HI-TRAILS
DBAIT Lure Lesson #1

Jennifer Kuwahara
Daniel Pavao
John Sandvig
June 2024

Lesson #1

Introduction to Hawaii Freshwater Streams
Context for problem

Station #5a: Smallmouth Bass

Photo credit: DLNR

Station #5b: ‘O‘opu Nākea

Photo credit:
DLNR

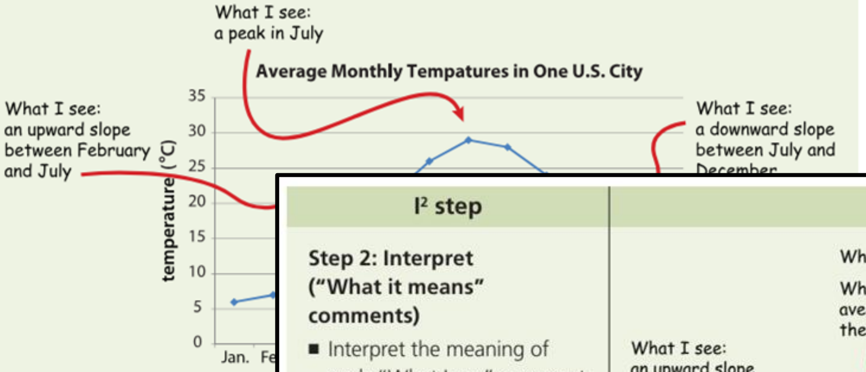
Station #5c: ‘opae ‘oeha‘a

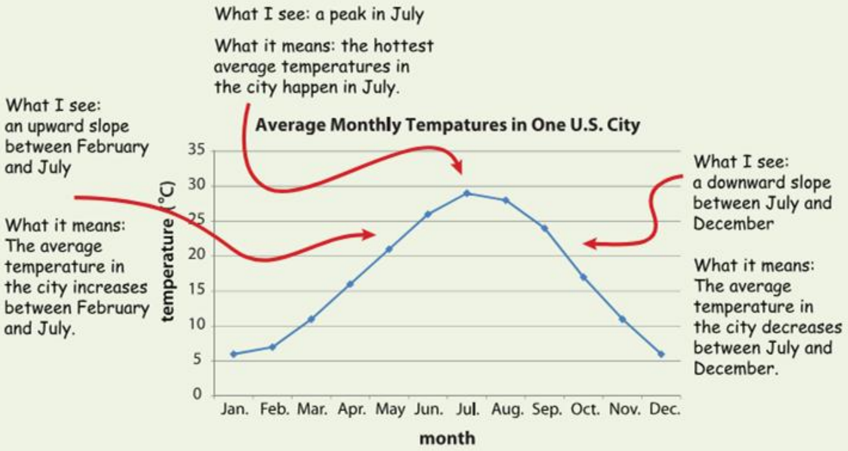
Station #6: Before the Ala Wai

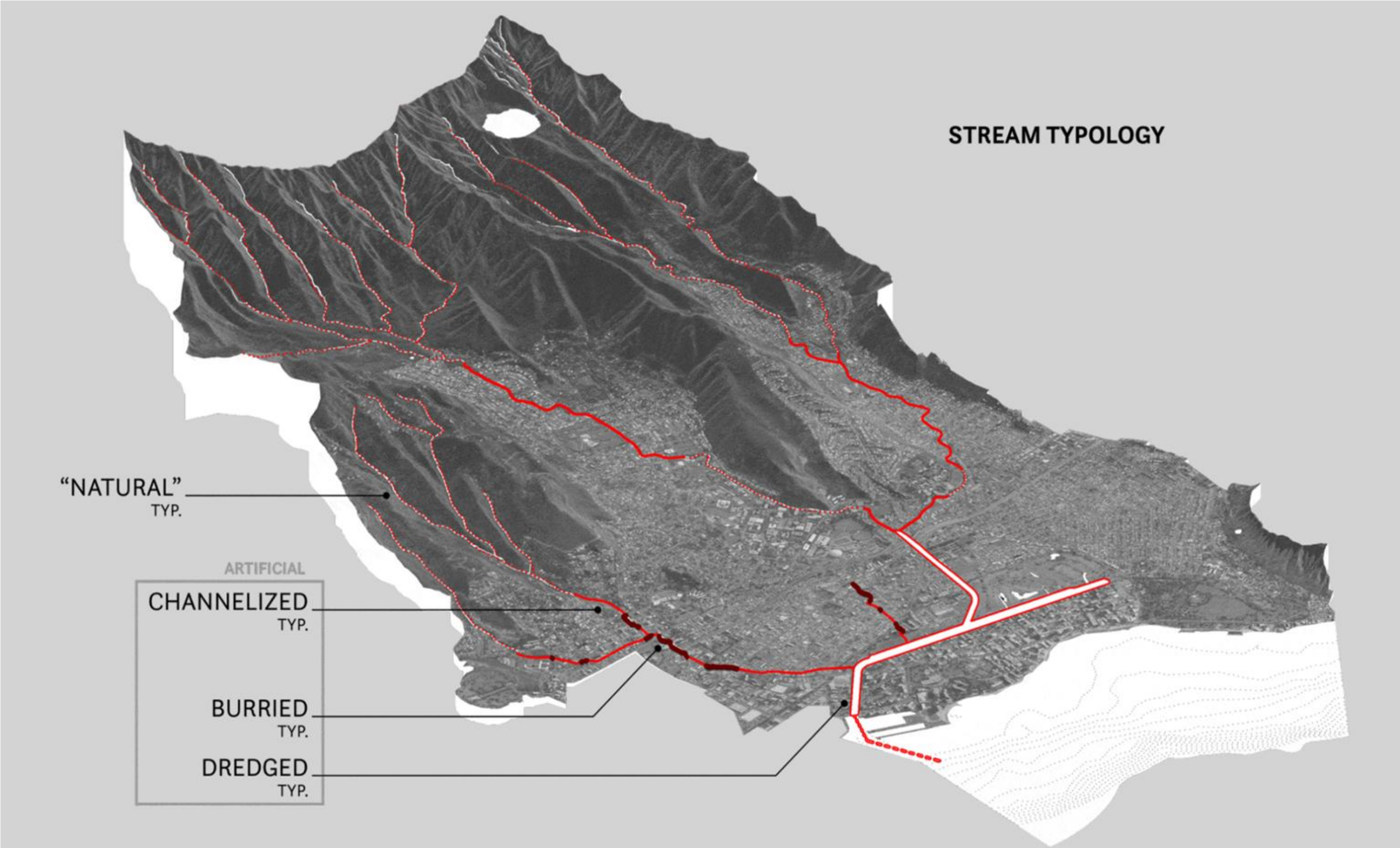
Data Analysis for potential lure design

Mānoa – Makiki – Pālolo Stream Comparison

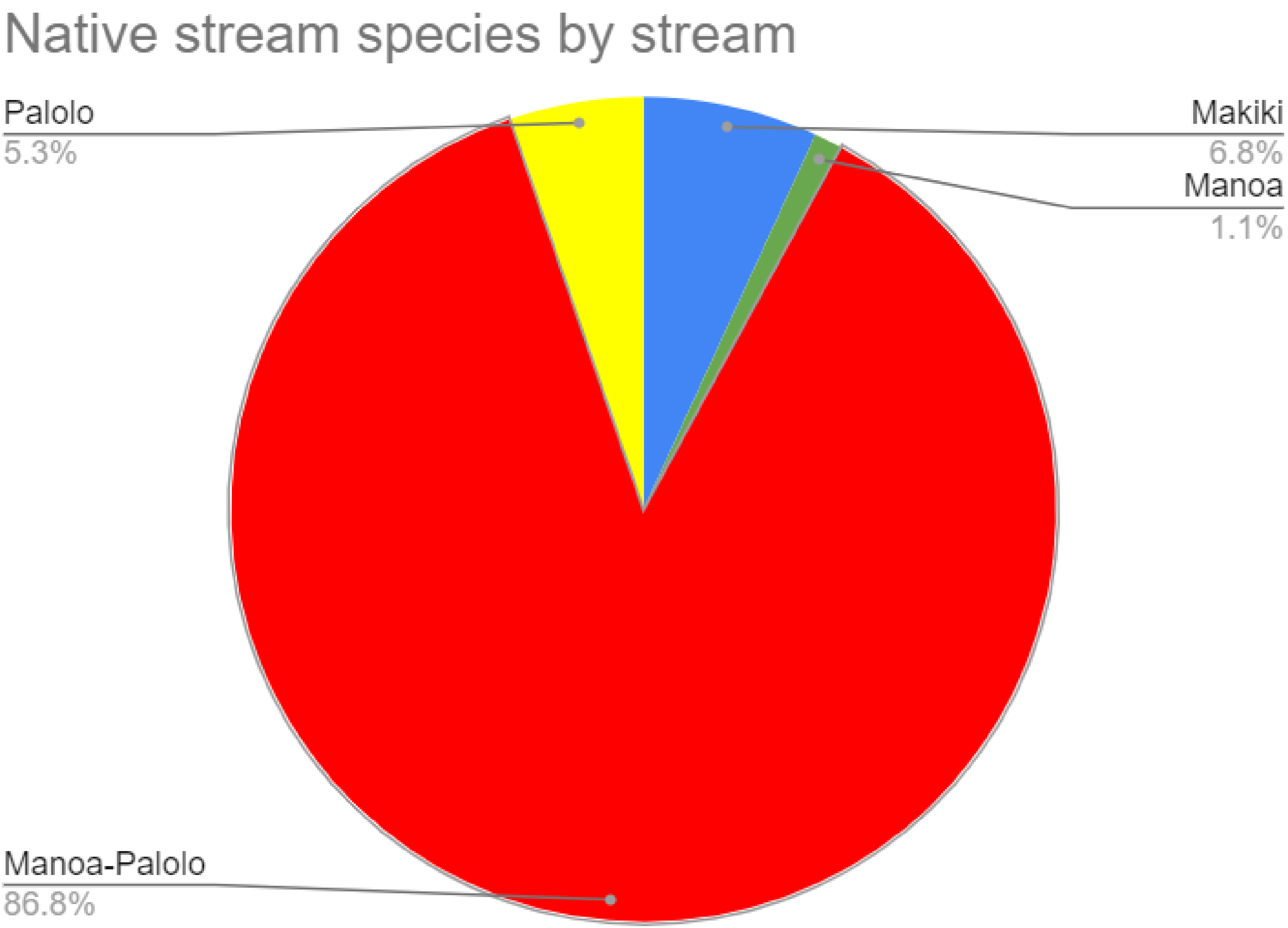
In case you are not familiar – I^2 Strategy - Identify & Interpret

I^2 step	Example
Step 1: Identify ("What I see" comments) ■ Identify any changes, trends, or differences you see in the graph or figure. ■ Draw arrows and write a "What I see" comment for each arrow. ■ Be concise in your comments. These should be just what you can observe. ■ Do not try to explain the meaning at this point.	 For this example, there are arr Notice that the arrows point t point. A "What I see" comme

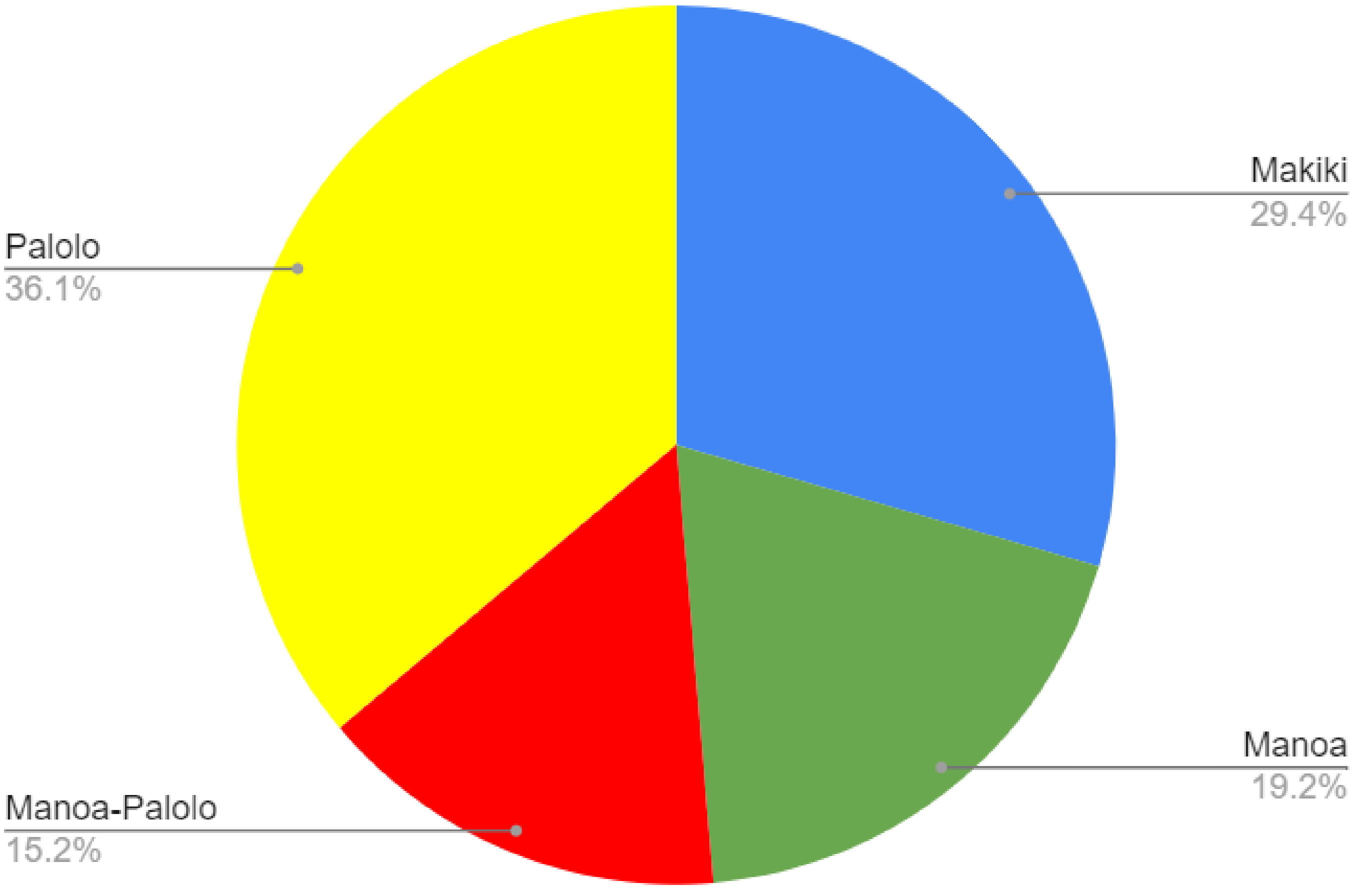
I^2 step	Example
Step 2: Interpret ("What it means" comments) ■ Interpret the meaning of each "What I see" comment by writing a "What it means" comment. ■ Do not try to interpret the whole graph or figure.	 In this example, "What it means" comments were added to each "What I see" comment. The "What it means" comments explain the changes, trends, and differences that were identified in Step 1.

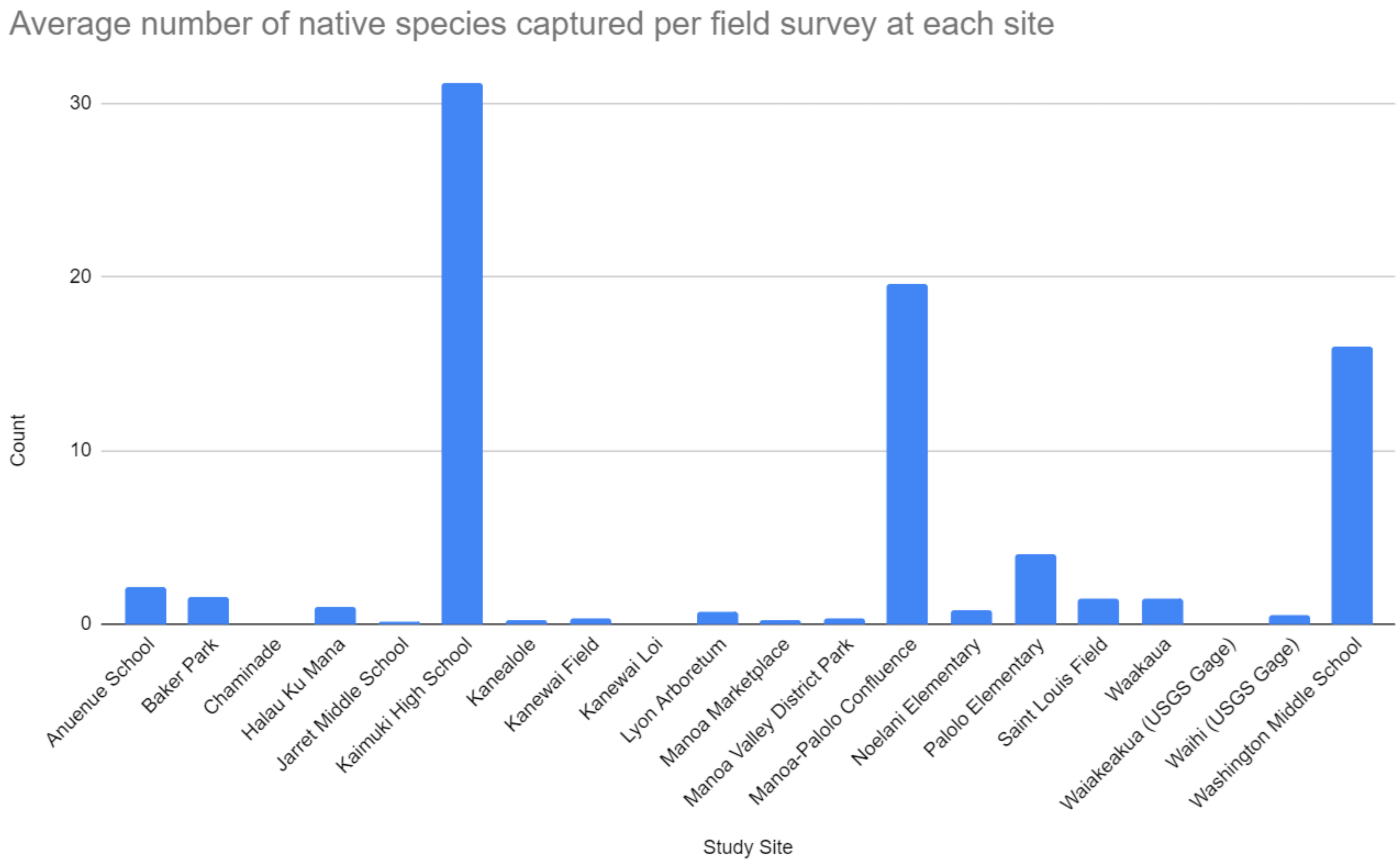

STREAM TYPOLOGY
"NATURAL"
TYP.
ARTIFICIAL
CHANNELIZED
TYP.
BURRIED
TYP.
DREDGED
TYP.


Pa‘ēpa‘ē o Nā Wai ‘Ekolu
Site logistics and info
Kanealole (1)
Halau Ku Mana (1)
Baker Park (1)
Washington Middle School (1)
Anuenue School (1)
Palolo Elementary (1)
Jarrett Middle School (1)
Saint Louis Field (1)
Chaminade University (1)
Lyon Arboretum (1)
Waihi USGS (1)
Waiakeakua USGS (1)
Waakaua (1)
Manoa Valley District Park (1)
Manoa Marketplace (1)
Noelani Elementary (1)
Kanewai Loi (1)
Hokulani Elementary (1)
Manoa-Palolo Confluence (1)
Kaimuki High School (1)
Makiki
Mānoa
Pālolo
Mānoa-Pālolo
Ala Wai Canal
Lyon Arboretum
Tantalus Lookout - Puu Ualakaa State Park
MAKIKI LOWER PUNCHBOWL - TANTALUS
Makiki District Park
Wa‘ahila Ridge State Recreation Area
Punahou School
Kapiolani Medical Center for Women & Children
University of Hawai‘i at Mānoa
Blaisdell Center
Metcalf St
S King St
MCCULLY MOILIILI
Japanese Cultural Center of Hawai‘i
Chaminade University
WILHELMINA RISE
Ala Wai Canal Fishery Management Area
Leonard's Bakery
Hilton Hawaiian Village Waikiki Beach Resort
Kahanamoku Beach
WAIKIKI
Fort Derussy Beach Park
KAIMUKI
Kahala Mall
Manoa Rd
Oahu Ave
Nehoa St
Palolo Ave
10th Ave
Waialae Ave
Ala Wai Blvd
Google My Maps

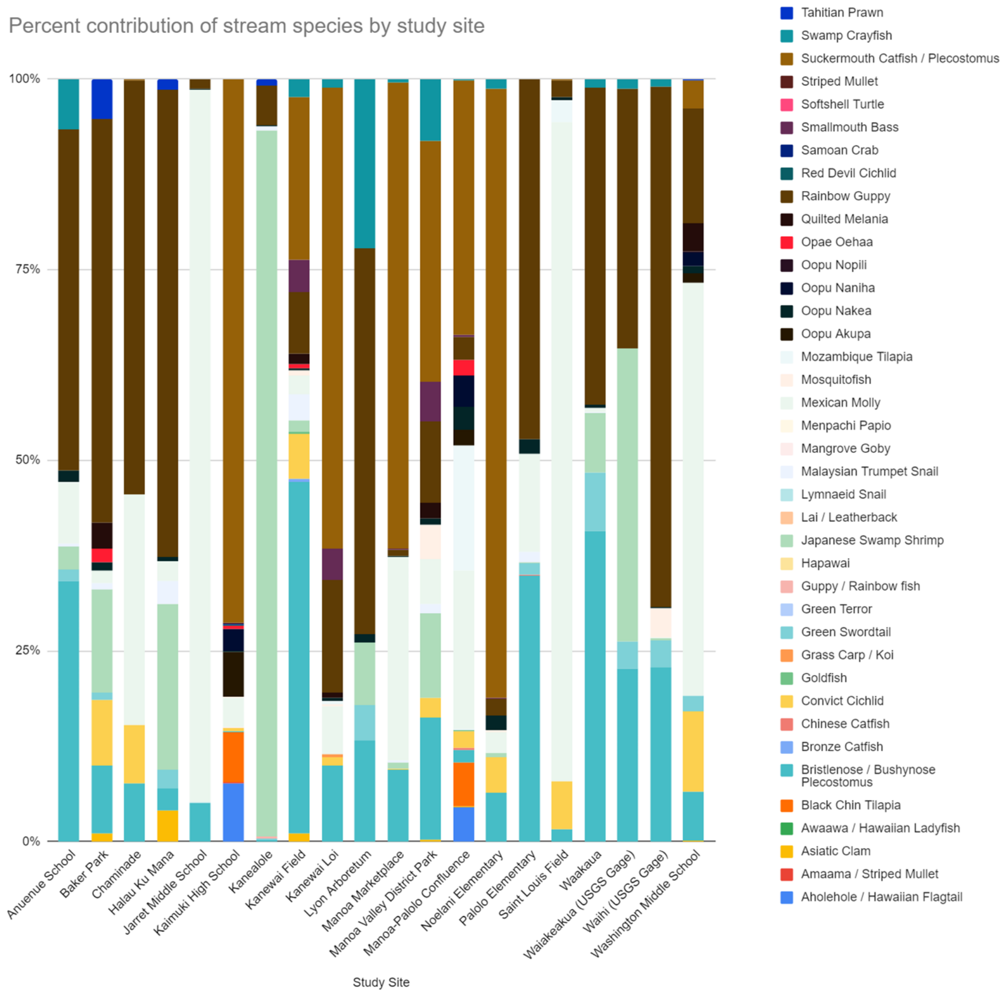

Native stream species by stream
Palolo
5.3%
Makiki
6.8%
Manoa
1.1%
Manoa-Palolo
86.8%

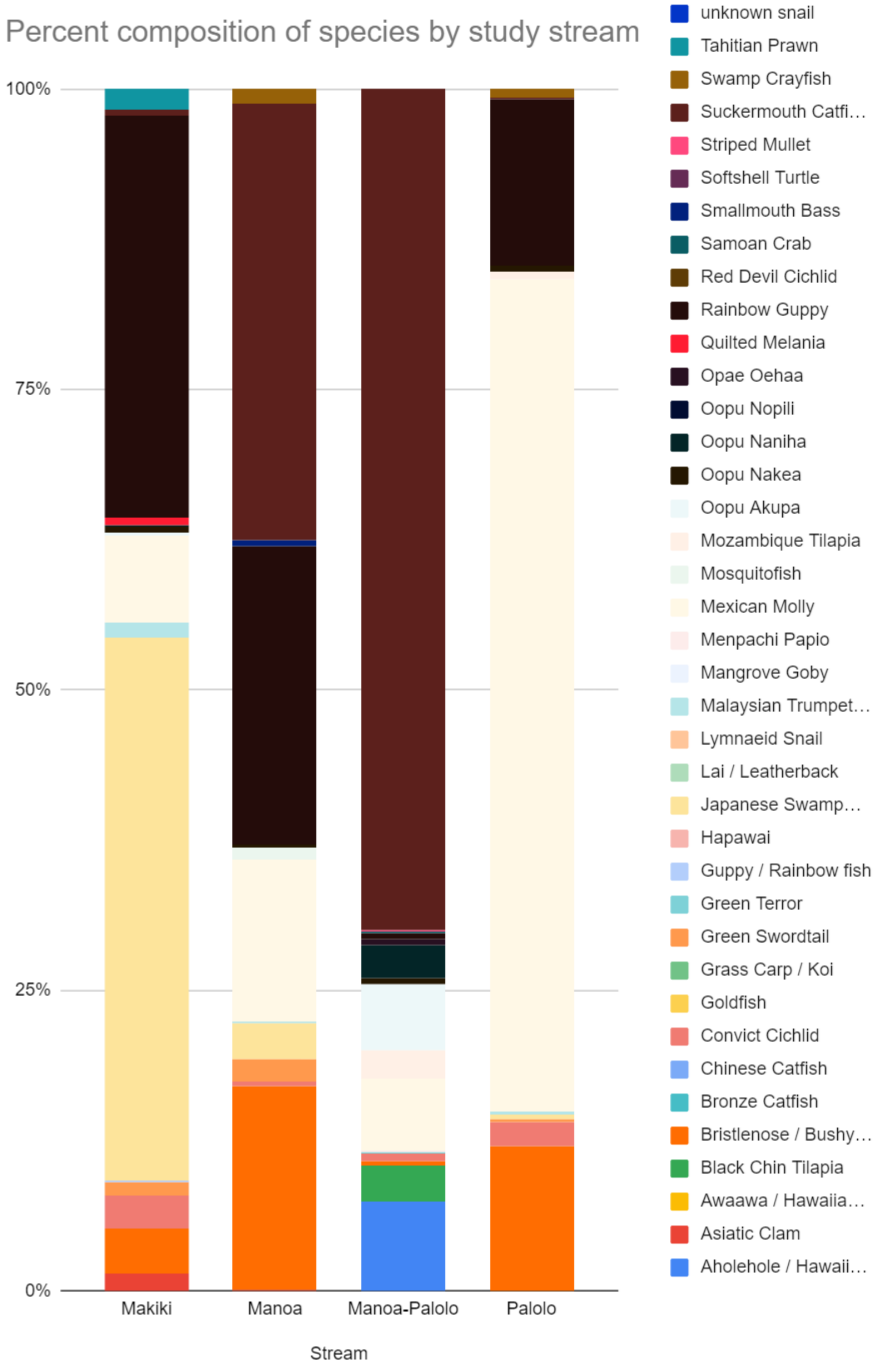
Non-native species by stream





Average number of native species captured per field survey at each site
Count
30
20
10
0
Anuenue School
Baker Park
Chaminade
Halau Ku Mana
Jarret Middle School
Kaimuki High School
Kanealole
Kanewai Field
Kanewai Loi
Lyon Arboretum
Manoa Marketplace
Manoa Valley District Park
Manoa-Palolo Confluence
Noelani Elementary
Palolo Elementary
Saint Louis Field
Waakaua
Waiakeakua (USGS Gage)
Waihi (USGS Gage)
Washington Middle School
Study Site


Percent contribution of stream species by study site
100%
75%
50%
25%
0%
Anuenue School
Baker Park
Chaminade
Halau Ku Mana
Jarret Middle School
Kaimuki High School
Kanealole
Kanewai Field
Kanewai Loi
Lyon Arboretum
Manoa Marketplace
Manoa Valley District Park
Manoa-Palolo Confluence
Noelani Elementary
Palolo Elementary
Saint Louis Field
Waakaua
Waiakeakua (USGS Gage)
Waihi (USGS Gage)
Washington Middle School
Study Site
Tahitian Prawn
Swamp Crayfish
Suckermouth Catfish / Plecostomus
Striped Mullet
Softshell Turtle
Smallmouth Bass
Samoan Crab
Red Devil Cichlid
Rainbow Guppy
Quilted Melania
Opae Oehaa
Oopu Nopili
Oopu Naniha
Oopu Nakea
Oopu Akupa
Mozambique Tilapia
Mosquitofish
Mexican Molly
Menpachi Papio
Mangrove Goby
Malaysian Trumpet Snail
Lymnaeid Snail
Lai / Leatherback
Japanese Swamp Shrimp
Hapawai
Guppy / Rainbow fish
Green Terror
Green Swordtail
Grass Carp / Koi
Goldfish
Convict Cichlid
Chinese Catfish
Bronze Catfish
Bristlenose / Bushynose Plecostomus
Black Chin Tilapia
Awaawa / Hawaiian Ladyfish
Asiatic Clam
Amaama / Striped Mullet
Aholehole / Hawaiian Flagtail



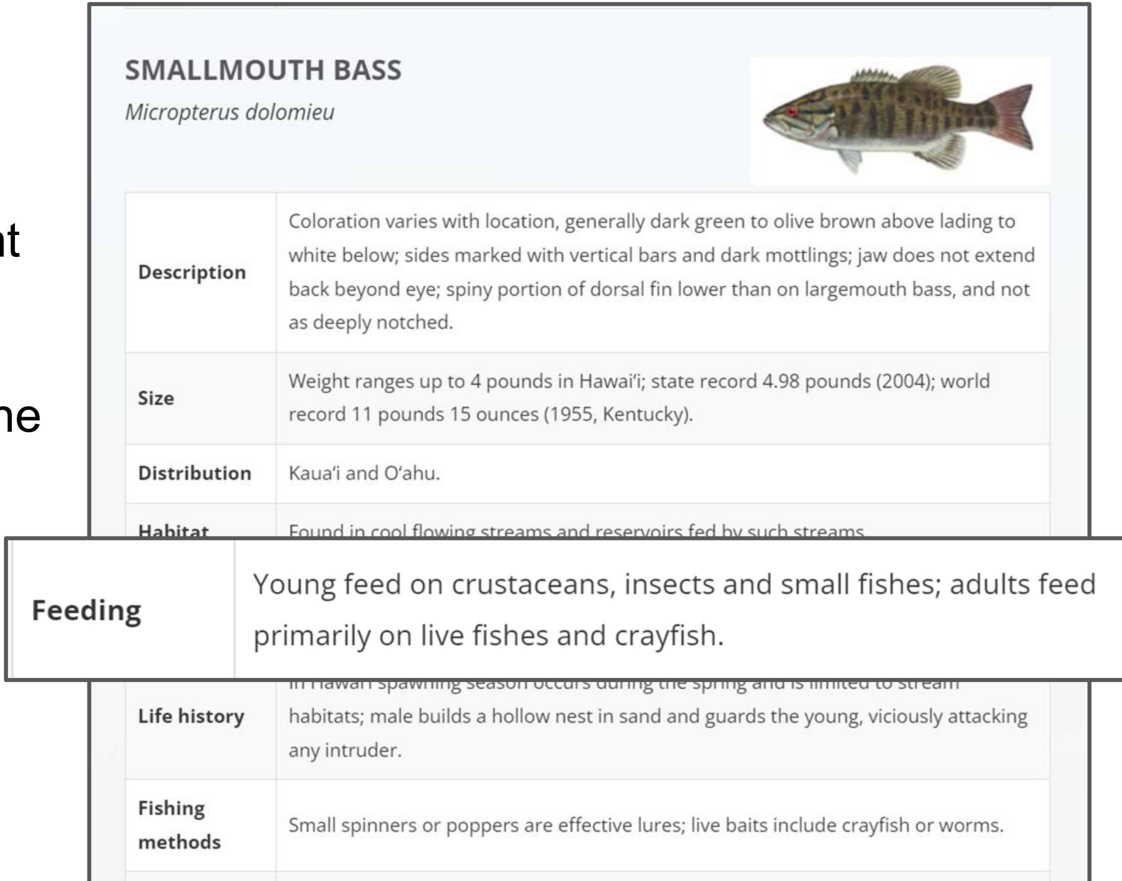
Percent composition of species by study stream
100%
75%
50%
25%
0%
Makiki
Manoa
Manoa-Palolo
Palolo
Stream
unknown snail
Tahitian Prawn
Swamp Crayfish
Suckermouth Catfi…
Striped Mullet
Softshell Turtle
Smallmouth Bass
Samoan Crab
Red Devil Cichlid
Rainbow Guppy
Quilted Melania
Opae Oehaa
Oopu Nopili
Oopu Naniha
Oopu Nakea
Oopu Akupa
Mozambique Tilapia
Mosquitofish
Mexican Molly
Menpachi Papio
Mangrove Goby
Malaysian Trumpet…
Lymnaeid Snail
Lai / Leatherback
Japanese Swamp…
Hapawai
Guppy / Rainbow fish
Green Terror
Green Swordtail
Grass Carp / Koi
Goldfish
Convict Cichlid
Chinese Catfish
Bronze Catfish
Bristlenose / Bushy…
Black Chin Tilapia
Awaawa / Hawaiia…
Asiatic Clam
Aholehole / Hawaii…

Mānoa vs Makiki vs Pālolo Stream

- Presence of Native Species
    - All streams
    - Mānoa Mānoa Stream scored the lowest for average counts, density, and %HS-IBI
- Barriers
- Physical
    - Pālolo Stream with the lowest score for physical stream habitat - highest temperature, pH, and turbidit
        - Invasive species densities highest
- Biological

Implications for Potential Lure Design??

- Smallmouth bass
- Invasive species
- Prohibits upstream movement of native amphidromous fish
- Could we “lure” them out of the streams?
- NOTE: Friday, Cory Yap will talk more about this



SMALLMOUTH BASS

Micropterus dolomieu

Description	Coloration varies with location, generally dark green to olive brown above lading to white below; sides marked with vertical bars and dark mottlings; jaw does not extend back beyond eye; spiny portion of dorsal fin lower than on largemouth bass, and not as deeply notched.
Size	Weight ranges up to 4 pounds in Hawai‘i; state record 4.98 pounds (2004); world record 11 pounds 15 ounces (1955, Kentucky).
Distribution	Kaua‘i and O‘ahu.
Habitat	Found in cool flowing streams and reservoirs fed by such streams
Feeding	Young feed on crustaceans, insects and small fishes; adults feed primarily on live fishes and crayfish.
Life history	In Hawai‘i spawning season occurs during the spring and is limited to stream habitats; male builds a hollow nest in sand and guards the young, viciously attacking any intruder.
Fishing methods	Small spinners or poppers are effective lures; live baits include crayfish or worms.

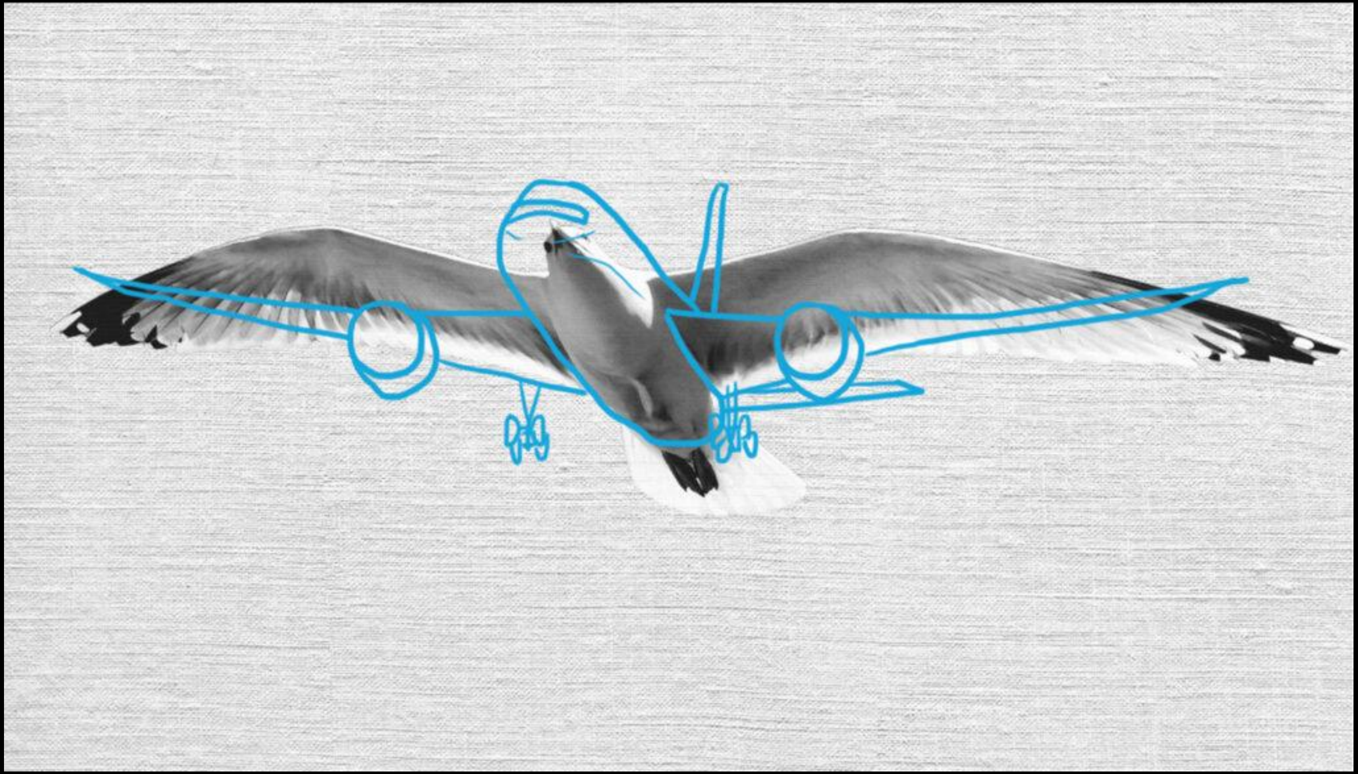
Lesson #2

2.1 - Design Brief introduction (challenge) + Lure design
2.2 - 3D CAD/Modeling

Lesson #2.1

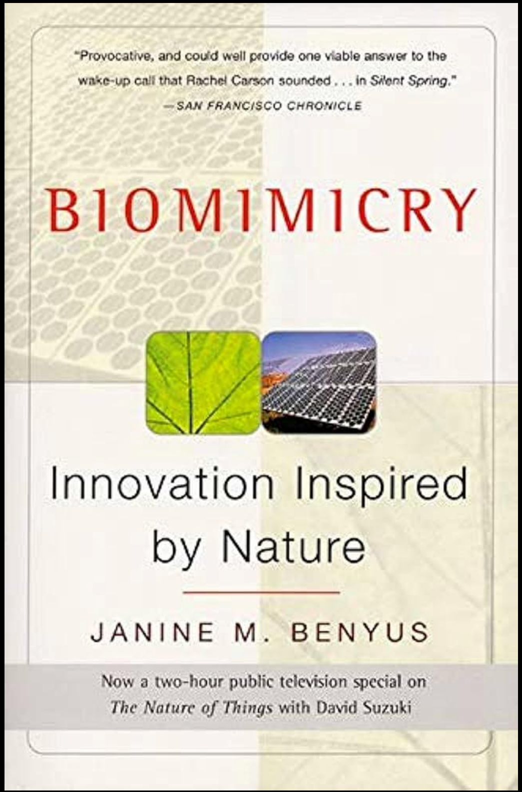
2.1 - Design Brief introduction (challenge) + Lure design

Introduction to Biomimicry



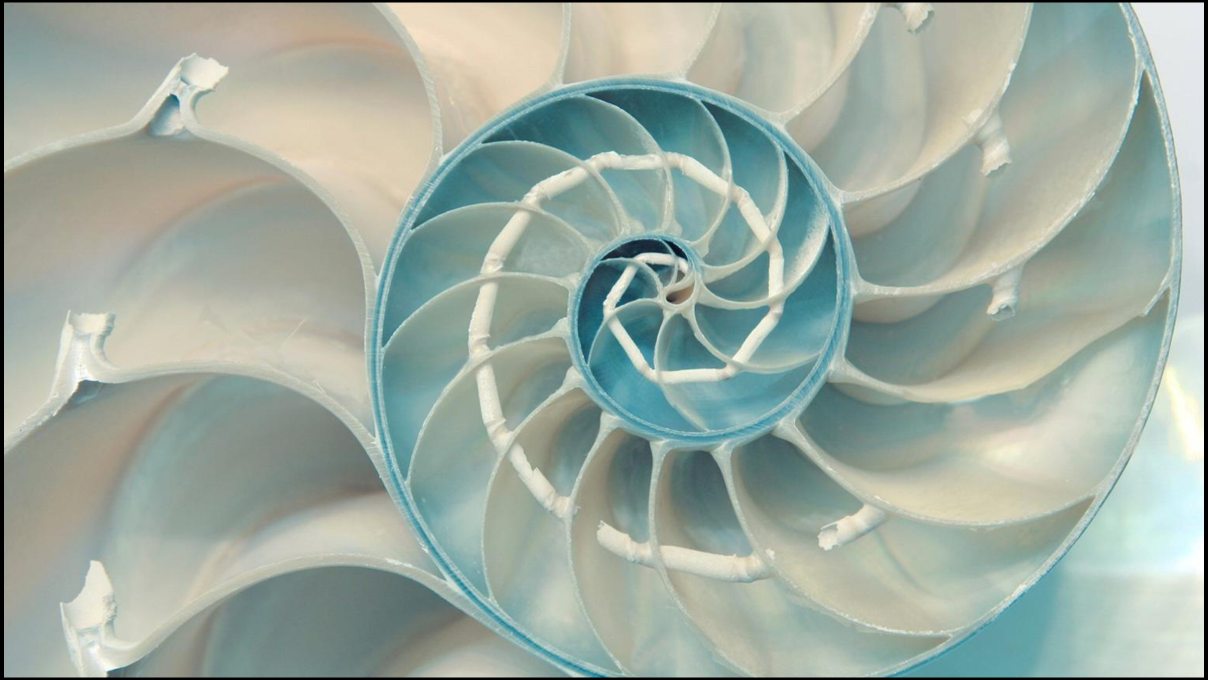
What is Biomimicry?

“Innovation inspired by nature”



What is Biomimicry - Video Clip

Biomimicry Guessing Game



NATURE WORKS EVERYWHERE

PRESENTED BY The Nature Conservancy

Biomimicry 1 minute - Elbow Partner Discussion

Guess which element in nature inspired the following products.

Velcro and Burdock Burs

A Swiss engineer modeled Velcro on the burs from the burdock plant, after noticing them stuck to his dog's fur.

By Alexander Klink (Own work) [CC BY 3.0 via Wikimedia Commons

Derek Harper [CC BY-SA 2.0 via Wikimedia Commons

Locally-relevant example

- ‘ulu leaves
- Ilie‘e fruits/flowers
- Similarly sticky like velcro

Turbine Blades and Whale Fins

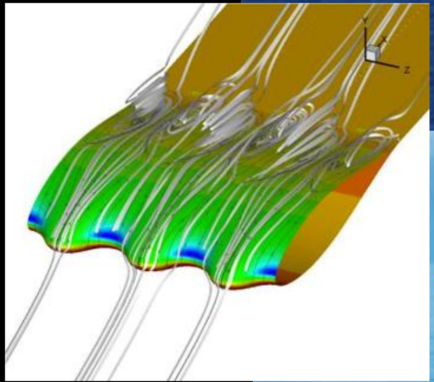
By adding small bumps to the front of turbine blades, mimicking those on a whale fin, engineers found that the bumps facilitated the movement of the blade through the air. This increased the windmill's efficiency.

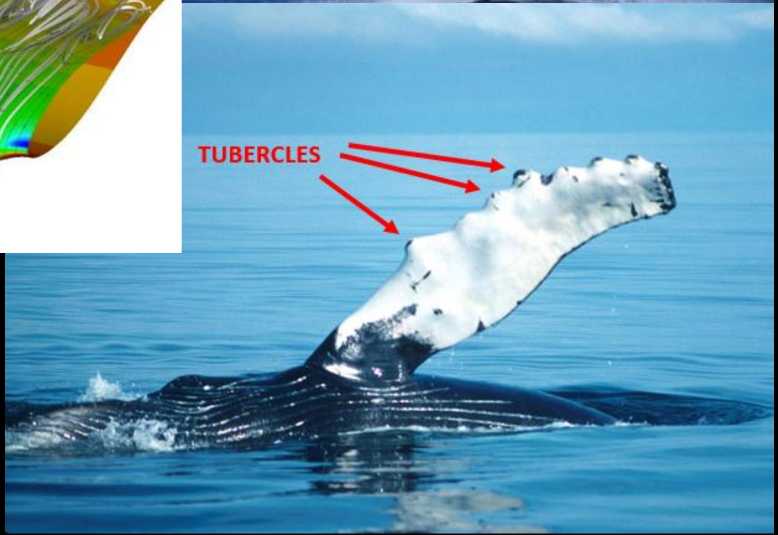
Chris English [CC BY-SA 3.0] via Wikimedia Commons

By Rob and Stephanie Levy [CC BY 2.0], via Wikimedia Commons

Koholā - Humpback Whale

- Tubercles allow lift at angles 40% steeper than with a smooth surface
- Vortices formed
  - Delay stall
  - Aid in maneuverability, agility
  - Potential application to helicopter blades in the future





Bullet Train and Kingfisher

When first designed, the Japanese bullet train made an ear-splitting sound as it emerged from a tunnel. Engineers found the solution to this problem in nature. The redesigned bullet train's nose was modeled on the shape of a kingfisher's beak. When kingfishers dive into water to catch fish, they are very stealthy so as to sneak up on their prey! Modeling the nose of the train in this way decreased noise issues while increasing efficiency.

By Alok Mishra [Public domain], via Wikimedia Commons

By Andreas Trepte (Own work) [CC BY-SA 2.5] via Wikimedia Commons

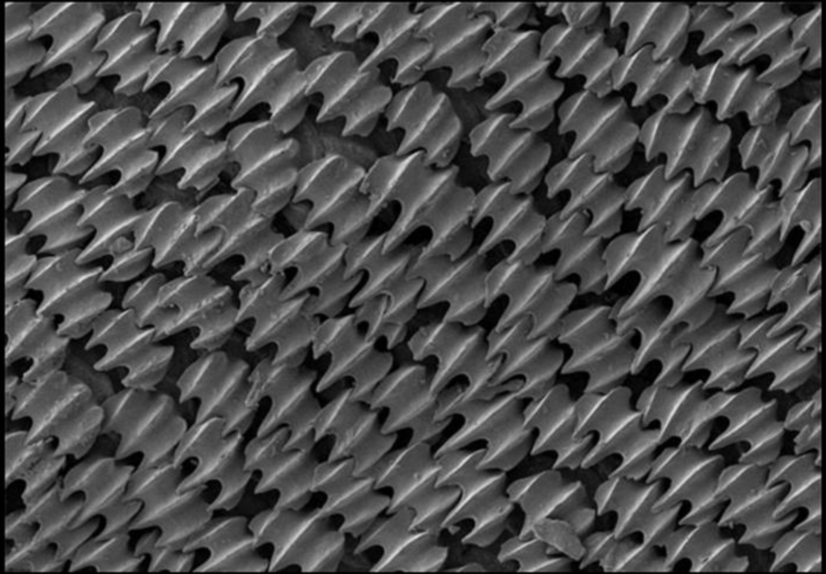
‘Ā - Red-footed Boobies

- Forage by plunge diving
- 4-8 meters above the water
- Strong bill, thicker bones, air sacks
- Some diving birds up to 60mph

Ship Coating and Shark Skin

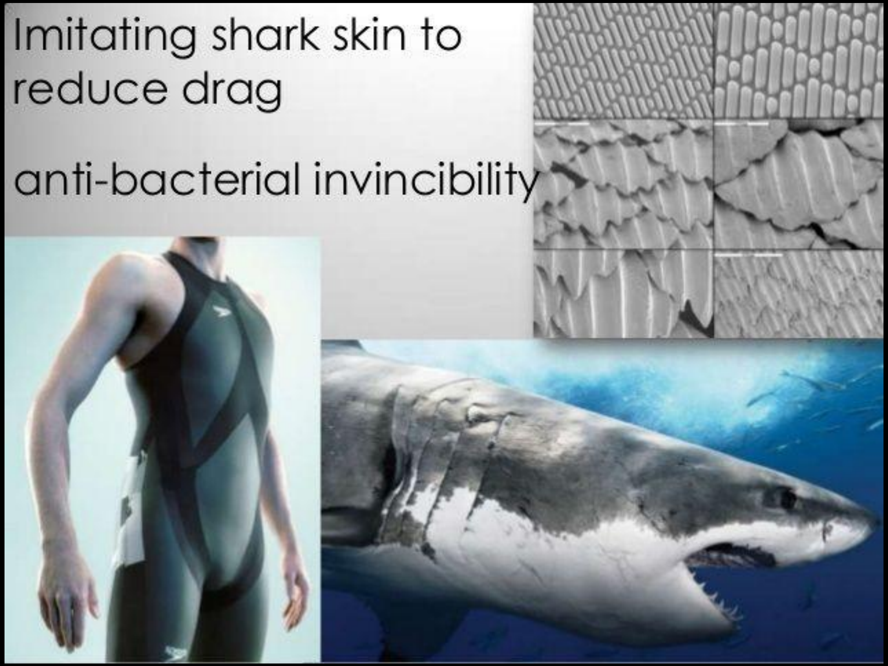
NASA scientists drew inspiration from nature when designing a new material to cover ships in order to reduce drag. Their inspiration came from the dentricles on shark skin that work to reduce drag and prevent bacteria from attaching. This coating can be used to help the U.S. Navy increase ship speeds while saving fuel.

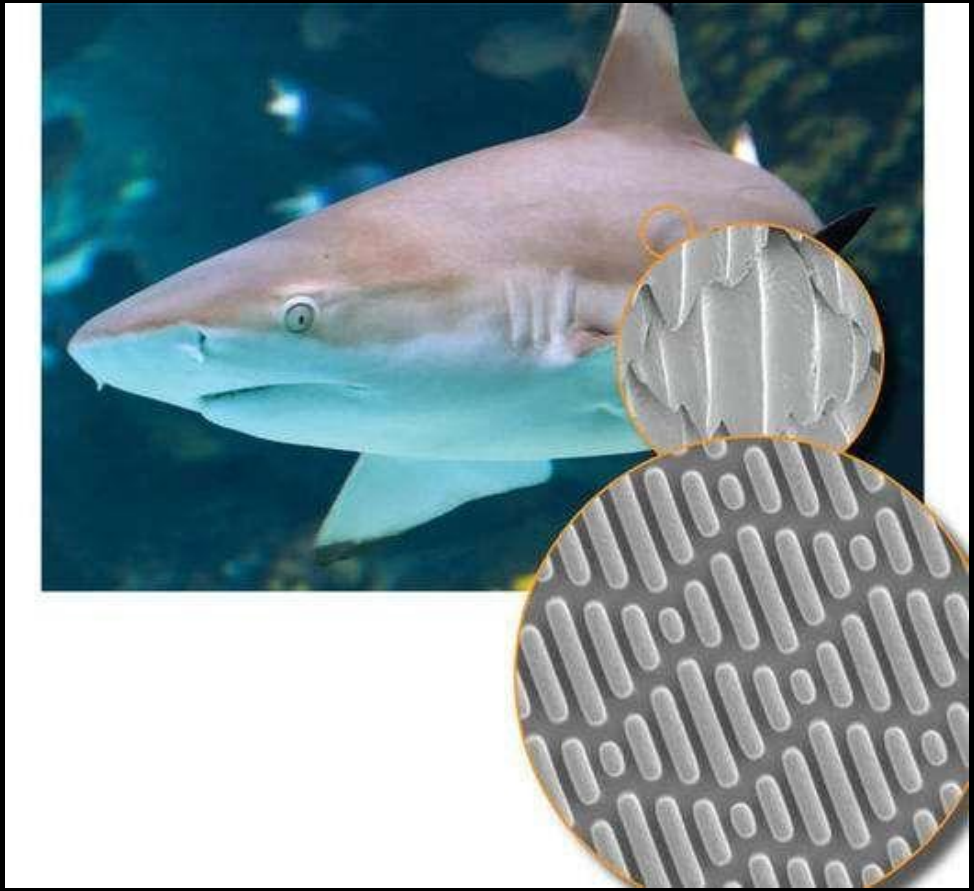
Public domain, https://commons.wikimedia.org/wiki/File:USS_Ronald_Reagan_(CVN-76).jpg#file)



Manō (Sharks)

- Shark skin - dermal denticles
- Reduce drag, turbulence, abrasion





Eastgate Building and Termite Mounds

Architects took a cue from nature when they designed the climate-control systems in this building in Zimbabwe. The building is modeled after a terminate mound whose structure helps control the temperature and facilitate air flow.

Jets and Geese

Scientists have proposed that jets might save gas by mimicking a familiar pattern in nature. Geese conserve energy by flying in this iconic V formation, which reduces wind resistance.

By kees torn (Jumbo Jet) [CC BY-SA 2.0] via Wikimedia Commons

By Gilles Gonthier from Canada (Volée d'oies -- Flight of geese Uploaded by Amqui) [CC BY 2.0], via Wikimedia Commons

Mōlī - Laysan Albatross

- Long distance flights to forage
  - Albatross, 11-12 ft wingspan
  - Example maneuver: gain height, angles wings while flying into wind, turn and swoop

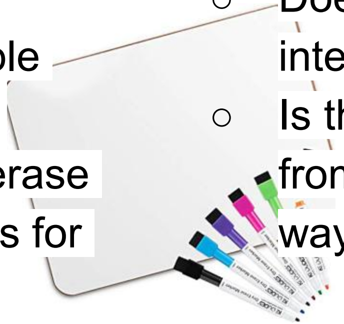
Design Challenge - Smallmouth Bass Fishing Lure

Scenario: Invasive species pose significant ecological threats in Hawai'i, due to their possession of adaptations to their new environments that leads to high levels of fitness. This exceptional fitness allows them to outcompete native species and threaten the survival of endemic species and communities. Many invasive species thrive in modified stream conditions that native species struggle to survive in (i.e. higher water temperature due to concrete bottom streams). **Smallmouth Bass** (*Micropterus dolomieu*) is one such species; it can be found in freshwater stream ecosystems in Hawai'i, particularly Mānoa steam, and disrupts the food webs in those locations due to preying upon a wide variety of other organisms, both native and non-native.

Design Challenge - Smallmouth Bass Fishing Lure

STEP 1 - Brainstorm it!

- Think back to Uncle Cory's presentation (*and your speaker notes*) - what kinds of species are present in the Manoa stream
- Recall the types of prey that the Smallmouth bass consume
- Research information and look at photos of the Smallmouth Mouth Bass; consider
- Sketch out 3 potential designs in your notebook as an individual
- Discuss your design ideas with your table group
- From there, sketch one out on the dry erase board and present your idea to the class for feedback



See the "Design Brief" for specifics:

- Design constraints:
  - Size, durability, material (including biodegradability), movement behavior, target species behavior (diet, location, "intelligence", etc), color/texture, scent
- Success Criteria
  - Can it be made easily?
  - Can it be used multiple times?
  - Does it move through the water in an intended and efficient manner?
  - Is the material(s) the lure is fabricated from environmentally friendly in some way (i.e. no plastics)?

Design Challenge - Smallmouth Bass Fishing Lure

STEP #2 - Model it!

- Discuss the various designs presented by groups
- Using peer and instructor feedback, come up with a final sketch
- Use clay to create the lure model that you think will make the most effective lure

NOTE: The lure shouldn't be much larger than the size of your palm/fist

Don't be ***too*** detailed - those details may not come through when manufactured

Design Challenge - Smallmouth Bass Fishing Lure

STEP #3 - Video Pitch Script

Write a script for your video pitch

- Describe the importance of steam ecosystems & how your lure provides a solution to target/remove invasive smallmouth bass
- What in nature helped to inspire the design? (how did you use biomimicry to inspire your design?)
- Identify and describe the features of your design that will “attract” the bass to pursue the lure?
  - Shape, color, texture, scent/taste, movement/behavior
- Is your design meant to be durable and reusable?
- Is your design easy or difficult to manufacture?

Design Challenge - Smallmouth Bass Fishing Lure

STEP #4 - Video Pitch

- *Pitch your design* - create a video showing your 3D model as well as addressing the points required in the script (step #3)
- Keep your video pitch to less than 5 minutes and ensure that all group members have contributed!

Upload your video to Padlet for feedback and voting

padlet

Planula Settlement Structure – Peer Feedback

STEP #5 - Peer Feedback

Watch the videos from all the groups in your class. In the comment section, provide feedback on at least **ONE** of the following:

- Positive aspects of the design
- The practicality of the design
- Parts of the design that could use improvement
- How well you think the students mimicked nature
- Unique qualities about the design

Lesson #2.2

2.2 - 3D CAD/Modeling of Lure + Lure Mold

Lesson #3

3.1 - 3D Slicing + printing the molds
3.2 - Fabricating the lure in molds
3.2 - Preliminary testing of lures

Lesson #3

3.1 - 3D Slicing + printing the molds

Lesson #3

3.2 - Fabricating the lure in molds
3.2 - Preliminary testing of lures