Single-Cell RNA Sequencing (scRNA-seq) and Spatial Transcriptomics
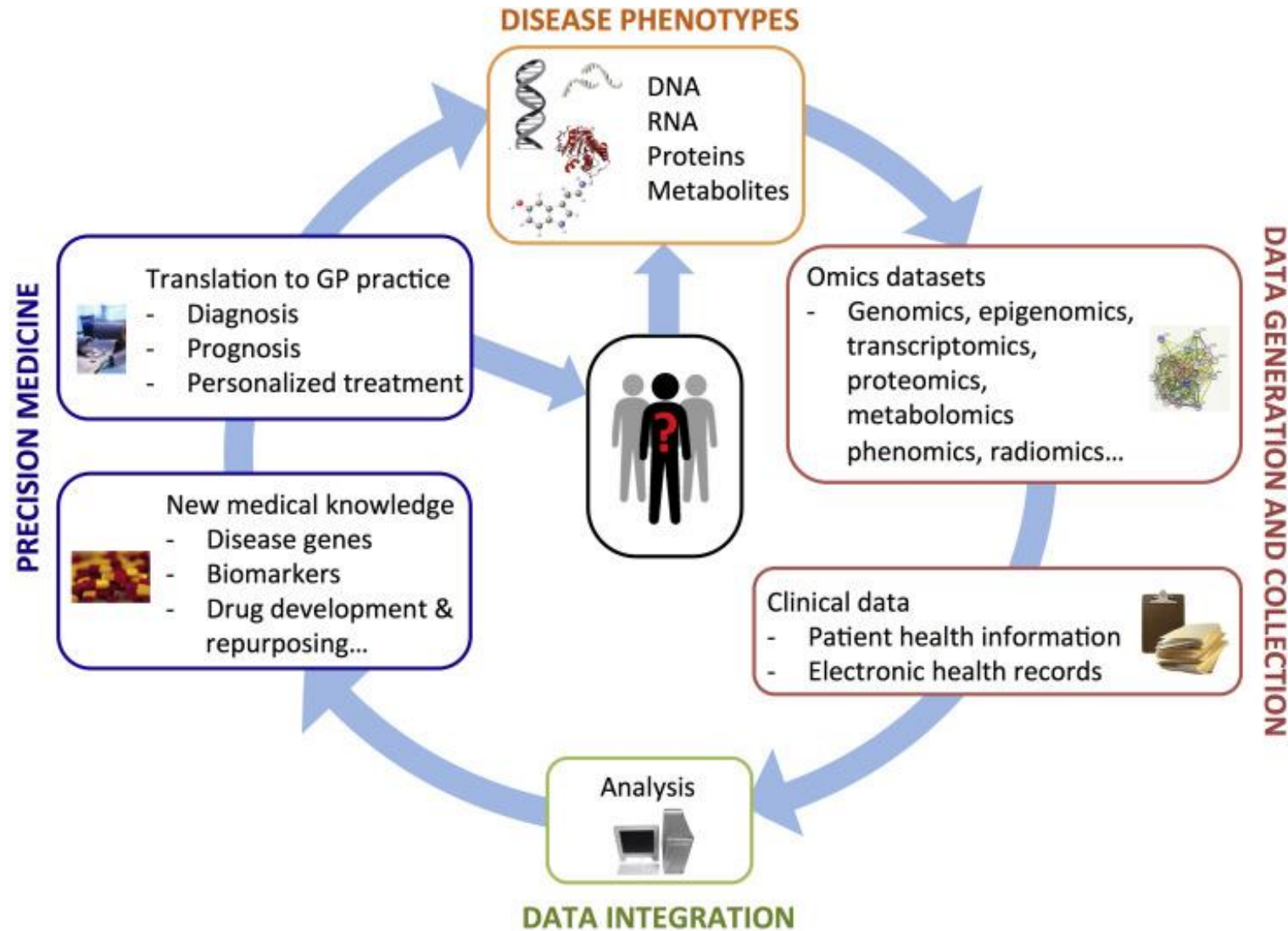
Yi-Kai Hong, Ph.D.
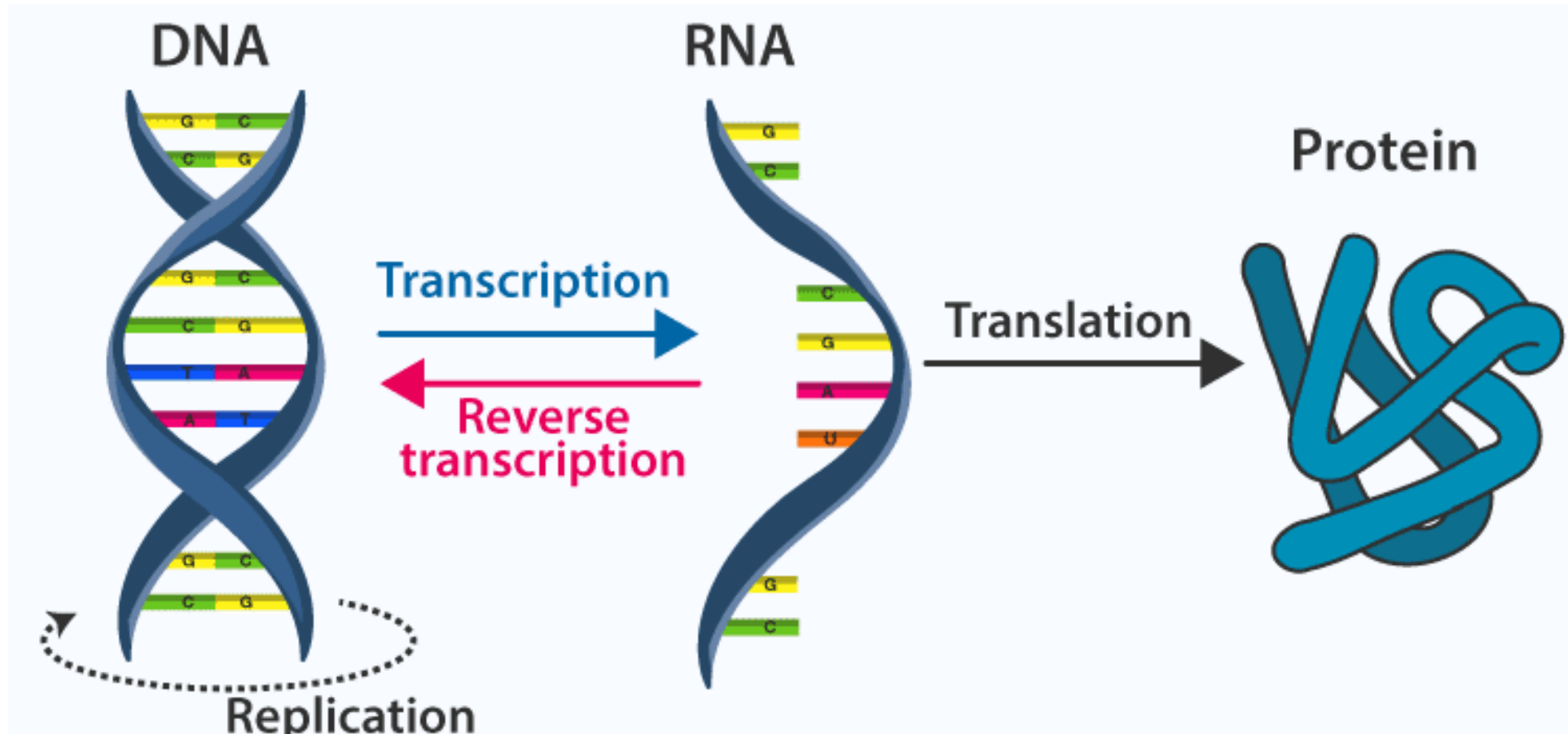
Postdoctoral Fellowship

Department of Dermatology, Feinberg School of Medicine, Northwestern University, Chicago

Feb 12, 2025

Precision medicine

Central Dogma

Sanger sequencing,
Whole exome sequencing,
PacBio or ONT

RNA sequencing,
Single-cell RNA sequencing,
Spatial transcriptomics,
GeoMx Digital Spatial Profiler
PacBio or ONT

Mass spectrometry,
Protein array,
Olink Proteomics
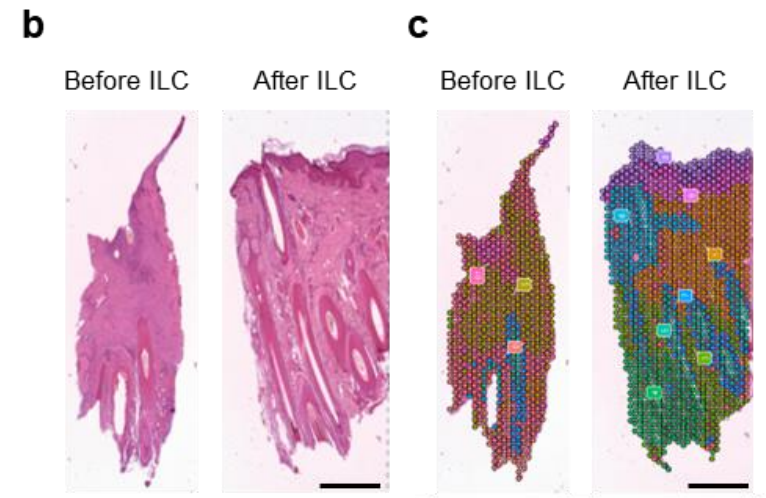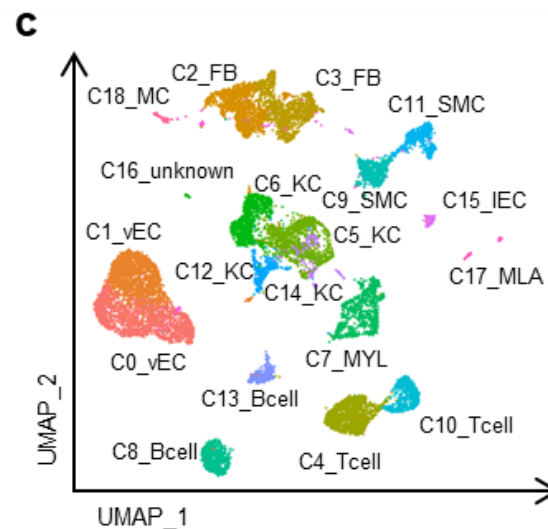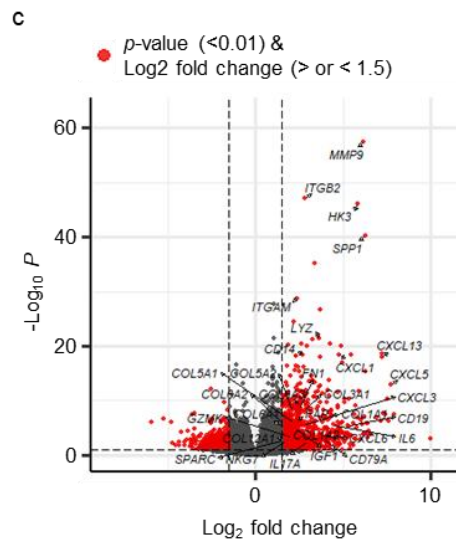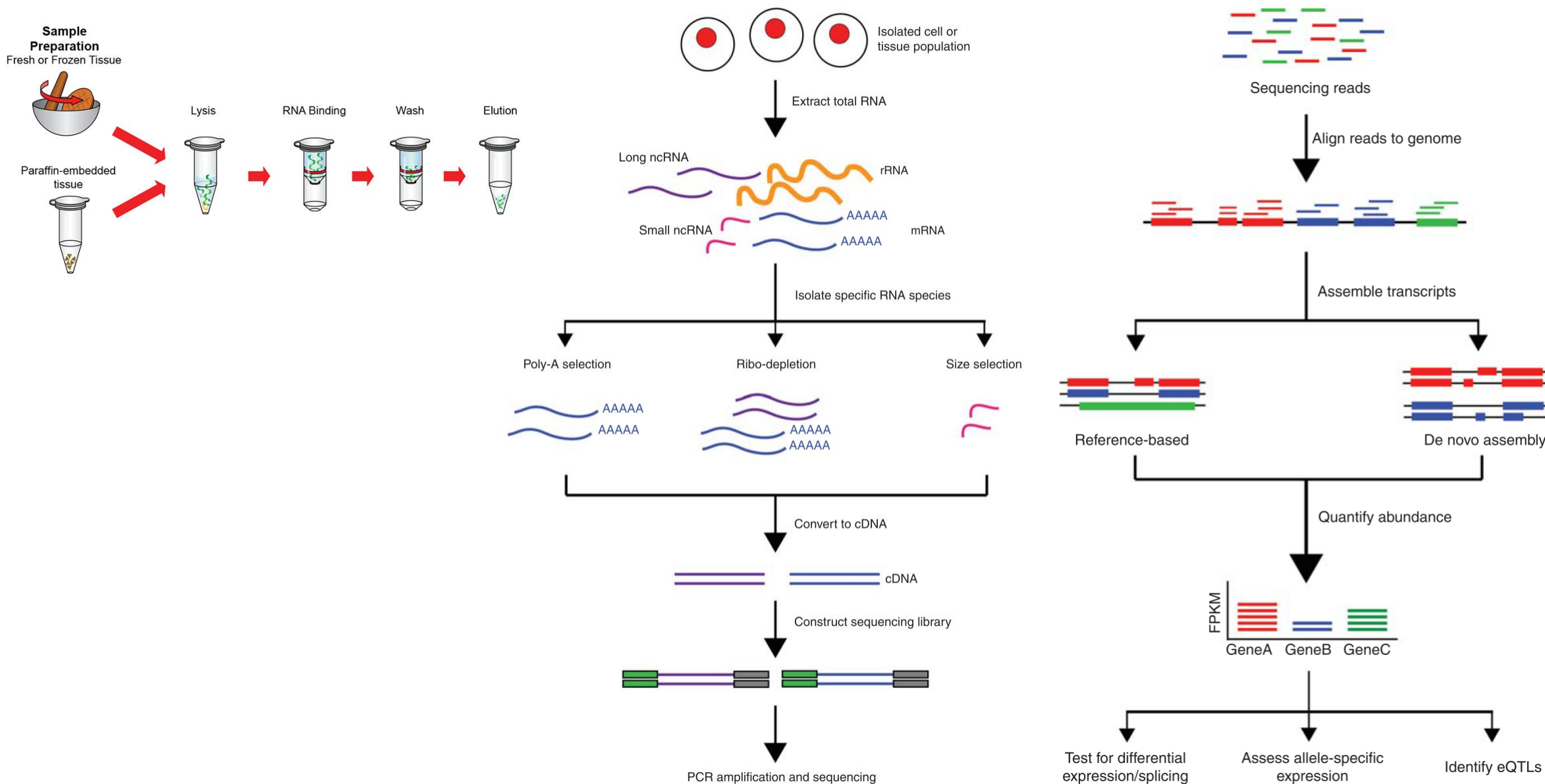
RNA sequencing

Cell = Fruit

Principle of RNA sequencing

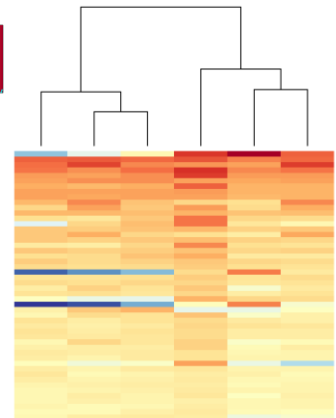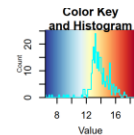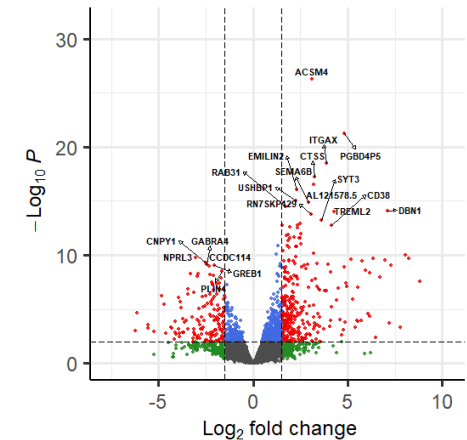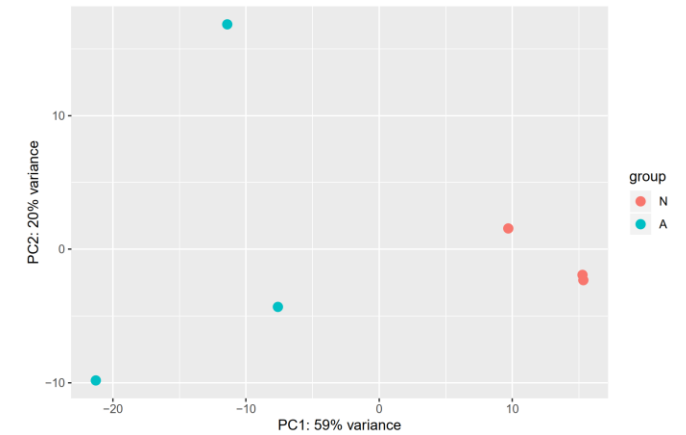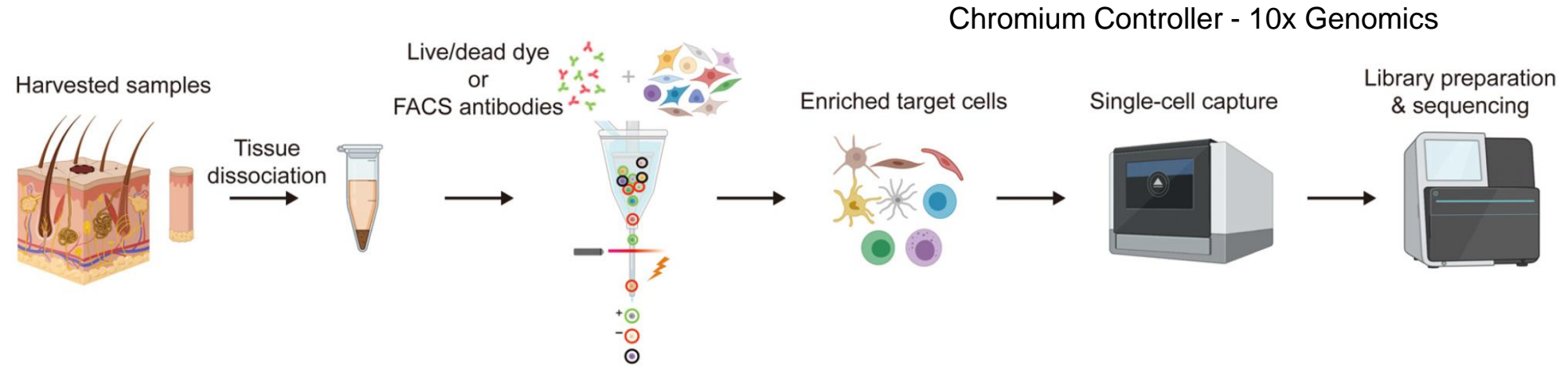# Analysis of RNA sequencing

- Principle Component Analysis (PCA)
- Differential Expressed Genes (DEG)
- Functional analysis (GO, KEGG, Reactome, IPA, GSEA)
- Protein–protein interaction networks
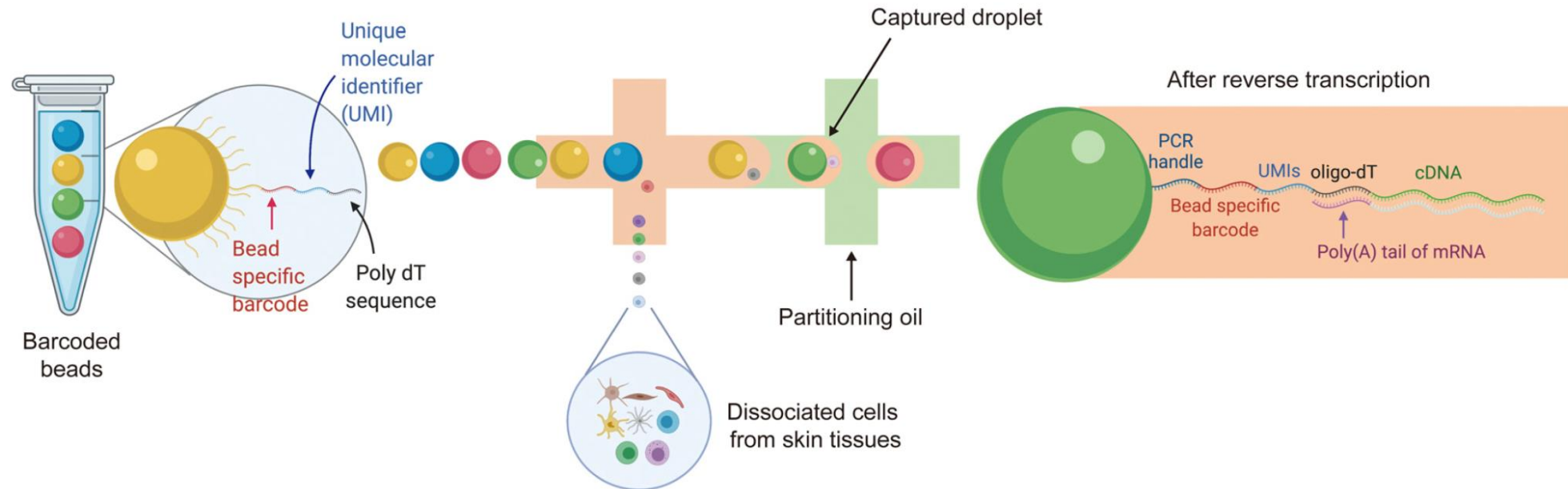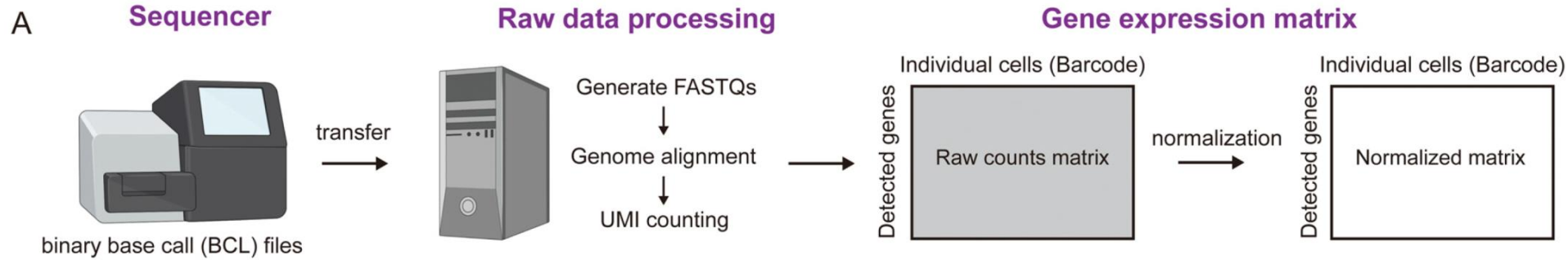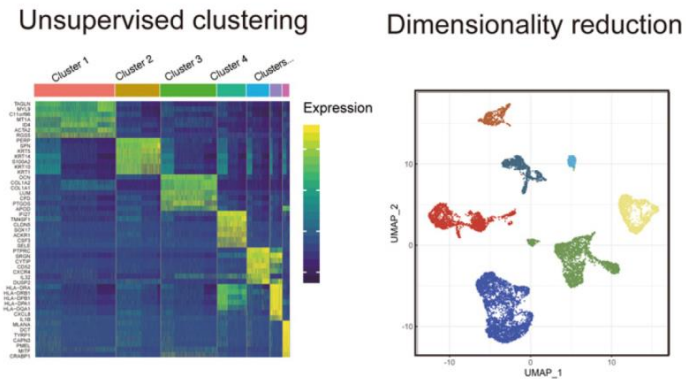- Cell type prediction
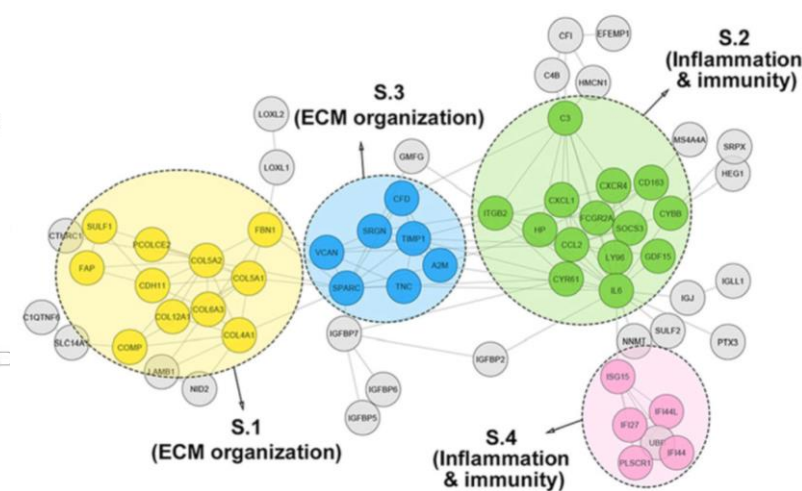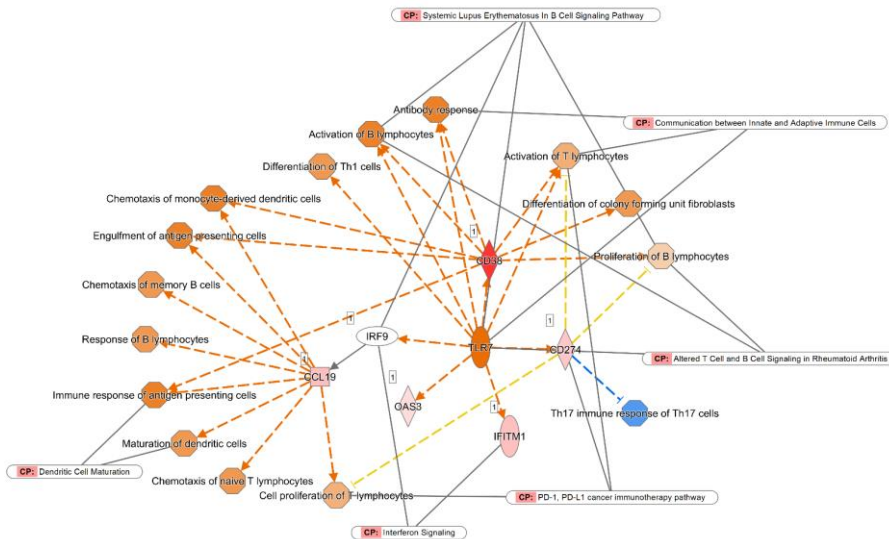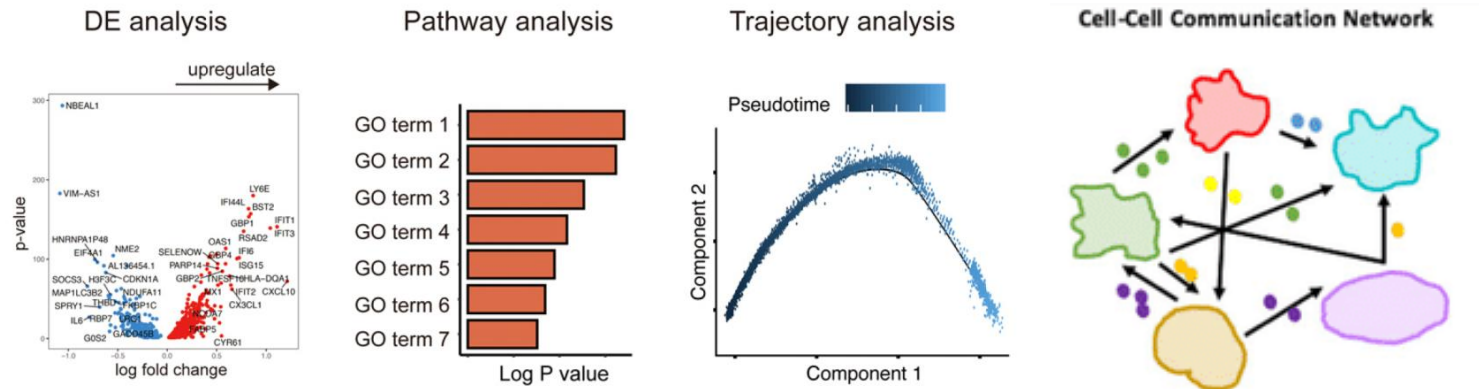
Principle of single cell RNA sequencing

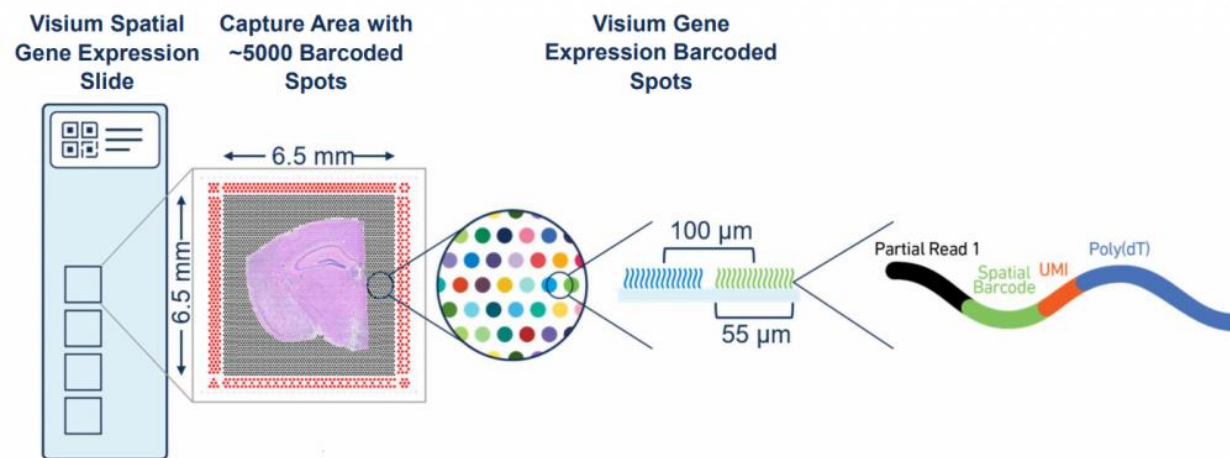11

Analysis of single cell RNA sequencing

Principle of spatial transcriptomics on Visium slide

Visium Spatial Gene Expression
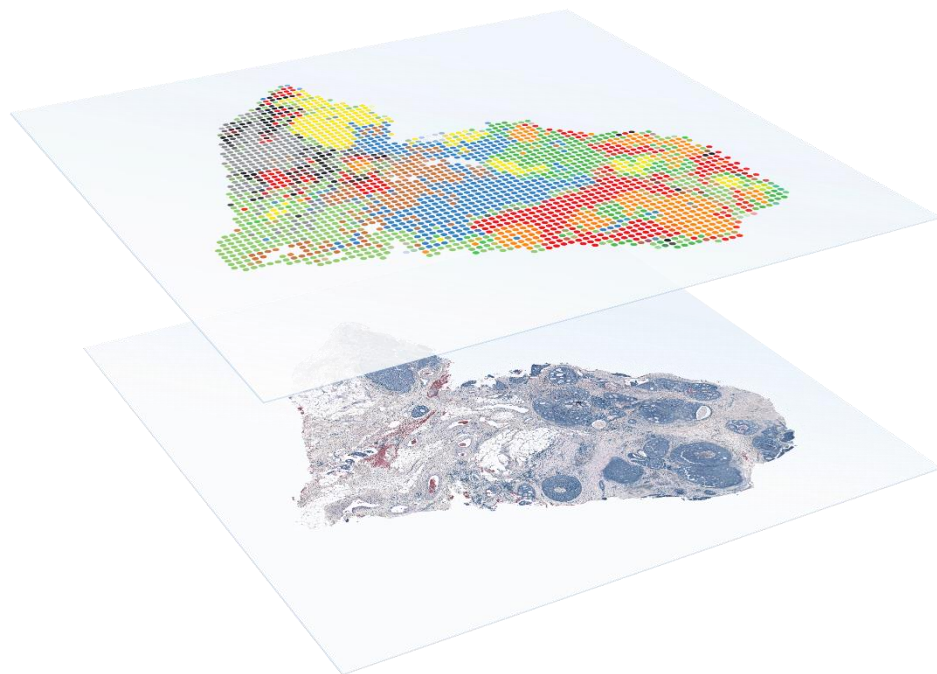
Map the whole transcriptome within the tissue context
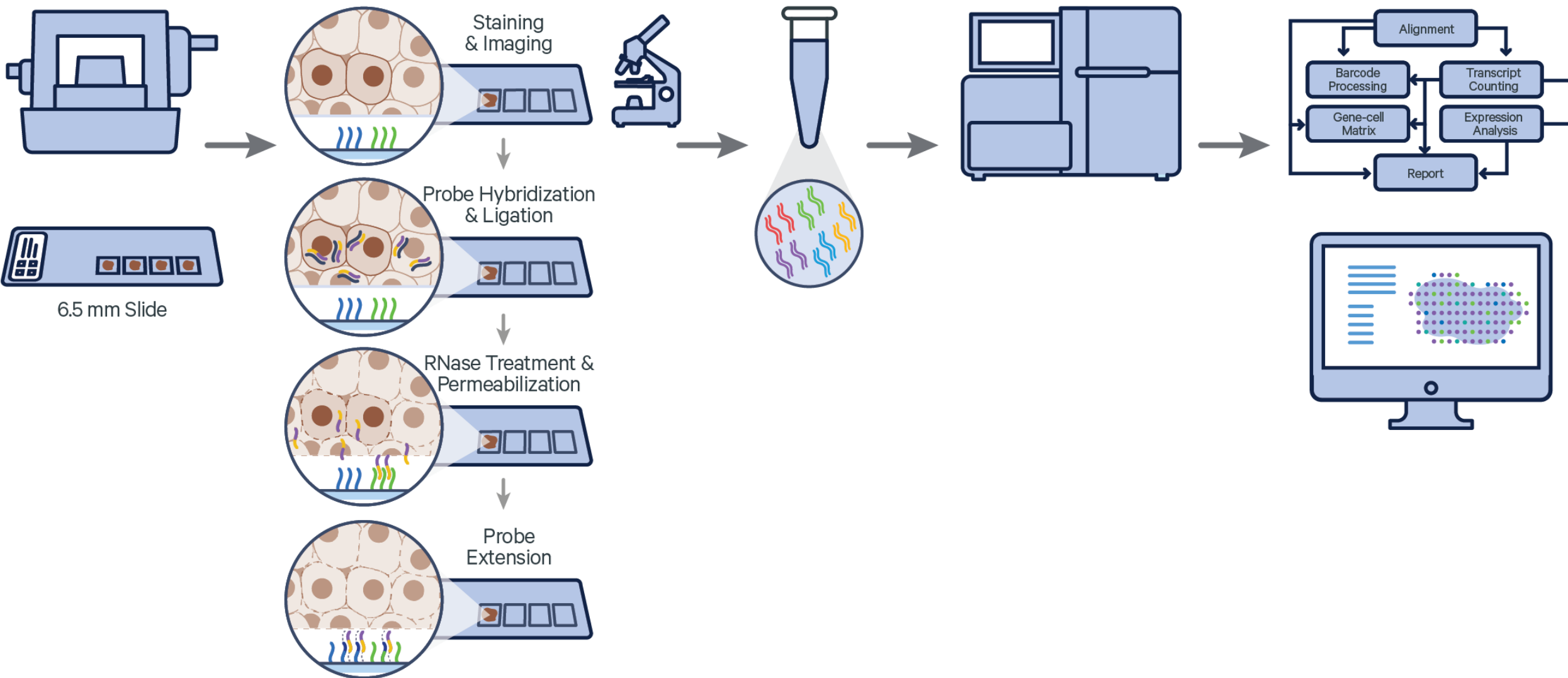
Sample Prep

Hybridization, Ligation & Barcoding

Library Construction

Sequencing

Data Analysis & Visualization

6.5 mm Slide

Staining & Imaging

Probe Hybridization & Ligation

RNase Treatment & Permeabilization

Probe Extension

Alignment

Barcode Processing

Transcript Counting

Gene-cell Matrix

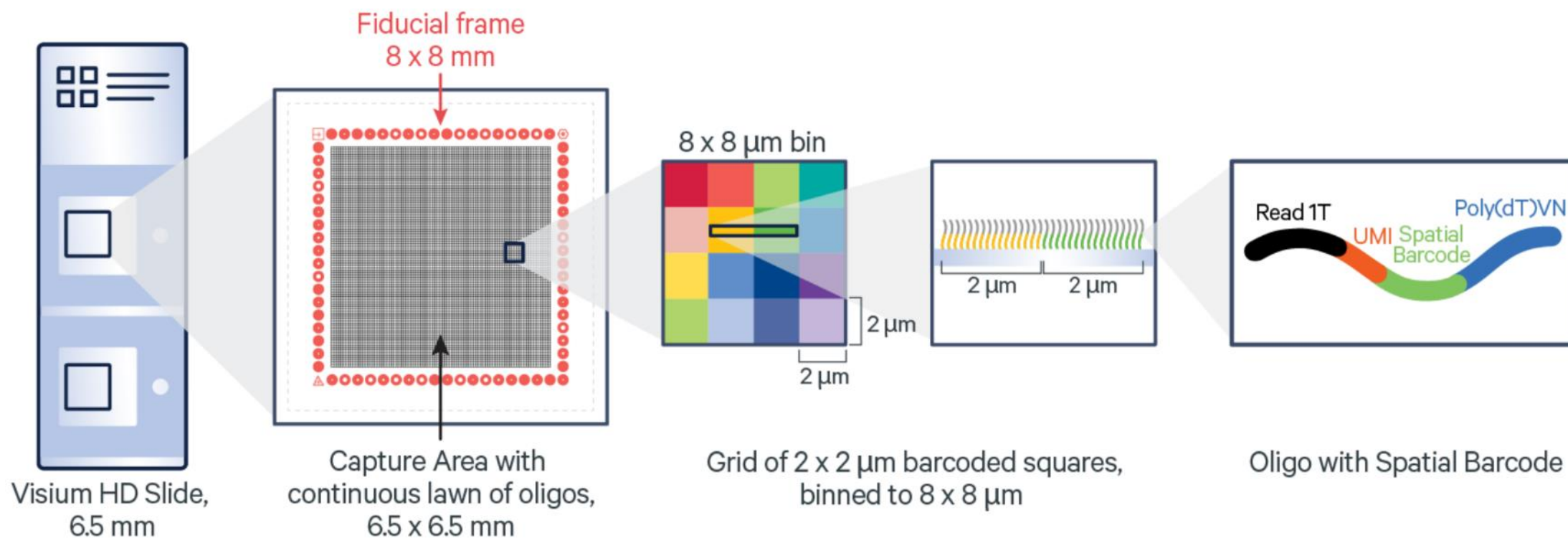Expression Analysis

Report

15

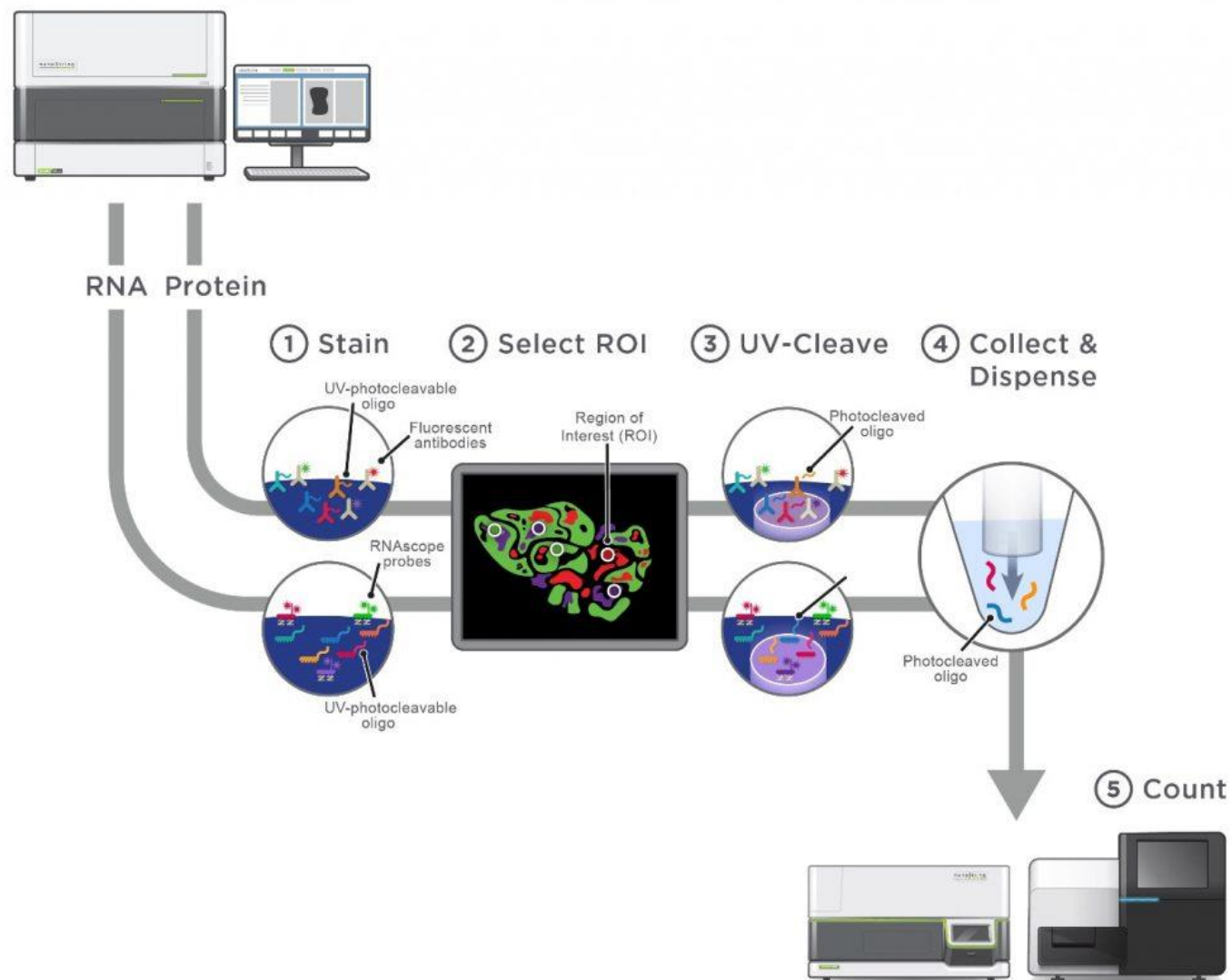# Principle of spatial transcriptomics on Visium HD slide

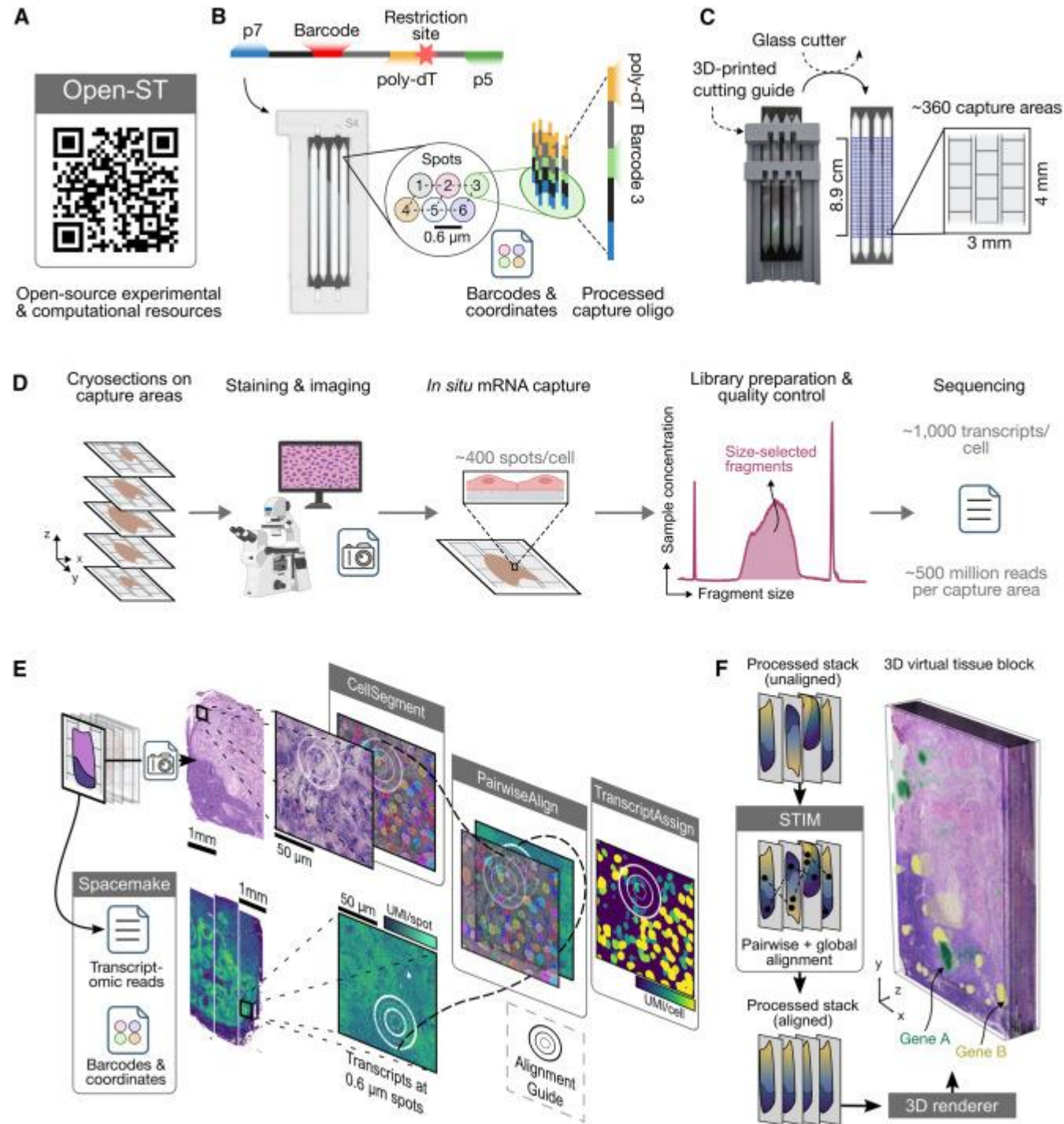The Visium HD CytAssist Spatial Gene Expression Slide

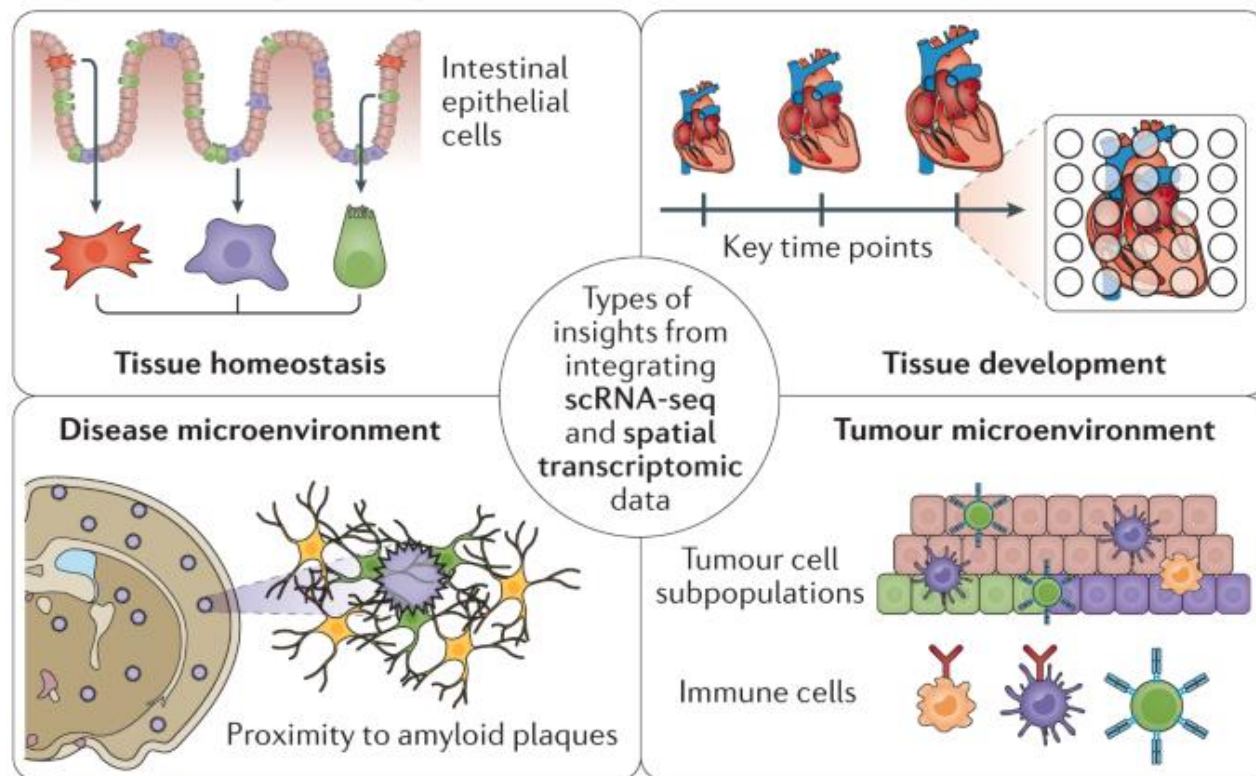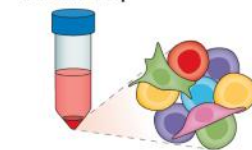2-3 days from tissue sections on slides to sequencing ready libraries

GeoMx DSP

Open-ST

19

Spatial transcriptomics
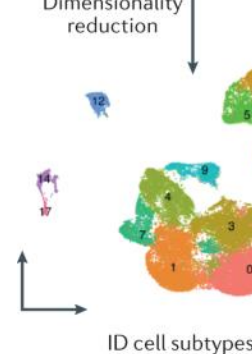

a Spatial transcriptomic experimental focuses

Intestinal epithelial cells

Tissue homeostasis

Key time points

Tissue development

Types of insights from integrating scRNA-seq and spatial transcriptomic data

Disease microenvironment

Proximity to amyloid plaques

Tumour microenvironment

Tumour cell subpopulations

Immune cells

b Identification of cell subpopulations

scRNA-seq

Dimensionality reduction

ID cell subtypes

c Physical localization of cell subpopulations in tissue

Cell-type deconvolution or mapping

Spatial transcriptomics (high-plex RNA imaging or spatial barcoding)
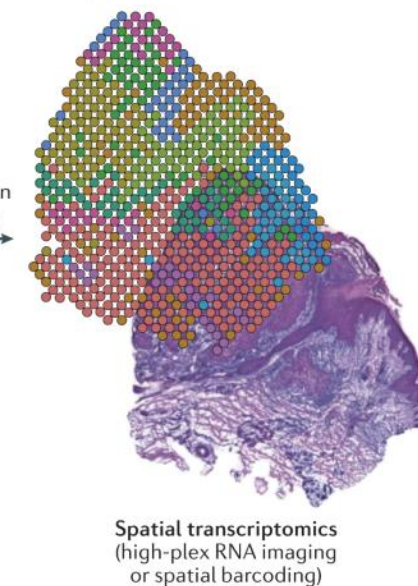
d Decode intercellular communication
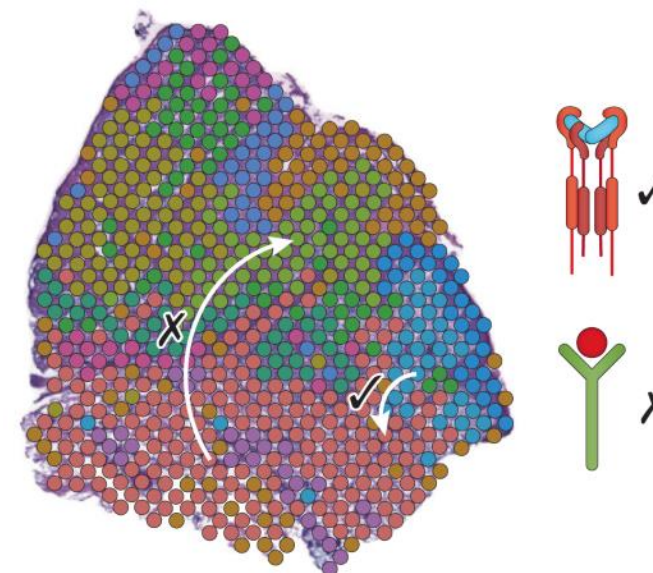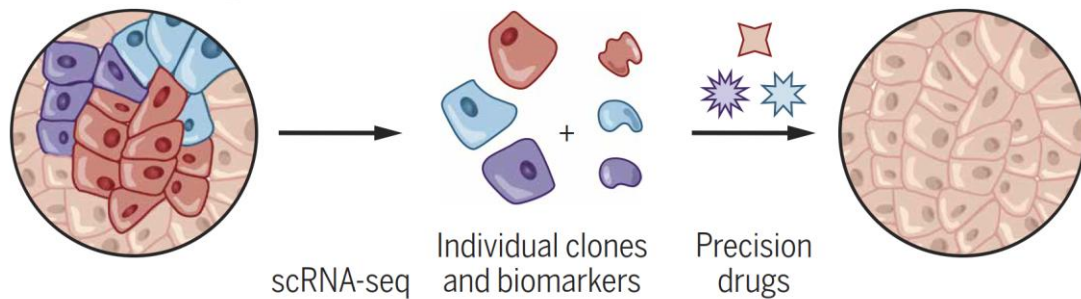
Spatially informed ligand–receptor algorithms
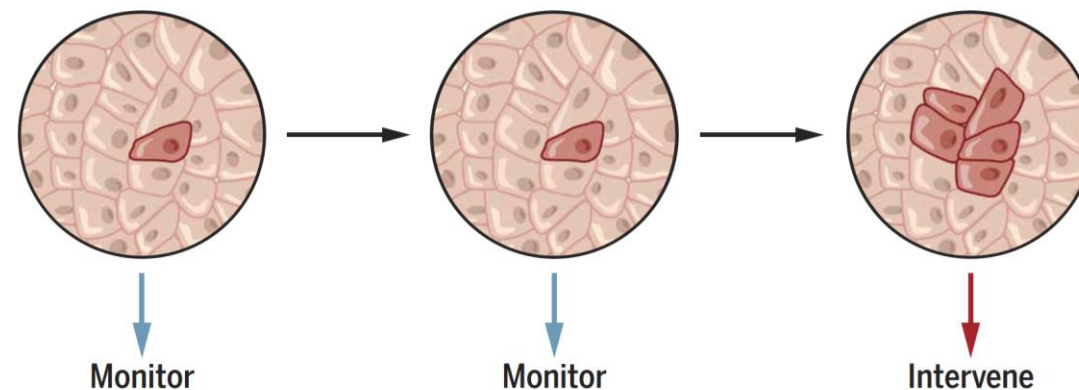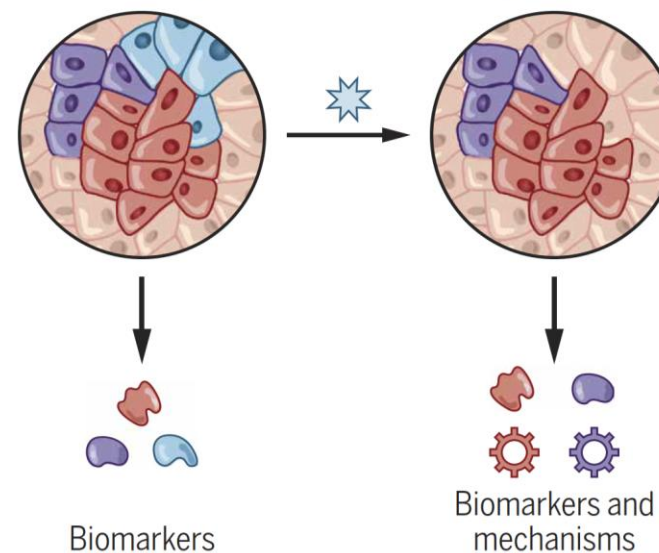
Clinical application
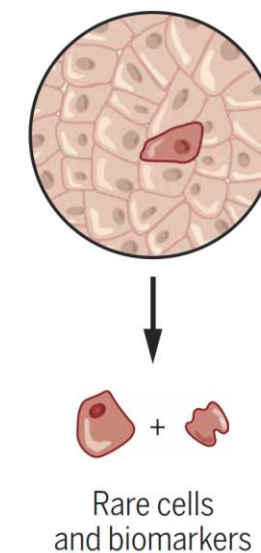
Thank you for your attention

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✉ jack810325@gmail.com