Research Capability and Infrastructure in Thailand

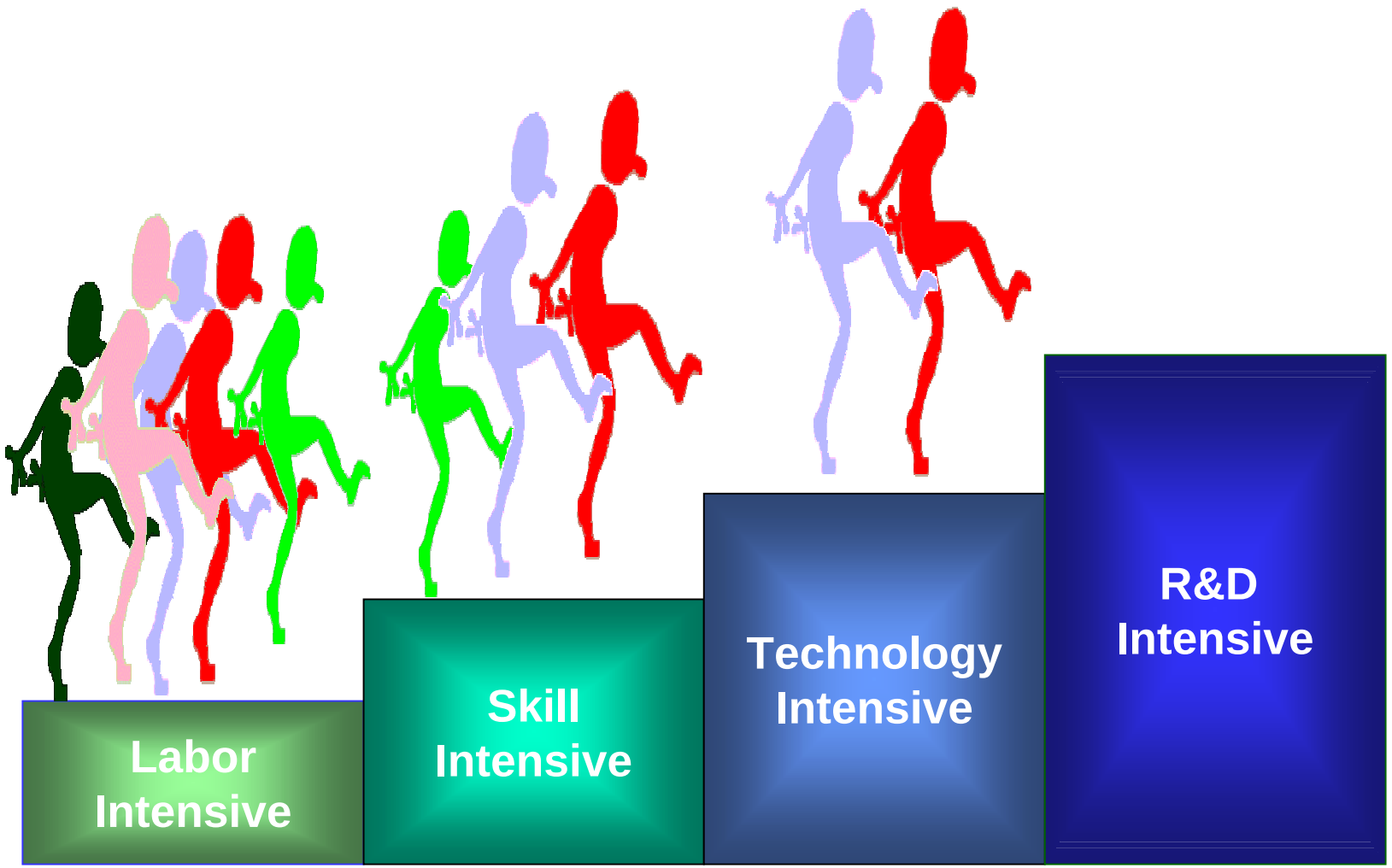
Morakot Tanticharoen

National Center for Genetic Engineering and Biotechnology,

National Science and Technology Development Agency

Thailand: a global village

FILLING THE GAP & BUILDING S&T STRENGTH



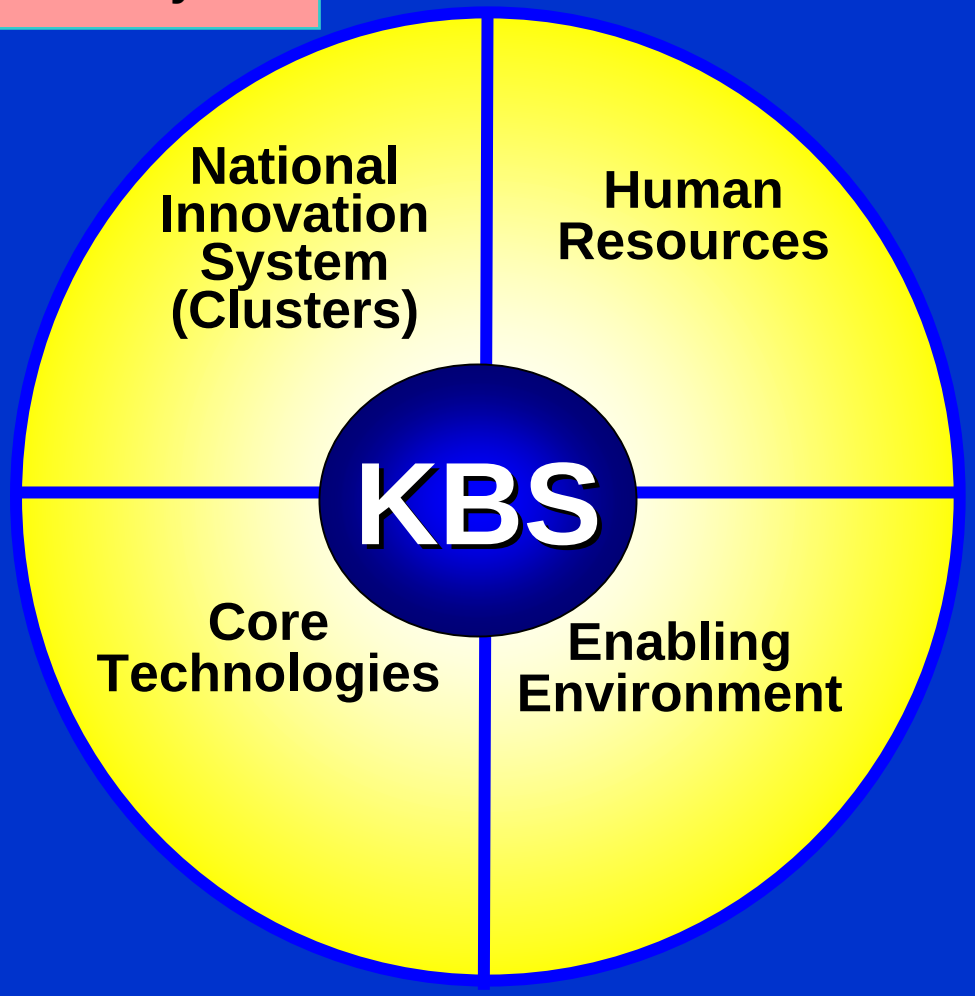
Framework of S&T Development for the Thai Economic and Society

Sustainable Competitiveness

Community Economic

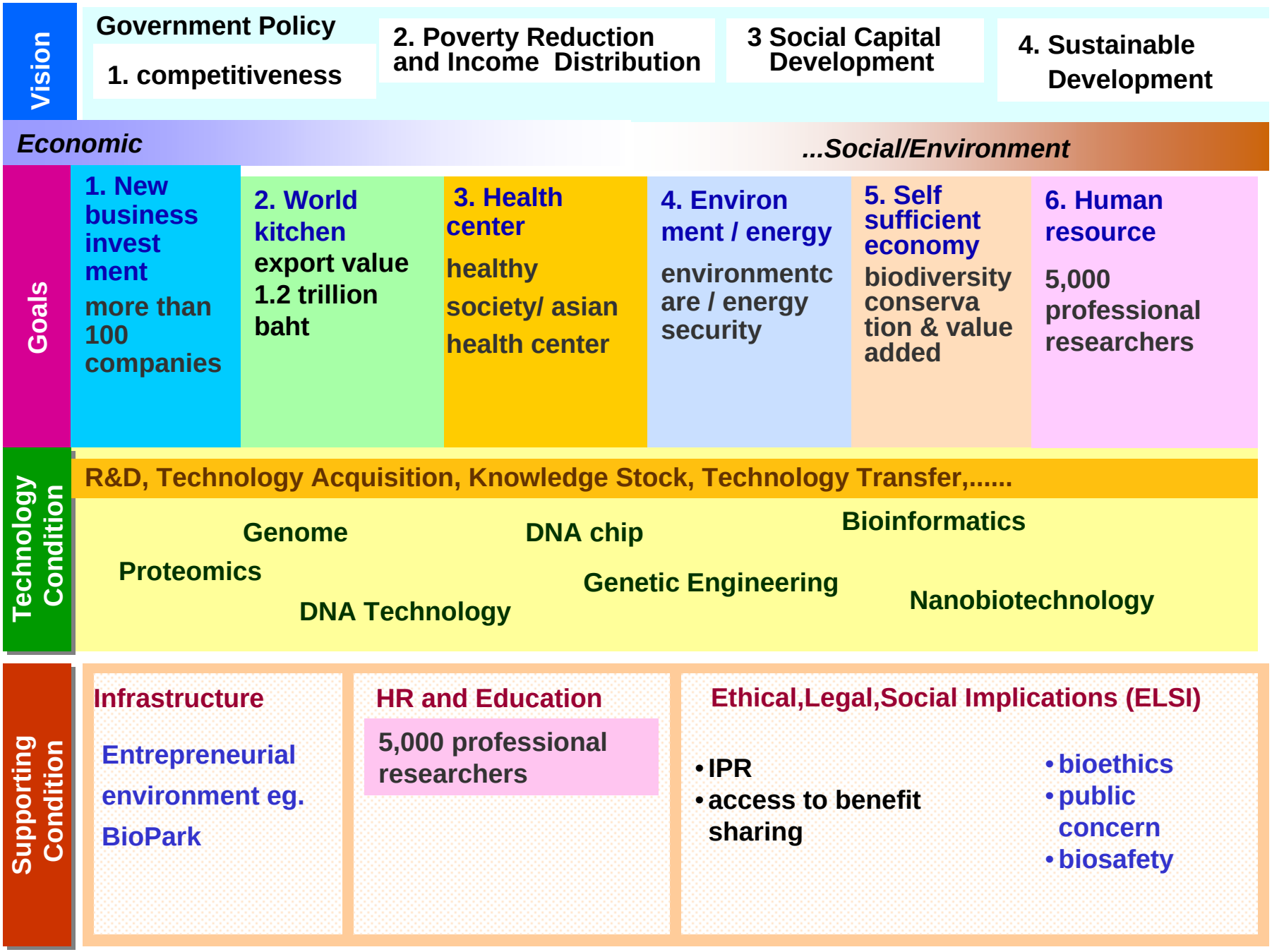
Learning Society

Quality of Life/ Environment



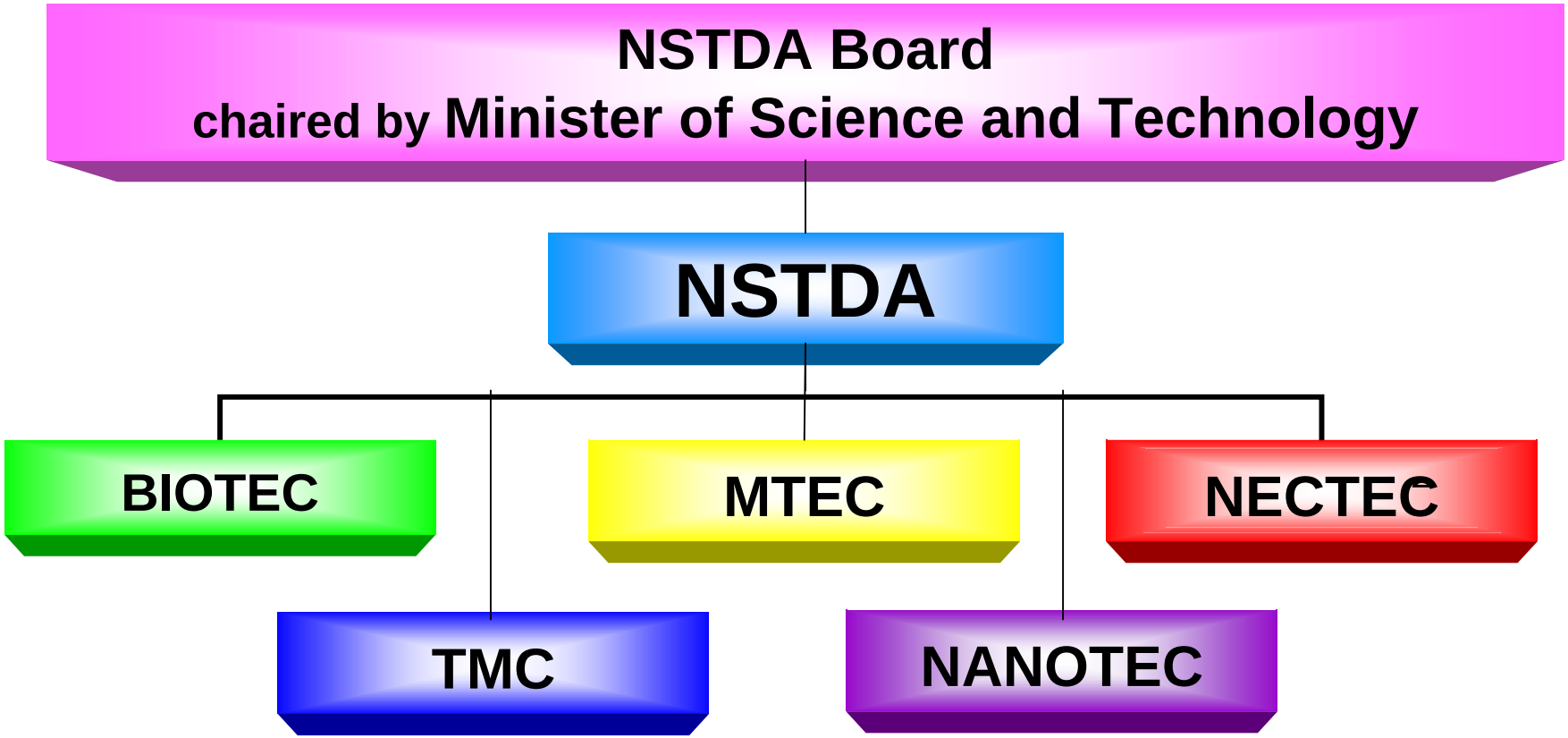
Core Technologies :

1) ICT
2) Biotechnology
3) Material Technology
4) Nanotechnology


Vision
Government Policy
1. competitiveness
2. Poverty Reduction and Income Distribution
3 Social Capital Development
4. Sustainable Development
Economic
...Social/Environment
Goals
1. New business invest ment
more than 100 companies
2. World kitchen
export value 1.2 trillion baht
3. Health center
healthy society/ asian health center
4. Environ ment / energy
environmentc are / energy security
5. Self sufficient economy
biodiversity conserva tion & value added
6. Human resource
5,000 professional researchers
Technology Condition
R&D, Technology Acquisition, Knowledge Stock, Technology Transfer,.....
Genome
DNA chip
Bioinformatics
Proteomics
Genetic Engineering
DNA Technology
Nanobiotechnology
Supporting Condition
Infrastructure
Entrepreneurial environment eg. BioPark
HR and Education
5,000 professional researchers
Ethical,Legal,Social Implications (ELSI)
• IPR
• access to benefit sharing
• bioethics
• public concern
• biosafety

NSTDA ORGANIZATION

(established by a special law in 1991)



NSTDA : National Science and Technology Development Agency
BIOTEC : National Center for Genetic Engineering and Biotechnology
MTEC : National Metal and Materials Technology Center
NECTEC : National Electronics and Computer Technology Center
NANOTEC: National Nanotechnology Center
TMC : Technology Management Center

National Science and Technology Development Agency

Welcome to Thailand Science Park

The first technology hub for Thailand is now ready
to serve the country with its world-class facilities and pool of talented people.

OPERATION PLAN

- **3 Operation Phases:**
  - **I. Build up Critical Mass in R&D**
  - **II. Bring in the Private Sector (Current Stage)**
  - **III. Grow the Park into a Community**
- **Opened in 2002 with Completion of Phase I Construction**

PHASE I

- **Build up Critical Mass in R&D:**
  - **Use NSTDA and its National R&D Centers as *The Flagship (Anchor Tenant)***
  - **Over 600 full-time researchers with post graduate degrees**
  - **Approx. 300 Ph.D.s & increasing at around 10% annually**
  - **Available services incl. joint & contract R&D**

PHASE II

- **Bring in the Private Sector**
  - **Harvest from what NSTDA has to offer (Phase I Investment)**
  - **60 Tenants**
  - **~500 Employees with ~300 personnel in RDE**
  - **~400 Mil. Bahts Direct Revenue/Yr (USD 10 mil)**
  - **~1,000+ Mil. Bahts Multi-Source Revenue/Yr (USD 25 mil)**

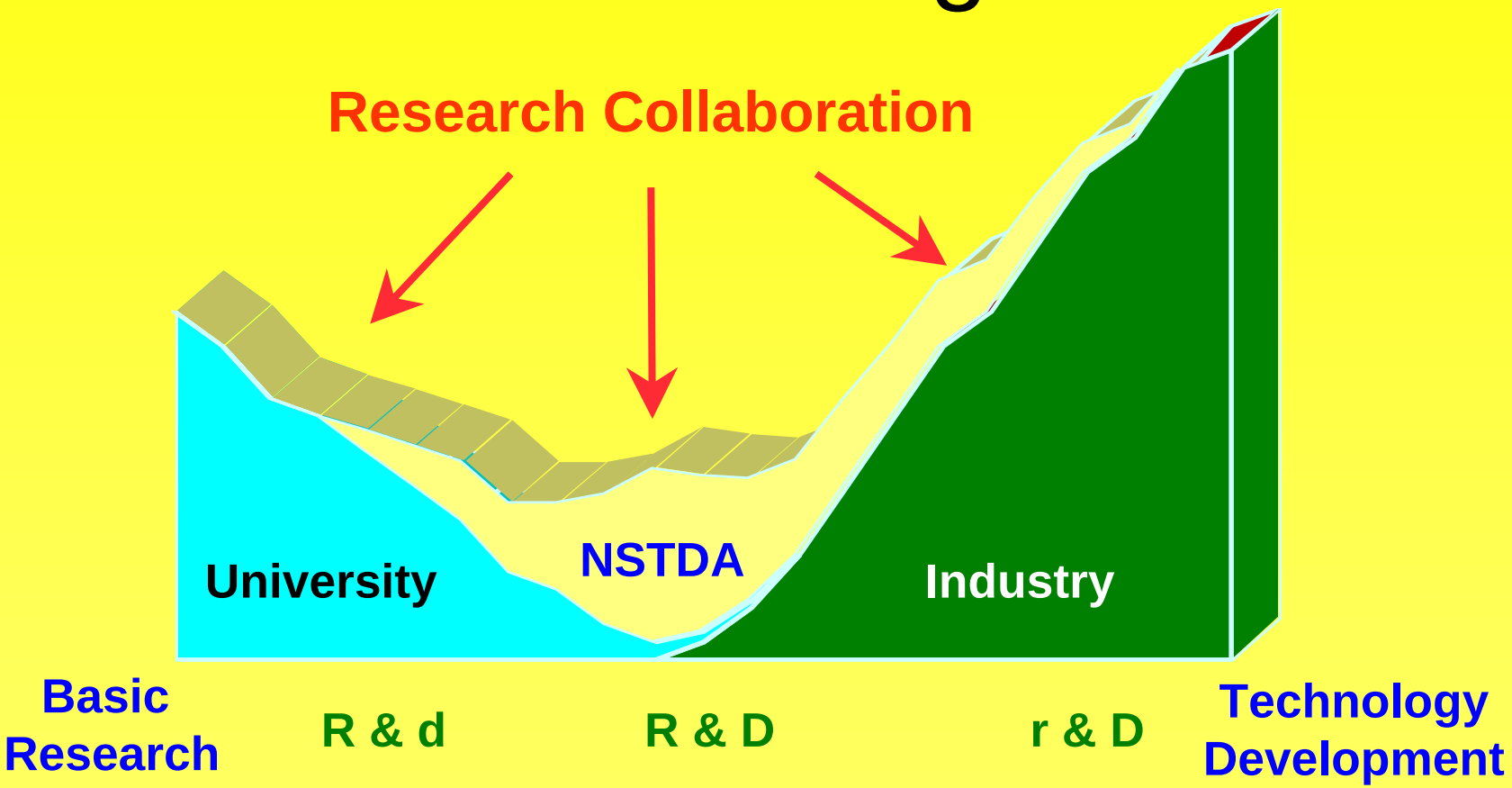
FROM THAILAND SCIENCE PARK TO BIOPARK (PHASE III)

- **Expansion from Thailand Science Park, covering the area of 124,000 sq. m.**
- **Additional investment of USD 50 mil**
- **To be completed in 2009 with BSL-3 facility, additional incubator space.**

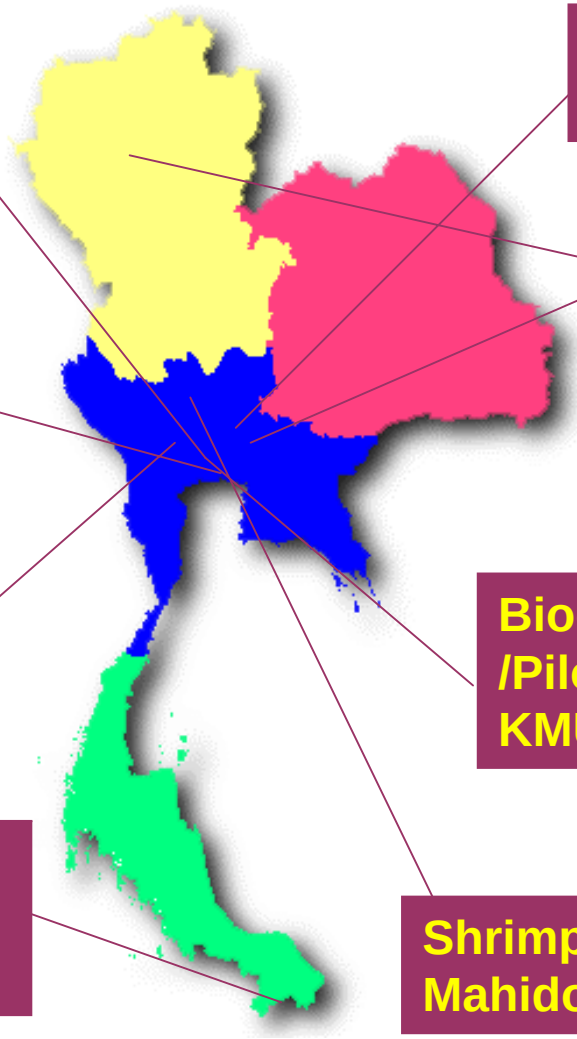
SAMPLE OF TENNANTS IN BIOTECHNOLOGY

- **Health Concepts International Co.**
- **Stem Cell for Life Co., Ltd. (to develop a cord blood bank facility)**
- **3 multinational companies in pipeline (1 Japanese + 2 American)**
- **Thai Traditional Medicine and Natural Products Development Center**
- **PSB Test (Thailand) Co., Ltd., (Singaporean subsidiary)**

Positioning



RESEARCH UNITS



Central Research Unit
Thailand Science Park

Marine Biotech
Chula Univ.

Rice Gene Discovery
Kasetsart Univ.

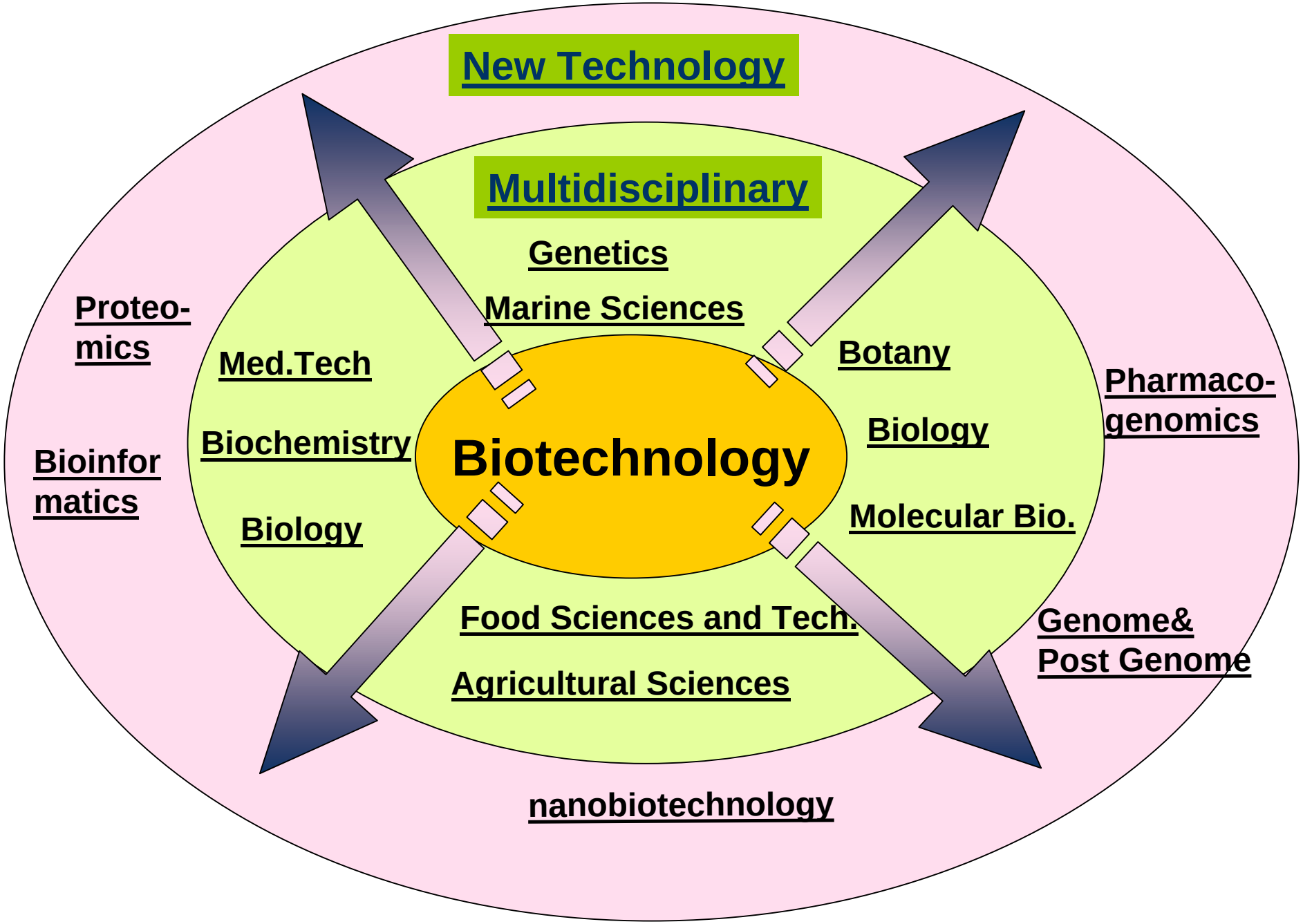
Peat Swamp & Tropical
Rain Forest
Royal Forest Department

Cassava/Starch R&D
Kasetsart Univ.

Medical Biotech
Mahidol Univ. and
Chiang Mai Univ.

Biochemical Engineering
/Pilot Plant
KMUTT

Shrimp Molecular Biology
Mahidol Univ.


New Technology
Multidisciplinary
Genetics
Marine Sciences
Med.Tech
Biochemistry
Biology
Botany
Biology
Molecular Bio.
Biotechnology
Food Sciences and Tech.
Agricultural Sciences
Proteo-
mics
Bioinfor
matics
Pharmaco-
genomics
Genome&
Post Genome
nanobiotechnology

HUMAN RESOURCE DEVELOPMENT

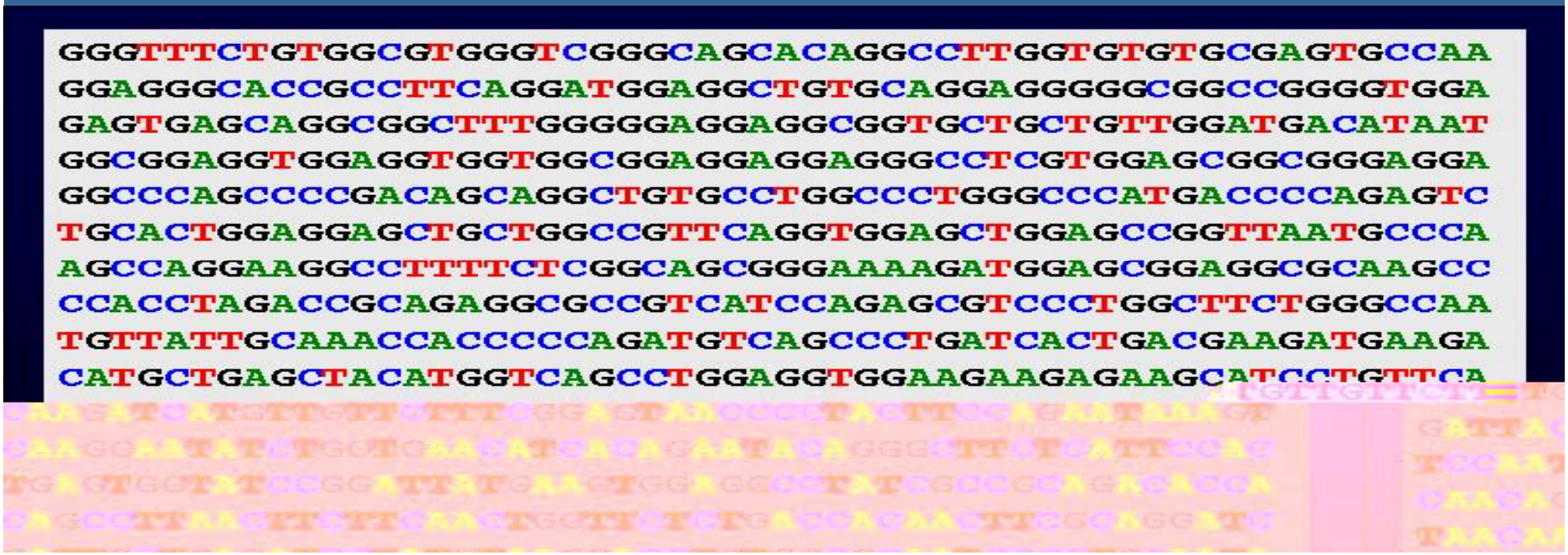
M.Sc. Program in Bioinformatics

- The 1st M.Sc. Bioinformatics in Thailand, started in 2003
- The 2-yr program includes 6 months internship in bioinformatics lab in Thailand and overseas (UQ in Australia, U of Washington in the US, NUS in Singapore, DTU in Denmark)

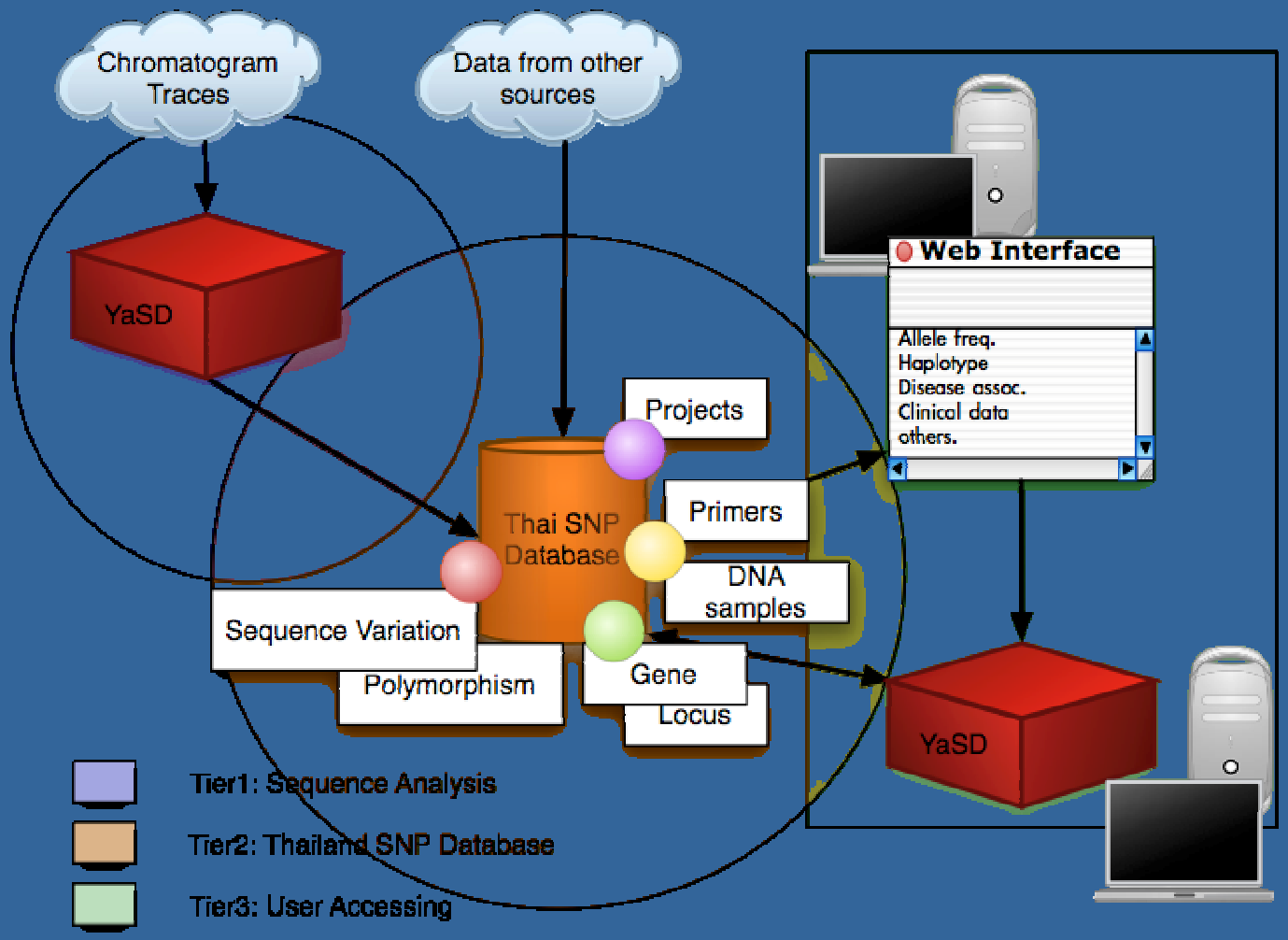
Thailand Single Nucleotide Polymorphism [SNP] Discovery

Centre National de Genotypage, France and BIOTEC, Mahidol U., Chulalongkorn Hospital and Rachanukul Institute,

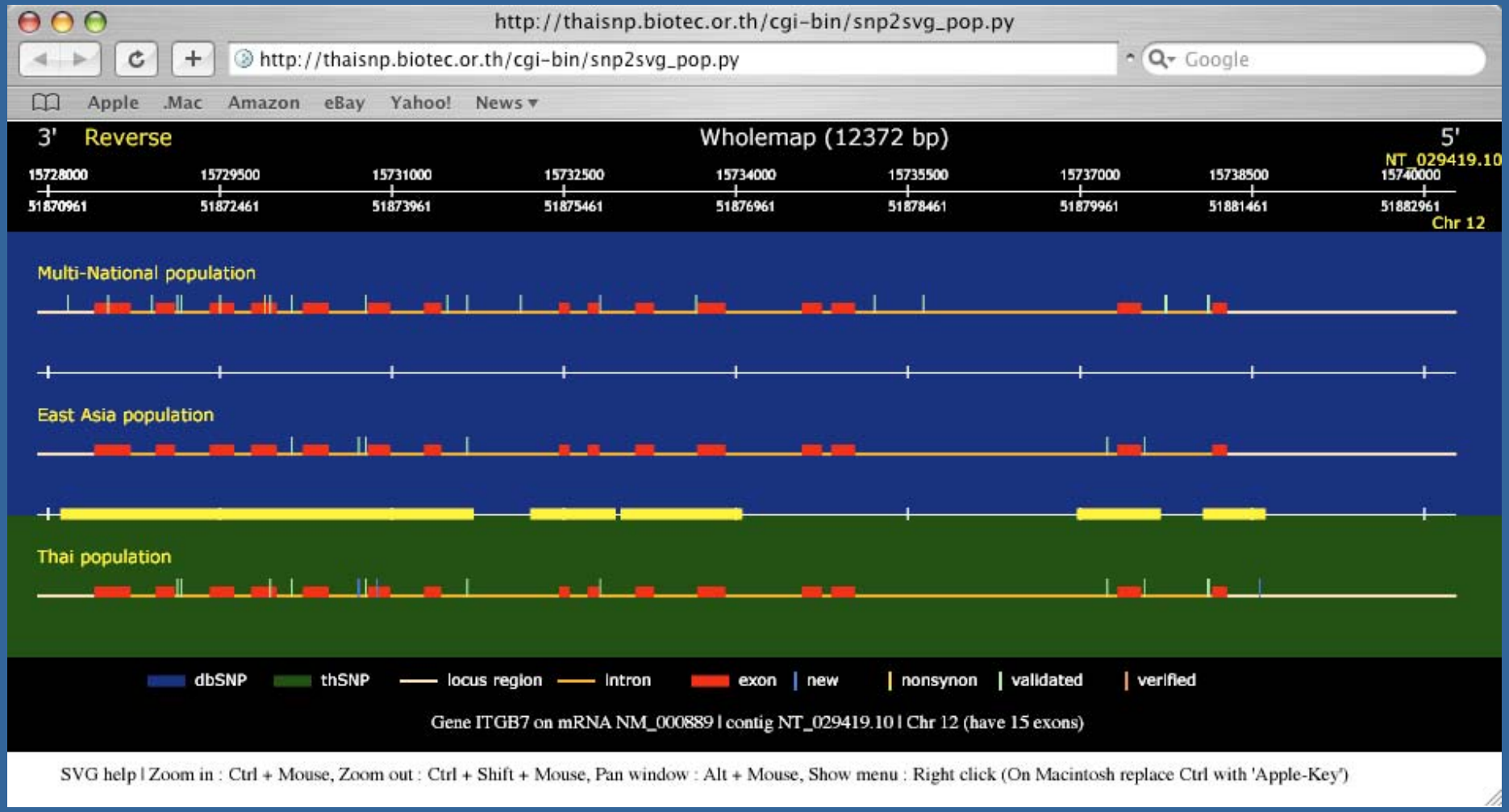
Department of Mental Health, Ministry of Public Health



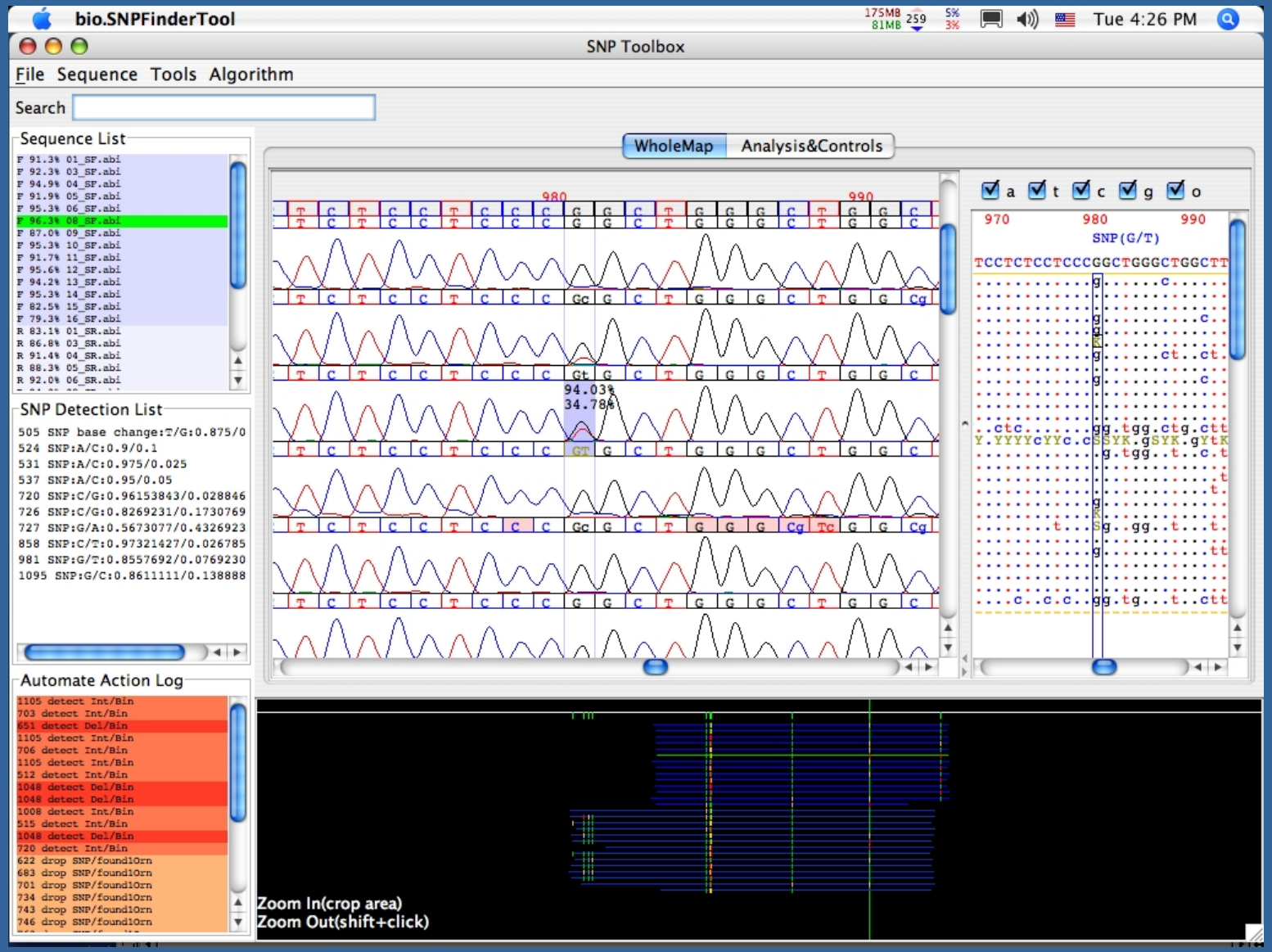
ThaiSNP Database Project

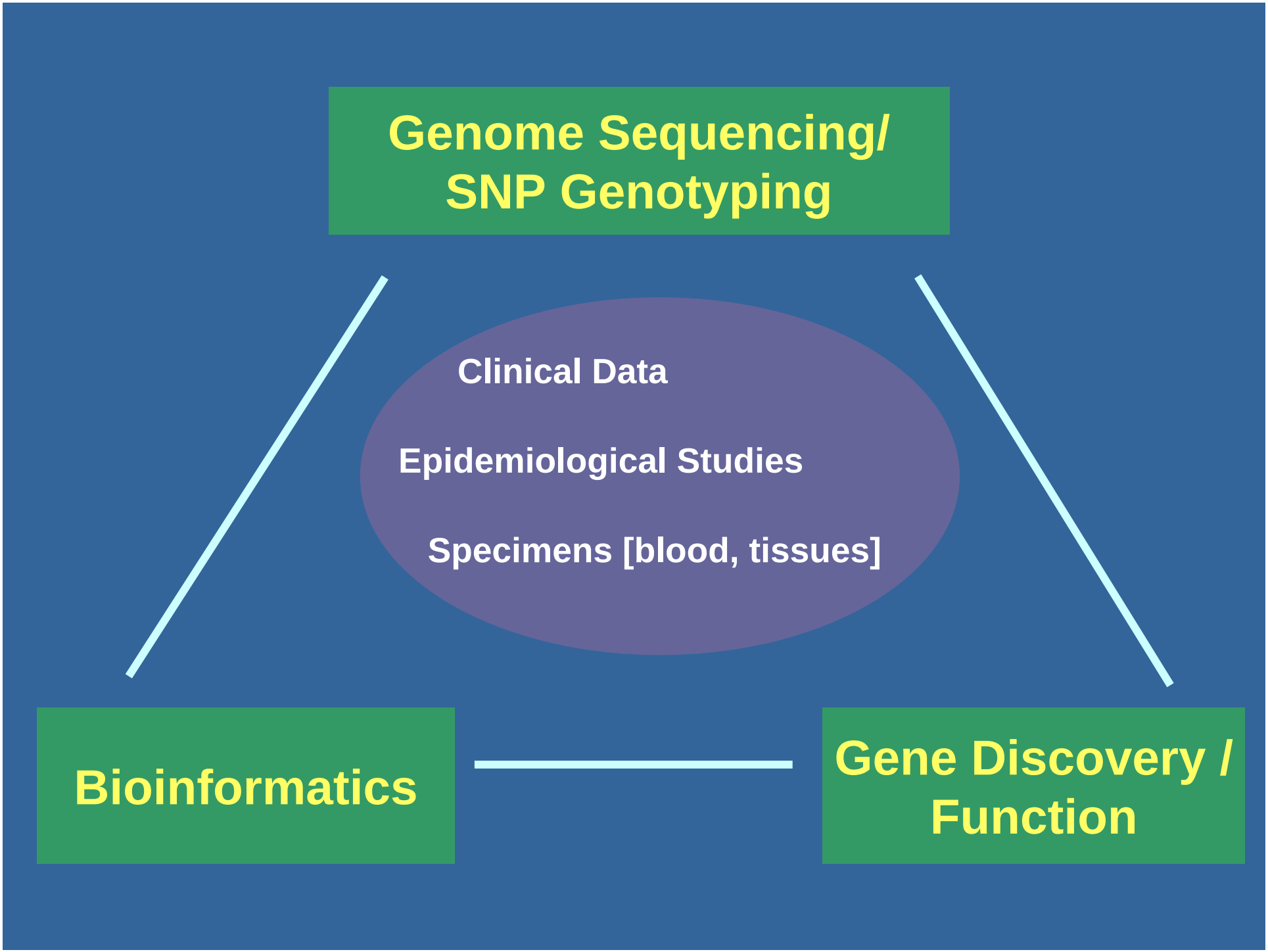


SNPs from different Populations



Automatic SNP Discovery



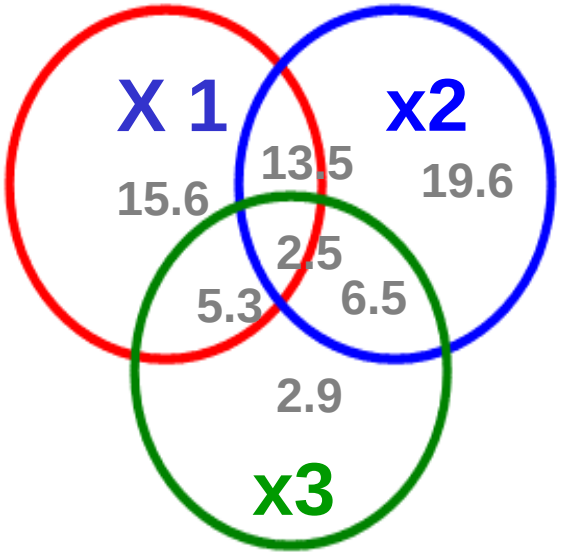

Genome Sequencing/
SNP Genotyping
Clinical Data
Epidemiological Studies
Specimens [blood, tissues]
Bioinformatics
Gene Discovery /
Function

Biomarkers for Osteoporosis

- **10 candidate genes**
- **SNP [each gene] from pubic database**
- **Pooled DNA samples from osteoporosis and non-osteoporosis group [not less than 55 yrs-postmenopausal]**
- **Determined allele frequencies**
- **If any difference, check individual genotyping**
- **Use artificial neural network to integrate the data of SNPs and clinical factors for the prediction of osteoporosis**

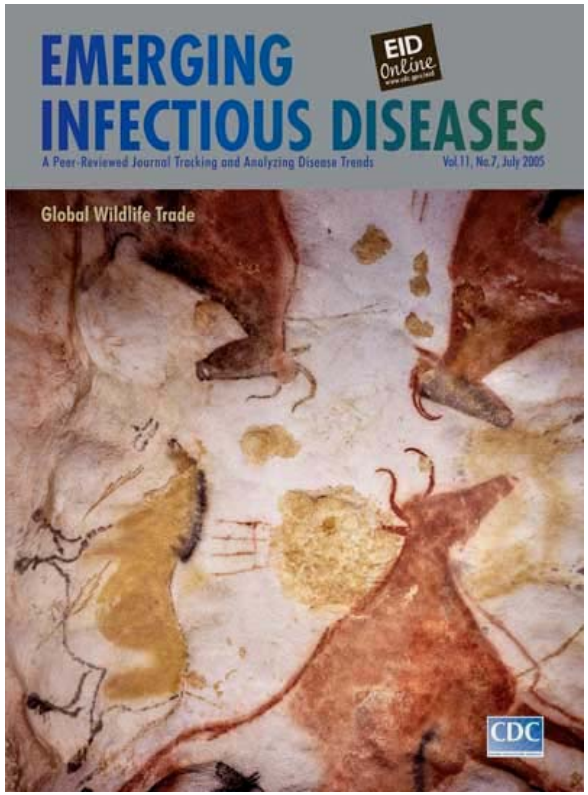
Biomarkers for Osteoporosis

- **Validate on association of marker genes**
- **Individual genotype from 20-40 yrs old [203]**
- **Adverse alleles on marker genes showed lower BMD than no adverse alleles group**
- **Found association of marker genes –genetic testing at younger age for prevention**

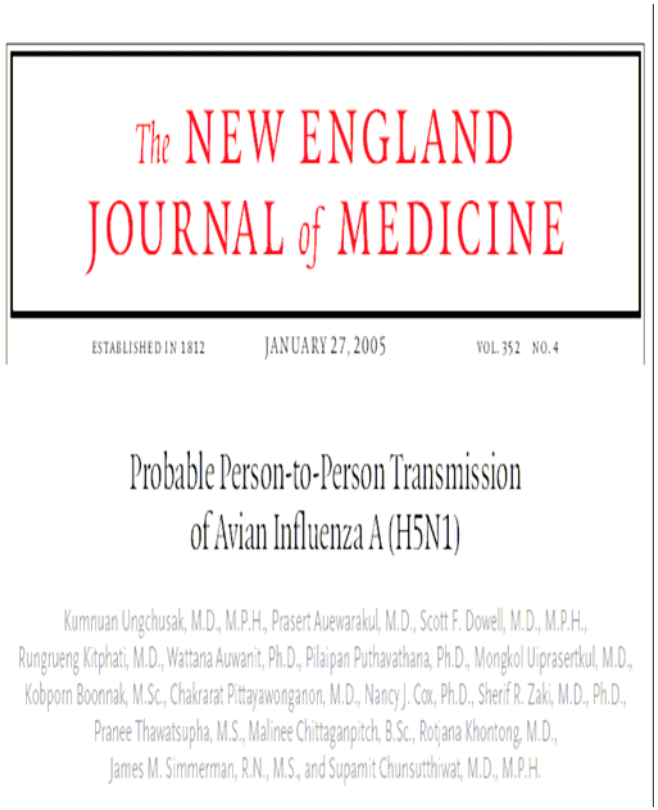


Highlight on Publications

Nature (8 July 2004): Genesis of a highly pathogenic and potentially pandemic H5N1 influenza virus in eastern Asian

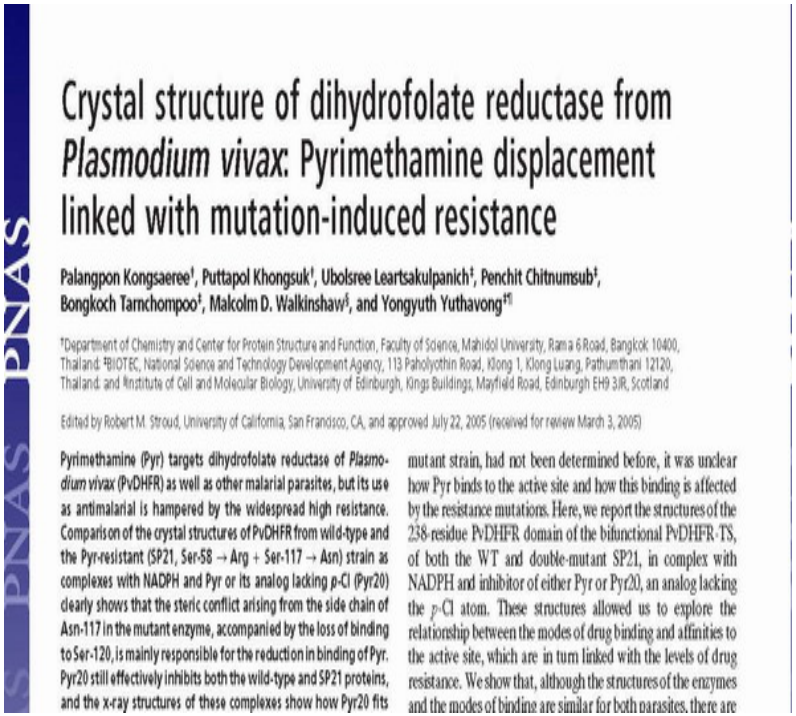


Emerging Infectious Disease (July 2005): Influenza A H5N1 Replication Site in Humans.



New England Journal of Medicine (27 Jan 2005) : Probable person-to-person transmission of avian influenza A (H5N1).

Highlight on Publications



PNAS

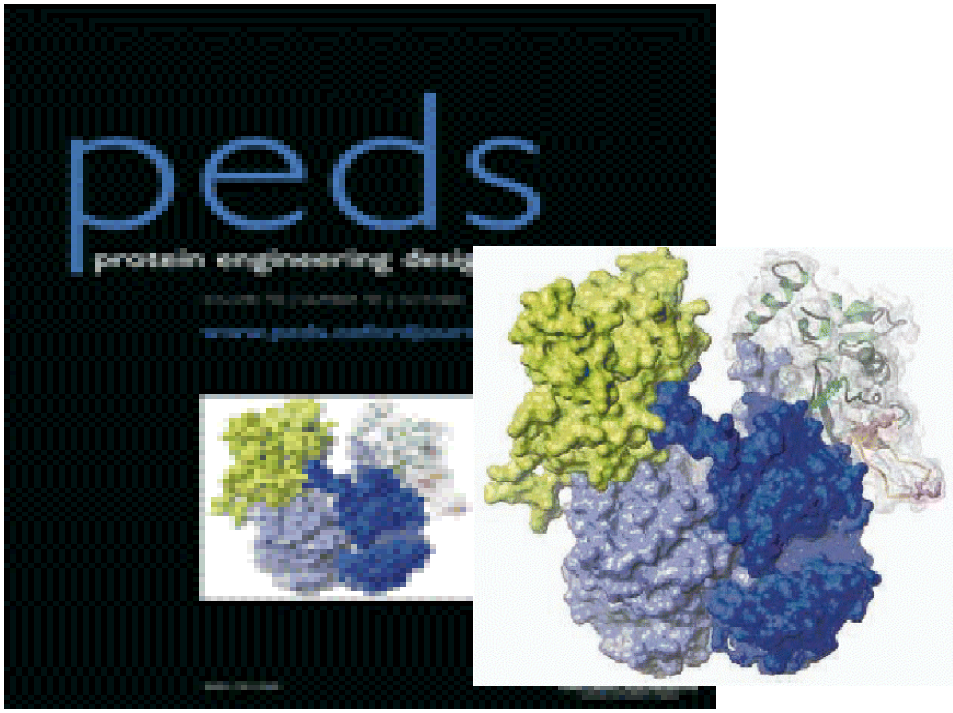
Crystal structure of dihydrofolate reductase from *Plasmodium vivax*: Pyrimethamine displacement linked with mutation-induced resistance

Palangpon Kongsaeree[†], Puttapol Khongsuk[†], Ubolsree Leartsakulpanich[‡], Penchit Chitnumsub[‡], Bongkoch Tarnchompoo[‡], Malcolm D. Walkinshaw[§], and Yongyuth Yuthavong[‡¶]

[†]Department of Chemistry and Center for Protein Structure and Function, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400, Thailand; [‡]BIOTEC, National Science and Technology Development Agency, 113 Paholyothin Road, Klong 1, Klong Luang, Pathumthani 12120, Thailand; and [§]Institute of Cell and Molecular Biology, University of Edinburgh, Kings Buildings, Mayfield Road, Edinburgh EH9 3JR, Scotland

Edited by Robert M. Stroud, University of California, San Francisco, CA, and approved July 22, 2005 (received for review March 3, 2005)

Pyrimethamine (Pyr) targets dihydrofolate reductase of *Plasmodium vivax* (PvDHFR) as well as other malarial parasites, but its use as antimalarial is hampered by the widespread high resistance. Comparison of the crystal structures of PvDHFR from wild-type and the Pyr-resistant (SP21, Ser-58 → Arg + Ser-117 → Asn) strain as complexes with NADPH and Pyr or its analog lacking *p*-Cl (Pyr20) clearly shows that the steric conflict arising from the side chain of Asn-117 in the mutant enzyme, accompanied by the loss of binding to Ser-120, is mainly responsible for the reduction in binding of Pyr. Pyr20 still effectively inhibits both the wild-type and SP21 proteins, and the x-ray structures of these complexes show how Pyr20 fits mutant strain, had not been determined before, it was unclear how Pyr binds to the active site and how this binding is affected by the resistance mutations. Here, we report the structures of the 238-residue PvDHFR domain of the bifunctional PvDHFR-TS, of both the WT and double-mutant SP21, in complex with NADPH and inhibitor of either Pyr or Pyr20, an analog lacking the *p*-Cl atom. These structures allowed us to explore the relationship between the modes of drug binding and affinities to the active site, which are in turn linked with the levels of drug resistance. We show that, although the structures of the enzymes and the modes of binding are similar for both parasites, there are



Proceedings of the National Academy of Sciences of the United States of America, PNAS (13 September 2005) : Crystal structure of dihydrofolate reductase from Plasmodium vivax: Pyrimethamine displacement linked with mutation-induced resistance

Protein Engineering Design and Selection (October 2005) : A simple dual selection for functionally active mutants of Plasmodium falciparum dihydrofolate reductase with improved solubility.

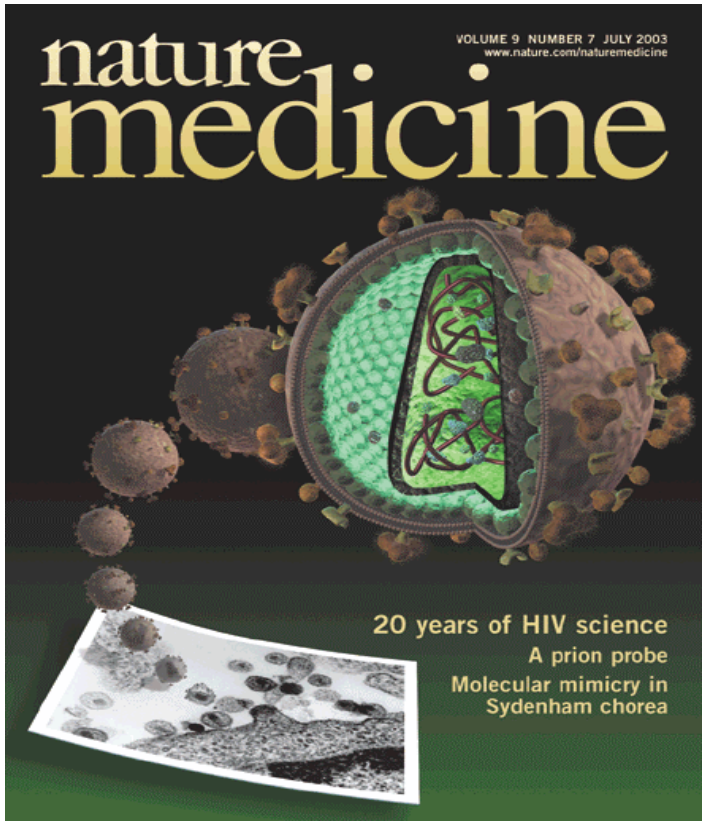
MALARIAL RESEARCH

- **Research grants from various international sources: Medicines for Malaria Venture, WHO, Drugs for Neglected Diseases, EU, INCO-Dev**

- **Dr. Sumalee Kamchonwongpaisan, the 1st Thai to be named HHMI (Howard Hughes Medical Institute) International Research Scholar in 2005. Award includes USD 70,000/yr for a period of 5 years**

Highlight on Publications

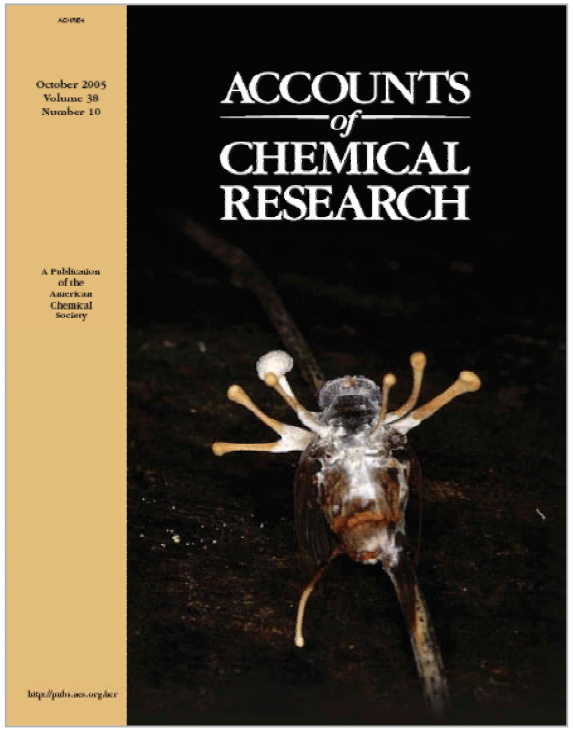
Nature Genetics (1 May 2005) : A variant in the CD209 promoter is associated with severity of dengue disease



Nature Medicine (July 2003) : Original Antigenic Sin and Apoptosis in the Pathogenesis of Dengue Hemorrhagic Fever.

INSECT PATHOGENIC FUNGI

Highlight on Publications



Accounts of Chemical Research (October 2005) : Bioactive Substances from Insect Pathogenic Fungi. The Review Paper was an invited based on over 100 international publications generated by this BIOTEC bioresources research team. The article was number ten on most-accessed articles during Oct – Dec 2005.

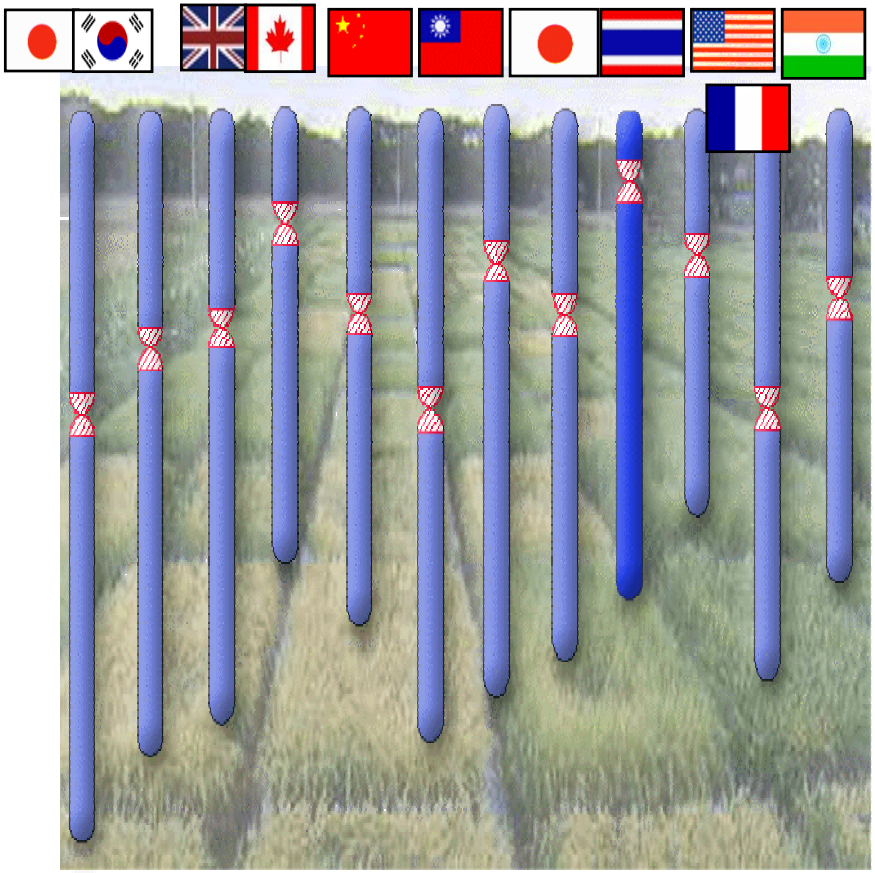
Public-Private Partnership

BIOTEC-Novartis Drug Discovery Partnership
30 March 2005

Public-Private Partnership

BIOTEC and Shiseido Co., Ltd., Japan
24 February 2005

International Rice Genome Sequencing Project



Shrimp Genome Research has been initiated in Thailand in 2003.

- Establish and characterize ESTs from diverse cDNA libraries to increase coverage of *P. monodon* genes.
- EST consortium: Taiwan, Thailand and Japan

CAPACITY BUILDING program for neighboring countries

Establishment of Regional Training Center in Biotechnology

- **Launch in 2004 as a result of the UNESCO Consultative Meeting on the Establishment of a Regional Training Center in Biotechnology**
- **Attract partners to support and co-organize training workshop, short course, research training, scientific conferences, etc.**

Regional Training Center in Biotechnology

- HRD Program for Neighboring Countries
- Regional Training Workshops and Short Courses

Past and present funding organizations and partners

ASEAN FOUNDATION

+ Governments of Thailand, New Zealand, France.

Upcoming activities:

1. HRD Program for Neighboring Countries (starting June 2006)
2. Workshop on Food Safety and Risk Assessment for neighboring countries (co-funded by French Government), 6-9 Nov 2006

HRD for Neighboring Countries and Pacific Islands

• Short and medium term training at BIOTEC laboratories (3-12 months).

• Operated since 2001 targeting at Cambodia, Laos, Myanmar and Vietnam. Pacific Islands has been added in 2005 with special funding from the New Zealand Gov.

• From 2001-2005, 46 scholarships have been granted. At least 6 former trainees are now studying in Germany, Canada and AIT in Thailand.

BUSINESS AND COMMERCIALIZATION

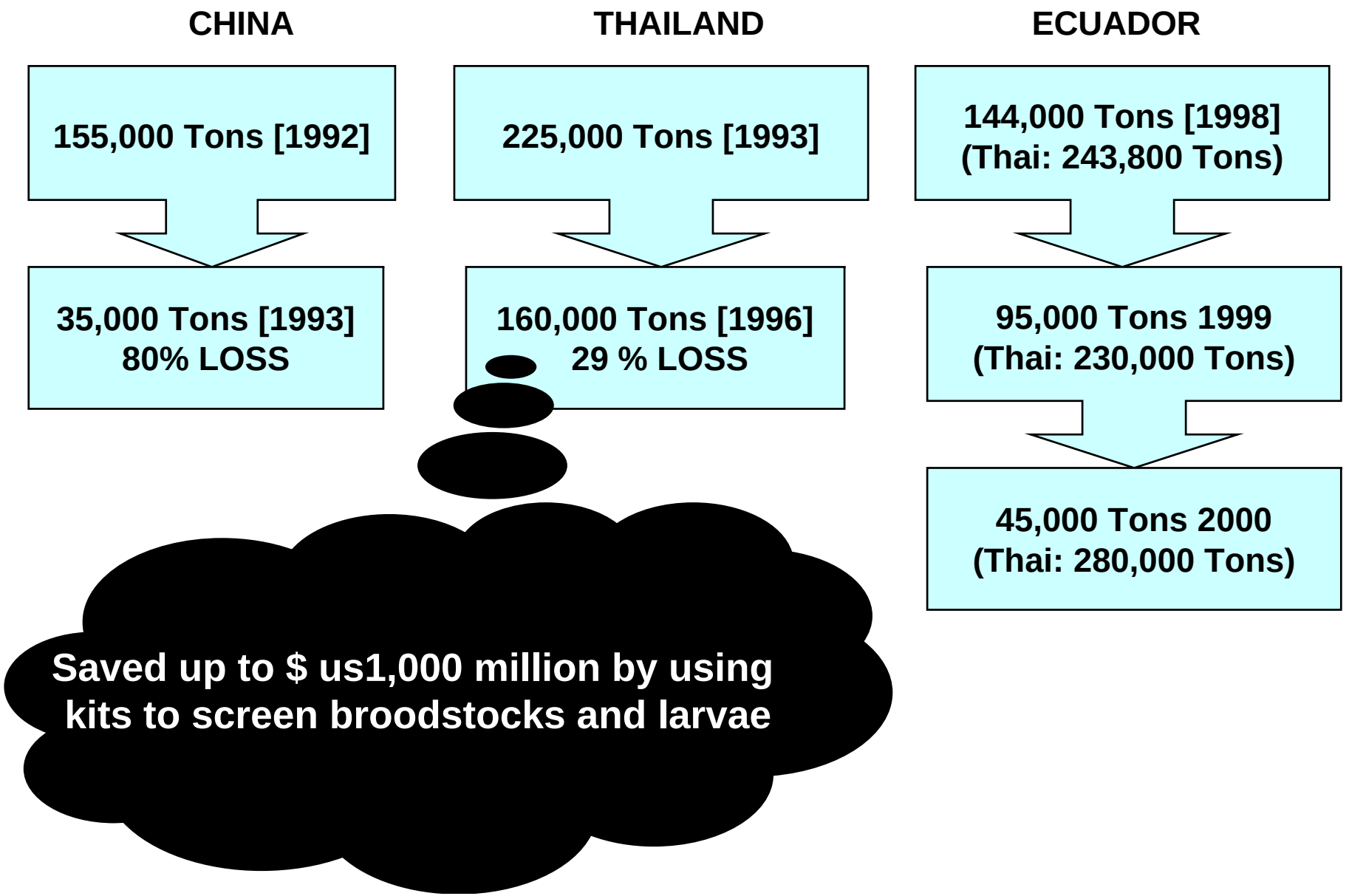
Shrimp Culture Research and Development Co., Ltd.
(joint venture with Inve Co., Ltd.)

Shrimp Biotechnology Business Unit (SBBU)

- manufacture and market test kits for shrimp diseases (YHV, WSSV, IHHNV, HPV, MBV)
- consultancy for farm management and disease control


Ezee Gene
PCR Test Kit

Loss of Shrimp Aquaculture from White Spot Syndrome Virus in China, Thailand and Equador

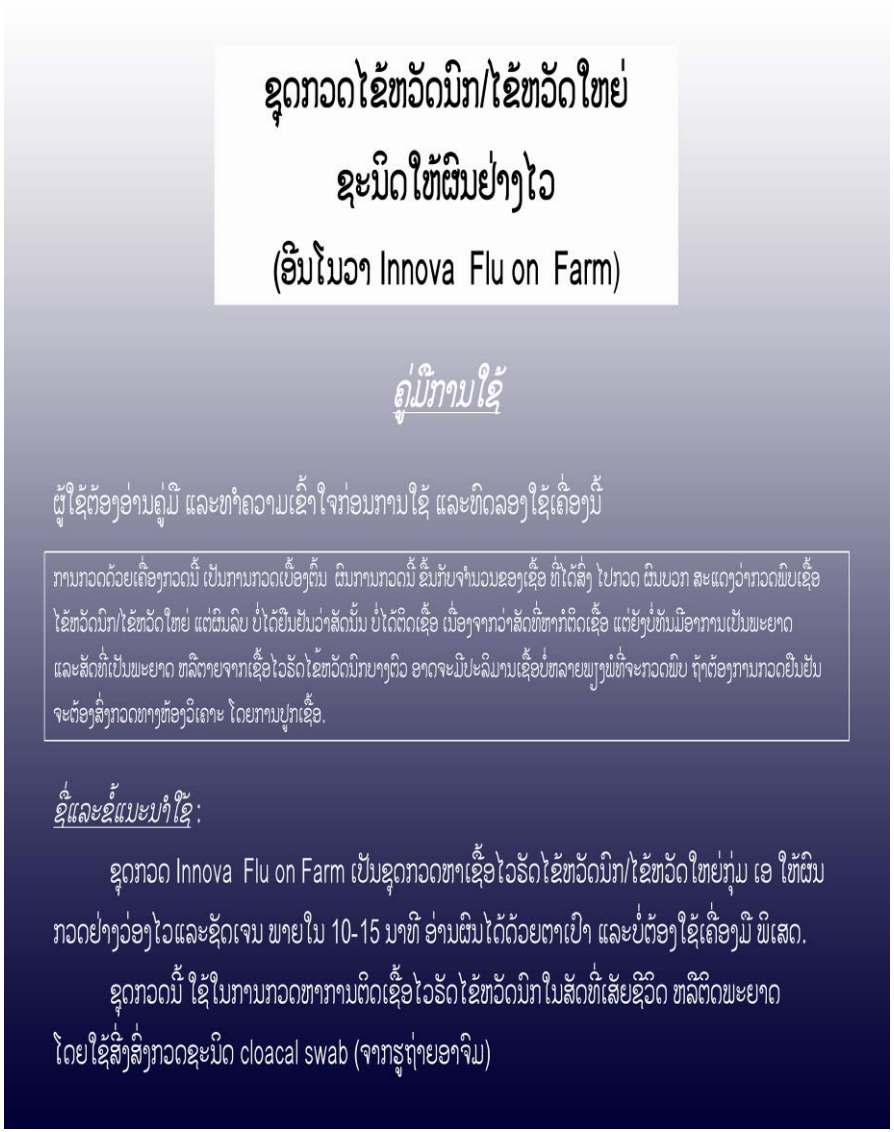


JOINT INVESTMENT

- INNOVA Biotechnology Co., Ltd.

INNOVA Flu A kit in Myanmar

INNOVA Flu A kit in Laos (on farm)



Legal tools /measures for bioresources

- Material Transfer Agreement (MTA)
- Material Acquisition Agreement (MAA)
- Confidentiality Agreement (CA)
- Licensing Agreement (LA)

1 or 2 page document can do the job

“Nucleic acids that enhance the synthesis of 2-acetyl-1-pyrroline in plants and fungi” patent also been applied in the following countries, besides the US [25 Jan 2005]

Country	Filing date
Australia	25 July 2005
China	15 Dec 2005
Philippines	22 Dec 2005
Thailand	24 Jan 2006
Japan	24 Jan 2006
Vietnam	24 Jan 2006
India	24 Jan 2006
France	24 Jan 2006
EPO System	24 Jan 2006

INTERNATIONAL COOPERATION

SCIENCE PARKS IN THAILAND

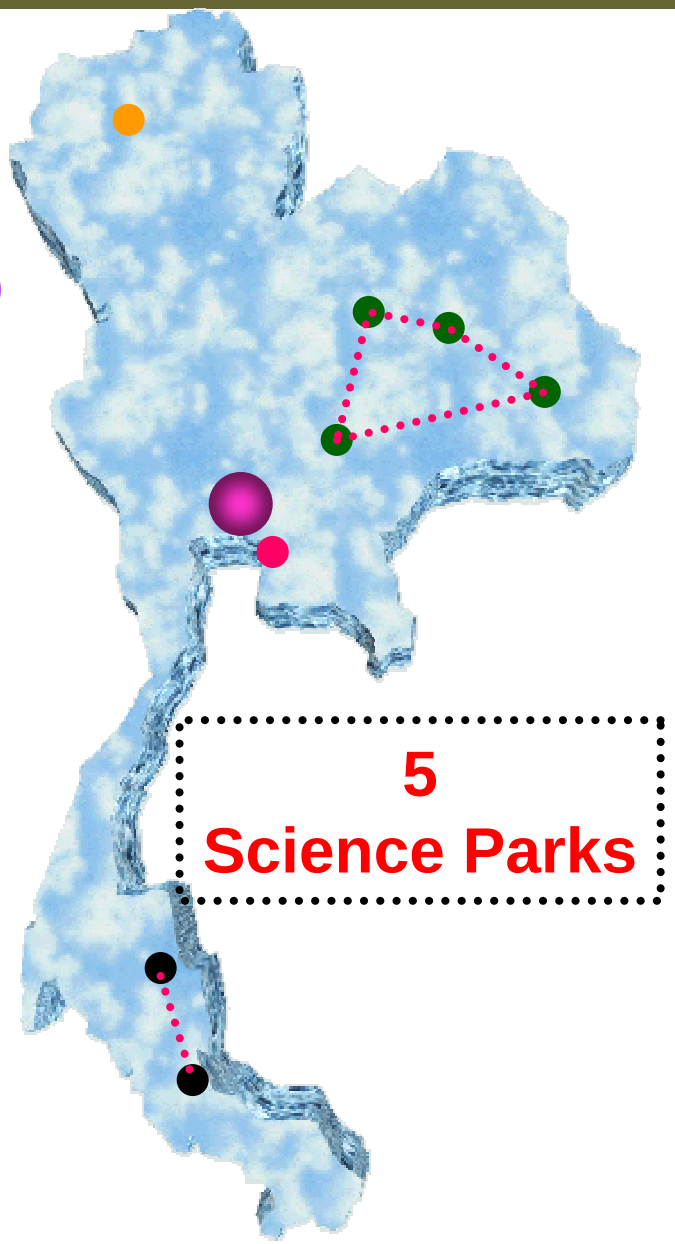
Northern Science Park
- Chiang Mai

Northeastern Science Park (2 locations)
- Khon Kaen and Nakorn Ratchasima
- With 4 Technology Business Incubators

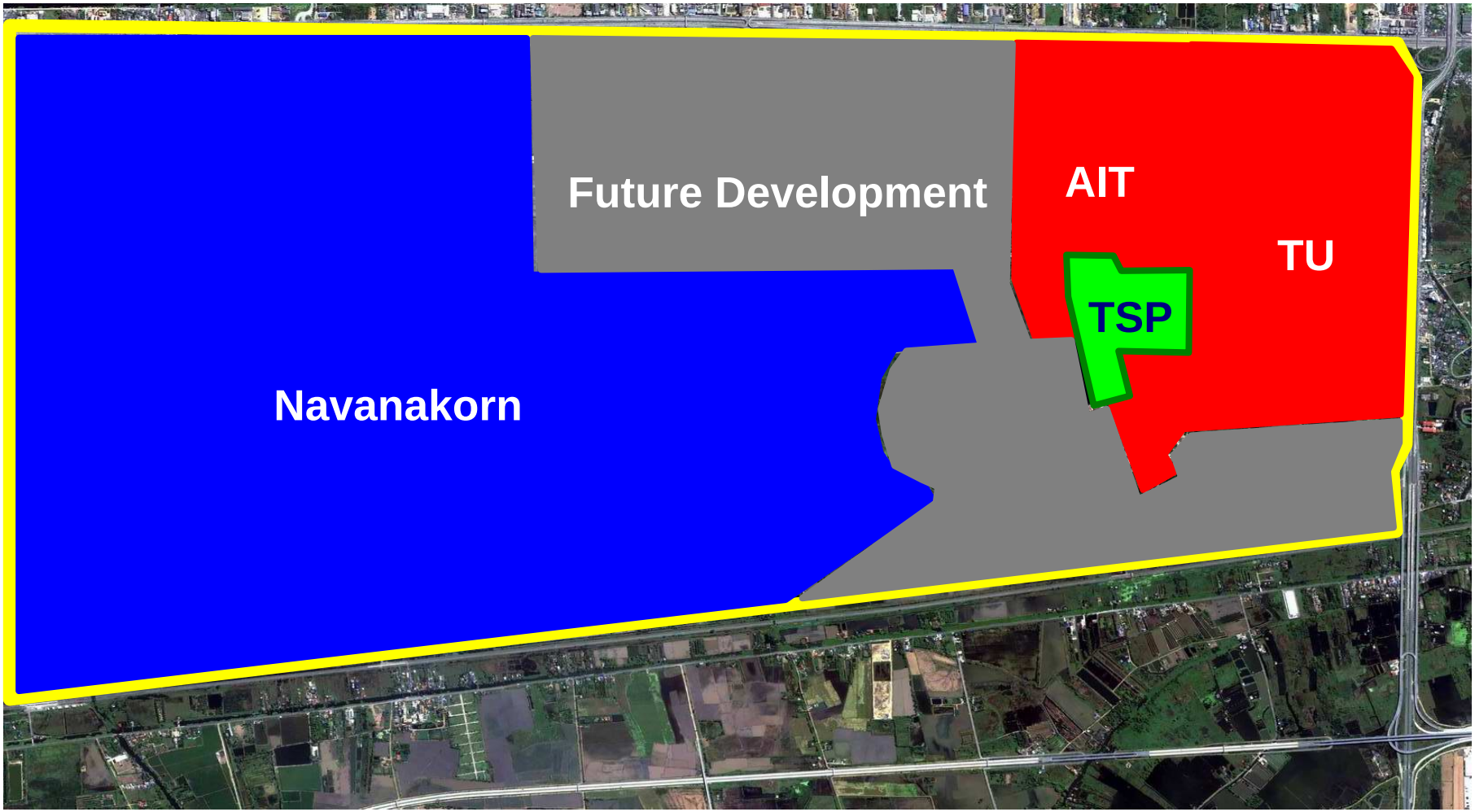
Thailand Science Park (Central)
- Patumthani

Eastern Science Park
- Chonburi

Southern Science Park
- Songkhla
- With 2 Technology Business Incubators



An Emerging S&T City of Thailand



Manufacturing Activities Industrial Research Activities Human Resource Activities

Thank You

http://www.biotec.or.th

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