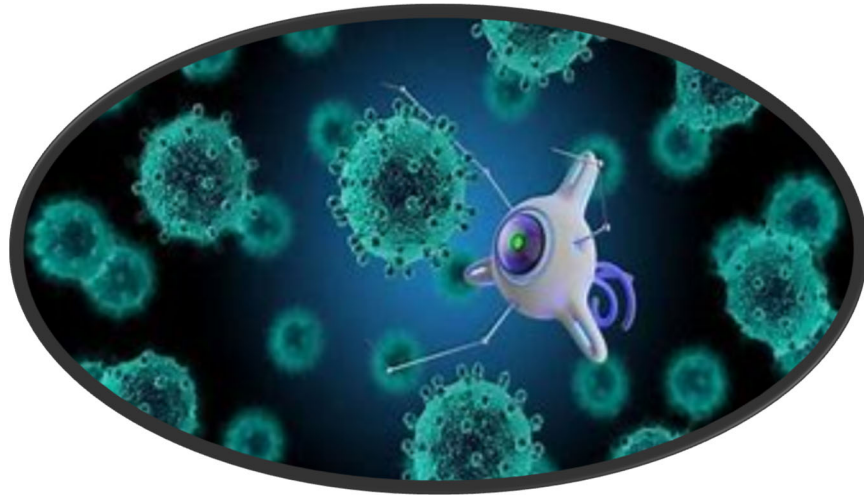


Wiggle, Wobble, Nanobot Challenge



Healthcare Nanotechnology Market Share...medgadget.com

Description

“Nanotechnology is the understanding and control of matter at dimensions between approximately (1 and 100 nanometers), where unique phenomena enable novel applications”. Students will be introduced to the concept of nanotechnology and will develop a working knowledge about the nanoscale and the nanoworld. Students will explore, relate and apply the topic of nanotechnology through simple robotic engineering and the topic of medicine. Students will learn about nanotechnology and use today as it is applied to medicine and robotics.

Objectives

Students will be able to:

- Students will gain a basic understanding of nanotechnology and its use and application today.

- Students will use the scientific process and the scientific method to perform simple experiments and to build various simple robotics using various materials with application to nanorobotics.
- Students will explore the use of nanorobotics in real world applications to medicine.

North Dakota State Standards

- HS-ET1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ET1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ET1-3** Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Schedule

- 10:30-10:45 Cultural Connection: Native American Inventions: Medicine & Camouflage. Video: 8 Incredible Inventions of the Indigenous Peoples of the Americas. **Video Time: Medicine (start 3:25-5:30 stop)**
- 10:45-11:30 Wiggle, Wobble, Nanobot Power Point Presentation.
- 11:30-12:00 Activity 1 Virtual Robotics
- 12:00-12:30 Lunch
- 12:30-1:15 Activity 2 Wigglebot
- 1:15-2:00 Activity 3 Wobblebot
- 2:00-2:30 Activity 4 Bristlebot & Brushbot
- 2:30-2:45 Activity 5 Nanobot Challenge
- 2:45-3:00 Wrap-Up & Questions

Cultural Connection: Native American Inventions: Medicine & Camouflage.

Video Time: Medicine (3.25-5:30 stop) [8 INCREDIBLE INVENTIONS OF THE INDIGENOUS PEOPLES OF THE AMERICAS | History - Bing video](#)



Camouflage

Indigenous peoples of North America made many contributions to technology that we use today. The Ojibway & Dakota Nations along with many other tribal nations lived off the land by hunting and gathering food. One of the main sources of food for the plains Indians was buffalo. In order to kill buffalo, the hunters had to master the art of camouflage in order to get close to their prey. In fact, it is reported that the indigenous people of North America were the first true inventors of camouflage. This skill gave the hunters an advantage allowing them to get close to the buffalo without being seen. Two ways that they did was through painting themselves and their clothing that would mimic their surroundings. Other ways of hiding themselves was to cover with blankets and hides. Native Americans were masters at the art of camouflage.

Medicine

All Native American tribal nations utilized medicine to fight infections. Many tribes had medicine men or shamans who carried medicine bundles. A medicine bag or bundle is a bag that contained many medicinal items that were used to care for the tribal members. The medicine bag was believed to protect or give spiritual power to the carrier. Some of the items that were contained in the bag or bundle includes herbs, seeds, bones, tobacco, grasses, horsehair or other items that the carrier thought to be of spiritual value. These bags were used for healing, protection and good luck for hunting etc.

Other Native American Inventions

Food: corn, beans, squash, pumpkins, sunflowers, wild rice, sweet potatoes, tomatoes, peppers, peanuts, avocados, papayas, potatoes and cacao	Baby Bottles
Rubber	Medicine: Anesthetics and Topical Pain Relievers
	Syringes
	Hammocks

Kayaks	Mouthwash
Snow Goggles	Raised-Bed Agriculture
Cable Suspension Bridges	

Introduction


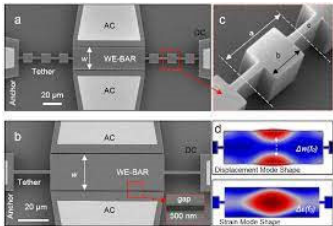
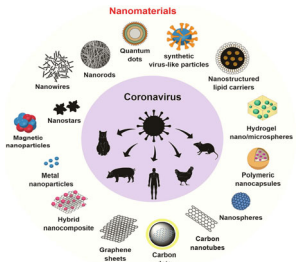
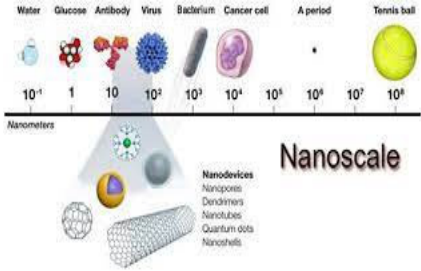
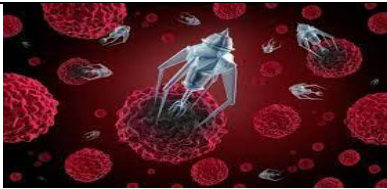
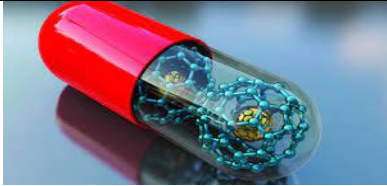
Nanotechnology manipulates material at the atomic and molecular scale and encompasses physics, chemistry, biology and technology to design, produce, synthesize materials to make them smaller, and stronger and better able to work in a variety of systems including the human body. Nanotechnology has many applications in today's society which include Nano-Medicine, Nanomaterials, Defense, Manufacturing, Spaceflight, Energy, and the Environment to name a few.

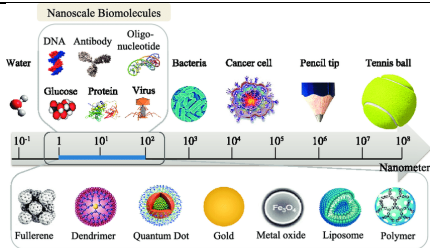
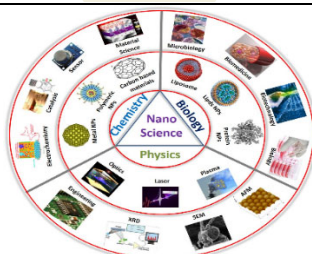

Nano-Medicine is the application of nanotechnology to help solve medical issues. Today, nano-scientists are using nanobots or robots which are about ~50–100 nm wide to carry out a very specific functions within the body. These nanobots can be used very effectively for drug delivery in the human body. Normally, drugs work and travel through the entire body before they reach the disease-affected area. This new technology will allow scientists to directly attack tumors or specific diseased areas within the body. The following slide is an excerpt from a video called “Welcome to the Era of Nanomedicine”.

Nanomedicine

Nanomedicine is the medical application of nanotechnology which uses biosensors, tissue engineering, and diagnostic devices to understand disease such as cancer. Scientist build nanoparticles that can conceal itself or evade itself from the surveillance of the human immune system. It camouflages itself in a way the body's immune system does not attack it. Nanoparticles go directly to the diseased tissue and this reduces the side effects of drugs. It also allows scientists to target the diseased tissue with a higher quantity of a drug via the nanoparticle. This treatment is being used today in clinical trials with cancer patients. Nanobots were developed in the preclinical trials with animals. This allowed scientists to develop nanoparticles that can change to a fluorescent nanoparticle that lights up in diseased tissue and which can then return information from the nanoparticles to be analyzed by optics. Micro robots have also been developed and they can travel through body fluids. The micro robots mimic human body tissues such as red blood cells. By taking the red blood cell membranes the robots camouflage themselves within the body and can circulate like the human red blood cell for about 120 days.

However, much is yet to be learned about how the nanobots are degraded in the body which raises the issue of ethics.

Nano-Term	Definition	Image
Nanotechnology	The usage of matter on the nanometer scale to produce structures, systems, and technological devices.	
Nanoelectromechanical Systems (NEMS)	A generic term to describe nanoscale electrical/mechanical devices.	
Nanomaterials	Nanoscale particles, films, and composites designed and assembled in controlled ways.	
Nanometer	A unit of measurement equal to one-billionth of one meter. The head of a pin is about 1 million nanometers across. A human hair is about 60,000 nanometers in diameter, and a DNA molecule is between 2-12 nanometers wide.	
Nanomachine	A nanoscale device capable of performing mechanical movements due to responses to specific stimuli.	
Nanomedicine	The application of nanotechnology to solve medical problems.	

Nanoscale	Length scale applicable to nanotechnology (i.e., 1-100 nanometers).																																					
Nanoscience	Combines science, engineering, and technology to study matter and processes at the nanoscale.																																					
Nanometer	one billionth of a meter or 1/1000 of a micrometer.	<table><tr><th>Prefix</th><th>Abbreviation</th><th>Relationship to Basic Unit</th><th>Exponential Relationship to Basic Unit</th></tr><tr><td>mega</td><td>M</td><td>1,000,000 x basic unit</td><td>10⁶ x basic unit</td></tr><tr><td>kilo</td><td>k</td><td>1,000 x basic unit</td><td>10³ x basic unit</td></tr><tr><td>deci</td><td>d</td><td>1/10 x basic unit</td><td>10⁻¹ x basic unit</td></tr><tr><td>centi</td><td>c</td><td>1/100 x basic unit</td><td>10⁻² x basic unit</td></tr><tr><td>milli</td><td>m</td><td>1/1000 x basic unit</td><td>10⁻³ x basic unit</td></tr><tr><td>micro</td><td>μ</td><td>1/1,000,000 x basic unit</td><td>10⁻⁶ x basic unit</td></tr><tr><td>nano</td><td>n</td><td>1/1,000,000,000 x basic unit</td><td>10⁻⁹ x basic unit</td></tr><tr><td>pico</td><td>p</td><td>1/1,000,000,000,000 x basic unit</td><td>10⁻¹² x basic unit</td></tr></table>	Prefix	Abbreviation	Relationship to Basic Unit	Exponential Relationship to Basic Unit	mega	M	1,000,000 x basic unit	10 ⁶ x basic unit	kilo	k	1,000 x basic unit	10 ³ x basic unit	deci	d	1/10 x basic unit	10 ⁻¹ x basic unit	centi	c	1/100 x basic unit	10 ⁻² x basic unit	milli	m	1/1000 x basic unit	10 ⁻³ x basic unit	micro	μ	1/1,000,000 x basic unit	10 ⁻⁶ x basic unit	nano	n	1/1,000,000,000 x basic unit	10 ⁻⁹ x basic unit	pico	p	1/1,000,000,000,000 x basic unit	10 ⁻¹² x basic unit
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Nanobot	Robots that carry out a very specific function and are ~50–100 nm wide. They can be used very effectively for drug delivery. Normally, drugs work through the entire body before they reach the disease-affected area.																																					

Activity 1 Nanomedicine Explorer, a virtual exhibit.

Learn more about nanotechnology & nanomedicine. Go to the link and show the students the following videos in order. They are very short, many less than a minute.

YouTube, Time (6:04): [Welcome to the Era of Nanomedicine - Bing video](#)

Wiggle, Wobble, Nanobot Challenge

Gamification: Game based learning creates fun. It helps information to stick. In this challenge you will be given three robots to build and a puzzle to complete.

Each room will have one puzzle to solve and one or two robots to build. Once you have completed the projects you may move onto the next room.

The materials for each robot will be in the room numbered for your group and your group will have one desk. Only use your supplies on your desk. If you need something please ask the instructor.

When the group has completed the project and puzzle task, bring them back to the main classroom and go onto your next room. If you are unable to figure out the puzzle, that's okay. Just bring it back to the room when your robot is finished.

This challenge is based on engineering. So take your time and do your best but monitor your time. Work together as a team.

Instructors group the students by counting off by 1-4. Each group should have 4 students. Two can work on the puzzle and two can work on the robot.

Activity 2 Wigglebot

Wigglebot Room: Find your desk with your team number. **Craze Maze Puzzle:** two students will work on the puzzle and two students will work on the wigglebot.

When you have completed both tasks, take your puzzle & wigglebot to your desk in the main room.

Go to the wobblebot room.

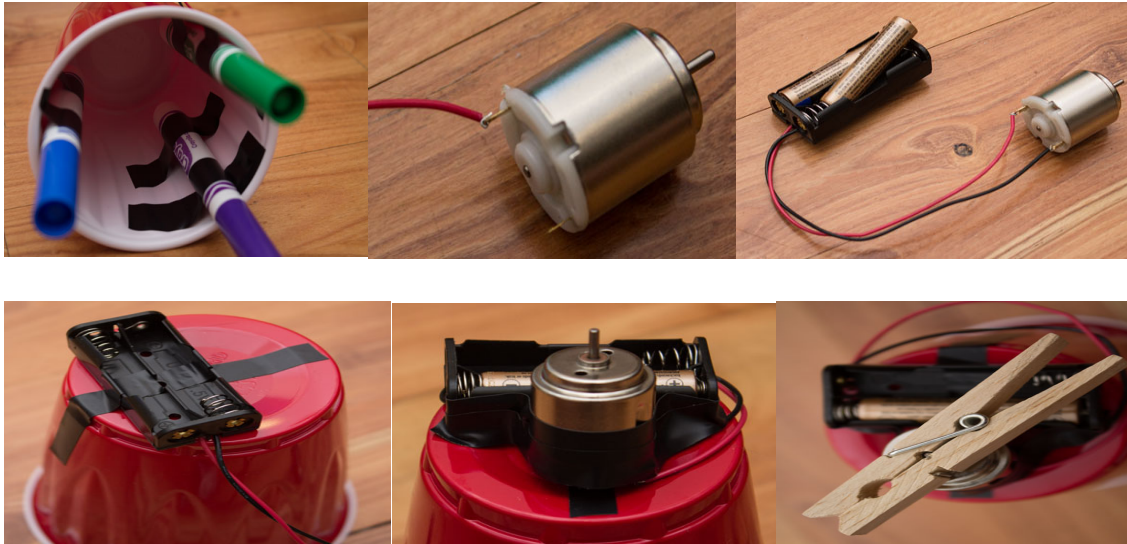


Materials



Disposable cup
Electrical tape
3 Markers
2 "AAA" battery holder
2 "AAA" batteries
1.5-3 V DC Motor
Clothespin
Popsicle stick
Permanent Marker for eyes

Procedure





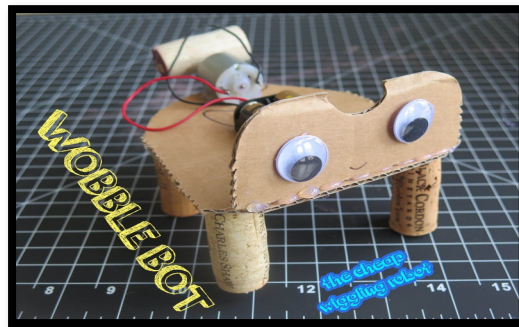
1. First tape the markers into the cup as legs.
2. Next attach the battery pack to the DC motor by wrapping the wire around the leads on the motor.
3. Now that the battery pack is attached to the motor, tape the battery pack onto the top of the disposable cup slightly off center. Cut the strips of electrical tape in half.
4. Next tape the DC motor onto the cup.
5. At this point you could turn on the motor by placing the batteries into the holder, to see that with the motor not off balance, nothing exciting happens. Next add on the clothespin to the motor and it should start to wiggle a little bit.
6. To make the wiggiebot wiggle more, you need the motor to be more off balance. Tape a popsicle stick to the clothespin. Fold the end of a long narrow piece of electrical tape over the motor and then wrap the tape around the motor so that the sticky side is facing out.
7. Attach the clothespin and weight to the motor.
8. Make a face on your wiggiebot.
9. Stop Here: bring your Wiggiebot & Puzzle to the room. You will plug in the batteries at the challenge.

Activity 3 Wobblebot

Wobblebot Room: Find your desk with your team number. **Wobblebot Crossword** and **Scramble Word**: two students will work on the puzzle and two students will work on the wobblebot.

When you have completed both tasks, take your puzzle & wobblebot to your desk in the main room.

Go to the bristlebot room.



Materials



Cardboard

2 batteries

[Battery Holder](#) (see non-pack option at end)

[DC Motor 1.5-3V](#)

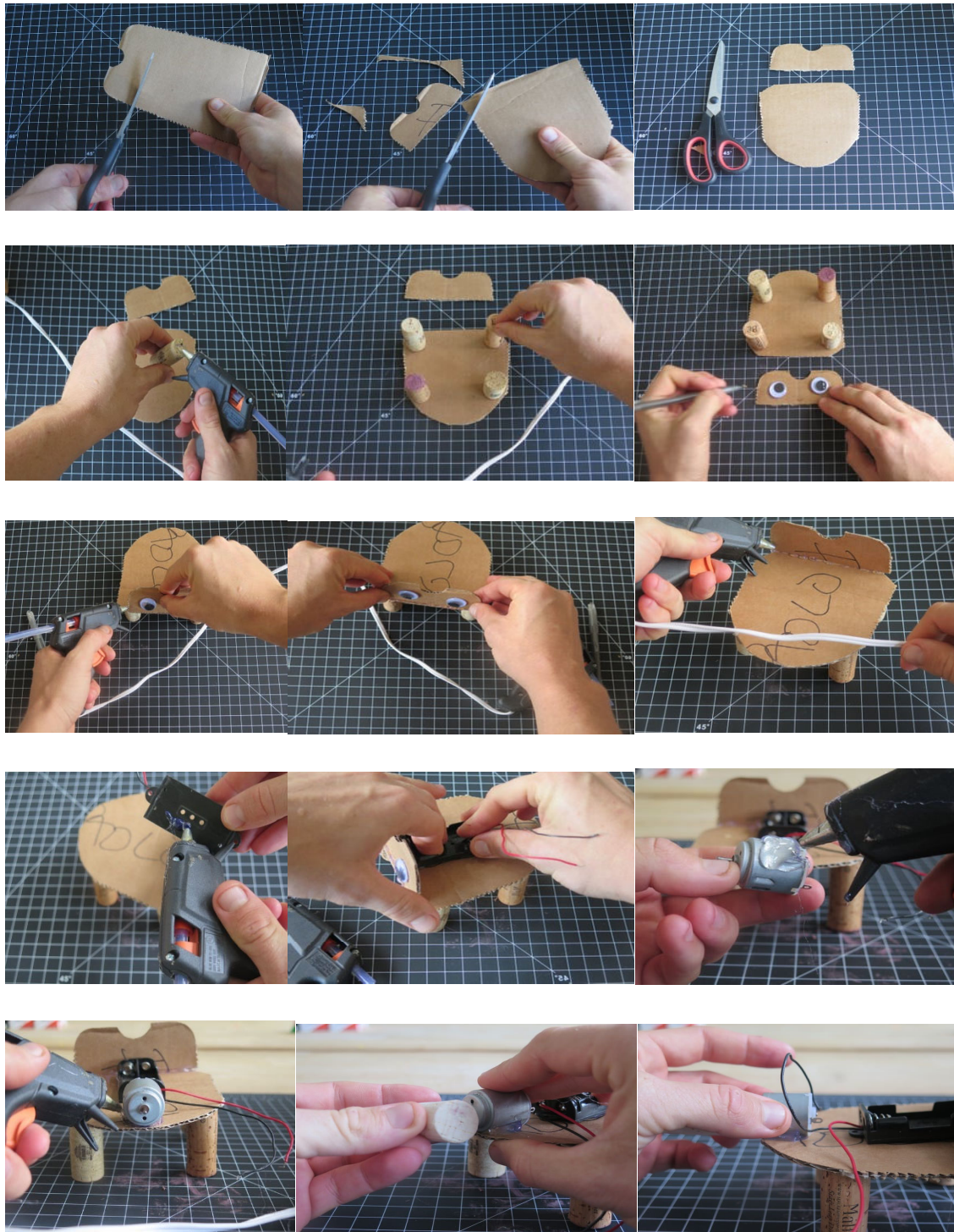
5 corks (or other materials for legs)

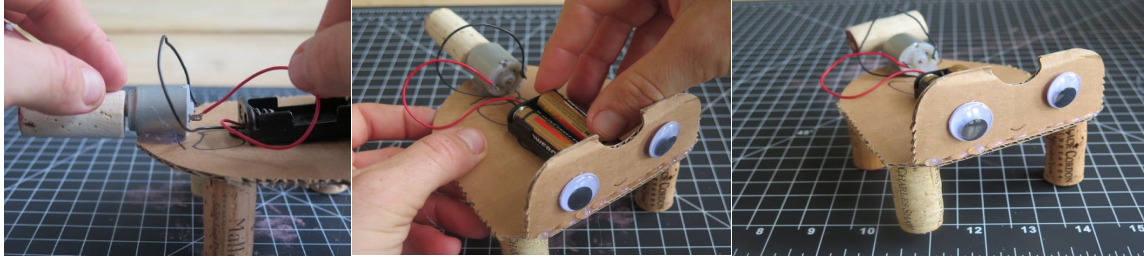
2 googly eyes

Hot Glue Gun

Scissors

Procedure





Shape Your Robot's Body and Head

1. Cut out whatever shapes you want for your robot body and head. Make sure to leave enough room for your battery holder and motor on the body, but truly go crazy with this step.

Attach Legs, Body, and Head

2. Use hot glue to attach your legs to the underside of your body. I used corks from a recycle craft shop, but so many things work great (e.g. markers, popsicle sticks, spools, toothpicks).

3. After, glue on your eyes and glue the head to your body. By now, your robot should be looking pretty darn awesome and is ready for you to fall in love with it.

Glue on Battery Pack and Motor

4. Start by gluing on your battery holder. Be pretty liberal with hot glue usage, as the wobbling will cause any lightly-attached object to fly off. This is especially true when gluing on the motor. Add TONS of hot glue before and after pressing it on your robot's cardboard behind.

5. After you have the motor and battery holder locked in, you can push your fifth cork on to the motor spindle. It's fun to experiment with different cork orientations. Place it slightly off-center for a wiggle, or way off-center for maximum wobble.

Wire Up Your Wobble Bot

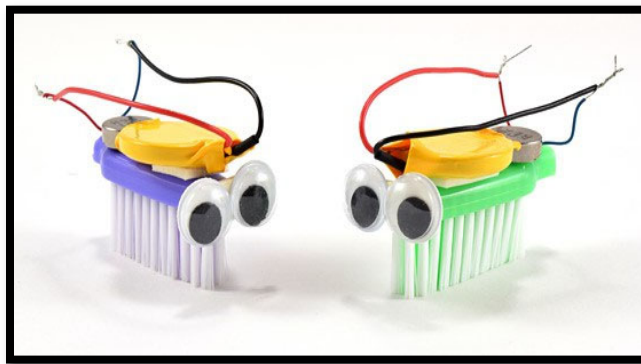
6. Attach the red and black leads from your battery holder to the two tabs at the base of your motor. If you're doing this project with kids, this is a great first circuit to make! If you'd like to make the wiring permanent, feel free to solder at this step.

7. Stop Here: bring your Wobblebot & Puzzle to the room. You will plug in the batteries at the challenge.

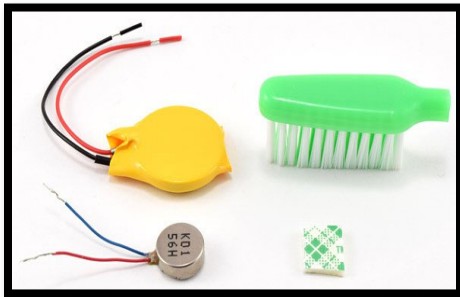
Activity 4 Bristlebot

Bristlebot/Brushbot Room: Find your desk with your team number. **Brain Teaser Puzzle:** two students will work on the puzzle and two students will work on the bristlebot & brushbot.

When you have completed both tasks, take your puzzle & bristlebot & brushbot to your desk in the main room.



Materials and Equipment



- Coin cell battery (2)
- Vibration motor (2)
- Toothbrush heads (1), cut off end
- Double-sided foam tape
- Scissors

Procedure

1. Stick foam tape to top of toothbrush.

Peel backing off foam tape.

2. Pull pieces of insulation off the ends of the coin cell battery (yellow) as shown, $\frac{1}{2}$ cm.

3. Battery with insulation pieces removed, Attach this battery to foam tape as shown.

4. Attach the smaller vibration motor to the back end of the toothbrush as shown. Peel the paper on the back of the motor off. Attach the motor to toothbrush.

Battery and motor attached to toothbrush.

Stop Here: bring your Bristlebot & Puzzle to the room. You will twist & connect your battery wires at the challenge.

a. Twist together red wires.

b. Twist together black wires.

c. Do not let red and black wires touch. This will create a short circuit, quickly drain the battery, and prevent the motor from vibrating.

Activity 4 Brushbot

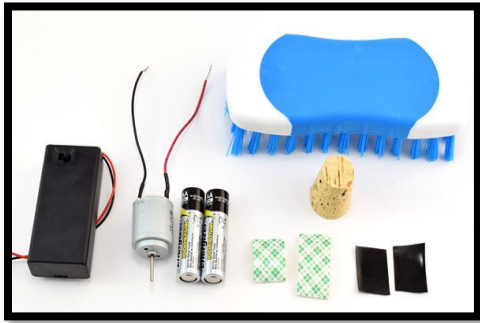
Brushbot Room: Find your desk with your team number. Puzzle: two students will work on the puzzle and two students will work on the brushbot

When you have completed both tasks, take your puzzle & brushbot to your desk in the main room.

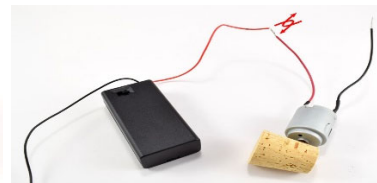
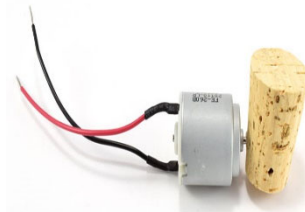
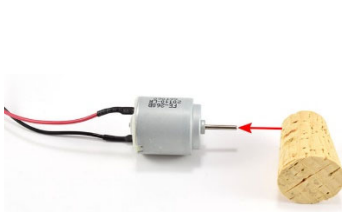
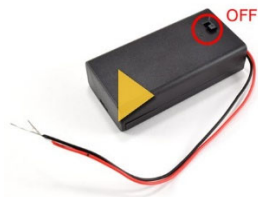
Go back to the main room and wait for the all of the teams to arrive.

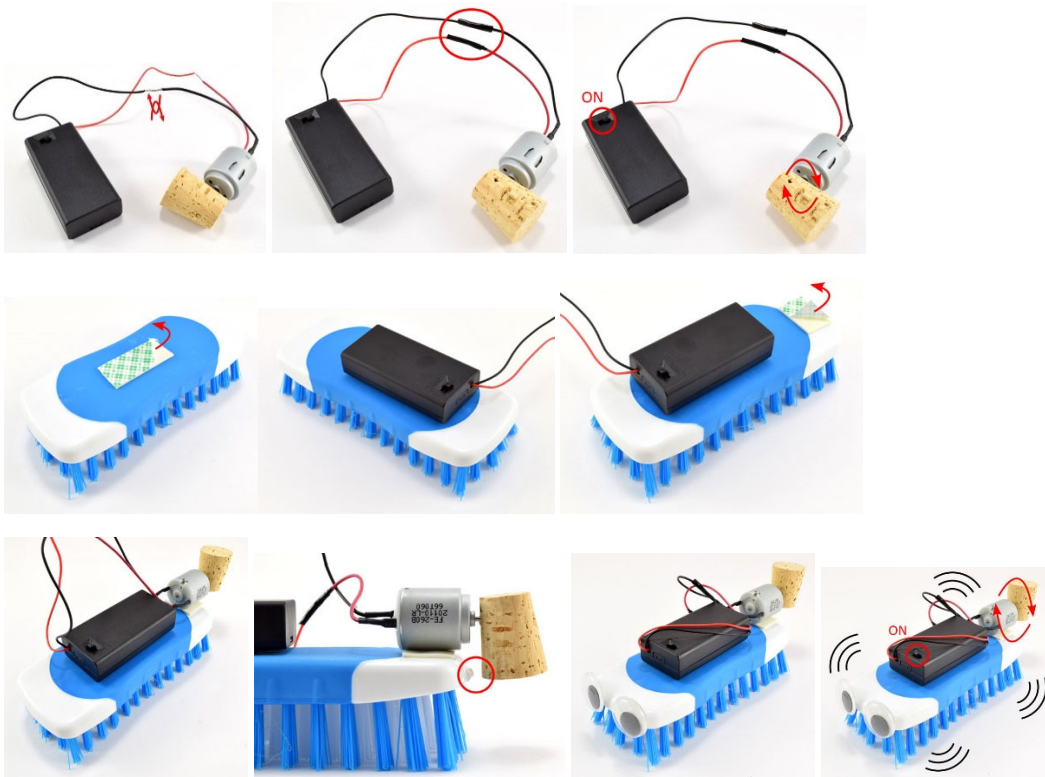


Material



AA batteries (2)
2xAA battery holder
3 volt DC motor
Scrub brush
Double-sided foam tape
Tape (any kind will work)
Cork
Small Phillips-head screwdriver
Scissors





Procedure

1. Make sure battery holder switch is in OFF position.
2. Remove screw from battery holder cover.
3. Slide cover off battery holder
4. Insert two AA batteries into holder. Make sure '+' signs on batteries line up with '+' signs in holder.
5. Slide cover back on until it clicks in place
6. Press cork onto motor shaft. Make sure cork is off-center
7. Tightly twist together exposed metal ends of red wires.
8. Tightly twist together the exposed metal ends of the black wires
9. Wrap both wire connections in electrical tape.
10. Turn switch ON. Cork should spin and motor should vibrate. If not, double-check your batteries and wire connections. Turn switch OFF when done
11. Place piece of double-sided foam tape on brush and peel off paper backing.

12. Press battery holder onto tape. Make sure on/off switch is facing up.

13. Place another piece of tape near one end of brush and peel off paper backing.

14. Press motor onto tape.

15. Make sure the cork can spin freely without hitting the brush.

Stop Here: bring your Brushbot & Puzzle to the room. You will turn on your battery pack at the challenge.

Activity 5 Nanobot Challenge

Material (5) sheets of paper, masking or colored tape, stopwatch. Tape a circle three feet in diameter on the floor. Fill out table as you go.

Challenge One: Each team will tape a sheet of paper on the floor inside the circle. How long does it take for the wigglebot to make two circles? Points by the fastest time for each team 5,4,3,2, 1 pts.

Challenge Two: How long does it take for your wobblebot, bristlebot and brushbot to leave the circle? Points by the fastest time for each team 5,4,3,2, 1 pts.

Challenge Three: Did your team complete the puzzles? Earn points even if you didn't complete the task.

Wrap-Up

Take pictures of the Nanobot Champs

Take pictures of the Nanobots

Clean-Up

Questions???

Resources

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