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Training Module for Teachers
“Introduction to the Climate Change Issues and the Practical
Application of the ‘Climate Box’ Interactive Learning
Toolkit in Educational Organizations”

GUIDELINES FOR CLIMATE CHANGE PROJECTS BY SCHOOLCHILDREN



September 2020

Outline

Introduction	3
1. Contributing to Forming Project Participants' Clear Motivation to Solve Climate Problems	3
2. Project Entry Points	3
3. Project Product.....	4
4. Climate Change Project or Research Work?	4
5. Network and Individual Projects	5
6. Socially significant projects of schoolchildren and youth on climate change. Examples of projects. An approximate list of topics that are relevant and accessible to schoolchildren, the choice of methodology, performance requirements, their design and presentation.....	6
7. Typical Mistakes	11
Conclusion.....	11

Introduction

The project by schoolchildren and youth on topics related to environmental protection, conservation of species diversity, biological resources, animals and plants of the Red Book requires a systematic organization of activities on the part of the scientific supervisor. A generally accepted distinguishing feature of a schoolchildren's project is the presence of an activity product, which, depending on the task, can be either material, for example, the number of trees planted, or abstract, for example, an increase in awareness of the targeted group on acute environmental issues.

This block of teaching materials on the use of an interactive learning toolkit "Climate Box" is devoted to the potential of using the toolkit for initiation, support and creation of Climate change projects by students aged 7 to 18 years. It is intended for teachers of basic and continued education.

Design and Research

Competent planning of students' project activities is the main prerequisite for the success of cooperation between teacher and student. In this regard, it is worth highlighting the following stages of planning project activities:

1. Contributing to Forming Project Participants' Clear Motivation to Solve Climate Problems

Educational materials for schoolchildren "Climate Box" is, among other things, a complex of text materials, including a section (part 2) devoted to the impact of climate change on nature and humans. The negative impacts of global climate change on weather, plants and animals, forests, water resources, agriculture, coastal, arctic and mountainous regions, cities, inevitably arouses sympathy and compassion among schoolchildren. But the teacher's task at this stage of studying the topic is not only the formation of a clear and scientifically based forecast of climate change consequences, but also the transformation of a negative forecast into the desire of children to make their own practical contribution to preventing the potential negative impacts or minimizing the consequences for the entire planet. It should be especially noted that the teacher's diligence in communicating materials about the climate change's harmful consequences for nature and humans must necessarily take place with the transfer of knowledge and demonstration of real prospects about the possibility of breaking these trends when encouraging the "climate friendly" behavior of students. Otherwise, the abundance of frightening forecasts can negatively affect the schoolchildren's motivation in mastering related disciplines (biology, geography), lead to a loss of interest in study of global climate change due to getting a defensive reaction to a set of such large-scale negative forecasts.

At the same time, special attention should be paid to highlighting the consequences of climate change for the region of the students. This will make it possible to formulate a list of specific problems using understandable and close examples: for example, schoolchildren of the northern regions will get a more visual representation and form greater motivation to solve climate problems by illustrating problems from thawing of permafrost, decrease in sea-ice cover of the Arctic Ocean, the impact on the life of polar bears, and schoolchildren in Central Asia will help understand reducing available freshwater resources, the occurrence of prolonged droughts, extremely high temperatures, which may later be included in the literature review of the future project.

In this regard, in the process of in-depth study of the textbook's 2nd part, covering negative forecasts should take place in combination with information that forms students' understanding that these negative tendencies can be reduced with students' active involvement by developing and implementing climate change projects.

2. Project Entry Points

The Climate Box textbook discusses in detail the mechanisms for preventing climate change. It provides reviews of "green" energy sources, the principles of energy efficiency and energy conservation; not only the set of terms around the concept of "carbon footprint" is disclosed, but also specific steps to reduce the carbon footprint are described. The detailed solutions to help the planet are presented in part 3 of the textbook and the poster, "Climate Change: tips on how to reduce your carbon footprint".

Teachers must not only comprehensively consider all the proposed options for decreasing the planet's climate burden by each student, but also consider these mechanisms from the possibility of individual local application within a family, class, school, neighborhood or any other social unit. Depending on the technical and material capabilities, coupled with the interest of students, the teacher should highlight a priority set of tools, which will serve as a driving force in obtaining a specific project product. One of the simplest and most accessible, but at the

same time effective steps is following practical advice in appliance efficiency and energy saving for reducing the use of energy from hydrocarbon sources, combustion of which produces the bulk of global emissions of greenhouse gases of anthropogenic origin. One of the consequences of global climate change is the reduction of available fresh water, students should be encouraged to have a careful attitude towards the use of fresh water. However, in the context of each project, it is important for students to understand the link between the project and its contribution to tackling climate change, either in terms of reducing carbon footprint, or reducing vulnerability and adapting nature, humans and economies to the negative impacts of climate change. Without understanding and demonstrating these links, the project cannot be considered “climate relevant”, even if it is oriented towards environment.

Thus, the project entry point, which will be a practical part of the project being implemented, can have both a multi-tool kit (saving fresh water, reducing energy consumption, carbon footprint, increasing the resilience of local communities to hazardous weather events), and a single-tool kit, where the above tips for reducing climate burden or vulnerability to climate change are used individually.

3. Project Product

The ability to make a forecast about the required project product and the result of the project implementation by the project initiator will help not only to comply with the formal requirements for the activity, but also provide the necessary link between the project goals and its results.

Based on the purpose of the Climate Box toolkit, the didactic material not only provides fundamental knowledge on the topic under consideration, but also motivates students to adjust their own attitude towards the daily life routine. In accordance with the 1st part of the Climate Box toolkit, the cause of climate change in the modern era is the increasing the emission of the Greenhouse gases into the atmosphere, which enhance the greenhouse effect and, therefore, contribute to an increase in the average air temperature on the planet. Thus, no matter what structure the development of the project takes, it is always necessary to consider prevention of greenhouse gases, into the atmosphere. The scale of Greenhouse Gases is not very important, but the very understanding the role of the participants in reducing greenhouse gas emissions is essential. On the other hand, an equally important practical project result may be a strategy for developing the ability of the project participants to adapt to the climate change impacts, i.e. creating a product that can reduce the harm from climate change. Such results refer to adaptation measures aimed at leveling the negative impact of global climate change by developing, for example, salt water desalination plants (as a preventive measure to solve the problem of fresh water shortage), selecting crops resilient to extreme weather phenomena (a way to prevent the occurrence of negative food consequences in case of frequent floods, droughts, sudden and unexpected occurrences of negative temperatures), informing the public about necessary preparedness in the event of hazardous weather events, etc.

4. Climate Change Project or Research Work?

Often, project supervisors devote excessive attention to reviewing the fundamental scientific prerequisites for global climate change. A detailed analysis of the causes of anthropogenic climate change is undoubtedly important to be included into the project preamble, the introduction part or in another block that demonstrates the understanding of the main topic. But here it is worth noting that project activity, unlike research, cannot be based solely on literary analysis and the collection of knowledge on the issue under consideration. In other words, the project cannot be represented by a short version of the Climate Box toolkit and not contain a specific practical result.

Description of terrain, landscapes, local climatic conditions and their changes due to global climate change, geobotanical description, species composition of flora or fauna, dynamics of the number of individual species, soil chemical and physical composition – all this and much more is inherent to a greater extent in children's research works, while the development of new, author's projects or scaling up and integrating classical environmental lifehacks that reduce greenhouse gas emissions by restructuring or revising social habits, expressed in a specific amount of retained units of greenhouse gases (liters, kilograms), the development of adaptation measures is more inherent in projects on climate problems.

Any project, even the most modest in scale and results, compares favorably with research work in the presence of a practical result. While research work loses its relevance when repeating and reproducing identical experiments by different, unrelated authors, because there is a duplication of homogeneous conclusions of the work. The project, on

the contrary, when reproduced and scaled up, demonstrates the synergy of positive results for the planet as a whole, summarizing and enriching the overall practical result.

5. Network and Individual Projects

Undoubtedly, the author's understanding of the ultimate project goal in the form of reducing the greenhouse gases emission or in the form of developing adaptation measures to global climate change is extremely important and is one of the most significant postulates that the success of the entire project. If this requirement is met, the next criterion for assessing success of the work will be the scale of the positive contribution made. The simplest method for assessing the project contribution is to calculate the amount of CO₂ retained and express in mass (kg), in accordance with international practice. In projects based on the optimization of the author's living conditions or those of families and organizations, it is recommended to evaluate the reduction of CO₂ emissions in the following ways:

- Online calculator for calculating the "carbon footprint". This method is recommended for children of primary and secondary school. There are many free services on the Internet, for example, at <https://calculator.carbonfootprint.com/calculator.aspx?lang=ru>, it is possible to calculate the mass of CO₂ released when using electricity, natural gas, heating oil, coal, wood pellets, etc. This suggests that when analyzing the dynamics of a decrease in the use of the above energy resources in everyday life, private households, enterprises, the author will be able to demonstrate in his work specific target indicators of the project results, expressed in the reduction of greenhouse gases in CO₂ equivalent for ease of comparison of results. Please note that calculators often use estimated specific greenhouse gas emissions from project activities based on the conditions of a given country or region within a country, as the share of hydrocarbon energy sources in a national or local grid can vary greatly –from 100% to 0% (if the entire consumed energy is produced from renewable energy sources); and the prevailing types of hydrocarbons in the energy system (coal, oil, natural gas) themselves can strongly affect the specific indicators of greenhouse gas emissions for a given area. Therefore, it is recommended that you use an online carbon footprint calculator that has been designed specifically for your country or even a region within a country.
- Independent calculation of CO₂ emission reduction. For older students, project supervisors are advised to create conditions for the formation of meta-disciplinary connections in the project structure. If the literature review of the project's problems was based on geographic data, climatology, then in the chapter "Project Results" the calculation of the CO₂ retained amount can be done by independent calculations. So, when saving electricity, students can take into account the efficiency of power plants supplying the consumer, the type of fuel on which they operate (gas, fuel oil, oil, coal), the amount of carbon fuel contains, and the relationship between the electricity use in everyday life, the formation of carbon dioxide during the combustion of a certain type of fuel, the power plant electric energy generation, losses (if possible) during electricity transportation. This block will allow you to strengthen the project with formulas and equations from chemistry, analyze the volume of exothermic reactions, get acquainted with physical quantities that express power, electric current, resistance, etc. On the websites of government agencies responsible for climate change in your country, you can search for average specific indicators of greenhouse gas emissions from the national energy system specially developed for your country, or even more detailed emission factors from different types of projects for independent calculations.

Taking into account the above, when a specific amount of retained CO₂ is included in the project description, the emissions of which were either reduced or prevented by optimizing the electricity and heat consumption or "caught" by the planted plants, a special role should be given to the network project structure. In this case, any individual project can be duplicated any number of times and implemented at various sites. Thus, if in projects based on energy saving due to, for example, replacing incandescent lamps with LED ones, replacing 1 lamp leads to savings of up to 70 watts per hour, (i.e. when using such a lamp for 5 hours a day, based on data from carbon footprint online calculator selected for this example, which indicates that on average, when using 1 kW / h, 490 g of CO₂ equivalent are emitted), which means that CO₂ emissions are reduced from 245 g to 75 g. Thus, the project transformation from individual implementation to the network one, leads to a multiple increase in the positive effect in terms of reducing greenhouse gas emissions, and therefore will exceed other projects in terms of the overall results.

6. Socially significant projects of schoolchildren and youth on climate change. Examples of projects. An approximate list of topics that are relevant and accessible to schoolchildren, the choice of methodology, performance requirements, their design and presentation

In view of the extremely high relevance of the global climate change processes for all mankind, even the projects that are very modest in their results in relation to the scale of the planet, have social significance, since the negative consequences that global climate change leads to affect all segments of the world's population and, in one way or another, all spheres of human life. Nevertheless, it should be noted that the social significance project should be considered not so much from the point of view of the scale of the invested efforts and the retained volumes of greenhouse gases or the adaptation measures taken to climate change, but from the point of view of final awareness of the chance to affect the leveling of negative processes on the planet by the project participants', search for solutions to optimize their own life and awareness of personal responsibility to the Earth. Undoubtedly, the developed behavioral model is likely to find widespread acceptance among peers or in adulthood. Apparently, this can be considered one of the main project results, when the role of the supervisor will be, among other things, to help the project participants to come to such conclusions.

Table 1 below shows examples of the climate change projects that can be implemented both individually and in network and adapted to the creative and practical capabilities of the authors. These examples should not limit the imagination of project participants when choosing a topic, setting a goal, ways to achieve it and analyzing the results.

In addition to the examples indicated in the table, it is worth noting that there have been other, more rare projects in practice of analyzing, consulting or presenting schoolchildren's projects on climate change in different countries participating in the Climate Box program:

1. Reuse of rechargeable batteries by restoring energy content. The project implementation allowed us to extend the battery life, which reduced the specific carbon footprint per unit of production.
2. Obtaining biogas from animal waste with subsequent combustion for heating premises. Here, the authors demonstrated a decrease in dependence on thermal power plants operation, in addition, the generated methane in the reactors was burned with the formation of CO₂ and water vapor, which, according to scientists, have less pronounced greenhouse characteristics than methane.
3. Construction of reservoirs for storing melt and rain water and, as a result, reducing the load on wastewater disposal in cities, villages, reservoirs, as well as rational use of fresh water for agriculture (as an adaptation measure for regions prone to more frequent droughts and experiencing "water stress").
4. Introducing drip irrigation (as well as an adaptation measure to conserve water resources in the face of increasing "water stress").
5. Replacement of disposable batteries in children's toys with rechargeable batteries, i.e. reducing the carbon footprint from using the device.
6. Avoiding the use of disposable cups, mugs and the transition (popularization) to reusable mobile dishes, including for use when visiting catering. The project reduces the carbon footprint from the production of disposable tableware and further processing (including incineration).
7. Avoiding the use of disposable bags in stores (the same).

Table 1

№	Approximate Name	Aim	Goals	Description and Comment
1.	Home worm farms as a way to reduce greenhouse gas emissions	Reduce the amount of greenhouse gas emissions from organic waste	<ol style="list-style-type: none"> 1. Analyze the volume of organic waste generated by the family, type, structure; 2. Estimate the share of organic waste occupied in the total mass of waste and the associated carbon footprint when transporting this waste from the place of origin to landfills, incinerators or sorting points; 3. Study the life cycle of California worms, compose a diet from the generated organic waste, calculate the capacity of the planned worm farm for processing organic waste; 4. Create a Californian worm farm, track the amount of recycled waste per unit of time, extrapolate the results to a calendar year; 5. Calculate the amount of reduction in greenhouse gas emissions by reducing the burden on utilities, expressed in kg of organic waste; 6. Compare the agricultural value of the resulting organic by-product from the worm farm with commercially available organic fertilizers that have a carbon footprint during production. 	<p>One of the most simple and intuitive projects. Its idea is to reduce organic waste, which, through processing by California worms, is converted into valuable fertilizer. Such a project allows to reduce the emissions of landfill gas - methane, which would be generated if the same volume of waste was sent to an ordinary and poorly managed landfill (where there is no separation and disposal of different types of waste).</p> <p>At the same time, there is a decrease in the burden on utilities and, as a result, after a year of such optimization, the number of garbage trucks (mileage) serving certain areas can be reduced.</p> <p>In addition, the created alternative to fertilizers will eliminate the need for producing specialized organic additives, which will further lead to a decrease in the carbon footprint.</p> <p>The implementation of such a project will lead to the fact that the author of the project will form a stable connection between excessive or unreasonably high consumption and the formation of a carbon footprint.</p> <p>The result of the project must be expressed in the amount of recycled organic waste, the amount of reduction in greenhouse gas emissions.</p>
2.	Pet food production as a way to reduce your pet's carbon footprint	Reduce the carbon footprint of live food for common bearded dragon (pogonavitticepes).	<ol style="list-style-type: none"> 1. Evaluate the diet of a bearded dragon (daily, weekly, annual); 2. Analyze the prospects for reducing the carbon footprint of products included in 	<p>A universal project scheme, when the understanding is formed that keeping pets also has its own carbon footprint, because the purchase of feed leads to a cascade of processes that work with greenhouse gas emissions (production, packaging for feed, transportation, store</p>

			<p>the diet, which consists of the following stages: production, packaging, transportation, sale;</p> <ol style="list-style-type: none"> 3. Study the life cycle of the mealworm (<i>Tenebrio molitor</i>), and its diet; 4. Create your own production of live food for the bearded dragon from the mealworm (<i>Tenebrio molitor</i>) based on organic household waste; 5. Calculate the carbon footprint reduction from the concomitant processing of organic waste (dry bread, banana peels, old cereals) and the introduction of an alternative way of feeding agamas (instead of buying). 	<p>operation, purchase and delivery).</p> <p>However, feeding your pets can be partially done by producing their own live food, either agama or aquarium fish. To do this, the author can maintain, breed a mealworm, feeding with waste from the table, thereby slightly reducing the amount of garbage, but at the same time reducing the carbon footprint from providing the agama with live home-made food.</p> <p>The result of the project should be expressed in the volume of recycled organic waste, the volume of reduction in greenhouse gas emissions due to the transition of agamas to an alternative diet that has a lower carbon footprint.</p>
3.	Reducing the carbon footprint of keeping aquarium fish (guppies, horseshoe crabs, mosquito fish).	Develop a mechanism to reduce the carbon footprint from keeping aquarium fish.	<ol style="list-style-type: none"> 1. Assess the need of kept aquarium fish for live food; 2. Study the life cycle of daphnia, bacteria and unicellular algae that daphnia feed on; 3. Estimate the volume of the carbon footprint generated by the need to provide aquarium fish with food (ready-made dry mixes or a combination with live food); 4. Set up an alternative home installation for the cultivation of daphnia, including the separate keeping of daphnia and unicellular algae, bacteria; 5. Change the standard type of feeding aquarium fish (buying ready-made food in packaging); 	<p>This project is based on the principles described in the Climate Box, which states that locally produced products have a lower carbon footprint than those brought from distant regions. This thesis is also true for pet food.</p> <p>Organizing your own production of daphnia that feed on unicellular algae (a regular container with green water) can lead to avoiding to buy food for aquarium fish, and therefore, reduce the carbon footprint of keeping an aquarium.</p> <p>The result of the project must be expressed in terms of reducing greenhouse gas emissions by switching feeding aquarium fish to an alternative diet with low carbon footprint.</p> <p>If desired, the use of carbon dioxide by unicellular algae during photosynthesis can also be taken into account.</p>

			6. Calculate the amount of carbon footprint reduction.	
4.	Inoculation of fungal spores into park dead wood as a way to reduce the carbon footprint during sanitary felling	Creating an alternative way to rid parks of dry trees	<ol style="list-style-type: none"> 1. Analyze the woody composition of the park and its condition. Determine wood suitable for replanting fungal spores; 2. Examine the life cycle of edible mushrooms such as oyster mushrooms; 3. Assess the level of greenhouse gas emissions under a standard scheme for cleaning parks from dead wood (transport operation and mileage, transportation to landfills); 4. Inoculate (reseed fungal spores) into a suitable wood; 5. Observe the wood destruction, use the resulting product for its intended purpose, calculate the benefits of obtaining products in a similar way. 	<p>A very common picture is the situation in city parks, when specialized equipment (chainsaws, lifts) is used to cut down and transport (freight transport) dead wood to get rid of dry trees.</p> <p>This method is not only a source of large greenhouse gas emissions, but also in the long term depletes soils by removing organic materials contained in old wood.</p> <p>The project can be implemented locally in the form of the production of mushrooms for the household based on wood from the parks, or more globally, ridding the entire park of dry wood by massive resettling of myceliums.</p> <p>Wood destruction by fungi will not only provide food for the parks' fauna, but also eliminate the need for sanitary felling in the long term.</p> <p>The result of the project should be expressed in the analysis of avoided greenhouse gas emissions due to local processing of organic matter by mushrooms. When using mushrooms for food, the project authors should take into account the reduction of the carbon footprint from the use of locally produced food.</p>
5.	Saving fresh water at home	Increase sustainable use of fresh tap water at home	<ol style="list-style-type: none"> 1. Analyze the household water consumption for certain periods (month, year); 2. Identify the most irrational water waste (low load of a washing machine, dishwasher, current tap, etc.); 3. Develop measures to prevent water waste (installing faucets, shower time sensors, posters reminding you to turn off the tap while brushing your teeth, water spray nozzles that increase the efficiency of the water jet, etc.); 4. Compare the results obtained with the 	<p>One of the consequences of global climate change is reduced access to clean fresh water. This is especially true for regions prone to droughts and experiencing a shortage of fresh water. In this regard, it makes sense to pay attention to projects aimed at saving tap water as one of the adaptation measures to increasing water stress in the region due to global climate change.</p> <p>This type of project is ideal for network implementation. The project result should be expressed in the negative dynamics of the tap water consumption with demonstrations of maintaining life quality and other measures (for example, to alert the population) aimed at strengthening the resilience of local communities to water problems associated with climate change. If such a project also avoids the use of energy to produce a reduced amount of fresh water, then its benefit in terms of</p>

			control period; 5. Summarize (specific savings in liters of water).	reducing greenhouse gas emissions can also be calculated.
6.	Rational use of electricity as a mechanism to reduce greenhouse gas emissions	Reduce the carbon footprint of an apartment by switching to energy-saving technologies	<ol style="list-style-type: none"> 1. Analyze the household electricity consumption for certain periods (month, year); 2. Identify the most irrational waste of electricity (lighting, heating devices, TV on, household appliances of low energy consumption class); 3. Develop measures to prevent wasteful energy consumption (installation of diode lamps instead of incandescent lamps, the apartment insulation to avoid using heaters, calculation of the economic benefit from replacing an old refrigerator with that of a higher energy saving class); 4. Compare the results obtained with the control period; 5. Summarize (specific energy savings expressed in kWh and the relationship of savings with the reduction of greenhouse gas emissions from electricity generation). 	<p>This type of project is ideal for network implementation. The project result should be expressed in the negative dynamics of energy consumption with demonstrations of maintaining life quality.</p> <p>In this project, it is worth noting that reducing carbon footprint by saving energy is accompanied by savings in the household budget for electricity.</p>

7. Typical Mistakes

The most frequent mistakes of the first projects of both authors and scientific leaders are deviations from the given topic "Climate change" into general environmental issues not related to this topic, or this connection has not been demonstrated in any way by the example of the project's benefits for solving the problem of climate change. It is often possible to find a good and high-quality research work in the form of a project, but, no matter how competently it was done from the point of view of conducting research, unfortunately, it still cannot be considered as a project. Even the presence of such chapters as the study of annual tree rings depending on the season temperature, fluctuations in the number of pests caused by climate change, etc., does not allow evaluating such works as a project due to the lack of specific tangible results in them (adaptation mechanism or reduction/capturing of greenhouse gas emissions).

As an example of another common mistake, one can single out works based on carrying out, of course, important and necessary environmental actions, such as cleaning up forest, embankment, park from garbage and even having a specific end product expressed in kg of collected waste, but such works are also not can be assessed as an activity that led to a reduction in greenhouse gas emissions if there is no clearly demonstrated practical result of this work in the form of strengthening adaptation mechanisms or reducing/capturing greenhouse gas emissions from such activities.

Conclusion

The presented guidelines can serve as a visual guide for working on schoolchildren's projects on climate change. By following these tips, children's and youth's projects supervisors will be able to avoid the unintentional substitution of project work for research work, will induce a deeper and more detailed study of the Climate Box as the main source of literature, allowing to justify the relevance of the project work. And the above results, expressed in the reduction of CO₂ emissions or measures to adapt to the global climate change consequences are comparable and easy to analyze.

Any implemented project, whether created according to the typical structure above, based on the examples given, or other exclusive work multiplied by creativity, children's excitement and motivation to make the world better and fairer, will bring great joy and satisfaction from the work done! Good luck!