# Hands-On Skeletal Histomorphometry Workshop

Organized by

Skeletal Biology and Biomechanics Core

**at**

**UCSF Core Center for Musculoskeletal Biology and Medicine**

# Skeletal Phenotyping Modalities

1. Micro computed tomography (μCT) → 3D bone structural parameters → quick and initial assessment of bone changes
2. Biomechanical testing → changes in bone strength and material properties
3. Histology (decalcified) → general morphological changes
4. Bone Histomorphometry (calcified) → quantify static and dynamic tissue and cellular changes
5. In situ hybridization (decalcified) → in situ gene expression
6. Immunohistochemistry (decalcified) → in situ protein expression

# Histomorphometry

**Quantitative measurement and characterization of microscopic images by manual or automated digital analysis using a computer to compare selected geometric areas, perimeters, length angle of orientation, and form factors.**

# Bone Histomorphometry

## Lists of Static and Dynamic Parameters

1. **Osteogenic: von Kossa** → total tissue volume (TV), bone volume (BV), Trabecular bone number (Tb.N), Trabecular bone connectivity density (Tb.CD), Trabecular bone thickness (Tb.Th), Trabecular bone spacing (Tb.Sp), and bone fraction (BV/TV).
2. **Mineralizing functions:**

   - **Goldner** → osteoid volume (OV), OV/TV, osteoid surface (OS), OS/BS, mean osteoid thickness (O.Th), ratios of O.Th/Tb.Th, osteoid maturation time (Omt).

   - **Calcein and/or demeclocycline labeling** → mineralizing surface (MS), MS/BS ratio, mineral apposition rate (MAR), and bone formation rate per bone surface (BFR/BS).
3. **Osteoclastogenic: TRAP** → bone erosion surface (ES), ES/BS, OCL number (N.Oc)/ BS, and N.Oc/ES.
4. **Chondrogenic:** von Kossa + Safranin O → total callus volume (TV), BV, Cartilage Volume (CV; stained by red Safranin O), Mineralized Cartilage Volume (MCV; co-stained by black von Kossa and red Safranin O). Bone fractions (BV/TV), total cartilage fractions (CV/TV), and mineralized cartilage fractions (MCV/CV) are derived

# Goals

1. Observe the process: embedding, sectioning, staining, and analysis of the calcified bone samples
2. Hands on the sectioning and image analyses
3. invest in the technique or get help from the Core?

# Instructors

1. Zhiqiang Cheng: “the King”
2. Alfred Li
3. Christian Santa Maria
4. Jenna Hwong