

# Advancing Spatial Biology

*Spatial Transcriptomics and ASOC Service Overview*



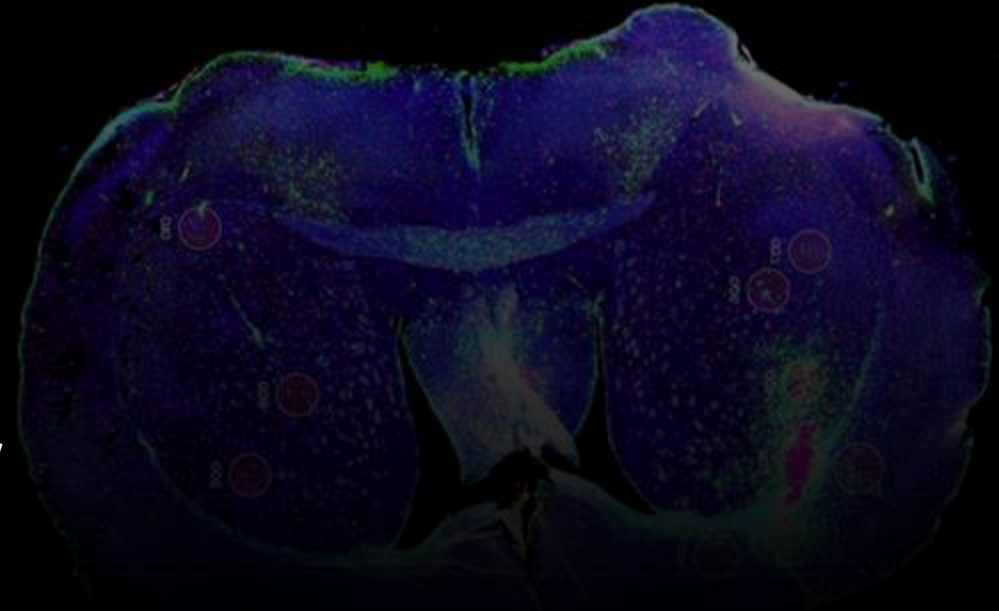
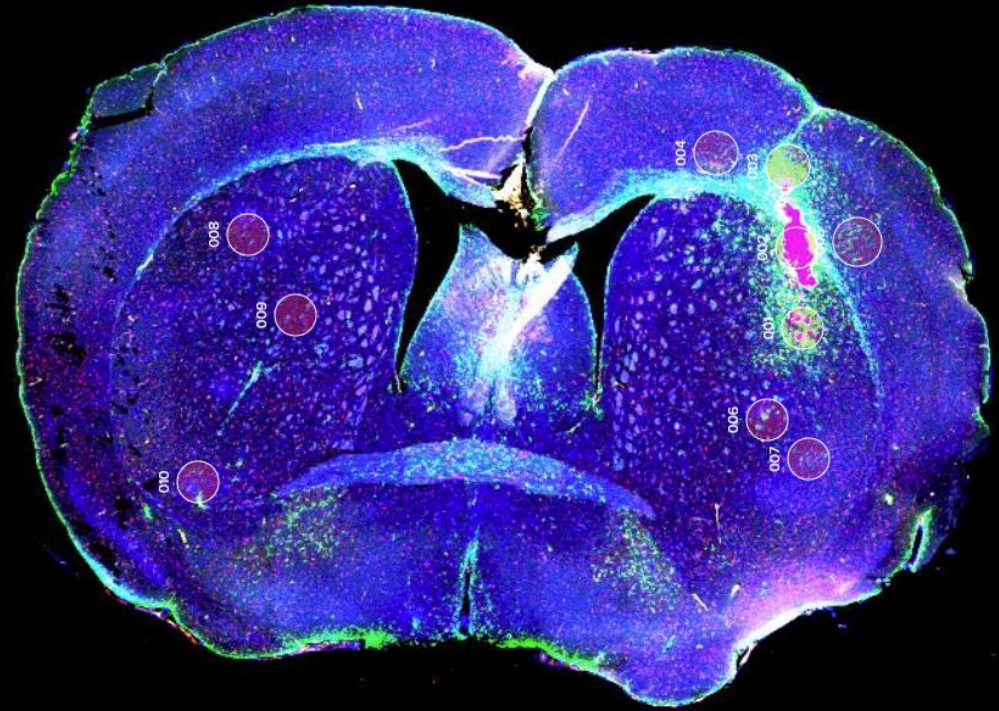
**UNIVERSITY OF  
CALGARY**

**07 NOV 2024, Spatial Omics Seminar**

**Bo Young Ahn, PhD**

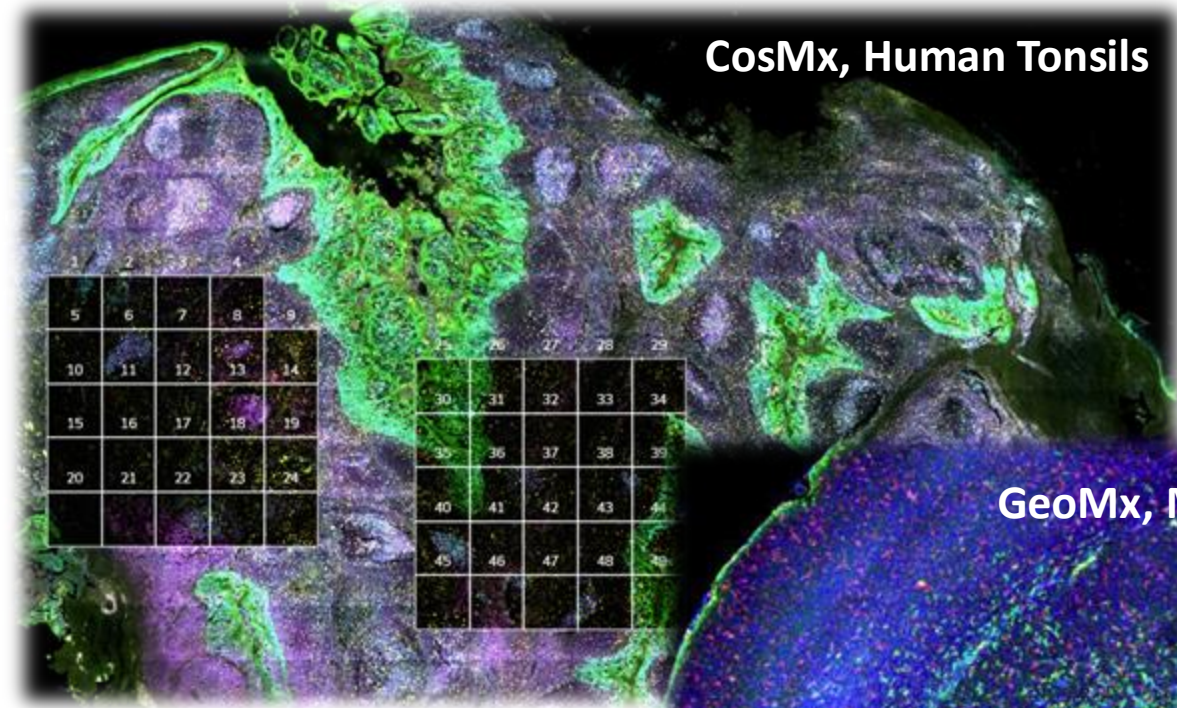
**Applied Spatial Omics Centre (ASOC)**

**Cumming School of Medicine, University of Calgary**

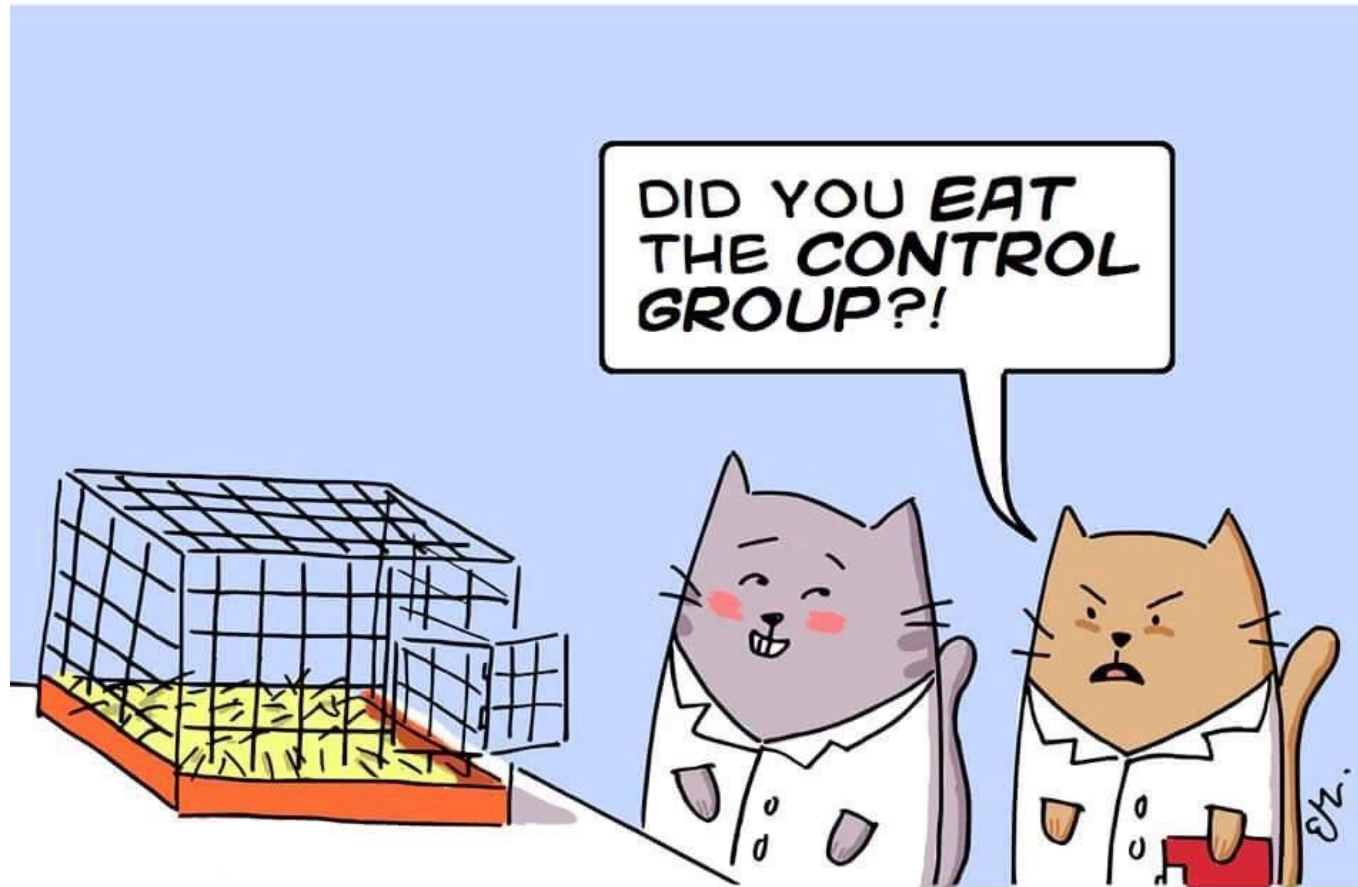


# Agenda

- Who We Are
- How We Help
- Why Work with Us
- What is Spatial Omics
- How it works – *GeoMx project case*



## WHY CATS MAKE BAD SCIENTISTS



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# CAT, *Centre for Advanced Technologies*

- Health Sciences Animal Resources Centre (HSARC)
- Micro CT Laboratory
- Experimental Imaging Centre (EIC)
- Flow Cytometry Facility (FCF)
- Southern Alberta Mass Spectrometry Facility (SAMS)
- Centre for Genome Engineering (CGE)
- Centre for Health Genomics and Informatics (CHGI)
- *Applied Spatial Omics Centre (ASOC)*
- Biomedical Technical Support Centre (BTSC)
- Central Sanitation and Sterilization (CSS)
- Microscopy and Imaging Facility (MIF)



# ASOC, *Applied Spatial Omics Centre*

**ASOC** provides comprehensive services in **histology, spatial transcriptomics, and bioinformatic analysis**, empowering researchers with the tools and expertise needed to drive innovations in biomedical research

## *Our Team member*



**Bo Young Ahn, PhD**  
Senior Spatial Biology Specialist



**Shiying Liu, PhD**  
Cell & Molecular Biology Specialist  
With CGE



**Kim Goring, MSc**  
Histology Specialist



**Heewon Seo, PhD**  
Lead Bioinformatician

# End-to-end Spatial Omics Service

## Project Initiation & Experimental Design



- Project Review and Platform & Service Overview
- Comprehensive RNA & DNA Purification for Genomic Research
- Core Histology Services for Spatial Transcriptomics
- Hands-On Histology Training for Trainees – *Launching Soon!*

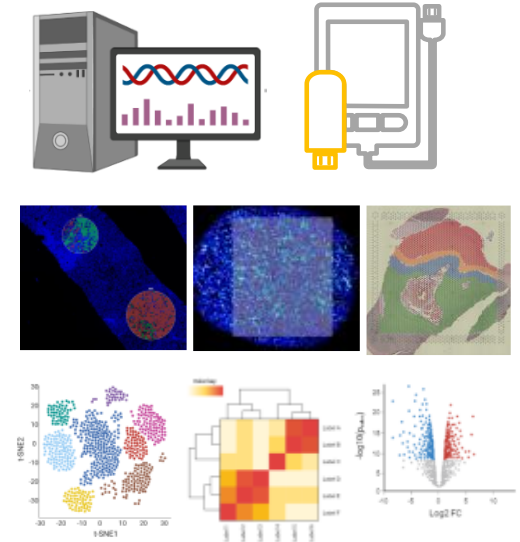
## Quality Control Test & Histology Service



## Spatial analysis platform Run & Read out



## DATA Processing & Analysis



- Custom Bioinformatics Analysis Services
- One-on-One Workshops in Spatial Data Analysis

# Obstacles of Spatial Omics Analysis for individual lab

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- High cost, expertise, and/or need for specialized equipment



- A wide range of technologies to choose from  
in situ hybridization, in situ sequencing, and in situ capturing technologies *etc*



- Tissue of interest may require additional optimization



# Why Work with Us

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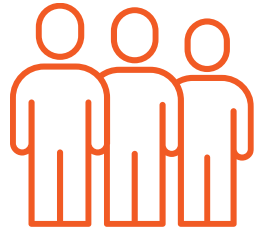
## ***Affordable***

- Services at cost, non-profit
- Centralization ensures top-tier equipment access



## ***Expertise***

- Specialized team dedicated to research support
- Seasoned staff with continuous, open communication channels
- End-to-end service



## ***Adaptable***

- Customizable options and rates
- Diverse services for all tech needs
- Open to faculty and external clients



Free consultation!!

<https://asoc.ucalgary.ca/>

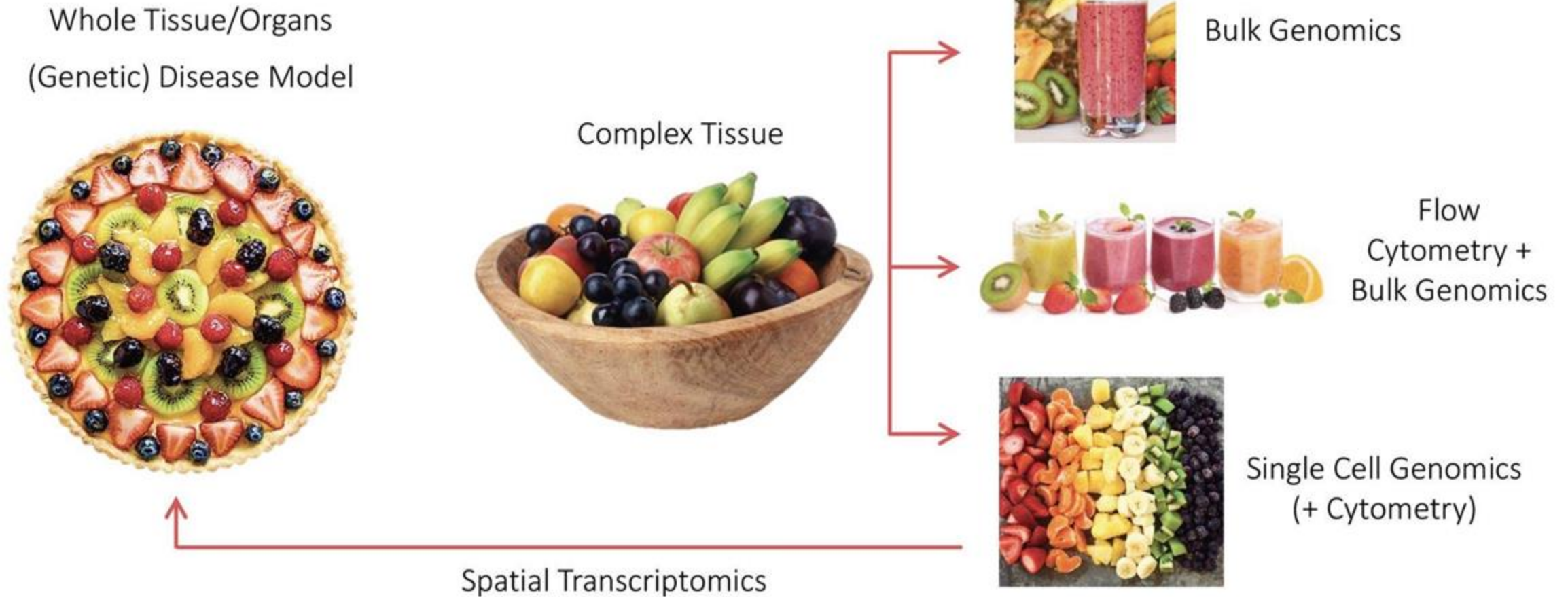
[ASOC@ucalgry.ca](mailto:ASOC@ucalgry.ca)

# What is Spatial Omics?

- Spatial Omics includes:
  - Spatial Transcriptomics
  - Spatial Proteomics
- Spatial Omics is an overarching term for all methods that assign **transcriptomics/proteomics data to the original location within the tissue.**

# Spatial Transcriptomics in Layman's Term

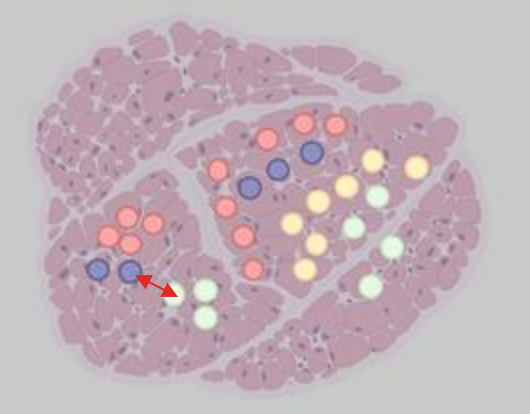
*Genomics Research is Evolving from Bulk to Single Cell to Spatial*



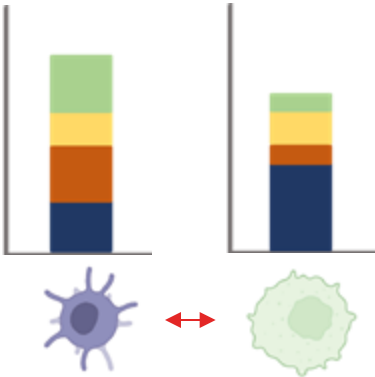
<https://twitter.com/LGMartelotto/status/1186745128615985152>

# Advances in Spatial Transcriptomics

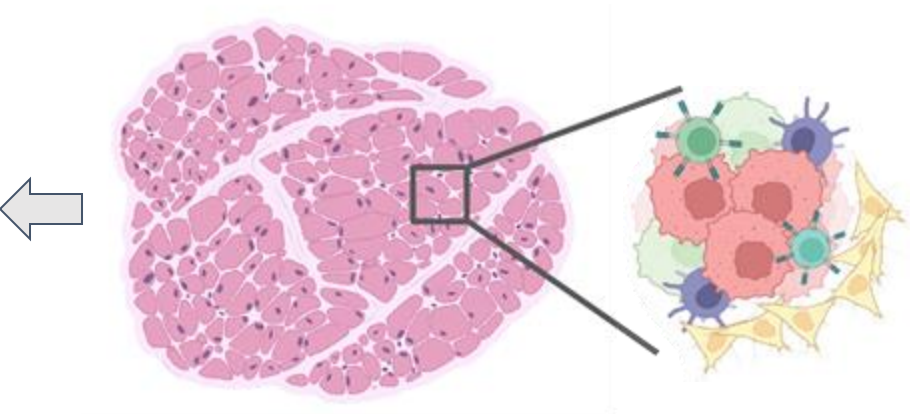
## Spatial Transcriptomics



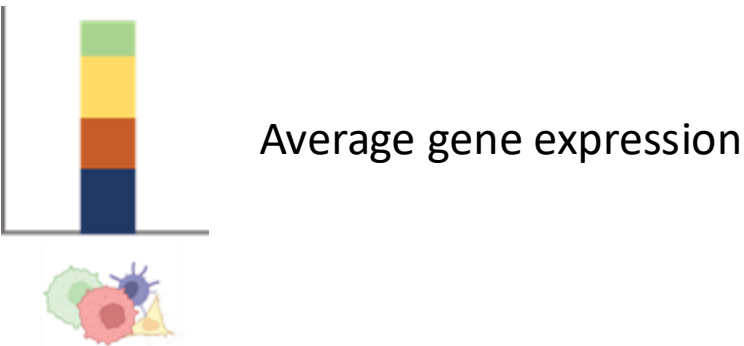
Map the locations of cell types across a tissue



Cell-cell interaction

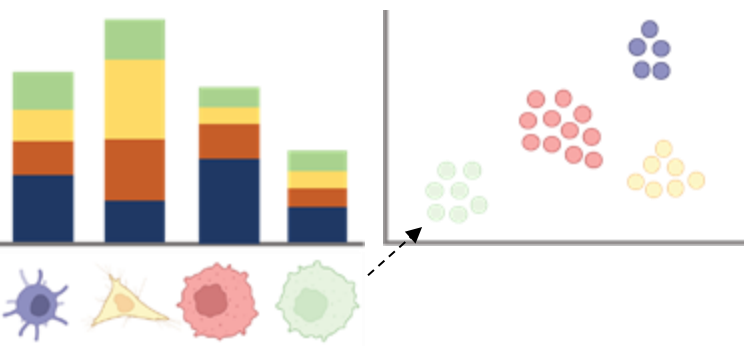


## Bulk Genomics



Average gene expression

## Single-cell Genomics



Cell-type gene expression

Cell-type clusters

| Property  | Bulk | Single-cell | Spatial |
|-----------|------|-------------|---------|
| Cell-type | X    | O           | O       |
| Location  | X    | X           | O       |

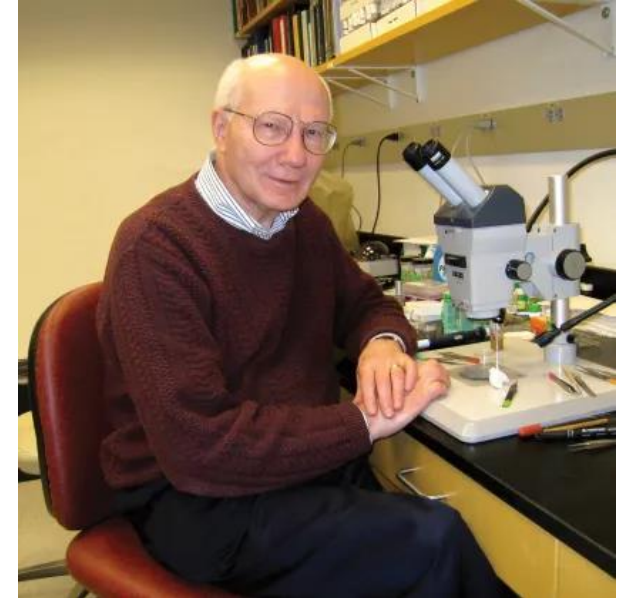
# History of Spatial Transcriptomics

- ***Spatial transcriptomics isn't brand new;***

It began in the 1970s but could only handle one gene at a time.

Dr. Gall lab reported a DNA-DNA hybridization method (*in situ* hybridization) using radioactive labeling for detecting the cellular localization of DNA sequences (*PNAS* 1969).

- The recent rise in spatial transcriptomics comes from the ability to measure hundreds, thousands, or even **whole transcriptome at once!**



Joseph G Gall (1928 – Sept 12, 2024)

# Four Main Key Spatial Transcriptomics Technologies

## Imaging-based method:

Fluorescence in situ hybridization -

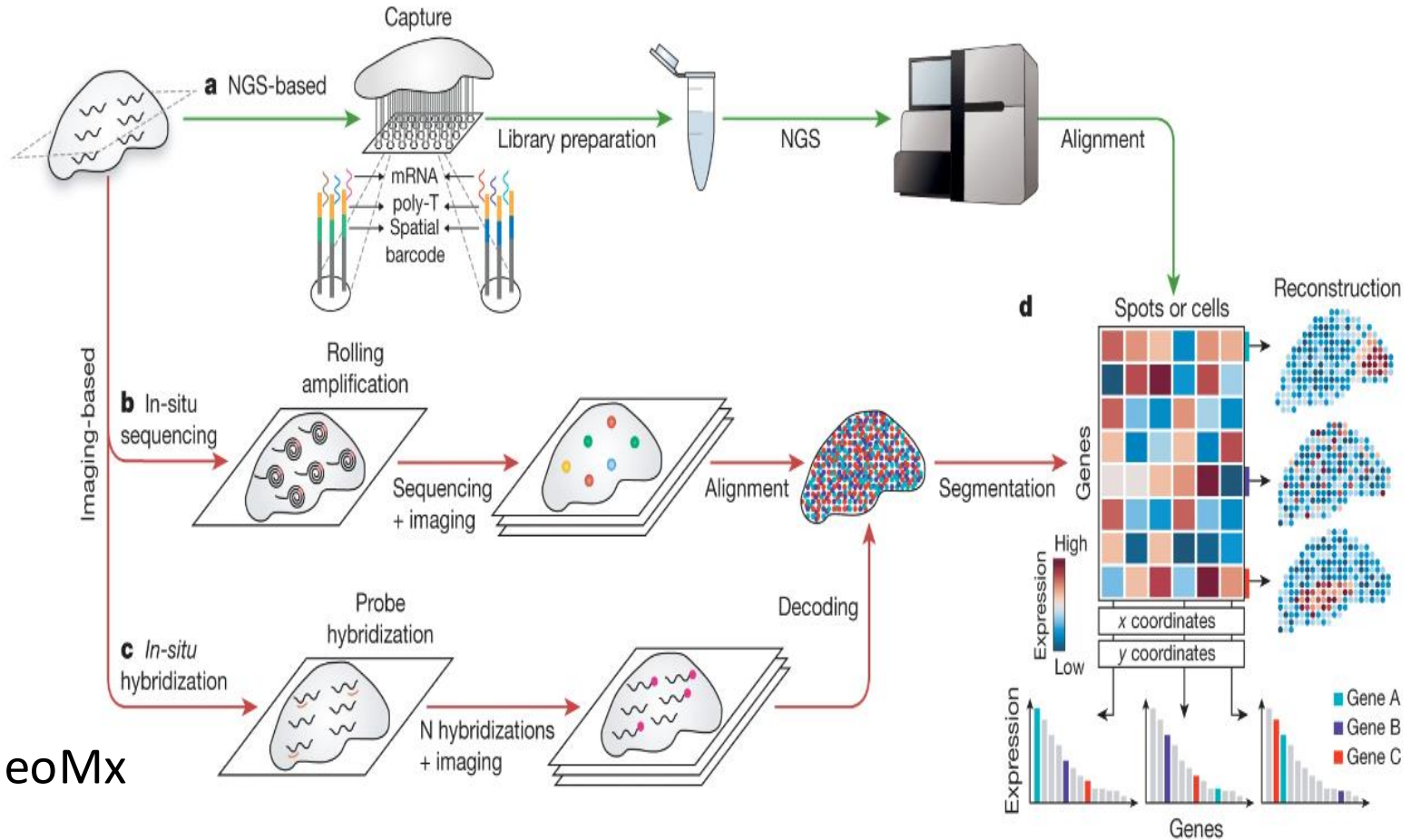
ex, MERFISH, CosMx

*in situ* sequencing – ex, Xenium

## Sequencing-based method:

*in situ* capture – ex, Visium

Region of interest (ROI)-based – ex, GeoMx



Rao et al., Nature (2021)

# How to Choose the Right Spatial Transcriptomics Platform

**What is the goal of the spatial experiment?**

1. What species are the samples from?
2. How are the tissue samples prepared?
3. What is the stage of the project?
4. For the experiment, how many control and test samples will be included?
5. How many sections of each sample type can fit onto a slide with the chosen platform

Hypothesis Generating

Profile many genes  
Determine larger area

GeoMx

Hypothesis Validating

Profile fewer genes  
Higher resolution

CosMx

## Project - Drug Repurposing in Breast Mets

*Aim* - Evaluation of Drug X and Z Efficacy in Treating Brain Metastases of Breast Cancer in a Mouse Model and Profiling Immune Response Pre- and Post-Treatment.

-> *Mouse WTA with the immune cell markers*

1. What species are the samples from? **Human tumor xenograft mouse brain**
2. How are the tissue samples prepared? **FFPE**
3. What is the stage of the project? **Hypothesis generating** -> **GeoMx**
4. For the experiment, how many control and test samples will be included?

**Model/Treatment, n=3: drug X, drug Z and control (no treatment)**

5. How many sections of each sample type can fit onto a slide with the chosen platform

**The mouse brains from 3 models would fit onto one GeoMx slide tissue area** -> **GeoMx**

# Why GeoMx - A Cost-Focused Perspective

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**95 AOIs from 32 ROIs -> 95 samples, Total cost - ~ \$8,000** (Bioinformatic analysis costs not included)

## Cost Breakdown for 95 Samples:

- **Spatial Transcriptomics (ST) with GeoMx:** Approximately **\$8,000** for 95 samples, provides spatial resolution within tissue.
- **Bulk RNA Sequencing:** Costs range from \$50 to \$100 per sample, bringing the total for 95 samples to around **\$4,750–\$9,500**, measures average gene expression across tissue without spatial or cell-specific detail.
- **Single-Cell Sequencing:** Generally ranges from \$500 to \$1,000 per sample, totaling approximately **\$47,500–\$95,000** for 95 samples, captures gene expression at single-cell resolution but lacks spatial context.

*Estimated costs for reference only. Actual prices may vary.*

# Acknowledgements

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Dr. Robyn Flynn

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