



Pro Excellentia



Free Thinkers

The popular Imagineers STEAM Club at Washington Elementary School in Alliance challenges students to tackle a variety of engineering, coding, and design problems that have no “right” answers; students are required only to use their imaginations and “think like an engineer.” (see story p. 9)



Martha Holden Jennings Foundation

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*Dedicated to fostering
Excellent Teaching and Deep Learning
in Ohio's secular schools.*

The purpose of the Martha Holden Jennings Foundation is "to foster the development of individual capabilities of young people to the maximum extent through improving the quality of teaching in secular primary and secondary schools" and "to provide a means for greater accomplishment on the part of Ohio's teachers by encouraging creativity in teaching and bringing greater recognition to the teaching profession."

Pro Excellentia is published to describe a sampling of those efforts.

We ask that you please share this copy with colleagues who may gain valuable information and ideas from articles covered in this publication.

Mary Kay Binder, Editor

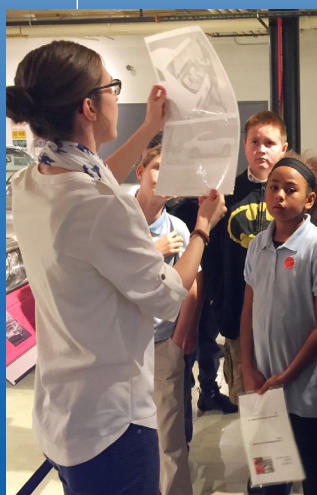
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The Halle Building
1228 Euclid Avenue
Suite 710
Cleveland, Ohio 44115



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Nature-Inspired Innovation

Great Lakes Biomimicry/Northeast Ohio Schools

Biomimicry: the design and production of materials, structures, and systems that are modeled on biological entities and processes

Last spring, biology students at Elyria High School were given a problem-solving task that produced winning results. Their assignment: Design and produce a fun and engaging toy, board game, video game, or carnival attraction to teach other students one concept found in the high school biology science standards. Additionally, the game had to incorporate a principle of biomimicry, a concept few if any of the students knew much about.

Biomimicry is “nature inspired innovation,” explains Stephanie Diane Pierce, Director of Creativity, Tools and Process, Great Lakes Biomimicry* (GLBio). Ms. Pierce works with students and teachers throughout northeast Ohio to incorporate the principles of biomimicry, a cutting edge field in the world of science, into the content standards. In simple terms, biomimicry is a process that looks to nature as a model for problem-solving and creative design. Citing one example, Ms. Pierce explains: One can study a pinecone to understand how its conical shape has allowed it to survive in nature.

Biomimicry’s core premise is that nature, innovative by necessity, has already solved many of the problems with which our world is grappling. Animals, plants, and microbes are the consummate engineers and design artists. They have found what works, what is appropriate, and most important, what lasts here on earth. After 3.8 billion years of research and development, what surrounds us is the secret to survival.

Ms. Pierce says the study of biomimicry, through problem-based learning, will produce “innovation leaders” who will bring about real change in the community.

GLBio recently received a grant from the Jennings Foundation to allow Ms. Pierce, alongside PhD Fellows studying Biomimicry at The University of Akron, to engage students in biomimetic projects in the classroom. These ventures are “multi-day, multi-step, design projects in which students tackle a real problem.” The game design challenge at Elyria High School, one of two public schools selected for this pilot project, was one such assignment.

At the onset, Elyria students were given a brief background on biomimicry but were then expected to learn and apply their learning on their own. Working in small groups, they chose a science standard to teach, determined the style of game they wanted to create; and selected from a long list of biomimicry concepts to incorporate into their designs. Such biomimicry topics included: the power of shape; adaptation, structure, and function; biophilic design; diversity; natural selection as an innovation engine; and replicating strategies that work.

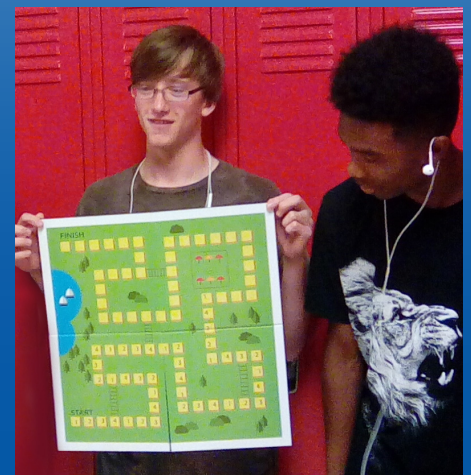
The challenge was open-ended allowing groups to dream up ideas for their unique game products. “Experts” (classroom teachers and University of Akron Ph.D. Fellows) were available during class time to answer questions or to offer a “workshop” on a specific topic (such as how to use photoshop to create authentic game pieces) only if the students asked. Grant funds would be used to manufacture professional-looking final game products that appear as if they were bought in a retail store.

Required for Deep Learning

“A lot of students have a difficult time with self-directed learning and we’re not giving them the answers,” says Ms. Pierce, while the students collaborated and grappled with their designs one week

into the project. “I literally threw them in. I basically said: ‘Here’s your problem and I want you to look at this deeper.’ We give them resources and problem-solving tools in order to assist them, but they guide their own learning.”

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Halfway through the two-week-long assignment one group was eager to share a draft of their creation—a board game designed to teach elementary age students about adaptation and evolution: Game players choose three animals at the start of play that try to survive natural disasters, invasive species, and human impact as they travel around the game board. The animals must adapt or evolve as they encounter each event and the player with the most surviving animals at the end of the game wins. Animal choices, they explain, include hawks, bald eagles, trout, sharks, deer, and bears.

"We had to find out about invasive species and how they impact whatever population they go after," says one student, explaining the research the team completed to prepare the text for information cards used to play the game. "We also had to find out how many different human impacts there are and how fast or how slowly they can impact the environment."

The students agree that the project has been fun: "It's just a new way to learn," one remarks. "It's not the old boring, 'take out your book and copy down what's there.'"

A Whirlwind of Learning

"This has given students an opportunity to really explore their creativity with very little or no direction," explains biology teacher Jennifer Bechtel, who teaches two-thirds of the 150 biology students who participated in the project. "They are learning about topics that interest them. Instead of me deciding what's important, they are choosing what's important to them."

"And it's turning out much better than I expected. I'm excited about that."

Ms. Bechtel agrees that some students struggled with the minimal amount of instruction the teachers provided for the project, which was intended to steer them toward deeper learning.

"The purpose is to help learners cope with complex, ambiguous, real-world tasks that require higher level thinking," explains Ms. Pierce. "In addition, it helps them face setbacks and challenges in areas in which they lack knowledge so that they gain independent problem-solving skills, persistence, and resilience."

"They didn't realize that they could do this, not for real," she adds, stating that the students were extremely proud when the final game products were delivered in four large boxes to the school. "Many reacted the way people react when they finally see their patent become official, or their painting appear in a gallery, or their book on the shelves. One young man told me: 'It felt incredible to have the resources and opportunity to create something of my own.'"



Ms. Pierce has shared the games with middle and high school students at Buchtel Cluster schools and National Inventors Hall of Fame School in Akron.

Another student remarked, "I've always wanted to be a video game developer, but this was about biology. And it wasn't hard. Actually it gave me the opportunity to get the feel of making a video game for the very first time."

Ms. Pierce admits that many of the games remain in various stages of completion, awaiting further editing and refinement by those who play them. This revision process, she says, extends the PBL experience beyond the original group of learners.

"I think they learned exactly what we hoped they would—that they are capable of creating something real!" she concludes. "No matter how complex the puzzle, or brief the time, or ambiguous the design limitations, I think these learners found that they can design something that will have value to others and be beneficial to the world. They really struggled with time they didn't have, with knowledge they needed, with technologies they had never used, and unexpected, derailing problems. But in struggle, we find persistence. These learners found it. They wrestled with the challenge of creating something new, polished, and epic; and they won!"

*For more information contact:
Ms. Stephanie Diane Pierce
Great Lakes Biomimicry, Inc.
sdpierce@glbiomimicry.org*

**As a result of Great Lakes Biomimicry (GLBio) cutting edge work during the past four years, Northeast Ohio is at the forefront of a global movement to look to nature as model, measure, and mentor. One of its goals is to develop a new breed of talent—creative, innovative, and inquisitive—prepared to fuel NEO's businesses and economics.*