Nanotechnology Spin-a-Prize!

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General Description

Type of program:
Stage presentation

Nanotechnology Spin-a-Prize! introduces visitors to the basics of nanoscale science, engineering, and technology ("nano") through a game show format. Visitors learn that nanometer-sized things are small and often behave differently than larger things do, and that work in this emerging field leads to new knowledge and innovations. Visitors also consider the ways that nanotechnology will affect our lives.

Program Objectives

NISE Network content map main concepts:
As a result of participating in this program, visitors learn that:

1. Nanoscale things are very small, and often behave differently than larger things do.
2. Scientists and engineers have formed the interdisciplinary field of nanotechnology by investigating properties and manipulating matter at the nanoscale.
3. Nanoscale science, engineering, and technology lead to new knowledge and innovations that weren't possible before.
4. Nanotechnologies have costs, risks, and benefits that affect our lives in ways we cannot always predict.

National Science Education Standards:

1. Science as Inquiry
    - K-4: Understanding about scientific inquiry
    - 5-8: Understanding about scientific inquiry
    - 9-12: Understanding about scientific inquiry

2. Physical Science
    - K-4: Properties of objects and materials
    - 5-8: Properties and changes of properties in matter
    - 9-12: Structure and properties of matter

5. Science and Technology
    - K-4: Abilities to distinguish between natural objects and objects made by humans
    - K-4: Abilities of technological design
    - K-4: Understanding about science and technology
    - 5-8: Abilities of technological design
    - 5-8: Understanding about science and technology
    - 9-12: Abilities of technological design
    - 9-12: Understanding about science and technology

6. Personal and Social Perspectives
    - K-4: Science and technology in local challenges
    - 5-8: Risks and benefits
    - 9-12: Natural and human-induced hazards
    - 9-12: Science and technology in local, national, and global challenges

7. History and Nature of Science
    - K-4: Science as a human endeavor
    - 5-8: Science as a human endeavor

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Time Required

Set-up	Program	Clean Up
		
5 minutes	20 minutes	5 minutes

Background Information

Definition of terms

Nano is the scientific term meaning one-billionth (1/1,000,000,000). It comes from a Greek word meaning “dwarf.”

A nanometer is one one-billionth of a meter. One inch equals 25.4 million nanometers. A sheet of paper is about 100,000 nanometers thick. A human hair measures roughly 50,000 to 100,000 nanometers across. Your fingernails grow one nanometer every second.

(Other units can also be divided by one billion. A single blink of an eye is about one-billionth of a year. An eyeblink is to a year what a nanometer is to a yardstick.)

Nanoscale refers to measurements of 1-100 nanometers. A virus is about 70 nm long. A cell membrane is about 9 nm thick. Ten hydrogen atoms are about 1 nm.

At the nanoscale, many common materials exhibit unusual properties, such as remarkably lower resistance to electricity, or faster chemical reactions.

Nanotechnology is the manipulation of material at the nanoscale to take advantage of these properties. This often means working with individual molecules.

Nanoscience, nanoengineering and other such terms refer to those activities applied to the nanoscale. “Nano,” by itself, is often used as short-hand to refer to any or all of these activities.

Materials

The materials for this program are all included in the NanoDays 2013 kit:

- Slides
- Prize wheel
- Dry erase board and marker
- Prizes (scratch-and-sniff stickers, temporary tattoos, or other small prizes)

Set Up

Time

10 minutes

Prepare and set up the materials:

- Be sure the slides are visible to the audience.
- Place the wheel and dry erase board in a location where the audience can see them and volunteers can easily access them.
- Have the prizes handy to distribute at the end of the program.

Program Delivery

Time

20 minutes

Safety

Visitors who spin the wheel and keep score during the program should take care approaching and leaving the presentation area.

Visitors should not spin the wheel too vigorously.

Talking points and procedure

Slide 1:
Welcome to Nanotechnology Spin-a-Prize, a game show about nanoscale science, engineering, and technology! My name is_____ and I'll be your host.

Nanotechnology Spin-a-Prize consists of two rounds. Before each round, I'm going to share some information with you. *Listen closely because the answers to the game will be revealed!*

You will all be contestants! The teams are divided by this row. [Gesture]
This is Team A. [Gesture]
This is Team B. [Gesture]
Who's on Team C? Just kidding—there is no Team C!

Slide 2:
Let's get started with Round 1 of Nanotechnology Spin-a-Prize!

Slide 3:
How many of you have heard of nanotechnology, or nano-anything?

[Show of hands]

Great!

In the field of nanotechnology, scientists and engineers make new materials and tiny devices. Sometimes they build things out of individual atoms! It sounds like science fiction, doesn't it? But nanotechnology is very real. It will affect all of our lives.

Some say new nanotechnologies will have a greater impact than any previous invention—more than electricity, more than cars, more than television, more than computers, even more than the internet! So we should all be paying attention to nanotechnology.

Slide 4:
Nano- is a prefix, like mega- or micro-. You've probably heard of megabytes or microscopes. Nano basically means super small.

In nanotechnology, researchers measure things using nanometers. A nanometer is a billionth of a meter. That's very, very, very small!

A 6-year-old child is about one meter tall—like the girl in the picture on the left.

The picture in the middle is of a red blood cell. A red blood cell is about a millionth of a meter, or one micrometer across. That's pretty small, but a nanometer is a thousand times smaller than that.

The picture on the right is a DNA molecule. DNA is found in your cells. A DNA molecule is two nanometers wide. That's two-billionths of a meter!

So nanotechnology is technology at the scale of atoms and molecules.

Remember to keep listening closely because the answers to the game will be revealed!

Slide 5:
Some things behave differently when they're nano-sized. For example, colors can change! A gold brick is yellow, but nanoparticles of gold reflect light differently and can look red or purple.

The photo on the right is of nano-sized gold particles. The different colors are because the gold nanoparticles are different sizes. The middle picture is of a stained glass window. Since the Middle Ages, nano gold has been used to make red stained glass.

Slide 6:
And there are other surprising nano properties that occur in nature.

For example, Blue Morpho butterflies get their iridescent color from tiny nano-sized structures in their wings. The nanostructures are colorless, but they're precisely spaced so they reflect blue light back to your eyes.

Geckos can walk up walls, but they don't have glue on their feet! Instead, their feet have millions of tiny nano-sized "hairs" that temporarily bond with the wall.

Slide 7:
Nanotechnology takes advantage of special properties at the nanoscale to create new materials and devices.

For example, computer chips have tiny transistors that are only nanometers across. The smaller the transistors are, the smaller and faster the computer chips can be.

Many cell phones and laptops have displays that use nano-sized liquid crystals. These liquid crystal displays let us create thinner, lighter devices.

Slide 8:
Nano-sized things are so small that we cannot see them with our eyes, or even with powerful light microscopes.

Scientists and engineers have special tools they use to study and make things on the nanoscale. A tool called an *atomic force microscope* (AFM) can "feel" things on the nanoscale and then create an image of them.

You're familiar with another special nano-detector: your nose! Nanoparticles are too small to see, but we can smell some of them. The tiny scent molecules that make things smell are measured in nanometers. So your nose is your very own nanosensor!

Slide 9:
Are you ready to answer the questions for Round 1 of Nanotechnology Spin-a-Prize?

[Audience cheers]

First, I need an official scorekeeper—someone who can write on the board and is good at adding up numbers.

[Have the volunteer stand by the scoreboard.]

Next, I need a representative from each team to spin the wheel!

[Get the names of the volunteers and have them stand by the wheel.]

All right, you will spin the wheel to find out how many points the question is worth.

The questions are True or False. Teams, shout out the answer to your representative.

We'll start with Team A. Spin that wheel!

[Volunteer spins the wheel.]

Slide 10:
True or false? A nanometer is a billionth of a meter.

Team A, what's your answer?

[Audience response.]

The correct answer is…

Slide 11:
True! A nanometer is a billionth of a meter.

That's so small that nanometers can be used to measure individual atoms and molecules. Nano-sized things are way too small to see, but we can smell some of them.

[Scorekeeper marks score.]

OK, Team B, your turn.

Spin the wheel! [Volunteer spins the wheel.]

Slide 12:
True or false? Nano is found only in technology.

Team B, what do you think?

[Audience response.]

The correct answer is…

Slide 13:
False! There are nanoscale effects everywhere, in nature and in technology. For example, lotus leaves stay clean even in muddy water because their leaves have nano-sized structures that repel water.

[Scorekeeper marks score.]

All right, back to Team A.

Spin the wheel! [Volunteer spins the wheel.]

Slide 14:
True or false? Scientists use tools that "feel" nano-sized things.

Team A, what's your answer?

[Audience response.]

The correct answer is…

Slide 15:
True! Scientists use tools that "feel" nano-sized things. Nano-sized things are way too small to see. Scientists study and make things on the nanoscale using special instruments such as the atomic force microscope.

[Scorekeeper marks score.]

And we end the round with Team B.

Spin the wheel! [Volunteer spins the wheel.]

Slide 16:
True or false? Things always behave the same, no matter what size they are.

Team B, what's your answer?

[Audience response.]

The correct answer is…

Slide 17:
False! Things can behave differently when they're nano-sized.

For example, chemical reactions often go faster when a material is nano-sized. That's because reactions occur on the surface of objects, and nanoscale objects have a lot of surface area for their volume. Aluminum, used everyday in drink cans, can be explosive when the aluminum particles are nano-sized!

[Scorekeeper marks score and adds them up.]

Slide 18:
What a great Round 1! The score stands at_____.

Thanks very much to our scorekeeper and team representatives! You can have a seat. Please give them a round of applause, and we'll head into Round 2!

[Applause]

Slide 19:
Our second and final round is about nano and society—how nanotechnology affects our lives.

Remember to listen closely because the answers for this round are about to be revealed!

Slide 20:
Nanotechnology is already part of our lives, and it will become even more important in the future. So as individuals and as a society, we need to think about the kind of future we want and how nanotechnology will be part of it.

Let's see some of the ways nano may be part of our future.

Slide 21:
Nanotechnology is helping us to create new sources of energy.

Thin-film solar panels are made of bendable nano-layers of material. These small, portable panels can provide a personal power source anywhere in the world. They produce almost as much electricity as traditional photovoltaic panels.

Fuel cells convert chemical energy into electrical energy without combustion, so they're a clean, efficient way to generate power. As more efficient catalysts are developed using nanoparticles, the use of fuel-cell cars may become more widespread.

Slide 22:
Another use of nanotechnology is in water filters.

On the left you can see a picture of a water filter that's packaged like a tea bag! It can be taken anywhere in the world and stuffed into the neck of a water bottle to purify water.

On the right, you can see a picture of another portable nanotechnology water filter. Many water filters can get out relatively big things like dirt and bacteria, but only filters with nano-sized pores can remove tiny things like viruses and salt ions.

Slide 23:
Nanotechnology might also lead to improvements in healthcare.

In the picture on the left, you can see a "lab on a chip." In the future, small chips the size of a postage stamp might need only a drop of blood and a few minutes to run a whole variety of medical tests. These "labs on a chip" will use nano-sized sensors.

Remember the red-colored nano gold? One day, tiny gold nanoshells might be used to treat cancer! In an experimental therapy, nano gold and near-infrared light are used to destroy tumors with few side-effects.

Slide 24:
Nanotechnology might also help us to create innovations we can hardly imagine today.

For example, some scientists think nanotechnology might allow us to create an elevator to space! Tiny carbon nanotubes are super-strong for their size, so they could be used to create a cable between a base station on earth and an anchor in space.

Another possibility is quantum computers. We might be able to greatly increase computer memory and processing power by using quantum bits, rather than our current binary system.

All right, listen up! Remember, you're learning the answers to the game!

Slide 25:
I've talked a lot about the possible benefits of nanotechnology. But what about the risks?

Many technologies can be viewed as either good or risky, depending on the circumstances. Let's consider fire, one of the oldest technologies. Fire is useful when we want to get warm or cook our food. But fire can also burn things down.

We have to think ahead and protect ourselves from the risks related to any technology. For example, we build fires in a safe place, we have a fire extinguisher or water handy, and we have fire fighters to respond if a fire gets out of control.

Just like other technologies, nanotechnology has potential to provide great benefits, but we also have to think about potential risks and how to protect ourselves.

Slide 26:
Everyone has a role in shaping nanotechnology. Companies and governments decide which technologies to invest in and how to regulate them. Individuals can help shape nano research and development by deciding whether to use products containing nanotechnology.

You're already making decisions about whether or not to use nanotechnologies, though you may not always know it.

How many of you use sunblock?

[Audience response.]

Many sunblocks contain nano-sized particles of zinc oxide or titanium dioxide. Manufacturers don't have to label whether the sunblock contains nano-sized particles, so you could be using nanoparticle sunblock without realizing it.

Slide 27:
Hopefully, Nanotechnology Spin-a-Prize will help you start thinking about how nanotechnology is part of our lives today and in the future.

But for now, are you ready to play the final round?

[Audience cheers!]

I need another scorekeeper—who would like to help with that?

[Have the volunteer stand by the scoreboard.]

And now I need two new team representatives to spin that wheel!

[Choose volunteers.]

We'll start with Team B this round.

Spin that wheel! [Volunteer spins the wheel.]

Slide 28:
True or false? Nanotechnology is far off in the future.

Team B, what's your answer?

[Audience response.]

The correct answer is…

Slide 29:
False! Nanotechnology is already part of our lives.

Many products containing nanotechnology can already be found on the shelves of sports stores, supermarkets, and electronics stores.

Nano-sized silver particles are one of the most common nanomaterials used in consumer products. There are socks, for example, that use nanosilver to kill the bacteria that make feet smell. Some people wonder what happens when you wash the socks and the nanosilver particles go down the drain.

[Scorekeeper marks score.]

OK, this one is for Team A.

Spin that wheel! [Volunteer spins the wheel.]

Slide 30:
True or false? In the future, nanotechnology might lead to amazing innovations.

Team A, what's your answer?

[Audience response.]

The correct answer is…

Slide 31:
True. In the future, nanotechnology might lead to amazing innovations.

For example, researchers are working on invisibility cloaks! Many nanotechnologies are smaller than the wavelength of visible light, so they can interact with light in special ways. Researchers are experimenting with ways of bending light to cloak objects—making them invisible to the human eye or to surveillance devices.

[Scorekeeper marks score and adds them up.]

OK, we're back to Team B. Spin that wheel! [Volunteer spins the wheel.]

Slide 32:
True or false? Nanotechnologies involve both risks and benefits.

Team B, what's your answer?

[Audience response.]

The correct answer is…

Slide 33:
True. All technologies involve both risks and benefits. For example, gasoline is toxic and flammable. But it's also useful, so we have regulations for producing, transporting, and using it safely.

As we develop and use new nanomaterials and technologies, we can try to maximize the benefits of nanotechnology and minimize the risks. And we can also try to share the risks more equally across different people.

[Scorekeeper marks score.]

OK, Team A, it's your turn for the final question of our game! Spin that wheel!

[Volunteer spins the wheel.]

Slide 34:
True or false? Ordinary people can't influence nanotechnology.

Team A, what's your answer?

[Audience response.]

The correct answer is…

Slide 35:
False. We all have a role in shaping our nano future.

Companies and governments decide which technologies to invest in and how to regulate them. Individuals can help shape nano research and development by deciding whether to use products containing nanotechnology.

[Scorekeeper marks score and adds them up.]

Slide 36:
That ends our game of Nanotechnology Spin-a-Prize! Congratulations everyone and thank you for playing. Give yourselves a round of applause!

The final score is_____. Well done!

There's a lot more to learn about nanoscale science, engineering, and technology—and today's NanoDays event is the perfect place to begin.

Slide 37:
Since you all worked so hard, here's a special prize for everyone: scratch and sniff stickers. Enjoy those nano-sized scent molecules, and enjoy the rest of your day!

Tips and troubleshooting

To make this program entertaining, it's important that the presenter—or game show host—have high energy. Make the wheel spinning and questions exciting for the audience!

It's fine to read the script directly off the slide notes or a printout, so long as you can do this smoothly and with enthusiasm. Audiences are used to seeing game show hosts reading the questions.

When you choose audience volunteers, try to choose visitors who will be comfortable in the presentation area for each round of questions. For the scorekeeper, be sure to choose a visitor who is old enough to write clearly and do the math.

You may need to encourage the volunteers to spin the wheel hard enough to make it exciting, but not so hard that it gets out of control. You or a volunteer can hold the wheel steady while it's being spun.

You may want to find a way to display the scoreboard at all times, or you can simply hold it up at the moments when the score is being reported to the audience.

Common visitor questions

Is sunblock with nanoparticles safe?
Many research studies have shown that sunblock containing nanoparticles of zinc oxide or titanium dioxide is safe to use. The zinc and titanium minerals in the sunblock don't go through the outer layer of healthy, adult skin. Still, some people have concerns about the use of nanoparticles in sunblock and other products for humans or the environment.

How are gold nanoshells used to treat cancer?
Gold nanoshells are tiny spheres of silica coated in gold. In an experimental therapy currently undergoing clinical trials with humans, gold nanoshells are injected into the patient. The nanoshells collect in tumors. Near-infrared light is shined on the tumor site. The light heats up the nanoshells, destroying the tumor and destroys with very little harm to nearby healthy tissue.

Going further…

NISE Net has a website with information and activities for the public:
http://www.whatisnano.org/

Clean Up

Time
5 minutes

Gather and store the materials.

Universal Design

This program has been designed to be inclusive of visitors, including visitors of different ages, backgrounds, and different physical and cognitive abilities.

The following features of the program's design make it accessible:

1. Repeat and reinforce main ideas and concepts
    - The presentation is organized into discrete chunks.
    - A content overview is provided at the beginning of the program (program outline), and the content is summarized at the end of the program.

2. Provide multiple entry points and multiple ways of engagement
    - Concise key phrases are used to support main ideas.
    - Main ideas are presented through multiple senses (sight, hearing, smell and touch).

3. Provide physical and sensory access to all aspects of the program
    - Main ideas are presented through multiple senses (sight, hearing, smell and touch).
    - Slides are made accessible by using large, high-contrast text and images and by using large, clear fonts.

To give an inclusive presentation of this program:

- Make sure your face is visible at all times.
- Make sure you don't stand in the way of the slides, the wheel, or the scoreboard.
- Ask the audience questions, and check in with them along the way to make sure they're engaged and with you.
- Use descriptive language when presenting objects and images.
- Make a handout of the presentation available to visitors, either to use during the presentation or to take home.
- Make sure your audience knows about any special accommodations you offer.

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