SysMind
DISCOVERING A SUSTAINABLE MINDSET

Co-funded by the European Union

TEMPLATE FOR LESSON PLAN

Title of thematic unit	GLOBAL WARMING as a PHONEMENA Natural and Anthropogenic Reasons, Carbon Cycles, Mitigation Strategies
Length	170 Mins, 3 School Classes Natural Warming Factors: Forest Fires and Milankovitch Cycles (30 Mins) Anthropogenic Reasons; Fossil Fuel Burning, Other Emissions (40 Mins) Carbon Cycles (30 Mins) Mitigation and Adaptation Strategies (40 Mins): Gamification (EN Road Simulator, 15 Mins) End Test (15 Mins)
Learning outcomes	-To be able to define/distinct the phenomenon of Global Warming due to anthropogenic impacts -Understanding Carbon Cycles and harmful impact of fossil fuels -Improved Consumer behavior and Ethical Consumerism - Increasing Awareness and Advocacy on Combating Global Warming

Teaching and learning resources and materials	Articles, Study Guides, Movies, Simulator, Video Lessons, Presentations, Discussions.
Learning methods and techniques	Group Discussion/debate, Gamification and Interactive Media, Self Explanation, Learner-Centered Instruction, Simulation Learning, Quiz
Instructions (course of the lesson)	Evocation: Global Warming Factors Learning Phase: Reflection Phase: Practicing on EN Road Simulation and Quiz (end Test). Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s-starting point of industrial revolution, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas (https://www.un.org/en/climatechange/what-is-climate-change). Instructor starts with an open-ended question “if you observe climate change throughout your lifespan”. Most of the trainees reply as they have warmer winters or hot summers. Trainer

	explains the difference between natural climate change reasons and human impact. Reasons Global warming is also a result of climate change and the main factor is anthropogenic activities. Causes of climate change are divided into two main groups as natural factors and anthropogenic reasons. “Natural” forest fires, emissions from active volcanoes and the earth's non-static movements over the solar system are all among the natural factors. The relationships between the Earth's dynamic orbital behavior and the climate were theorized by a scientist named “Milutin Milankovich” and later proved to be true with glacial samples by successor scientist. Therefore, these dynamic movements are called Milankovich cycles. Unfortunately, there is a strong dependency between the sustainability of existing economic systems and the pollution of the world using fossil fuels and attempts are made to manipulate society's understanding on this issue. It is therefore important to develop the trainee's understanding of the distinction between natural and anthropogenic drivers of climate change. Because for change, it is necessary to believe in change first. In human behavior, action is taken after the comprehension-internalization step. There are many samples for this-manipulation; statements by some politicians preserving benefits of small interest groups, bespoked papers and news etc. Their main function is to create confusion in society. By elaboration, student’s awareness and more thinking are ensured.

	Essential Cycles Carbon is the backbone of life on Earth. We are made of carbon, we eat carbon, and our civilizations—our economies, our homes, our means of transport—are built on carbon. We need carbon, but that need is also entwined with one of the most serious problems facing us today: global climate change (https://earthobservatory.nasa.gov/features/CarbonCycle). In nature, some essential elements move dynamically between sources and reservoirs. This change is made by means of natural agents (Biomass). Carbon and Nitrogen are among these dynamic elements. The movements are called the carbon and nitrogen cycle. The main reason for global warming is that human beings use fossil carbon, which is stored as a result of carbon cycles, for industry at a pace far above its regeneration rate. Despite decreased dependency, fossil fuels accounted for 82% of primary energy use last year, down from 83% in 2019 and 85% five years ago (www.bp.com). Alternatives and Solutions By the trainining tools (visuals) and implementation, the trainee understands how can we replace current energy systems and why we need alternative ones. t is necessary to create alternatives to the use of fossil fuels, to increase efficiency in energy systems and to slow down the rate of global warming. In order to explain the importance of alternative systems and policies to the trainees, carbon cycles should be included in the curriculum. In fact, carbon cycles are in most of the high school level curricula. In this module, the rational consideration of carbon cycles is aimed at elaborating the formal school

	curriculum and reiteration, linking with real world phenomena: climate change. Alternative economic and energy systems may also been considered in this module briefly. For instance; The bioeconomy (or bio-based economy, renewable carbon initiatives) comprises those alternative parts of the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – to produce demanded goods. In addition, the problem that "is it possible to design a completely reliable-clean energy system for today's industries that uses fully renewable energy and renewable carbon?", should be addressed within the scope of debates within the lesson. There are some small-mid scale demos in parts of Europe. Trainee group may organize field visits and observes how the systems are operating. In this way, the EU added value of SYSMIND is also improved. By means of didactic content and debates, listening others and self-explanation, trainee improves their own ethical consumerism behavior. Intercultural Competence: The world is like a big garden where all children play in the same garden. All children are exposed to the harm caused by naughty children. For this reason, the rules of the game should be equal for everyone, and those who continue to misbehave should be removed from the game. International efforts to prevent global warming should exist and their effectiveness should increase gradually. This module can take a look at the brief history and current state of international efforts. In particular, the carbon tax and the healthy functioning of carbon markets are at least as important as afforestation. Better intercultural competences ensure dialogue that is more

	efficient. Here, realization of global efforts may be linked with one dimension of culture models (such as long term goal orientation, task oriented societies, power distance and improved dialogue/weakening hierarchy). Widely recognized culture models in relevant literature, frequently do not take religion as an additional dimension in considered model. On the other hand, “a distinct culture” may be influenced by adopted and practiced religion. According to Hofstede, the type and version of the religion adopted in a given country/geography is the result of previously existing cultural patterns in a given area and a culture-forming factor (not a dimension). He argues that religion adopted in a given area strengthens existing cultural models, making them basic elements of its doctrine (6D Model of National Culture, https://geerthofstede.com/culture-geert-hofstede-gert-jan-hofstede/6d-model-of-national-culture/). However, linking religion’s impact on culture and environmental problems is extremely difficult. Yet, religious platforms may contribute to solutions (or actions) and dialogue for common actions between communities. Gamification Part Rather than giving only one-way information to the trainees, it is more productive to include them in the subject and to give them roles and responsibilities. For this reason, it is thought that it would be appropriate to include some interactive tools. In this regard, very effective tools have been developed. C-ROADS is a free, award-winning computer simulator that helps people understand the long-term climate impacts of national and

	regional greenhouse gas emission reductions at the global level. On the other hand, En-ROADS (By MIT Sloan Institute and Ventana Systems) is a freely-available online simulator that provides policymakers, educators, businesses, the media, and the public with the ability to test and explore cross-sector climate solutions. En-ROADS is a global climate simulator that allows users to explore the impact of roughly 30 policies—such as electrifying transport, pricing carbon, and improving agricultural practices—on hundreds of factors like energy prices, temperature, air quality, and sea level rise. Developed by Climate Interactive, the MIT Sloan Sustainability Initiative, and Ventana Systems, En-ROADS is a system dynamics model carefully grounded in the best available science, and has been calibrated against a wide range of existing integrated assessment, climate, and energy models. En-ROADS runs on an ordinary laptop in a fraction of a second, is freely available online, offers an intuitive user-friendly interface, and is available in over a dozen languages. (https://www.climateinteractive.org). During the training, instructor asks participants to find the most effective set of policies to prevent global warming, giving them only several limited options. Playing this game creates a prize-winning competition among the participants and increases motivation to learn.
Evaluation (assessment)	Online Test of Knowledge, Consequences of Simulation Game