


# ***Nano 101:***

## How to Introduce the Smallest Science

# Nano 101 Presentations

Big idea	Format
 (#1) Small and different	Lots of introduction slides plus one NanoDays activity

# Example: Slides for Big Idea #1

## *nano is small and different*

- Why should the audience care about nano?
- What does “nano” mean? How large is a nanometer?
- Did people invent nano-things?
- What’s cool and different about nano?

*Don't try to re-invent the wheel – use NISE resources  
(like movies and images) to make things easier!*

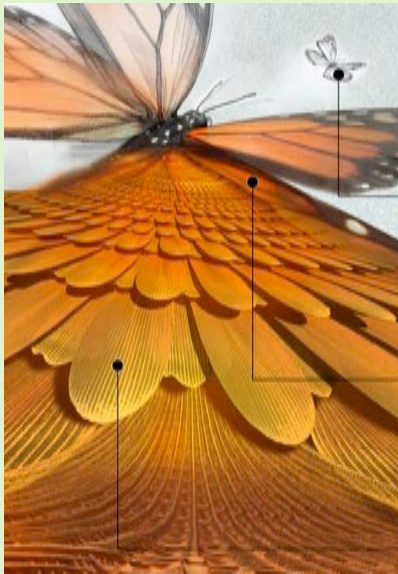
# Intro to Nano

"Nanotechnology: What's the Big Deal?" is a broad overview of the unique challenges and opportunities presented by nanoscale science, and dives into the super tiny scale of nanotechnology.

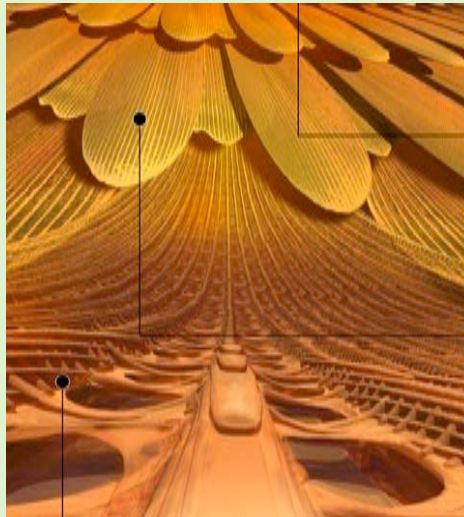


# Did Scientists “Create” Nano?

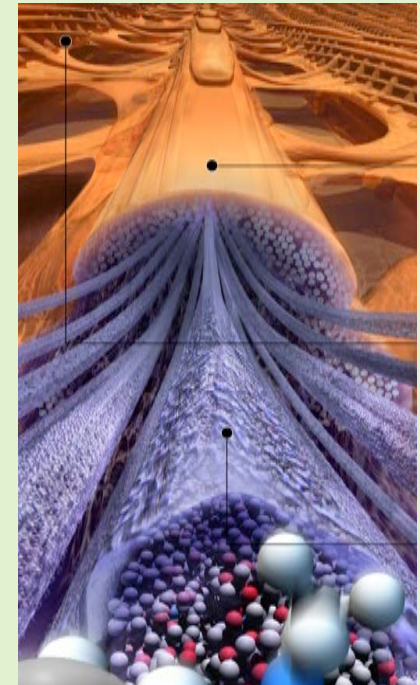
No, it was already in nature!



centimeters to micrometers



micrometers



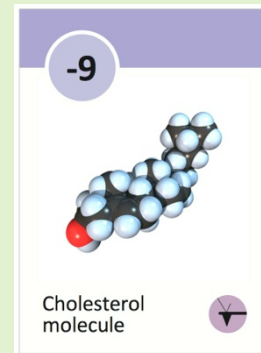
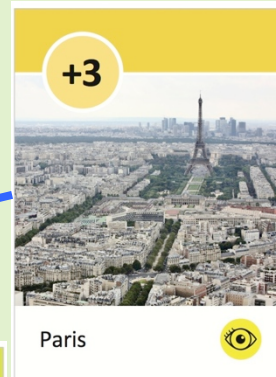
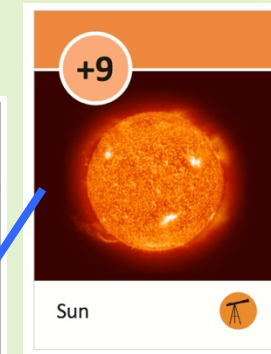
nanometers



# How Big is a Nanometer?

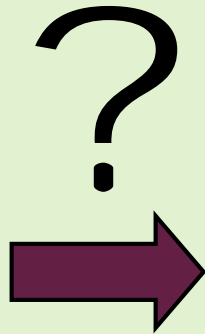
[http://nisenet.org/catalog/programs/exploring\\_size\\_-\\_powers\\_ten\\_game\\_nanodays\\_2011\\_2012\\_2014](http://nisenet.org/catalog/programs/exploring_size_-_powers_ten_game_nanodays_2011_2012_2014)

Prefixes for SI Units		
Prefix	Meaning	Notation
giga-	1,000,000,000.	1.E+09
mega-	1,000,000.	1.E+06
kilo-	1,000.	1.E+03
	1.	1.E+00
milli-	.001	1.E-03
micro-	.000001	1.E-06
nano-	.000000001	1.E-09



# How Big is a Nanometer?

If you could paint a teaspoon of paint one nanometer thick, how much area would it cover?



# Smallness Leads to New Properties

Surface area is  
really important!

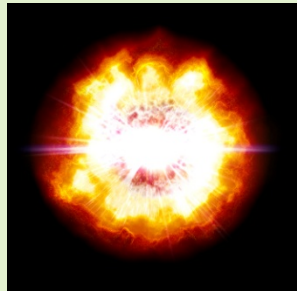




# Smallness Leads to New Properties



Bulk Aluminum



Nano Aluminum

**Reactivity**  
**Melting point**  
**Strength**  
**Conductivity**  
**Color**



Bulk Gold



Nano Gold

# Designing a Presentation

**I often switch  
the order of  
#2 and #3**



Big Idea	Things to talk about
(#1) Small and different	Examples of objects at different size scales Properties that are different at the nanoscale (color, reactivity, etc.)
(#2) Studying and making tiny things	Biomimicry and special tools (like atomic force microscopes or electron microscopes)
(#3) New technologies	Nano sunblock, nano fabric, solar cells, liquid crystal displays, etc.
(#4) Society and future	Issues related to societal and ethical implications

# Designing a Presentation

- Try to cover all 4 of the big ideas
- Give a general introduction to nano
- Incorporate NanoDays activities to make things interactive and fun
- Consider restrictions such as: time, cost, safety, audience's age and attention span, etc.

# Example Format: Teachers

Event organizers selected activities, with some input from me

<b>Turtle Bay Exploration Park</b>	<b>Big Idea(s)</b>
Exploring Size - Measure Yourself	(#1) Small and different
Exploring Properties – Surface Area	(#1) Small and different
Exploring Products - Sunblock	(#1) Small and different (#3) New technologies
Exploring Tools - Mitten Challenge	(#2) Studying and making tiny things
Exploring Tools - Special Microscopes	(#2) Studying and making tiny things

# Example Format: Teachers

Event organizers selected activities, with some input from me

Resource Area for Teachers	Big Idea(s)
Exploring Materials - Nano Fabric	(#1) Small and different (#3) New technologies
Exploring Products - Nano Sand	(#3) New technologies
Exploring Products - Sunblock	(#1) Small and different (#3) New technologies
Exploring Fabrication - Gummy Capsules	(#3) New technologies (#2) Studying and making tiny things
Exploring Materials - Graphene	(#3) New technologies (#2) Studying and making tiny things



# Example Format: Middle School Girls

## How I chose activities:

1. Don't require a chemistry room
2. Cheap
3. Girls could keep materials
4. Fun
5. Quick

# Example Format: Middle School Girls

1. Don't require a chemistry room
2. Cheap
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4. Fun
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Girls in Engineering Camp	Big Idea
Exploring Properties - Surface Area	(#1) Small and different
Exploring Products - Sunblock	(#1) Small and different (#3) New technologies
Exploring Materials - Nano Fabric	(#1) Small and different (#3) New technologies
Fortune fish	(#3) New technologies (#2) Studying and making tiny things

*Had other materials in case of extra time: Exploring Forces – Static Electricity, Exploring Fabrication - Gummy Capsules, Exploring Tools - Special Microscopes*

# My Favorite Activities

Topic	Activities	Demos
Small and different	<a href="#">Exploring Products - Sunblock</a> , <a href="#">Exploring Properties - Surface Area</a> , <a href="#">Exploring Materials - Nano Fabrics</a> , <a href="#">Exploring Materials - Thin Films</a>	<a href="#">Exploring Structures - Butterfly</a> , <a href="#">Exploring Materials - Graphene</a>
Studying and making tiny things	<a href="#">Exploring Tools - Special Microscopes</a> , <a href="#">Exploring Tools—Transmission Electron Microscopes</a>	<a href="#">Exploring Tools – Mystery Shapes</a> , <a href="#">Exploring Fabrication – Gummy Capsules</a>
New technologies	<a href="#">Exploring Products - Sunblock</a> , <a href="#">Exploring Materials - Nano Fabrics</a> , <a href="#">Exploring Products - Nano Sand</a> , <a href="#">Exploring Materials - Thin Films</a>	<a href="#">Exploring Materials - Graphene</a>
Part of our society and future	<a href="#">Exploring Products – Sunblock</a>	<a href="#">Exploring Properties - Invisibility</a>

# My Favorite Videos – By Topic

Topic	Videos
Overview of nano	<a href="#">Intro to Nano (NISE product)</a> , <a href="#">How Small is Nano? (NISE product)</a> , <a href="#">Introduction to Nanoscience</a> , <a href="#">Do You Know What Nano Means?</a> , <a href="#">Nano Careers</a>
Nano in nature	<a href="#">Zoom into a Blue Morpho Butterfly (NISE product)</a> , <a href="#">Zoom into a Lotus Leaf (NISE product)</a>
Nano is different	<a href="#">Nano and Me – Gold (NISE product)</a> , <a href="#">Nano and Me – Aluminum (NISE product)</a> , <a href="#">Nano and Me – Silver (NISE product)</a> , <a href="#">Nano and Me – Gravity (NISE product)</a> , <a href="#">What's Nano about Bubbles? (NISE product)</a>
Societal/ethical implications	<a href="#">Invisibility Cloak (NISE product)</a> , <a href="#">Three Angry Scientists (NISE product)</a> , <a href="#">Wonders and Worries of Nanotechnology (NISE product)</a> , <a href="#">Wonders and Worries of Nanotechnology: Regulation (NISE product)</a>
Products	<a href="#">Intro to Nanomedicine (NISE product)</a> , <a href="#">What's Nano about Water? (NISE product)</a> , <a href="#">Battling Cancer with Nanotechnology (NISE product)</a>
Tools	<a href="#">What Happens in a Nano Lab? (NISE product)</a> , <a href="#">How to Make Filthy Water Drinkable?</a> , <a href="#">Intro to Nanomedicine (NISE product)</a> , <a href="#">Battling Cancer with Nanotechnology (NISE product)</a> , <a href="#">Clean Room Lab Tours</a>

# My Favorite Videos – By Age

Age group	Videos
Pre-K – 5 <sup>th</sup> grade	<a href="#">How Small is Nano? (NISE product)</a> , <a href="#">Do You Know What Nano Means?</a> , <a href="#">What Happens in a Nano Lab? (NISE product)</a> , <a href="#">Nano and Me – Gold (NISE product)</a> , <a href="#">Nano and Me – Aluminum (NISE product)</a> , <a href="#">Nano and Me – Silver (NISE product)</a> , <a href="#">Nano and Me – Gravity (NISE product)</a> ,
6 <sup>th</sup> – 8 <sup>th</sup> grade	<a href="#">Intro to Nano (NISE product)</a> , <a href="#">What Happens in a Nano Lab? (NISE product)</a> , <a href="#">Nano and Me – Gold (NISE product)</a> , <a href="#">Nano and Me – Aluminum (NISE product)</a> , <a href="#">Nano and Me – Silver (NISE product)</a> , <a href="#">Intro to Nanomedicine (NISE product)</a> , <a href="#">What's Nano about Water? (NISE product)</a> , <a href="#">What's Nano about Bubbles? (NISE product)</a> , <a href="#">Invisibility Cloak (NISE product)</a> , <a href="#">Zoom into a Blue Morpho Butterfly (NISE product)</a> , <a href="#">Zoom into a Lotus Leaf (NISE product)</a> , <a href="#">Nano Careers</a>
High school / adults	<a href="#">Intro to Nano (NISE product)</a> , <a href="#">Introduction to Nanoscience</a> , <a href="#">Intro to Nanomedicine (NISE product)</a> , <a href="#">Nano Careers</a> <a href="#">Zoom into a Blue Morpho Butterfly (NISE product)</a> , <a href="#">Zoom into a Lotus Leaf (NISE product)</a> , <a href="#">How to Make Filthy Water Drinkable?</a> , <a href="#">Invisibility Cloak (NISE product)</a> , <a href="#">Battling Cancer with Nanotechnology (NISE product)</a> , <a href="#">Three Angry Scientists (NISE product)</a> , <a href="#">Wonders and Worries of Nanotechnology (NISE product)</a> , <a href="#">Wonders and Worries of Nanotechnology: Regulation (NISE product)</a>



# Other Resources We'll Post Online

- **This presentation**
- [Wonderful NISE booklet](#) on the 4 main concepts related to nano
- **Example slides**
  - ["Nano 101 for Staff" \(a NISE product\)](#)
  - ["Nano 101 for Staff \(Greta Zenner version\)" \(a NISE product\)](#)
  - ["Nano 101 for Staff \(Tim Miller version\)" \(a NISE product\)](#)
  - Lizzie's Intro to Nano slide deck

# Things I've Learned

- Don't try to reinvent things! There are so many materials available on the NISE website
- Kids love NanoDays activities, but it's a good idea to clean up each set of materials so they actually pay attention when you're talking
- Surface area concept is confusing
- Adults like the teaspoon of paint example, but kids don't like it as much (probably don't feel comfortable guessing)
- Adults really like the "Wonders and Worries of Nanotechnology" videos

# Designing a Presentation

When choosing topics to present, it can help to consider the four key concepts developed by NISE:

1. **Small and different:** Nanometer/sized things are very small, and often behave differently than larger things do.
2. **Studying and making tiny things:** Scientists and engineers have formed the interdisciplinary field of nanotechnology by investigating properties and manipulating matter at the nanoscale.
3. **New technologies:** Nanoscience, nanotechnology, and nanoengineering lead to new knowledge and innovations that weren't possible before.
4. **Part of our society and our future:** Nanotechnologies have costs, risks, and benefits that affect our lives in ways we cannot always predict.

*To learn more about these concepts:*

[http://www.nisenet.org/catalog/tools\\_guides/engaging\\_public\\_nano\\_key\\_concepts](http://www.nisenet.org/catalog/tools_guides/engaging_public_nano_key_concepts)