COMMITTEE: Special Conference on the Environment

ISSUE: The impact of Nanotoxicology

STUDENT OFFICER: Despina Petradakis and Orsalia Toutouza

POSITION: Chair and Co-chair

Dear delegates,

My name is Despina Petradakis. I'm 17 years old and am currently attending the 12th grade of Arsakeia Schools of Psychiko. I have the great honor to be serving as the President of the Special Conference on the Environment in the 5th CSMUN. To say a little about my MUN experience I have attended eight MUN conferences, and this will be my second time as an official. I want to help others experience MUN conferences as best as possible. I would like to advise you all to: be as prepared as you can, participate as much as possible, and enjoy yourselves. I look forward to meeting you all and working together.

Dear Delegates,

My name is Orsalia Toutouza and it is my honor to serve as the Deputy President of the Special Conference on the Environment during the 5th Campion School Model United Nations Conference. This will be my 7th conference and my first time serving as a Student Officer. Even though I am planning to study medicine, MUN is a true passion for me and I wish that the upcoming session of the Special Conference will be a memorable experience for all. The issue which is to be discussed during the upcoming session is of paramount interest and this study guide aims at getting you familiarized with some key terms and basic information that will help you understand the issue and seek for effective and implementable solutions. Considering that a starting point of your preparation, you are advised to extend your research to various sources and be aware of your delegation's policy. Should you come up with any question concerning the issue or the debate, feel free to contact me through my email address. Wishing you a fruitful and rewarding debate, I am looking forward to meeting you.

The following study guide will help you familiarise yourselves with the issue upon us and prepare you for fruitful debates!

If you have any questions or problems concerning the topic, we are more than happy to help. You can contact us at our personal emails:

Despina: dpetra2000@yahoo.com

Orsalia: toutouza.orsalia@hotmail.com

TOPIC INTRODUCTION

Nanotoxicology is a branch of bionanoscience which deals with the study and application of toxicity of nanomaterials: a sub-specialty of particle toxicology. It addresses the toxicology of nanoparticles (particles <100 nm diameter) which appear to have toxicity effects that are unusual and not seen with larger particles. Due to the quantum size effects and large surface area to volume ratio, nanomaterials have unique properties compared with their larger counterparts. Size is therefore a key factor in determining the potential toxicity of a particle. However, it is not the only important factor. Other properties of nanomaterials that influence toxicity include: chemical composition, shape, surface structure, surface charge, aggregation and solubility, and the presence or absence of functional groups of other chemicals. The large number of variables influencing toxicity means that it is difficult to generalize about health risks associated with exposure to nanomaterials – each new nanomaterial must be assessed individually and all material properties must be taken into account.

With the increasing development of nanotechnology and its extensively used applications, a wide range of nano-structured materials are now used in, pharmaceutics, cosmetics, biomedical products, and commercial industries. While nanoscale materials have more unique physicochemical properties than bulk materials, they also have unpredictable impacts on human health. There is presently no authority to specifically regulate nanotech-based products. Nanotoxicological studies are intended to determine whether and to what extent these properties may pose a threat to the environment and to human beings.

Worth noting is the fact that very little attention has been directed towards the potential immunogenicity of nanostructures. Nanostructures can activate the immune system, inducing inflammation, immune responses, allergy, or even affect to the immune cells in a deleterious or beneficial way (immunosuppression in autoimmune diseases, improving immune responses in vaccines). More studies are needed in order to know the potential deleterious or beneficial effects of nanostructures in the immune system.

DEFINITION OF KEY TERMS

Nanotoxicology:

a growing branch of bionanoscience and of toxicology which focuses on the toxicity of nanomaterials and on the application of their toxicity. In addition, nanotoxicology examines the toxicological responses that occur due to the physical and chemical characteristics of nanomaterials and nanoparticiples. Overall, this branch of toxicology faces rapid development and is becoming more popular as studies reveal negative effects of nanomaterials on the environment and on health.

Nanomaterials:

"a natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm", as quoted by the Recommendation on the definition of a nanomaterial (2011/696/EU), a document of the European Union. Their use is mainly useful in healthcare, electronics and cosmetics.

Nanoparticiple:

any particle in two or three dimensions and with a size smaller than 100 nm and greater than 1nm.

Nanoscale:

scale that applies to all structures with size ranging from approximately 1 nm to 100 nm and also referred to as nanoscopic scale.

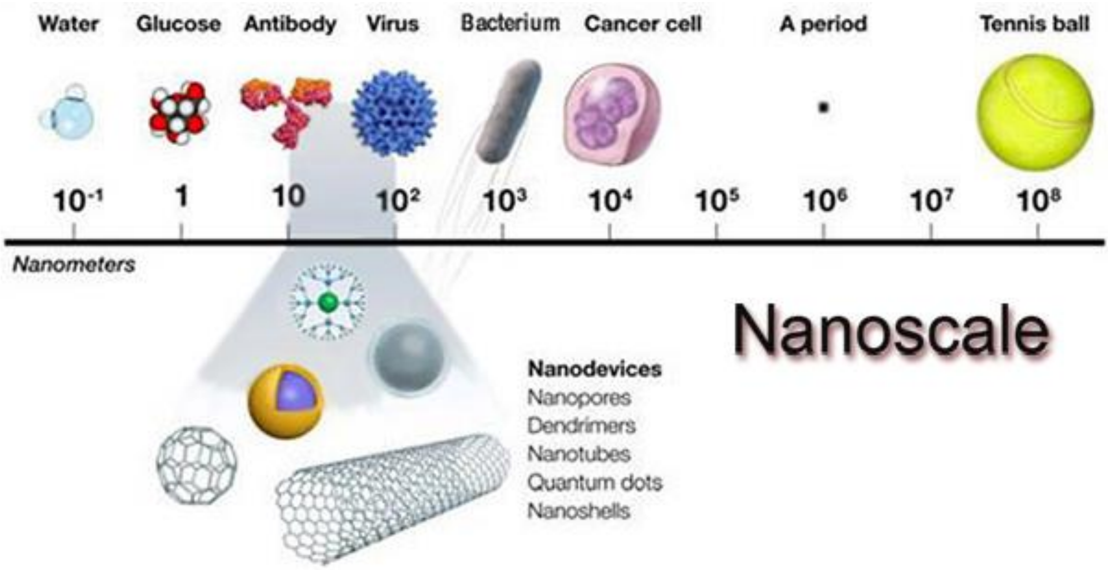

Figure 1: The nanoscale with examples

Toxicology:

field that examines toxic substances and their effects, particularly on living systems, with a number of branches, including nanotoxicology. Dating back to ancient times, the recent proliferation of toxic substances resulted to the multiplication of the applications of this domain.

COUNTRIES AND ORGANIZATIONS INVOLVED

United States of America (USA)

Being a great research center for technology in general, the United States of America has shown special interest for nanotechnology and nanotoxicology, along with their applications and effects. A non-profit bi-partisan association has been founded for this goal, called the International Center for Technology Assessment (ICTA). Based in Washington, D.C., this organisation aims at publishing complete assessments and analyses of the social impacts of technology and expands beyond social effects, including economical, political, ethical and environmental effects. Moreover, the ICTA has suggested stronger regulation for the use of nanotechnology via its NanoAction project.

Sweden

The Swedish Karolinska Institute, one of the most important institutes in technological research, has conducted a research in which numerous nanoparticles were inserted to epithelial cells of human lung . In 2008, the results indicated the following:

- Iron oxide nanoparticles caused little damage to the DNA, yet they were not toxic
- Carbon nanotubes caused little DNA damage
- Zinc oxide nanoparticles caused slightly more damage than the aforementioned
- Titanium dioxide only caused DNA damage and had no other effect on the cells
- Copper oxide was proved to be the worst of all nanoparticiples and was recognized by the researchers as the only participle, of those tested, with a clean health risk.

Austria

The presence of Austria in technology is of supreme importance and at the moment Austria hosts one the most prestigious centers for nanotoxicology, the European Center for Nanotoxicology. This research has essentially contributed to the structuring and the development of the sector of nanotoxicology and functions as a contact point for researchers from every country of the world. In this way, international contacts among key individuals within the area of nanotoxicology are strengthened and interests of all countries are mediated in a more beneficial way for the society.

China

Ever since 1990, China has been running numerous national programs in the wide domain of nanotechnology and thus, in nanotoxicology. The global community faces China as a leading country in technology and in the study of nanomaterials, while nanotechnology industries thrive in China. However, China's engagement in dialogue concerning international nanotechnology is nearly absent and quite alarming for those aiming at democratizing the use nanoparticiples for the benefit of those most in need.

South Africa

According to data dating back to 2003, South Africa has been very active in nanomaterials with approximately 12 universities, 4 science councils and various companies being impressively active in nanotechnology.

European Commission

As a key determinant for the applications of nanotoxicology, particularly in European states, the European Commission has published a review in 2016 that reviewed the Recommendation on the definition of a nanomaterial of 2011 and provided the public with some definitions which were undoubtedly necessary for the wider understanding of the topic. Other than that, the European Union's legislation includes several pieces which regulate the use of nanomaterials and offer technical guidance for the most efficient implementation of law.

HISTORICAL BACKGROUND

Nanotechnology has advanced exponentially over the past decade, with nanoscale materials being exploited in several applications and in several disciplines (including industry, science, pharmacy, medicine, electronics, and communication products). Between 2011 and 2015 a 30-fold increase in nano-based products was reported and in 2015 an estimated global market of over $1 trillion. Metal NPs (specifically carbon and silver NPs) represent the largest and fastest growing group of NPs. Hence, human and environmental exposure is already occurring and is predicted to increase dramatically. This growth in nanotechnology has not advanced without concerns regarding their potential adverse environmental impacts. Several reviews have reported on the toxicity of various NPs. However, much is still unknown.

In March 2004 tests conducted by environmental toxicologist Eva Oberdörster, Ph.D. working with Southern Methodist University in Texas, found that Nanoparticles can be inhaled, swallowed, absorbed through skin and deliberately or accidentally injected during medical procedures. They might be accidentally or inadvertently released from materials implanted into living tissue.

Díaz, B. from the University of Vigo (Spain) has shown (Small, 2008) that many different cell lines should be studied in order to know if a nanostructure induces toxicity, and human cells can internalize aggregated nanoparticles. Standardization of toxicology tests between laboratories are needed.

There is a need for new methodologies to quickly assess the presence and reactivity of nanoparticles in commercial, environmental, and biological samples since current detection techniques require expensive and complex analytical instrumentation. There have been recent attempts to address these issues by developing and investigating sensitive, simple and portable colorimetric detection assays that assess for the surface reactivity of

NPs, which can be used to detect the presence of NPs, in environmental and biological relevant samples.

Researcher Shosaku Kashiwada of the National Institute for Environmental Studies in Tsukuba, Japan, in a more recent study, found that salinity may have a large influence on the bioavailability and toxicity of nanoparticles to penetrate membranes and eventually kill the specimen.

As the use of nanomaterials increases worldwide, concerns for worker and user safety are mounting. To address such concerns, the Swedish Karolinska Institute conducted a study in which various nanoparticles were introduced to human lung epithelial cells. The results, released in 2008, showed that iron oxide nanoparticles caused little DNA damage and were non-toxic.

The latest toxicology studies on mice involving exposure to carbon nanotubes (CNT) showed a limited pulmonary inflammatory potential of MWCNT at levels corresponding to the average annihilable elemental carbon concentrations observed in U.S.-based CNT facilities. The study estimated that considerable years of exposure are necessary for significant pathology to occur.

TIMELINE OF EVENTS

Date	**Description of Event**
1857	Michael Faraday discovered colloidal “ruby” gold, proving that nanostructure gold under certain gold under certain lighting can produce different-colored solutions
1936	Erwin Müller invented the field emission microscope and allowed near-atomic-resolution images of materials.
1970s	Cell culture techniques became available
1980s	Focus on glass fibres
1990s	-Early nanotechnology companies began to operate -Domination of the environmental particles in the particle toxicology
2004	The term nanotoxicity was coined
2008	NNI Strategy for Nanotechnology-Related Environmental, Health, and Safety (EHS) Research
2011	Recommendation on the definition of a nanomaterial (2011/696/EU)
2016	The review of the European Commission on the Recommendation on the definition of a nanomaterial was concluded

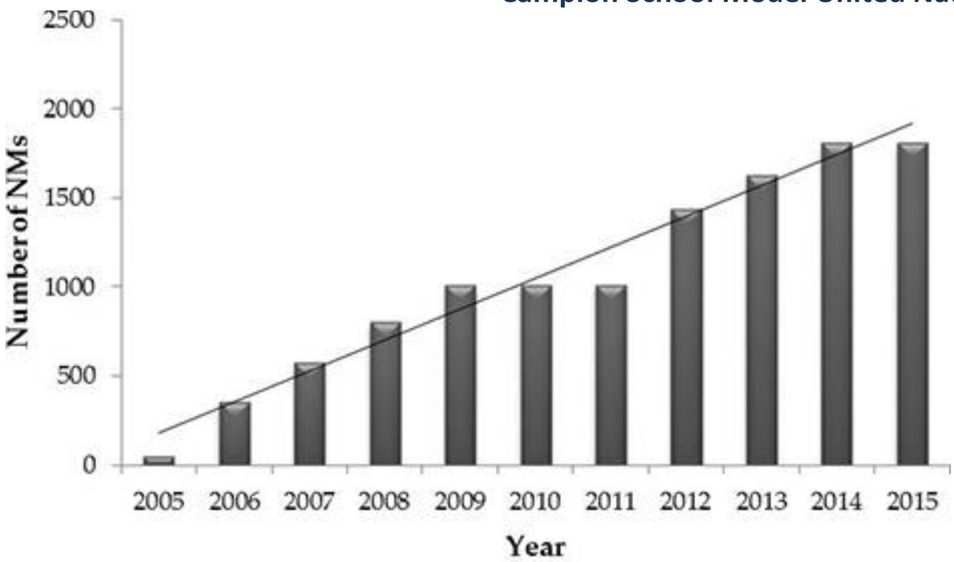

Figure 2 Growth of the use of nanomaterials

POSSIBLE SOLUTIONS

It is still too early to determine whether nanomaterials or nanoparticles are harmful or not, however the effects observed lately have made many public and governmental institutions aware of

1. the lack of knowledge concerning the properties of nanoparticles
2. the urgent need for a systematic evaluation of the potential adverse effect of Nanotechnology

Furthermore, some guidance is needed as to which precautionary measures are warranted in order to encourage the development of "green nanotechnologies" and other future innovative technologies, while at the same time minimizing the potential for negative surprises in the form of adverse effects on human health and/or the environment.

It is important to understand that there are many different nanomaterials and that the risk they pose will differ substantially depending on their properties. At the moment, it is not possible to identify which properties or combination of properties make some nanomaterials harmful and which make them harmless, and properly it will depend on the nanomaterial is question. This makes it is extremely difficult to do risk assessments and life-cycle assessment of nanomaterials because, in theory, you would have to do a risk assessment for each of the specific variation of nanomaterial – a daunting task!

BIBLIOGRAPHY

Azadeh-Oxford, Nina . "Cognition:Nanotoxicology: a definition." Nanotoxicology: a definition. Cognition, 20 Nov. 2008. Web. 27 June 2017. <genuspolitics.blogspot.gr/2008/11/nanotoxicology-definition.html>.

"Definition of a nanomaterial." Definition-Nanomaterials-Environment-European Commission. European Commission, n.d. Web. 27 June 2017. <http://ec.europa.eu/environment/chemicals/nanotech/faq/definition_en.htm>.

"Toxicology." Britannica School, Encyclopædia Britannica, 7 May. 2017. school.eb.co.uk/levels/advanced/article/toxicology/73093. Accessed 27 Jun. 2017.

"What is a Nanoparticle? A detailed definition." HORIBA. N.p., n.d. Web. 27 June 2017. <http://www.horiba.com/scientific/products/particle-characterization/applications/what-is-a-nanoparticle/>.

Walters, Chavon, Edmund Pool, and Vernon Somerset. "Nanotoxicology: A Review." Nanotoxicology: A Review | InTechOpen. InTech, 26 Oct. 2016. Web. 27 June 2017. <https://www.intechopen.com/books/toxicology-new-aspects-to-this-scientific-conundrum/nanotoxicology-a-review>.

"Study Sizes Up Nanomaterial Toxicity." Study Sizes Up Nanomaterial Toxicity|Chemical&Engineering News. N.p., 1 Sept. 2008. Web. 27 June 2017. <cen.acs.org/articles/86/i35/Study-Sizes-Nanomaterial-Toxicity.html?type=paidArticleContent>.

"Our Mission." International Center for Technology Assessment. N.p., n.d. Web. 27 June 2017. <http://www.icta.org/about/>.

Sinner. "The European Center for Nanotoxicology - An Austrian hub for Nanotoxicology." N.p., n.d. Web. 27 June 2017. <http://www.oecd.org/sti/nano/44859597.pdf>.

"Nanotechnology Timeline." Nanotechnology Timeline | Nano. N.p., n.d. Web. 27 June 2017. <https://www.nano.gov//timeline>.

Donaldson, Ken, and Anthony Seaton. "A short history of the toxicology of inhaled particles." Particle and Fibre Toxicology. BioMed Central, 2012. Web. 27 June 2017. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3436721/>.

AZoNano, Written By. "Nanotechnology and Developing Countries - Part 2: What Realities?" AZoNano.com. N.p., 19 Oct. 2005. Web. 29 June 2017. <http://www.azonano.com/article.aspx?ArticleID=1429#_Health-Related_Nanotechnology_Devel>.