NANOWARE Educators Guide

MODULE 1: WHAT IS NANOTECHNOLOGY?

DELIVERABLE: R1/T1.3

NANOWARE

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Contents

1. Introduction Part

Grade Level: High School

Subject Area: Macro, micro, and nanotechnology

Time required: 90 minutes.

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

- distinguish between macro, micro and nano scales (LO1)
- apprehend the nanoscale and learn to calculate in nanometres (LO2)
- learn historical facts about the history and evolution of nanotechnology (LO3)

Summary: NANOWARE has developed an information package for teachers that includes background information and documents about the basic principles and differences in Macro, Micro, and Nanotechnology and the basics about the history and evolution of nanotechnology. This information package is referred to as the NANOWARE Educators Guide.

2. Lesson Background Information

Nanotechnology has started to have a very important place in our current lives. Macro, micro and nano refer to different scales that help us conceive the size of objects, their applications, and their properties. The macroscale concerns anything that can be seen with the naked eye, or else the “geometry on the order of millimetres and above”. In other words, the macro is something large in scale. The microscale refers to “submillimetre length scales down to the micrometre range”. The Microscopic matter is not visible to the naked eye without the use of a microscope. The nanoscale (1-100 nm) refers to matter measured in extremely small units of length called nanometres. A nanometre (nm) is equal to a billionth of a meter. Nanotechnology is the understanding and control of matter at the nanoscale. At this scale, materials present unique physical, chemical, mechanical, and optical properties; the manipulation of materials in the nanoscale can produce new structures, materials, and devices thanks to their special properties. As a result, nanotechnology can be used across various fields, like chemistry, biology, physics, material science, and engineering. Even though the term nanotechnology was born in the mid-20th century and nanoscience evolved in the decades that followed, nanoparticles and structures have been used for centuries.

Sources:

1. https://www.nano.gov/nanotech-101/what/definition
2. https://ec.europa.eu/health/scientific_committees/opinions_layman/en/nanotechnologies/l-2/1-introduction.html
3. https://www.nnin.org/education-training/k-12-teachers/nanotechnology-curriculum-materials/level/high-school

Materials:

- https://www.youtube.com/watch?v=j_wQgy97Pi4
- https://builtin.com/hardware/nanotechnology
- https://www.youtube.com/watch?v=D4aAwzGlVJU
- Access to PowerPoint (optional for classroom presentation)
- Some related videos

3. Suggested Teaching Strategies

To get students' attention to introduce nanoscale and nanotechnology, the teacher may use a video (https://www.youtube.com/watch?v=xW8Oocswn9s) related to nanotechnology (Activity 1) and may discuss with the students the scales of various complex materials and structures.

Activity 1 Name	**"What is Nanotechnology" video**	**Tool**
Short Description	Show students a video about nanoscale and nanotechnology to get their attention. And discuss with the students the scales of various complex materials and structures.	https://www.youtube.com/watch?v=xW8Oocswn9s
Objectives	To increase students' basic understanding of nanotechnology and nanoscale.	
Keywords	Nanotechnology, Nanomaterials, Macro, Micro and Nanoscale	
Ages	9-12	

To get students' attention to measure some items, the teacher may use a ruler to measure some objects having a different scale, then convert their scales to nanometres (Activity 2) and may discuss with the students, scales of various complex materials and structures.

Activity 2 Name	**"Measure your hand in nanometers"**	**Tool**
Short Description	For this activity, show the students some objects and measure their scale by using a ruler. After that, ensure the students measure their hands. Convert the object's scales to the nanometre.	Some objects, ruler, calculator
Objectives	To increase students' basic understanding of nanoscale.	
Keywords	Nanoscale, Nanotechnology	
Ages	9-12	

To encourage the students to express ideas, promoting interaction and communication between them, the teacher may do “Activity 3- “Intro to Nano” video (https://www.nisenet.org/whatisnano / https://vimeo.com/11362918). The teacher may help the students to express their views and their opinions. Through this activity, students will have a chance to develop an understanding of nanomaterials and their usage purposes in various industries.

Activity 3 Name	**“Intro to Nano” video**	**Tool**
Short Description	Show students a video about nano. And discuss how material properties (physical and chemical) in different scales can be used in various industries, like medicine.	https://www.nisenet.org/whatisnano (https://vimeo.com/11362918)
Objectives	To encourage students’ discussion about materials properties used for various purposes.	
Keywords	Nanotechnology, Nanomaterials	
Ages	9-12	

To help the students understand the history of nanoscience from ancient times to recent extraordinary applications, like the latest nanochip technology. The teacher may show “Activity 4- “History of Nanoscience” video”. Through this activity, students will have a chance to understand and learn existing applications of nanotechnology.

Activity 4 Name	**“History of Nanoscience” video**	**Tool**
Short Description	Show students a video about the history of nanoscience. Discuss existing applications of nanotechnology and even urge students to come up with new ones!	https://www.youtube.com/watch?v=YHPilQuZ0U0
Objectives	To encourage students’ discussion about applications of nanotechnology and the application areas of nanotechnology in the future.	
Keywords	Nanoscience, Nanotechnology,	
Ages	9-12	

Pre-requisite Knowledge: (general)

Students should search about the history of nanoscience and the differences between macro, micro and nano scales. Students should also search for nanotechnology applications in various industries before taking the lesson. 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 nanotechnology knowledge of students)

Learning Objectives	**Exceptional 4**	**Satisfactory 3**	**Developing 2**	**Unsatisfactory 1**	**Total**
Explains the differences of macro, micro and nano scales/technology (LO1).	Can clearly explain LO1 .	Provides some explanation of LO1.	Provides less of an explanation but with details missing.	Does not explain LO1.	
Undertands how small nanoscale is (LO2).	Can clearly explain LO2.	Provides an explanation of LO2.	Provides some explanation but with details missing	Does not explain LO2.	
Calculate in nanometers (LO2).	Can clearly explain LO2.	Provides some explanation of LO2.	Provides less of an explanation but with details missing.	Does not explain LO2.	
Explains the developments of nanotechnology in the history (LO3).	Can clearly explain/show LO3.	Provides some explanation/demonstration of LO3.	Provides less of an explanation /demonstration but with details missing.	Does not explain/show LO3.	