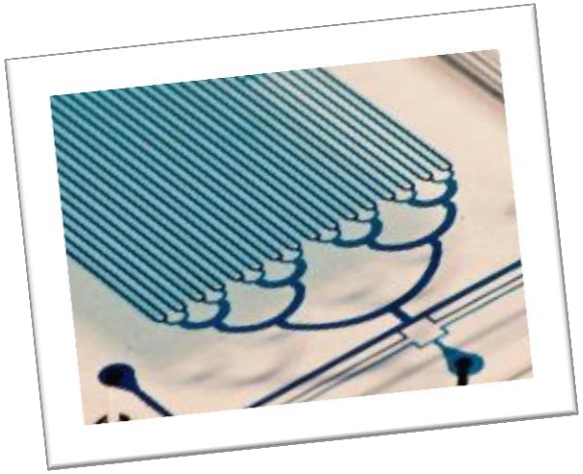
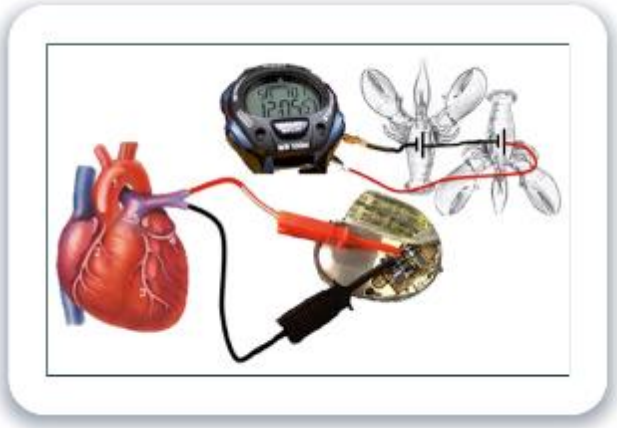
Santa Clara University

School of Engineering

Department of Bioengineering

http://www.scu.edu/engineering/bioengineering/index.cfm





Agenda

An introduction (30 min)

Group Activities (90 min)

- ❑ ***Group I Innovation (30 min)***
- ❑ ***Group II Cell Imaging (30 min)***
- ❑ ***Group III Manufacturing (30 min)***

What is Bioengineering?

Definition from NIH

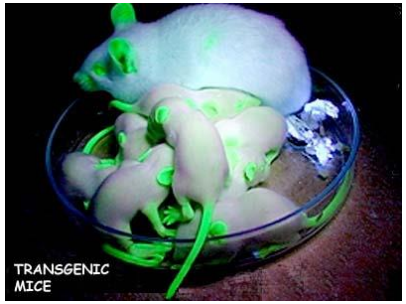
- Integrates physical, chemical, mathematical, computational sciences and engineering principles to study biology, medicine, behavior, and health
- Advances fundamental concepts and creates knowledge from the *molecular* to the *organ systems* levels
- Develops innovative biologics, materials, processes, implants, devices, and informatics approaches for the prevention, diagnosis and treatment of disease, for patient rehabilitation, and for improving health

Bioengineering

Bioengineering is the fastest growing segment of engineering today and holds the promise of improving the lives of all people in very direct and diverse ways.

Bioengineering Is Changing Our World

Transgenic Pet!



Source: A glowing kitten stands next to a normal cat (Mayo Clinic)

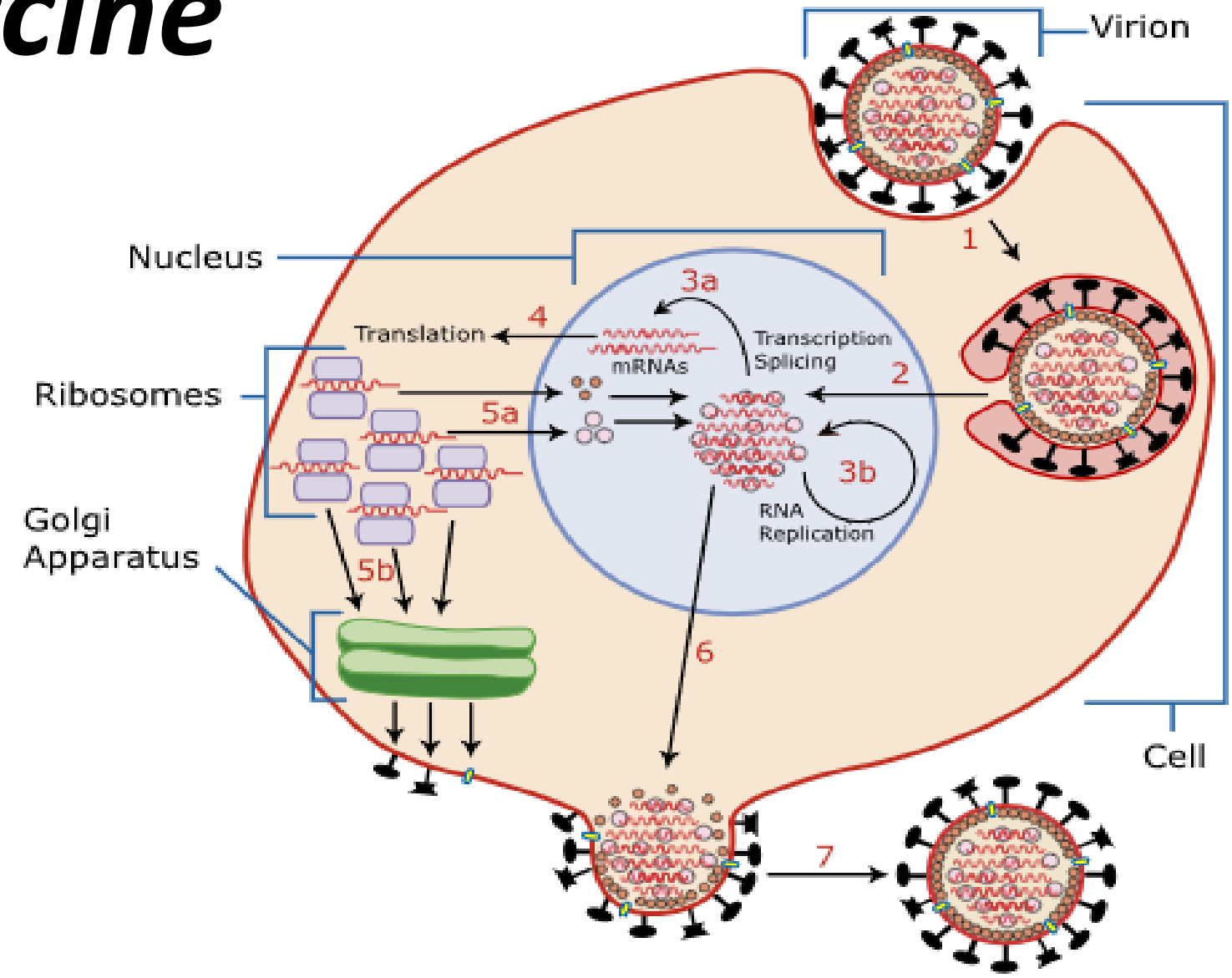
Source: Neitz Laboratory

Dalton, a squirrel monkey treated with gene therapy, enjoys his new **color sense**

Bioengineering saves lives!

Emma lives a normal life, owning to a new ***Gene & Cell therapy***

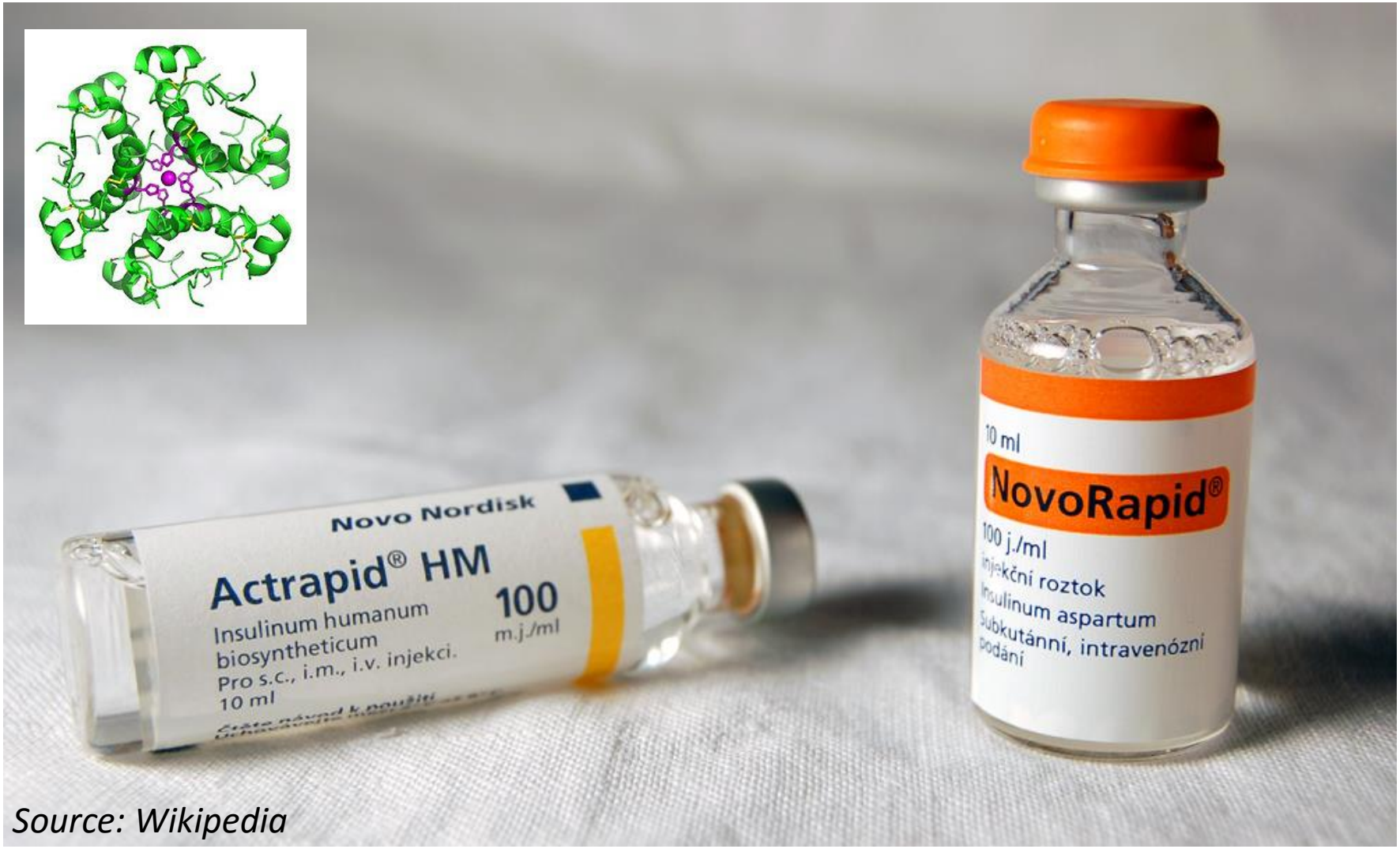
Vaccine



Source: Wikipedia

Medicine

Human Insulin



Source: Wikipedia

Diversity in Bioengineering

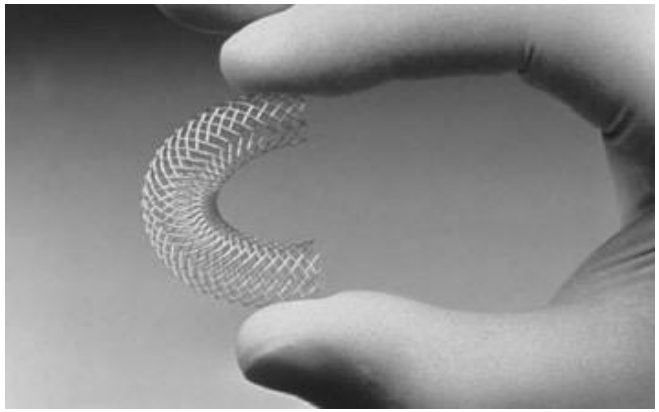
- Bio-Imaging Engineer
- Validation Engineer
- Vaccine Development Scientist
- Manufacturing Development Engineer
- Regulatory Affair Specialist
- Biostatistician
- Bioinformatics programmer
- Stent Engineer
- Fermentation Engineer
- Biomedical Engineer
- Membrane Scientist
- Bio-MEMS researcher
- Environmental Bio-safety Engineer
- Automation Engineer
- Tissue Engineer
- Formulation Scientist
- Medical Doctor
- And many others……..

Projected Biotechnology Jobs 2012-2020

Source: Employment Development Department, California

Commonly encountered bioengineering technologies and recent advances

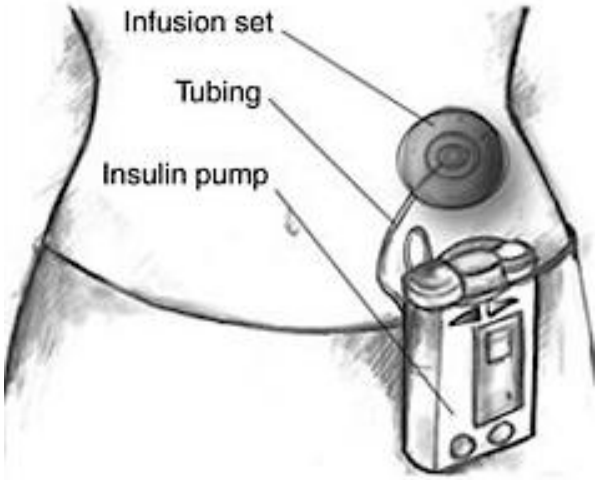
Medical devices and implants



Source: VIR Chicago

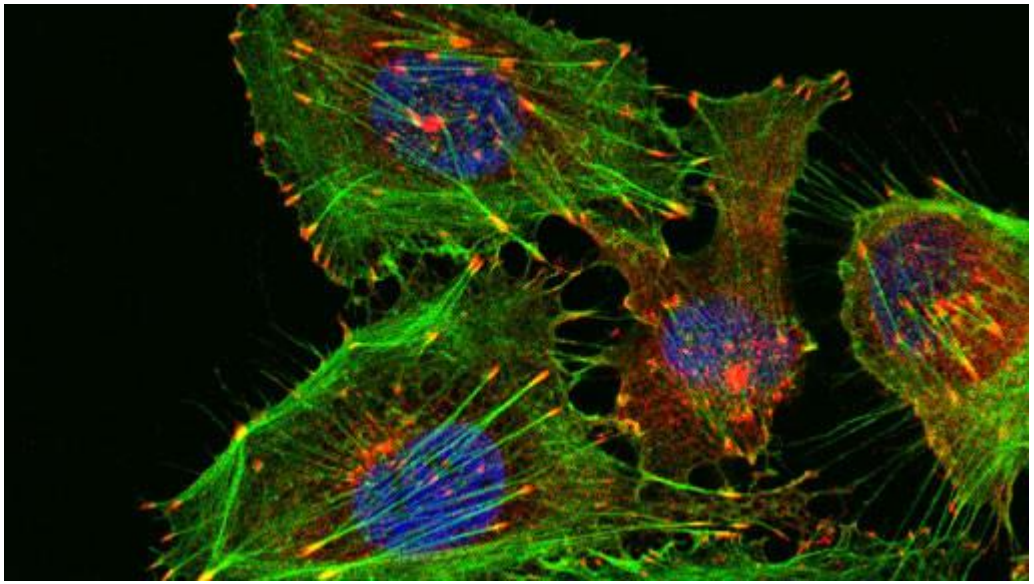
Source: Medtronic

Source: Wikipedia

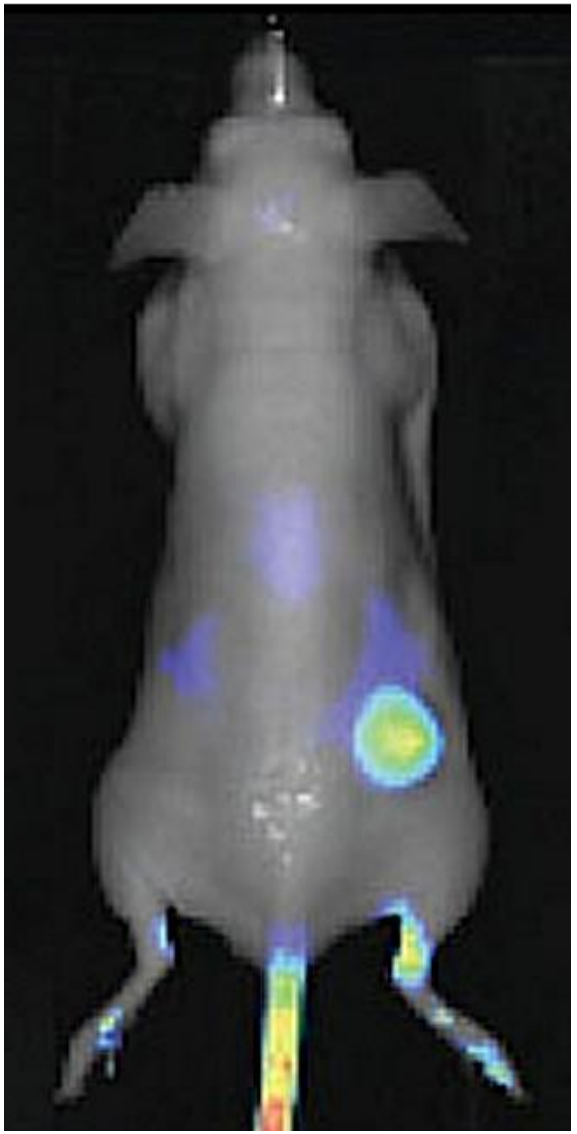


Source: NIH NIDDK

Biomedical imaging

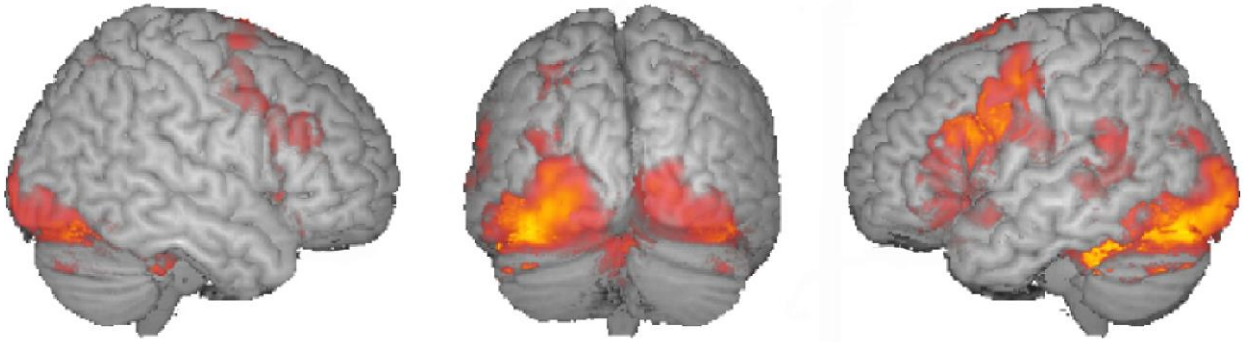


Source: www.innomol.eu

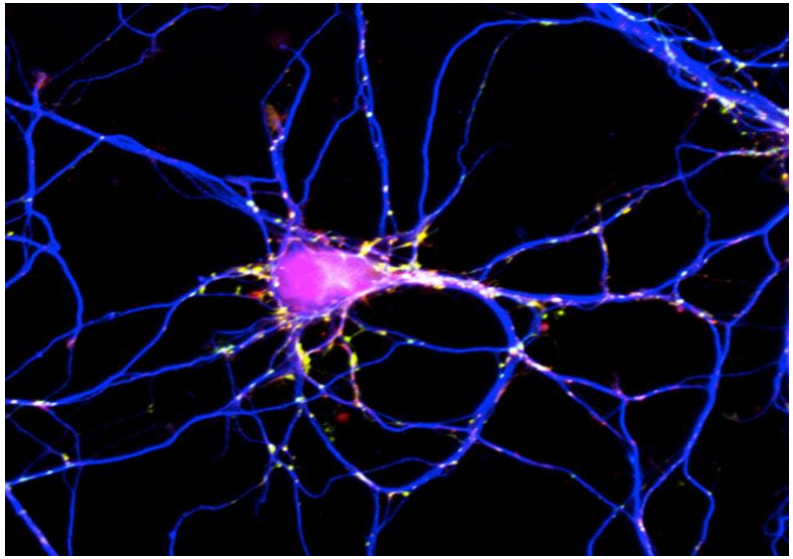


Source: LI-COR Biosciences

Biomedical imaging

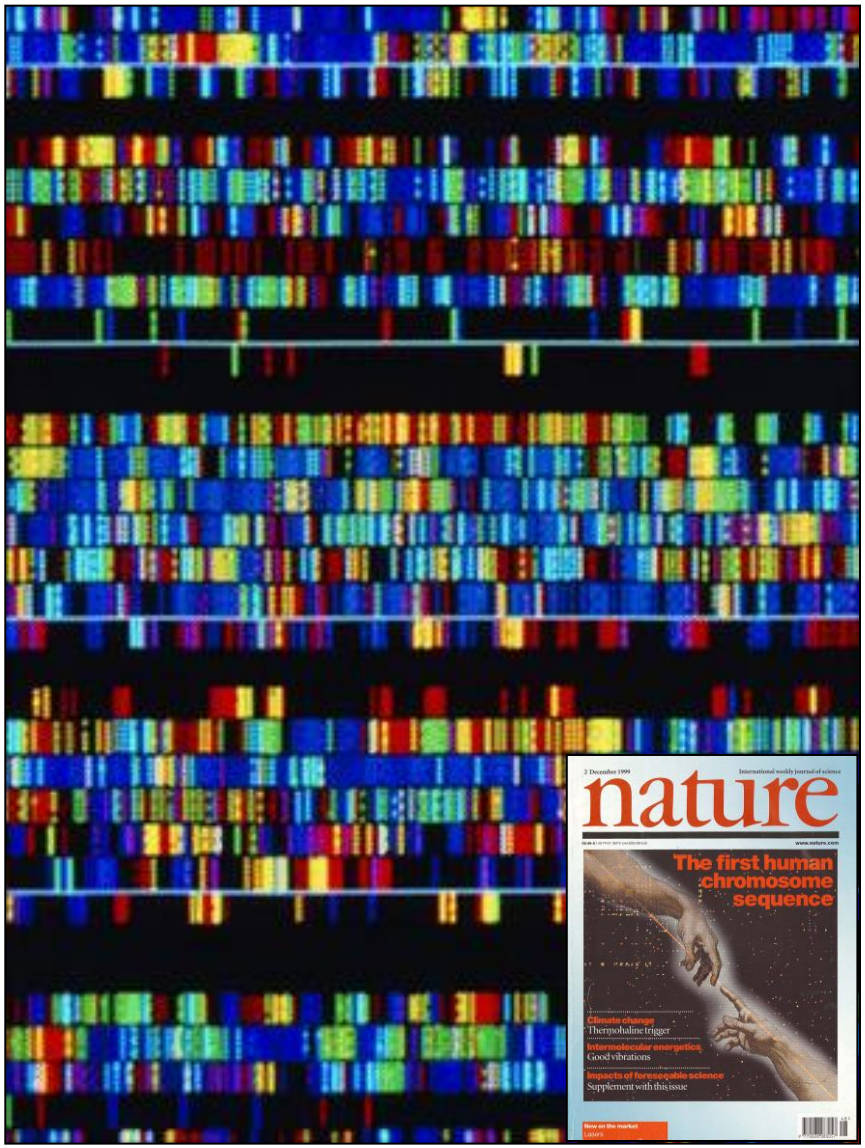


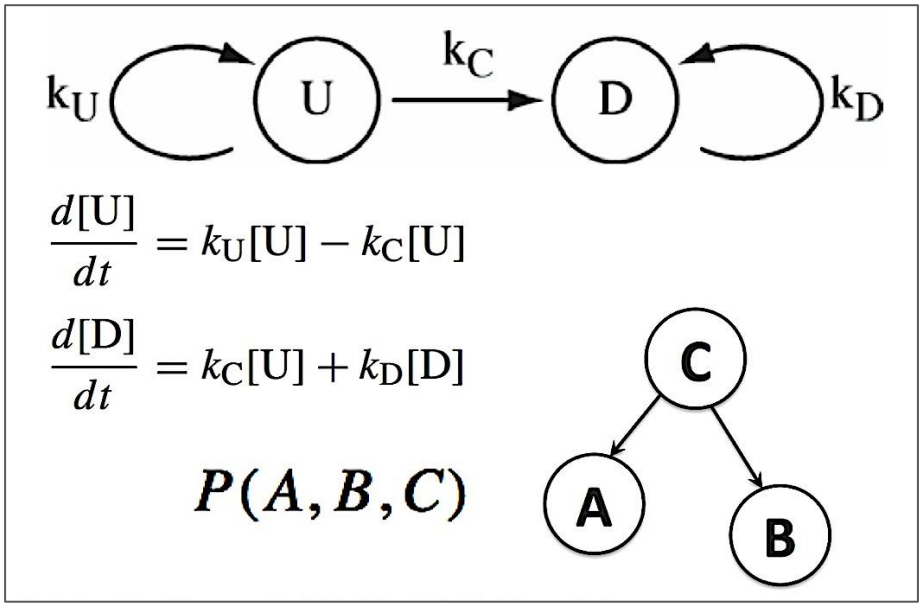
Source: New York University

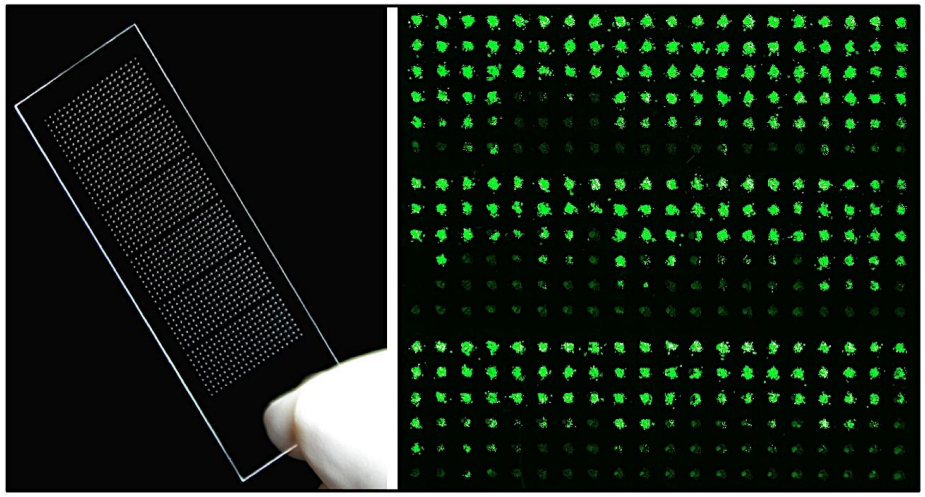


Source: British Society for Cell Biology

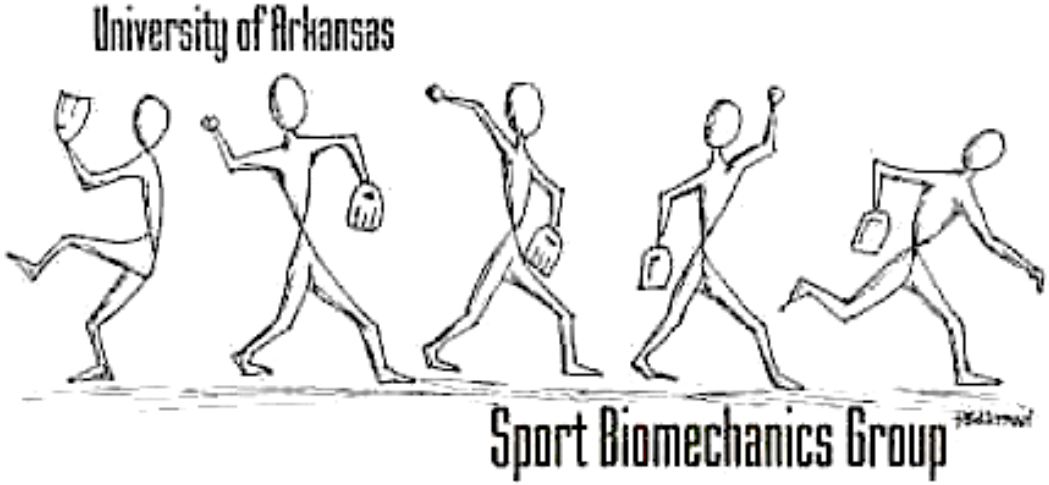
Genomics and Bioinformatics

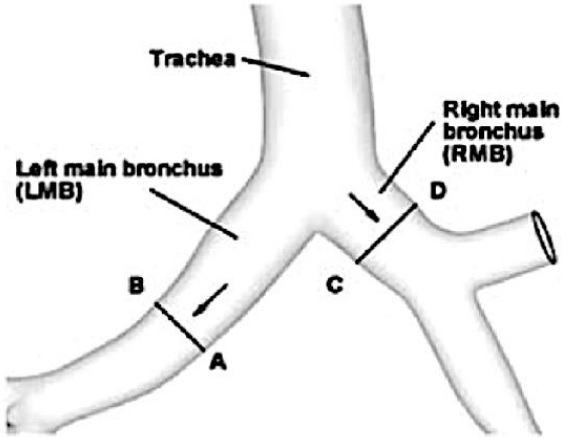


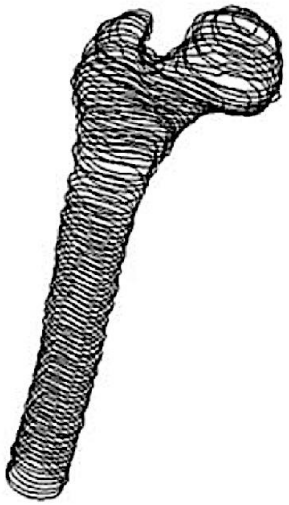


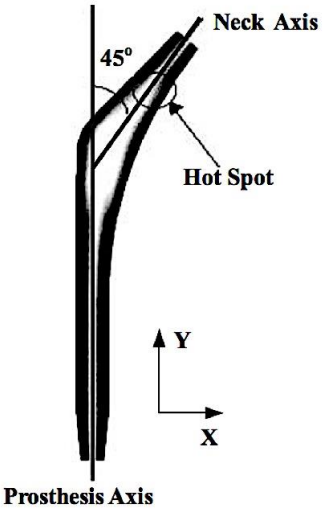


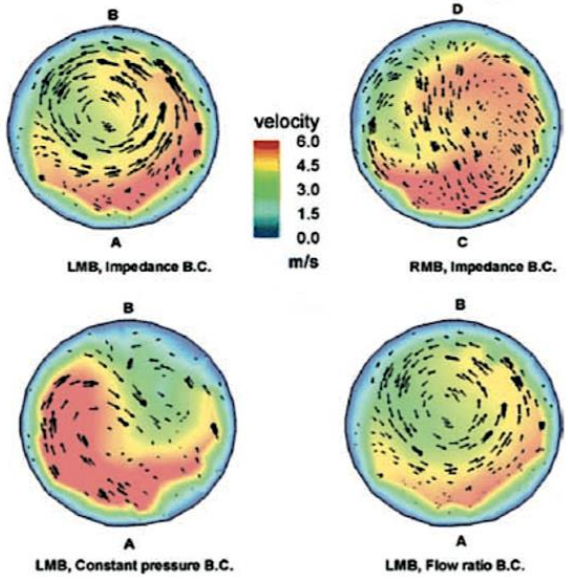
Biomechanics & Physiological Modeling



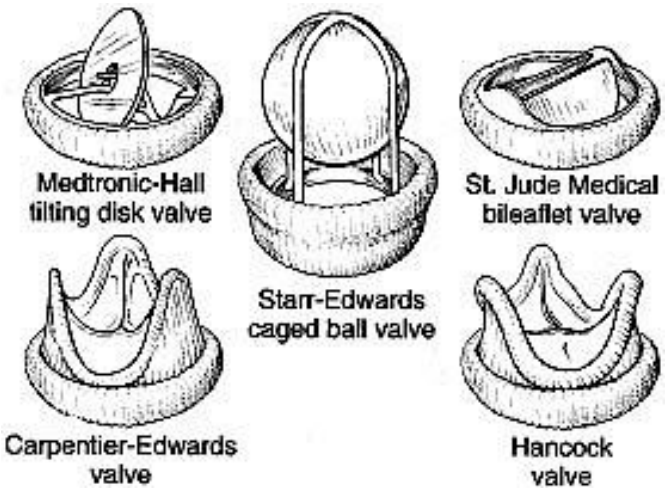


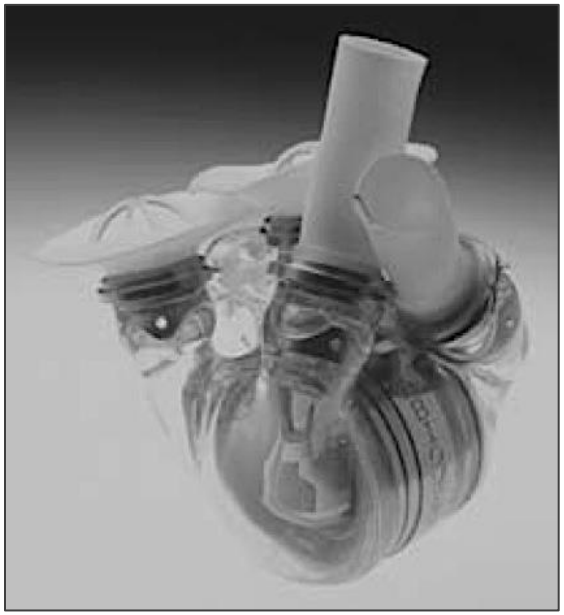




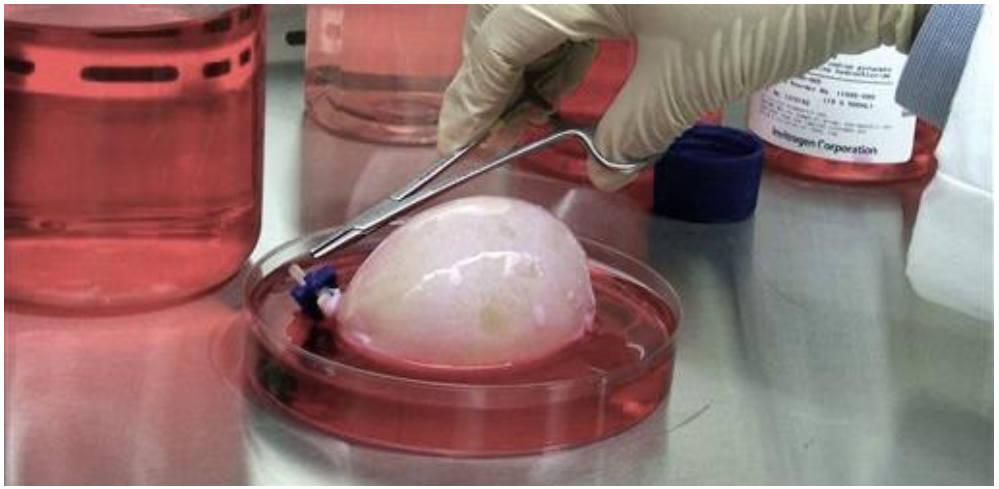


Artificial Organs & Tissue Engineering



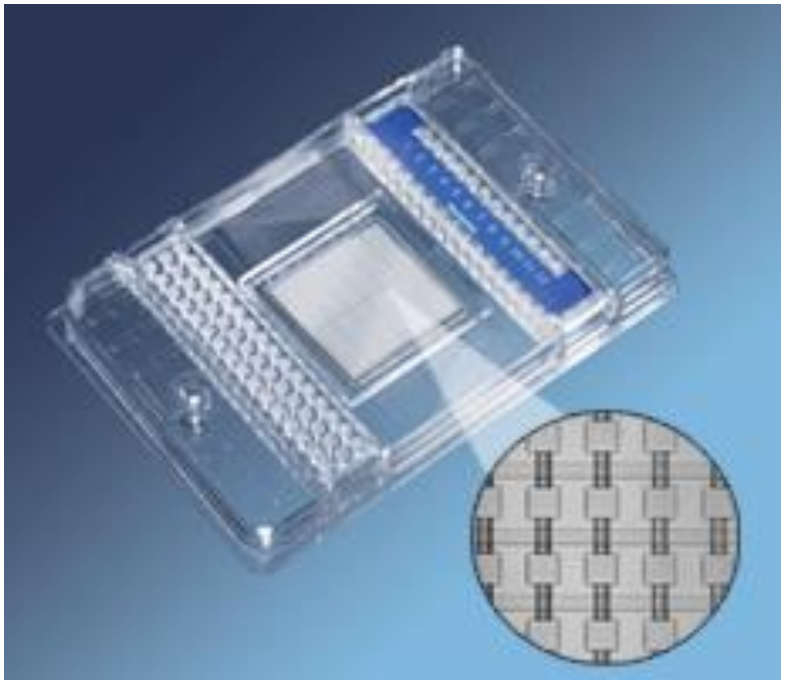


Source: Texas Heart Institute

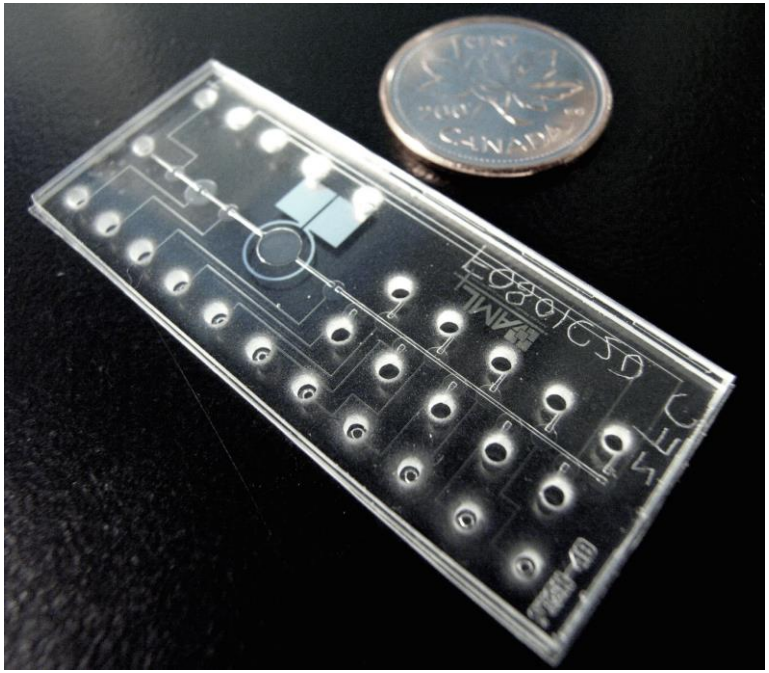


Source: Antony Atala Lab

Microfluidics and Bio-MEMS



Source: Fluidigm



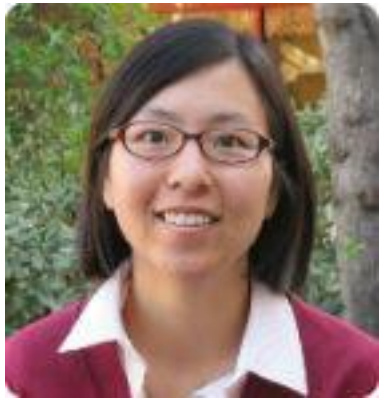
Source: Wikipedia

Bringing 21st century Bioengineering to Santa Clara University

SCU Bioengineering faculty

Dr. Emre Araci
Implantable, miniaturized microfluidic technologies

Dr. Prashanth Asuri
in vitro platforms that mimic *in vivo* conditions



Dr. Ashley Kim
Integrated microfluidic sensors and devices

Dr. Bill Lu
Molecular sensors and genome engineering

Dr. Yuling Yan
Biomedical imaging; Image and signal analysis

Dr. Jonathan Zhang
Protein engineering; Biodevice engineering

Dr. Maryam Mobed-Miremadi
Biomembrane characterization and transport modeling

Bioengineering Laboratories

Biomolecular Engineering Laboratory
Facilitates processing of synthetic biomolecules towards biomedical and industrial applications.

Tissue Engineering Laboratory
Equipped to design & develop *in vitro* functional biological substitutes and toxicity screening models.

Micro/Nanosystems Laboratory
Develops innovative microfluidic platforms for applications in diagnostics and cellular engineering.

Biosignals Laboratory
Wide range of instrumentation and computational systems to analyze and interpretate various human biosignals.

Past Senior Design Capstone projects

- Engineering mammalian cells as biosensors to detect diseases
- Detecting baby at home: detect fetal movement using ultrasound
- Probing mechanical properties of stem cells using AFM
- SAFire: Gas sensing mechanism to prevent surgical airway fires during electrosurgery *(In collaboration with Medtronics)*
- Pathogen detection using microfluidic electrochemical DNA sensors
- Improving mechanical strength of biological glues using nanotubes
- Recognition of blood vessel proximity using Doppler Ultrasound
- Transcutaneous transfer of radio frequency energy as an alternative power source for implantable medical devices
- TheraPE - a minimally invasive pulmonary embolectomy device *(In collaboration with GVMED)*

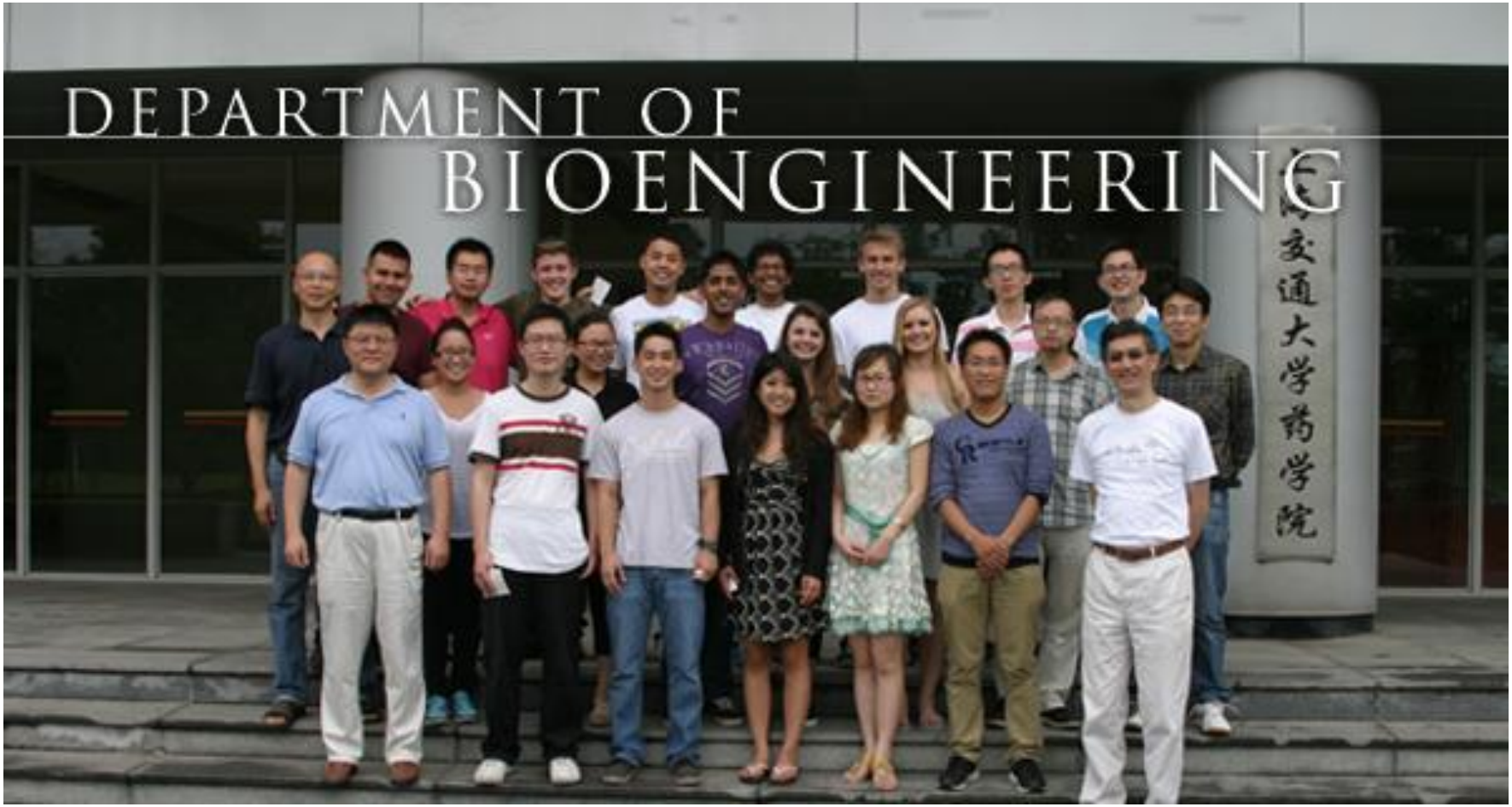
Student presentations at National & International conferences

- Miniaturized Systems for Chemistry and Life Sciences (µTAS)
- American Chemical Society
- Materials Research Society
- American Institute of Chemical Engineering
- Biomedical Engineering Society
- IEEE Engineering in Medicine and Biology Society
- International Conference on Bioinformatics & Bioengineering
- International Conference on Computational & Mathematical Biomedical Engineering
- Annual Pacific Voice & Speech Foundation Conference

Student research published in peer-reviewed journals

- Biotechnology & Bioengineering
- Protein Science
- Proceedings of the IEEE Biomedical Circuits and Systems
- PloS One
- Cellular and Molecular Bioengineering
- AIChE Journal
- Journal of Experimental Biology and Medicine
- World Journal of Stem Cells
- IEEE Journal of Translational Engineering in Health and Medicine

International summer exchange program



Jointly organized by Department of Bioengineering, Santa Clara University and Shanghai Jiao Tong University School of Pharmacy

SCU BIOE students – where are they now?

Acclarent

MULTISPAN

avinger

MAXIM

spiracur

AMGEN

Complete genomics

CSS-Dynamac

Genentech
A Member of the Roche Group

Boston Scientific

Medtronic

stryker

INTUITIVE SURGICAL®
da Vinci Surgery

CARDIODX

Google

HITACHI
DATA SYSTEMS

NASA

SCU BIOE students – where are they now?

- UC-Berkeley, UCSF, UCLA, UCSC
- Johns Hopkins
- Columbia University
- Stanford University
- Rensselaer Polytechnic Institute
- University of Kentucky
- Oregon State University
- John A. Burns School of Medicine, Hawaii

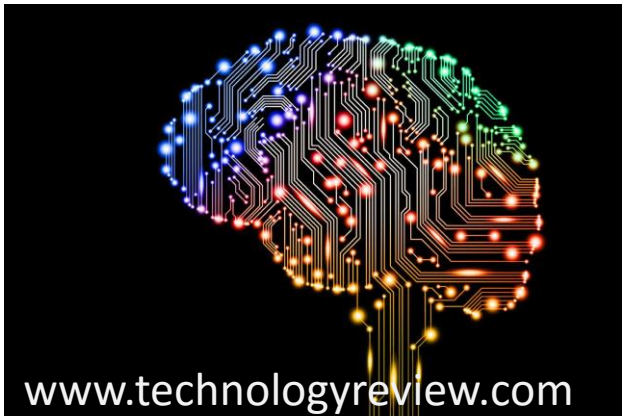
Berkeley
UNIVERSITY OF CALIFORNIA

VE RI TAS
HARVARD
UNIVERSITY

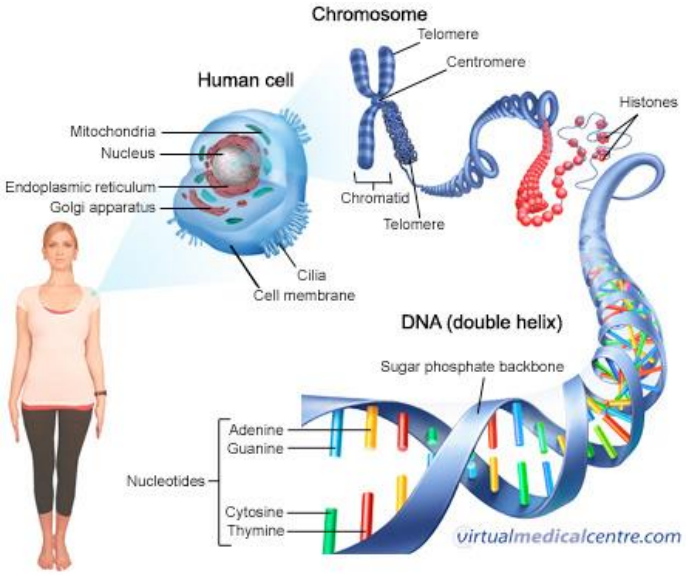
UCSF
University of California
San Francisco

Bioengineering – Future

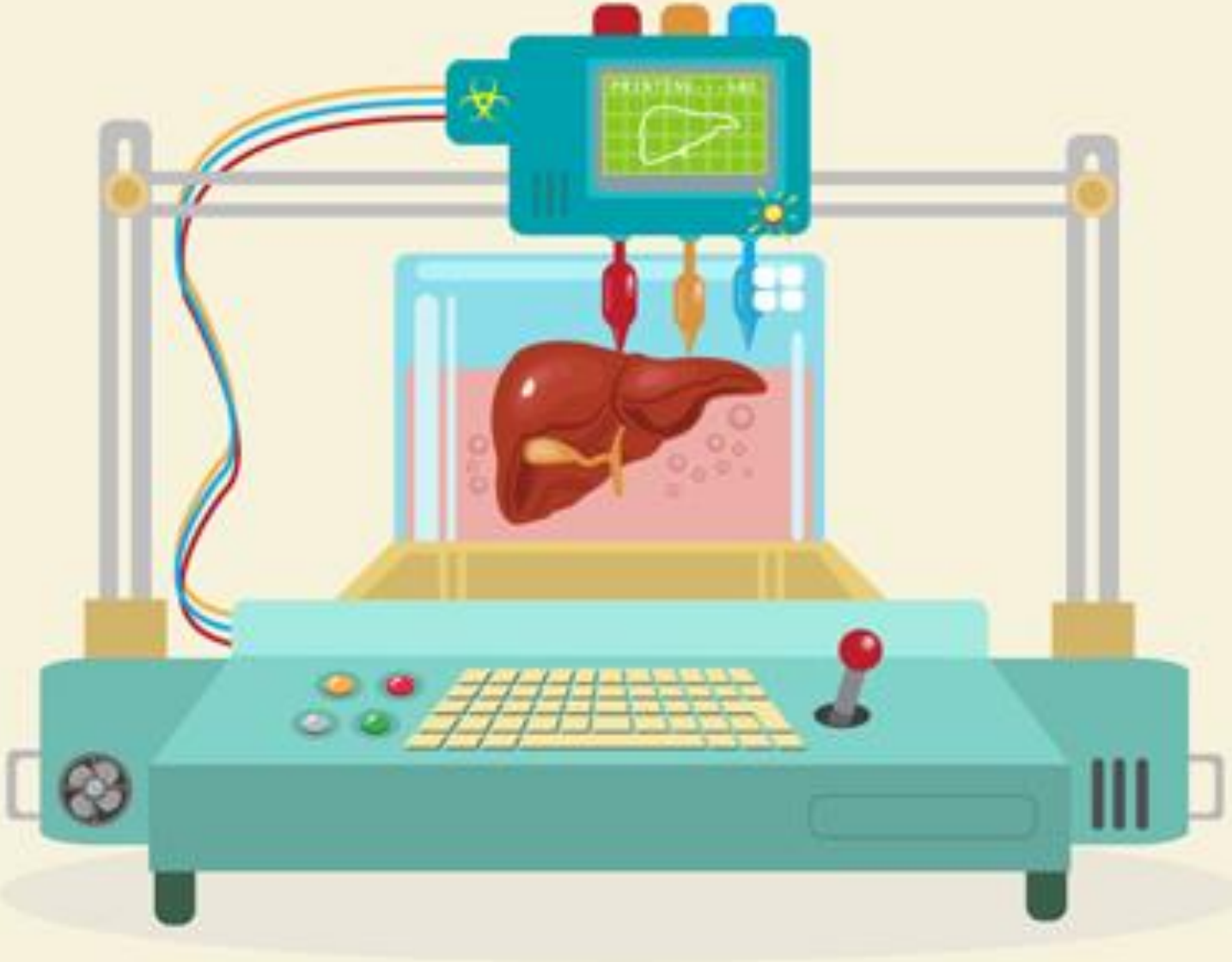
Artificial intelligence



Precision Medicine



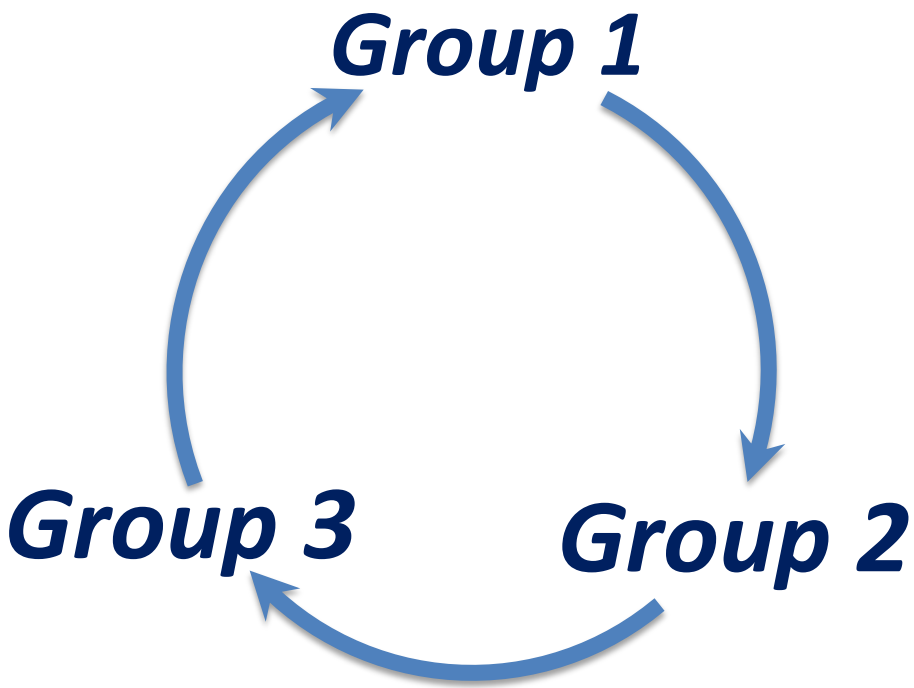
3D Bioprinting



Thank You

Any Questions?

Group Activities



Section I

Innovation

Biao Lu

Section II

Student Research-
Cell Imaging

Zach, Grace, Eddy

Section III

Assemble An Assay Kit for Cancer Screening

Natalie, Michelle