





KAKANI KATIJA: DESIGNED BY NATURE

STUDENT PRESENTATION STUDY GUIDE

May 26, 2025 at 10:15 am Jack Singer Concert Hall at Arts Commons



KAKANI KATIJA

A former member of the U.S. International Figure Skating Team, bioengineer Dr. Kakani Katija now studies the graceful movements of life below the ocean surface. Kakani received her doctorate in bioengineering at the California Institute of Technology and is dedicated to developing underwater technologies to better observe biological and physical processes where they happen in the ocean. She is currently a principal engineer at the Monterey Bay Aquarium Research Institute, and she heads the Bioinspiration Lab.

KAKANI KATIJA RESOURCES:

FOLLOW THE EXPLORER!

Instagram: <u>@kakanikatija</u>

<u>Kakani Katija - National Geogrpahic</u> <u>Kakani Katija: Ocean Currents: Jellyfish & the Moon | Nat Geo Live (</u>Youtube) <u>MBARI Ocean Stories - Kakani Katija (</u>Youtube) <u>Illuminating the Deep, Dark Ocean | Kakani Katija |</u> <u>TEDxSantaCatalinaSchool</u> (Youtube)





HOW DOES A JELLYFISH



Bioengineer Kakani Katija explains how jellyfish swim using fluid mechanics. Researchers study the movement of jellyfish and their impact on the water around them. Jellyfish not only push water into their bells but also drag a constant flume of water behind them, contributing to ocean mixing.

Classroom challenge: Kakani Katiji studies nature to discover new ways to apply her discoveries to human technology. When you look at a jellyfish, how do you imagine that sort of movement can be applied to a human invention?

WHAT OTHER INVENTIONS DO YOU THINK MIGHT HAVE BEEN INSPIRED BY ANIMALS?



Unlike humans, jellyfish do not have concentrated eyes; their ability to see is facilitated by a network of nerves and proteins called opsins. Katija's work is inspired by nature and aims to apply its principles to future technology.



Opportunistic carnivores, jellyfish eat copepods, fish larvae, fish eggs, phytoplankton, and planktonic eggs. Larger jellyfish may feed on crabs, shrimp, and fish. Jellyfish catch prey with their "oral arms" containing nematocysts which stun prey.



WHAT IS BIOMIMICRY?

Biomimicry Institute. Janine Benyus on Biomimicry – Innovation Inspired by Nature (Youtube)

Biomimicry is a practice that learns from and mimics the strategies used by living organisms to solve challenges comparable to the ones we face as individuals and societies. The benefit is that nature presents us with many strategies far better at working harmoniously with the rest of nature than many human developed strategies have been. The goal then is to create products, processes, and systems that solve our greatest design challenges sustainably and in harmony with all life on earth.

Example: <u>How a kingfisher helped reshape Japan's bullet train – BBC</u> (Youtube)

LOCAL CONNECTIONS



Calgary might not have an ocean in its backyard, but we do have some fascinating water-based ecosystems. Calgary's Indigenous name, Mohkinstsis, means "elbow" in Blackfoot, referring to the meeting of the Bow and Elbow rivers.

You can discover more about Calgary's connection to the water at the Bow Habitat Station in Inglewood. Their free Pearce Estate Park Interpretive Wetlands is a natural space to explore Alberta's aquatic ecosystems.

photo: <u>To Do Canada. Bow Habitat Station & Pearce Estate Park</u> <u>Calgary</u>

RESOURCES:

Biomimicry Institute. What is biomimicry Tinyverse. Biomimicry 101 - Examples Of How We Copied Nature (Youtube)



LOOK AROUND YOU

You can learn about biomimicry just by stepping outside and observing nature.

- 1. Take a walk outside and choose one living thing in the environment. Is it a tree? An insect? An animal?
- 2. Ask yourself what special ability does it have? If it's a tree, how does it spread its seeds? If it's an insect or animal, how does it move? How does it gather food? How does it navigate its world?
- 3. Think about how this could be applied to technology. Would you direct traffic in the same way that ants move in a colony? Could you fly in the same way that a tree or plants spreads its seeds?

You can go the other way too! Start with the application and look for solutions in nature.

- 1. What in nature hold objects? Change colours? Move silently in water, ground, or the air?
- Pick one thing and figure out how it does that. If it's holding something, does it have sticky pads? A wrapping tentacle or trunk? Does it clamp objects in between two jaws or five fingers? Does it have a bowl shaped flower?
- 3. Ask yourself if you could make something that works in the same way.





SUPERPOWERS FROM NATURE!

Can we pull from nature to build a super creature?

- 1. Pick one thing our creature needs to do. Can it carry a car? Can it fly into space? Can it dive into the deep sea? Can it hide in a forest?
- 2. Take a piece of paper and fold it into three equal parts.
- 3. One person draws or collages on the top section of the paper to create the head of our character. Use whatever materials you have around you.
- 4. Fold your image back to hide it. Extend the lines of your character's neck over the edge of the fold so that your collaborator will know how to connect their image to yours.
- 5. Pass the paper on to the next person. Keep your image hidden and have them add a body to our creature in the middle section of the page.
- 6. Repeat! Pass the paper to a third person, hiding the first two sections of the page, and have them add the legs and feet. Remember to draw lines over the fold into each new section so the next person knows where to start.
- 7. Unfold the page and reveal your collaborative image.





DEEP SEA VOCABULARY

Aerospace	A business concerned with the manufacturing and operation of vehicles that fly in and above Earth's atmosphere
Apparatus	A device or piece of machinery involving many different parts or instruments
Aquarium	A container or tank where aquatic plants and animals are kept, or an institution that keeps such containers
Avoid	To stay away from something
Behavior	Anything an organism does involving action or response to stimulation
Bioengineer	A person who applies engineering principles to the study of biology
Biology	The study of living things
Biolumines- cence	A chemical reaction that takes place inside the light-producing organ of a glowing creature ex: fireflies
Biomedical	Having to do with the study of the application of natural and physical sciences to medicine and medical treatment
Biomimicry	Observing what works in nature and mimicking or imitating it to solve problems, create and innovate
Campus	The grounds and buildings of a school, hospital, or business park
Conservation	Is the protection of things found in nature that are in danger of being overused or extinct

Current	A steady, predictable flow of fluid within a larger body of that fluid
Data	Information collected during a scientific study
Daunting	Intimidating, frightening, or discouraging
Detect	To notice
Device	To scatter and disappear
Emerging Explorer	An adventurer, scientist, innovator, or storyteller recognized by National Geographic for their visionary work while still early in their careers
Encourage	To inspire or support a person or idea
Engineer	A person who plans the building of things, such as structures (construction engineer) or substances (chemical engineer)
Expedition	A journey with a specific purpose, such as exploration
Fieldwork	Scientific studies done outside of a lab, classroom, or office
Fluid	Material that is able to flow and change shape
Fluid dynamics	The study of fluids in motion
Hydro- thermal	Related to hot water, especially water heated by the Earth's internal temperature
Hypothesize	To form a statement or suggestion that explains certain questions about certain facts

Invertebrates	Animals without a back bone or spine
Jellyfish	Animals with a soft jelly-like bodywith no bones that live in the oceans
Marine	Having to do with the ocean
Nocturnal	To be active at night
Ocean	A very large expanse of sea. The world has five oceans: the Atlantic, Pacific, Indian, Arctic, and Antarctic
Plasma	Created by adding energy to a gas so that some electrons leave their atoms
Propel	To push forward
Regenerate	A living organism ability to regrow/ replace lost or injured tissue ex a lizards tail can regrow if injured
Rotate	To turn around a center point or axis
Scuba	A self-contained underwater breathing apparatus
Symmetrical	Having the same arrangement of parts on either side
Technology	The science of using tools and complex machines to make human life easier or more profitable
Tide	The rise and fall of the ocean's waters, caused by the gravitational pull of the moon and sun
Vent	A crack in Earth's crust that spews hot gases and mineral-rich water



A NEW SEASON OF ADVENTURE AWAITS YOUR CLASS



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