Bristlebots Design Workbook.

EDITION I
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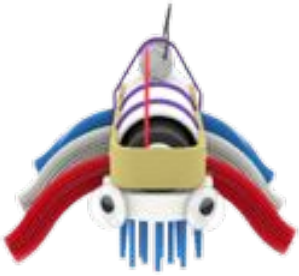
About the Bristlebots Design Workbook.

"To transform our culture by creating a world where science and technology are celebrated and where young people dream of becoming science and technology leaders"

-Dean Kamen, US FIRST Robotics

The *Bristlebots Design Workbook* is created to aid educators to easily integrate Science, Technology, Engineering, and Mathematics (STEM) into their curriculum. The workbook introduces various activities and lesson plans that works to stimulate minds of students and encourages them to "think outside the box."

The workbook utilizes the bristlebots robotics platform to demonstrate multitudes of STEM application in a wide range of educational environment. The bristlebots kits provided by bristlebots llc provides a easy and cost effected introduction into the world of robotics and STEM.



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How to use this workbook.

"My teacher's were some of the greatest influences in my life, by challenging me and trusting me, these mentors got me to understand I can do anything I put my mind to."

- Morgan Freeman

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Indicators:

The indicators aids to identify what the content of the page covers in the disciplines of Science, Technology, Engineering, and Math (STEM). (Definitions from Dictionary.com)

Science

Systematic knowledge of the physical or material world gained through observation and experiment.

Technology

Creation and use of technical means and their interrelation with life, society, and environment.

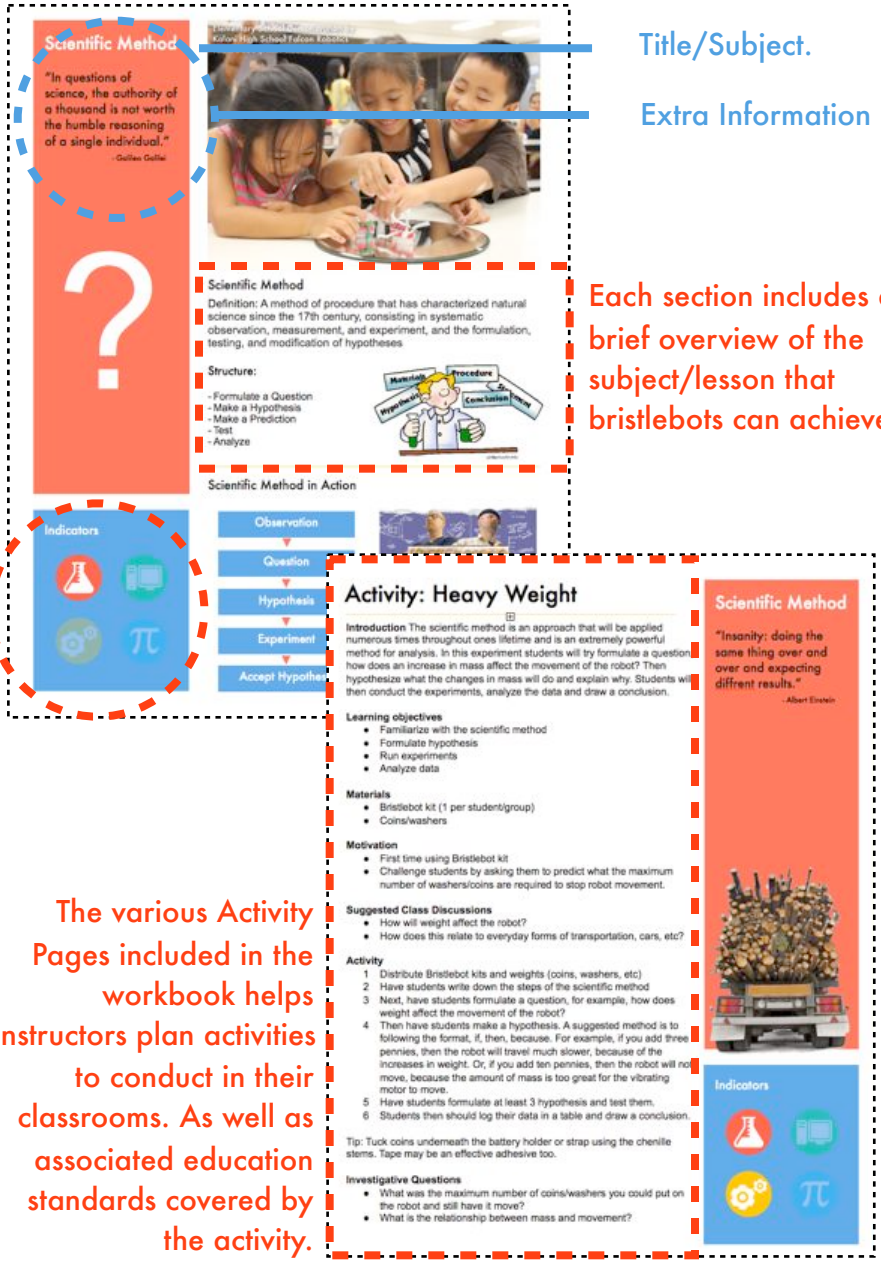
Engineering

Art of making practical application of the knowledge of pure sciences, physics, and chemistry.

Mathematics

Systematic treatment of magnitudes, relationship between figure and forms, and relationship between quantities expressed symbolically.

Example Pages



Title/Subject.

Extra Information

Each section includes a brief overview of the subject/lesson that bristlebots can achieve.

The various Activity Pages included in the workbook helps instructors plan activities to conduct in their classrooms. As well as associated education standards covered by the activity.

Table of Contents

Discover new ways of using your new bristlebot kit! You will be surprised how such a small and easy to make robot can have so many ways to educate and inspire people.

Science	Technology	Engineering	Mathematics
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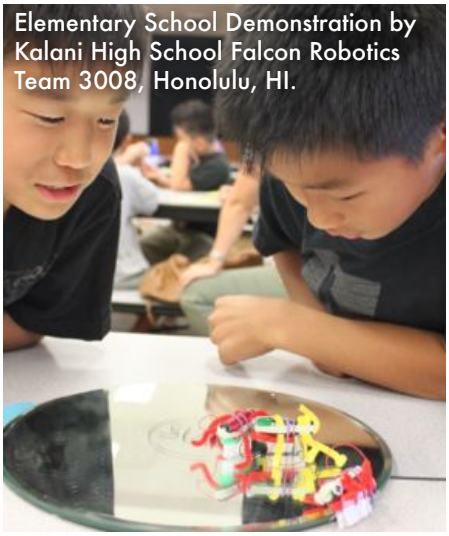


Elementary School Demonstration by Kalani High School Falcon Robotics Team 3008, Honolulu, HI.

"We're going to build the world's coolest piece of technology to solve the biggest world problem."

- Dean Kamen, US FIRST Robotics

What are Bristlebots?

The Bristlebots system has been used in all levels of education from K-12 to promote Science, Technology, Engineering and Math both in and out of the classroom. Bristlebots is an easy and cost effective introduction into the world of robotics and STEM. Using Bristlebots in the classroom, students can begin to learn the process of encountering problems with critical thinking, ingenuity, and innovative solutions.

Indicators

Elementary School Demonstration by Kalani High School Falcon Robotics Team 3008 (FIRST Robotics).

What are Bristlebots?

Bri • stle • bot

Noun:

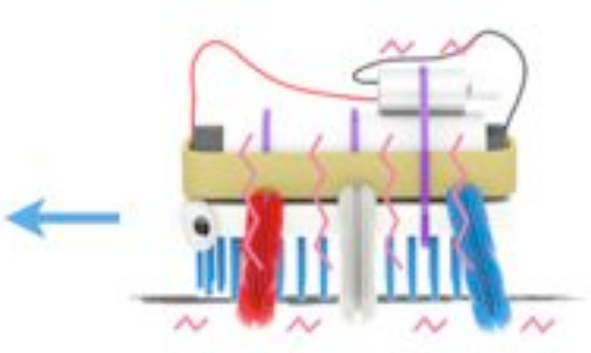
A introductory robotics kit that is the stepping stone for STEM education, innovation, creativity, and fun. The Bristlebot is a toothbrush robot with movement generated by a vibrating cell phone motor.

Synonyms:

Brushbot, Fun, Seed, Introductory, Family Activity, Curricula Enhancement, Robotics

How it works

Bristlebots is a simple to assemble robot where motion is caused by the transfer of kinetic energy from the motor, vibration, thru the robot to the ground. The bristles rapid motion, from the vibration, enables the robots locomotion.



Step 1: Attach battery holder

Materials required for step 1:

> Battery Holder > Brush Head > 3 Small Rubber Bands >Battery

Instructions:

Use the purple rubber bands to secure the battery holder to the top of the brush head.

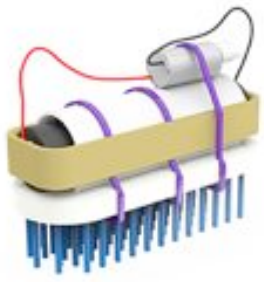
Step 2: Wire

Materials required for step 2:

> AAA Battery > Motor > Small Rubber Band >Large Rubber Band

Instructions:

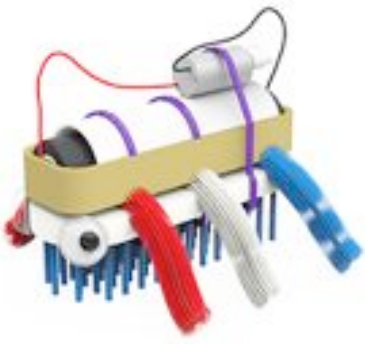
- Insert battery into holder. Stretch large rubber band to wrap around the battery holder, securing the battery in place.
- Use another small rubber band to secure the motor onto desired location. (Note: make sure motor can spin freely)
- Place the exposed wire ends of the motor to the separate ends of the battery between the large rubber band. (Note: Motor polarity can also be changed by flipping the ends of the wire)



Step 3: Engineer

Materials required for step 3:

> Chenille Stem > Wiggle Eye > Glue Dots



Instructions:

- Chenille Stems can be used to help the robots balance and adds aesthetic values.
- Use the glue dots to attach eyes to your robot.
- Decorate to make your robot unique.
- Innovate! Add your own ideas and materials to make your robot better!

Assembly

Materials in Kits

- Brush Head
- Motor
- AAA Battery
- Battery Holder
- Small Rubber Bands
- Large Rubber Band
- Chenille Stem
- Wiggle Eyes
- Glue Dots

Optional Materials

- Construction Paper
- Coins
- Tie Straps
- Paint
- Markers
- Scissors
- Hot Glue Gun
- Popsicle Sticks

Indicators

Scientific Method

"In questions of science, the authority of a thousand is not worth the humble reasoning of a single individual."

- Galileo Galilei

Definition: A method of procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses

Indicators

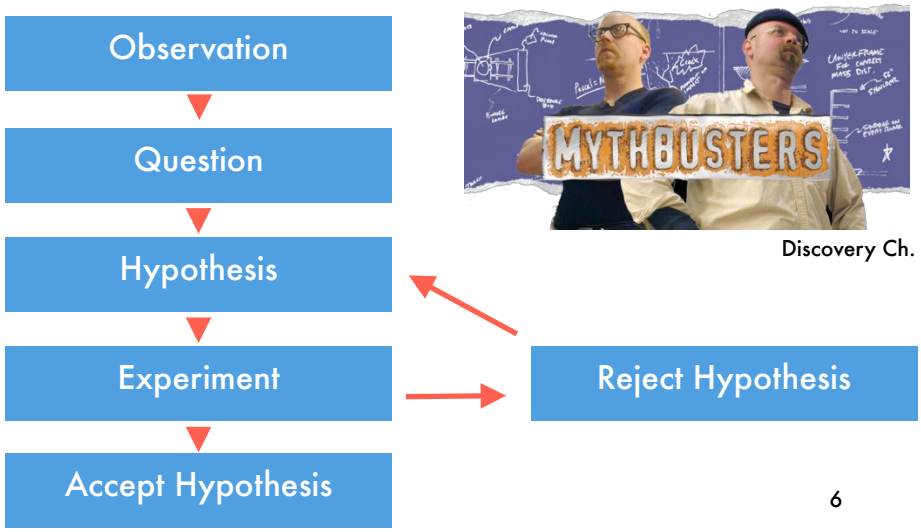
Scientific Method

Definition: A method of procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses

Structure:

- Formulate a Question
- Make a Hypothesis
- Make a Prediction
- Test
- Analyze

Scientific Method in Action



Discovery Ch.

Activity #1: Heavy Weight

Grades K-4

Science As Inquiry Standard: Abilities necessary to do scientific inquiry
Science As Inquiry Standard: Understanding about scientific inquiry

Grades 5-8

Science As Inquiry Standard: Abilities necessary to do scientific inquiry
Science As Inquiry Standard: Understanding about scientific inquiry

Introduction The scientific method is an approach that will be applied numerous times throughout your lifetime and is an extremely powerful method for analysis. In this experiment students will try formulate a question, how does an increase in mass affect the movement of the robot? Then hypothesize what the changes in mass will do and explain why. Students will then conduct the experiments, analyze the data and draw a conclusion.

Learning objectives

- Familiarize with the scientific method
- Formulate hypothesis
- Run experiments
- Analyze data

Materials

- Bristlebot kit (1 per student/group)
- Coins/washers

Motivation

- Challenge students by asking them to make a hypothesis predicting what will happen to the robots speed with the addition of weight.

Suggested Class Discussions

- How will weight affect the robot?
- How does this relate to everyday forms of transportation, cars, etc?

Activity

1. Distribute Bristlebot kits and weights (coins, washers, etc)
2. Have students write down the steps of the scientific method
3. Next, have students formulate a question, Ex: How does weight affect the movement of the robot?
4. Then have students make a hypothesis. A suggested method is to following the format, if, then, because. For example, if you add pennies, then the robot will travel much slower, because of the increases in weight.
5. Have students formulate a hypothesis and test it.
6. Have students post their findings on a class graph/chart and draw a conclusion based on the data.

Investigative Questions

- What was the maximum number of coins/washers you could put on the robot and still have it move?
- What is the relationship between mass and movement?

Scientific Method

"Insanity: doing the same thing over and over and expecting different results."

- Albert Einstein

Penny weight

Indicators

Scientific Method : Activity #1 : Heavy Weight

Name: _____ Group: _____ Date: _____

How does weight affect the bristlebot? Using the scientific method test how adding more or less weight affects speed, motion, and direction of the bristlebot.

Questions:

Hypothesis:

If:

Then:

Because:

Experiment:

Result:

Conclusion:

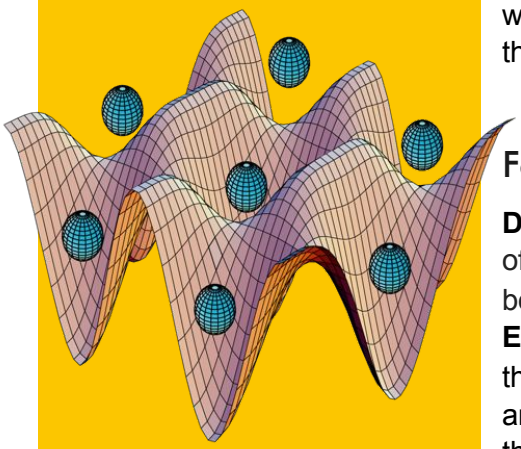
What's next?:

Notes:

Physics

"To every action there is always opposed an equal reaction."

- Isaac Newton



Mass

Definition: The amount of matter within an object.
Example: A 10kg block of concrete has more mass than a 5kg block of concrete. The 10kg block of concrete has more matter, thus more mass.

Volume

Definition: Amount of space an object takes.
Example: If you fill a 1 Liter water bottle, the volume of the liquid is 1 Liter. Or, If you measure a box to be 1cm x 1cm x 1cm, the volume would be 1 cubic centimeter.

Density

Definition: The amount of mass within a certain volume.

Density = mass / Volume D = m/v

Example: Oil is more dense than water. If 10ml of water and 10ml of oil is placed in the same container the oil will sink to the bottom.

Force

Definition: An influence tending to change the motion of a body or produce motion or stress in a stationary body. Push or Pull.
Example: A person applies a pushing force to open the door. The bristlebot's motors vibration bounces up and down the bristles rapidly apply a pushing force on the ground.

Indicators

Friction

Definition: The resistance that one surface or object encounters when moving over another.
Example: When a person is walking, there exists friction between the shoe and the ground allowing the person to push off and move forward. The friction between the bristles and ground allow the robot to move in a forward direction.

Newton's First Law

Definition: An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
Example: Unless a force is applied to the robot (a push, pull, motor turning) the robot will stay at rest. It will not change direction or speed unless a new force is applied.

Newton's Second Law

Definition: The change in velocity of an object is directly proportional to the amount of force applied to that object.

F = mA Force = mass*Acceleration (Units: Newtons, Pound)

Example: The more force exerted to move an object the faster the object will move. However, if the object is twice as massive twice the force is needed in order to move the object at the same rate. The lighter the bristlebot the less force it needs to move, therefore a light bristlebot is more likely to move faster.

Newton's Third Law

Definition: For every action, there is an equal and opposite reaction.

Example: When an object pushes on the bristlebot, in effect the bristlebot is pushing back at the object. If an object is at rest, the object is neither falling or floating. The ground is exerting the same amount of force up on an object as the object's mass is pushing down on the ground.

Electric Current

Definition: The movement or flow of electrically charged particles.
Example: The flow of electrons in a wire when connected to a battery.

Electric Circuit

Definition: An electrical device that provides a path for electrical current to flow.
Example: The connection between the positive terminal of the battery, the motor, and the negative terminal of the battery is a circuit.

Physics

Physical Science Standards

Levels K-4
Properties of objects and materials
Position and motion of objects
Light, heat, electricity, and magnetism

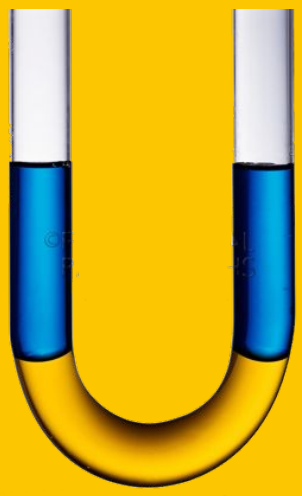
Levels 5-8
Properties and changes of properties in matter
Motions and forces
Transfer of energy

Indicators

Physics

"No amount of experimentation can ever prove me right; a single experiment can prove me wrong."

- Albert Einstein



Indicators

Activity #2: Mass, Volume, Density

Grades 5-8

Physical Science Standard: Properties of objects and materials

Introduction Students use the brush head and scales to determine the mass, volume, and density of the toothbrush head as well as additional objects. Using a scale (tri arm, or a balance), have students find the mass, volume, and density of various homogenous objects (Objects made of one material, ex water, lead weight, wood block). Then have them find the same measurements of the brush head.

Learning Objectives

- Students learn how to calculate density
- Students also learn that the calculated density of the brush head is of two different materials (the bristles and plastic).

Materials

Brush from bristlebot kit, Lead weight, Wood block, Water & 200ml+ beaker, Scale (Tri arm or balance), Masses

Motivation

- Students learn how to calculate mass, volume, and density.

Suggested Class Discussions

- Compare the objects and ask them what they think will be the greatest in density
- Ask them how to measure the volume of the block and the volume of the brush.

Activity

1. Divide the class into small groups of students or individuals
2. Have them gather up one of each material
3. Have students find the mass & volume of all the materials.
   i. For the water, measure the mass of the beaker
   ii.Measure the mass of the beaker + water using scale/balance.
   iii. Measure the volume of the water in the beaker
   iv. Calculate (mass of beaker + water)-(mass of beaker) to find mass of water.
   v. For the lead, use the scale/balance to find mass
   vi. Fill beaker to 100ml, drop the lead in the water. Find the new volume. Calculate (Volume of water + lead) - (100ml).
   vii. For the wooden cube, use the scale/balance to find the mass.
   viii. Use a ruler to calculate the volume of the cube (length x width x height)
   ix. For the brush, use the scale/balance to find the mass.
   x. Fill beaker to 100ml, drop the brush in the water. Find the new volume. Calculate (Volume of water + brush) - (100ml).
4. Have students calculate the density of each object.

Investigating Questions

- What is the difference between weight and mass?

Activity #3: Closed & Open Circuit

Grades K-4
Physical Science Standard: Light, heat, electricity, and magnetism

Grades 5-8
Physical Science Standard: Transfer of energy

Introduction Students use the motor and battery in their introduction to open and closed circuits.

Open circuits are circuits that are “broken”, they are not connected and electric current cannot flow. Closed circuits are completed circuits, they allow charge to flow. When you flip a light switch on, you “close” the circuit, and the current can flow, allowing the light to turn on. Similarly, when you attach the leads of the motor to the battery, you “close” the circuit, this can be seen by the motor spinning.

Learning Objectives
- Students learn the difference between open and closed circuits

Materials
Bristlebot Kit

Motivation
Students will learn how to power their robot for the first time.

Suggested Class Discussions
- Discuss what types of closed circuits exist at home
- What are some ways you can change a closed circuit so it becomes open?
- What happens when you reverse the wires? (reverse the polarity).

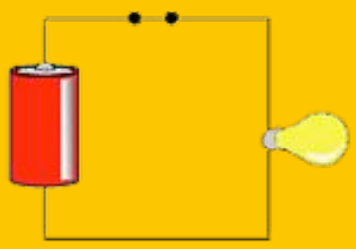
Activity
1. Divide the class into small groups of students or individuals
2. Have them unpack their kits, using only the motor and battery.
3. Have them connect the leads to the battery, and disconnect.
4. Go over investigative questions, have them draw the circuit as open and closed.

Investigating Questions
- What happens when you open and close a circuit?
- What does the electric current do when the circuit is closed? When it is open?
- How many energy transfer can you find?
- What forms of energy exist in the robot’s motion?

Physics

“Byrne’s Law: In any electrical circuit, appliances and wiring will burn out to protect the fuses.”

- Robert Byrne



Indicators

Physics : Activity #2 : Mass, Volume, Density

Name: _____ Group: _____ Date: _____

Determine the mass, volume, and density of the toothbrush head, water, lead weight, and wood block.

i. For the water, measure the mass of the beaker
ii.Measure the mass of the beaker + water using scale/balance.
iii. Measure the volume of the water in the beaker
iv. Calculate (mass of beaker + water)-(mass of beaker) to find mass of water.
v. For the lead, use the scale/balance to find mass
vi. Fill beaker to 100ml, drop the lead in the water. Find the new volume.
Calculate (Volume of water + lead) - (100ml).
vii. For the wooden cube, use the scale/balance to find the mass.
viii. Use a ruler to calculate the volume of the cube (length x width x height)
ix. For the brush, use the scale/balance to find the mass.
x. Fill beaker to 100ml, drop the brush in the water. Find the new volume.
Calculate (Volume of water + brush) - (100ml).

Object	Mass	Volume	Density
Water			
Lead Weight			
Wood Block			
Toothbrush head			

Conclusion:

What's next?:

Physics : Activity #3 : Closed & Open Circuit

Name: _____ Group: _____ Date: _____

Open circuits are circuits that are “broken”, they are not connected and electric current cannot flow. Closed circuits are completed circuits, they allow charge to flow. When you flip a light switch on, you “close” the circuit, and the current can flow, allowing the light to turn on. Similarly, when you attach the leads of the motor to the battery, you “close” the circuit, this can be seen by the motor spinning.

Create a closed circuit to turn the motor of the bristlebot on. What happens when the wire ends are switched? What happens with more than one battery? When is it a closed circuit and when is it a open circuit?

Draw a picture of a open and closed circuit.

Open Circuit

Closed Circuit

Conclusion:

What’s next?:

Biology

Indicators

Ecosystems

Definition: A biological community of interacting organisms and their physical environment.
Example: Aquatic Ecosystems, Terrestrial Ecosystems.

Habitat

Definition: The natural home or environment of an animal, plant, or other organism.

Food Chain

Definition: A series of organisms each dependent on the next as a source of food.
Example:

Primary Producer: Grass
Primary Consumer: Grasshopper
Secondary Consumer: Rat
Tertiary Consumer: Snake
Quaternary Consumer: Hawk

Producers: Organism capable of producing complex organic compound from simple inorganic molecules through photosynthesis or chemosynthesis.
Primary Consumers: Any organism that consumes or feeds on autotrophs or decaying matter.
Secondary and higher level consumers: Organism that feeds on primary consumers.
Decomposers: Organism whose ecological function involves the recycling of nutrients by performing the natural process of decomposition as it feeds on dead or decaying organisms.

Range

Definition: Set conditions throughout which an organism naturally occurs.

Population Size

Definition: The number of individual organisms in environment.

Activity #4: Ecosystem Design

Grades K-4
Life Science Standard: Characteristics of organisms
Life Science Standard: Organisms and environments

Grades 5-8
Life Science Standard: Structure and function in living systems
Life Science Standard: Regulation and behavior
Life Science Standard: Populations and ecosystems
Life Science Standard: Diversity and adaptations of organisms

Introduction: Students create a simple, imaginary ecosystem. They describe the interrelations between the species inhabiting the ecosystem and their physical environment. They then imagine an alteration in their environment and project the impact that such a change would have on the organisms living in their ecosystem.

Suggested vocabulary words to include in the project: food chain/food web; producer; primary, secondary and tertiary consumer; decomposer; pyramids of energy, mass and number; community; population; niche; threatened species; endangered species; extinction.

Suggested Class Discussions

- What type of ecosystems are there?
- Where do you think a bristlebot lives? (e.g. office desk, book shelf, rain forest) Where does YOUR bristlebot live?
- Name some producers, consumers, and decomposers.

Activity

1. Divide the class into small groups, distribute at least 3 kits per group.
2. Your mission is to design an ecosystem.
   A. Location: Your ecosystem can be anywhere for your bristlebot.
   B. Organisms: Creative and original designs for organisms are encouraged.
3: Have students include at least one species of each of these in their ecosystems:
   - Producers
   - Primary consumers
   - Secondary and higher level consumers
   - Decomposers

4.For each species be sure students include characteristics such as
   - Habitat
   - Population size
   - Number of offspring it produces and when
   - Diet
   - Predators
   - Any vulnerabilities to its ecosystem

5.Using materials such as poster boards and paint, have students create their own ecosystem and the respective habitats for each organism.
6.Once they are finished have them present their ecosystems along with a description of the organisms and their position in the food chain.

Biology

Materials
- Bristlebot Kit (3 per group)
- Scissors
- Poster
- Construction Paper
- Coloring Materials
- Tape

Learning Objectives
- Define ecosystem
- Identify roles of organism as producers, consumers, and decomposer.

Motivation
- Groups can present their animal (bristlebots) and ecosystem.
- Judges can judge each groups creativeness, accuracy, imagination.

Indicators

Biology

Levels K-4
Characteristics of organisms
Organisms and enviroments

Levels 5-8
Structure and function in living systems
Regulation and behavior
Population and ecosystems
Diversity and adaptation of organisms

Materials

- Bristlebot Kit (1 per group)
- Poster
- Craft supplies

Learning Objectives

- Design an animal which is adept to survival
- Understand how traits of an animal aid to its survival.
- Imagination activity

Motivation

- Groups can present their animal (bristlebots) and ecosystem.

Indicators

Activity #5: Animal Traits

Introduction This activity allows students to use some of their creativity to imagine how traits of animals would enable them to better adapt to a particular island in order to survive. Make up a story as elaborate as you want to explain how the animals (Bristlebots) ended up on their Island (A, B, C or D) and how long they have been on the island in order to change so much.

Suggested Class Discussions

- What traits were most likely to aid in the survival of the animal?

Activity:
1.Divide the class into small groups, distribute at 1 kit per group.
2.Each group gets an island and must design an animal (Bristlebot) which has features that enable them to adapt to the conditions in the environment.
3.Have students draw the island, the animal (Bristlebot) with its features and explain how each trait allows the animal to survive. You could then have the groups present their animal.

Give each group one of the following environments:

Atoll
The island is fairly flat, with some rolling hills and a lagoon in the center. The ground is soft dirt, and several species of shrubs grow on the island. There is no animal life on land, but the water is abundant with fish. The island is surrounded by a coral reef which keeps predators out and is a habitat for much of the local marine life. The shore is sandy with no algal growth. There is no fresh water.

Tide Pools
This environment has a rocky shoreline. Numerous tide pools dot the environment along the shore where the wave action is somewhat sheltered by rock outcrops. The tide pools host barnacles, abalone, sea urchins and crabs. Algae grows within the environment, however, it is quite sparse in the tide pools where the various animals feed. The current is strong along the rocky outcrops where the algae grows best, nutrients travel frequently in its swell. There is no fresh water.

Dry Desert
This environment is somewhat barren. A few species of cactus thrive on the landscape. A large cactus-eating tortoise inhabits the environment. A species of very large bird nest in the desert. They build their nests on the rocks, and protect their eggs from the sun by standing over the nests with outspread wings. The nests are always found in the windy part of the landscape. There is freshwater in the form of steams and ponds in tiny oasis.

Lush Tropical Jungle
This environment is an extinct volcano in the tropics. Vegetation on the volcano changes with the altitude. Grasses grow at the base. Further up the slope the grasses give way to low shrubs. Half way up, the island becomes quite lush; tropical plants and trees dominate the landscape. At this altitude, the volcano experiences frequent rain showers. There are two species of birds that inhabit the faces of the volcano. One is a raptor which preys upon the smaller birds. The other fishes the waters in the streams and small ponds. Both nest in trees.

Biology : Activity #4 : Ecosystem Design

Name: _____ Group: _____ Date: _____

Your mission is to design and depict an ecosystem.

A. Location: Your ecosystem may be anywhere, including other planets!

B. Biological community: Imaginary organisms are accepted.

Include at least one species of each of these:

- Producers
- Primary consumers
- Secondary and higher level consumers
- Decomposers

For each species be sure to include its:

- Range
- Population size
- Reproductive behavior, (number of offspring, care of offspring, etc.)
- Nutritional requirements, if an animal, or soil and water
- Sensitivity to environmental insults
- Any known usefulness/attractiveness to humans

Physical components: Your species must be appropriate for their physical environment. Be sure to consider:

- Climate: temperature, seasons, humidity and precipitation
- Resources/Food

Describe Location of Eco-System:

Location: Terrain: Other:

Climate: Resources:

Producer: **Image:**

Range:

Population Size:

Reproductive Behavior

Nutritional Requirements:

Sensitivity to environment:

Human relationships:

Primary Consumer: **Image:**

Range:

Population Size:

Reproductive Behavior

Nutritional Requirements:

Sensitivity to environment:

Human relationships:

Secondary and Higher Level Consumer: **Image:**

Range:

Population Size:

Reproductive Behavior

Nutritional Requirements:

Sensitivity to environment:

Human relationships:

Decomposers: **Image:**

Range:

Population Size:

Reproductive Behavior

Nutritional Requirements:

Sensitivity to environment:

Human relationships:

Show relationship between all species in your eco-system:

Biology : Activity #5 : Animal Traits

Name: _____ Group: _____ Date: _____

Design an animal (Bristlebot) which has features that enable them to adapt to the conditions on the island.

Island (Check one that was assigned):

- ☐ Atoll
- ☐ Tide Pools
- ☐ Dry Desert
- ☐ Lush Tropical Jungle

Describe your assigned island and depict an image of it:

Describe your animal (bristlebot) and draw an image of it:

Engineering

"Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning."

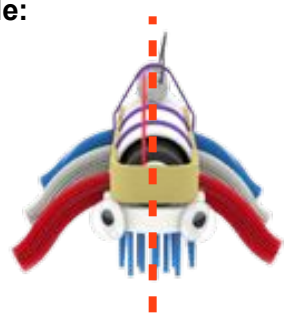
- Albert Einstein

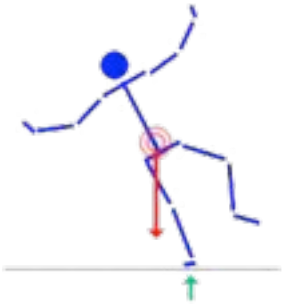
FRC Team 3008
CAD Rendering

Indicators

Center of Gravity

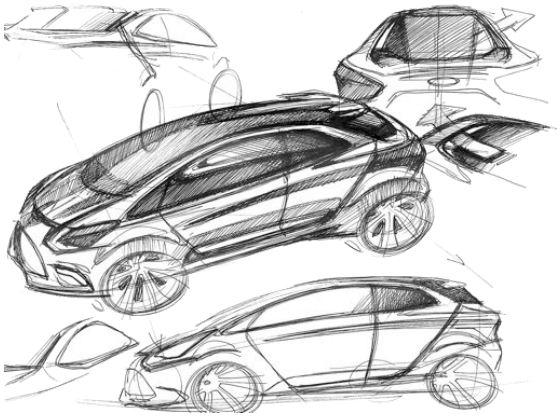
Definition: A point from which the weight of a body or system may be considered to act. In uniform gravity it is the same as the center of mass.
Example:





Sketching

Definition: The act of drawing out your idea or design prior to modeling it in CAD or building it. An essential part of planning.
Example: Often times in product development, engineers will sketch out several versions of their design. The result is a much better final design than what they would have had if they went ahead and built their very first idea.



Computer Aided Design

Definition: Software used in art and architecture and engineering and manufacturing to assist in precision drawing.
Example: The Boeing 747 was the very first aircraft totally designed using CAD. CAD enables engineers and designers to make their product on the computer, check for errors, run analysis and tests, and modify instead of building prototype after prototype.

Testing, Trial, and Error

Definition: Testing a design or procedure multiple times and improving it till you get an acceptable result
Example: Thomas Edison attempted to make the light bulb over a thousand times. He employed the method of trial and error to get his final working light bulb. After each attempt he moved on to a new design or solution that he felt would make it work. The creation of the airplane follows a similar method. For centuries man tried gliders and powered winged contraptions improving the design through trial and error until the Wright Brothers first successful flight.

Kalani High School Falcon Robotics Team 3008 (FIRST Robotics).

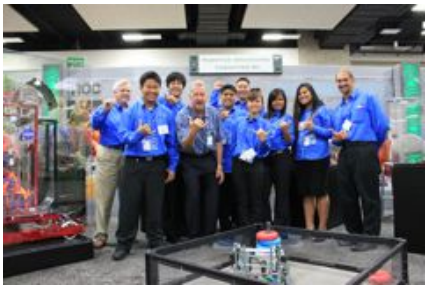
Kalani Falcon Robotics Team 3008

US FIRST Robotics

Kalani Robotics Team 3008 is a student-led team founded in 2008. Team 3008 has over 20 dedicated members that come in on a regular basis and take part in the many events that they participate in and host. In the four years Kalani Robotics has been active as a robotics team, they have accumulated two FIRST Chairman's Awards in Hawai'i, along with various awards including the Entrepreneurship Award and the Judge's Award.

Falcon Robotics in the Community

Kalani Robotics perform numerous community outreach incentives to stimulate Science, Technology, Engineering, ad Mathematics in their community. The team spends much of their time hosting and coordinating events at local schools and malls to allow many people to experience the world of robotics. The robotics team participate in events like APEC and AFCEA technology conference to gain support from global industries.



Engineering

"An innovation is one of those things that society looks at and says, if we make this part of the way we live and work, it will change the way we live and work"

- Dean Kamen

FIRST®

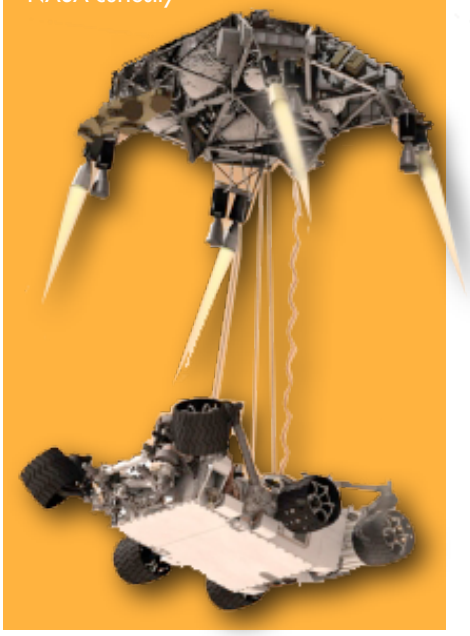
Indicators

Engineering

"Houston, Tranquility Base here. The Eagle has landed"

- Neil Armstong

NASA curiosity



Indicators

Activity #6: Controlled Descent

Grades K-4

Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology

Grades 5-8

Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology
Physical Science Standard: Transfer of energy

Introduction Students use their problem solving skills to determine a way to safely land their Bristlebot from a drop using only the provided materials. Innovations used to cushion the descent of precious cargo has been used for centuries like during the recent Mars landing by NASA's rover Curiosity.

Learning Objectives

- Students learn about engineering solutions used to protect precious cargo during descent
- Students design their own solutions to protect their Bristlebots

Materials

- Bristlebot Kit - Scissors - Tape - Plastic Bags
- Tissue Paper - Packing Foam - Straws

Motivation

These robots are durable, but dropping them from a height such as a 6 foot ladder or the second floor will require you to fix your robot. Designing a container to protect your robot will prevent damage from happening.

Activity

1. Divide the class into small groups of students
2. Have them brainstorm possible ideas for protective solutions that will protect their robot
3. Give each group a set of materials to make their own designs
4. Suggested Step: Have students make two loops of chenille stems around their robot, similar to an orbit, to show just how effective their solution was in cushioning the fall (bent chenille stems indicate a design that was not very effective).
5. After they have finished have students drop their robot and protective design from a certain height.
6. Have the students examine the condition of their robot and package. Have them answer questions such as the condition. Finally have students write down possible solutions that would have made their robot survive better.

Investigating Questions

- What design worked the best? Why?
- What is important to keep in mind when designing solutions for controlled descents?
- How much did weight play an issue?
- How can this activity be applied to real-life situations?

Activity #7: Caution, Fragile!

Grades K-4 & 5-8
Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology

Introduction Students use their creative skills to determine a way to safely mail their Bristlebot using only the provided materials. To test the packing designs, the Bristlebot is mailed through the postal system and evaluated after delivery. Packaging engineers are responsible for creating packages for all types of products. They design cardboard boxes that are simply held together with glue and/or tape (or neither), boxes that have intricate folds to increase strength, and protective material used within the boxes. When designing packaging, they consider the size and shape of the object, whether it is fragile, and if it needs special temperature control.

Learning Objectives

- Students learn about design and packaging techniques.
- Students learn what happens to mail in the postal system.

Materials

- Bristlebot Kit (1 per student) -Scissors - Tape
- Construction Paper - Newspaper - Tissue Paper
- Packing Foam - USPS small priority box

Motivation

Damaged goods are shipped all the time, how can you design a package to protect your robot? Engineers need to find low cost solutions for packaging fragile goods.

Activity

1. Have groups of student brainstorm possible ideas for packaging solutions that will protect their robot
2. Give each group a set of materials to make their own packages
3. After they have finished have students mail packages for extra credit, if the robot survives provide an additional bonus as an incentive.
4. Have the students examine the condition of their robot and package. Have them answer questions such as the condition, possible sources of damage (water damage, temperature, handling). Finally have students write down possible solutions that would have made their package survive better.

Investigating Questions

- What packaging worked the best? Why?
- What is important to keep in mind when packing the robot?
- What happened to the robots that did not make it through the mail safely?
- How can this activity be applied to real-life situations?

Engineering

"A good scientist is a person with original ideas. A good engineer is a person who makes a design that works with as few original ideas as possible"

- Freeman Dyson

Indicators

Scientific Method : Activity #6 : Controlled Decent

Name: _____ Group: _____ Date: _____

Determine a way to safely land their Bristlebot from a drop using only the provided materials.

Questions:

Sketch Ideas:

Trials:

1.

2.

3.

Conclusion:

What's next?:

Notes:

Scientific Method : Activity #7 : Caution, Fragile!

Name: _____ Group: _____ Date: _____

Determine a way to safely mail their Bristlebot using only the provided materials. To test the packing designs, the Bristlebot is mailed through the postal system and evaluated after delivery. Packaging engineers are responsible for creating packages for all types of products. They design cardboard boxes that are simply held together with glue and/or tape (or neither), boxes that have intricate folds to increase strength, and protective material used within the boxes. When designing packaging, they consider the size and shape of the object, whether it is fragile, and if it needs special temperature control.

Questions:

Sketch Ideas:

Condition after shipping (optional):

Conclusion:

What's next?:

Notes:

Engineering

Materials
- Bristlebot Kit (per student)
- Scissors
- 2 Yard Sticks
- Timer
- Tape

Learning Objectives
- How to use creativity and everyday materials to build something useful.
- How to utilize designs and sketches in creating a product.
- Trial and error, learning from previous designs

Indicators

Activity #8: Speedster!

Grades K-4 & 5-8
Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology

Introduction Being able to recognize a problem and design a potential solution is the first step in the development of new and useful products. In this activity, students are given a Bristlebot Kit and must design it to travel as straight as possible.

Motivation
After designing and building the robots students will participate in a drag race. The robot that reaches the end first (goes the fastest) wins. Designing your robot to go straight may be a key feature for a winning robot.

Suggested Class Discussions
- Discuss why new products are made and innovations take place.
- Ask them how they could modify a their robot to move straight.
- Talk about formulating an idea and sketching a picture before construction.
- Point out how there is more than one way to make your robot go forward. (Use of chenille stems, construction paper, cutting the bristles, creating a bumper that guides the robot down the track).

Activity
1. Prepare a station with the materials available for students to use.
2. Have students work alone or in pairs.
3. Talk about safety; do not eat the glue, careful with scissors, etc.
4. Introduce the activity to the students and let them examine the materials, brainstorm for ideas and sketch designs. Have the students explain their sketches to you before they start construction. Tell the students that they may use as much or as little of the materials available.
5. Once students have completed their robots, have them lay them out on a table so that everyone in the class can see each design. Encourage them to try out the different robot designs, but remind them to be respectful of everyone's inventions.
6. To test the designs create a track using the two yardsticks. Tape them down to a table, preferably with a smooth surface and have students run their robot down the track.
6. After everyone has tested the designs, have the class decide which of the robot design features is the most effective and explain what features they liked about it.

Investigating Questions
- What materials were the best to use for this project?
- What would you have done differently?
- What other materials could have worked?
- Did planning out your robot design prior to building aid in the construction of the robot?

Activity #9: Straight Shot!

Grades K-4 & 5-8
Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology

Introduction Students use their problem solving skills to design their robot to travel as straight as possible.

Learning Objectives
- Students learn problem solving through trial and error
- Students learn to analyze a problem, brainstorm solutions, and test their design

Materials
Bristlebot Kit (1 per student)
Scissors
Blue painters tape

Motivation
- The group or individual who's robot travels the straightest is the winner.

Suggested Class Discussions
- How can you manipulate your robot?
- What would trimming the bristles do?
- What about removing some?
- Does the number of bristles matter? Think friction and weight.
- Would the drag caused by pipe cleaners have an effect?

Activity
1. Divide the class into small groups of students
2. Have them envision how force is applied on the surface by the robot, propelling it forward
3. Have them come up with at least 3 possible modifications
4. Have them choose a solution(s) and test
5. Using the blue painters tape, make a pathway on a table that the robots will travel down. For additional grading points, have multiple "zones". If the robot stays in zone one (the narrowest) offer bonus points. If it strays into the next zone offer full credit, and so on.

Investigating Questions
- What modification worked the best? Why?
- Does weight play a factor? Why or why not?

Engineering

"Research is what I'm doing when I don't know what I'm doing."

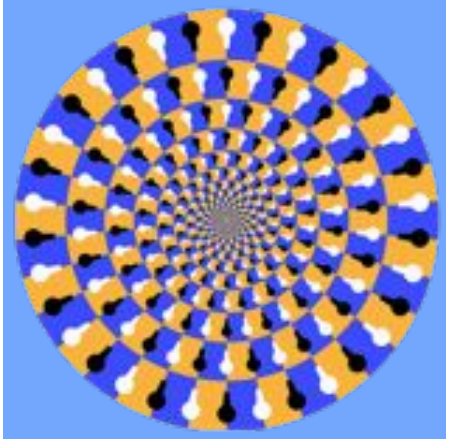
- Wernher von Braun

Indicators

Engineering

"Each problem that I solved became a rule, which served afterwards to solve other problems."

- Rene Descartes



Indicators

Activity #8: Donuts!

Grades K-4 & 5-8
Science And Technology Standard: Abilities of technological design
Science And Technology Standard: Understanding about science and technology

Introduction Students use their problem solving skills to design their robot to travel in as tight a circle as possible.

Learning Objectives

- Students learn problem solving through trial and error
- Students learn to analyze a problem, brainstorm solutions, and test their design

Materials

Bristlebot Kit (1 per student)
Scissors
Blue painters tape or paper plate
Timer

Motivation

- The group or individual who's robot stays within the blue tape boundary or on the paper plate longest wins.

Suggested Class Discussions

- How can you manipulate your robot?
- What would trimming the bristles do?
- What about removing some?
- Does the number of bristles matter? Think friction and weight.
- Would the drag caused by pipe cleaners have an effect?

Activity

1. Divide the class into small groups of students
2. Have them envision how force is applied on the surface by the robot, propelling it to stay as stationary as possible, or in a circle as long as possible.
3. Have them come up with at least 3 possible modifications
4. Have them choose a solution(s) and test
5. Using the blue painters tape make a circle, or flip the paper plate upside down. Have the students test their robot on the surface and time how long it stays on the surface or within the boundary.

Investigating Questions

- What modification worked the best? Why?
- Does weight play a factor? Why or why not?
- How do the features of the robots compare to those in the activity "Straight Shot"?

Brushbot Olympics 2012
Celebrate Children's Day
Hawaii State Capital

Competition

"You have teenagers thinking they're going to make millions as NBA stars when that's not realistic for even 1 percent of them. Becoming a scientist or engineer is."

- Dean Kamen

Bristlebot Robotics Competition

Bristlebots Robotics Competition (BRC)
The Bristlebots Robotics Competition (BRC) works to standardize competition rules for organization to utilize and host their own workshops. The rules can be adjusted and manipulated to work best for each organization.

There are currently 4 official competition games

- Drag Race
- Sumo
- Joust
- Creativity and Design

HAWAI'I SPACE GRANT CONSORTIUM
NASA

Hawaii Space Grant Consortium
The HSGC host the Brushbot Olympics at the Hawaii State Capital during the annual Celebrate Children's Day. During the event numerous schools participate in a friendly competition using bristlebots. The winning team receives certificates, awards, and prizes.

Indicators

Competition

"If you can't explain it simply, you don't understand it well enough"

- Albert Einstein

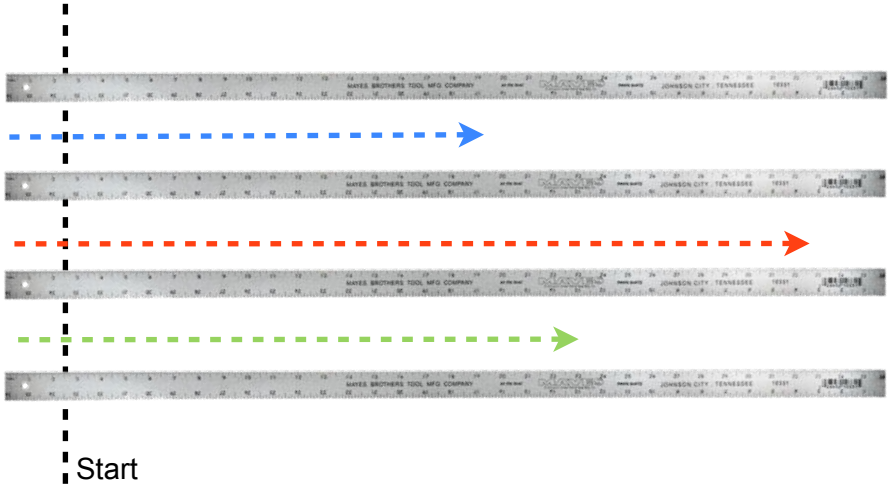
Brushbot Olympics 2012
Celebrate Children's Day
Hawaii State Capital

Competition #1 : Drag Race

Race to the finish
The most classic game of all, bristlebots drag racing. This game can easily be done using a few yardsticks, tape, and a smooth surface. All you need now is to design a robot that can cross the finish line first.

Robots that did well during the activity, Speedster, will most likely fair the best in this competition.

Setup
A 3 foot long track is a good length for robots to race. Find a table, and tape down the yardsticks as barriers to create the tracks. Use tape to indicate a start and finish line.



Indicators

Brushbot Olympics
2012
Celebrate Children's

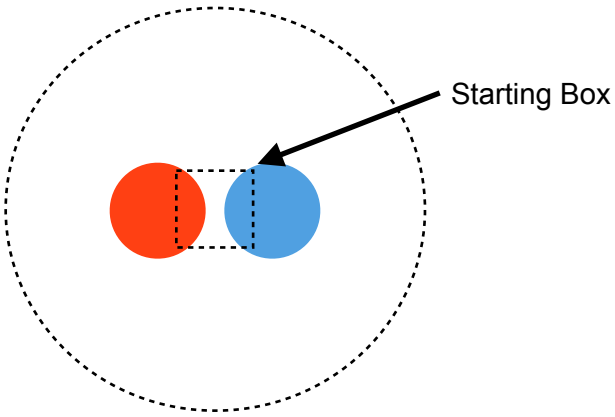
Competition #2 : Sumo

Stay in the ring the longest

Bristlebots sumo is like the Japanese sumo matches. All you need is a circular smooth surface platter, place two or more robots in the center and see who stays in the longest.

Robots that did well during the activity, Donut, will most likely fair the best in this competition.

Setup
Smooth surfaces are best for operating bristlebots. However using a paper plate flipped upside down as a raised stage for the Sumo Competition will work as well. Draw a 2"x2" square in the center and have robots start touching a part of the square. The last robot to fall off is the winner. Another alternative to paper plates is creating a ring with blue painters tape on the table. This will result in a much smoother surface and faster robots.



Competition

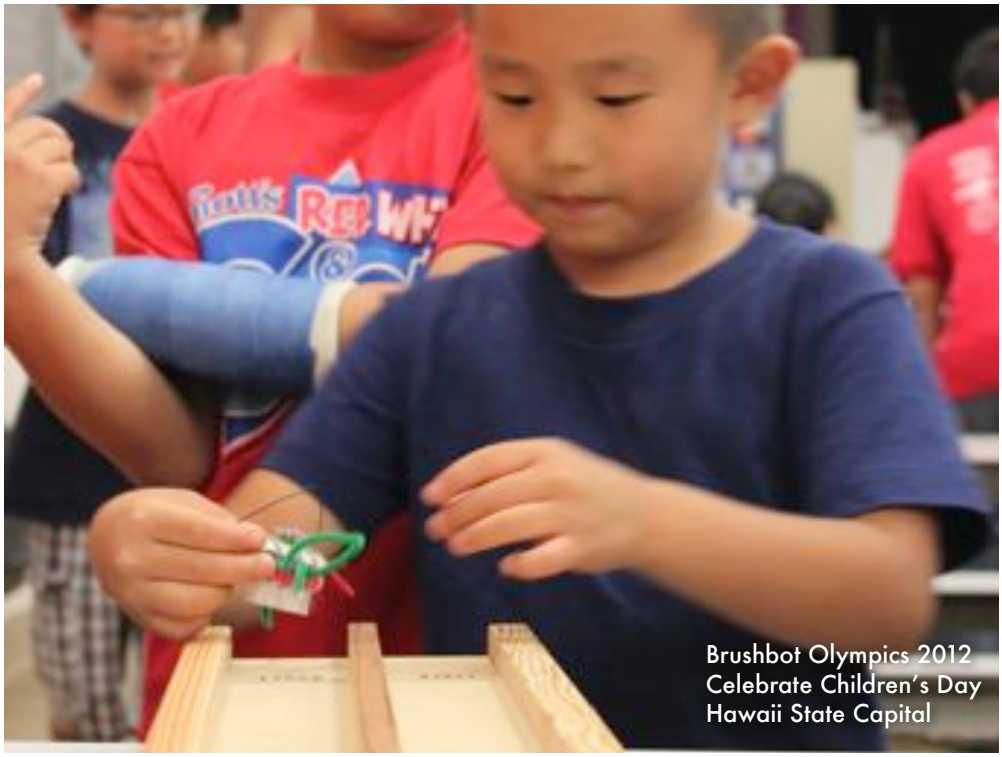
"To the optimist, the glass is half full. To the pessimist, the glass is half empty. To the engineer, the glass is twice as big as it needs to be. "

Indicators

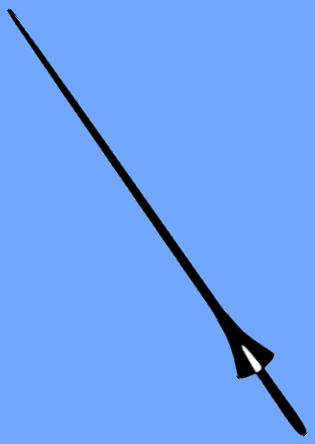
Competition

"Great things in business are never done by one person. They're done by a team of people."

- Steve Jobs



Brushbot Olympics 2012
Celebrate Children's Day
Hawaii State Capital

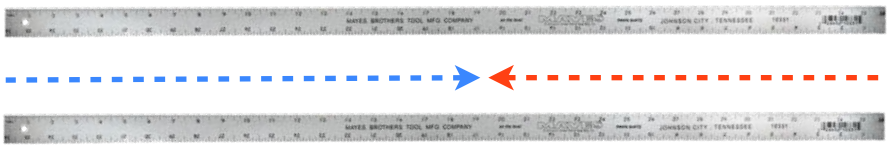


Competition #3 : Joust

Push to the end
Possibly the most competitive and exciting, joust involves two robots and two forces in opposite directions. Robots that travel straight or travel the fastest may have unpredictable results. The goal is to push your opponent to their side of the track.

Setup
Similar to the set up in Drag Race, use two yardsticks to create barriers for a track. Use painters tape to indicate the start lines for each side of the track. Have students place robots behind the line and release at the same time. The robot that pushes the other to their side is the winner!

Indicators



Brushbot Olympics 2012
Celebrate Children's Day
Hawaii State Capital

Competition #4 : Creativity/Design

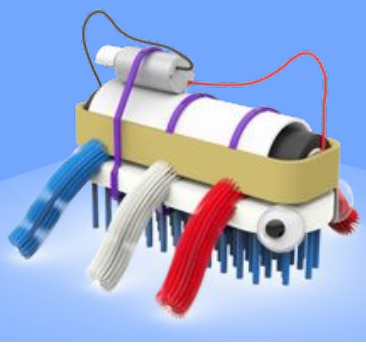
Aesthetics are important
Let's take the iphone as an example. Even with all its intuitive user friendly features if the product wasn't aesthetically appealing or innovative in design, it would not be the successful product it is today.

Setup
Have students submit their robots or line them up on a table. Examine each one or have the students explain their robot, for example, any innovative designs they incorporated or creative look they came up with. In effect, have the students "sell" their robot, and explain why theirs has the most innovative or creative design.

Competition

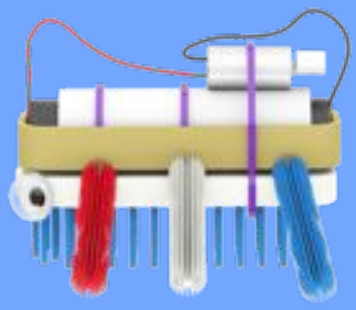
"I'm quite into the idea of engineering being beautiful"

- Sean Booth



Indicators

Bristlebots LLC



"I don't work on a project unless I believe that it will dramatically improve life for a bunch of people."

- Dean Kamen, US FIRST Robotics

Bristlebot Kits (Free Shipping)

Each bristlebot kits includes the following: (1) instructional box, (1) custom toothbrush head, (1) vibrating motor, (1) battery holder, (1) AAA battery, (3) GluDots, (3) small rubber bands, (1) large rubber band, (1) chenille stem, (2) wiggle eyes.

 x4	 x40	 x160	 x320
4 Kits	40 Kits	160 Kits	320 Kits
$25	$225	$886	$1725
	Save $25	Save $114	Save $275

Eight New Colors

Each Kit comes with a custom tooth brush head with standard bristles that can be modified for desired effects.

Everything you need.

The kit includes all the material needed to construct and decorate one bristlebot.

Each bristlebots kits includes the following: (1) instructional box, (1) custom toothbrush head, (1) vibrating motor, (1) battery holder, (1) AAA battery, (3) GluDots, (3) small rubber bands, (1) large rubber band, (1) chenille stem, (2) wiggle eyes.

Comments or Suggestions?

Please take our product survey at,

http://www.surveymonkey.com/s/XRTCMW6

Questions you may see on our survey:

➠ What would you like to see improved on our products?

➠ What new ideas for a educational robotics would you like to see?

➠ How is the pricing on our kits?

➠ What have you used bristlebots for?

The survey will help us in improving current products but also motivate future product development. We work hard to promote STEM education by providing robotics teams, science groups, and the community with educational tools to help fuel their educational endeavors.

Help us Help you better!

PRESENTED IN PART BY HINOVATECH USA

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