Zoology & medicine

By Ajay Krishnan

About Your Teacher

Year: 1st

Major: Psychology & Integrative Biology, premedicine

On-Campus Involvements:

- Berkeley Wetlab Research
- Kickboxing
- Theater

Off-Campus Involvements:

- Crisis Counselor
- Bilingual Medical Interpreter
- Stanford Social Science Research

Random tidbits:

- V4 rock climber
- Male Model
- Opera singer

1) Sleepy Jellyfish

2) Cone Snail Crack

3) Alligator Immunity

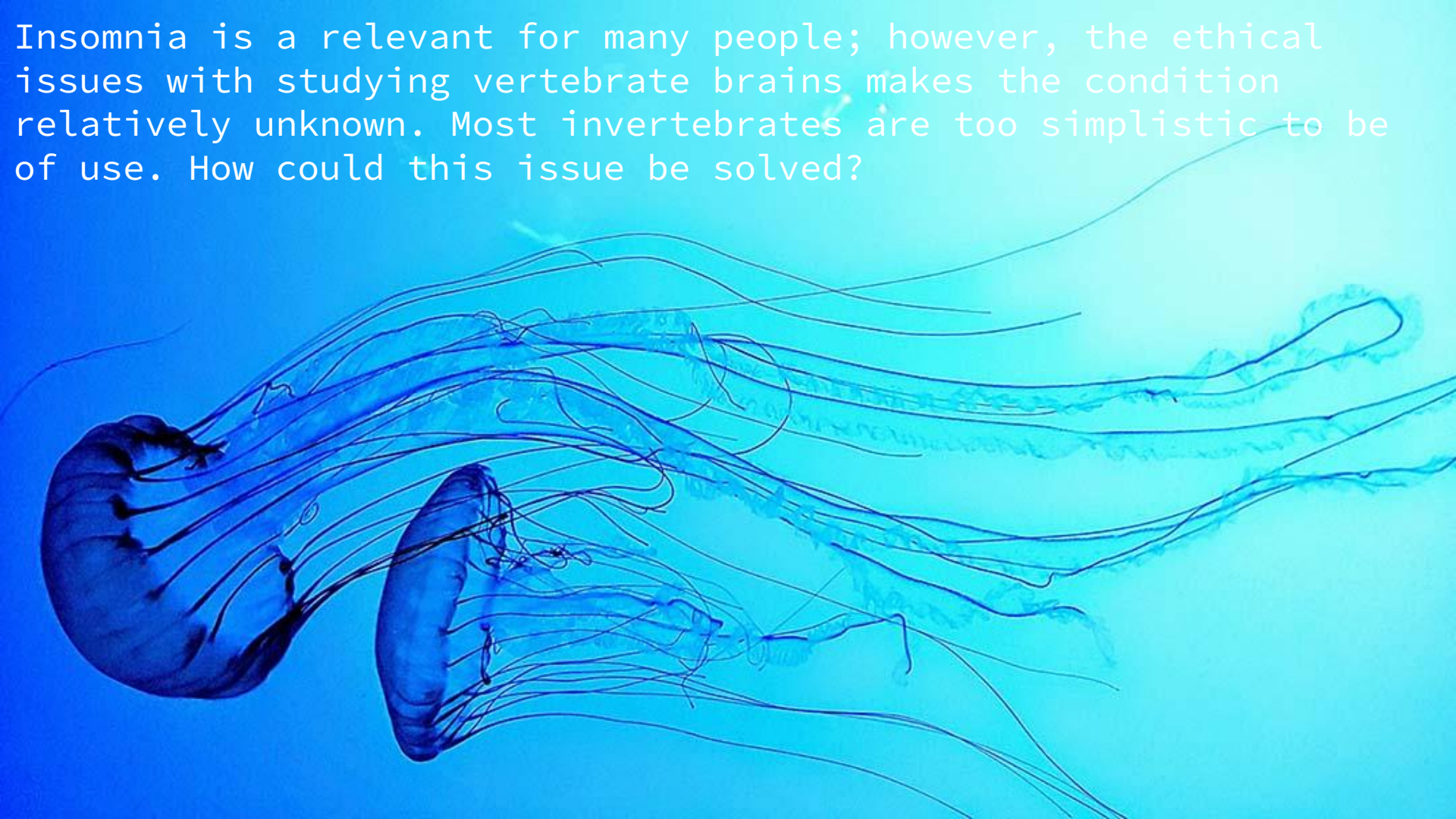
4) Blue Blood Standard

5) Hagfish Adhesives

6) Case Studies

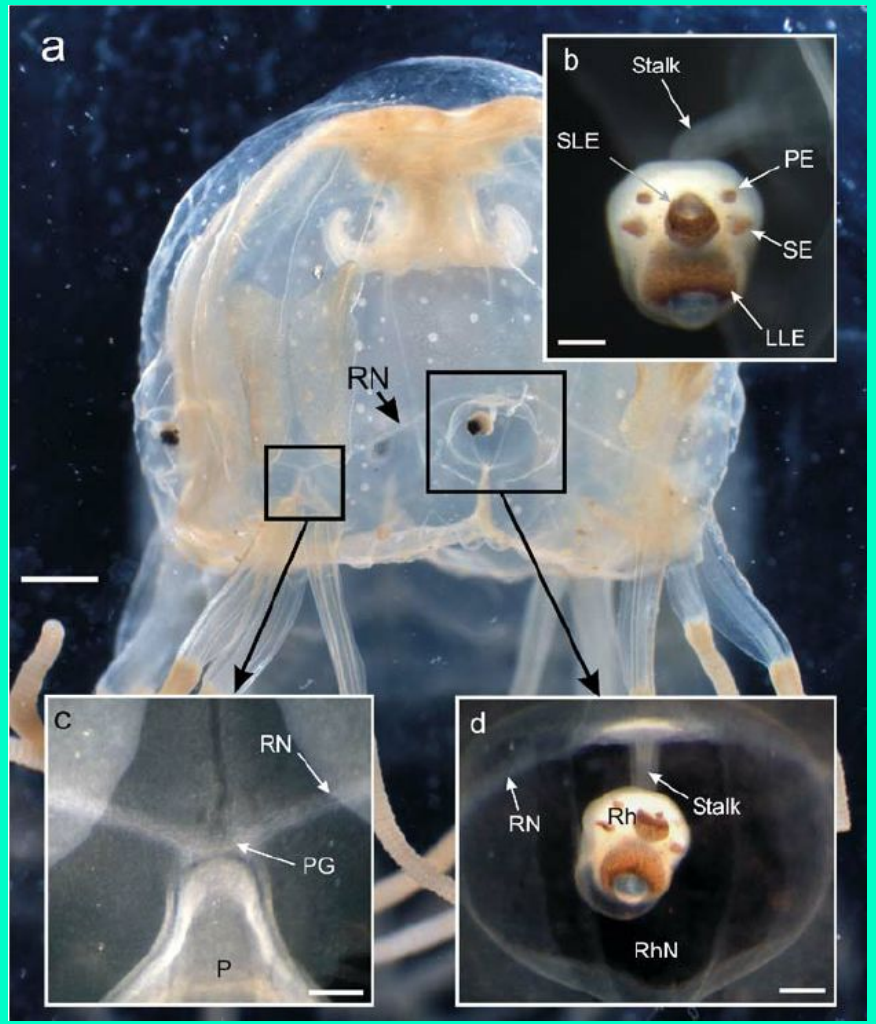
7) Conversation on Stewardship

Insomnia is a relevant for many people; however, the ethical issues with studying vertebrate brains makes the condition relatively unknown. Most invertebrates are too simplistic to be of use. How could this issue be solved?



Brain Activity in Jellyfish - Psychology

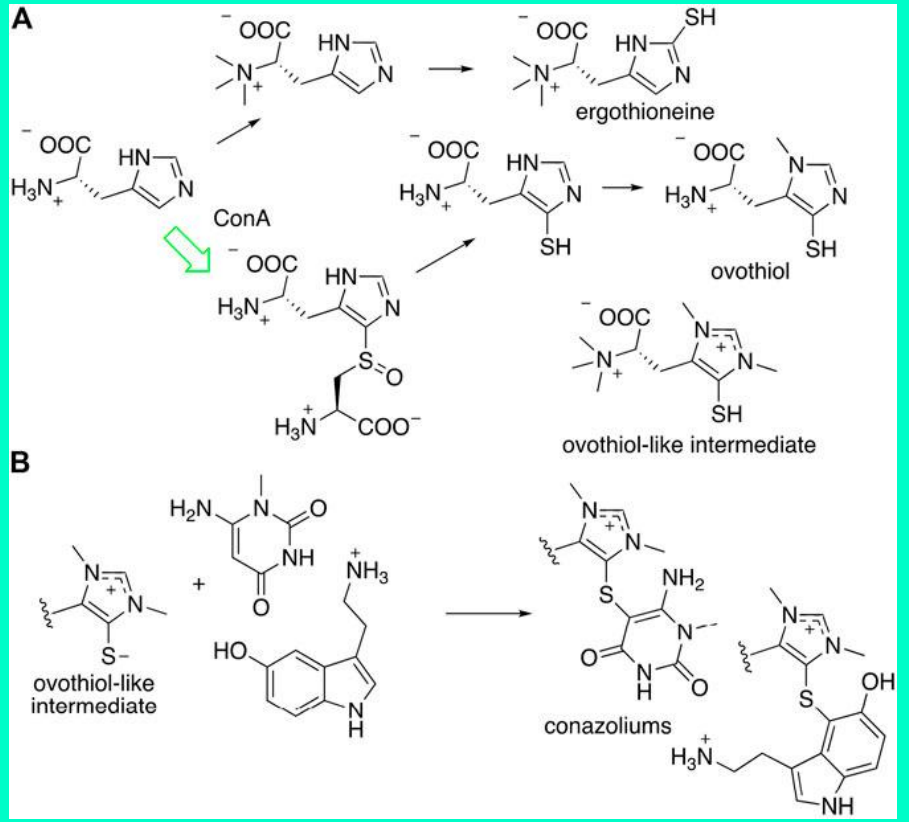
- Basal ganglia rules supreme
- Controls pulsation (a jellyfish's ability to move)
- Cycles between fast and slow (like a sleep cycle)
- Mechanical sleep deprivation (ie shooting bubbles) changes pulsing cycle (hinders it), chemical sleep deprivation (ie injection of acetylcholine) rips cycles apart



Millions of people rely on insulin. A pharmacological crisis party caused by price gouging has left many without the life-saving drug. Does an alternative exist for those requiring the life-saving substance?

Cone Snail Venom - Pharmacology

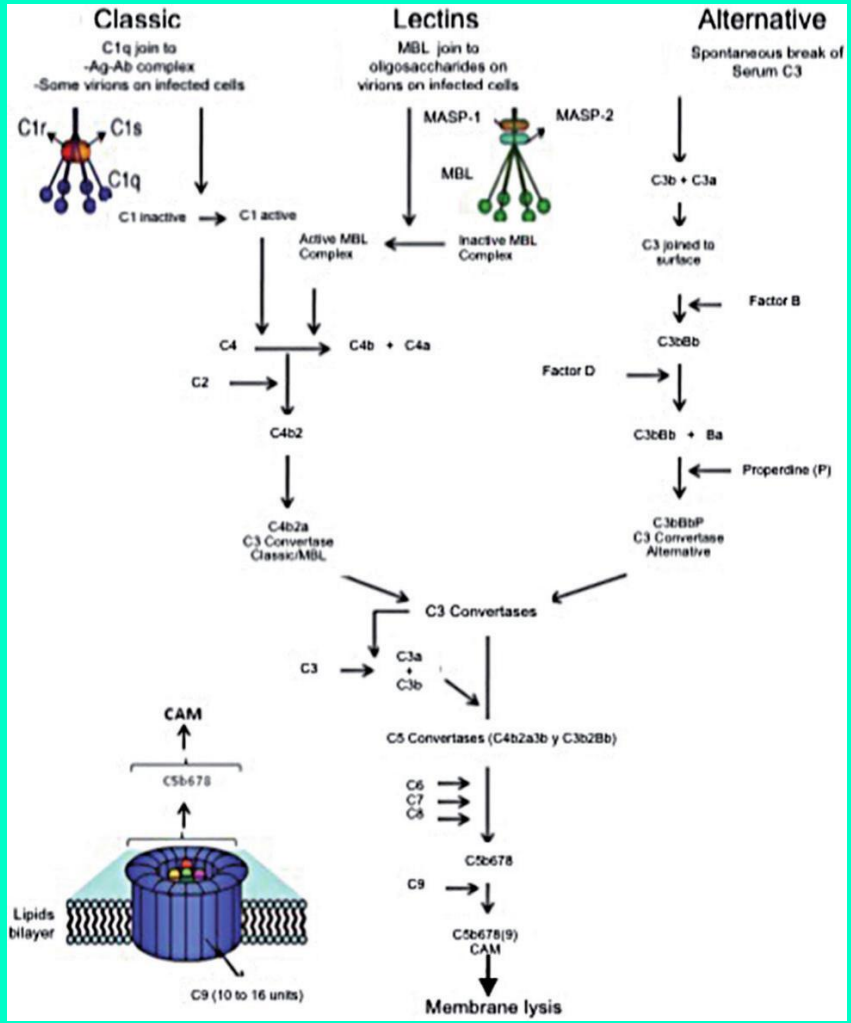
- Known for its complexity (venom in general = drug development)
  - Tons of volatile hydrogen atoms/electronegative oxygen atoms
- Has to be fast acting (otherwise cannot catch prey)
- Modify existing compounds in prey, different effects in different animals
  - Somatostatin —> insulin
- Fish act as proxies for humans, so effects on them = effect on us

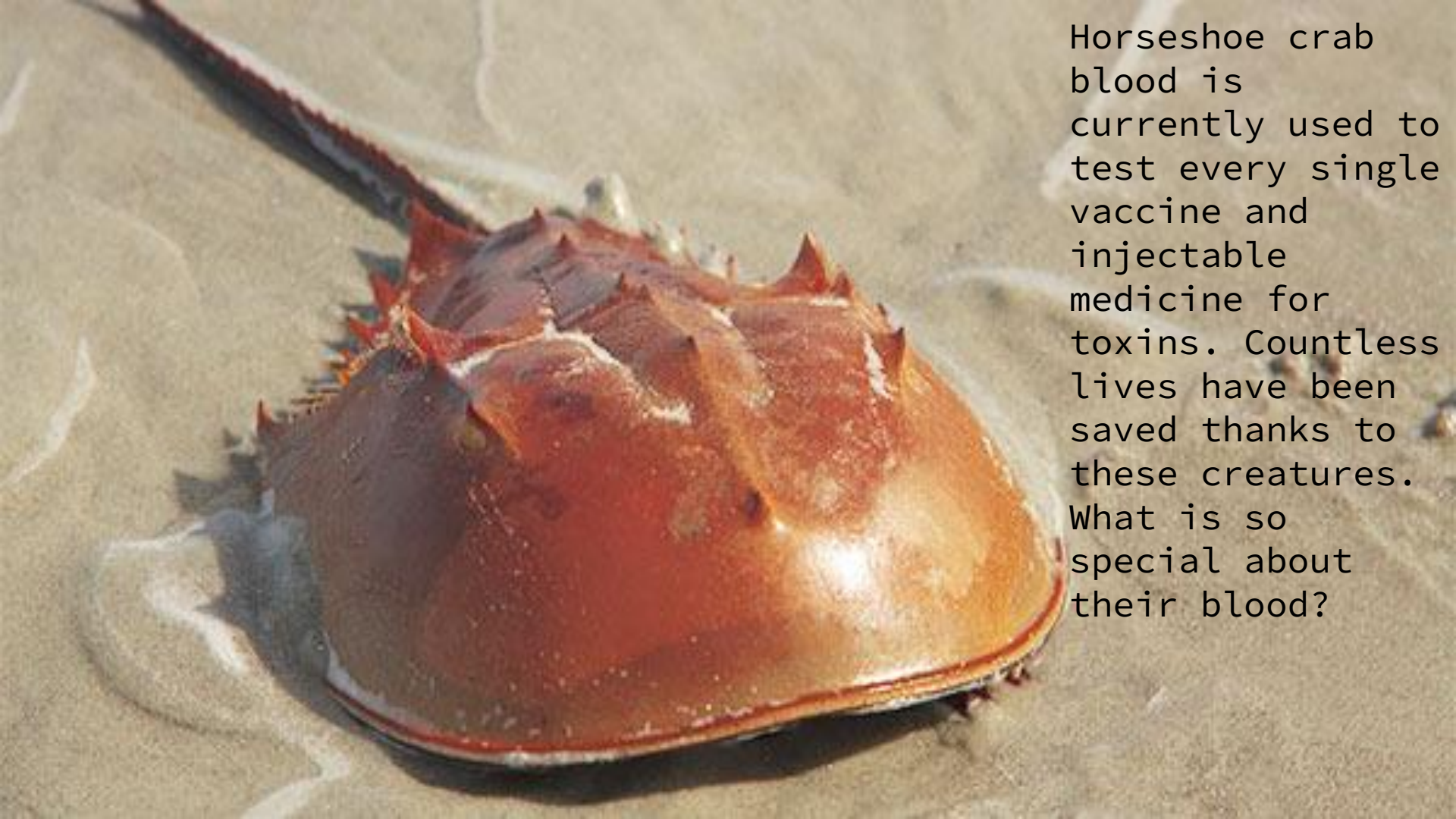



Alligators live in filthy water and oftentimes fight with other alligators, leaving gaping open wounds. Yet, infections are essentially nonexistent. How can their defense mechanisms be used to improve our antibiotics?

Alligator Defense Systems - Immunology

- Normal antibiotics: target necessary enzymes for cell wall growth
  - Good…until a mutation develops
- Alligator immunity starts at white blood cells
  - Zones of inhibition
  - Strong peptides with in vitro-capabilities –> distinct membrane lysis
- Can cure HIV
- Warning: not for use in unmodified form

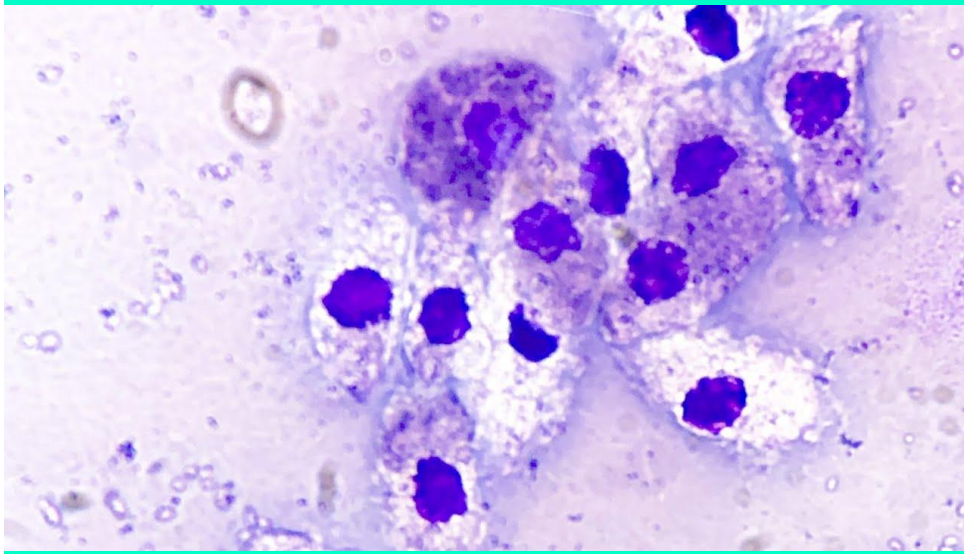


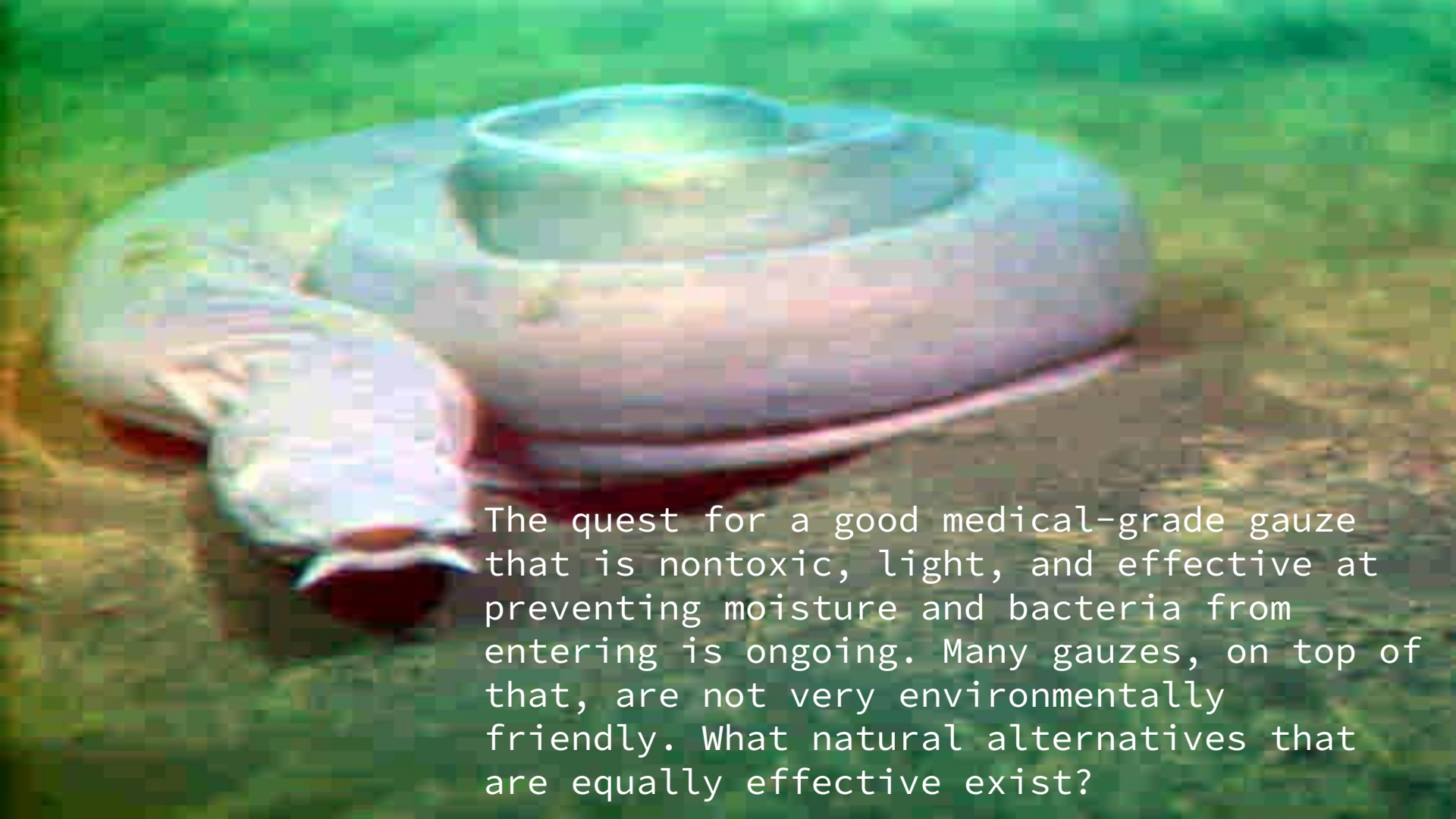


Horseshoe crab blood is currently used to test every single vaccine and injectable medicine for toxins. Countless lives have been saved thanks to these creatures. What is so special about their blood?

Properties of Horseshoe Crab Blood - Molecular Biology

- Bright blue in color
- Very sensitive to many fever-inducing toxins (ie endotoxins) & beta-glucans
  - Highly reactive to lipopolysaccharide
  - Amebocyte (immune system queens) degradation –> hemolymph coagulation
- Gel clumps are easily visible (and absence too)
- Limulus amebocyte lysate test
  - Gold standard for vaccination

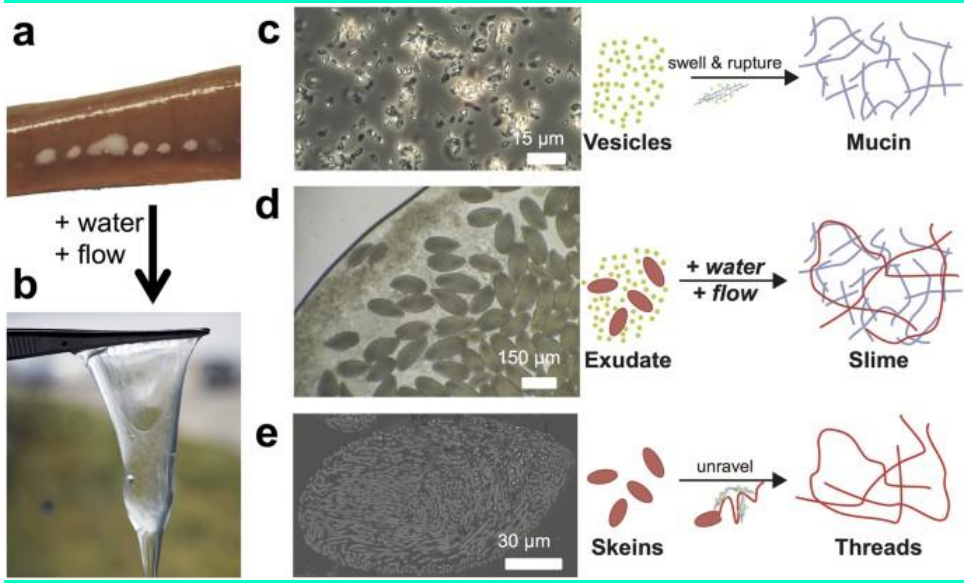




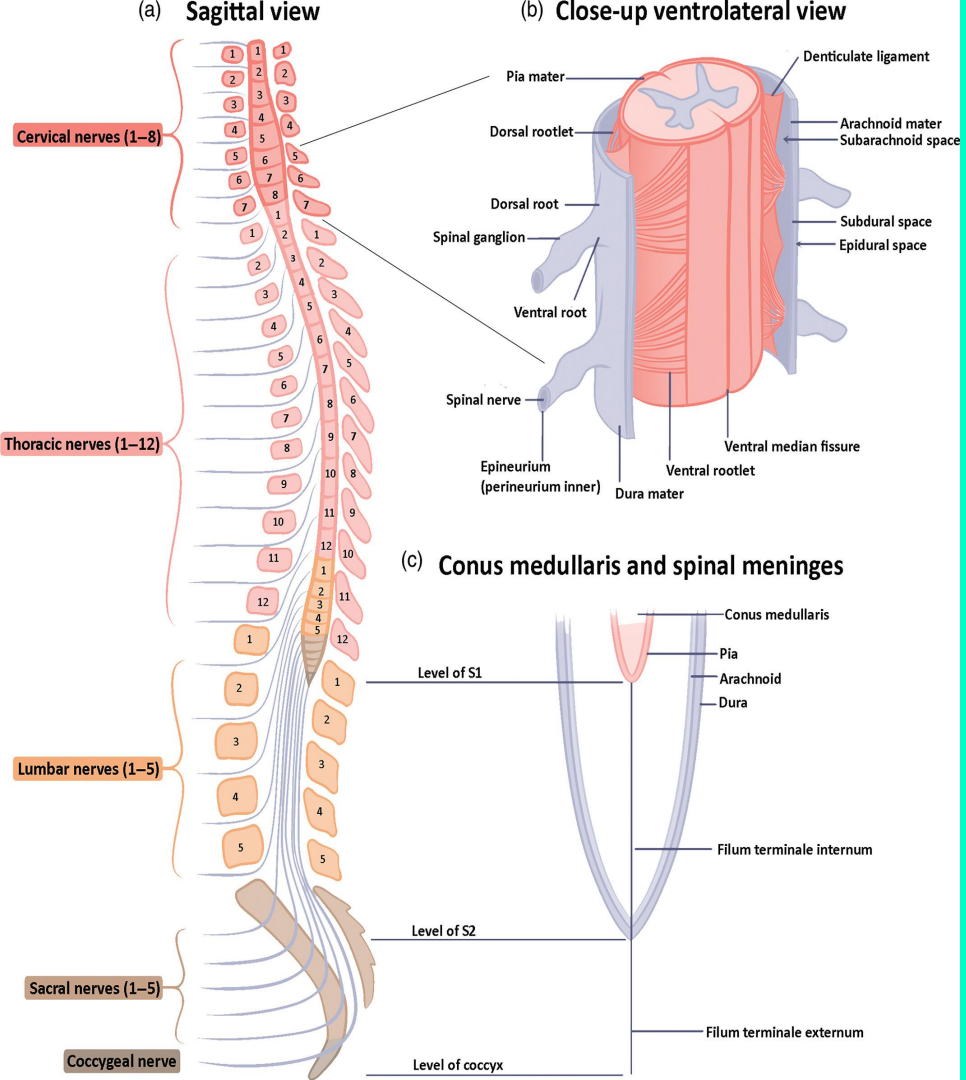
The quest for a good medical-grade gauze that is nontoxic, light, and effective at preventing moisture and bacteria from entering is ongoing. Many gauzes, on top of that, are not very environmentally friendly. What natural alternatives that are equally effective exist?

Crosslinking of Slime - Materials Science

- Crosslinking allows molecules to join other molecules
- Expand 10k in a fraction of a second, can stop a car
- Glycoprotein called mucin (in huge vesicles), mucin filled with covalent bonds, seawater dissolves intramolecular bonds
- Intermediate filaments increase strength
- Absorbs water easily, filament crosslinking decreases pathogen entryways, easily expandable/degradable



The platypus has many strange features and abilities. Unlike other mammals, it lays eggs, it can see perfectly in the dark using electroreception, has a painful barb with venom equivalent in strength to morphine, has antibacterial milk, has ten pairs of sex chromosomes (including 5 bird chromosomes), and lacks a stomach or teeth. How can the platypus be influential to our team of ecologists and biomedical scientists?



The spinal cord is one of the most important body parts for daily functioning yet is surprisingly fragile. Unfortunately, no cure or procedure exists to repair a broken spinal cord, leaving many paralyzed either partially or fully after a single accident. Looking at the natural world, what inspiration could your team of ecologists and biomedical scientists pull from to potentially solve this issue?

Conversation on Environmental Stewardship: Blue Blood & Cancer

- Blood extraction involves piercing the heart and draining
- Eggs are taken from the wild, affecting seabirds (94% decline)
- Coastline health declines since crabs eat sediment
- Microhabitat for small organisms
- Synthetics (rFC) had strict regulations, horseshoe crab blood does not + extreme need
- Balancing act: how much do we rely on rFC vs. blue blood?