

# **NABT BIOLOGY EDUCATION RESEARCH SYMPOSIUM**

## **EXPLORING OUTCOMES FROM PARTICIPATING IN AN OUTDOOR SCIENCE ACTIVITY**

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### **Introduction**

Connecting to the natural world can result in the inspiration to take action to better the environment (Liddicoat & Krasny, 2014). Further, receiving education about nature can allow a child to view the natural world in a positive light (Cheng et al., 2012). Outdoor education can excite students, motivating them to learn about new topics in a hands-on setting (Peacock et al., 2021). To give students more opportunities to explore hands-on science learning while following Next Generation Science Standards, we created a free downloadable science activity booklet about pollination that can be used in classrooms, educational programs, at home, and more.

### **Literature Review**

Rather than envisioning themselves as a scientist, students often picture scientists as having stereotypical traits (Ivgin et al., 2021). For example, students often describe a male working alone in an indoor space. Further, as students age, their desire to become a scientist decreases as they do not believe they possess the correct characteristics (Ivgin et al., 2021).

Many students, such as those belonging to low-income school districts or English Language Learners, experience disadvantages in their science education (Lee, 2005). Outside of the classroom, outdoor education opportunities are often expensive and take place in inaccessible locations (Paisley et al., 2014). This places those with fewer economic means at a further disadvantage.

Experiencing science, especially in an outdoor setting, has been found to come with many benefits. Learning outdoors can promote a student's academic achievement and can lead to an increased interest in the course of study (Marchant et al., 2019). Having access to outdoor areas has even been seen to promote a child's memory, their ability to pay attention, and is linked with better performance on standardized tests (McCormick, 2017). Learning in an outdoor setting is also exciting for students, lending itself to maintaining a student's attention while they learn in a hands-on environment (Peacock et al., 2021).

This study seeks to identify what aspects of an outdoor science activity will allow students to view themselves as scientists. Further, this study identifies the aspects of science practices that might encourage students to have the desire to take part in science. Through understanding the outcomes students receive from an outdoor science activity, we can further understand how to engage children in science learning.

Using a pollination science activity we wished to answer the following research question: What elements from an outdoor science activity facilitate students to feel like a scientist?

### **Methodology**

To give students the opportunity to experience hands-on science learning while following Next Generation Science Standards, we created a free, downloadable science activity about pollination that can be used in classrooms, educational programs, at home, and more. This activity takes 30-60 minutes to complete and is designed to engage 5th-grade students in outdoor

science practices. The outdoor portion of this activity can be completed anywhere flowering plants are present, such as a garden, schoolyard, or local park. Necessary supplies include the printed activity booklet, a utensil to write within the booklet, and a time-keeping device such as a watch or cell phone. The booklet is designed for participants to draw predictions, observe plant-pollinator interactions, and interpret results through an outdoor investigation. Structural elements of this activity include using models performing an investigation, analyzing and interpreting data constructing explanations and arguments, obtaining and communicating information, explicit cultural connections to the science content, and an introduction to a local and historically underrepresented scientist who studies pollination for their research program.

**Participants**

Following IRB-approved guidelines, we recruited 68 fifth-grade children from a local elementary school to complete this activity booklet about pollination. Using a four-item instrument, student responses were collected after they completed the activity. These student responses were coded to identify common emergent themes.

**Data Sources**

This study uses a qualitative approach to explore participant responses from the pollination science activity booklet. Participants were provided with a physical copy of the booklet and went outdoors as a class to complete the activity. Once students completed the activity, they answered four post-activity questions located at the end of the booklet (see Table 1). These responses were written by the participants in the booklets and later blinded and typed into digital form.

**Table 1. Post-activity Questions**

Post-activity Questions
What part of this activity did you enjoy the most?
What part made you feel the most like a scientist?
What part was the most helpful to you in learning about pollinators?
What was the most important thing you learned?

For my data analysis, we began by using an inductive approach to code the student responses (Saldaña, 2016). For example, one student stated that they most enjoyed, “When we had to see if something got on the flower.” This student response was coded as, “Observing flowers for pollinators.” Once codes were assigned to each student response, we used a deductive approach to categorize the codes (Saldaña, 2016). Each student response was identified as referring to the activity’s science practices, and/or outdoor experiences. For example, one student reported that they most enjoyed skipping rocks and discovering new places. This response was categorized under Outdoor Experience as the student most enjoyed playing outside. Another student reported that they most enjoyed writing down data and doing research. This student response was categorized under Science Practices 2 and 3, which are Developing and Using Models and Planning and Carrying Out Investigations respectively. The category Outdoor Experiences holds responses referring to outdoor elements of the science activity. The Science Practices categories hold responses that reference the eight NGSS Science Practices (NRC *Framework*, 2011, p. 49). Additional categories were added as needed, as some participants reported outcomes surrounding nature appreciation or not receiving any mentionable outcome.

## Results

We identified emergent themes concerning what aspects made students feel most like a scientist (see Table 2). Overall, students reported that the three most influential aspects of completing the pollination activity were Developing and Using Models (89.71% of students), Planning and Carrying out Investigations (95.59% of students), and Obtaining, Evaluating, and Communicating Information (88.24% of students). Students noted that they most felt like scientists when they were “recording data and timing ourselves,” “writing down the smell, size, shape, and color,” and “writing down the data.” The students frequently reported outcomes relating to the activity booklet’s built in models, data collection pages, and informational text and imagery. Making observations and collecting data, using models, and comprehending the activity’s informational materials were continuously reported student outcomes from the outdoor activity.

**Table 2. Emergent Themes Identified**

Emergent Themes	# of Students (n=68)	% of Students (n=68)
The three most influential aspects of completing the pollination activity were 2. Developing and Using Models, 3. Planning and Carrying out Investigations, and 8. Obtaining, Evaluating, and Communicating Information	2. n=61 3. n=65 8. n=60	2. 89.71% 3. 95.59% 8. 88.24%
Students most felt like scientists when engaging in science practices involving 2. Developing and Using Models. and 3. Planning and Carrying out Investigations	2. n=43 3. n=59	2. 63.24% 3. 86.76%
Allowing students to have outdoor experiences while engaging in science practices supported student enjoyment of the activity.	n=21	30.88%
Having access to the booklet for relevant science content information was reported as most helpful and important during the activity.	n=60	88.24%

Engaging in science practices involving planning and carrying out investigations and developing and using models were most responsible for students to feel like scientists. Within the “Felt Scientific” prompt, 86.76% of the student responses referred to planning and carrying out investigations while 63.24% mentioned developing and using models. One student, Josiah, stated that he most felt like a scientist “When we got to observe” while Cassidy reported feeling like a scientist while “writing down the data.” Students reported that they most felt like scientists when making observations and collecting and recording data within the booklet.

Allowing students to have outdoor experiences while engaging in science practices supported students’ enjoyment of the activity. More specifically, we found that 30.88% of fifth graders felt that having outdoor experiences fostered enjoyment of the pollination activity. Allison stated “I enjoyed hiking”, while Clara most enjoyed “climbing rocks.” These students simply enjoyed this outdoor experience as it gave them the opportunity to play outside.

In addition to making them feel like scientists, students also reported that they most enjoyed planning and carrying out investigations and developing and using models. Planning and carrying out investigations were reported as most enjoyable by 76.47% of students. Meanwhile, developing and using models was viewed as most enjoyable by 45.59% of student participants.

Having access to the activity booklet for relevant science content information was reported as being most helpful and important during the activity. When asked about the most

important and helpful aspects of the activity, 88.24% of students wrote about the content information within the activity booklet. When asked about the most helpful aspect of the activity, one student stated, “The pictures helped because we would know what they looked like,” while another reported “Reading the booklet.” Additionally, 47.06% of students found the information from completing science practices through developing and using models helpful and important while 35.29% reported planning and carrying out investigations most important and helpful.

However, there were some outliers noted within the student responses. Two students did not enjoy the activity or feel like a scientist as a result of completing the pollination activity. When asked what they most enjoyed, Jerry stated “No part of this, (it) just felt like a school project for kids.” Similarly, two students reported a lack of enjoyment in the activity and/or not feeling as though the activity booklet aided in the understanding of the topic of pollination. For example, when asked what he most enjoyed about the activity as well as what aspects made him feel most like a scientist, Devon stated “none”. When asked what part of the activity was most helpful in learning about pollination, Lorelai stated “Nothing”.

Some students also noted nature appreciation in their responses to the post-activity questions. For example, when asked what was the most important thing learned, one student stated, “To always respect the pollinators and the flowers.” While most other students reported outcomes related to science practices or science content, outliers were also present.

### **Discussion**

To understand student outcomes as a result of taking part in science activities, we created an outdoor science booklet for 8–12-year-olds to engage in science topics. We gathered data from 68 participants and found that the eight science practices and outdoor experiences were elements that impacted participant’s outcomes from participating in the science activities. In terms of the quotes from students, we were able to identify common themes from the pollination outdoor science activity that students claimed made them feel like a scientist. Upon identifying emergent themes, evidence suggests that science practices were influential outcomes from taking part in an outdoor science activity about pollination. Students continuously mentioned obtaining, evaluating, and communicating information, planning and carrying out investigations, and developing and using models as being the most influential aspects of the outdoor science activity. Literature indicates that outdoor education may be a motivating factor for students to learn about science as well as offer opportunities to engage in active learning in nature (Peacock et al., 2021). However, in this study we have found that science practices are the biggest takeaway for fifth graders rather than being present outdoors.

In terms of enjoyment, we found that students most enjoyed taking part in science practices and outdoor experiences. This aligns with previous studies that show when people spend even short amounts of time in nature or an hour outdoors taking part in nature-related activities, their moods can be boosted (Harvey et al., 2021; Neill et al., 2019). Learning outdoors is often viewed as exciting by students, encouraging them to be more engaged in hands-on activities in nature (Peacock et al., 2021).

We found that relevant science content within the activity booklet were most important and helpful for learning science. Many students described what they had learned by observing and collecting data during the activity as the most important things learned, stating “different colors and smells attract different pollinators,” and “not all animals like the same plants.” Similarly, students reported that “making observations” and “watching (the pollinators) go to the flowers” was most helpful in learning about pollination. When the students had access to science content while taking part in the outdoor activity, their learning was supported.

Students most felt like scientists when we provided them with the opportunity to engage in science practices involving planning and carrying out investigations and developing and using models within the booklet. This demonstrates that when children are given the opportunity to do scientific investigations in a hands-on environment, they can embrace the subject matter to feel like a scientist. Allowing students to collect data and learn about science outdoors leads to an enjoyable experience that helps students feel like scientists. Offering a cost-free activity to students could be the motivator that sets students on the path to STEM subjects and feeling like a scientist.

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