



A CASE STUDY ON NANOSCALE AND NANOTECHNOLOGY

by

Evelina Vasileva, 7-th Highschool "Sv. Sedmochislenici" Sofia Bulgaria

BASIC INFORMATION:

Evelina Vasileva is a teacher in 7th Highschool "Sv. Sedmochislenici" in Sofia, Bulgaria. The lesson "Nanoscale and nanotechnology" was implemented with students in the 8th grade.

The school is in Bulgaria's capital city – Sofia.

INTRODUCTION/BACKGROUND

The "Nanoscale and Nanotechnology" lesson provides the opportunity to explore and understand the metric system, nanoscale, properties of nanoscale particles and what nanotechnology deals with. Students will develop the ability to convert ordinary measurement scales into nano and visualize the nano scale.

PURPOSE

- ✓ To increase awareness about nanotechnology
- ✓ To comprehend nanoscale
- ✓ To enhance the ability to convert units into nanometres

OBJECTIVES

The lesson/activities is designed for the **10 form students**, and are applied in a class of **Biology** and health education

The objectives are:

1. to introduce students to some of the applications of nanotechnology in the everyday life
2. To watch the "Powers of Ten" film
3. To measure various objects around the room (a cell phone, a boy's height , a book, a single hair, sugar cube etc) and convert them to nano
4. To examine the properties and dimensions of objects in the link "<http://htwins.net/scale2/>"
5. To examine the relationship between surface area/volume ratio and physical properties of objects using sugar cubes.

The proposed activities allow students to:



1. Get to know possible applications of nanotechnologies
2. Visualize the dimension ratios in the micro- and macro world
3. Enhance the ability to convert decimal into exponential units and vice versa
4. To realize how small nano particles are
5. Work as a team

LEARNING RESULTS

- Students learned more about:
- Conventional and nanotechnology,
- What is the ratio between our scale and nanoscale
- How to convert decimal into exponential units and vice versa
- The importance of the total surface for the physical and chemical properties of the matter.

CLASSROOM MANAGEMENT & SEQUENCE OF EVENTS

Observation, brain storm, visualization, practical work

1. Introduction – nanotechnologies’ application in everyday life; Watching movie “Nanotechnology” at <http://www.youtube.com/watch?v=OKXwdG-Kk2Q>
2. Talking about “scale”- large and small
3. Watching “The powers of ten”
4. Exercise 2: Measure different objects in the classroom and convert their sizes into nanometre.
5. Starting the Activity-3 described in Students’ Guidelines. The scale of The Universe <http://htwins.net/scale/> - an individual work performed by one student observed and guided by the class.
6. Starting the Activity-4 described in Students’ Guidelines: Defining the surface/volume ratio of geometrical shapes

RESOURCES

1. <http://www.youtube.com/watch?v=9bh2H-oFMQQ>
2. <http://htwins.net/scale/>
3. <http://www.youtube.com/watch?v=DchhhtISUck>
4. <http://www.youtube.com/watch?v=oSCX78-8-q0>

PROCESS (ENDING)



Step-1: Asking the following questions about the text.

Question 1: What is nanotechnology?

Step -2: Watching the movie “Nanotechnology” and discussing the importance of nanotechnologies – their application in everyday life.

Step -3: Watching “Powers of Ten” video in Activity-1. (Before watching the video asking students to realise some key words like nano, meter, largest scale and smallest scale.)

Step -4: Asking questions about the activity.

1. What is scale?
2. What is the largest scale shown in the video?
3. What is the smallest scale shown in the video?
4. How do you feel about travelling this long distances in empty space shown in the video?

Step -5: Starting the Activity-2 described in Students’ Guidelines: Measure the objects given in the activity in couples and convert the measurements into nanometre.

Step -6: Asking the following question about the activity.

1. Compare the size of red blood cells and a single hair.
2. Compare the size of a bacteria and a virus.
3. Compare the width of a single water molecule and a single gold atom.

Step -7: Starting the Activity-3 described in Students’ Guidelines. The scale of The Universe“<http://htwins.net/scale/>”

Step -8: Asking the following question about the activity.

1. What is the size of smallest thing visible to an electron microscope?
2. Compare the sizes of water molecules and Buckyball. Show the difference by
3. drawing shapes with the same scale difference on the board.
4. Compare the sizes of a cell, cell nucleus and carbon nanotube.

Step -9: Starting the Activity-4 described in Students’ Guidelines.

Step -10: Asking the following question about the activity.

Measure, calculate and compare the sizes of the figures you build with sugar cubes.

CONCLUSION

Discussion of the following:

Do you think nanotechnology will be beneficial or detrimental to health of the people in the future?

IMPACT ON STUDENTS

The students were mostly interested in the examples of application of nanotechnologies in the production of tissues, prostheses, alloys etc.

They faced difficulties in converting decimals into exponential units and vice versa.



They also found it difficult to calculate volume and surface area of the geometrical shapes so only a small group of students tried to solve the problem

STUDENTS' FEEDBACK

Expressed feedback:

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Processed feedback (graphical results):

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(Diagrams/Graphs)

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CONCLUSION

It would be more efficient to first get students to know better about the application of nanotechnologies.

There should be more time to base the necessity of calculating surface to volume ratio. Also there should be more examples of the changed properties of substances when the total surface increases.

As a whole students liked watching “The powers of ten” and the activities related to measuring but disliked the mathematical problems.

References

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Videos

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NANO TECHNOLOGY SCIENCE EDUCATION (NTSE)
Project No: 511787-LLP-1-2010-1-TR-KA3-KA3MP



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Links

<http://vlab.ntse-nanotech.eu/NanoVirtualLab/>

<http://ntse.ssai.valahia.ro/>

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Images/video taken during the activity/project/lesson(s)

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CASE STUDY ON “NANO SCALE AND NANOTECHNOLOGY”

Implemented by Evelina Vasileva, National VET school of optics and fine mechanics “M. Lomonosov”, Sofia, Bulgaria

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4. To realize how small nano particles are



5. Work as a team

LEARNING RESULTS

Application of nanotechnology
Metric system and measuring units and their derivatives
Working with optic appliances

CLASSROOM MANAGEMENT & SEQUENCE OF EVENTS

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PROCESS (ENDING)

- Brainstorming for the possible applications of nanotechnology. Showing the movie “Nanotechnology”.
- Smooth transition to the movie “Power of the ten” and focusing the attention on the exponential growth on each 10 seconds receding from the zero point, as well as the similarity between $10^9 - 10^0$ and $10^0 - 10^{-9}$.
- Giving materials and reading the text
- Commenting on the table with measuring units
- Giving rulers and with their help the students measure different objects, their own height, etc – practical work.



- Writing down some of the results on the board and converting to nanometers. Here the students have difficulties.
- One student works on the computer with the program “Model of the Universe” under my guidance and the help of other students defines the size of the microobjects.
- Showing the movie “A journey to the nanoworld” for students to observe the work of the Atomic force microscope and to realize the size of nano-particles, which it scans to make an image.
- Excerpt from the movie – “A boy and his atom”, to see atoms, which can be manipulated during the production of nanoproducts.
- Task 4 – there are sugar cubes on the tables. The students have a task to calculate the surface and the volume of the sugar cubes, as well as their derived figures.
- Comparing the results. Again, there are problems with the mathematical tasks.
- Conclusion about the importance of nanotechnology today and in the future and about the possibility for the students to study science.
- Doing the test.
- Filling the table for self-assessment

IMPACT ON STUDENTS:

The students (8th grade) were impressed by the possibility of tissues to remain dry and clean. They were impressed by the ratios in the distances in the “Power of ten”
They had difficulties with the mathematical tasks.

CONCLUSION:

My conclusion is that age matters when presenting this topic to the students. In the 8th grade they are much more impressed with the practical application of nanotechnology. Also, it does matter if the activity is done in 90 minutes without a break than in two 40-minute lessons. The reason for looking at ratio surface/volume should be explained. As a whole, the lesson is easy for implementation but a little bit static.