NANOWARE Educators Guide

MODULE 4: HOW DO WE SEE NANOPARTICLES?

DELIVERABLE: R1/T1.3



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1. Introduction Part

Grade Level: 9-12

Subject Area: Visualizing Nanoparticles

Time required: 90 minutes.

Learning Objectives (LO): Students will be able to:

- explain the limits of vision of the human eye (LO1)
- describe what the purpose of using the light microscope and its operational principles is (LO2)
- describe why we cannot visualize atoms using the light microscope (LO3)
- explain visualization methods we can use to visualize atoms and nanoparticles (LO4)

Summary: NANOWARE has developed an information package for teachers that includes background information and documents about visualising nanoparticles and getting acquainted with imaging methods of nanoparticles. This information package is referred to as the NANOWARE Educators Guide. Below is an overview of its content.







2. Lesson Background Information

Nanotechnology is the name given to all of the engineering and technology studies carried out in sizes ranging from 1 to 100 nanometres. Nanotechnology is a field in which studies are carried out in small sizes that cannot be evaluated with the measurement units used in daily life. Therefore, it has its unit of measurement. This measurement unit is called a nanometre and describes a specific size, such as millimetres or centimetres. One nanometre is a unit of measurement equal to one billionth of a metre. Nanoparticle, on the other hand, is used to express a single substance with dimensions of 1 to 100 nanometres. These parts cannot be seen with the naked eye. At the same time, it is not possible to see it when viewed with light microscopes. The teacher may want to become familiar with basic information about visualization methods to visualize atoms and nanoparticles such as SEM, TEM, AFM, and STM by accessing materials on the internet in the resource section below.

Sources:

- 1. <u>https://www.nnin.org/education-training/k-12-teachers/nanotechnology-curriculum-</u> materials/level/high-school
- 2. https://nanohub.org/resources/18107

Materials:

- https://www.youtube.com/watch?v=j_wQgy97Pi4
- Access to PowerPoint (optional for classroom presentation)
- Light Microscope
- Calculator







3. Suggested Teaching Strategies

To get students' attention to nanotechnology, the teacher may use a video (https://www.youtube.com/watch?v=j_wQgy97Pi4) introducing nanotechnology (Activity 1) and may discuss with the students why nano-scientists work with such small particles.

Activity 1 Name	Nanotechnology Video	ΤοοΙ
Short Description	Show students a video introducing nanotechnology to get their attention. And discuss with the students why nano-scientists work with such small particles.	https://www.youtube.com/w atch?v=j_wQgy97Pi4
Objectives	To increase students' basic understanding of nanotechnology and nano-sciences.	
Keywords	Nanoscience, Nanotechnology	
Ages		





To help students understand how small objects on the nanoscale are, the teacher may do "Activity 2- How big it is!" which is a size and scale activity. The teacher may help the students to make size conversions of objects. Through this activity, students will have a chance to develop an understanding of how small a nanometer is in comparison to common objects.

Activity 2 Name	How big it is!	ΤοοΙ			
Short	For this activity, students work in	Latin prefix w/meter	Measure as an exponent	Measure as a number	Common Expression
Description	groups of 4 or 5. Then, show to the	Terameter	1012	1,000,000,000,000	One Trillion
		Gigameter	109	1,000,000,000	One Billion
	students the following figure about	Megameter	106	1,000,000	One Million
	the metric system.	Kilometer	10 ³	1,000	One Thousand
	,	Milimeter	10-3	0.001	One Thousandth
		Micrometer	10-6	0.000001	One Millionth
		Nanometer	10-9	0.00000001	One Billionth
Objectives	To increase students' basic	Picameter	10-12	0.0000000001	One Trillionth
	understanding of the metric system and nanoscale and make size conversions of objects.				
Keywords	Nanoscience, Nanotechnology,				
Ages	14-17				





To help the students understand how the microscopes work, the teacher may do "Activity 3-Light and Electron Microscope Videos". The teacher may help the students understand when we should use these microscopes and what are the differences between them. Through this activity, students will have a chance to develop an understanding of why we use these microscopes.

Activity 3	Light and Electron Microscope	ΤοοΙ		
Name				
Short	Show students such videos	ages 9-12:		
Description	introducing light microscopes and	https://www.youtube.com/w		
	electron microscopes to get their	atch?v=tVcEEw6qbBQ,		
	attention. And discuss with the	ages 13-17:		
	students why scientists need to see	https://www.youtube.com/w		
	very small objects.	atch?v=FnOvLEaC4gg		
Objectives	To increase students' basic	https://www.youtube.com/w		
	understanding of nanotechnology,	atch?v=GY9lfO-tVfE		
	nanosciences and imaging	https://www.youtube.com/w		
	techniques.	atch?v=a0G7iyz4McM		
		https://www.youtube.com/w		
Keywords	Nanoscience, Nanotechnology	atch?v=Qq8DO-4BnIY		
•		https://www.youtube.com/w		
Ages	9-17	atch?v=ZyXrtODhJEA		
		https://www.youtube.com/w		
		atch?v=6gIneqf6pYU		





To help the students experience how the microscopes work through a hands-on application, the teacher may do "Activity 4- Observing Samples Using Light Microscope". The teacher may show students how to prepare a slide of an onion peel and observe it under a light microscope. Through this activity, students will have a chance to experience and learn how to prepare samples and visualize them using the light microscope.

Activity 4 Name	Observing Samples Using Light Microscope	ΤοοΙ
Short Description	Show students a video on preparing samples and visualizing them using the light microscope and then show the students how to prepare a slide of an onion peel and observe it under a light microscope	https://www.youtube.com/watc h?v=6gIneqf6pYU Materials used within the video and a light microscope
Objectives	To increase students' understanding of preparing samples and visualizing them using the light microscope.	
Keywords Ages	Nanoscience, Nanotechnology, 14-17	

Pre-requisite Knowledge: (general)

Students should know about the metric system of measurement (SI units) and conversion of the metric units; they should define nanoparticles; they should know about the visualization limit of the human eye and students should know the purpose of using the light microscope. Students should know how to perform a search on a specific topic either on the Internet or at their schools' facilities.





4. Assessment

Assessment: (rubric for assessment of visualizing nanoparticles knowledge of students)

	Exceptional	Satisfactory	Developing	Unsatisfactory	Total
	4	3	2	1	
Knows limits of the human eye/ the reason for usage of microscopes (LO1).	Can clearly explain LO1.	Provides an explanation of LO1.	Provides some explanation but with details missing.	Does not explain LO1.	
Explains nanotechnology within the environment (LO2).	Can clearly explain LO2.	Provides some explanation of LO2.	Provides less of an explanation but with details Missing.	Does not explain LO2.	
Describe why we cannot visualize atoms using the light microscope (LO3).	Can clearly explain LO3.	Provides some explanation of LO3.	Provides less of an explanation but with details missing.	Does not explain LO3.	
Knows how to prepare samples and visualize them using the light microscope (LO4).	Can clearly explain/show LO4.	Provides some explanation/dem onstration of LO4.	Provides less of an explanation/d emonstration but with details Missing.	Does not explain/show LO4.	