INQUIRY & INVESTIGATION

The Ecological Interactions Olympiad: A Classroom Activity for Reinforcing Scientific Knowledge

NABT BioClub RECOMMENDATION

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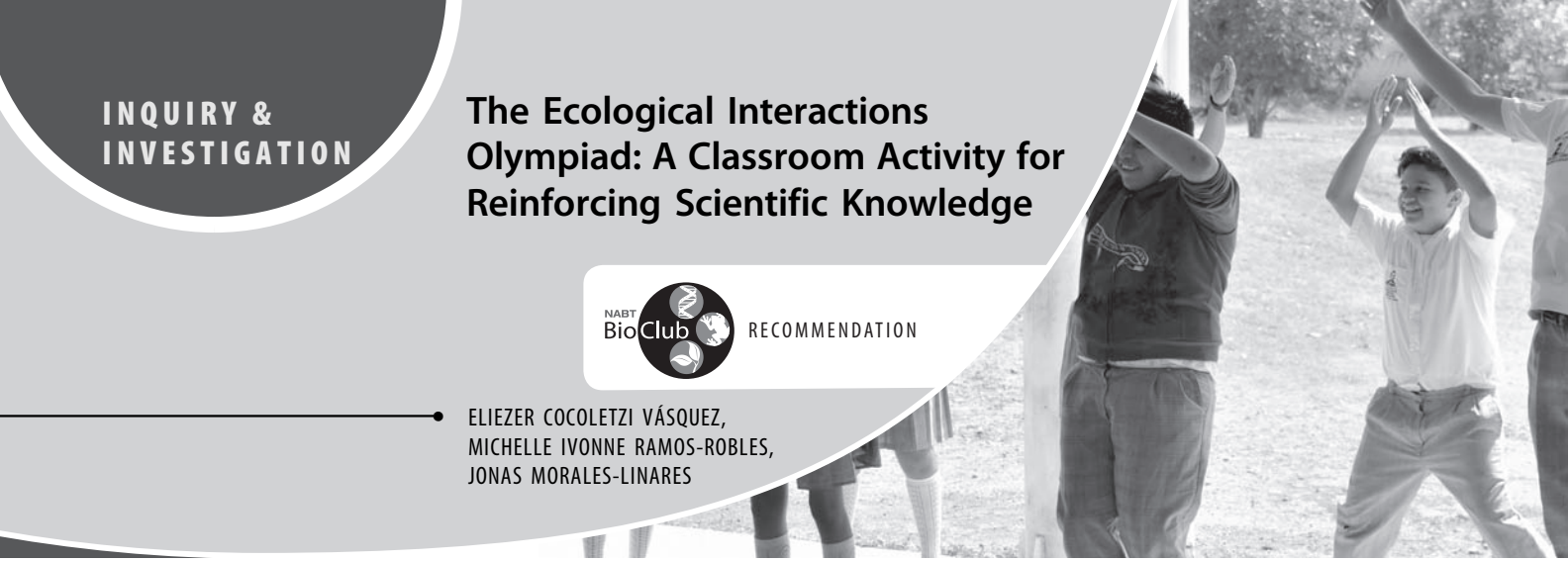

Abstract

Different methods and strategies for teaching scientific knowledge have been proposed and integrated within existing classroom dynamics. These represent opportunities for reinforcing and teaching scientific concepts in the classroom, especially in ways that students can easily understand. In this article, we propose a dynamic classroom activity for teaching ecological interactions between plants and frugivorous birds, as an example. This same model could also be used or adapted to teach diverse ecological concepts to students. This teaching strategy is divided into two parts: (1) a theoretical class, and (2) a group activity that we called The Ecological Interactions Olympiad. *We describe this method step-by-step and provide suggestions for applying it to other scientific topics. The aim of using such learning strategies is to increase the attention and interest of young students in scientific topics and to improve their critical thinking skills and awareness of the events and interactions that occur in nature, which could ultimately contribute to the conservation of nature.*

Key Words: *birds; ecosystems; ecological interactions; environmental education; frugivory; nature conservation; trees.*

Introduction

Scientific knowledge is important for teenagers because it can enhance the quality of their lives and can provide them with skills to discover, understand, and better conserve the environment. As part of this, showing students that learning science can be fun, can enhance their interest. Successful classroom dynamics for teaching scientific topics should motivate students to participate and to discover how the world works, and enable them to build a solid understanding and basis of scientific knowledge (Gabb, 2006). Learning oriented around everyday life events, or in this case, events that occur in nature, favors mental processes that consolidate both practical and intellectual skills, preparing students for further schooling and life (Bergmann & Sams, 2012; Sutherland et al., 2004).

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A dynamic classroom environment includes instructional activities that engage students in learning beyond listening, reading, and memorizing. Such activities can provide instructors with feedback about what and how well students are learning (Earl, 2012). Successful activities lead students to consider newly presented ideas or concepts and connect these to prior knowledge in meaningful ways, thereby constructing their own understanding of a topic. Furthermore, collaboration among students promotes a sense of community and connection among them, enhancing their sense of belonging and motivation for learning (Stefanich & Bell, 1985). Thus, one key result of dynamic classroom activities is the strong cohesion of students (Chang & Bordia, 2001).

Ecological interaction was the scientific concept used in this study to test the proposed classroom activity. Indeed, biological species are not isolated entities but interact with one another in various ways, which are referred to as ecological interactions. These occur when two individuals of different species interact in a given time and space in order to survive. In general, interactions can be classified as positive (mutualistic) or negative (antagonistic) (Strauss & Irwin, 2004). In positive interactions, the individuals of both species receive benefits. For example, during pollination, a bee feeds on the nectar of a flower and consequently transports pollen from flower to flower, promoting plant reproduction. Another example is seed dispersal: a bird feeds on fruits and then deposits plant seeds in its excreta in places where they may germinate. The benefits of positive interactions are the survival and reproduction of the involved species. In contrast, negative interactions generally regulate the growth of species' populations. For example, predation occurs when a carnivore feeds on prey; in herbivory, an animal feeds on plants. Meanwhile, in parasitism, an animal or plant species partially or completely obtains its resources

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from another species (host), causing damage to the host without killing it (Herrera & Pellmyr, 2002; Pacini et al., 2008).

Furthermore, ecological interactions occur in all ecosystems and help to promote and maintain the biodiversity of the Earth. However, ecological interactions, in addition to individual species, are highly threatened by the loss and fragmentation of ecosystems and other factors, such as poaching (Gentry, 1992; Montagnini & Jordan, 2005). Whereas environmental teaching often focuses on isolated concepts, our argument is that a focus on ecological interactions can help students to understand concepts of cause and effect and their role within and influence on the biological and physical world. In this sense, when one species or habitat is negatively affected by human activities, a cascading effect may also occur, resulting in negative effects on other species and habitats. In this context, awareness of our planet and its resources and how these are shared with other species that, in turn, provide us with important natural resources is an important concept to understand, and one point of intervention is within the educational system. Therefore, transferring knowledge of ecological interactions to new generations and to students is fundamental for creating a change in consciousness and promoting greater respect for nature.

In response to this problem, we present a teaching strategy to capture the attention and interest of a wide range of students. We tested a dynamic classroom activity with high school students to facilitate their learning of diverse scientific topics. In this case, the topic of ecological interactions was used to exemplify this strategy. The method involves two parts: (1) a theoretical class, and (2) a group activity referred to as *The Ecological Interactions Olympiad*.

○ Lesson: Ecological Interactions

The day before initiating this activity, we recommend that the teacher inform students that an activity will be carried out the following day, allowing students to investigate information about the topic on their own. The activity should engage students to make observations about the world around them and to infer, compare, and communicate ideas based on prior knowledge. To promote student participation, the teacher should start the class with a question, covering the main concept of the topic that will be reviewed. Based on students' responses, the teacher should confirm the current knowledge of students by, for example, writing the concept on the blackboard. Because students are in constant contact with technology, the teacher can use audio-visual tools to convey the desired subject in a dynamic and fun way. The teacher should take into account the concepts brought up in the initial class discussion to inform the questions to be later used in the activity.

To exemplify this method, we first asked the students: What is ecology? Then, we explained this concept with PowerPoint slides that included photos and videos of several of the main ecological interactions. The presentation included the following topics:

- The concept of ecology
- Definition of ecological interactions
- Types of ecological interactions, positive and negative, and examples
- The ecological and economic importance of plant-animal interactions
- Conservation of ecological interactions
- Review of the learned concepts and discussion of examples of ecological interactions provided by students.

To reinforce the lesson, we recommend that the activity be performed outdoors, although it can also be done in the classroom.

○ Activity: The Ecological Interactions Olympiad

Physical activities promote cognitive processes and the learning of complex issues. In addition, physical activities can double as group activities or reinforce the role of the teacher as the group leader (Clarke & Hollingsworth, 2002). In the following, we describe how this activity was carried out.

Materials

- Plastic rolls to make the game board
- Permanent markers to draw on the board (we recommend using at least five colors)
- Scissors for cutting and adhesive tape for joining the board segments
- Square carton boxes to use as dice
- Medium-sized cards to write on or half sheets of paper to print out the questions, challenges, and penalties
- Papers and pencils to record the progress of the game.

Making the board

We suggest using vibrant colored plastic to make the game board; we used blue plastic. The plastic was divided into four equal sections of 1 × 6 m. To create the board, the first section was divided into five squares of 1 m^2, which were drawn with permanent markers and numbered from 1 to 5. In the final square of the first section, the outline of a star was drawn— this frame is the challenge frame. The same was done with the three remaining plastic sections, which were labeled in consecutive order from 6 to 20. The final square of the second and third sections corresponded with "challenge," an activity to be performed by the entire group. Finally, the final square of the fourth section marked the end of the game, and whichever team arrived first to this square won (Figure 1). The dice can be made from square carton boxes, and a black permanent maker can be used to

Figure 1. Board with frames numbered from 1 to 20; every fifth frame contains a challenge (the star frames).

draw the dots. Since students enjoy making the dice, we encourage the teacher to allow students to make custom dice. We recommend creating 60 cards with questions about the main topic, in this case ecological interactions, in addition to 10 penalties and 10 challenge questions. Examples of these are provided in Appendix 1. We recommend that each question be printed on a half sheet of paper. The instructor or someone else must read aloud each question for the entire class to hear.

Conducting the activity

Our own experience showed that the assistance of two or three instructors is ideal. One of the instructors should divide the class into groups of five students, depending on the size of the class. Five to eight groups per class are ideal for the activity. To begin, one member of each team must roll the dice to determine the order of participation. The team with the highest number goes first. During the game, only one student will go forward and stand at the board. On the first turn, one member from the first team rolls the dice (Figure 2), and the number on the dice corresponds to the number of squares that the team will move forward. Then, the instructor must randomly take a card, which can correspond to a question or a penalty, and read it (Figure 3). The game will continue until the students reach the end of the board. If the card indicates a question, any member of the group may answer within 10 seconds. The instructor along with the classroom will count down to 10 seconds. If any student of the team knows the answer, the member of the group will remain in the frame. However, if the student cannot answer, the instructor may ask the rest of the class to respond to the question. If no students can remember the answer, this may be an indicator that the information provided during class was not adequate and that some topics must be reinforced.

The cards with challenges must be separated. When one member of the team arrives to the challenge frame, the whole team must do the activity. The dynamic will end when a team obtains the exact number of steps to get to the end frame. If the team passes the end frame, then it must regress by the number of frames exceeded. The team that reaches the end frame first wins (Figure 4).

Figure 2. The activity begins when a member of each team rolls the dice to determine the order of participation of the teams. Then, a member of the first team rolls the dice to determine the number of frames that their team can move forward.

Figure 3. After rolling the dice, the instructor will randomly take a card and read it aloud for the entire class to hear, but only the participating team must answer the question.

Figure 4. The activity ends when a member of a team obtains the exact number of steps to arrive at the end frame.

For students who cannot perform the challenges that require physical activity, we suggest that they take on the role of referee to monitor that the dynamics are being carried out in an orderly fashion or read the questions to the participants. In addition, we included some challenges that do not involve physical activities.

○ Conclusions

This activity was designed to be used with different biology and ecology topics to promote the understanding and learning of scientific knowledge in a fun and active way. In addition, this activity motivates students to pay attention in class and to retain complex concepts. In the present case, students became more aware of the importance of ecological interactions and how to better conserve the environment and to discover more about this topic. *The Ecological Interactions Olympiad* activity is therapeutic because students shout, run, move the whole body, and laugh; these activities in

combination have been demonstrated to be effective in helping students to understand and learn complex concepts. Based on the activity presented herein, instructors can develop additional visual information for other concepts, using creativity to improve their teaching strategies.

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Appendix 1. Examples of cards for The Ecological Interactions Olympiad

Questions

- What is ecology?
- What is biodiversity?
- What is an ecosystem?
- What are ecological interactions?
- State two examples of ecological interactions.
- Why is the study of ecological interactions important?
- State an example of a positive interaction.
- State an example of a negative interaction.
- What is pollination?
- State an example of a pollinator.
- What is seed dispersal?

- State an example of an animal that disperses seeds.
- State an example of an herbivorous animal.
- State an example of a carnivorous animal.
- What do you call animals that eat plants?
- What do you call animals that eat animals?
- What is a parasitic animal?
- What is a parasitic plant?
- State 3 actions for conserving ecosystems.
- State 3 actions for conserving ecological interactions.
- State 3 benefits that humans obtain from ecological interactions.

Penalties

- Move back one frame.
- Move back three frames.
- Move back five frames.
- Move back to frame #1.
- Roll the dice again.

Challenges

- Run 200 meters.
- Jump 50 times.
- Sing a song.
- Do 30 squats.
- Do 15 push-ups.
- Tell a joke.
- Tell a story about ecological interactions.