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MEDIA RELEASE

Kits to revitalize classroom teaching

IBN's Nano-Bio Kits help teachers show the latest applications in bioengineering and nanotechnology through interactive experiments

SINGAPORE, March 9, 2007 – The Institute of Bioengineering and Nanotechnology (IBN) is arming teachers here with new tools to revitalize their teaching of science in the classrooms. IBN today launched a series of educational Kits to help secondary school and junior college teachers inject cutting-edge concepts in their laboratory lessons. Minister of State for Trade and Industry Mr S Iswaran unveiled the Kits to some 400 students and teachers at the Institute's Open House for Schools at the Biopolis today.

Aimed at students between the ages of 15 and 19, the IBN Nano-Bio Kits feature interactive experiments and lessons on practical applications in nanobiotechnology, drug delivery and medical devices. The first three Kits in the range include the Biological Fuel Cell Kit, the Thermo-responsive Hydrogel Kit, and the Dielectrophoresis Chip Kit, and they come equipped with lesson plans, background readings, experimental components and instructions, as well as worksheets and quizzes. Teachers are also provided with worksheet answers, experimental instructional videos, and slides to help them plan lesson modules based on the scientific topics relevant to each Kit.

The first Kit in the series, the **Biological Fuel Cell Kit**, demonstrates how biochemical energy may be converted into electricity using enzymes that are fixed on nanoparticles. Bio-fuel cells are a 'green' alternative to conventional energy sources, as they run on sugar solutions and are emission-free. Students can assemble their own bio-fuel cell with the materials provided in the Kit and learn the basics of fuel cell technology and chemical processes. "Students will have fun assembling this kit and learning about how electricity can be generated from sugar. It also provides teachers with high-quality educational materials that supplement the curriculum," said IBN Research Scientist Dr Edwin Chow Pei Yong, who designed the Biological Fuel Cell Kit.

The **Thermo-responsive Hydrogel Kit** illustrates how a thermo-sensitive material is made, and how the rate of diffusion of particles within the material is altered at different temperatures. Practical applications of such materials include controlled and targeted drug delivery systems for disease treatment. Students can synthesize the hydrogel and study its behavior at different temperatures. They can also observe how particles diffuse through the hydrogel. Said its inventor, IBN Senior Research Scientist Dr Motoichi Kurisawa: "IBN's Thermo-responsive Hydrogel Kit helps students understand basic polymer science and drug delivery systems. They can make their own hydrogels and learn the significance and importance of this technology in creating a novel drug delivery system."

The **Dielectrophoresis Chip Kit** shows how cells behave under dielectrophoresis (DEP), which is the movement of an object in a non-uniform electrical field. "How can we use an electric field to capture a cell that is less than 1/10th the diameter of a strand of hair? How can we make a device with micrometer-sized features? With the DEP Chip Kit, students can find out the answers to these questions through simple lab experiments," said IBN Research Officer Xu Guolin. DEP is commonly

used in numerous biological applications for cell manipulation, separation and characterization for diagnostics and drug discovery. Students can produce their own DEP chips using basic photolithography techniques and observe the movement of cells on these chips.

Through the scientists' discussions with teachers at IBN's first Workshop for Teachers in December 2004 and interactions with students and teachers on attachment at IBN, it was clear that there was a pressing need for teachers to familiarize their students with the latest biomedical technologies and concepts in their classrooms. Hence, the Institute has worked with selected schools and research attachment teachers over the past year to conceptualize and design interactive experiments that can be conducted in school laboratories using its series of Nano-Bio Kits.

Three rounds of field trials were subsequently held at 12 selected secondary schools and junior colleges. The Kits were so popular with the students and teachers at these schools that IBN sold over 100 of them ahead of their official launch. Anglo-Chinese School (Independent), Hwa Chong Institution, Raffles Institution, and National Junior College have incorporated the use of the Kits in their school curriculum and IBN scientists have conducted enrichment courses at these schools. In addition, the Institute has sold the Kits to Anderson Junior College, Nanyang Polytechnic, Singapore Polytechnic, National University of Singapore and United World College (South-east Asia).

"What is most exciting about the Biological Fuel Cell Kit is that students can learn through hands-on experiments about concepts such as electrochemistry, electricity and respiration," said Mr Joseph Chong, a science teacher at Raffles Institution. Ms Elaine Quah, a senior teacher for Biology who teaches lower secondary pupils in the Gifted Education classes at Raffles Institution, also said: "The Kits provide a refreshing way of teaching topics across the disciplines within the science domain and gives an excellent opportunity for us to introduce nanotechnology and its application to our young students."

Added Mr Chong's student Marc Tan Jia Renn: "I was pleasantly surprised that experiments on topics of such an advanced level could be scaled down to our level in the laboratory."

National Junior College teacher Ms Ong Yann Shiou said the Thermo-responsive Hydrogel Kit allowed her students to conduct interesting experiments illustrating drug delivery easily in the school laboratory. "The students enjoyed themselves thoroughly during the lesson."

Mr Sukandar Hadinoto who teaches chemistry at the NUS High School of Mathematics and Science added that the Dielectrophoresis Chip Kit was very useful in demonstrating real-world applications. He said: "The Kit provided an insight into the concentration of electric fields, and how this could be used in lab-on-chip applications."

IBN will be holding quarterly workshops for all teachers who are interested in using the Kits in enrichment courses or as part of their school curriculum.

The Nano-Bio Kits have also attracted interest from overseas. The Japanese National Museum of Emerging Science and Innovation (Miraikan) learnt about IBN's initiative through its Nano-Bio Kit website (www.nano-biokit.com) and has invited the Institute to showcase the Kits as one of the exhibits at the "SCIENCE NEWS! from Asia" event in June. The three-month exhibition will showcase Asia's achievements in science, and the Nano-Bio Kits have been selected to demonstrate Singapore's educational and scientific efforts in the new technologies. Enquiries are also coming in from other Asian countries, Australia, Canada, and the United States.

To help IBN kick-start the Nano-Bio effort, Exploit Technologies Pte Ltd, the commercialization arm of the Agency for Science, Technology, and Research (A*STAR), had provided IBN with S\$150,000 in funding for the marketing and production of the Kits, as part of Exploit's Commercialization of Technology (COT) initiative. The Institute is currently looking for industrial partners to target the overseas markets.

"The Nano-Bio Kits are testaments of how science empowers students in their creative learning. Exploit Technologies is committed to promoting the creative Kits to teachers and students in Singapore and overseas through our funding and active marketing. It is remarkable that the Kits have received orders and spawned interests in Asia, the USA and Australia prior to its official launch. We are seeking to spin-off the technology into a company or licensees who can market the Kits to help the students," noted Dr Muhammad Tani bin Tabiin, Assistant Manager, Biomedical Sciences, Exploit Technologies.

The Nano-Bio Kits are part of IBN's overall efforts to cultivate an active research culture among the young in Singapore under its Youth Research Program (YRP), which was established in 2003. Through the YRP, the Institute hopes to encourage more Singaporean youth to take up careers in research by exposing them to the exciting possibilities in the biomedical industry through activities such as open houses, workshops, career talks and research attachments. This multi-faceted Program has attracted more than 13,500 participants to date, among whom are 617 students and teachers who have undergone full-time attachments at the Institute.

"Our young people are integral to the success of Singapore's biomedical sciences initiative," said IBN Director Noreena AbuBakar, who established and chairs the YRP. "Through our outreach efforts, we will continue to provide our youth with opportunities to experience research at the cutting-edge of bioengineering and nanotechnology, with the hope that they will become world-class scientific talents in the future."

Please refer to Annex A for more details on the Nano-Bio Kits. Annex B contains a fact sheet on IBN's YRP.

About the Institute of Bioengineering and Nanotechnology (IBN)

The Institute of Bioengineering and Nanotechnology (IBN) is a member of the Agency for Science, Technology and Research (A*STAR). Established in March 2003, the Institute's mission is to establish a broad knowledge base and conduct innovative research at the interface of bioengineering and nanotechnology. Positioned at the frontiers of engineering, IBN is focused on creating knowledge and cultivating talent to develop technology platforms that will spur the growth of new industries. IBN also fosters an exciting, multidisciplinary research environment for the training of students and young researchers to spearhead biomedical advancement in Singapore. For more information, visit www.ibn.a-star.edu.sg.

For media queries and interviews, please contact:

Adeline Goh (IBN)
DID: +65 6824 7004
HP: +65 9686 3160
agoh@ibn.a-star.edu.sg

Nidyah Sani (IBN)
DID: +65 6824 7005
HP: +65 9762 9720
nidyah@ibn.a-star.edu.sg

Shawn Tan (Exploit
Technologies)
DID: +65 6478 8425
HP: +65 9678 4570
shawn@exploit-tech.com

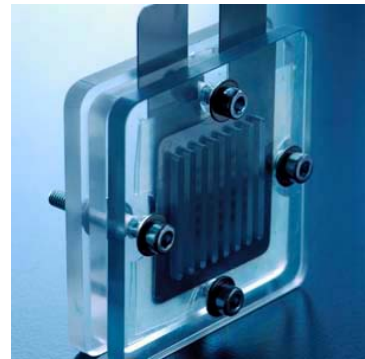
Annex A: IBN Nano-Bio Kit Fact Sheet

The Institute of Bioengineering and Nanotechnology (IBN) has specially designed and created Nano-Bio Kits, a teaching resource, to help teachers introduce cutting-edge research in bioengineering and nanotechnology to their 15- to 19-year-old students. These Kits enable students to conduct a series of experiments, which illustrate various scientific concepts and techniques, in their school laboratories using commonly available equipment. The Nano-Bio Kits demonstrate aspects of IBN's research and emphasize practical applications in nanobiotechnology, drug delivery and medical devices. The first three Kits in the series are the Biological Fuel Cell Kit, Thermo-responsive Hydrogel Kit and Dielectrophoresis Chip Kit. Each Kit contains lesson plans, experimental components and instructions in a manual, which equips teachers with background scientific knowledge related to the Kit. Questions are also provided for students to apply the learning points taught in the lessons. An interactive multimedia CDROM in each Kit provides instructional ideas and slides.

Biological Fuel Cell Kit

This Kit demonstrates how biochemical energy may be converted into electricity using enzymes immobilized on nanostructured particles. Biofuel cells are a 'green' alternative to conventional energy sources, as they run on sugar solutions and are emission-free. Students can assemble their own biofuel cell with the materials provided in the Kit.

- 1 Kit per student or group of 2-4 students
- Price: SGD120 (excl. GST); Consumables can be purchased separately.



Thermo-Responsive Hydrogel Kit

This Kit shows how a thermo-sensitive material is synthesized, and how the rate of diffusion of particles within the material is altered at different temperatures. Practical applications include controlled and targeted drug delivery systems for disease treatment. Students can synthesize a thermo-responsive hydrogel through polymerization, and study its behavior at different temperatures. They can also observe how particles diffuse through the hydrogel.

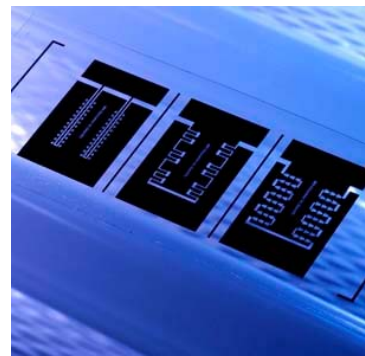
- 1 Kit per student or group of 2-4 students
- Price: SGD60 (excl. GST); One-time use only.



Dielectrophoresis Chip Kit

This Kit illustrates how cells behave under dielectrophoresis (DEP). DEP is commonly used in numerous biological applications for cell manipulation, separation and characterization. Students can fabricate their own DEP chips using basic photolithography techniques. They will also be able to control the movement of cells on their DEP chips.

- 1 Kit per group of 15 students
- Price: SGD100 (excl. GST); Consumables can be purchased separately.



Annex B: IBN Youth Research Program Fact Sheet

The Institute of Bioengineering and Nanotechnology (IBN) began its Youth Research Program (YRP) in October 2003 with the objective of exposing young Singaporeans to cutting-edge scientific research in bioengineering and nanotechnology. The Program, established and chaired by IBN Director Noreena AbuBakar, aims to give students a first-hand experience in research, so as to instill in them an appreciation of the impact of biomedical research in their daily lives and to foster their interest in scientific pursuit. In addition, the YRP reaches out to teachers to help them incorporate the latest advances in science in their school curriculum. It also targets parents, who play a major role in nurturing their children's interests and career aspirations.

The YRP activities include:

- Open Houses
- Visits
- Workshops
- School Talks
- Career Fairs
- Research Attachments for students and teachers
- Development of Educational Kits

To date, more than 13,500 students and teachers from 169 schools have been involved in IBN's YRP. The Institute has organized 29 Open Houses and workshops, and participated in 54 career talks and exhibitions at junior colleges, polytechnics and universities. So far, it has received more than 1,070 research attachment applications from students and teachers, some of whom are from the USA, Europe and other parts of Asia. Over 600 students and teachers have been on full-time attachments at IBN. They received a chance to carry out research for at least a month, under the supervision of IBN scientists. More than 60 of them have returned for subsequent attachments and some have gone on to win local and international awards for their IBN research projects.

This year, the YRP expanded its scope with the IBN Nano-Bio Kits (www.nano-biokit.com) to help teachers introduce concepts in bioengineering and nanotechnology to their students. Targeted at 15- to 19-year-old students, the Biological Fuel Cell, Thermo-Responsive Hydrogel and Dielectrophoresis Chip Kits feature experiments and lessons on practical applications in nanobiotechnology, drug delivery, and medical devices. IBN has since sold over 100 sets of these Kits to interested schools ahead of their official launch on March 9, 2007. More information on the Nano-Bio Kits is available at www.nano-biokit.com.

For further details on the YRP and its calendar of events, please log on to yrp.ibn.a-star.edu.sg.