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How can you explain
what is meant by

NANOTECHNOLOGY

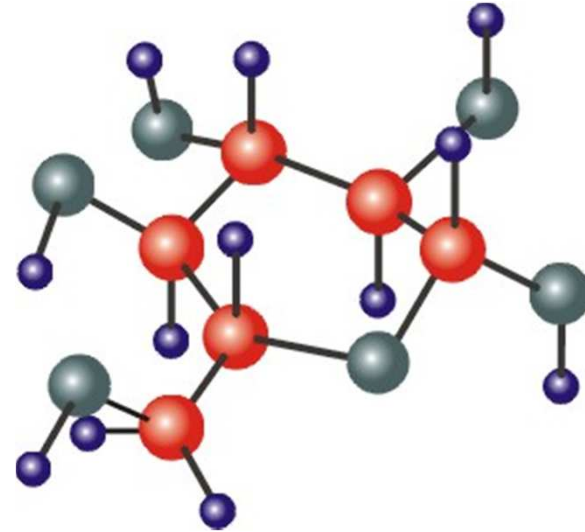
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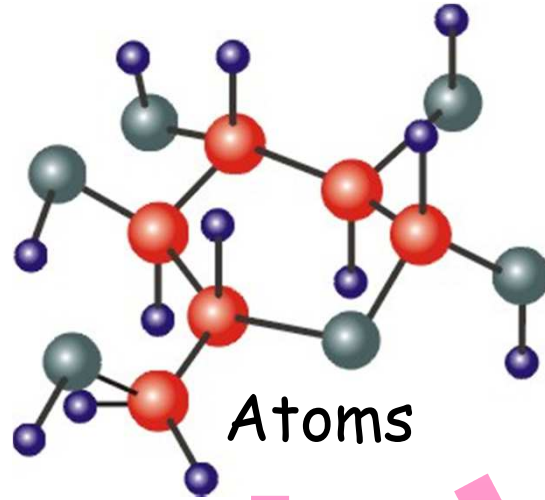
- You do remember that everything is made of **atoms**, don't you?
- A stone, a pen, a video game, a TV, a **dog** and **you too** are formed by atoms.





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Stone



You too



Video game



TV



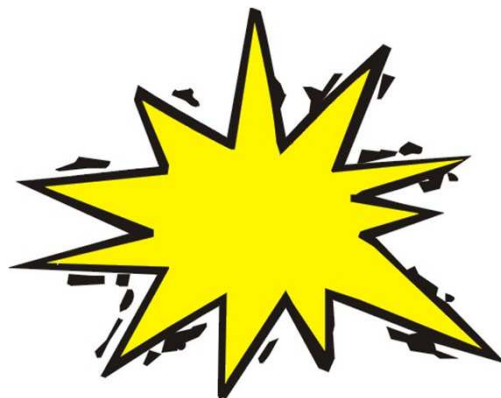
Dog



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- Atoms build molecules or form materials.
- **Nanotechnology** deals with the manipulation of atoms and/or molecules to produce materials, devices and even machines.

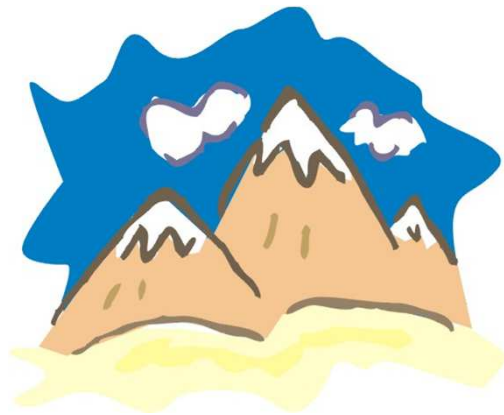




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Ever since the first human beings started to “make things”, we have started *from “big things”* (wood, stones, mineral ores) to obtain or extract what we want.



Now we want to start *from “small things”* (atoms and molecules), to assemble them and to obtain what we want. It’s a bit like a children’s game.



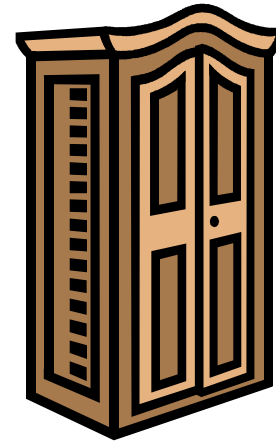
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to “make things”, we have started *from*
“big things” to obtain or extract what we want.



Wood





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to “make things”, we have started *from*
“*big things*” to obtain or extract what we want.



Stone





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Mineral ores



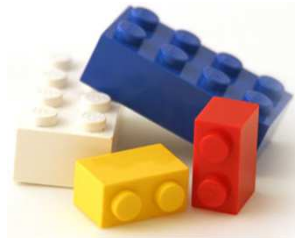


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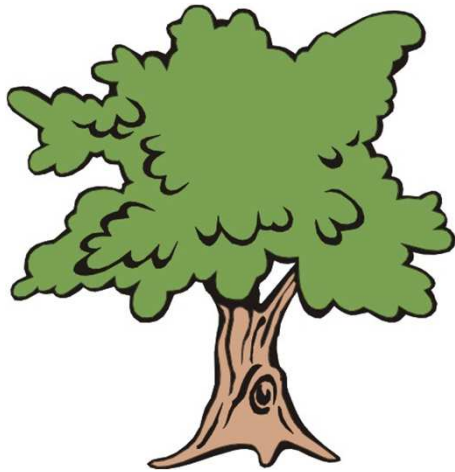




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A **canoe** was made from a **tree** ...



Would you make **toothpicks** out of a **tree trunk** or wouldn't it be better to start from smaller particles?



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• Starting from “big things”

has meant producing things with the precision that “we were able to achieve”, but -at the same time- producing lots of **waste or pollution, and consuming a lot of energy.**

As we got better at technology, precision improved and waste/pollution diminished, but the approach was still the same.





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• *Starting from "small things"*

means *absolute precision* (down to one single atom !),

complete control of processes (no waste?) and

the use of *less energy* (with

less CO₂, less greenhouse

effect, ... *perhaps you*

heard about that on TV.





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Starting from "small things"

- means *absolute precision* (down to one single atom!),
complete control of processes (no waste?) and
the use of *less energy* (with less CO_2 ,
less greenhouse effect,

... perhaps you heard about that on TV).





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Advantages of starting from "small things"

- the distance between the centre of two footballs is bigger than the distance between the centre of two nuts → **smaller means nearer (and quicker to connect)**



- you can dissolve sugar or salt quicker when it is in powder form and slower when it is in the form of crystals or blocks → **smaller can become more reactive**



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Try this **eXercise**:

- How many faces has a cube?
- If its side is 1 cm, how much is its total surface area?
- If you cut the cube three times (vertically, horizontally and transversally) how many cubes do you obtain?
- Each side of every cube will be 0,5 cm; what is the total surface area of all the new cubes?

You will see that given equal weight (or better, mass), **smaller means more surface area** and, as for the example of sugar and salt in water, **more reactivity**.



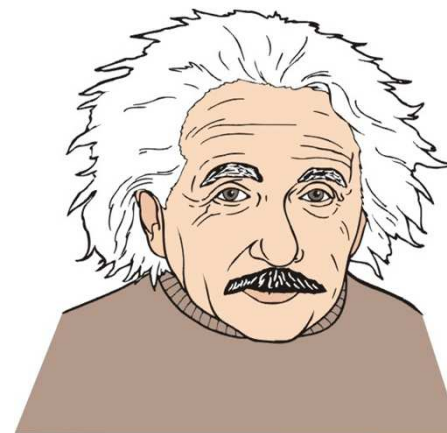
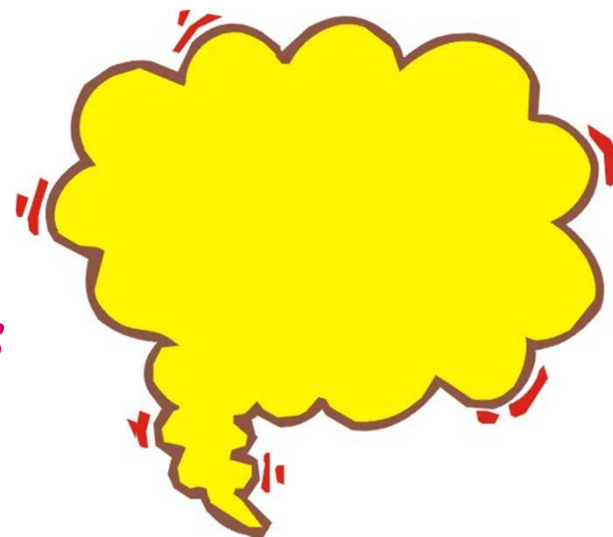
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- Research into nanotechnology is a particularly challenging adventure.
Many of the world's best minds are engaged in this.

And we need brilliant students and scientists more than ever.

*We can see and move atoms
We can see and move molecules*





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- Can we do it already? Not really. That's why *we need a lot of research.*
- Right now we can do a few things: mostly in electronics, optics and material sciences, such as **nano-particles**, e.g. those in **sun creams** (do you use factor 8 or factor 20?). It's the amount of nano-particles that are inside to absorb the ultra-violet radiation that can burn your skin.





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In the future, possible applications are *fantastic* to figure out, such as:

- > *measurements* with one-atom precision;
- > sensors to detect dangerous substances;
- > *electronics* where we can use every single electron;
- > membranes for separations with very high precision;
- > *materials* that change properties as we need them;
- > nano-machines;
- > *nano-robots* that enter your body to clean or fix it

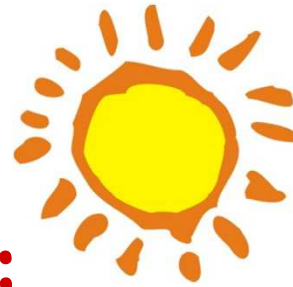
...but we are only at the beginning. To achieve all this, we have to use our brains and optimise our efforts.



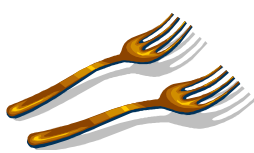
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Some examples concerning materials:



textiles that change properties as a function of needs, such as keeping you cool in summer and warm in winter;



forks, spoons, dishes, pots, clothes, ... that do not get dirty or wet - just like a lotus leaf when you pour a drop of water on it; eventually, you will not hear mum saying that you got your T-shirt dirty!

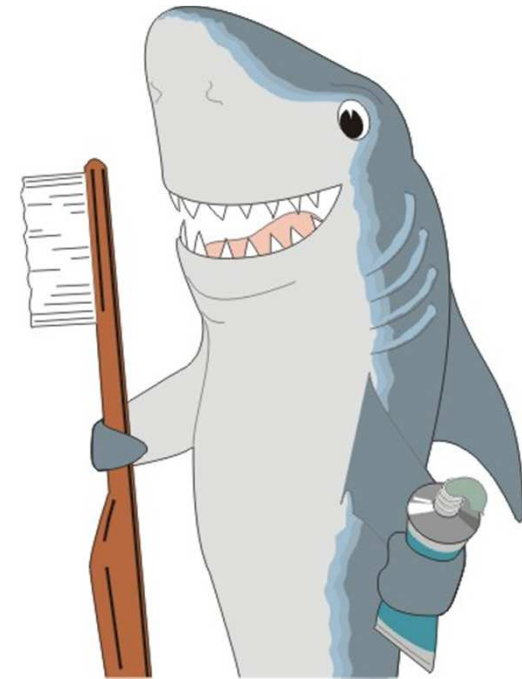


Carbon nano-tubes can be stronger than steel and lighter than plastic



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- ...
- materials that can fix your **bones** and **teeth** so that you cannot tell the difference;
 - materials that are very resistant and very light to make **cars**, **aircraft** and **space vehicles** able to go on longer journey with much less energy consumption;
 - and more in the future (**just think that mobile phones did not exist only ten years ago!**).

Materials with finer structure or smaller grains
can be stronger and lighter



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What do we need to progress faster ?

- *skilled staff,*
- *brilliant students,*
- *infrastructures (laboratories, ...),*
- *instruments (microscopes, ...),*
- *co-ordination of efforts and
"critical mass", funds,*
- *and that people understand what we are trying to do !*





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To **know more**, you can make a search on the internet by typing "**nanotechnology**".

Or start with these two web sites (in English):

@ <http://cordis.europa.eu/nanotechnology> to see what we are doing in Europe,

@ www.nano.gov for the USA (and do not miss the part **for kids** !)





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By the way ...

- The prefix "**nano**" comes from the ancient Greek word for "**dwarf**".
- In science and technology it indicates the dimension of **one billionth** (and you know that e.g. the prefix "**kilo**" indicates **one thousand**).



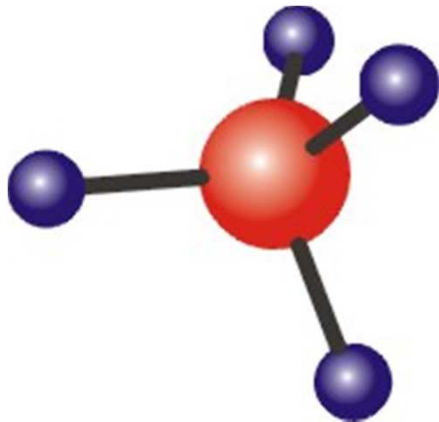


0.000 000 001 metre

- One **nanometer** is thus **one billionth of metre** (or one millionth of millimetre, etc.). It can be expressed as 10^{-9} metres and shortened to **nm**.

- The radius of one atom of **gold** is 0.14 nm.

- Half a nanometre is the linear dimension of a small molecule like **methane** (CH_4). One human **hair** is around 100 thousand times bigger.





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For more information ...



... do you want to contact us?

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