NANOWARE Educators Guide

MODULE 2: NANOMATERIALS

DELIVERABLE: R1/T1.3

NANOWARE

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DIGICULT

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1. Introduction Part

Grade Level: High School

Subject Area: Categorisaton and Application Methods of Nanomaterials

Time required: 90 minutes.

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

- explain how different nanomaterials are characterized (LO1)
- describe how nanomaterials are used in practice (LO2)
- explain differentiate the types of nanomaterials (LO3)
- describe the synthesis of nanomaterials (LO4)

Summary: NANOWARE has developed an information package for teachers that includes background information and documents about nanomaterials, their types and their use in practice. This information package is referred to as the NANOWARE Educators Guide. Below is an overview of its content.

2. Lesson Background Information

There are different types of nanomaterials, such as natural, artificial, incidental, intentionally produced/engineered and anthropogenic nanomaterials, and they are categorized concerning their synthesis, albeit naturally or artificially created. Nanoparticles are small particles that range between 1-100 nanometres in size. There are different groups of nanoparticles; fullerenes, metal nanoparticles, ceramic nanoparticles, and polymeric nanoparticles. Nanoparticles have a high surface area and nanoscale size, which offers them unique physical and chemical properties. As a result, they have multiple applications in various industries and examples from common products showcase the importance and potential of such materials in human progress.

Sources:

1. https://www.nano.gov/resources/education-and-outreach/teacher-resources
2. https://www.teacheron.com/nanomaterials-tutors

Materials:

- https://www.youtube.com/watch?v=nedDa4kgdFc
- https://www.youtube.com/watch?v=PNElByWIGNc
- Access to PowerPoint (optional for classroom presentation)
- Some related videos

3. Suggested Teaching Strategies

To get students' attention to nanomaterials, the teacher may use a video (https://www.youtube.com/watch?v=IkYimZBzguw) introducing nanomaterials (Activity 1) and may discuss with the students what nanomaterials mean.

Activity 1 Name	**"The Mighty Power of Nanomaterials" video**	**Tool**
Short Description	Show students a video introducing nanomaterials to get their attention. And discuss with the students what nanomaterials mean.	https://www.youtube.com/watch?v=IkYimZBzguw
Objectives	To increase students' basic understanding of nanotechnology and nanosciences.	
Keywords	Nanoscience, Nanotechnology, Nanomaterials	
Ages	9-12	

To help students learn the basics about buckyballs, nanotubes and graphene, the teacher may do “Activity 2- Bucky Balls, Nanotubes and Graphene”. The teacher may help the students to learn nanoscience and its applications. Through this activity, students will have a chance to develop an understanding of nanoscience and its applications.

Activity 2 Name	**“Bucky Balls, Nanotubes and Graphene” video**	**Tool**
Short Description	For this activity, students work in groups of 4 or 5. Then, show to the students the following figure about the metric system.	https://www.youtube.com/watch?v=PqApsO-rqpo
Objectives	To increase students’ basic understanding of nanoscience and its applications.	
Keywords	Nanoscience, Nanotechnology, Nanomaterials	
Ages	9-12	

To help the students understand how nanomaterials seem, the teacher may do “Activity 3- Describe and discuss!”. The teacher may help the students understand how nanomaterials seem by showing some nanomaterials pictures. Through this activity, students have a chance to develop an understanding of nanomaterials in their minds.

Activity 3 Name	**Describe and Discuss**	**Tool**
Short Description	Show students a PowerPoint presentation with pictures of nanomaterials and basic definitions to be used as talking points.	Presentations of some pictures of nanomaterials
Objectives	To increase students’ basic understanding of nanotechnology, nanosciences and imaging techniques.	
Keywords	Nanoscience, Nanotechnology, Nanomaterials	
Ages	9-12	

To help the students experience how nanoscience can improve medicine and other industries, the teacher may do “Activity 4- “What is nanomedicine” video”. Through this activity, students have a chance to experience and learn how the special properties of nanomaterials are/can be used in medicine.

Activity 4 Name	**“What is nanomedicine” video**	**Tool**
Short Description	Show students a video on “What is nanomedicine” and discuss how the special properties of nanomaterials are/can be used in other industries besides medicine.	https://www.youtube.com/watch?v=_jGRRNuMmZQ&t=147s
Objectives	To increase students’ understanding of how nanoscience can improve medicine and other industries	
Keywords	Nanoscience, Nanotechnology, Nanomaterials	
Ages	9-12	

Pre-requisite Knowledge: (general)

Students should know about nanomaterials, their types and their synthesis methods. They should define nanoparticles/nanomaterials; they should know about their applications. 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)

Learning Objectives	**Exceptional 4**	**Satisfactory 3**	**Developing 2**	**Unsatisfactory 1**	**Total**
Explain how different nanomaterials are characterized (LO1).	Can clearly explain LO1.	Provides an explanation of LO1.	Provides some explanation but with details missing.	Does not explain LO1.	
Explains how nanomaterials are used in practice (LO2).	Can clearly explain LO2.	Provides some explanation of LO2.	Provides less of an explanation but with details missing.	Does not explain LO2.	
Explains types of nanomaterials (LO3).	Can clearly explain LO3.	Provides some explanation of LO3.	Provides less of an explanation but with details missing.	Does not explain LO3.	
Explains the synthesis of nanomaterials (LO4).	Can clearly explain LO4.	Provides some explanation of LO4.	Provides less of an explanation but with details missing.	Does not explain LO4.	