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Heatwaves Awareness Education through Online Learning (HEAT)

WP2 - Deliverable n. 2.2b

Title:

Curriculum for lower secondary school students on Heat Waves

Working Team:

Eirini Chatzara
Apostolia Galani
Evangelia Mavrikaki
Myrto Koutra -Heliopoulou
Maria Christoforaki
Manos Skoufoglou

Leading Organisation: NKUA

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Framework

Heatwaves, which are defined as prolonged periods of exceptionally hot weather in a specific location, can be extremely dangerous. The EU's Copernicus Climate Change Service attributed these unusually hot conditions to climate change and suggested that such events are likely to become more frequent, intense and last longer in the future – indicating a concerning trend that may continue this year.

From the research already conducted with Greek, Italian, Romanian and Belgium teachers' and students' population it is obvious that although the heatwaves as a phenomenon affects Europe and causes extremely dangerous results, it is not part of the curricula of the countries we examined.

In recent times, as Europe becomes hotter (<https://www.ecmwf.int/en/about/media-centre/news/2022/ecmwf-directors-talk-about-european-heatwaves>) it is important to create a curriculum about heatwaves and incorporating it to the school curriculum: By educating students and preparing teachers to teach about heatwaves their awareness about the potential risks is raised, so people and future citizens become ready to make informed decisions and take appropriate actions to protect themselves and their communities. A curriculum helps students to learn more about health and safety so they can live in a more secure way and prevent themselves from dangerous phenomena. The knowledge of heatwaves and the different types /patterns Europe faces cultivates a better understanding of climate change and its effects. Moreover, it encourages discussions on adaptation strategies, sustainable practices, social justice, urban planning, proactive planning, decision making and citizenship engagement.

A curriculum on heatwaves plays a crucial role in building climate literacy, promoting public health and safety, fostering environmental stewardship, and empowering individuals and communities to respond effectively to the challenges posed by heatwaves and climate change.

The curriculum developed within the project heatwaves, is based on the following:

- The recent literature review which has been conducted within this project see *Deliverable n. 2.1a Title: Analysis of Current Climate Change Education Frameworks: Inventory of literature, national and international standards, reports, and books, referring to teaching climate change focusing on online education.*
- The *Students' and Teachers' misconceptions* as there were described in *Deliverable n. 2.1b, under the title: Analysis of Current Climate Change Education Frameworks: Students' and Teachers' misconceptions about climate change, global warming and heatwaves*
- *The Technical Research on Heatwaves and Urban Design: An Inventory of literature to identify: a) characteristics of the urban environment that are more susceptible to the effects of heatwaves b) solutions for fighting against heatwaves as found in urban design (Deliverable n. 2)*
- *The pedagogical and didactical approaches that fit to the content of heatwaves.*

- *Interdisciplinary learning is the core of this curriculum.* Heatwaves are a complex phenomenon influenced by multiple factors, including atmospheric science, ecology, public health, urban planning, and social dynamics. A curriculum on heatwaves provides an opportunity for interdisciplinary learning, encouraging students to connect various fields of study, analyze data, and think critically about the interconnectedness of environmental and societal issues.

The structure of the curriculum

The curriculum is developed in six topics

1. Heat Waves and Climate Change
2. Addressing Heatwaves / Climate Misconceptions
3. Heat Waves in Urban Environments
4. Climate Resilience - Responding to Heat Waves
5. Assessing the Public Discussion about Heat Waves and Climate Change
6. Personal and Community Action for Sustainability

Each one of the topics has the following fields:

- Main Objectives
- Specific Goals – What learners will be able to do after finishing the
- Cross-Curricular Connections – Relevant school items connected to the topic
- Health/Environmental/STEM Education – Other subjects / fields with which the topic is connected
- Key Concepts of the topic
- Proposed Activities – There are divided in two categories: Type of Activity (ie. Experimental learning, Socioscientific Reasoning Practices , etc.) and Description of the activity
- Learning mode - Learning format (Online, blended, Face to Face, etc.) and Interaction format (ie. Asynchronous, Synchronous)
- Resources – Material for teachers to get inspired and informed
- Use of Online Heatwave Game – Ideas that can be used within a game to present the topic.

The Assessment Methods that a teacher use, can vary in the case of Heatwaves: Quizzes, projects, presentations, or research papers, to evaluate students' understanding of heatwaves can be used. Moreover, they provide opportunities for students to demonstrate their knowledge and apply critical thinking skills.

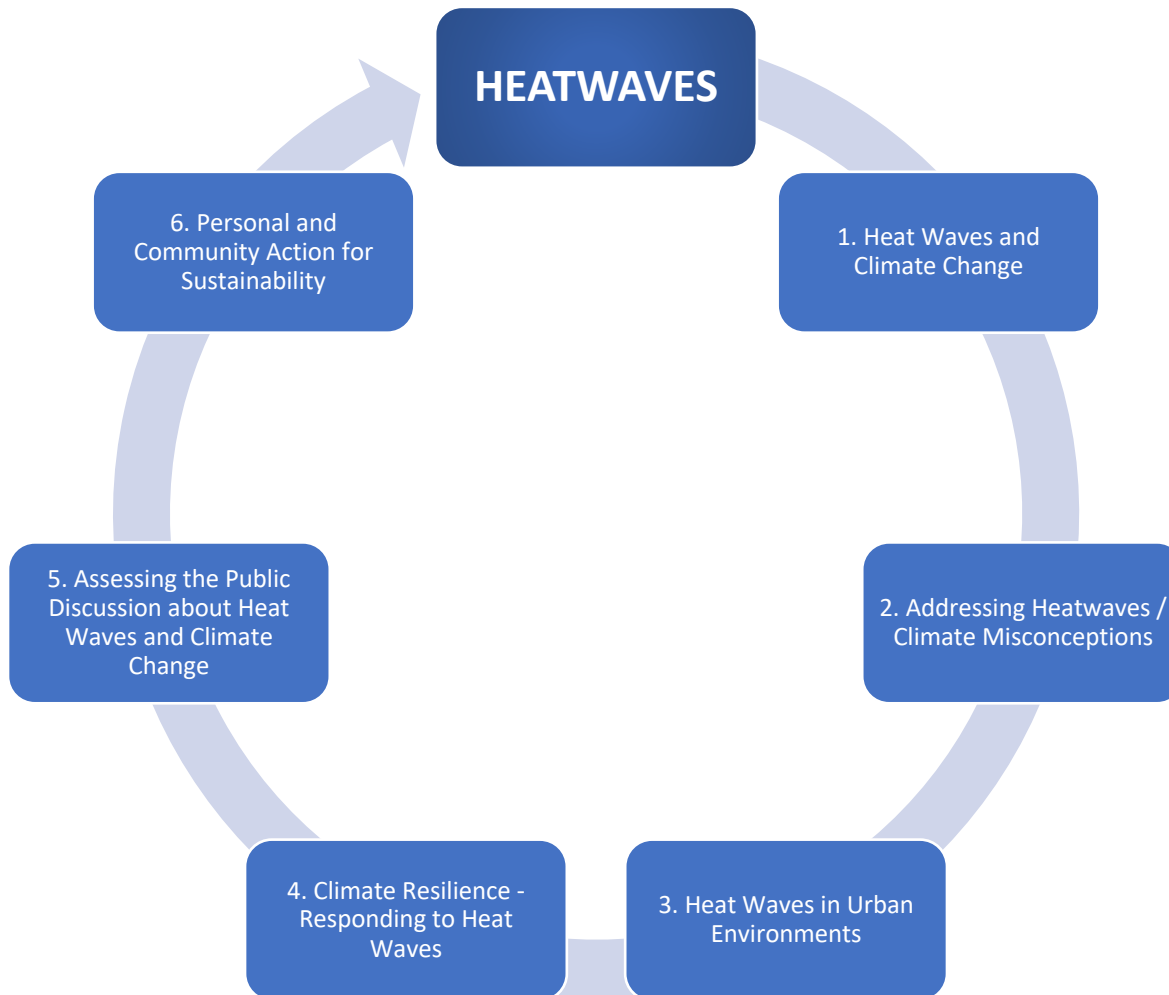


Figure 1: The different topics of the Heatwaves curriculum

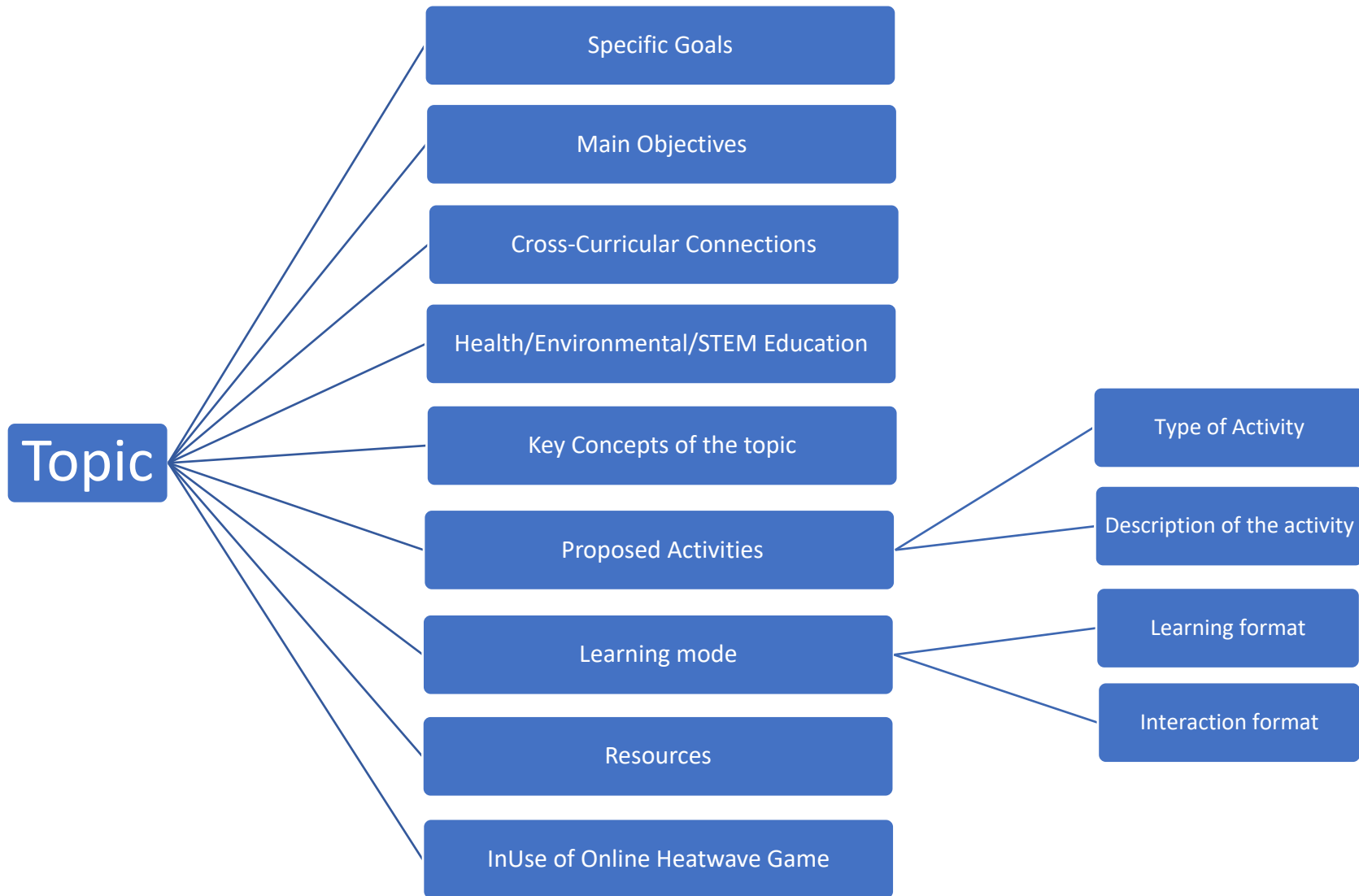


Figure 2: The structure of the topics

Topic 1. Heat Waves and Climate Change

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental/STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
1. Heat Waves and Climate Change	To understand the causes and impacts of Heat Waves and the link between their increasing severity and frequency with anthropogenic climate change.	<p>1.1 Explain the basic scientific concepts behind Climate Change and Heat Waves</p> <p>1.2 Analyze real-world data to ascertain the increasing severity and frequency of Heat Waves</p>	<p>Science, Geography, Mathematics</p> <p>Mathematics, Geography, Science</p>	Environmental Education	<p>Greenhouse effect, Greenhouse gases, Global Warming, Extreme weather events/Heat Waves</p> <p>Climate vs Weather, Impact of climate change on weather patterns, Heat Wave frequency and severity</p>

1.3 Recognize human activities that contribute to the multifactorial interplay between Heat Waves and Climate Change

Science, Social Studies, Geography

Urbanization, Fossil fuels

Topic 1. Heat Waves and Climate Change (Continue from p. 6)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
Inquiry Based Learning	Guided Inquiry: Assign groups to research and present on specific climate change concepts like surface temperature rise, greenhouse gases, or the greenhouse effect.	Blended	Synchronous	WP2-1 Inventory of literature Online Heat Wave Game	Heat Waves: Physical Understanding and Scientific Challenges - Barriopedro - 2023 - Reviews of Geophysics - Wiley Online Library	Introduce concepts of heatwaves and climate change. For example, a narrative introduction of how the weather patterns have changed in the city (climate change) and the heatwaves are more often and severe.
	Data Analysis: Students analyze real-world data on heat wave frequency and severity, creating graphs and calculating trends.	Online	Asynchronous			

Human Impact
Research: Groups
research and present
on how specific human
activities (like fossil
fuel consumption,
deforestation, or
industrial farming)
contribute to climate
change and heat waves.

Blended

Synchronous

Topic 2. Addressing Heatwaves / Climate Misconceptions

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental/STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
2. Addressing Heatwaves / Climate Misconceptions	To replace students' misconceptions with scientific concepts regarding Heat Waves and Climate Change.	2.1 Identify common misconceptions about heat waves and climate change 2.2 Use scientific facts to debunk the identified misconceptions	Science, Social Studies Science, Language	STEM Education	Common misconceptions about heat waves / climate change Scientific method, Nature of Science

2.3 Evaluate heat
wave-/climate-
related information
critically

Language, Science

Trustworthy scientific sources,
Interpretation of data

Topic 2. Addressing Heatwaves / Climate Misconceptions (continue from p.10)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
Experiential Learning	Evaluation of different sources of information on Heat Waves and Climate change.	Online	Asynchronous	WP2-2 Students' and Teachers' misconceptions Online Heat Wave Game	10 Global Climate Facts	Quiz-style elements where students as "mythbusters" identify and correct the misconceptions, in order to "access" the different layers.
	Myth-busting' activities: debunk common misconceptions about heat waves and climate change with scientific argumentation.	Blended	Synchronous			

Socioscientific Reasoning Practices

Debate on Heat Waves about topics such as: "Heat waves are just part of summer weather and have nothing to do with climate change.", or "Only big corporations and industries need to take action on climate change, individual actions are insignificant. "

Face-to-face

Synchronous

Topic 3. Heat Waves in Urban Environments

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental/STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
3. Heat Waves in Urban Environments	To understand how urban areas' features exacerbate Heat Wave effects and how Heat Waves impact urban populations.	3.1 Explain the Urban Heat Island effect (UHI) 3.2 Identify the urban characteristics that contribute to the UHI	Geography, Science Geography, Social Studies	STEM Education	Urban microclimate, Definition of UHI Factors that contribute to UHI, Urban vs Rural areas

3.3 Propose potential solutions for reducing heatwaves impact within their local urban environment

Geography, Science, Civic Education

Effect of reflective materials, green spaces, water bodies

Topic 3. Heat Waves in Urban Environments (continue from p. 14)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
Inquiry Based Learning	Guided Inquiry: Research UHI	Blended	Synchronous	WP2-3 Technical Research on Heatwaves and Urban Design Online Heat Wave Game	5E scenario for students 9-12 years old by NASA	City planning simulation in layers, as described by mathimagensis.
Authentic Learning Practices	- Guest lectures from local health officials or climate scientists - Field (or virtual) trips/ to local meteorological station	Face-to-face	Synchronous		Knowledge needed to support teachers & students at a local level	

Indoor/Outdoor
Workshops

Research and Guided Inquiry to
assess the effects

Blended

Synchronous

Topic 4. Climate Resilience - Responding to Heat Waves

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental /STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
4. Climate Resilience - Responding to Heat Waves	To develop skills for mitigating and adapting to Heat Waves	<p>4.1 Describe the impacts of Heat Waves on health</p> <p>4.2 Advocate for the importance of mitigation and adaptation to Heat Waves and Climate Change</p> <p>4.3 Propose strategies for mitigating UHI in terms of urban planning and adapting to Heat Waves in terms of health</p>	<p>Science</p> <p>Civic Education, Language</p> <p>Science, Geography</p>	Health Education	<p>Health impacts of Heat Waves, Heat-related illnesses, Impact on vulnerable groups</p> <p>Early warning and emergency measures,</p> <p>Climate change mitigation strategies, climate change adaptation, and heatwave safety</p>

Topic 4. Climate Resilience - Responding to Heat Waves (continue from p.18)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
Cross-scientific Reasoning Practices	Guest lectures on the impacts of Heat Waves on health	Online	Synchronous		Urban Adaptation Map Viewer (health focus)	Scenario where students devise mitigation strategy and get immediate feedback, for example the tempesomething effective and doable.
	Debate or campaign for the importance of mitigation and adaptation measures	Face-to-face	Synchronous			
	- Map the temperatures in various areas of their school to identify the warmest and the coolest spots - Suggest feasible interventions to improve their school's preparedness for a Heat Wave	Face-to-face	Synchronous			

Topic 5. Assessing the Public Discussion about Heat Waves and Climate Change

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental/STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
5. Assessing the Public Discussion about Heat Waves and Climate Change	To analyze Media and Political Beliefs' Influence on Public Discourse	5.1 Analyze the influence of media and political beliefs on public perception of climate change	Social Studies, Media Studies	STEM Education	Media literacy with focus on climate change, influence of politics on climate change perception
		5.2 Evaluate media reports on climate change critically	Language, Media Studies		Multimedia analysis and interpretation
		5.3 Create an information campaign on Heat Waves issue	Media Studies, Language, ICT		Information Campaign Planning

Topic 5. Assessing the Public Discussion about Heat Waves and Climate Change (Continue from p. 20)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
	- Media analysis activities - How different stakeholders (municipalities, governments, NGOs) portray Heat Waves in public discourse	Online	Asynchronous		Information from: - Local and/or European media sources - National/International institutions/organizations	n/a
Socioscientific Reasoning Practices	Analyze and critique news articles and media reports on climate change	Online	Asynchronous			
	Create and publish their own coverage of the Heat Waves issue (for example in their school newspaper, YouTube channel or podcast)	Blended	Synchronous			

Topic 6. Personal and Community Action for Sustainability

Topic	Main Objectives	Specific Goals	Cross-Curricular Connections	Health/Environmental/STEM Education	Key concepts
		Learners will be able to:	Relevant School Subjects*		
6. Personal and Community Action for Sustainability	To apply gained knowledge to develop actions in their local communities.	6.1 Identify their individual/community carbon footprint	Science, Mathematics	Environmental Education	Civic responsibility towards environment, climate change activism and community resilience

6.2 Create a personal/community action plan to reduce the carbon footprint Civic Education, Science

6.3 Collectively develop and propose a community action plan to promote sustainability and raise awareness about Heat Waves Civic Education, Science, Social Studies

Topic 6. Personal and Community Action for Sustainability (Continue from p. 22)

Proposed Activities		Learning mode		Supporting HEAT Material	External Resources	Use of Online Heatwave Game
Type of Activity**	Description	Learning format	Interaction format			
Authentic Learning Practices	-What is carbon footprint? -Do research to calculate personal/community carbon footprint.	Online	Asynchronous	WP2-2 Students' and Teachers' misconceptions WP2-3 Technical Research on Heatwaves and Urban Design Online Heat Wave Game	https://www.footprintnetwork.org/ https://footprint.wwf.org.uk/	Run campaign and maybe upload a file (perhaps a poster) to finish the game and get the badge of the Heat Guardian (or whatever).

Experiential Learning	Develop and run a climate change awareness campaign	Blended	Synchronous	
	Community-based action plans on Heat Wave preparation	Blended	Synchronous	52 steps towards a greener city - Publications Office of the EU

*Science may refer to Geography, Physics, Biology, Chemistry, Environmental Science, Earth Science based on each country's curriculum.

** For further details on Activity Types please refer to Deliverable n. 1: *Analysis of Current Climate Change Education Frameworks*