CAREERS IN NANOSCIENCE & NANOTECHNOLOGY:

A SOUTH AFRICAN PERSPECTIVE

AN OVERVIEW OF THE NANOTECHNOLOGY PUBLIC ENGAGEMENT PROGRAMME (NPEP)

The NPEP is an initiative funded by the Department of Science and Technology (DST) and implemented by the South African Agency for Science and Technology Advancement (SAASTA), the business unit of the National Research foundation (NRF). Launched in early 2008, the NPEP programme aims to promote credible, fact based understanding of nanotechnology through awareness, dialogue and education to enable informed decision making on nanotechnology innovations to improve the quality of life.

The objectives of the Nanotechnology Public Engagement Programme are to:

- Create awareness around nanotechnology;
- Educate the public on, and enhance their understanding of nanotechnology;
- Enable and stimulate meaningful public debate around nanotechnology;
- Stimulate interest in nanotechnology and nanoscience as a career in order to ensure long term capacity building in the field; and
- Get industry involved in the development of nanotechnology and taking the lead in nanotechnology innovation.

The success of any awareness programme depends largely on how the message being conveyed is formulated and/or articulated. For a variety of reasons, different societal groupings require different forms of information formulation and articulation. To enable the articulation of information to suit the needs of different societal groupings, the target audience has been divided into four categories namely: **(i) Learners, (ii) Science Community, (ii) General Public and (iv) Industry.** main purpose of the NPEP is to implement the activities aimed at informing and educating the public about nanoscience and nanotechnology. The NPEP is therefore part of the implementation of the National Nanotechnology Strategy.

NANOTECHNOLOGY AS A CAREER IN SOUTH AFRICA

Nanotechnology has been pronounced as the science of the miniature, and the technology of the future. It is one of the most exciting and wide areas of research which may lead to the greatest technological advances of the 21st century. Nanotechnology can be defined as the application of science, engineering and technology to develop novel materials and devices in different fields in the nano-range. Worldwide, nanotechnology job projections are estimated to be nearly two million by 2015, with the US, Japan and Europe leading the charts.

While nanotechnology is popular overseas, in SA it is still in its infancy. Many SA universities and scientific institutions are now doing research and development (R&D) in this field. The scope and application of nanotechnology is overwhelming. It is one of the most diverse fields and the hottest topic for many scientists and engineers. The interdisciplinary nature of nanoscience and nanotechnology allows for study in many fields, such as chemistry, biology, physics, engineering, environmental science, agriculture, medicine, law, business, pharmacy, social science, e.g. ethics, etc. This has resulted to opening of job opportunities worldwide.

To pursue a career in the field of nanotechnology, candidates must possess a postgraduate qualification in the subject. They must have a master's degree (MSc or MTech) or a doctoral degree (PhD or DTech) in nanotechnology. At present, no South African educational institution offers a degree (graduate or postgraduate) in nanotechnology directly. The equivalent of this is typically a masters or doctoral degree in any of the physical sciences and engineering fields (e.g. chemistry, physics, biology, chemical engineering, mechanical engineering, electronics, etc.) or pharmacy and medicine where the degree is completed by research involving the exploitation of nanostructured materials (synthesis, properties and/or application).

NANOTECHNOLOGY AS A CAREER - ELIGIBILITY CRITERIA

Candidates who wish to obtain a PhD/DTech in any field in SA must have passed their high school (Matric) and have a BSc degree, BSc honours degree, and an MSc degree from a reputable institution in SA. The same route applies to obtaining a qualification in nanotechnology. Since nanotechnology is a new field of study in SA, the curriculum is still being developed, and since this involves different disciplines (e.g. physics, engineering, materials science, chemistry, biology), each discipline has its own eligibility criteria depending on the level of difficulty of the programme or the nature of the curriculum. Therefore the criteria presented below are more generic in the South African context. Anybody who aspires to pursue a career in nanotechnology can contact the respective department at their university of choice for specific requirements.

WHICH HIGH SCHOOL SUBJECTS ARE RECOMMENDED?

Doing well in the sciences and mathematics is the first step necessary for an individual to become a nanotechnologist. Candidates at high school must strive to obtain points above the minimum entry requirements for a BSc degree in order to be considered. A mark above 60% in any of the science subjects is highly recommended. Universities generally have their own point systems with clear minimum requirements for any of the measures in the biological, physical, earth, mathematical or health sciences, as well as engineering (chemical, mechanical, industrial, metallurgical, electrical, etc.). This and more information can be obtained at faculty administrative offices as well as SA university websites. Since nanotechnology is multidisciplinary, it is up to the candidates to decide in which field (e.g. life sciences or engineering) they wish to obtain their BSc degrees. The driving factor is the candidate's passion and strength in that field.

WHICH FIRST DEGREES ARE ACCEPTED?

The eligibility criteria for doing a postgraduate degree in nanotechnology is a BSc or B-Tech degree with a minimum of 50% score in the physical sciences (physics, chemistry, mathematics), biological and life sciences and engineering. Some departments have reviewed their subject choices such that they provide courses that are sufficiently broad in terms of the material taught in order to keep the career options wide, while offering the possibility of studying certain topics in depth. To date, almost all departments in SA universities, particularly those that do research in nanotechnology at postgraduate level, introduce nanomaterials at either second or third year level in some of their existing subjects (e.g. materials science). The extent to which universities offer these courses depends on the research focus of the university.

SKILLS REQUIRED AT POSTGRADUATE (MASTERS AND PhD) LEVEL

At present in SA, most universities offer nanotechnology under their existing science and engineering fields of study. The masters or doctoral degree requires research in a specific area involving the use of nanostructured materials (synthesis and/or application). Upon completion of the degree the candidate usually has gained sufficient skills in the subject (nanoscience and nanotechnology) and could be employed anywhere as a nanotechnology specialist. The difference is that the degree is not designated as an MSc or PhD in nanotechnology as other universities are now doing worldwide. In SA, nanotechnology is for the most part a research field, where new structures are discovered and the properties of nanomaterials are studied. Thus in order to study nanotechnology, one should have a good background in physics and chemistry. Mathematics usually gives an added advantage. Candidates should have an open, enquiring and scientific mind with sound analytical skills and a natural propensity for research work.

WHERE CAN ONE STUDY TO BECOME A NANOTECHNOLOGIST IN SOUTH AFRICA?

Most SA universities are now providing postgraduate degrees by research project in nanotechnology. Many SA universities do research in partnership with industry (e.g. Sasol, Element 6, Rand Water, Eskom etc.), research centres (e.g. CSIR, Mintek, NECSA, etc.) and other international universities around the world. Details of the research topics (masters and PhD level) can be obtained from the institutions' websites which can be found by searching the name of the institution in the world wide web.

Where to find bursaries and scholarships

Several government agencies, research foundations and private companies offer bursaries/scholarships and even internship programmes for nanotechnology-based studies in South Africa. These are highlighted below.

National Research Foundation (NRF): The NRF has various programmes ranging from undergraduate to postdoctoral degrees in the form of scholarships and grants supporting nanotechnology-based research. Information regarding scholarships and other grants can be found on the NRF's website: http:// or enquiries can be e-mailed to them at . Some programmes include the NRF's Free Standing, Innovation, Scarce Skills SABI, Square Kilometre Array (SKA), DAAD Scholarships and the Nanotechnology Equipment

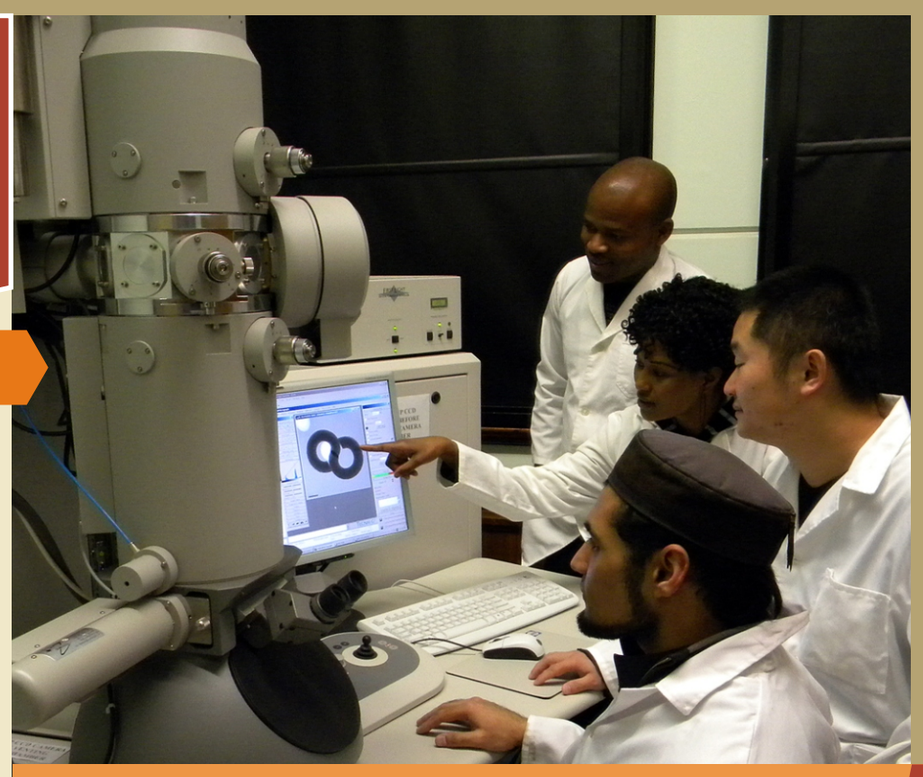
The DST/NRF Centre of Excellence in Strong Materials (CoE-SM): This is a South African research network hosted by Wits University, in partnership with others universities and organisations (e.g. NMMU, UJ, UKZN, UL, MINTEK and NECSA). Website: , Email:

Council for Scientific and Industrial Research (CSIR): The CSIR provides bursaries and studentships to students who are registered and based at universities or at the CSIR. The CSIR National Centre for Nanostructured Materials (NCNSM) is dedicated to nanoscience and nanotechnology. Website: , Email: , or for queries relating to the NCNSM.

Sasol: This is a petrochemicals company which funds projects at universities with an interest in catalysis. For example, a research partnership between the petrochemicals group Sasol and UCT exists and adds great value to research in nanotechnology. Website: , Email: .

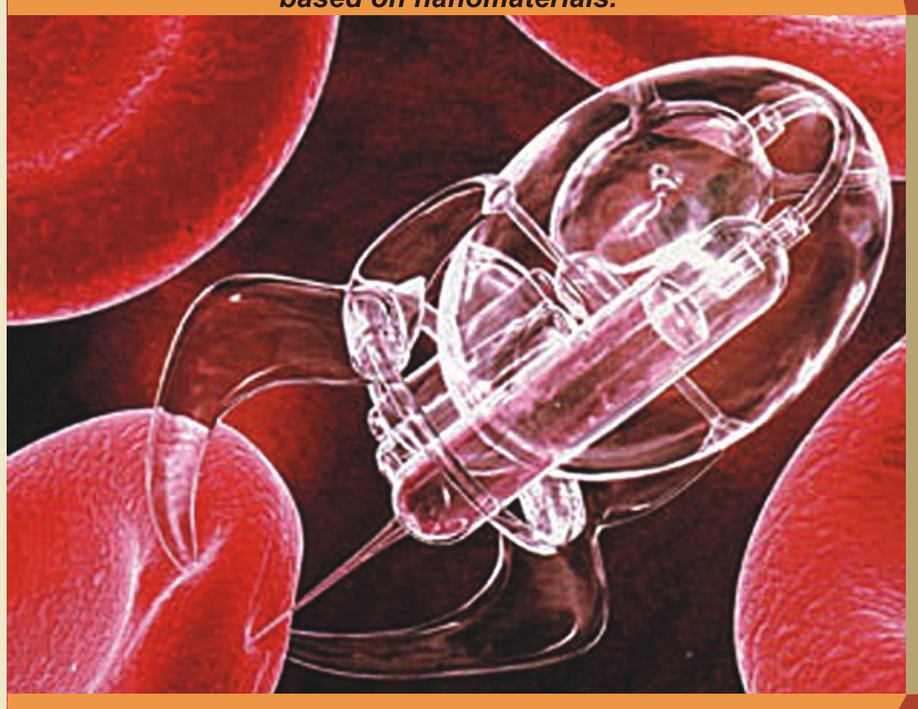
Microscopy Society of Southern Africa (MSSA): Supports microscopy studies (most of these involve nanoparticles/materials). Website: http://www.microscopy.org.za, Email: .

India-Brazil-South Africa (IBSA) Programme: This is a collaborative programme between the DST of SA, India and Brazil which supports education and human resource development in the area of nanotechnology. Website: , Email: LSikhwivhilu.



Some PhD students from the Chemistry Department, Wits University, studying carbon nanotubes using an electron microscope. Carbon nanotubes can for reinforcing polymers for water purification or coating materials, as catalysts supports for metals in various chemical reactions or fuel cells. There are many applications for carbon nanotubes.

The Vestergaard-Frandsen's LifeStraw® is an example of a personal water purification and filtration product which allows users to drink from otherwise disease-ridden water sources. Recently researchers at University of Stellenbosch have designed a similar product called the 'tea bag' filter based on nanomaterials.



A working nano-mechanical machine fixing blood cells.

Nanotechnology is being exploited for space exploration

science & technology
Department: Science and Technology
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | SAASTA South African Agency for Science and Technology Advancement

NANOTECHNOLOGY PUBLIC ENGAGEMENT

HySA Public Awareness Hydrogen South Africa