

NANOTECHNOLOGY

OPPORTUNITY TO FIND INTERSUBJECT RELATIONS

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Today trend in education is to apply the intersubject relations for understanding the context between science subjects. Nanotechnology has been described as a technology of the twenty-first century. We understand nanotechnology as an interdisciplinary field including chemistry, physics, biology, material science and engineering. It has offered the opportunities to find connections between science subjects.

We want to introduce nanotechnology to the students of master study program Physics Teaching. Students have already necessary physical and mathematical background for broadening their science knowledge. This poster presents fundamentals of module Nanotechnology for above mentioned students of Physics Teaching. The module introduces terminology, student's activities, intersubject relations, characterization tools, usefulness and risk of nanotechnology.

The current science knowledge should be integrated into the training of future teachers.

These are exaples of Module Nanotechnology:

WHAT IS NANOTECHNOLOGY?

STUDENT'S ACTIVITY

Then they can pass on these knowledge to their students with confidence.

INTRODUCTION

Nanomaterials are used in our daily lives. Users mostly do not know why the nanomaterials are so exceptional.

Nanotechnology is a rapidly evolving field with many applications and does not deserve attention of scientists only. For high school students it is important to know about possibilities of nanotechnology. They will know more about their antibacterial socks with silver nanoparticles and maybe nanotechnology will catch them for following university studies.

Physics teachers can integrate nanotechnology to their lessons like a new separate unit or put the knowledge into the regular lessons in appropriate places.



How small is nanometer?

Students work in groups. They select an item to represent 1 nanometr. For example a coin. Students measure a di-

The diameter of the coin = 1 nanometer. Students should figure out how long a 1 meter would be.

Step 1: nanometer 1 nanometer 1 micrometer lice Step 3: milimeter **1** milimeter

NANOMATERIALS

Worksheet

FULLERENS

Intersubject Relations – chemistry, mathematic

Create a small groups and work up the following tasks.

- 1. The Nobel Prize in for discovery of fullerens was awarded in 1996.
- 2. What type of geometric shapes are the faces of fulleren C_{20} ? What Platonic solid is fulleren C₂₀? Fulleren C_{20} is
 - the most stable \times unstable fulleren.

The reason is

- 3. Build C_{20} from the Orbit molecular building system. Make a picture.
- 4. What type of geometric shapes are the faces of fulleren C_{60} ?

Fulleren C_{60} is

the most stable \times unstable fulleren.

Look for the physical and chemical properities of C_{60} :

5. Build C_{60} from the Orbit molecular building system. Make a picture.

What can you write about C_{60} symetry?



Model of fulleren C₂₀ from

Orbit molecular building

system



RISK OF NANOMATERIALS INTERSUBJECT RELATIONS

Nanotechnology is interesting and useful technology. Is it safe for us or not?

Health safety and potential risk of nanomaterials and nanotechnology are recent topics on national and international level.

Nanoparticales are around us - Diesel nanopaticales, carbon blacks, manufactured nanoparticles and naturally occurring nanoparticles. They are small and have a larger surface area - larger impact for chemical reactions. Nanomaterials are able to cross biological membranes and access cells, tissues and organs that largersized particles normally cannot.



Model of fulleren C₆₀ from Orbit molecular building system

References:

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How these nanoparticles behave inside the body? What are their pathways into the body?

These are good questions for biology and chemistry.