



FAO INTERNATIONAL TECHNICAL CONFERENCE ON AGRICULTURAL BIOTECHNOLOGIES IN DEVELOPING COUNTRIES

1 - 4 March 2010, Guadalajara, Mexico



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UNIVERSIDAD DE CHILE



University of Chile

Academic Staff & Students

- 3,400 Faculty; 1,100 Full time
- ~25,000 Undergraduate students
- ~6,000 Graduate students in Doctoral, Master and Specialization Programs, in different areas.

Academic Programs offered

- 45 Professional Degrees (5 to 7 years),
- 18 Licentiate Degree Programs (4 years)
- 1 Bachelor's Degree Program (2 years),
- 34 Ph.D. Accredited Programs by CNA(*)
- 120 Specialized Master Programs
- 75 Professional Specialization Programs
- 66 Post Professional Programs

Annual Budget ~ US \$ 500 million

(*) CNA: National Commission for Graduate Studies Accreditation



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Undergraduate Careers related to Biotechnology

- Engineering in Molecular Biotechnology (FSc. 5y + 1/2y Seminar) + 1y Thesis Master Degree. (276 students)
- Civil Engineering in Biotechnology (FPhy&MatSc. 6y, 60 students)
- Biochemistry (FCh&PharSc. 6y) + 1y Thesis Master Degree (244 students)



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Master Programs in areas related to Biotechnology -

➤ Master in Applied Biochemistry. (Fac. Ph & Chem Scs.)

Speciality:

Protein Biochemistry & Biotechnology

➤ Master in Enology & Viticulture (Fac. Agr. Scs.)



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Ph.D. Programs in Biology and Medicine Areas related to Biotechnology

- Agronomical and Veterinary Sciences (60 students)
- Aquaculture (10 students)
- Biochemistry (40 students)
- Biomedical Sciences (111 students)
- Microbiology (27 students)
- Molecular, Cellular Biology and Neurosciences (46 students)
- Pharmacology (37 students)



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Ph.D. Programs in Chemistry, Physics and Technology Areas related to Biotechnology

- Chemical Engineering - Biotechnology (12 students)
- Mathematical Modeling



Centers of Excellence of the University of Chile

- Millennium Institute of Ecology & Biodiversity (FSc)
 - Millennium Institute of Cell Dynamics & Biotechnology (FSc/FP&MSc/FQ&PhSc) Dir. Dr. Juan Asenjo.
- Millennium Institute of Complex Engineering Systems (FP&MSc)
 - Millennium Center in Cell Genomics (FSc)
- Millennium Center for Integrative Neuroscience (FMed)
- Millennium Nucleus: Information & Randomness: Fundamental & Applications (FP&MSc)
- Millennium Scientific Nucleus for Web Research (FP&MSc)
- Center for Advanced Research in Material Science (FP&MSc)
 - Center for Mathematical Modeling (CMM) (FP&MSc)
- Center of Astrophysics (FP&NSc/PCU)
 - Center for Molecular Studies of the Cell (FMed)

Total funding 2008 US \$ ~14 million

Funded by Millennium Initiative or CONICYT



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Technology Transfer

Consortia: 7 Consortia financed by CONICYT and CORFO.

Areas: Winegrowing, Fruitculture, Aquaculture (Salmon), Mining, Bioenergy and Telecommunications.

Public funding: US\$ 15.2 million. Private funding: US\$ 13.3 million.

Patents (2004-2008): 25 applications in Chile, 11 of which applied abroad, and 4 awarded in different countries.



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Three Major Changes of XXI Century Biology that Affect the Training needed for Biotechnologists in Developing Countries.

- 📁🌐 Biology as a science is undergoing a very drastic paradigm shift.
- 📖🌐 There are important changes in the geopolitics of science and technology in the Developing World.
- 📖🌐 A much closer interaction of science and society is necessary.



The Biology Paradigm Shift

- 🔍 The golden age of biochemistry and molecular biology (1944-1990) operated under a reductionist paradigm. Studies of purified biological molecules in a test tube. The goal was to purify, to isolate. "Don't waste clean thoughts to on dirty enzymes".
- 📖 Genome Project 1988-2002. Made available the complete genetic message of humans and thousands of other species of animals, plant and microbes.
- 📖 The XXI Century Post Genomic Era. The old reductionist paradigm is not satisfactory. The holistic paradigm seeks to understand the whole dirty soup of thousands of components interacting in the cell. Systems biology, Integrative biology. Proteomics, Transcriptomics Metabolomics.



Implication of the Paradigm Shift for Training Biologists and Biotechnologists

- ① Reductionism resulted in ultra specializations. Each one of us knew more and more about less and less. The holistic approach requires a broad knowledge and a capacity to integrate, to handle complexity.
- ① Complex non linear systems like the living cell need a new mathematics that can handle many variables and chaos.
- ① Other sciences-physics, chemistry, play new and important roles. Research teams have to be multidisciplinary in scope. Bioinformatics is a core subject.
- ① Groups of multidisciplinary researchers as doctoral tutors may replace a single mentor.

Carnegie Foundation Report 2005. The Formation of Scholars Rethinking Doctoral Education for the XXI Century.



The New Geopolitics of the Old Third World

- 🌐 The strong emergence of China, India and Brazil as economic and scientific powerhouses. Scientific capacity and ambitious projects are not the monopoly of the industrial world.

Developing countries are entering frontier science and technology areas: China in space exploration, India in pharmaceuticals, Brazil in biofuels.

- 📄 Other emerging developing countries have acquired capacities for training scientists – Mexico, Argentina, Chile, Colombia in Latin America and are carrying out sophisticated science.



Implications for Training

- 📁 Developing country biotechnologists should be trained in frontier, sophisticated techniques and the infrastructure for research needs to be strengthened.
- 📄 The scientifically proficient countries of the developing world have now the responsibility for training and strengthening the scientifically lagging countries in their regions. South - South.



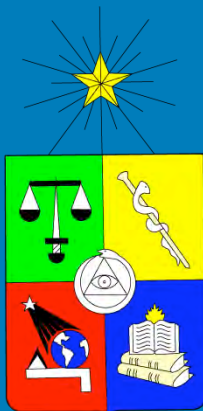
Closer relationship of Science and Society

- 📁🌐 The great velocity in which new knowledge becomes applied to create new wealth and to solve socioeconomic problems.
- 📄🗣️ Ethical issues about the applications of science greatly concern society. Biosafety, GMO's, Cloning of Humans.
- 📄🗣️ Accountability of expenditures in science and technology. Society has a right to know the objectives and results of the research that is funded by the tax payers.
- 📄🗣️ Science can only prosper in a scientifically literate society that values science and scientists.



Implications for Training of New Relationship of Science with Society

- 📁🔍 Biotechnologists have to receive training on entrepreneurship, on technology transfer, on intellectual property issues, on dealing with private business.
- 📄🔍 Biotechnologists should be trained on bioethics and should learn to have respect and consideration for the opinion of non scientists.
- 📄🔍 Biotechnologists should learn how to communicate what they are doing and the implications of their work for the general public.
- 📄🔍 Biotechnologists should be made aware of their social responsibilities and to work with primary and secondary school teachers to improve the scientific literacy of the general population.



Many Thanks