NANOSCIENCE AND NANOTECHNOLOGIES

https://identitiesproject.eu/nanoscience-and-nanotechnology/

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Modular blocks	Goals of the block	Activities	IDENTITIES approach to interdisciplinarity	Role of participants	Mode of interaction	Suggested digital tools	Workload time	Non-editable format	Editable format	Hints for implementation
ID explorer - Introduction	The ID explorer - introduction block aims at engaging students with NST topic	Interactive lecture on NST - related real - world problems / applications				Word Cloud	2 h	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-explorer.pptx.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-explorer.odp	It is suggested not to give emphasis on detailed descriptions of the phenomena, but rather keep an introductory level. On the contrary, empasis should be given in the variety of knowledge/phenomena/applications across several STEM-oriented fields of research, as well as engagement with real-life contexts and applicability, innovation. Also, attention should be given on whether the menti poll results are been shown to the students during the voting. If that is the case, then students may also reflect on the ones stated before by peers.
		Collective discussion on identification of NST - related real - world problems, the disciplines engaged and identification of the initial epistemological and linguistic activators				Padlet		https://identitiesproject.eu/wp-content/uploads/2022/11/ID-explorer_-Guide-1.docx.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-explorer_-Guide-1.docx.odt	In contrast to the previous activity, during this activity, space should be given to students to reflect on their own ideas. Extensive feedback is not needed in this primary phase due to the exploratory/introductory character of the session. It is suggested that each student writes down his own thoughts in a notepad, so adequate time is requested for the self-thinking process. Discussion is recommended to be engaging among the members and not just referring to their own responses.
ID student	The ID student block aims at students' experience of NST - related applications	Interactive lecture on core NST concepts/ phenomena/ applications - Introduction				Padlet	8 h	https://identitiesproject.eu/wp-content/uploads/2022/11/NST-introduction.ppt.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/NST-introduction.odp	Nanoscience-Nanotechnology should be regarded as a general 'umbrella' term that transcends content knowledge / phenomena / applications from all S-T-E-M disciplines. Also, it is critical that students grasp that nanoliteracy encompasses different elements (content/phenomena/methods/instrumentation/socioscientific issues). It is recommended that the students are given space and time to reflect on NST concepts/phenomena/applications that might have experienced from their daily lives or the news, before the relative elements are presented and discussed with them.
		Students explore NST applications concerning "smart" housing (thermochromic glasses & biomimetic applications about waterproofing)				Assignment		https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-1.docx-1.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-1.docx-2.odt	When students are presented with models (images, gifs..) it is important to let them reach to a common conclusion/ interpretation regarding each phenomenon before the facilitator shares any scientific interpretation.
		Students explore NST applications concerning 3rd - generation solar cells				Assignment		https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-2.docx-2.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-2.docx-2.odt	Emphasis should be given on the considerations of efficiency by taking environmental factors as well. It is reccommended that comparisons across generations / types of sollar cells should be made in order to foster understandings of innovation, as well as the mechanisms that facilitated the advancement .
		Students explore NST medical applications such as the use of Au nanoparticles for cancer therapy through selective targeting				Assignment		https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-3.docx-1.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-3.docx-1.odt	
		Students explore NST instrumentation/microscopes				Assignment		https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-4.docx-2.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/Activity-4.docx-2.odt	This activity is connected with Activity 1 of ID student block regarding "smart" housing so it is necessary that it is conducted after that. The aim is not to explain in detail how microscopes work but students to gain an overview of multiple representations and the limitations of microscopes.
ID analyst	The ID analyst block aims at students' indentification of disciplinary and interdisciplinary concepts & skills related to NST applications	Collective discussion on the epistemological and linguistic activators regarding NST concepts, phenomena, applications students experienced in ID student block				Padlet	5 h	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_worksheet-1.docx-1.pdf https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_worksheet-2.docx.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_worksheet-1.docx-2.odt https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_worksheet-2.docx.odt	
		Interactive lecture on STEM integration models				Assignment		https://identitiesproject.eu/wp-content/uploads/2022/11/Presentation_ID-analyst_Reflection.pptx.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/Presentation_ID-analyst_Reflection.odp	It is critical to denote that these models represent different representations of STEM from teachers' point of view. Even though some of them could be considered as more informed, it shouldn't be regarded that there is one correct answer. It is important along with the visual representations, to also include verbal representation on the models (Dare at al., 2019)
		Students reflect on STEM integration models				Survey / Questionnaire		https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_reflection-worksheet.docx.pdf	https://identitiesproject.eu/wp-content/uploads/2022/11/ID-analyst_reflection-worksheet.docx.odt	Students should be encouraged to justify their opinions. Sufficient time should be given to students to reflect on arguments that drove their choices. Also the way that they are called upon to draw additional models could be considered that it is affected also by the software or modality (paper / online).

Legend

Keywords for the IDENTITIES approach to interdisciplinarity

- Identities of the disciplines ● mathematics ■ physics ▲ computer science
- Interdisciplinarity zone
- Boundary objects
- Boundary-crossing mechanisms
- Epistemological activators
- Linguistic activators

Keywords for the participants' roles in the module

- Role of explorer
- Role of student
- Role of analyst
- Role of teacher-designer

Keywords for the type of participants' engagement in the activities

- Individual activity
- Group activity
- Interactive activity trainer-trainees