

# Molecular Biology and Applications to Biological Research

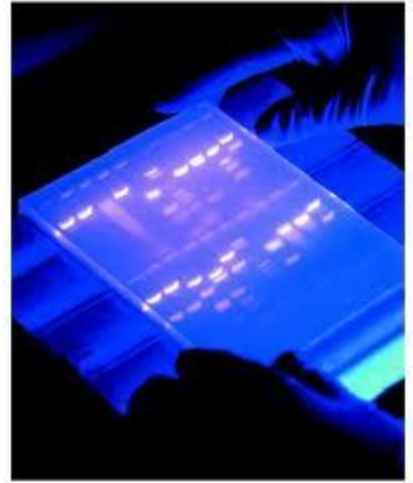
Instructor: Khristian Erich Bauer-Rowe

## Class I: Introduction to Molecular Biology: DNA and RNA

- DNA transcription and replication
  - o Techniques: Gel electrophoresis, DNA sequencing, PCR, Q-PCR
- RNA translation
  - o Techniques: RT-PCR, *in situ* hybridization

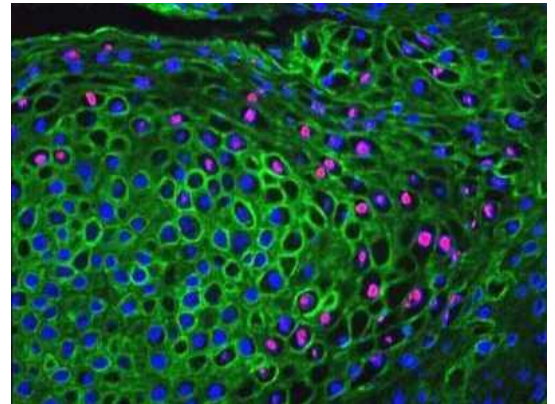
## Class II: Gene Regulation I: DNA

- Transcription factors
  - o Of special interest: Zinc Finger Proteins
- Activators and Repressors
  - o Of special interest: The lac operon
  - o Techniques: Cre-lox recombination (Tamoxifen-induced)
- Epigenetics
  - o Chromatin regulation: Methylation and demethylation
    - Of special interest: Temozolomide and glioblastoma



## Class III: Gene Regulation II: RNA

- RNA splicing
  - o Of special interest: RNase P and tRNA
  - o Of special interest: RNA world hypothesis
- RNAi and mRNA degradation
  - o Techniques: : RNAi knockdown



## Class IV: Proteins: Signaling, Modifications, and Experimentation

- Post-translational modifications
  - o Of special interest: phosphorylation
- Signaling sequences and destinations
- Techniques: Western Blot, Fluorophores, GFP fusion proteins, epitope tags, immunohistochemistry, immunoprecipitation, ChIP

## Class V: Viruses

- Viruses
  - o Structure and reproduction
  - o Techniques: Transfection
  - o Of special interest: epidemics and pandemics
  - o Of special interest: gene therapy

## Class VI: Cell Cycle Regulation

- Checkpoints
- MPF cyclin interactions
- Techniques: arresting and promoting the cell cycle

## Class VII: Cancer Pathways

- The six hallmarks of cancer
  - o Of special interest: cell immortalization
  - o Of special interest: Gleevec and Leukemia

## Class VIII: Stem Cells (with a focus on cancer stem cells)

- Three properties of stem cells
- Embryonic vs Adult stem cells
- Stem cell theory of cancer
  - o Of special interest: mTOR pathway in ISCs
- Synthetic biology – programming cells

