

# **Developing an Interdisciplinary Environmental Educational Program on Insect Conservation for Primary School Children**

**Geanina M. Sitar, Cristian Sitar, Alina S. Rusu**

# Developing an Interdisciplinary Environmental Educational Program on Insect Conservation for Primary School Children

Geanina M. Sitar<sup>a, c\*</sup>, Cristian Sitar<sup>b</sup>, Alina S. Rusu<sup>a, c</sup>

<sup>a</sup> Doctoral School "Education, Reflection, Development", Faculty of Psychology and Educational Sciences, Babes-Bolyai University, 7 Sindicatelor Street, Cluj-Napoca, Romania

<sup>b</sup> Zoological Museum, "Babeş-Bolyai" University, 5-7 Clinicilor, 400006, Cluj-Napoca, Romania

<sup>c</sup> Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Calea Manastur Street, No. 3-5, Romania

\*Corresponding author: [giacob@yahoo.com](mailto:giacob@yahoo.com)

## Abstract

### Keywords:

interdisciplinary curriculum; species literacy; experiential learning; insects.

Environmental education plays a critical role in shaping sustainable behaviours and cultivating a deeper understanding of ecological systems. This paper presents a theoretical framework supporting the interdisciplinary design of an environmental educational program in primary schools, with a specific focus on insect conservation. Insects, as vital contributors to ecosystem functioning, require dedicated attention and conservation efforts, making them an ideal focal point for engaging young learners. The proposed framework integrates essential components necessary for the elaboration of activities and learning objectives of the program, such as: effective environmental education, encompassing knowledge acquisition, attitude formation, and behavioural change. It emphasizes the provision of comprehensive and accurate information about insects, including their ecological roles and the challenges they face. To encourage behavioural change and a sense of responsibility, the framework underscores the need for hands-on experiences and direct interaction with insects. Practical activities, such as observing living insects can enable primary school students to develop a personal connection with insects and foster a sense of responsibility for their conservation. Furthermore, the framework underscores the importance of fostering positive attitudes towards insects, challenging any pre-existing negative perceptions, and nurturing empathy towards these invaluable species.

## Zusammenfassung

### Schlüsselworte:

Interdisziplinärer Lehrplan; Artenkenntnis; Erfahrungslernen; Insekten.

Die Umweltbildung spielt eine entscheidende Rolle bei der Gestaltung nachhaltiger Verhaltensweisen und der Entwicklung eines tieferen Verständnisses ökologischer Systeme. Dieser Artikel präsentiert einen theoretischen Rahmen, der die interdisziplinäre Gestaltung eines Umweltbildungsprogramms an Grundschulen unterstützt, wobei ein spezieller Schwerpunkt auf dem Schutz von Insekten liegt. Insekten sind als unverzichtbare Beitragende zur Funktion von Ökosystemen von besonderer Bedeutung und erfordern daher gezielte Aufmerksamkeit und Schutzmaßnahmen, wodurch sie einen idealen Schwerpunkt für junge Lernende darstellen. Der vorgeschlagene Rahmen integriert wesentliche Komponenten, die für die Ausarbeitung von Aktivitäten und Lernzielen des Programms erforderlich sind, wie zum Beispiel effektive Umweltbildung, die Wissensvermittlung, die Bildung von Einstellungen und die Verhaltensänderung umfasst. Er betont die Bereitstellung umfassender und genauer Informationen über Insekten, einschließlich ihrer ökologischen Funktionen und der Herausforderungen, denen sie gegenüberstehen. Um Verhaltensänderungen und ein Verantwortungsbewusstsein zu fördern, unterstreicht der Rahmen die Notwendigkeit praktischer Erfahrungen und direkter Interaktion mit Insekten. Praktische Aktivitäten wie das Beobachten lebender Insekten ermöglichen es Grundschulern, eine persönliche Verbindung zu Insekten aufzubauen und ein Gefühl der Verantwortung für deren Schutz zu entwickeln. Darüber hinaus betont der Rahmen die Bedeutung der Förderung positiver Einstellungen gegenüber Insekten, indem bestehende negative Wahrnehmungen herausgefordert und Empathie für diese unschätzbaren Arten gefördert werden.

## 1. Introduction

In recent years, the global decline of insect populations has emerged as a pressing environmental concern, giving rise to significant ecological disturbances across diverse regions worldwide (Didham et al., 2020; Forister et al., 2019; IPBES, 2019). A compelling case study from southern China serves as a vivid illustration of the profound impacts of insect population decline. In this region, the decline

of insect pollinators has led to declining apple productivity, necessitating the intervention of manual pollination by the affected community (Partap et al., 2000).

While the decline of insects is not a new phenomenon, it is only in the last decade that it has gained widespread scientific recognition. In 2017, a paper published by Hallmann et al. shed light on the



alarming situation of insects in Germany. Aligned with their research findings, the authors delve into the significance of fostering awareness regarding the critical roles played by insects in ecosystems (Hallman et al., 2017). These roles encompass pivotal functions such as pollination, serving as vital food resources for other taxa, and contributing to the maintenance of overall ecological structure, among others.

While initiatives and actions related to climate change, biodiversity, and sustainability are gaining momentum across Europe (Dormido et al., 2023; ), there remains a critical gap in educational programs regarding pollinators and the decline of insects (Calmuțchi & Melentiev, 2017; Christ & Dreesmann, 2022; Cornienco & Vornicu, 2021; Samways, 2015).

In the context of insect conservation, both environmental education and direct interaction with nature play vital roles (Ingram & Golick, 2018; Weeks & Oseto, 2018). Environmental education aims to instill in children a deep understanding and appreciation of the environment (Coyle, 2005; Gralton et al., 2004). Through direct interactions with insects and their habitats, individuals can strengthen their connection to nature, fostering a personal commitment to conservation (Cho & Lee, 2018; Schönfelder & Bogner, 2017; Weeks & Osero, 2018 ). However, it is important to acknowledge that educational programs in schools often overlook the significance of pollinators and the overall decline of insect populations (Calmuțchi & Melentiev, 2017; Christ & Dreesmann, 2022; Cornienco & Vornicu, 2021). Negative attitudes and misconceptions surrounding insects can hinder efforts of education providers to include them in conservation discussions and initiatives (Cardoso et al., 2011; Kellert, 1993; Samways, 2015). Overcoming these challenges requires addressing the fears and biases associated with insects, and highlighting their critical role in ecological balance and biodiversity.

## 2. Problem Statement

The imperative need for insect conservation framework is underscored by several factors, some of them being cultural and societal specific. Firstly, the presence of insects in the Romanian primary science curricula is rather limited (Calmuțchi & Melentiev, 2017; Cornienco & Vornicu, 2021). Insufficient attention given to insects in school curricula can limit the development of a holistic understanding of their ecological significance (Christ & Dreesmann, 2022). Additionally, prevailing environmental education guidelines often neglect to prioritize insects, resulting

in missed opportunities to foster a solid knowledge base about these vital species. Negative attitudes towards insects further compound the issue by impeding their integration into educational contexts (Bjerke & Østdahl, 2004; Kellert, 1993; Soga et al., 2020).

Furthermore, the global controversy surrounding the emergence of insect-origin protein has recently ignited international debates (Lombardi et al., 2019), highlighting the pressing need to address insects within educational spheres. To effectively confront these challenges, we consider that it is imperative to prioritize robust and comprehensive insect conservation initiatives within educational frameworks while actively cultivating positive attitudes towards insects.

## 3. Purpose of the Study

The purpose of this study is to design an interdisciplinary environmental education framework for primary school students that focuses on insect conservation, integrates effective education strategies, provides comprehensive knowledge about insects and their ecological roles, promotes behavioural change through hands-on experiences, and fosters positive attitudes towards insects while nurturing empathy for their conservation.

## 4. The proposed framework

In the domain of environmental education, numerous guidelines exist to provide direction and structure. Our proposed framework builds upon a comprehensive definition of education as a practice dedicated to nurturing attitudes, values, skills, motivation, knowledge, and actions that effectively address environmental issues (Green & Baek, 2022). To establish the competencies of our program, we conducted a thorough examination of diverse guidelines specifically tailored for environmental education (Athman & Monroe, 2001; Bakhtiar, 2016; Green & Baek, 2022). Through meticulous analysis, we identified the essential components and adapted them to the context of insect conservation.

### 4.1. *Insects' Conservation Literacy and Competencies of Environmental Educational Program*

The goal of the proposed framework is to equip elementary school students with Insect Conservation literacy. Our primary considerations of the theoretical framework development are fourfold: knowledge acquisition, skill development, the formation of positive attitudes and actions towards insects. We decided to equally offer attention to all these

competencies since developing all four is necessary to attain insect conservation literacy. Table 1 presents our definition and the subcategories of the four competencies. For simplicity, we use number order to indicate each of the subcategories.

**Knowledge** The aim of the knowledge competency in insect conservation is to develop a comprehensive understanding of insect biology, diversity, habitats, and adaptations. Students will gain knowledge about the fundamental aspects of insects, their ecological roles, and the interrelationships between insects and their habitats. The knowledge competency in insect conservation focuses on two key aspects: Insect Biology and Diversity, and Insect Habitats. Through engaging learning experiences, students will delve into the fascinating world of insects, exploring their anatomy, life cycles, behaviors, and the incredible diversity of insect species. They will also develop an understanding of the critical roles insects play in ecological processes, such as pollination, decomposition, and their place within food chains.

**Skills** Skills competency equips individuals with the necessary abilities to engage in insect identification and scientific observation and data collection. In terms of insect identification, the goal is to enable individuals to recognize and differentiate common insect species. Through the development of this skill, individuals become proficient in identifying insects based on their unique characteristics, utilizing resources such as field guides, magnifying lenses, and observation techniques for accurate identification. Additionally, the skill competency encourages individuals to learn how to classify insects based on their physical attributes, thereby enhancing their understanding of the diversity and adaptations within different species. Moving on to scientific observation and data collection, the aim is to promote techniques that allow individuals to systematically observe insect behavior and interactions, employing methods that contribute to a deeper understanding of insect ecology. By collecting valuable data through these observations, individuals actively contribute to conservation efforts in the field.

**Attitudes** The main aim of the Attitudes competency is to foster appreciation and respect for insects by cultivating a sense of wonder and appreciation for the beauty and diversity of insects. Individuals are encouraged to explore the intricate world of insects, recognizing their unique qualities and the important roles they play in ecosystems. By fostering a genuine appreciation, individuals develop

a deeper understanding of the value and significance of insects in the natural world. Promoting ethical behavior towards insects, including responsible handling and release, is another key aspect of this competency. Individuals are encouraged to treat insects with care and respect, recognizing their intrinsic value as living beings. This includes handling insects responsibly and avoiding actions that could harm their well-being. By promoting ethical behavior, individuals can contribute to the preservation and protection of insect populations.

**Actions** Taking concrete actions is a fundamental aspect of insect conservation. The primary goal of this competency is to engage in activities that promote habitats suitable for insects. Individuals are encouraged to create insect-friendly gardens, build insect shelters, and establish habitats that provide essential resources for insects to thrive. By providing suitable environments, individuals contribute to the preservation and conservation of insect populations. Engaging in friendly practices that support insect populations is another key aspect of this competency. Individuals are encouraged to plant gardens that attract pollinators, such as bees and butterflies, by including a variety of native plants that provide nectar and pollen. These actions can contribute to sustaining insect populations and ensuring their access to essential food sources.

Table 1. Insects' Conservation competencies and its subcategories

Insects' Conservation Competencies	Competencies Subcategories	Operational Objectives
<b>Knowledge</b>	K1: Insect Biology and Diversity	K1.O1. Understand the basic anatomy, life cycles, and behaviors of insects. K1.O2. Explore the diversity of insect species and their ecological roles. K1.O3. Learn about the importance of insects in pollination, decomposition, and food chains.
	K2: Insect Habitats	K2.O1. Study the different habitats where insects thrive, such as forests, meadows, and water bodies.
<b>Skills</b>	S1: Insect Identification	S1.O1. Develop skills to recognize and differentiate common insect species. S1.O2. Use field guides, magnifying lenses, and observation techniques to identify insects. S1.O3. Learn to classify insects based on their physical characteristics.

	S2: Scientific Observation and Data Collection	S2.O1. Practice observing insects scientifically and documenting their behavior and interactions.
<b>Attitudes</b>	AT1: Appreciation and Respect for Insects	AT1.O1. Cultivate a sense of wonder and appreciation for the beauty and diversity of insects. AT1.O2. Promote ethical behavior towards insects, including responsible handling and release.
<b>Actions</b>	A1:Habitat Preservation and Enhancement	A1.O1. Engage in activities that promote habitats suitable for insects, such as creating insect-friendly gardens or building insect shelters. A1.O2. Engage in friendly practices that support insect populations, such as planting gardens that attract pollinators.

#### 4.2. Insects Conservation Program Framework for Primary School Students

A full content structure of the proposed framework is demonstrated in Table 2. The framework is designed for students in the third and fourth grades. It is suitable for learners who may not have any prior knowledge or skills about insects. The framework serves as a beginner's guide to insects and their conservation, making it accessible and interesting for all students in these grade levels.

In constructing each module, the primary objective was to foster competencies that enhance primary school students' literacy in insect conservation. The content within these modules is meticulously curated to provide a comprehensive understanding of insects and their conservation, ensuring a balanced focus without overemphasizing any particular aspect. Moreover, to promote skill development, the modules incorporate hands-on activities that actively engage students in real-life insect conservation practices, allowing them to gain practical experience and a deeper appreciation for the subject matter.

The proposed framework for insect conservation education is thoughtfully organized into three distinct modules, each centered around a specific theme. This structured approach spans a duration of three weeks, allowing for the exploration of a different module each week. Within each module, students will engage in two or three carefully designed lessons, tailored to either a 60-minute or 90-minute timeframe, depending on the nature of the activities involved.

##### *Module 1: How to Recognize Insects. Types of Insects*

During the initial week, students are introduced to the significance of recognizing insects and their crucial role within ecosystems (Table 1). Following

this theoretical session, we have designed a Practical Activity called "Insect Identification," which aims to provide a hands-on experience for each student. Equipped with mini-identification brochures, students are encouraged to actively engage with the captivating world of insects, fostering a deeper understanding of their characteristics and diversity. As a means of assessing their progress and facilitating personal reflection, we propose that students maintain a dedicated journal throughout the entire program implementation. This journal will serve as a platform for students to record their daily observations, thoughts, and questions, further enhancing their connection with insects and fostering a sense of curiosity and exploration.

To maximize the levels of engagement and enthusiasm during the insect conservation program, we have incorporated a field trip as part of the second lesson. Contrary to traditional practices where field trips are scheduled towards the end of the program, we have opted to organize the excursion at the beginning. Drawing from past experiences, we have observed that children are more readily stimulated when they have direct encounters with insects early on. By immersing students in a real-world setting right from the start, we aim to ignite their curiosity and foster a deeper connection with nature. This strategic decision to prioritize the field trip early in the program is intended to maximize the students' engagement and enthusiasm throughout the entirety of the environmental program.

In the third lesson of our framework, the focus is on developing knowledge about the life cycles of insects. The concept of insect life cycles is introduced, followed by a practical activity called "Building a Life Cycle Wheel". Each participant receives circular templates, construction paper, and markers to create their own life cycle wheel. They can choose an insect from the provided examples or based on personal preference. The different life cycle stages of the chosen insect are drawn and labelled on the wheel, with discussions encouraged to explore similarities and differences between various insect life cycles. This activity aims to deepen understanding and appreciation for the diverse paths of insect development.

##### *Module 2: How to Determine Insects – Case Study: Butterflies. My Insect Collection*

The second module (Table 3) is dedicated to the world of butterflies. Studies have shown that butterflies are among the few insects that are highly appreciated by the public. By engaging in appropriate

activities, students have the opportunity to transform their attitudes towards insects in general. Therefore, the primary objective of this module is to introduce students to the classification and characteristics of butterflies, thereby enhancing their understanding of the diverse species and how to identify them accurately. In addition, we propose an engaging practical activity called "My Insectarium." During this activity, students will have the chance to learn about the process of creating an insectarium and preserving insects for display. They will also gain valuable insights into responsible collecting practices and the ethical considerations associated with insect collection.

### *Module 3: The Importance of Insects. How to Protect Insects?*

Module 3 is dedicated to protected species (Table 4). In order to foster responsible behavior towards insects, students need to understand the concept of protected species and be familiar with key conservation initiatives for these species. Therefore, in the lessons of this module, the focus should be on species protected under the Annexes II and IV of the Council Directive 92/43/EEC, Annex II of the Bern Convention that are present in the students' country of residence. For this module, we propose two practical activities.

The first activity is "Group Activity: Designing an Insect Habitat," where students are guided to design a habitat for their favorite insect, taking into consideration its ecological needs. This hands-on activity will encourage students to think critically about the requirements of their chosen insect species and create a suitable habitat that meets those needs. The second activity involves the identification of protected species using field guides. It is an interactive activity called "Recognition Games for Protected Insects". Students will participate in games where they have to identify and match protected insect species with their corresponding descriptions or images. To motivate their participation and success, stickers featuring the identified species and model insects could be provided as rewards.

These activities aim to engage students actively in the learning process, deepen their understanding of protected species, and promote responsible actions towards insect conservation. By encouraging students to design insect habitats and test their knowledge through recognition games, they will develop a stronger connection with the concept of protected insects and be inspired to contribute to their preservation.

Table 2. The first module of the content structure of the proposed Insects Conservation Program framework

Module	Lesson	Activities
<b>1. How to Recognize Insects. Types of Insects. (3 lessons)</b>	1. Title: <i>Exploring the World of Insects</i> Objective: To introduce students to the characteristics and diversity of insects, enabling them to recognize different insect groups. Duration: 60 minutes	<b>Introduction (10 minutes)</b> <ul style="list-style-type: none"> <li>Engage students by asking them questions about insects and their characteristics.</li> <li>Discuss the importance of recognizing insects and their role in ecosystems.</li> </ul> <b>Theoretical Foundation (20 minutes)</b> <ul style="list-style-type: none"> <li>Present a slideshow or video introducing the key characteristics of insects.</li> <li>Explain the criteria for recognizing insects and differentiating them from other invertebrate groups.</li> </ul> <b>Practical Activity: Insect Identification (30 minutes)</b> <ul style="list-style-type: none"> <li>Provide mini-determinator brochures to each student.</li> <li>Distribute insect specimens and magnifying glasses for closer examination.</li> <li>Guide students in identifying and categorizing the insects using the provided resources.</li> <li>Encourage students to observe and discuss the various adaptations and anatomical features of the insects.</li> </ul> <b>Conclusion (10 minutes)</b> <ul style="list-style-type: none"> <li>Recap the main concepts learned during the lesson.</li> <li>Highlight the importance of accurate insect recognition and its relevance to insect conservation.</li> <li>Assign a follow-up activity, such as creating a poster or writing a short description of a chosen insect.</li> </ul>
	2. Title: <i>Exploring the World of Insects through Direct Observation</i>	<b>Introduction (10 minutes)</b> <ul style="list-style-type: none"> <li>Engage students by discussing their previous encounters with insects and their curiosity about them.</li> <li>Explain the importance of direct observation in understanding insect diversity.</li> </ul> <b>Field Trip: Insect Exploration in the Park (60 minutes)</b>

Objective: To introduce students to the diversity of insects by making direct observations in a natural environment.	<ul style="list-style-type: none"> <li>• Take students on a trip to the nearest park or green space.</li> <li>• Instruct students to observe insects in their natural habitat and encourage them to document their observations in their journals.</li> <li>• Provide guidance and answer questions during the observation session.</li> </ul>
Duration: 90 minutes	<p><b>Reflection and Discussion (20 minutes)</b></p> <ul style="list-style-type: none"> <li>• Gather students together and facilitate a discussion about their observations.</li> <li>• Encourage students to share interesting findings, ask questions, and express their thoughts and feelings about the insects they observed.</li> <li>• Highlight the significance of firsthand experiences in learning about insects.</li> </ul> <p><b>Journal Entry (during the program)</b></p> <p>Assign each student a journal to record their daily observations, thoughts, and questions related to insects.</p> <p>Instruct students to make entries in their journals regularly, documenting their encounters with insects and any new insights gained.</p>
3. Title: <i>Building a Life Cycle Wheel for an Insect</i>	<p><b>Review and Discussion (10 minutes)</b></p> <ul style="list-style-type: none"> <li>• Recap the previous lesson's field trip and encourage students to share their experiences and observations from the park visit.</li> <li>• Facilitate a discussion about the diversity of insects encountered during the field trip.</li> </ul> <p><b>Theoretical Foundation: Insect Life Cycles (20 minutes)</b></p> <ul style="list-style-type: none"> <li>• Introduce the concept of insect life cycles, emphasizing the stages of metamorphosis (e.g., egg, larva, pupa, adult).</li> <li>• Provide examples of different insect life cycles, such as butterflies, beetles, or bees.</li> </ul> <p><b>Practical Activity: Building a Life Cycle Wheel (25 minutes)</b></p> <ul style="list-style-type: none"> <li>• Distribute materials for creating a life cycle wheel, including circular templates, construction paper, markers, and fasteners.</li> <li>• Instruct students to choose an insect from the examples provided or their own preference.</li> <li>• Guide students in drawing and labelling the different life cycle stages of their chosen insect on the wheel.</li> </ul> <p><b>Presentation and Sharing (15 minutes)</b></p> <ul style="list-style-type: none"> <li>• Allow students to present their life cycle wheels to the class, explaining the chosen insect and its life cycle stages.</li> <li>• Encourage students to discuss similarities and differences between their chosen insects' life cycles.</li> <li>• Facilitate a class discussion on the significance of understanding life cycles in insect conservation and the interdependence of insects within ecosystems.</li> </ul>
Objective: To deepen students' understanding of insect life cycles by creating a visual representation of a chosen insect's life cycle. Duration: 60 minutes	

Table 3. The second module of the content structure of the proposed Insects Conservation Program framework.

<b>Module 2.</b> <b>How to Determine Insects – Case Study: Butterflies. My Insect Collection. (2 lessons)</b>	1. Title: <i>Journey into the World of Butterflies</i>  Objective: To introduce students to the classification and characteristics of butterflies, enhancing their understanding of butterfly diversity and identification.  Duration: 60 minutes	<p><b>Introduction (10 minutes)</b></p> <ul style="list-style-type: none"> <li>• Engage students by discussing their prior knowledge of butterflies and their unique characteristics.</li> <li>• Share interesting facts or anecdotes about butterflies to spark curiosity.</li> </ul> <p>Theoretical Foundation (20 minutes)</p> <ul style="list-style-type: none"> <li>• Present a visual presentation or video explaining the classification and characteristics of butterflies.</li> <li>• Introduce the concept of butterfly families and common identifying features within each family.</li> </ul> <p><b>Practical Activity: Butterfly Observation (30 minutes)</b></p> <ul style="list-style-type: none"> <li>• Provide students with mini-determinator brochures specific to butterfly identification.</li> </ul>
--	---	--

	<ul style="list-style-type: none"> <li>•Set up observation stations with preserved butterfly specimens or high-quality images.</li> <li>•Instruct students to carefully examine the butterflies, comparing their features to the information provided in the brochures.</li> <li>•Encourage students to discuss and record their observations.</li> </ul> <p>Conclusion (10 minutes)</p> <ul style="list-style-type: none"> <li>•Recap the main concepts covered in the lesson.</li> <li>•Emphasize the importance of accurate butterfly identification for conservation purposes.</li> <li>•Assign a follow-up activity, such as researching and presenting information about a specific butterfly species.</li> </ul>
<p>2. Title: Creating My Butterfly Collection</p> <p>Objective: To familiarize students with the process of creating an insect collection, promoting responsible collecting practices and ethical considerations.</p> <p>Duration: 60 minutes</p>	<p><b>Review (10 minutes)</b></p> <ul style="list-style-type: none"> <li>•Recap the classification and identifying characteristics of butterflies discussed in the previous lesson.</li> <li>•Encourage students to share their observations and thoughts on butterfly diversity.</li> </ul> <p><b>Theoretical Foundation: Collecting Ethics (20 minutes)</b></p> <ul style="list-style-type: none"> <li>•Present a discussion on responsible insect collecting, emphasizing the importance of ethical considerations and conservation efforts.</li> <li>•Discuss the concept of protected insect species and the importance of preserving their habitats.</li> </ul> <p><b>Practical Activity: Building an Insect Collection (25 minutes)</b></p> <ul style="list-style-type: none"> <li>•Provide refrigerated insects for students to examine and study.</li> <li>•Demonstrate proper insect handling techniques and the use of entomological tools.</li> <li>•Guide students in mounting and preserving their chosen insects using available materials.</li> </ul> <p><b>Reflection and Presentation (15 minutes)</b></p> <ul style="list-style-type: none"> <li>•Have students present their completed insect collections to the class, explaining their choices and the ethical considerations taken during the process.</li> <li>•Facilitate a class discussion on the significance of responsible insect collecting and the role of collections in scientific research and education.</li> </ul>

Table 4. The third module of the content structure of the proposed Insects Conservation Program framework

<p><b>Module 3: The Importance of Insects. How to Protect Insects?</b></p> <p>(2 lessons)</p>	<p>1 Title: Exploring the Role of Insects in Ecosystems</p> <p>Objective: To raise awareness about the importance of insects in maintaining healthy ecosystems.</p> <p>Duration: 90 minutes</p>	<p><b>Introduction and Discussion (15 minutes)</b></p> <ul style="list-style-type: none"> <li>•Engage students by discussing the different roles insects play in ecosystems, such as pollination, decomposition, and pest control.</li> <li>•Highlight the interdependence of insects and other organisms in a food web.</li> </ul> <p>Video Presentation and Discussion (30 minutes)</p> <ul style="list-style-type: none"> <li>•Show video clips or use illustrated posters to demonstrate the specific contributions of insects to various ecosystems.</li> <li>•Facilitate a class discussion about the impact of insect conservation on ecosystem health and balance.</li> </ul> <p><b>Group Activity: Designing an Insect Habitat (30 minutes)</b></p> <ul style="list-style-type: none"> <li>•Divide students into small groups and assign each group a specific habitat (e.g., garden, forest, pond).</li> <li>•Instruct students to brainstorm and design an insect-friendly habitat that provides food, shelter, and water for different insect species.</li> <li>•Encourage creativity and emphasize the importance of creating a balanced and sustainable habitat.</li> </ul> <p>Presentation and Discussion (15 minutes)</p> <ul style="list-style-type: none"> <li>•Have each group present their insect habitat design to the class.</li> <li>•Facilitate a discussion about the features and elements that make a habitat suitable for insects.</li> </ul>
---	---	--



2. Title: Protected Insects and Ethical Considerations  
Objective: To introduce students to protected insect species and promote responsible actions towards insect conservation.  
Duration: 60 minutes

•Discuss ways in which individuals can contribute to insect conservation by creating insect-friendly environments in their own communities.

#### **Theoretical Foundation: Protected Insects (20 minutes)**

- Introduce the concept of protected insects, such as Natura 2000 species, and their significance in biodiversity conservation.
- Use brochures and visual aids to showcase examples of protected insects, emphasizing their unique characteristics and habitats.

#### **Interactive Activity: Recognition Games for Protected Insects (30 minutes)**

- Conduct recognition games where students identify and match protected insect species with their corresponding descriptions or images.
- Provide stickers featuring identified species and model insects as rewards for successful identification.

#### **Discussion and Ethical Considerations (10 minutes)**

- Engage students in a discussion about the importance of responsible actions towards protected insects.
- Emphasize ethical considerations, such as avoiding harmful actions like collecting protected insects and respecting their natural habitats.

## 5. Conclusions

The framework presented here provides a comprehensive and targeted approach to environmental education, with insects as the central theme. Carefully designed, the program aims to captivate, engage, and educate primary school students, taking into account their interests and learning capabilities. By integrating knowledge acquisition, skill development, and fostering positive attitudes towards insects, the framework strives to cultivate a profound understanding of these remarkable creatures.

Through this program, students will acquire both factual knowledge and practical skills, enabling them to actively contribute to insect conservation efforts. By emphasizing the interconnectedness of ecological systems and promoting responsible environmental stewardship, the framework aligns with sustainable development principles. It recognizes that education plays a pivotal role in nurturing a sustainable mindset among students, empowering them to make informed decisions and take meaningful actions for the well-being of our planet.

By adopting this framework, educators can inspire and guide students towards becoming active stewards of the environment, instilling a deep sense of responsibility and fostering a lasting commitment to the preservation of our natural world.

### Authors note:

**Geanina M. Sitar** (biologist) is currently enrolled as a PhD student at the Doctoral School “Education,

Reflection, Development” (domain: Sciences of Education) at Babes Bolyai University, Cluj-Napoca. Her professional and research interests are insect conservation, environmental education, and interdisciplinary curriculum development.

**Cristian Sitar** (biologist) is currently a Curator at the Zoological Museum of Babeş Bolyai University, Cluj-Napoca and Associate Professor at the Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. His professional and research interests are insect ecology, Taxonomy, insect conservation, environmental education, and interdisciplinary curriculum development.

**Alina S. Rusu** (biologist and psychologist) is currently a Professor at the Faculty of Animal Science and Biotechnologies, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Romania. She is also PhD coordinator affiliated to the Doctoral School “Ed

## References

- Athman, J. A., & Monroe, M. C. (2001). Elements of Effective Environmental Education Programs. School of Forest Resource and Conservation, University of Florida, Gainesville, Florida, 37-48 website: <http://files.eric.ed.gov/fulltext/ED463936.pdf> [accessed 21.06.2023].
- Bakhtiar, A. M. (2016). Curriculum development of environmental education based on local wisdom at elementary school. *International Journal of Learning, Teaching and Educational Research*, 15(3), 20-28.

- Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös*, 17(2), 109-129.
- Calmuțchi, L., & Melentiev, E. (2017). Educația și cercetarea–factori principali în implementarea procesului dezvoltării durabile. *Acta et commentationes (Științe Exacte și ale Naturii)*, 3(1), 52-59.
- Cardoso, P., Erwin, T. L., Borges, P. A., & New, T. R. (2011). The seven impediments in invertebrate conservation and how to overcome them. *Biological conservation*, 144(11), 2647-2655.
- Cho, Y., & Lee, D. (2018). 'Love honey, hate honeybees': reviving biophilia of elementary school students through environmental education program. *Environmental Education Research*, 24(3), 445-460.
- Christ, L., & Dreesmann, D. C. (2022). SAD but true: Species Awareness Disparity in bees is a result of bee-less biology lessons in Germany. *Sustainability*, 14(5), 2604.
- Cornienco M., & Vornicu C. (2021). Dezvoltarea spiritului ecologic al școlărilor mici prin activități extracurriculare. Editura Cartea Vranceană, ISBN 978-606-95212-5-0
- Coyle, K. (2005). Environmental literacy in America: What ten years of NEETF/Roper research and related studies say about environmental literacy in the US. National Environmental Education & Training Foundation.
- Didham, R. K., Basset, Y., Collins, C. M., Leather, S. R., Littlewood, N. A., Menz, M. H., ... & Hassall, C. (2020). Interpreting insect declines: seven challenges and a way forward. *Insect Conservation and Diversity*, 13(2), 103-114.
- Dormido, L., Garrido, I., L'Hotellerie-Fallois, P., & Santillán, J. (2023). Climate change and sustainable growth: international initiatives and European policies.
- Forister, M. L., Pelton, E. M., & Black, S. H. (2019). Declines in insect abundance and diversity: We know enough to act now. *Conservation Science and Practice*, 1(8), e80.
- Green, A., & Baek, J., (2022). Developing Student Outcomes For Environmental Literacy In K-12 Education. Project: NOAA Bay Watershed Education and Training (B-WET).
- Hallmann, C. A., Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., ... & De Kroon, H. (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PloS one*, 12(10), e0185809.
- Imbernon, R., Pioker-Hara, F., Francoy, T., Alexandre, G., Lopes, G., Faht, E., & Silva, B. (2022). Bees and Society: Native Biodiversity as a Strategy for Environmental Education Based on the Processes of Nature. In *Enhancing Environmental Education Through Nature-Based Solutions* (pp. 201-220). Cham: Springer International Publishing.
- Ingram, E., & Golick, D. (2018). The six-legged subject: a survey of secondary science teachers' incorporation of insects into US life science instruction. *Insects*, 9(1), 32.
- IPBES. (2019). Global assessment report on biodiversity and ecosystem services of the intergovernmental science-policy platform on biodiversity and ecosystem services. IPBES Secretariat. <https://ipbes.net/global-assessment>
- Kellert, S. R. (1993). Values and perceptions of invertebrates. *Conservation biology*, 7(4), 845-855.
- Lombardi, A., Vecchio, R., Borrello, M., Caracciolo, F., & Cembalo, L. (2019). Willingness to pay for insect-based food: The role of information and carrier. *Food Quality and Preference*, 72, 177-187.
- Partap, U. M. A., Partap, T. E. J., & Yonghua, H. E. (2000). Pollination failure in apple crop and farmers' management strategies in Hengduan mountains, China. In VIII International Symposium on Pollination-Pollination: Integrator of Crops and Native Plant Systems 561 (pp. 225-230).
- Samways, M. J. (2015). Future-proofing insect diversity. *Current opinion in insect science*, 12, 71-78.
- Schönfelder, M. L., & Bogner, F. X. (2018). How to sustainably increase students' willingness to protect pollinators. *Environmental Education Research*, 24(3), 461-473.
- Soga, M., Evans, M. J., Yamanoi, T., Fukano, Y., Tsuchiya, K., Koyanagi, T. F., & Kanai, T. (2020). How can we mitigate against increasing biophobia among children during the extinction of experience? *Biological conservation*, 242, 108420.
- Treagust, D. F., Amarant, A., Chandrasegaran, A. L., & Won, M. (2016). A Case for Enhancing Environmental Education Programs in Schools: Reflecting on Primary School Students' Knowledge and Attitudes. *International Journal of Environmental and Science Education*, 11(12), 5591-5612.
- Weeks, F. J., & Oseto, C. Y. (2018). Interest in insects: the role of entomology in environmental education. *Insects*, 9(1), 26.