do not indoctrinate your children. Teach them how to think for themselves, how to evaluate evidence, and how to disagree with you.”

(Richard Dawkins)

NATURKOSMETIK



Zakaj uporabljamo „nano“ sončne kreme?

**Sun Lotion sensitive**  
100% mineralischer Lichtschutz  
Nano-frei\*

**Soleil Family & Kids**

**LSF/SPF**

**30**

# Projektno delo – avtentični problemi

## Ali lahko zaščitimo dihala pred nanodelci?

Onesnažen zrak v Pekingu: dihati ali ne dihati, to je zdaj vprašanje

Po oranžnem alarmu je prišla edina možna rešitev – zapihal je veter in del strupov odnesel drugam.

Zorana Baković  
sre, 16.01.2013, 09:00



<http://www.delo.si/novice/svet/onesnazen-zrak-v-pekingu-dihati-ali-ne-dihati-to-je-zdaj-vprasanje.html>

### Ali naj nosimo maske?

Zaradi opozoril pred preseženo koncentracijo delcev v zraku nekateri kupujejo zaščitne maske. NIJZ: Za delce maske niso niti primerne niti učinkovite.

I. H. / Ljubljana  
1. 2. 2016, 12:59

<http://www.zurnal24.si/onesnazen-zrak-visoka-koncentracija-delcev-pm10-masko-opozorilo-vrtcem-clanek-264386>

### Onesnažen zrak ubija

Objavljeno: 30.03.2014 15:00 | Posodobljeno: 30.03.2014 15:00  
Avtor: U. S.  
Ključne besede: > smog, > onesnaženje

Svetovna zdravstvena organizacija opisuje onesnaženje zraka kot največji okoljski dejavnik tveganja za zdravje. Strokovnjaki ga ne povezujejo samo z boleznimi dihalnih poti, ampak tudi z boleznimi srca ter možgansko kapjo.





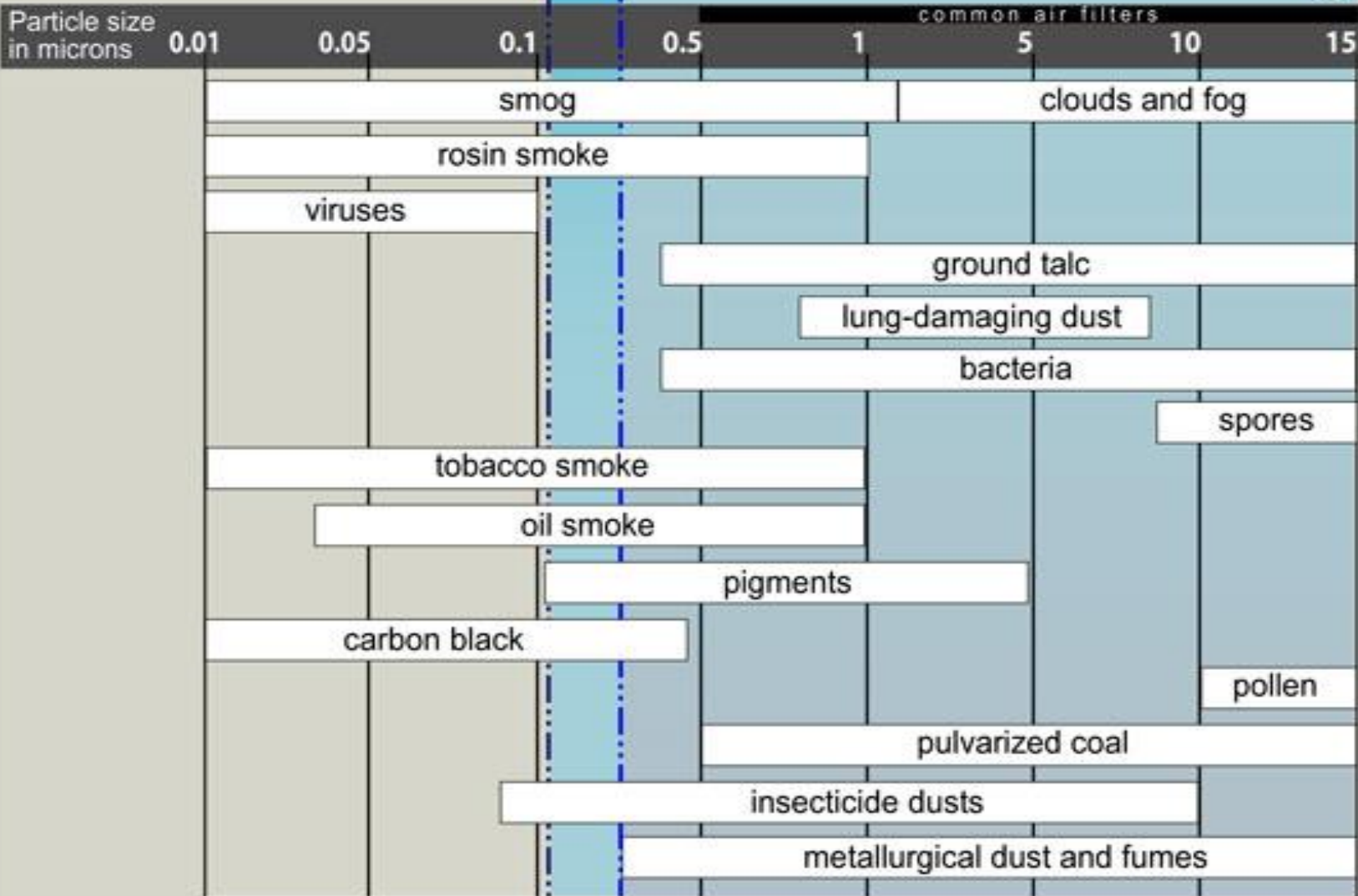
# Particle Size Chart

Common types of particulate matter

**ULPA**  
up to 99.9995% efficient to 0.12 microns

**HEPA**  
up to 99.97% efficient to 0.3 microns

**FILTER TYPE**



Sentry Air Systems

# HEPA FILTRI ... ULPA FILTRI

HEPA- High Efficiency  
Particulate Air

ULPA - ultra-low particulate air

Filtra zadržita delce z velikostjo nad  
300 nm, najboljši pa nad 100 nm.

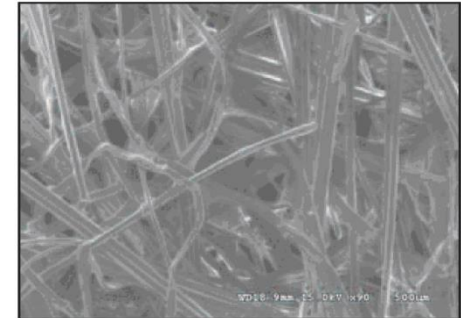
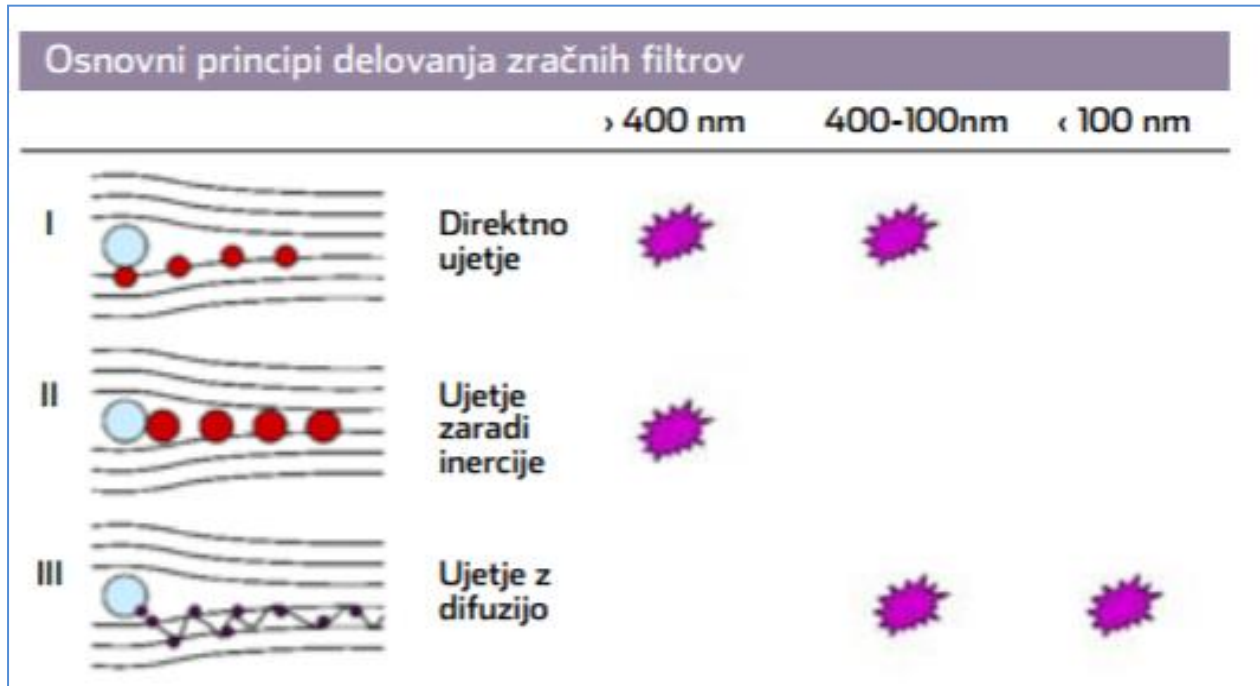
Oznake na filtrih:

- P100 – filter zadrži 99,97 % nanodelcev z velikostjo več kot 300nm
- P95- – filter zadrži 95 % nanodelcev z velikostjo več kot 300nm

Classification	Filter type	Percentage efficiency at MPPS
E10	HEPA	≥ 85
E11	HEPA	≥ 95
E12	HEPA	≥ 99.5
H13	HEPA	≥ 99.95
H14	HEPA	≥ 99.995
U15	ULPA	≥ 99.9995
U16	ULPA	≥ 99.99995
U17	ULPA	≥ 99.999995



# Delovanje vlaknastih filtrov

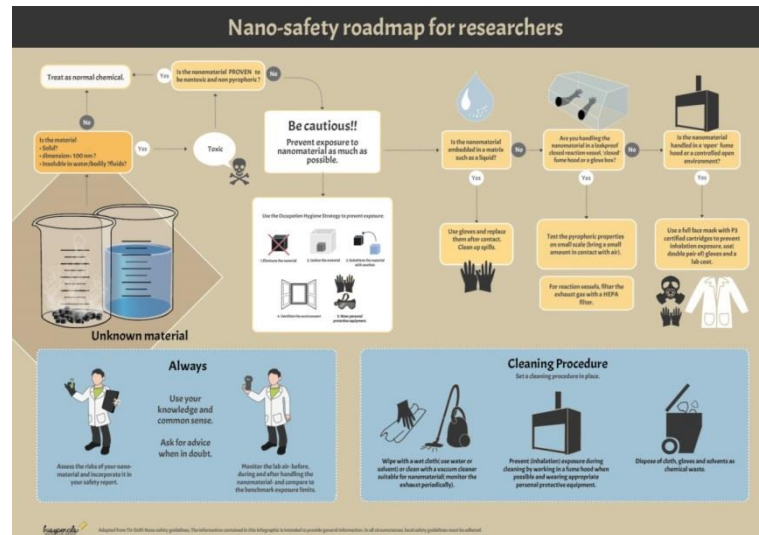


Kvaliteta filtra se podaja s % delcev z velikostjo 300 nm, ki jih filter prepusti.

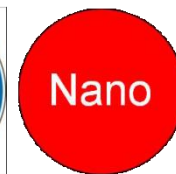
## Kako naj bo zaščiten „nano“znanstvenik, delavec...?



# Priporočena osebna zaščita za znanstvenike: rokavice, očala, maske s HEPA filtri



P- stavki



## Exploring Tools—Dress Up Like a Nanoscientist

Try this!

1. Have a friend stand a few feet in front of you. If they want, have them put on a pair of goggles. Hold up the “Dress Up Like a Nanoscientist” card in your hand and align your friend’s face with the cutout.
2. Imagine your friend as a future nanoscientist! If you have a camera (or a phone with a camera), take a picture!

*Tip:* To keep things in focus, you may need to hold your arm straight out and have your friend move further back away from you.





# NAMESTO ZAKLJUČKA

Pravkar kupujete avto...

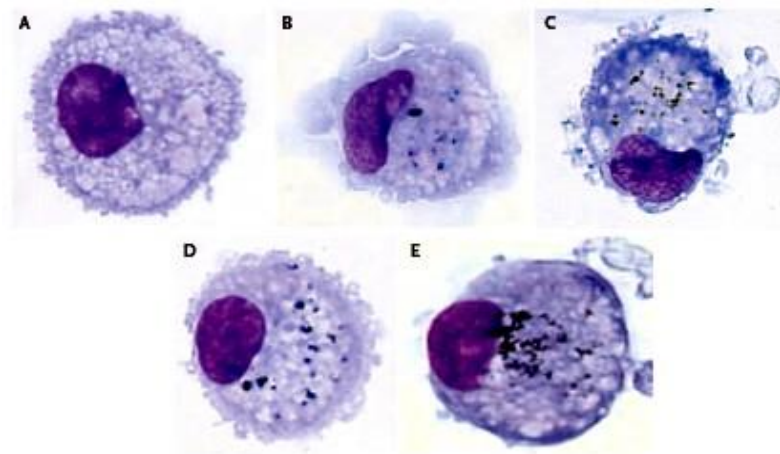
Boste kupili diesla ali...?



# Zakaj ne diesla?

Ogljik iz dieselskih motorjev škoduje delovanju pljuč pri zdravih otrocih  
(The New England Journal of medicine, July 6, 2006)

Jonathan Grigg



Razpolovna doba za ogljikove delce v makrofagih je 3.9 mesecev. Vsak  $1 \mu\text{m}^2$  ogljika v makrofagih povzroči 17 % zmanjšanje siljenega izdiha v sekundi.

V primerjavi z bencinskimi motorji, diesel motorji proizvajajo manj  $\text{CO}_2$ , ampak **več  $\text{NO}_x$  in nanodelcev**. Študije na podganah so pokazale, da visoke doze črnega ogljika iz dieselskih motorjev povzročajo pljučnega raka. Mehanizem nastanka raka je povezan z visokimi dozami nanodelcev in z obremenitvijo pljuč zaradi nalaganja ogljika.

Ne kadim,  
a vedno vžgem!

Loesje

**HVALA ZA POZORNOST**



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