

# **Professional Guidelines for establishing an Open Nano Lab / a Nano Researcher Live area**

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## **Handbook**

This handbook and its appendices present professional guidelines on how to establish an Open Nano Lab or a Nano Researcher Live area in a science museum / science centre in cooperation with a local partner university.

Of course the construction of such areas requires individual planning depending on the local circumstances, and thus this work can not be seen as a complete set of instructions, but far more as a guidance manual containing the experiences gathered in the 'Open Research Laboratory' of the Deutsches Museum in a condensed form.



Prepared at the Deutsches Museum, Munich, Germany  
in the scope of the 7th Framework Programme project



by Paul Hix  
(vers. 2 - 08.2009)

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*Scientist explaining his work in  
the Open Research Laboratory  
of the Deutsches Museum*

## **What is an Open Nano Lab?**

An Open Nano Lab (ONL) is a fully functional nanoresearch laboratory situated in the public space of a science museum or science centre, with researchers from a local university conducting their work in full public view. Visitors thus receive an insight into the processes and methods of a modern laboratory by observing how doctorate and graduate students obtain data and images from their instruments, and how these are processed or discarded.

An Open Nano Lab thus enables visitors to explore various aspects of the scientists' daily tasks, as well as openly discuss the social and ethical aspects of modern research work. This is where the often cited dialogue between scientist and lay-person - including the next generation of researchers - actually takes place.

The advantages of an Open Nano Lab in the field of science communication are manifold. On the one hand the general public is offered a venue for dialogue on current research, whilst on the other the researchers can learn and practice valuable communication skills, something usually not possible in a university environment. Additionally, if so desired, it is possible for social scientists to analyse the interactions the visitors as well as the everyday work processes of the researchers in the Open Nano Lab.



*Researchers working in the public environment  
of the Open Research Laboratory*

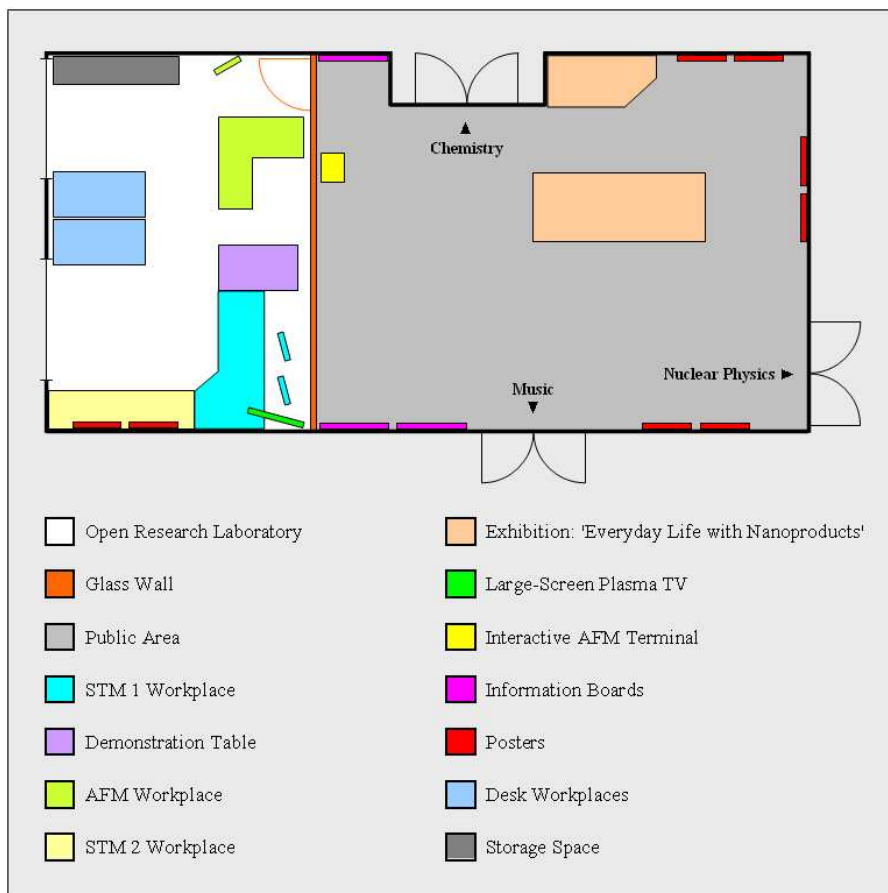
## Research in an Open Nano Lab

The Open Nano Lab concept is based on the public display of research and the corresponding interaction of the scientists with a broad public. Thus, it is immediately apparent that the scientists and their instruments play the central role in an Open Nano Lab. In order to achieve this, a close cooperation between university and science museum / science centre is absolutely essential, with the former providing the scientists and the research topics, and the latter offering space as well as communication and presentation expertise.

It is obvious that a scientist working in a public environment faces a number of challenges in the fields of science communication, knowledge exchange and work environment. In this regard the Open Nano Lab concept takes to an extreme the conclusion of the Wolfendale Committee<sup>1</sup> that scientists who receive public funding have a duty to communicate their research to the public. Although this approach by no means offers a comprehensive insight into nanoscience as a whole, it does present the manifold processes of research including set-backs and detours, as well as the positive aspects of new discoveries and exciting new directions for exploration.

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<sup>1</sup> Wolfendale Committee (1995): *Final Report*; London, Office of Science and Technology



*Floor plan of the  
Open Research Laboratory  
in the Deutsches Museum  
(room size  $\sim 85\text{m}^2$ ; lab size  $\sim 35\text{m}^2$ )*



## **Example of an Open Nano Lab**

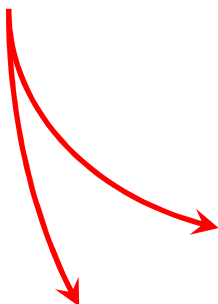
The Open Nano Lab concept is based on the set-up and experience of the Open Research Laboratory of the Deutsches Museum. This provisional laboratory was established to test the viability of conducting research work live in a museum environment. In its current setting it is situated in a room approximately 85 m<sup>2</sup> in size, one third of which is taken up by the laboratory. It is separated from the public area by a 1,20 m high glass wall which clearly defines the laboratory area whilst at the same time enabling the visitors to observe the daily work of the scientists.

Within the laboratory are a number of SPM workstations with visitor monitors, a presentation area for demonstrating various nano-experiments, as well as desk working places and a storage area. Information boards and nanoscience posters are positioned on the walls of the public area along with an exhibition of currently available nanoproducts titled 'Everyday Life with Nanoproducts'. A large-screen TV mounted on the wall constantly shows films of nano-effects, simulations of the function of SPMs, images with atomic resolution of various scanned surfaces. This arrangement was planned and chosen for both space requirements of the utilised room as well as for its central presentation of the research work.



*A scientist from the local university communicates his work to school classes and to the general public in a Nano Researcher Live area*

**university laboratory**



**school classes**



**museum / science  
centre visitors**

## **What is a Nano Researcher Live area?**

A Nano Researcher Live (NRL) area is an enhanced version of common “meet the scientist” activities, combining a permanent nano-environment (e.g. exhibits, demonstrations and interactive presentations) with a live presentation area where scientists from a local partner university explain and discuss their current work in a public forum. Thus it is a venue where the broad public can inform themselves about nanotechnology on a daily basis and, in addition, are able to personally engage with nanoresearchers themselves on a regular, bi-weekly basis. Here, museum or science centre visitors can openly discuss the social and ethical aspects of modern research work with researchers, whilst they on the other hand can learn and practice valuable communication skills, something usually not possible in a university environment.

A Nano Researcher Live area needs to be individually designed according to the resources and the requirements both of the partner science museums / science centres and of the scientists from the partner universities. It encompasses a central presentation area as well as further elements such as information on the current research work of the university partner, a demonstration area, a nanoproduct exhibition and static and interactive nano-related presentations.

## **Preparations for a Nano Researcher Live event**

On average once every two weeks a coordinator in the partner science museum / science centre organises a Nano Researcher Live event with a scientist from the local university. In organising such an event, it is vital for a museum coordinator to discuss in advance with the respective scientist which presentation aids (e.g. poster, images, multimedia,...) and exhibits (e.g. instruments, samples,...) are required for supporting a successful dialogue with the attending visitors. This should take place well in advance to the event, so that there is sufficient time for preparation.

It is also necessary to organise an event rota, coordinating date, participating researcher and topic. This both helps the scientists to plan for the event, and enables the science museum / science to advertise the event (e.g. invite school classes).

Furthermore, basic communication schooling for the participating researchers needs to take place before the event. This will be organised by the coordinator according to the provided schooling material. It is also a good idea for scientists who are new to the programme to visit a Nano Researcher Live event in order to observe the communication techniques of their more experienced colleagues.

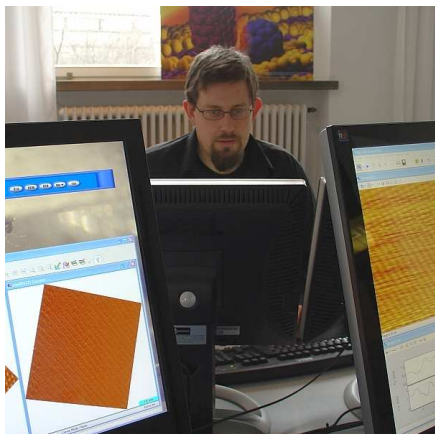
## **Nano Researcher Live events**

As previously mentioned, the focus of a Nano Researcher Live event is to give the researcher an opportunity to present his or her work in public, as well as to enter into a dialogue with the museum visitors. Thus it is necessary to have both pre-planned presentations, opportunities for questions, as well as times for casual discussions with the visitors. This gives the scientists practice in communicating their work, whilst at the same time requiring them to address the concerns of the visitors, thus challenging them to see their work within the wider scope of society.

With all these things in mind, here is a list of possible elements of a Nano Researcher Live event:

- presentations of work to visitors / school classes
- question & answer time with researcher
- informal discussion time with researcher
- nano-demonstrations
- explanation of nano-products
- other, e.g. video conference into lab (if technically possible)

Of course all these elements can be grouped in various combinations depending on the individual requirements of the respective locality and participants.



*A variety of elements of an Open Nano Lab:*

*(clockwise from top left)*

*Researcher, Atomic Force Microscope,  
Demonstrations, Nanoproduct Exhibition*

## Elements of an ONL / NRL area

Obviously, the main elements of an Open Nano Lab are the researchers and their scientific equipment. In order to show currently progressing research, **it is vital that the scientists' work is presented on visitor monitors** which mirror the monitors of the work stations. However, apart from the live presentation of nanoresearch, the concept of the Open Nano Lab intends to present a comprehensive overview of the current state of nanotechnology and nanosciences. In order to achieve this, the presentation of the scientists' work is supplemented by a variety of elements.

Some elements for an ONL /NRL area which have proven to be very successful in the Deutsches Museum are live demonstrations of various nano-effects and an exhibition of everyday nanoproducts. Others have been mentioned in the above chapter 'Example of an Open Nano Lab'. All these elements are implemented to aid and support the scientist in explaining his work and the fundamental reasons and thought processes involved. This can be achieved either by generating an interest in the subject matter, by explaining the tools and instruments used, or simply by using an exhibit or demonstration to create a basis for discussion on the ethical, legal or social aspects of nanotechnology research and developments.

## Dimensions

Researchers need space to work, visitors need room to move, information needs presenting, demonstrations need showing and exhibitions need showing. Combining all these different elements to create an Open Nano Lab obviously requires planning and forethought. In this process a close cooperation between science centre / science museum and university is absolutely essential in order to provide an ideal laboratory environment for the scientists whilst at the same time optimising all of the elements required to present the ongoing research work, to give insights into nanotechnology and facilitate a dialogue with the public.

Obviously, the precise arrangement and set-up of an Open Nano Lab greatly depends on the individual floor plan of the designated lab area, the requirements of the scientists, the dimensions of the scientific equipment and the visitor profile of the science centre / science museum. For this reason it is only possible to present some important points to consider when planning an Open Nano Lab:

- presentation of research work should be central to lab
- location should be chosen as a compromise between space, visitor flow and noise considerations
- accommodate additional elements (see below) as far as possible



## ...at a glance

### Open Nano Lab

Floor area of Open Nano Lab 25-40m<sup>2</sup>

*(depending on number of work places,  
more if large research equipment is used,  
includes area for nano-demonstrations)*

Number of work places min 3

*(depending on research field, e.g. one for  
measurement, two flexible ones for preparation,  
evaluation, background research)*

Glass wall height 1,00m-1,20m

*(or similar solution)*

Visitor monitors depending on number  
*(mirroring scientists' work monitors)* of work stations

### Nano Researcher Live area

Presentation area ~ 30 seats

*(i.e. stage / podium + room for groups)*

### Visitor area

Floor area of visitor area min 30 m<sup>2</sup>

*(room for groups of up to 30 people,  
e.g. school classes)*

Size of Nanoproduct exhibition min 5m<sup>2</sup>

*(depending on exhibited objects)*



*Advanced Pocket-Size Scanning Tunneling Microscope  
(Huber Diffractionstechnik GmbH & Co. KG)*

## **Research Equipment**

Despite the public environment, the research conducted in an Open Nano Lab must be conducted in a process closely resembling that of investigations in a university laboratory, using identical preparation, measurement and evaluation equipment. This guarantees that the research results gained in an Open Nano Lab are identical in quality and relevance to those generated in a university environment. It also ensures that the scientists need not spend time familiarising themselves with equipment or processes, but instead can concentrate fully on combining their research work with the new communication challenges they encounter in working in public.

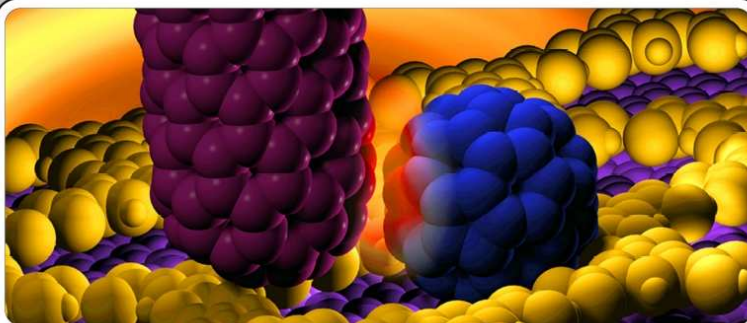
Thus it is highly advisable that the research equipment in an Open Nano Lab is identical to that used in the university partners' laboratories. Initially, the recommendation must be to use duplicates of the instruments used in the university labs. Depending on the financial scope of the project and the commitments of the partners, it is also possible to directly transfer some equipment from the university laboratories to science museum / science centre. Additionally, in running the Open Nano Lab it is necessary to allow a certain flexibility in regard to equipment as research goals and scientific investigations constantly shift to new directions.



## Das kleinste Fußballspiel *The smallest soccer game*



S. Griessel, M. Lackinger, F. Jamitzky, T. Markert, W.M. Heckl (LMU München)  
M. Hietschold (TU Chemnitz)



### Fußball mit Molekülen

Die atomar feine Spitze eines Raster-Tunnel-Mikroskops (STM) schießt einen „Bucky Ball“ von einem Tor in das nächste, welches 2 Nanometer (milliardstel Meter) entfernt ist.

Dieser „Bucky Ball“ ist ein fußballförmiges Molekül und besteht aus 60 Kohlenstoff-Atomen.

Eine bienenwaben-förmige molekulare Struktur bildet die Tore. Dieses hexagonale Gitter entsteht durch Selbstorganisation aus Molekülen der Trimesinsäure.

### Playing soccer with molecules

The ultra fine tip of a scanning tunneling microscope (STM) kicks a „bucky ball“ from one goal to the next over a distance of 2 nanometers (billionths of a meter).

This „bucky ball“ is a soccerball-shaped molecule and consists of 60 carbon atoms.

A honeycomb-shaped molecular structure forms the goals. This hexagonal grid is formed by the self-organisation of trimesic acid molecules.



## Das kleinste Loch der Welt *The smallest hole in the world*

Wolfgang M. Heckl (LMU München)  
John Maddocks (University of Sheffield)



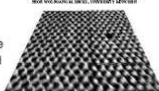
### Entfernung eines Atoms

Ein Loch mit einem Durchmesser von 3,16 Å ( $3,16 \times 10^{-10}$  m) wurde durch das Entfernen eines einzelnen Schwefelatoms aus einer Kristalloberfläche erzeugt.

Dabei wurde die Spitze eines STM als „Nanobohmaschine“ verwendet.

1994 verlieh das Guinness Buch der Rekorde W.M. Heckl und J. Maddocks den Weltrekord für das kleinste Loch der Welt.

SMALLEST  
MAN MADE HOLE



WORLD  
RECORD  
GUINNESS BOOK  
OF RECORDS

### Removal of an atom

A hole with a diameter of 3,16 Å ( $3,16 \times 10^{-10}$  m) was created by removing a single sulfur atom from a crystal surface.

This was achieved by using the tip of a STM as a „nano-drill“.

In 1994 the Guinness Book of Records awarded W.M. Heckl and J. Maddocks the record for the smallest man made hole.

*Poster from the Open Research Laboratory*

## Information

In order to present a comprehensive insight into the nano-world, elements giving varied and detailed information are necessary. The main way to present this is by means of information boards or posters. These should give fundamental information on the concept of the ONL / NRL area, the instruments and their functionality, as well as an introduction into nanosciences and nanotechnologies. The current research work of the scientists can also be illustrated here.

In the preparation of all information presentation tools a close cooperation between university and science museum / science centre staff is essential. The former have expertise in the subject matter, the latter in presenting this expertise to the public. In addition, scientific communication is improved if the researchers have a direct influence on the presented information.

Additionally, a wide variety of presentation approaches on the subject of nanoscience and nanotechnology (multimedia, interactive demonstrations, static exhibits etc.) should be incorporated. Apart from offering a comprehensive insight into various aspects of the field, this significantly increases the effectivity of an ONL / NRL area, as different visitors are attracted by various exhibits.



*Demonstration of the behaviour of a  
ferrofluid in a magnetic field*

## **Nano-Demonstrations**

Demonstrations of various nano-effects enable the scientist to present some of the differences between the macroscopic and the nanoscopic worlds in a simple and easy-to-understand way. By demonstrating the behaviour of glass nanoparticles, for example, visitors can understand that simply due to their small size particles in the nanometer range can lead to unexpected effects such as the floating of a single particle-coated drop of water on a water surface. This can lead directly to interesting discussions, for example by justifying reasons for research in this field. In order to involve the visitor more, with a little development many nano-demonstrations can be designed for an interactive hands-on approach.

However, care must be taken that these demonstrations do not take on a preeminent role in the ONL / NRL area. In this case it is possible that the visitor could perceive these nano-effect presentations to be the central element of the ONL / NRL area instead of acting as a supplement to explaining the research and thus leading to a scientific dialogue. As this is contrary to the central reasons for establishing such a laboratory, the researcher has to be aware of this danger and utilise the demonstrations accordingly.



*Exhibition  
'Everyday Life with Nanoproducts'  
at the Deutsches Museum*




## **Nanoproduct exhibition**


By including an exhibition of currently available nanoproducts in an ONL / NRL area it is possible to show the significance that nanotechnology has attained in daily life. The range of products should attempt to cover a variety of applications based on various nano-effects such as the antibacterial properties of nano-silver clusters or the water-repellent lotus effect. It should also include a selection of nanotechnology applications in medicine and sports, due to their importance in society and the potential impact nanotechnology is predicted to have in these fields. A minimum total of 20 objects from these fields should be sufficient to give a comprehensive overview of the nanoproduct market.

Such an exhibition can be an excellent starting point for discussions on ethical, legal and social challenges which the use of nanotechnology poses. For example, some products openly advertise their nanotechnology content, whilst others neglect to mention this aspect, demonstrating how unregulated commercialisation reflects the attitudes of various consumer groups and can thus be misleading. A further benefit of such an exhibition is that it is easier to evoke a discussion on the potential benefits and risks of nanotechnology with the visitors with actual product examples at hand.

# Open Nano Lab - Professional Guidelines




INTERESTED?

Deutsches Museum 

**STILL TO COME...**

The current laboratory is only a beginning. In 2008 it will be relocated into the ZEITRAUM NEUE TECHNOLOGIEN, and thus incorporated into a large permanent exhibition on nano- and biotechnologies. It is planned that there will be even more activity in the lab, with increased information enabling new scientific projects. We are always looking for new partners who are willing to support us financially in this process or who would like to collaborate in scientific projects.




**In-depth information, media presentation and an exhibit of currently available nano-products represent the visitor's experience. Additionally, we regularly offer experimental presentations in which various nano effects are demonstrated.**



WE  
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KIP-PROF. DR. WOLFGANG JO. HILGER  
BAYERISCHE FORSCHUNGSGESELLSCHAFT  
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For further information please contact:

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Mail: p.hix@deutsches-museum.de

THE OPEN RESEARCH LABORATORY

With the "Open Research Laboratory" the Deutsches Museum for the very first time presents science "live" to the general public. Nano-research is conducted in order of the exhibitions, with Ph.D. students working at their scientific instruments whilst answering questions and engaging the visitors in discussion. This is where the often cited dialogue between scientist and layperson – including the next generation of researchers – actually takes place. At the same time scientists from the museum's own social and humanisation research institute analyse the communication with the visitors as well as the everyday work processes in the laboratory.

Since its foundation the Deutsches Museum not only focuses on presenting scientific results in an understandable way, but also tries to visualise how research takes place – e.g. by displaying original exhibits such as the Otto-Hahn-table.

More than ever it is important for society to comprehend the processes of science, as our future is being developed in research laboratories. Because of this, the Deutsches Museum not only exhibits research instruments, but also publicly displays the scientists – in a place which over a million people visit each year to learn more about natural sciences and technology.

**PUBLIC UNDERSTANDING  
OF RESEARCH**





The central research instrument of the laboratory is a Scanning Tunneling Microscope, which scans the surface of a sample with utmost resolution and is very fine-tuned to enable the direct observation of molecular processes.

Current research focus lies on the self-organising process of molecules on various surfaces. Our research will also contribute to the development of new surface coatings.

Using nano-research as an example, visitors to the museum are given an insight into the processes and methods of a microscopic laboratory. They can observe how the scientists obtain data and images from their instrument, and how these are processed or discarded. It is also possible to discuss various aspects of their research with the scientists.



*Flyer promoting the Deutsches Open Research Laboratory  
(top: front, bottom: back)*

## **Additional Elements and Recommendations**

Combining scientific research and public presentation is not a simple task. In the Open Nano Lab concept, the scientists are at the challenging forefront of communication. For this reason it is necessary to accommodate to their needs as much as possible. Over the next pages are some recommendations of ways to facilitate the work of the scientists in public without decreasing the effectivity of the concept. Even if it might not be possible to implement all the suggestions given here, it is highly recommendable to find individual solutions unique to every location. Only if the scientists are offered a research environment they feel comfortable in, will an Open Nano Lab be successful in both research and communication fields.

## Scientific Group

Strive to have a small independent scientific work group consisting of at least five people working in the lab. Many instrumental setups (especially SPMs) can easily be used by five or six people for concurrent research projects, as a scientist doesn't conduct measurements around the clock. Instead, a lot of time goes into background research, evaluation, paperwork, planning and communication with the visitors. This ensures a higher usage of the instruments themselves, thus increasing both scientific output as well as offering greater insights for the visitors.

Additionally, the task of communicating with the visitors can be shared in turn, enabling the other researchers to concentrate more on their scientific work. With a certain number of people in an Open Nano Lab, a rota system can be developed for the communication tasks, thus ensuring that each researcher has sufficient interaction with the public. Additionally, a small work group also ensures that young researchers have the opportunity of sharing and discussing results, plans and future ideas within the group, thus generating an environment ideal for scientific discourse. As a further benefit, this gives the visitors a more comprehensive insight into how modern research works on a day-to-day basis.

## Quiet Room

If possible, ensure that the scientists have an additional office room away from public view. This would act both as a 'quiet area', where the researchers can retreat from the visitors for a short time if necessary, as well as providing additional work space in a more peaceful environment. This factor is especially important as some tasks such as writing or literature research are difficult to conduct when there is a lot of background noise. In an office away from public view it would also be possible to conduct internal discussions and group meetings that would otherwise disturb ongoing measurements or presentations in the Open Research Laboratory.

However, as these tasks are also fundamental elements of research, the scientists working in the laboratory should be encouraged to perform as many of these processes as possible in public view, retiring to the private office only when absolutely necessary.

## **Private Entrance**

Scientific research does not know opening hours. In order to create optimum working conditions for the scientists, access to the Open Nano Lab needs to be assured outside of museum opening hours, ideally by incorporating a private laboratory entrance in the vicinity of the Open Nano Lab.

This would greatly increase the effectiveness of the research conducted in the Open Nano Labs. It would facilitate working after hours, thus eliminating the need to interrupt promising measurements when the museum closes. It would also be possible to further increase the size of the scientific group, as instrument use could also be scheduled after closing time. A private entrance would also enable visiting scientists to come and go without having to be escorted from the main museum entrance.

The main focus, however, must remain on conducting measurements during museum opening hours. Only if additional instrument time is required due to ongoing measurements or the size of the working group or should work after hours be considered.

## **Mobile Demonstrations**

It is worth considering having various experimental and demonstration setups built on mobile carts (e.g. a cart for sample preparation, a cart for ferrofluid demonstrations, ...) which are simply wheeled into the laboratory or demonstration area when required. Especially if most equipment has to be locked away at night for security reasons, this would greatly reduce setup time for routine laboratory tasks. At the same time it would increase the effectiveness of visitor communication, as presentations would profit from a greater variety of tried and tested demonstrations.

Also, if a lecture or presentation on nanotechnology is given elsewhere in the museum (e.g. in a central lecture hall), it is easily possible to incorporate the demonstrations of the Open Research Laboratory. This can be especially important in locations with limited space in and around the laboratory. Additionally, it also facilitates the removal of complete setups for testing, improvement or repair if necessary.

## Appendices

Further details and suggestions for establishing an ONL / NRL area are given in the following appendices to this book:

- List of Nanoproducts  
(gives an overview of a variety of currently available nanoproducts which can be used in a nanoproduct exhibition)
- List of Texts  
(contains a compilation of various exhibition / information board / poster texts from the Open Research Laboratory)
- List of Nano-Demonstrations  
(gives an overview of a variety of nano-demonstrations which can be shown in a science museum / science centre)



## ONL / NRL area Checklist

Here is an 'at-a-glance' overview of the components necessary for an Open Nano Lab in the form of a checklist.

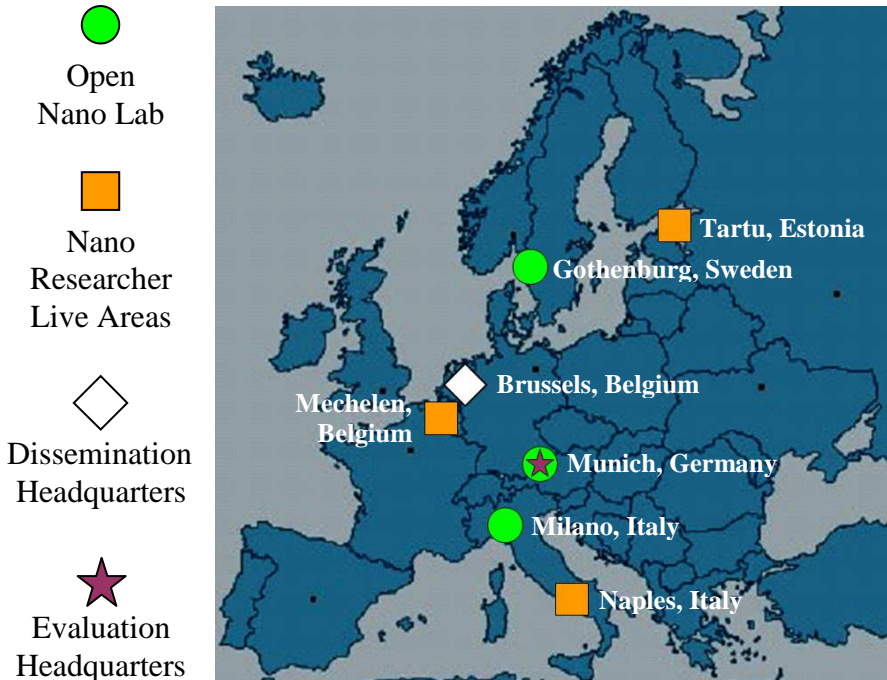
Basics	ONL	NRL
University Partner	<input type="checkbox"/>	<input type="checkbox"/>
Science Centre / Science Museum Partner	<input type="checkbox"/>	<input type="checkbox"/>
Funding (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>
Elements		
Dimensions		
Size	<input type="checkbox"/>	
Glass Wall	<input type="checkbox"/>	
Research Equipment	<input type="checkbox"/>	
Visitor Monitors	<input type="checkbox"/>	
Information	<input type="checkbox"/>	<input type="checkbox"/>
Nano-Demonstrations	<input type="checkbox"/>	<input type="checkbox"/>
Nanoproduct Exhibition	<input type="checkbox"/>	<input type="checkbox"/>
Presentation area		<input type="checkbox"/>
Additional Elements and Recommendations		
Scientific Group	<input type="checkbox"/>	
Quiet Room	<input type="checkbox"/>	
Private Entrance	<input type="checkbox"/>	
Mobile Demonstrations	<input type="checkbox"/>	<input type="checkbox"/>
Variety of Presentations	<input type="checkbox"/>	<input type="checkbox"/>

## **The NanoToTouch Project**

The NanoToTouch project aims to create innovative environments for the broad public to learn about and to discuss nanoresearch by directly involving the actors of research themselves. This will be accomplished by taking the laboratory environment and the research work out of enclosed academic campuses and relocating them right in the midst of the public in science museums and science centres. In three Open Nano Labs around Europe (Munich, Milan & Gothenburg) the visitors will experience 'live' the day-to-day practices and processes of nanoresearch conducted by young scientists. In a further three locations (Mechelen, Tartu & Naples) young researchers will be given the chance to communicate their work in specially designed Nano Researcher Live areas.

Thus, NanoToTouch pushes science communication to its extreme, merging communication and research in a powerful way and responding to the need for more transparency and accessibility in science. Furthermore, the strong synergetic network approach of the project enables contents and models to be developed for further distribution and implementation in educational and scientific communities.

## The NanoToTouch Consortium



### Consortium Members:

♦ Deutsches Museum ♦ Ludwig-Maximilians-Universität ♦ Museo Nazionale della Scienza e della Tecnologia 'Leonardo da Vinci' ♦ University of Milano - CIMAINA ♦ Universeum AB ♦ Chalmers University of Technology ♦ Technopolis ♦ Universiteit Antwerpen ♦ AHHA Science Centre ♦ University of Tartu ♦ Fondazione IDIS - Città della Scienza ♦ National Research Council - Institute of Cybernetics "E. Caianiello" ♦ Technische Universität München ♦ Ecsite - The European Network of Science Centres and Museums ♦

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