

Macro to Micro: Innovation Inspired by Nature

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Are you ready for an experience? Most people and most students want to be excited, entranced interested, amazed and blown away. How does that happen in 7th grade Life Science and carry into Art and English? How are the dots connected between subjects? What can we learn from nature? How do we understand the scale of the universe? How does macro relate to micro?

Answers may flow from innovation inspired by nature, part of an emerging field of study that combines biology and technology called biomimicry from the Greek “bios’ meaning “life” and mimesis, “to imitate.” Biomimicry is a practice to study designs in nature and emulate them to solve human problems, for example, a solar cell inspired by a leaf [1]. To learn from nature one must observe using all the senses and be open to receiving this new information. This type of study is not new. Biomimicry has been in use from the beginning of humanity. Leonardo Da Vinci’s ability to imitate nature helped to bring about the Renaissance. He observed the natural world around him with great curiosity, studying adaptations, functions and designs. Learning was integrated and flowed between science, art, philosophy, engineering, and architecture. His creative process included drawing and writing to help him to fully understand and capture his observations, then translate them into innovative works of art and engineering [2].

Re-connecting with and finding value in nature is the beginning of the process of biomimicry. Microscopy is an excellent tool for studying nature in a functional way to see how organisms have adapted in the context of their environment. Revealing the unseen structures begins a new understanding and appreciation for the natural designs developed over 3.8 billion years of life on earth. Structures and processes found at the micro and nano scale play a key role in the performance of the organism. This knowledge can help us through a new era of human challenges that need solving as population growth expands our foot print on the planet.

Toward these ends, a microscopy/biomimicry education pilot was developed for 7th grade Life Science Classes in Ely, Minnesota. The teacher was interested in biomimicry and looking for a new way to integrate science with art in the core curriculum in her classes. Value proposition design tools were used to create microscopy and biomimicry products tailored to meet the needs of the teacher and her students. A customer profile and corresponding value map of and products and services is diagramed in Figure 1A [3]. The teaching module was designed to carry students out into nature and take them from observing an organism in its environment, to focusing on fine structures under an electron microscope, to generating ideas for new innovations.

We delivered the education pilot below to each of two class periods, 41 students total. Studies of evolution, technology, art and English language arts throughout the year in the Ely School will build on the materials and knowledge gained in an initial three-day education experience laying the groundwork for utilizing a grant with the Perpich Center for the Arts in Minnesota [4].

Class 1 “Macro to Micro: Innovation Inspired by nature”: We introduced the students to biomimicry, then gave them an understanding of the scale of the universe, how microscopes work and how properties and structures at the micro-scale can determine how an organism functions on the macro-scale.

Class 2 Go Outside: We facilitated the second class period at a park adjacent to the school. Students found a specimen to study (a plant part, a feather, or an insect), which they observed, photographed, sketched, and collected (Figure 1B). Selected specimens were brought back to the lab over 200 miles away to be prepared and analyzed using a light microscope and electron microscope. Digital images were sent to the class.

Class 3 Virtual Microscopy: The class logged into the electron microscope using remote access software (Figure 1C). They could operate the microscope and viewed several of their samples on their desktop projected on a screen in the classroom as if they were in the room with the instrument. They asked to get out of their seats and sit under the screen. They watched their samples be magnified and reveal structures at the micro level. One girl said “This is why I want to go into science”.

We created a “Nature’s Technology Brief” template as a framework and reporting format for students to research a particular adaptation, determine the design principle and come up with an application idea. Ideas/prototypes will be drawn or sculpted later in the year in Art class. The students will write a persuasive paper marketing their product in English Language Arts Class.

Feedback: The teacher said, “I couldn’t have imagined it would go this well”.

References:

- [1] J Benyus “Biomimicry: Innovation Inspired by Nature”, (HarperCollins Publishers Inc, New York) 1997 p.1.
- [2] “Leonardo da Vinci, the Codex Leicester, and the Creative Mind” exhibit seen at the Minneapolis Institute of Arts June, 2015.
- [3] A Osterwalder et al, “Value Proposition Design”, (John Wiley & Sons Inc., Hoboken, NJ) p.8.
- [4] Perpich Arts Integration Project <http://artsintegration.perpich.mn.gov/>. Accessed Feb. 13, 2016.



Figure 1. A) Value Proposition Design of Microscopy / Biomimicry Services for education. B) Students observing and collecting an organism. C) Remote microscopy of a mite.