WELCOME TO

BIORENDER at MIPS

Getting started in BioRender

Reach out to Lee Kozar (kozar@stanford.edu) if you'd like to purchase a discounted license under Stanford's subscription

*Need a lab affiliation through the Computational Services and Bioinformatics Facilities
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BSc, Neuroscience
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BioRender
Our Goal

Communicating science is HARD.

>1B Hours spent building expensive visuals

Years trying to move research through the pipeline

Countless dollars wasted in errors and delays
Our Goal

To give everyone the tools and practical knowledge to visually communicate their research.
Use Cases

Presentations
Grant Figures
Publications
Protocols

Graphical Abstracts
Lecture Slides
Posters
Educational Materials
Today's Agenda

1. The Basics: Icons and Biobrushes
   - Requesting Custom Icons
   - Protein Data Bank Integration

2. Advanced Tools
   - Poster Builder
   - Graphing

3. Foundations of Design
   - Color and Contrast
   - Simple Compositions

4. Figure Makeover!
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4. Figure Makeover!
Regular and Grouped Icons
Protein Data Bank and Personal Uploads
Custom Icon Requests
(2/person/year, 25-30 business day turnaround)
Medical Imaging Modalities

**Ultrasound**
- Ultrasound with high frequency reflects on soft and hard tissues
- Used to measure the direction and speed of movement
- Cannot see past bones
- Mostly superficial tissues
  - Pregnancy
  - Cardiovascular imaging
  - During surgery
  - ...

**Computed Tomography**
- Source of X-rays and detectors rotate around patient
- Virtual slice through the patient for quick diagnosis
- Low dose of dangerous X-rays
- Mostly hard tissues
  - Broken bones
  - Liquid build up in lungs
  - Blood circulation
  - ...

**Magnetic Resonance Imaging**
- Large magnet and radio waves that influences water molecules to create an image
- Functional, structural and chemical information
- Long and loud scans
- Mostly soft tissues
  - Brain imaging
  - Tendons and ligaments
  - Cardiovascular imaging
  - ...
Essential for the Sensation of Touch:

PIEZO Channels

Scientist Spotlight

Dr. Ardem Patapoutian

Dr. Ardem Patapoutian, PhD, is a Howard Hughes Medical Institute investigator of Scripps Research. He received the 2021 Nobel Prize in Physiology or Medicine (jointly). His research focuses on the mechanisms underlying somatosensation - specifically ion channels that are responsible for the ability to sense heat and mechanical stress.

PIEZO Channels: How Do They Allow Mechanosensation?

Both PIEZO1 and PIEZO2 have a three-bladed, propeller-like structure. Both are homotrimeric - the three subunits come together to form the central membrane-spanning pore. They contain nine repetitive units, each with four transmembrane helices.

PIEZO1 and PIEZO2 are both mechanically-activated cation channels. Based on protein structure, it was predicted that the ‘blades’ of the PIEZO channels undergo a lever-like flattening motion upon application of mechanical stress. This opens up their central pore, allowing an influx on positive charge. The exact mechanism by which mechanical force leads to the central pore opening is not fully understood.

Relevance of PIEZO Channels in Physiology and Medicine

Since their discovery, PIEZO1 and PIEZO2 have been proven to be critical mechanosensors throughout the human body, contributing to multiple important physiological processes.

Lungs

PIEZO2 acts as an airway stretch sensor in respiratory tissue and is critical for normal breathing.

Blood pressure

Both PIEZO1 and PIEZO2 act as baroreceptors and are essential in blood pressure regulation.

Vascular cells

PIEZO1 is an important sensor of shear stress in vasculature and required for embryonic vascular development.

Bladder

PIEZO2 is a sensor for stretch in the bladder urothelium and innervating sensory neurons.

Malaria

Polymorphisms and mutations in PIEZO1 have been shown to protect against symptoms of malaria.

Immune cells

PIEZO1 regulates macrophage phagocytic activity and thereby facilitates erythrocyte turnover.

1. The Nobel Foundation
4. Piezo1 and Piezo2 are essential components of distinct mechanically-activated cation channels (2010) PMID: 20813920
5. Structure-based membrane dome mechanism for Piezo mechanosensitivity (2017), PMID: 29231809
6. PIEZO1 and PIEZO2 sense airway stretch and mediate lung inflation-induced apnoea (2017) PMID: 28002412
7. Structure and mechanogating of the mammalian tactile channel PIEZO2 (2019), PMID: 31435011
8. PIEZOs mediate neuronal sensing of blood pressure and the baroreceptor reflex (2014), PMID: 24958852
9. PIEZO1 integration of vascular architecture with physiological force (2014), PMID: 25119025
10. Piezo1, a mechanically activated ion channel, is essential for vascular development in mice (2014), PMID: 24958852
11. PIEZO2 in sensory neurons and endothelial cells coordinate vasoconstriction (2020), PMID: 31971022
13. A common polymorphism in the mechanosensitive ion channel PIEZO1 is associated with protection from severe malaria in humans (2020), PMID: 32265284
15. A rise of PIEZO1 is iron metabolism in mice and humans (2021) PMID: 33571427
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Color Contrast

Rule of Thumb: Do not stack colors that are close in color value!
Color contrast (value)
Simple Compositions to Follow

- Unidirectional (horizontal)
- Unidirectional (vertical)
- Cyclical
- Z-shaped
- M-shaped
- L-shaped
- Fork-shaped (horizontal)
- Fork-shaped (vertical)
Differences in Gut Microbiota

SPS

Stress Resilient

Anti-inflammatory phenotype:
- Microbiota
- Cytokines
- SCFAs
- Epi/Norepinephrine
- ↓ Intestinal & BBB permeability

Stress Vulnerable

Pro-inflammatory phenotype:
- Microbiota
- Cytokines
- SCFAs
- Epi/Norepinephrine
- ↑ Intestinal & BBB permeability
  Inflammation

Exogenous SCFA/Soluble high fibre

Stress resilience
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Figure Makeover!
Endothelial cell
Normal brain cell
EGFR+ tumor cell
Astrocyte
Panitumumab-IRDye800
MRI
NIR
High-grade glioma

EGFR+ tumor cell
Normal brain cell
Astrocyte
Endothelial cell

Zhou Q et al. Theranostics. 2021
Panitumumab-IRDye800 infusion

Control

Panitumumab-IRDye800 (Pan800) binding

High-Grade Glioma

Blood Vessel

Near-infrared (NIR) fluorescent imaging
Magnetic resonance imaging (MRI)

Pan800 binding

Tumor cell
EGFR
Astrocyte
Endothelial cell
RBC
Smooth muscle cell
Endothelial basal lamina
Vascular basal lamina
Glial basal lamina
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Thank you for joining us!

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