CHAPTER 5

Environmental Education in Out-of-School Settings

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The Place of Environmental Education in Science Teaching

Science is the process and effort of systematically examining nature and the environment we live in, the natural events and phenomena that occur here, and predicting what has not occurred. Science education, on the other hand, aims to raise individuals who act to produce scientific solutions to all the problems they encounter in daily life. The emphasis on daily life in science education comes from the interpretation that science is directly intertwined with nature and the environment and that it is daily life itself (Köseoğlu & Kavak, 2001). The current science curriculum considers it necessary that students realize the mutual interaction between people, society, and the environment and act with the awareness of sustainable development (Turkish Ministry of National Education, 2018).

Environmental problems are one of the greatest problems of daily life that require a solution be found on the world's agenda. Environmental problems occur as a result of the balance between all living and non-living factors being disrupted by human hands and activities. The most important feature of these problems is that they are global problems that concern all humanity regardless of gender, socioeconomic and sociocultural status, race, belief, language, or age and that harm all life (Erten, 2004; Erten, 2019; Escobar, 1995; Nag & Vizayakumar, 2005; Rees, 1995). What, then, is the solution to environmental problems? The answer to this question is quite unequivocally environmental education. Environmental education, which aims to raise environmentally aware generations, is an important tool for individuals to develop environmentally-friendly behaviors, protect the environment, and acquire all the knowledge, skills, values, attitudes, and abilities necessary to do this (Erten, 2002; 2004). A transdisciplinary process, environmental education increases students' ecological knowledge and instills positive attitudes toward the environment. In addition, it shows the entire process needed to turn these attitudes into behavior. Therefore, it addresses the cognitive, affective, and psychomotor domains (Erten, 2004; 2020). The main purpose of environmental education is to raise environmentally aware individuals. Environmental awareness encompasses attitudes toward the environment, environmental knowledge, and environmentally friendly behavior. Environmental knowledge is knowledge of environmental problems and the information necessary to fix them. Attitude toward the environment, on the other hand, means all positive or negative attitudes and thought developed regarding environmental problems. Environmentally friendly behaviors mean making it a habit

to protect the environment (Erten, 2004). Environmental education is a tool for raising environmentally friendly individuals, and it is also a necessity for the future to create a sustainable society (Carson, 2007). Many studies say that students do not have sufficient environmental knowledge, their attitudes are not at the desired level, and they do not engage in environmentally friendly behaviors (Erten, 2002, 2003, 2005). To develop environmentally-friendly behavior, students need to participate in science teaching activities related to this subject. Both the design and the implementation of teaching activities are directly related to the curriculum. For this reason, examining curricula from the standpoint of environmental education will present a different perspective.

Environmental Education in the Science Curriculum

Education is the process of developing behaviors in the desired direction, and the ability to develop environmentally-friendly behaviors, teach environmental knowledge, and develop attitudes toward the environment is directly related to the curriculum, which is an important part of the education process. The place of environmental education, which is seen as the most important solution to a global problem, has become more evident both on the world agenda and in education policies and curricula in parallel with this (Alım, 2006). Curricula are undoubtedly important teaching tools in the planning and management of education and teaching processes, and in determining the behaviors that students will acquire. Defined as transdisciplinary, environmental education requires that curricula contain environmental goals and objectives that will cover all programs, not just the learning outcomes within the scope of science teaching. Environmental education in out-of-school settings is a process that is planned in line with a learning outcome and aims to support formal learning with informal learning. Therefore, the design and implementation of teaching processes in such settings are directly affected by the underlying approaches of science teaching programs.

Entirely from this perspective, two curricula that reflect the ecocentric and anthropocentric approaches are examined in detail under this topic heading. In this section, the ecocentric approach reflects the Canadian Science Curriculum (2007), and the anthropocentric approach reflects the State of Nebraska Science Curriculum (2011) in the United States. To do this, the concepts of ecocentric and anthropocentric first need to be discussed. According to Kortenkamp and Moore (2001), people's ethical understandings toward the environment are either ecocentric or anthropocentric in approach (as cited by Erten, 2007). For ecocentric individuals, the entire world is a value and these individuals are conscious of recycling, not using anything wastefully, and the efficient use of resources. Anthropocentric thinkers, on the other hand, are those who only care about environmental problems because they are affected by them. The attitudes of these people are mostly underpinned by utilitarianism and are limited to dealing with environmental problems so they do not adversely affect human existence (Erten, 2007; Erten & Aydoğdu, 2011).

Examples of environmental education in the Canadian and Nebraska Science Curriculum are given below. The learning outcomes of Turkey's 2018 Science Curriculum are also included to examine where Turkey stands between these two curricula.

Table 1. Canada, Nebraska and Turkey Science Curriculum Environmental Education Learning Outcomes

TURKEY		
Subject	Unit	Outcomes
Creatures and Life	Energy Conservation and Environmental Issues	1. Discusses the causes and possible consequences of global climate change. *a. The greenhouse effect is explained. b. In the context of global climate change, how environmental problems can affect the future of the world and human life is questioned. c. Students are asked to express their predictions about the impact of environmental problems on the future of the world through artistic means. d. Students are made to calculate their ecological footprint (safe sites with such domain extensions as .edu, .org, and .mil may be utilized). e. The measures taken by the countries of the world to prevent global climate change (e.g., Kyoto Protocol) are touched on.*
	Sustainable Development	1. Takes care to use resources sparingly.
		2. Designs projects to use resources sparingly.
		3. Explains the importance of sorting solid waste for recycling.
		4. Offers solutions by using research data on the contribution recycling makes to the country's economy.
		5. Offers solutions by identifying the problems that may be encountered in the future if resources are not used sparingly.
		6. Discuss the importance of the conscious and economic use of electrical energy in terms of both family and national economy. *a. Studies carried out by official institutions and non-governmental organizations in our country on energy efficiency and what needs to be done in terms of electrical energy use are specified. b. The damage caused to the country's economy by the illegal use of electricity is emphasized.*
		7. Takes care to use electricity economically at home. Students are asked to do long-term studies to reduce their electricity bill, the process is monitored.
NEBRASKA (USA)		
Subject	Unit	Outcomes
Social Studies	Flow of Matter and Energy in Ecosystems	GENERAL EXPECTATIONS Students will define the relationships in an ecosystem.
		1. Flow of Energy: Defines the roles of producers, consumers, and decomposers in an ecosystem.
		2. Ecosystems: Recognizes living and non-living factors that affect the survival of organisms in an ecosystem.
		3. Impact on Ecosystems: Acknowledges that all organisms cause changes in their environment, some beneficial and some harmful.
		4. Biological Adaptations: Defines the adaptations made by plants or animals to survive environmental changes.

Social Studies	Structure and Function of Living Systems	1. Impact on Ecosystems: Determines the positive and negative effects of human activities on an ecosystem.
	CANADA	
Subject	Unit	Outcomes
Understanding the System of Life	Interactions in the Ecosystem	GENERAL EXPECTATIONS 1. Evaluates the impact of human activities and technology on the environment and ways to manage these effects.
		2. Explores the interactions within the ecosystem and identifies all the factors that affect the balance between the different components of the ecosystem.
		3. Shows that he/she understands the interaction between biotic and abiotic factors in the environment.
		SPECIFIC EXPECTATIONS *1. Associating Science and Technology with Society and Environment* 1.1. Evaluates the effects of new technologies on the environment.
		1.2. Analyzes the costs and benefits of the strategies chosen to protect the environment.
		2. Developing Research and Communication Skills 2.1. Designs an ecosystem model. Uses this model to explain the interactions between biotic and abiotic components.
		2.2. Uses scientific process and inquiry skills to explain the events that affect the balance within the ecosystem.
		2.3. Uses the concepts of sustainability, biotic, ecosystem, community, and population in verbal and written communication.
		2.4. Uses different ways to communicate with different audiences for various purposes. E.g., designs a presentation that explains the reciprocal relationships between the biotic and abiotic components in a particular ecosystem.
		3. Understanding Basic Concepts 3.1. Defines ecosystem as a system of interaction between living organisms and their environment.
		3.2. Defines the biotic and abiotic elements in an ecosystem and their interactions.
		3.3. Defines the roles and interactions of producers, consumers, and decomposers within an ecosystem.
		3.4. Describes the energy transfer in a food chain and explains the effects of eliminating any part of the chain.
		3.5. Explains how matter and energy circulate in the environment and support sustainability.
		3.6. Explains why an ecosystem is limited by the number of living things.
		3.7. Describes how human activities and technology change the balances and interactions in the environment.
		3.8. Defines how Aborigines view sustainability.

Understanding Matter and Energy	Pure Substances and Mixtures	SPECIFIC EXPECTATIONS *1. Associating Science and Technology with Society and Environment* 1.1. Evaluates the positive and negative environmental effects related to the disposal of pure substances and mixtures.
Understanding Earth and Space Systems	Heat	SPECIFIC EXPECTATIONS *1. Associating Science and Technology with Society and Environment* 1.1 Evaluates the social and environmental benefits of technologies that reduce heat loss or transfer.
		1.2. Evaluates the environmental and economic effects of using traditional and alternative forms of energy.

In Canada's Science Curriculum, where the ecocentric perspective is clearly seen, it is seen that environmental education is included in almost all subject areas and units under the title of "Relating Science and Technology to Society and the Environment." This situation defines environmental education as a supradisciplinary process that should be extended to all educational processes, as can be seen in the learning outcome examples in Table 1. An example of the anthropocentric perspective, the approach in Nebraska's curriculum is completely different from that in Canada. This curriculum has been prepared based on the STEM approach. The STEM approach, which is based on solving daily life problems, is the continuation of the technological developments up to the present day, meaning, it is a philosophy underpinned by an anthropocentric understanding. Since the competition between societies is fundamental to this idea, people are more burdened with nature due to the technology race between countries and the need for more raw materials. This philosophy argues that man is the most important creature and has introduced many environmental problems that have brought the world to the point of extinction today. Recent studies show that there is a belief that STEM is only related to the disciplines that make up its name (Bybee, 2010). But, the Organisation for Economic Co-operation and Development-OECD 2006 report says that environmental science can be added to STEM as a discipline. This program, which is based on the amalgamation of science, technology, mathematics, and engineering disciplines, includes environmental education learning outcomes in a broad perspective only at the 5th-grade level. Other than that, there are no learning outcomes related to environmental education at the 6th- and 7th-grade levels, while there is only one learning outcome at the 8th-grade level. These learning outcomes are only in the Social Studies subject, where biology topics are fundamental. Whereas, in Canada's science curriculum, every subject area, every unit, and every learning outcome is treated with an environmental education dimension. In addition to all these results, it is seen that there are many differences between these two programs when it comes to environmental education. Another of these differences is the level of learning outcomes. In the Canadian Science Curriculum, the learning outcomes are those relating to the steps of analysis, synthesis, and assessment, which require high-level

thinking and appeal to the cognitive, affective, emotional, and psychomotor domains. The state of Nebraska, however, takes only knowledge outcomes as a basis. Learning outcomes that require explanation and definition for ecological concepts take the form of environmental education outcomes. In our country's Science Curriculum, there are environmental education learning outcomes at every grade level. These outcomes do not belong only to the discipline of biology or the subject area of Creatures and Life. They are spread throughout almost every subject area. In this respect, it is similar to Canada. However, it is also seen that the learning outcomes in these subject areas are not in harmony with other outcomes. Many studies measure student achievement at the international level. One of them, PISA (The Program for International Student Assessment), is a study that measures the raising of scientifically literate individuals on a country basis and forms the basis of Turkish National Education's science curricula. In the first PISA exam held after the 2005 curriculum, in which environmental education started to be practiced in science teaching with the constructivist approach in Turkish National Education, Canada ranked first among OECD countries, while Turkey ranked 47th (OECD, 2006). The 2018 PISA results show Canada ranking 5th among OECD countries, the United States 13th, and Turkey 30th (OECD, 2019). All these results show the international success of the Canadian Science Curriculum, which is prepared with an ecocentric perspective.

The Place and Importance of Out-of School Setting in Science Teaching

Informal Learning and Informal (Out of School) Learning Environments

The aim of education in general, and formal and informal education in particular, is to ensure the personal development of individuals and become a contemporary society. Formal education is carried out in schools in a planned, programmed, and purposeful manner. Informal education, on the other hand, includes unplanned, random, and individual experiences. Informal learning environments are defined as learning environments based on communication and interaction, where students gain first-hand experience, individually and in groups, and share this experience with teachers, experts, families, and peers. Examples of out-of-school learning environments include such settings as zoos, botanical gardens, national parks, and industrial establishments (Diamond, 1986). It is very difficult to distinguish between formal and informal education concepts because they contain the same concepts in their definitions (Dierking, 1991; McGivney, 1999). This can be better demonstrated with an example. Consider a class of students who are taken to a botanical garden for environmental education. When these students approach the exhibitions in the botanical garden freely and without the influence of any authority, this type of learning is defined as informal learning. However, these students can participate in the planned teaching activities in the botanical garden accompanied by a guide. In this case, they will be taught in a teacher-centered and planned process. For this reason,

this type of learning can be said to be closer to formal learning. For this reason, it is not possible to separate formal and informal learning distinctly (Eshach, 2007). To be able to define science teaching in informal (out-of-school) environments, it is first necessary to understand and explain the social details between formal and informal learning including physical details such as being in school and outside of school, and the communication between the teacher and the learner (Dierking, 1991; McGivney, 1999). Teaching science in informal (out-of-school) environments is the bridge between formal education and informal education, a way of bringing together formal and informal learning by creating experiences. These environments create a bridge between the school and the natural environment and contribute to making the best use of the students' potential (Hannu, 1993).

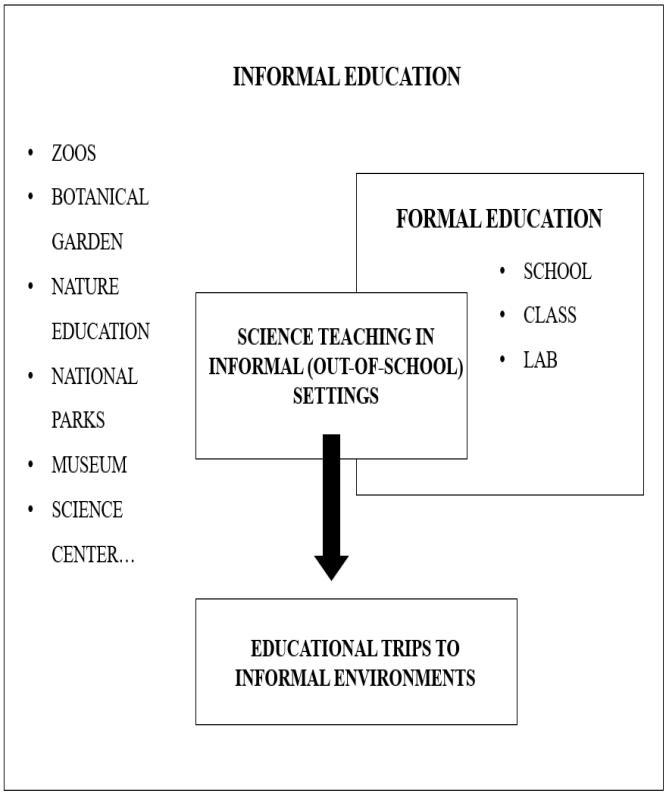


Figure 1. Formal, Informal Education and Science Teaching in Informal Settings

Generally speaking, learning is not a process to be confined between walls. For this reason, the activities to be carried out in out-of-school learning environments should be geared toward the learning outcomes in the science curriculum outside the school walls and should, therefore, be able to improve students' science learning (Karademir, 2018). Another important issue here is that students should be free in this process and involved in it by gaining first-hand experience (Han & Bilican, 2018; Ünsal & Karademir, 2017; Türkmen, 2010). Studies on science teaching in out-of-school settings suggest that the focus in teaching activities is fun and that this prevents the activity from serving any learning outcome (Rennie & McClafferty, 1996, Shortland, 1987, Wymer, 1991,

Ansbacher, 1998, as cited in Eshach, 2007). The most important step to be taken here is for teachers to prevent this process from straying from the goal (Rapp, 2005, as cited in Bozdogan, 2008). According to Dewey, if the learner has fun and participates in the learning process by doing, this indicates that he is learning better (Eshach, 2007). In other words, learning is related to individual experiences. All this shows that when learners, driven by curiosity, contribute to the process by doing and experiencing and having fun, this contributes to them learning in a meaningful and lasting way. In other words, teaching science in out-of-school settings is much more comprehensive than a field trip and includes detailed design and implementation processes.

Effects of Out-of-School Learning Environments on the Science Teaching Process

Many studies examining how science activities that are planned and implemented effectively in out-of-school learning environments contribute to students' learning mention two positive effects. The first is the long-term effect. The long-term effect states that trips made with a learning objective in out-of-school learning environments are not forgotten for years (Anderson and Lucas, 1997, Duterroil, 1975, Falk & Dierking, 1992, Field, 1975, Peart, 1984, Wright, 1980, cited in). Piscetelli & Anderson, 2001). For example, Falk and Dierking (1997) revealed in their study that a trip made in primary school made an impression that lasted for years and that what was learned there was not forgotten during that time. The study reported that 0% of the individuals in the study group forgot the information they learned back then. Wolins, Jensen, and Ulzheimer stated in 1992 that the biggest reason for permanent learning in teaching activities done in out-of-school settings is learning by doing and students managing this process with a sense of curiosity. Another positive effect is the learning-enhancing effect. Many studies state that teaching science in out-of-school settings will not only provide cognitive but also affective and psychomotor development in students if an effective plan is prepared and implemented. The learning-enhancing effect is a reflection of a student-centered process. A learning environment that fosters learning by doing and experiencing is the basis of communication and social interaction. This interaction and communication should be between peers, teacher and student, child and family, in short, every individual in that setting (Davidson et al., 2010; Falk & Adelman, 2003; Randler, 2010; Randler et al., 2012; Tunniclife, 1998; Türkmen et al., 2018; Yardımcı, 2009). In addition, results show that the communication between the expert and the teacher while preparing the plan for the trip improves students' learning (Davidson et al., 2010).

Out of School Learning Activities, Design, and Implementation

For a science teaching activity in an out-of-school setting to be considered successful in terms of students' learning, an effective plan needs to be made and implemented (Hodge, 2004). In recent years, using out-of-school settings has been seen as an important part

of science teaching programs and therefore the science teaching process. Important elements for a successful trip are a fully prepared plan, cost, ties to the curriculum, plus parental support and participation (Israel, 2000, Johnson, 2000, Kiefer 1998, cited in Hodge, 2004). A detailed plan of the activity before, during, and after the trip should be created for teaching science in effective out-of-school environments.

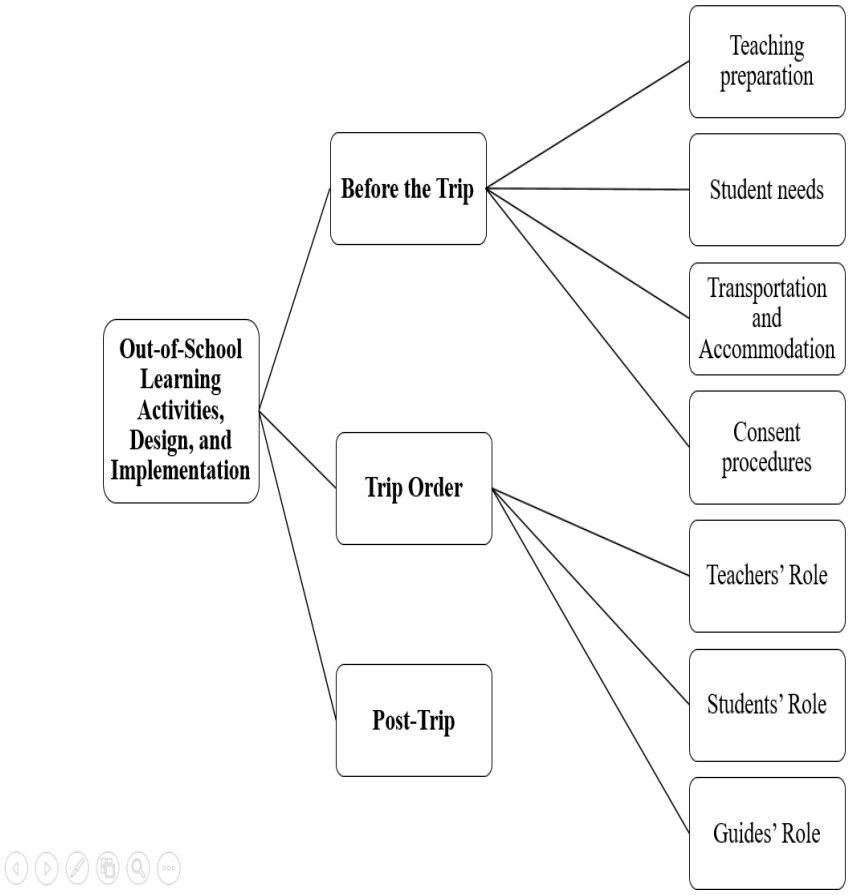


Figure 2. Out-of-School Learning Activities, Desing and Implementation

Before the Trip

The preparations made before the trip include the educational design, the physiological needs of the students, transportation and accommodation, and consent procedures. Effective planning beforehand directly affects how the process works both during and after the trip (Türkmen, 2010).

Teaching preparation: Teachers should first visit the learning environment where they plan to travel. First of all, information should be gathered about the quality of the education provided in the out-of-school setting, any exhibitions there, as well as plants and animals (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010). Then, a learning outcome should be determined within the scope of the curriculum. In the 2018 science curriculum prepared by the Turkish Board of Education and used today, these learning outcomes are usually implicitly given. However, considering the scope

and parameters of these curricula, teachers have to actively use out-of-school settings (Karademir, 2018). If we look particularly at the science teaching activity in out-of-school settings within the scope of environmental education, the activity's design process will be directly affected by the curriculum having an ecocentric or anthropocentric perspective. Any environmental education activity in out-of-school settings prepared for the learning outcome of a curriculum that has an ecocentric perspective will be a process that directly affects ecology knowledge, attitudes, and behaviors to improve students' environmental awareness. Environmental education learning outcomes in an anthropocentric curriculum will require lesson planning only to develop cognitive knowledge. The learning outcome examples given in Table 1 under the title Environmental Education in the Science Curriculum support this interpretation. For environmental education to be an effective process in out-of-school settings, teachers must have an awareness of the subject.

The next step should be preparing a lesson plan by establishing a relationship between the selected outcome and the chosen environment. This plan covers the outcome determined directly by the teachers in the science curricula, the basic concepts and skills associated with this outcome, the entire out-of-school learning environment, or the part of it that relates to the selected learning outcome (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Turkmen 2010). The next process is nothing more than a complete lesson plan. When making this plan, it is important to prepare a worksheet that will guide the students on the trip. This material should guide the students in the activity, increase their sense of curiosity, and assist their observations. In this way, the learning process will become directly student-centered (Laçin-Şimşek, 2011). After planning, an appointment should be made with the chosen environment by determining an appropriate time. Another task that teachers need to do is to inform students about the process (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010).

Student needs: Care should be taken to ensure that there are places near the destination where individuals can meet their physiological needs such as food and toilet (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010).

Transportation and Accommodation: At this time, transportation should be arranged, the starting time and the duration of the trip should be calculated, the number of students participating and the cost, if any, of this transportation should be determined, and its safety should be ensured in advance. If the chosen location for the trip is outside the city, a hotel/B&B should be arranged for accommodation (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010).

Consent procedures: Teachers are required to obtain consent from the parents, school administration, and District/Provincial Directorates of National Education depending on the location of the trip. Each country's education policy has a different consent process

(Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010).

Trip Order

The trip order is the order in which the teaching takes place. The plan made before the trip is put into practice at this time. This process can be examined under the headings of teacher's role, student's role, guide's role. Teachers should not only keep the process under control but also ensure that it is student-centered. For students to achieve the objective at this time, the teachers need to use special teaching methods in line with the plan. The students need to undergo an appropriate experience to achieve this objective (Bozdoğan, 2008). Care should be taken to make this process as free as possible for students and not set too many tasks that will distract or tire them (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010). Students must be actively involved in this process and interact with it. Students should experience this process as if it is a part of daily life, by doing and having fun (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010). The guide is there to provide students with information about the location, the subject area associated with it, any exhibitions, objects, and creatures. For an ideal learning process, guides should avoid giving direct information to students. First of all, students should be offered the opportunity to gain experience by doing, experiencing, and exploring. (Bozdoğan, 2014; Laçin-Şimşek, 2011; Orion & Hofstein, 1994; Türkmen 2010). The exhibitions in the informal setting and their themes directly affect the guides' attitudes toward the students as much as the quality of the environment of discovery and active participation offered to the students. According to the literature, when a limited discovery environment is offered to the students, or they are given direct information by the guides, or they are unable to act freely in that setting, this results in them getting bored (Piscitelli & Anderson, 2001). In other words, simply taking students to an informal learning environment is not enough for meaningful learning. In addition, the relationship between the exhibitions and objects that students encounter in the informal learning environment and the subject covered must be established (Laçin-Şimşek, 2011).

Post-Trip

The post-trip process is important in terms of associating what was learned on the trip with the subject's terminology and getting the most out of it. In the post-trip process:

- ✓ Students should share their experiences on the trip and the information in the worksheet that guided the trip.
- ✓ Students' experiences and observations at this time should be associated with the terms and concepts of the underlying subject area. The place of these terms and concepts in daily life should be mentioned.
- ✓ The post-trip process can be done in the informal setting or on return to the

classroom. An assessment must be made at this time. This assessment is necessary not only for the students but also for the entire process and the teacher. As a result of the assessment, teachers will reveal the extent to which the stated objectives were met, where the students had trouble learning, what they could not learn, and their misconceptions. Teachers will learn from this to better plan the next trip by considering the positive and negative aspects of the entire process. They will be able to observe how the process affects students' achievement scores and attitudes. (Bozdoğan, 2008; Laçin Şimşek, 2011).

The Relationship Between Environmental Education and Out-of-School Learning Settings

The environment is defined as the setting in which all living and non-living entities interact and live in balance (Erten, 2004). The recent developments in science, and therefore in technology, particularly disrupt the balance of the environment, resulting in many environmental problems. All people regardless of age are affected by this situation. Undoubtedly, one of the groups most affected by the excessive and irregular urbanization we are facing today is children. Children today spend most of their time away from nature. Instead of playing games in natural settings, they prefer the games on computers, tablets, and phones offered by today's technology. For this reason, they are on their way to becoming individuals who are strangers to nature, know little about environmentally friendly behavior, and are not environmentally aware. The biggest reason for this is the decrease in natural areas, uncontrolled and unregulated urbanization, education systems and teaching programs that are not based on ecocentric thinking, and no steps being taken to address this shortcoming in children (Erten, 2004; Kahyaoğlu, 2016; Karataş & Aslan, 2012). In addition to curricula prepared on the basis of ecocentric thought, such as the Canadian Science Curriculum, there is also the school of thought that advocates an independent environmental education program by considering environmental education to be superior to all disciplines (Sokoli & Doka, 2004; Duan & Fortner, 2010). Although it is thought that this form of environmental education will be more effective in raising environmentally friendly individuals, it is not very common. After all, science is nature itself. Being away from nature, using only formal learning environments, and not being able to go outside the school walls shows that this process is lacking in science, in general, and in environmental education, in particular. This is because it is not possible to expect individuals who do not know the environment and are not part of the environment to protect the environment. Studies on this subject say in support of this comment that there is no connection between the theoretical knowledge covered by environmental education and the application of this knowledge in daily life (Bolstad, 2003; Barker & Lynnette, 2004; OECD/CERI, 2008). Environmental education should be student-centered rather than teacher-centered, the activities designed should be based on current

educational approaches rather than direct theoretical knowledge transfer and supported by different learning environments. However, studies have revealed the importance of environmental education in out-of-school settings.

Carrying out environmental education in out-of-school settings will create a holistic view of the environment and will provide first-hand environmental information, which is necessary to create environmental awareness. During this process, students will understand the importance of the environment by freely doing, experiencing, and observing since they will participate in teaching activities in a more natural and social setting compared with formal learning environments. Students will form a physical and psychological communication bond with the natural environment and will be able to empathize. In addition, out-of-school learning environments come with an abundance of teaching materials. In this respect, out-of-school learning environments are likened to fun and free open-air laboratories where students obtain first-hand experiences and spend time socially in communication and interaction. This is an easier and more effective way of developing a positive attitude toward the environment and environmental friendliness because teaching activities carried out in out-of-school settings have both a long-term effect and a learning-enhancing effect. Today, it is crucial to raise ecologically literate individuals as well as develop environmentally-friendly behaviors and a positive attitude toward the environment. Ecologically literate individuals are individuals who are conscious of sustainable development, strive not to disturb the balance underpinning the environment, internalize the rules and limits of nature, and live their lives as a part of the environment. According to these individuals, the environment is superior to humans and it is the greatest legacy to be left to the future (Harrison, 2010; Küçük & Yıldırım, 2019).

The time that students spend in zoos, botanical gardens, nature education, camps, on field trips, and the experiences they gain increase their emotional bonds with the environment, their mindfulness and sense of responsibility toward the environment, and their social relations, as well as their cognitive development (Dresner and Mary, 1994; MacRae, 1990; Palmberg & Kuru, 2000). For example, let us consider an activity where students are to collect garbage during a trip in the forest. Although it may seem like a simple activity, the experiences that students will gain during this activity will make them think directly about environmental problems. In this way, the processes of researching and questioning environmental problems, in general, and waste and garbage problems, in particular, will begin. Then, the process will continue with assuming responsibility for nature, acting mindfully, and establishing a social bond with nature. As a learning outcome of this activity, students might not litter anywhere again. Environmental education in out-of-school settings will not only teach science by addressing the cognitive, affective, and psychomotor domains, it will also enable students to take many courses related to ethics (Woodhouse & Knapp, 2000). A historical review of environmental education

in out-of-school settings shows that environmental protection-themed meetings held at the international level occupy an important place. The 1972 "Human Environment" conference held by the United Nations, known as the first organization to conduct studies on environmental conservation internationally, stands out. Similarly, the Tbilisi Declaration, published in 1977, in which environmental problems were brought to the agenda and environmental education was handled with the most up-to-date approaches, occupies an important place. Then, with the meeting held in Rio in 1992, the widest-ranging decisions regarding environmental education were made. In Turkey, after 1994, the first steps were taken toward the environmental education strategies outlined in the Seventh Five-Year Development Plan and the Tbilisi Declaration (Küçük & Yıldırım, 2019).

Another issue that needs to be discussed under this heading is undoubtedly the out-of-school learning settings that are suitable for the aims and objectives of environmental education. Zoos and natural life parks, botanical gardens, nature education, national parks, and industrial establishments are learning environments identified with environmental education in this sense. Zoos are natural parks with wild and domestic animals (Balkan-Kıyıcı, 2011); botanical gardens are learning environments that include plants, the groups formed by these plants, and the kinship relations between these groups (Nuhoğlu, 2011). National parks are natural areas that have both national and international value in terms of science and nature and are far from industrialization and urbanization (Varnacı-Uzun, 2011), while industrial organizations are learning environments that show the existing needs of people and the processing process of raw materials using the required physical and chemical processes (Atabek-Uzun, 2011). What all these environments have in common, regardless of their aims and objectives or the living and non-living entities they display, is that they are places where students can learn the five senses by working, where they are socially affected and can develop many skills, especially scientific processes, higher-order thinking, and social skills, and feel like they are a part of daily life (Karademir, 2018; Türkmen, 2010). For this reason, it is necessary to take students to out-of-school settings as if it were a part of their routine daily life. In this way, students will behave as if they are scientists, be at the center of the learning environment, and have lasting learning experiences (Türkmen, 2018). Another common point is the efforts made by people to stop the natural areas they need from being removed from their lives, especially since natural areas such as zoos, botanical gardens, and national parks are disappearing in big cities and metropolises. By way of a new approach, the use of digital environments is becoming widespread while the teaching and training processes that take place in formal learning environments for educational purposes are supported by out-of-school learning environments. Virtual museums, zoos, botanical gardens, and aquariums have gained importance especially during the pandemic where education has become digital. However, given that the purpose of out-of-school environmental

education is to raise individuals with environmental awareness by directly observing nature, and considering the effects of technology on nature, it can be said that this process will not be effective without proper planning. Another criterion is that the teacher who will practice this must be well-versed in not only the teaching process in out-of-school settings but also environmental education and technology (Karademir, 2018).

Zoos

Zoos are places many different types of animals (wild and domesticated alike) are fed, looked after, and put on display so that people can watch and study them (Shettel-Neuber, 1998). People today are faced with climate crises caused by global warming. These changes in the balance of the environment lead to a reduction in animal and plant species, and many groups of creatures are in danger of becoming extinct. That is why the Association of Zoos & Aquariums (AZA) was founded in 1924. Zoos, organizations that protect endangered species in their natural habitats, that ensure the continuation of existing wildlife, accomplish all this with an expert staff, and that also design training courses on this subject and support scientific studies are recognized by this institution (AZA, 2019). Zoos are environments that provide mutual interaction between humans and animals, design and implement various training courses with experts, and can bring about changes in visitors' knowledge, attitudes, and behaviors (Falk et al., 2007). Zoos, which are one of the important out-of-school learning environments, also possess institutional characteristics. Although zoos have separate goals when considered as separate institutions, it is possible to focus on five fundamental goals when looking at them in general. The first of these goals is the exhibition of various species of animals so they can be observed by people. The second is recreation, which allows animals to be renewed regularly so that they can continue their natural lives. The third is education as it shows how diverse natural life is. The fourth is to facilitate the study of wild and natural life. The fifth is to protect endangered species, which is an important outcome of environmental education (Türkmen, 2019). In addition, zoos are very important for environmental education as they will ensure people take responsibility for preserving biodiversity (Lee, 2015).

Following the industrial revolution, which is regarded all over the world as the greatest step toward globalization, excessive and unregulated urbanization and the increase in the number of skyscrapers and high-rise buildings in settlements caused people to move away from natural life, and rural life suddenly turned into urban life. Working processes have also changed in this new order, and agricultural society has become an industrial society. This situation has affected people's lives not only economically but also socially. This whole process parallels the environmental problems that have arisen due to changing human behavior and life. Nature is an integral part of man. Having distanced itself from nature, man has started making an effort to move large national parks into the city. It is

also known that as people move away from the natural environment and this situation becomes a way of life, so interest in natural environments increases. This is why the first designs for zoos began to emerge in the 20th century. In the 1970s, in particular, increasing environmental problems caused states to place environmental science and solutions to environmental problems on the world agenda. This situation directly affected the institutional structure of zoos. These institutions aim to protect animals in addition to providing education and recreation, which are key raisons d'etre for zoos, and they frequently change the way animals are exhibited. It is very important both for the animals there and the visitors that the animals are in their natural habitat. This is why, although many zoo typologies have emerged, the main purpose of all zoos is to provide visitors with the most accurate information about animals and to be places that can best describe natural life (Yılmaz, Özbilen & Mumcu, 2010).

When different science lesson curricula are examined, the aims, objectives, and learning outcomes show that science lessons can be carried out by associating them with zoos. Zoos support not only students' cognitive skills but also their affective and psychomotor domain skills (Randler, Baumgärtner, Eisele & Kienzle, 2007). In addition, students find the science subjects taught at the zoo more interesting than when they are taught at school. In this situation, students acquire positive attitudes and behaviors toward science lessons, natural life, the environment, and animals (Lukas & Ross, 2005).

Picture 1. Examples of Zoos (Berlin Zoological Garden, Berlin-Germany

Botanical Gardens

Botanical gardens are institutions where plants are exhibited and preserved in collections to continue scientific research and educate individuals. They are educational institutions where training is given directly or indirectly to protect endangered species and to raise environmental awareness in individuals of all age levels. More than 4 million plants are preserved and exhibited in more than 2,500 botanical gardens all over the world (Botanic Gardens Conservation International, 2018). Botanical gardens play very important roles in environmental education. In particular, many plant species are in danger of becoming

extinct due to global warming. The collections created in botanical gardens plus the fact that these collections form separate exhibition areas not only attract the attention of individuals but they also make them realize what they need to know about biodiversity. During the time they spend in botanical gardens, they experience the ideal habitats that plants need to live and get the opportunity to compare factors such as temperature, humidity, and light with their condition in real life. In doing so, they learn why plant species are endangered, and as a result, experience directly related to global warming is created (Önder & Konaklı, 2011). In this respect, botanical gardens are a window that reveals information about the causes of global warming and how it affects the world (Ali & Trivedi, 2011).

As a learning environment, botanical gardens are a great place of discovery for people of all ages. They offer opportunities for everyone from early childhood to adulthood where they can gain experience by doing, studying, and questioning. In addition to all this, they host educational activities designed to raise environmentally aware individuals. Through these activities, students gain experience regarding environmental problems and environmental pollution. Students who gain first-hand information about the consequences of environmental problems and how these results affect plant species begin to think about the causes of environmental problems (Önder & Konaklı, 2011). In this respect, they contain information that supports many of the subject areas and learning outcomes in the science curriculum. Many units such as living things and life, the living world, man and the environment, the relationship between living things and energy, energy transformations, and environmental science can be supported by botanical gardens as well as by the formal education given in schools.

Picture 2. Examples of Botanical Gardens (Royal Botanic Gardens, Istanbul University Alfred Heilbronn Botanical Garden)

Nature Education

It is important to raise awareness among students about the place in the natural order of all living and non-living entities on the planet, their importance, and value, and to

raise awareness of what needs to be done to maintain the mutual interaction within this balance. It is known that individuals who do not know the order and holistic structure of the ecosystem cannot make sense of the concept of nature and the importance of the environment (Atasoy, 2005). Environmental education programs that include field trips in nature, camps, nature walks, and various adventure activities allow individuals to become one with the natural environment, establish deep relationships and take responsibility for nature (Palmberg & Kuru, 2000). Nature education is defined as learning the language of nature in the shortest way. The purpose of nature education, which includes many disciplines, is to treat everything that nature offers as a teaching subject area, a learning outcome, and material, and to present students with the opportunity to examine all of this in its natural habitat (Ozaner, 2004). Rousseau says that for students to be able to realize for themselves, the teaching processes should be directly based on nature. For this reason, every child must develop in harmony with nature (Clark & Martin, 2016). The first examples of nature education in the world were seen in the United States in the 1980s. It came to the agenda in Turkey with the "Scientific Environmental Education in National Parks" project supported by TÜBİTAK (Scientific and Academic Research Council of Turkey) toward the end of the 1990s. Today, nature education projects are mostly carried out with TÜBİTAK's support (Keleş, 2011).

One of the environmentalist settings necessary to show the importance of nature and the environment to students with new approaches is the forest school. Forest schools are open-air schools where students participate in activities in the woodland and forest areas and develop their individual and social skills (FSA, 2002). In forest schools, all the living things in that environment, especially trees, are used to improve students' self-esteem and sense of freedom. They develop many skills such as cooperation and problem-solving through practice in woodland areas (Onur, 2016). This is known as a modern school approach that provides concrete outdoor experiences and is particularly important for science education. Although forest school theory emerged in the United States in the 1920s, forest schools continue to gain importance today (Marshall, 2013).

Picture 3. Examples of Forest Schools

National Parks

According to the Turkish National Parks Law (1983), national parks are defined as "from a scientific and esthetic viewpoint, parts of nature that possess natural and cultural resource values rarely found nationally or internationally and that include areas for conservation, recreation, and tourism." The International Union for the Conservation of Nature (IUCN) defined national parks in 2008 as "large natural areas that are compatible with environmental and cultural considerations, provide a basis for scientific, educational, recreational, and visiting opportunities, and are reserved for the conservation of entire species and ecosystems endemic to the region, as well as large-scale ecological processes." In short, national parks are places that ensure the conservation of natural areas on a country basis by attaching importance to biodiversity and passing them down to future generations (Blanco, 2002). National parks allow students to experience nature and wildlife one-on-one and are key learning environments for raising environmental awareness (Lugg & Slattery, 2003). In addition to all these services that they offer, they are important educational institutions in that they support scientific research so that societies can prosper. Furthermore, many countries support the use of national parks as part of the environmental education process (Blanco, 2002; Gurnett, 2009; Lugg & Slattery, 2007). Thanks to this, like other out-of-school learning environments, students get to know nature and become aware of the issues they need to consider to conserve nature. In this way, it is possible to teach many science concepts to students permanently.

Picture 4. Examples of National Parks (Yosemite National Park, Yedigöller National Park)

Industrial Organizations

Industry directly affects people's daily lives and is the sum of the methods and tools used for the efficient application of the energy resources it provides while producing

products that meet the needs and expectations of people by processing raw materials. Industrial organizations may be listed as packaging, iron-steel, electricity-electronics, food, chemistry, cosmetics, building-construction, automotive, textile, machinery-metal industry and power plants, and recycling facilities (Atabek-Yiğit, 2011). Industrial organizations are one of the important environments that can be used in teaching science effectively (Braund & Reiss, 2006; Uitto et al., 2006). In the teaching activities that will take place in these settings, students learn how the products they use in their daily lives are produced, what stages they go through until they take their final form, and how they relate to the concepts they learn in the science lesson at school. In particular, they learn first-hand how the environment is used in the production of industrial products and how to combat the resulting environmental pollution (Balkan-Kıyıcı & Atabek-Yiğit, 2010.). Considering the place and importance of recycling facilities, recycling, and zero waste concepts in environmental education, it is thought that they are very important places to study how waste is transformed into secondary raw materials after seeing the necessary processes and their inclusion in the re-production processes. Nuclear energy, thermic, natural gas, geothermal, solar, and wind power plants are very important learning environments for gaining concrete experience in the subject of renewable and non-renewable energy sources. In particular, acquiring first-hand knowledge in these settings and communicating and interacting with the guides who work there will be a unique experience for students in terms of gaining environmental awareness and developing garbage- and waste-reduction, and energy-saving behaviors and attitudes.

Eco-Friendly Person Activıtiy

Before the Trip

Teaching preparation

First of all, the out-of-school learning environment and the learning outcome from the science curriculum should be determined. The botanical garden was chosen as the learning environment and "Students will question the importance of biodiversity for natural life." from Turkish 2018 Science Curriculum as the learning outcome for this teaching activity. Then, the process Trip Order was designed by establishing a relationship between the environment and the learning outcome. A worksheet has been prepared to guide students through the process. Detailed information on this subject is given under the heading of Trip Order.

Determination of the out-of-school environment

Ege University Research and Application Center of Botanical Garden and Herbarium is a garden with 13 greenhouses in order to contribute to the science of biology, to promote the plant richness of the world and Turkey, the plant diversity of the Aegean Region, and

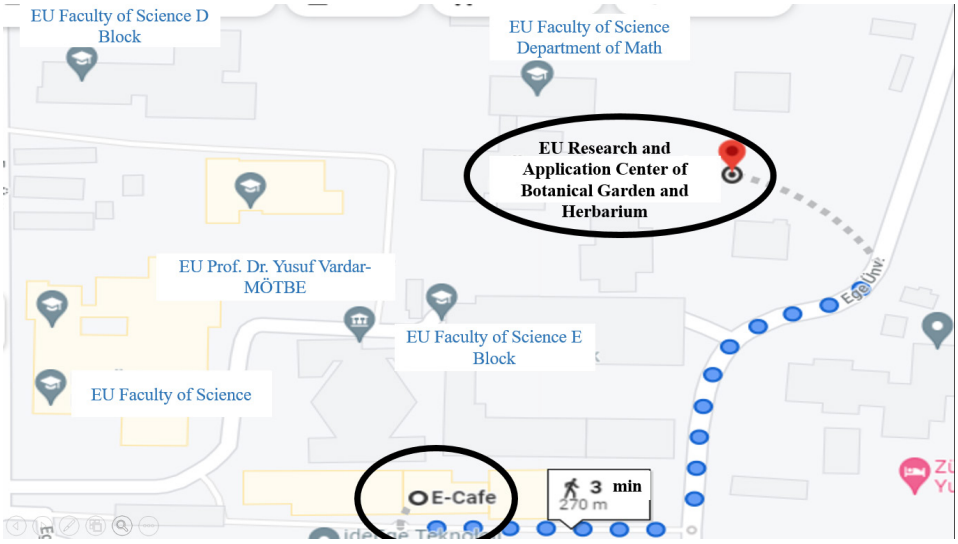
to preserve and keep these examples alive. It is an out-of-school learning environment where graduate students and research assistants inform visitors as guides. There are also information boards. Within the scope of this course, students will have the opportunity to examine the plant diversity in the Aegean Region in the botanical garden, and they will gather their knowledge by working like scientists.

NOTE: Plants are systematically explained and introduced to the students by experts in the botanical garden. The plan should be mentioned when making an appointment, as the teacher wants to provide an environment for students to explore. For this reason, in this process, instead of giving direct information, the guide should be in the environment to answer the questions asked when needed. Students will freely explore the garden.

Picture 5. Ege University Research and Application Center of Botanical Garden and Herbarium

Student needs

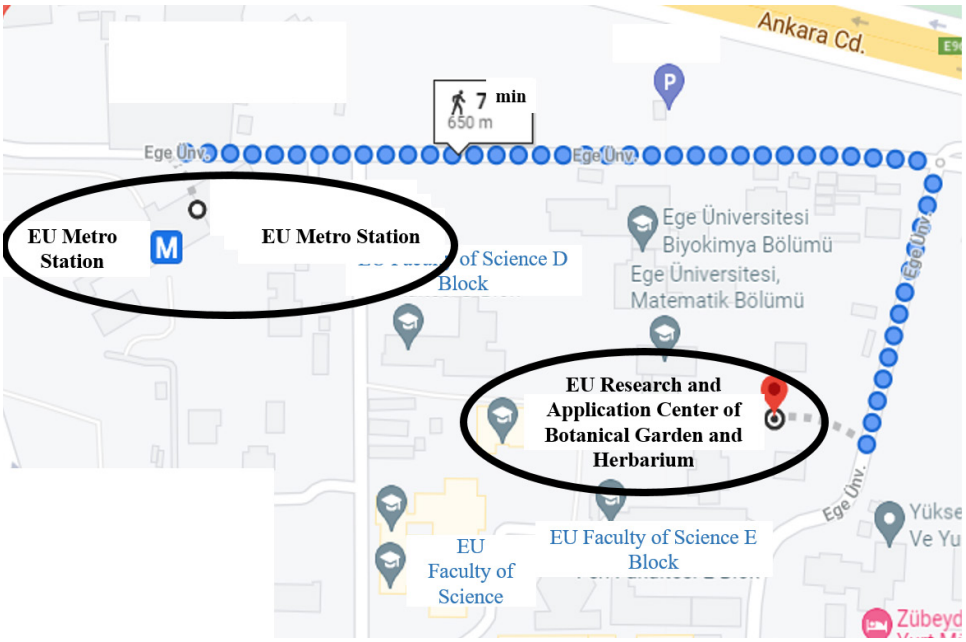
Students will be able to meet their needs from the E-Cafe located near the Ege University Botanical Garden and from the canteens of the Faculty of Science. The location of these places is given in the picture below.



Picture 6. The place of Ege University Research and Application Center of Botanical Garden and Herbarium and E-Cafe

Transportation and Accommodation

The botanical garden is located very close to the EU metro station. Depending on the location of the school, it may be preferable to use the shuttle vehicles. It may also be a more appropriate choice for students' safety. The location of these places is given in the picture below.



Picture 7. The place of Ege University Research and Application Center of Botanical Garden and EU Metro Station

Consent procedures: Before the trip, permission should be obtained from the principal, parents and, if necessary, from the district national education directorates.

Trip Order

It is a process that takes place entirely in the botanical garden during the trip. Students will act in 5 homogeneous groups. There will be a parent at the head of each group. Students will meet the guide in the environment, the guide will be there to provide information and answer questions. The teacher will distribute worksheets to the students. In this process, students will seek answers to the questions in the worksheet. In this process, they will be in intense communication with the guide, teachers and parents. The questions on the paper are as follows. The process will end after students find answers to all questions.

1. Which plants did you study in the botanical garden? Select these 5 that you have examined and write down their similarities and differences in detail.

For this question, students will examine plants, compare the similarities and differences of the 5 plants they have chosen, and write them in a chart. They will be expected to find the answer that the species of plants, their appearance and physiological characteristics are different, but the region they live in is the same. This information is on the information plates next to it. Also, the guide is there to provide this information.

2. **How many different plants have you seen living in the Aegean Region in the botanical garden? Do these differences also apply to other regions and living beings?**

For this question, students can examine plants, count and collect information from information boards. With this question, they will be expected to deduce that there are many different plants living in the Aegean Region and that this difference will be valid for other regions and living things.

3. What benefits does this diversity bring us? What would happen if living things were not so diverse? Explain with an example from the botanical garden.

With this question, students will question the importance of biodiversity and they can do this with the data they collect

4. What information did you find about endangered creatures in this environment? How does this affect the environment? What can we do about this issue?

Students who question the importance of biodiversity will also learn about endangered creatures with this question. They will become aware of the scientific studies of the botanical garden for endangered plants. They will understand what responsibilities they have as an environmentally friendly individual on this subject.

Post-Trip

It is a process that takes place entirely in the school, classroom. At this stage, students will share their answers with the class and discuss the questions. The teacher will gather and summarize the answers to the students' questions, the information they have gathered. The evaluation part will take place in the classroom. At this stage, all aspects of the students' educational activities will be evaluated. Students will be asked open-ended and multiple choice questions. In general, students are expected to reach the following information in this process.

Biodiversity includes plants, animals, ecosystems and habitats. Biodiversity is one of the most basic elements for the continuation of life on Earth. Unfortunately, biodiversity is rapidly decreasing day by day. Biodiversity has become one of the most important problems affecting all living species today. Today, biodiversity is disappearing at a rate of 1000 times its normal rate. Overexploitation of resources, climate change, excessive air pollution and the spread of diseases; accelerates the loss of biodiversity. This human population growth will reveal overconsumption, climate change and the incredible loss of biodiversity. However, this is not an irreversible path. We can take measures to slow or stop the decline of biodiversity.

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