

Bio-Inspiration: Nature as Muse

Watch it online <http://www.kqed.org/quest/television/bioinspiration-nature-as-muse>
TV story length 11:20 minutes

QUEST SUBJECTS

Life Science	Biology Health Environment
Earth Science	Geology Weather Astronomy
Physical Science	Physics Chemistry Engineering

CA SCIENCE STANDARDS

Grade 7

Evolution

3. (a) Genetic variation and environmental factors cause evolution and diversity of organisms.

Grades 9-12

Genetics

4. (c) Mutations in the DNA sequence of a gene may or may not affect the expression of the gene or the sequence of amino acids in an encoded protein.

5. (c) Genetic engineering is used to produce novel biomedical and agricultural products.

Evolution

8. (a) Natural selection determines the differential survival of a group of organisms.

Investigation and Experimentation

1. (d, k) formulate explanations by using logic and evidence; recognize the cumulative nature of scientific evidence

PROGRAM NOTES

Did you know that the idea for Velcro came from cockleburs? Since the 15th century, engineers have been looking to the natural world for design ideas. Now, biologists and engineers at UC Berkeley are studying geckos, cockroaches and other organisms with the aim of creating a broad range of new, human-engineered products.

In this segment you'll find...



- an explanation of the science of biomimetics (or bio-inspiration).
- examples of products inspired by biomimetics.
- a look at bio-inspired research studies and what is involved.

TOPIC BACKGROUND

Although inventors have long looked to nature for inspiration, biomimetics—or bio-inspiration—is considered a relatively new discipline. In this field of study, scientists and engineers research nature's best designs and processes in an attempt to imitate these models and systems to solve human problems. With biomimicry, scientists and engineers



are no longer looking to extract substances from the natural world the way they have in the past, but rather are looking to see what they can learn and invent by studying natural systems. The core concept behind this discipline is the idea that nature is the perfect engineer. In the natural world, plants, animals and microbes have been solving problems, such as how to convert solar power into usable energy, for billions of years without human intervention. So, according to biomimetics, what better way for humans to learn how to harness and use solar energy than to study photosynthesis? According to one leader in the field, biomimetics is best described as "using nature as a model, mentor and measure."

There are several general steps involved in the biomimicry process. First, a scientist or engineer will think about a problem and what he or she wants the solution to be able to do. For example, perhaps doctors need a better way to deal with certain kinds of surgical wounds. Regular sutures and adhesives don't work, and they need something stronger. Scientists and engineers will then look at how the natural world deals with this problem. They first think about where such natural models might be found. For example, in looking for strong suturing materials they would look for animals or plants that have incredibly strong "threading" qualities, such as the spider. They then brainstorm different ways to emulate or modify this natural model so that humans can use the spider's design. The best solutions must serve a purpose and work better and be cheaper than other possibilities. The end result in this case might be a synthetic spider silk that can be used as a biomedical device. Not only is spider silk stretchy and flexible, but a strand of it is stronger than the same diameter strand of steel. In fact, engineers are currently at work on this synthetic material. The hope is that not only will it be useful as a suturing tool, but it might also work as fabric for lightweight bulletproof vests and biodegradable fishing lines.

VOCABULARY

Diversity

an assortment or variety of different forms or types

Design

the arrangement of elements or details

Mutation

a significant and basic change or alteration

Innovation

a new method, idea or device

Technology

the application of science, especially to commercial or industrial objectives

Biomimicry

the science of studying systems in nature and adapting them to solve modern human problems

Strategy

an adaptation or complex adaptations that serve or appear to serve an important role in achieving evolutionary success

Adhesive

a gummed or sticky substance used for binding

Inspire

to guide, motivate or influence

PRE-VIEWING

- How are science and nature connected?
- What kinds of things might inspire inventors and engineers to create new products?

VIEWING FOCUS

NOTE: You may choose to watch the television segment twice with your students: once to elicit emotional responses and get an overview of the topic and again to focus on facts and draw out opinions.

- What is bio-inspiration or biomimicry? How does this science work?
- Why can't engineers and scientists just look at and copy nature? What makes biomimicry more difficult than that?
- What animals have inspired scientific inventions? What kinds of inventions have they inspired?

Also see:

- Segment Summary Student Sheet
http://www.kqed.org/quest/downloads/QUEST_SegSum_StudentSheet.pdf
- Personal Response Student Sheet
http://www.kqed.org/quest/downloads/QUEST_PersResp_StudentSheet.pdf

QUEST, PBS and NPR LESSON PLANS and RESOURCES

NOTE: Resources from the Teachers' Domain collection require a fast and free registration.

Design Inspired by Nature Teachers' Domain

<http://www.teachersdomain.org/resource/eng06.sci.engin.design.biomimicry/>

A collection of images presents students with some recognizable inventions and designs inspired by nature.

RoboSnail Teachers' Domain

<http://www.teachersdomain.org/resource/eng06.sci.engin.systems.robosnail/>

This video segment adapted from the Massachusetts Institute of Technology shows how a team from the Mechanical Engineering Department is using snail movement as the inspiration for robotic locomotion.

Transforming the Future of Flight Teachers' Domain

<http://www.teachersdomain.org/resource/eng06.sci.engin.systems.futurefly/>

In this video segment adapted from NASA, see how designs from nature have inspired modern aerospace engineers to create the next generation of flying machines.

A New Way to Hear PBS: Scientific American Frontiers

http://www.pbs.org/perl/media.cgi?t=w&f=virage/scientific/pbssaf1308_220k.asf&s=2584217&e=3293326

This video segment from **Scientific American Frontiers** examines the novel ear of a parasitic fly and explains how scientists are using this discovery to build a better hearing aid.

Gecko Toes Inspire Design of New Medical Bandage NPR

<http://www.npr.org/templates/story/story.php?storyId=19279821>

This February 22, 2008, radio segment from **Talk of the Nation** discusses a newly invented surgical adhesive bandage inspired by sticky gecko toes.

Discuss Bio-Inspiration: Nature as Muse on the QUEST Blog QUEST

<http://www.kqed.org/quest/blog/2008/10/21/producers-notes-for-bio-inspiration-nature-as-muse>

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www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

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www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

U.S. Geological Survey
www.usgs.gov

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21st CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Media in Science Education?

www.kqed.org/quest/downloads/QUEST_Why_Media_08-09.pdf

- “As science educators, we know how important critical thinking and new technology skills are in the scientific community...” ([read more](#)).

Science Multimedia Analysis

www.kqed.org/quest/downloads/QUEST_Science_Multimedia_Analysis_08-09.pdf

- “By increasing students’ awareness of the intersections between media and science, we give them the tools to think like scientists...” ([read more](#)).

How to Use Science Media for Teaching and Learning

http://www.kqed.org/quest/downloads/QUEST_Media_Tips_08-09.pdf

- If we consider all forms of media “texts” from which students gather information, we can use similar literacy strategies to engage them in video, audio, blogs and Explorations. Once students have obtained information from multiple media sources, how do they share what they have learned? Through their own media-creation projects, of course!

Using Google Maps to Create Explorations

http://www.kqed.org/quest/files/download/52/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the **QUEST** site? Use this place-based educational guide for educators and group leaders to create similar science-based maps with youth.

OTHER WAYS TO PARTICIPATE IN QUEST



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Mondays at 6:30am and 8:30am



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KQED Channel 9
Tuesdays at 7:30pm