

SINGAPORE'S BIOMEDICAL RESEARCH

Singapore has devoted significant resources during the past decade to build a critical mass in cutting-edge research and development in the biomedical sciences. In line with the goal of government to deliver the economic impact and the global trends, the next phase of research will have more translational focus and clinical and industry relevance while sustaining the core excellence of basic research in cell biology, molecular biology, and genomics so that a proper balance between basic research, translational research, clinical research, industry collaboration and application is achieved.

Research is conducted in the universities, research institutes, and medical centres. The two major universities are the National University of Singapore (NUS) and the Nanyang Technology University (NTU). Life sciences and biomedical research in NUS is based in the Department of Biological Sciences (<http://www.dbs.nus.edu.sg/>) and various departments in the Yong Loo Lin School of Medicine (<http://medicine.nus.edu.sg/corporate/>). In addition, a few research centers and institutes were also created and are located in the NUS such as the Cancer Science Institute of Singapore (<http://www.csi.nus.edu.sg/web/Common/homepage.aspx>), the Mechanobiology Institute (<http://www.dbs.nus.edu.sg/mechano/>), the Temasek Life Sciences Laboratory (<http://www.tll.org.sg/>), and the NUS Centre for BioImaging Sciences (<http://cbis.nus.edu.sg/>). The Singapore government (with participation of A*STAR) and Duke Medical School has created Duke-NUS Graduate Medical School (<http://www.duke-nus.edu.sg/web/index.php>) which hosts vibrant basic and clinical research programs to train graduate medical students. At NTU (<http://www.ntu.edu.sg/Pages/default.aspx>) the School of Biological Sciences (<http://www.sbs.ntu.edu.sg/Pages/Home.aspx>) has a well-established PhD program and the newly established Lee Kong Chian School of Medicine in partnership with Imperial College of Medicine (<http://www.lkcmedicine.ntu.edu.sg/Pages/index.aspx>) conducts basic and clinical research.

The first research institute was Institute of Molecular and Cell Biology (IMCB) (<http://www.imcb.a-star.edu.sg/php/main.php>) founded in 1987. Originally a part of the National University of Singapore (NUS) (<http://www.nus.edu.sg/>), IMCB later became an autonomous research institute (RI) of the Agency for Science, Technology and Research (A*STAR) (<http://www.a-star.edu.sg/>). Since 2000, the Singapore government and A*STAR have strengthened the biomedical research community through the establishment of other RIs and consortia/centers under the umbrella of Biomedical Research Council (BMRC) (<http://www.a-star.edu.sg/AboutASTAR/BiomedicalResearchCouncil/tabid/64/Default.aspx>). These other RIs and consortia are located at Biopolis (http://www.one-north.sg/hubs_biopolis.aspx), a biomedical hub that also hosts common shared facilities/resources, and include the Genome Institute of Singapore (GIS), Institute for Medical Biology (IMB), Institute of Bioengineering and Nanotechnology (IBN), Bioprocessing Technology Institute (BTI), Bioinformatics Institute (BII), Singapore Institute for Clinical Sciences (SICS), Singapore Immunology Consortium (SigN), Singapore Bioimaging consortium (SBIC), Experimental Therapeutics Center (ETC), and the p53 Lab. Biopolis is the site for industry-based research efforts such as the Novartis Institute for Tropical Diseases (Chugai Pharmabody Research Pte. Ltd. , and the Procter & Gamble (P&G) Innovation Centre Singapore.

In addition to A*STAR and the universities, there are also other research institutes and centers primarily based in hospitals such as National Cancer Centre Singapore (NCC) (<http://www.nccs.com.sg/>), the Singapore Eye Research Institute (<http://www.seri.com.sg/>), and the National Neuroscience Institute (<http://www.nni.com.sg/>). In addition to the two medical schools with strong partnership with Duke University and Imperial College of Medicine, several partnering research initiatives have been established such as Singapore-MIT Alliance for Research and Technology (SMART) (<http://smart.mit.edu/>).

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Minister's Office, the Academic Research Fund (AcRF) of the Ministry of Education, the National Medical Research Council (NMRC) (<https://www.nmrc.gov.sg/corp/index.aspx>) of the Ministry of Health, and the Temasek Trust (http://www.temasekholdings.com.sg/media_centre_news_releases_160507.htm).

The current focus to recruit young and promising scientists to Singapore is evidenced by the prominent NRF Fellowship (<http://www.nrf.gov.sg/nrf/otherprogrammes.aspx?id=142>), which aim to attract the best young scientists to Singapore to conduct independent research. To facilitate the collaboration between basic scientists and medical doctors and to enhance translational research, A*STAR and NMRC have established several programs such as the Singapore Translational Research Award and the Clinical Scientist Award programs.

Training the next generation of scientists is another important aspect in Singapore's biomedical efforts. PhD students are trained in the universities at NUS DBS and Medical School and Duke-NUS Medical School. The NUS Graduate School for Integrative Sciences and Engineering (NGS) (<http://www.nus.edu.sg/ngs/>), attracts the Ph.D. students both locally and internationally. Similarly, NTU hosts various Ph.D. programs (<http://admissions.ntu.edu.sg/graduate/scholarships/Pages/ResearchScholarship.aspx>). Working with NUS and NTU, A*STAR has established an attractive Ph.D. program called the Singapore International Graduate Award (SINGA) (<https://www.singa.a-star.edu.sg/>). The program aims to recruit international students to pursue Ph.D. training in A*STAR RIs, NUS and NTU. The A*STAR Graduate Academy (A*GA) (<http://www.a-star.edu.sg/AboutASTAR/ASTARGraduateAcademy/tabid/74/Default.aspx>) has recruited over 1000 Singaporean scholars who are at various stages of pursuing doctoral studies in major research universities in the US, UK, and locally in A*STAR RIs, NUS and NTU. The collective efforts of A*STAR, NUS and NTU will have huge impact in training the future scientists and nurturing future leaders to sustain the momentum in biomedical research and future clinical and translational research.