

VI. Research Programs in Biotechnology at Arizona State University

A) *Examples from the College of Liberal Arts and Sciences*

Research Programs in Items # 1-4 focus on a theme of Plant Biotechnology, pharmaceuticals, botanical products. Research Programs in items # 5-6 focus on a theme of Plant Biotechnology, production of commercially important oils. Research Programs in items # 11-14 focus on developmental aspects of fertilization, birth defects, skeletal, neural and muscular disfunction.

- 1) **Charles Arntzen:** Florence Ely Nelson Presidential Chair at Arizona State University: The extensive research program under the supervision of Dr. Arntzen engages in many aspect of biotechnology including nutraceuticals and botanical drug products, vaccine production, edible drug delivery systems. Dr. Arntzen has served as consultant to numerous agricultural industries and is President/CEO *emeritus* of the Boyce Thompson Institute for Plant Research, Inc (Cornell University). He is a member of the National Academy of Sciences.
- 2) **Lokesh Joshi:** Employing plants as expression systems for pharmaceutical products - Research includes the use of plants to make antibodies for immunization of humans as well as the isolation of anti-cancer compounds.
- 3) **Tsafrir Mor:** Vaccine production in plants and expression of human genes in plants - This research program focuses on the production of acetyl choline esterase with regard to the production of human genes in plants.
- 4) **Ilga Winicov:** Plant root tissue as an expression system for pharmaceutical products. This research serves a key role in enhancing the delivery of pharmaceuticals in genetically modified plants that secrete the product through their roots into the collection system.
- 5) **Milton Sommerfeld:** Prospecting for oil among the algae - This research program uses microalgae and metabolic manipulations to increase the production of commercially important oils that can be harvested from the microalgae. The microalgae are selected for optimal growth in the environmental conditions of the Sonoran Desert.
- 6) **Qiang Hu:** Development of high density bioreactors for microalgae - This research program develops large containment devices for microalgae that make use of environmental conditions of the Sonoran Desert, particularly the sunlight in the Sonoran Desert.
- 7) **Ralph Backhaus:** Exploitation of specialized oxidative enzymes that deal with polyunsaturated fatty acids - This research program is developing enzymes that prevent damage to the body. In collaboration with the Mayo Clinic in Scottsdale, a system is being developed that prevents damage caused by ischemia.

8) **Ken Hooper:** Prevention of macula degeneration - This research program has identified nutritional supplements from algae (isolated at low cost) that can be effective in the treatment of macula degeneration (that is, it can prevent degeneration of the retina in the eye of humans).

9) **Wim Vermaas:** Genetic Engineering and Applications - This research program engages in many applications of genetic engineering including the modification of algae for treatment of water to remove impurities and as CO₂ scrubbers for power plant exhaust.

10) **Wayne Frasch:** Nanoscale molecular motors - Development of the very stable enzyme, ATP synthase, for use as a nanoscale molecular motor.

11) **Robert McGaughey:** Assisted Reproductive Technologies - This research program addresses problems with human infertility. Dr. McGaughey in collaboration with Drs. Douglas Chandler, and David Capco investigate conditions that influence egg development, fertilization and embryo implantation into the uterus.

12) **Alan and Jeanne Rawls:** The genetic basis of birth defects - These research programs investigate the genetic regulation of bone, muscle and heart formation during fetal development.

13) **Stuart Newfeld:** The genetic basis of development - This research program examines the regulation of pathways that control the formation of the body including genes that regulate bone formation.

14) **Chris Lorsen:** Molecular basis of neuromuscular disorder - This research program examines RNA processing, transcription regulation, and their relationship to the development of disease.

15) **Sudhar Kumar:** Bioinformatics - This research program focuses on molecular evolution of genes, genomes, and developmental complexity and utilizes the various genome database projects.

16) **Bert Jacobs:** Viral biology approach to infectious disease - This research program is involved in vaccine production and viral gene therapy.

17) **Yung Chang:** The immune system and fighting disease - This research program investigates normal lymphopoiesis, immunodeficiency, and oncogenesis of lymphoid system. Technology to maintain progenitor lymphoid cells is also being developed.

18) **Neal Woodbury:** Molecular machines, single molecular events and nanotechnology- This research program genetically modifies components of cells to perform specific functions initiated by laser pulses.

19) **Devens Gust:** Solar energy harnessing, molecular electronics, and optoelectronics - This research program is directed at using light energy to fuel biomolecular machines

20) **Cancer Research Institute:** The Cancer Research Institute, Arizona State University (Tempe, AZ) has endeavored to discover new anticancer drugs that can be added to the therapeutic arsenal. Under the Direction of Dr. G. Robert Pettit, ASU-CRI is at the forefront of the fight against cancer.

B. Examples from the Department of Bioengineering in the College of Engineering and Applied Sciences

Research Programs in items #1-5 focus on biomaterials and genetic manipulation of tissues. Items #9-13 focus on cardiovascular control. A focus on neuro/muscular/skeletal disorders exist from items # 1-4, 8-11.

1) **Alyssa Panitch:** Development of biosynthetic material through molecular biology - This research program focuses on the use of recombinant DNA technology to create artificial proteins for various tissue-engineering applications including induction of angiogenesis and arterial reconstruction.

2) **Stephen Massia:** Biomaterials and interaction with the body - This research program employs synthetic biomaterials with cell and tissues for interactions with bone, vascular grafts, and heart.

3) **Vincent Pizziconi:** Biohybrid sensor devices and materials interactions with the body - This research program uses approaches designed to promote retention of implants as well as taking a systems approach to cellular phenomena specifically in bone formation.

4) **Brent Vernon:** Smart materials for drug delivery and tissue reconstruction - This research program uses materials designed to exhibit differential responses to the environment in the body.

5) **Eric Guilbeau:** Biomaterials - This research program is directed toward the development of biomaterials that are suitable for the substitution or replacement of the natural pericardium to eliminate adhesion formation after cardiac surgery. Dr. Guilbeau's laboratory is also involved in the design and development of physiological biosensors for the measurement of important biological substrates like blood glucose and the development of cell-based biosensors

6) **Antonio Garcia:** Bioseparations and microfluidics in biotechnology - This research employs molecular interaction to provide low costs clinical diagnostics. In addition, current research is focused on molecular engineering and immobilization technology.

- 7) **Jit Muthuswamy:** Microdevices in medical treatments - This research program employs microfabricated actuators and sensors as enabling technologies in the neurophysiology of brain injury. These technologies are targeted toward obtaining electrical and neurochemical information at the cellular level while animals are recovering from brain injury.
- 8) **Daryl Kipke:** Neural bioengineering - This research program has many applications including cochlear implants, development of the next generation of implantable microelectrode arrays, and the development of “smart electrodes.”
- 9) **Collen Brophy, M.D.:** Cardiovascular Cellular and Molecular Biology - This research program develops pharmaceutical agents that act to counteract vasospasms in vascular grafts and in cerebral ischemia.
- 10) **Richard Herman:** Neurovascular control and Telemedicine - This research program investigates neurovascular control and evaluates high frequency, broad-band wireless technology and non-invasive patient monitoring.
- 11) **James Sweeney:** Cardiac function - This research program emphasizes the development of implanted electrical stimulation devices that act to augment or restore neuromuscular or cardiac function that has been lost due to injury or disease. Basic research projects seek to discover deeper understanding of the fundamental mechanisms of neuromuscular and cardiac stimulation and their applications
- 13) **Bruce Towe:** Wound healing - This research program examines the possibility of stimulating the healing of open slice wounds. Pulsed microampere-order electrical currents from battery powered microelectronic circuits are applied to special electrically conductive suture materials. This laboratory is also conducting basic science investigations of methods to noninvasively localize cardiac infarction and ischemia through cardiac bioelectric-evoked responses.