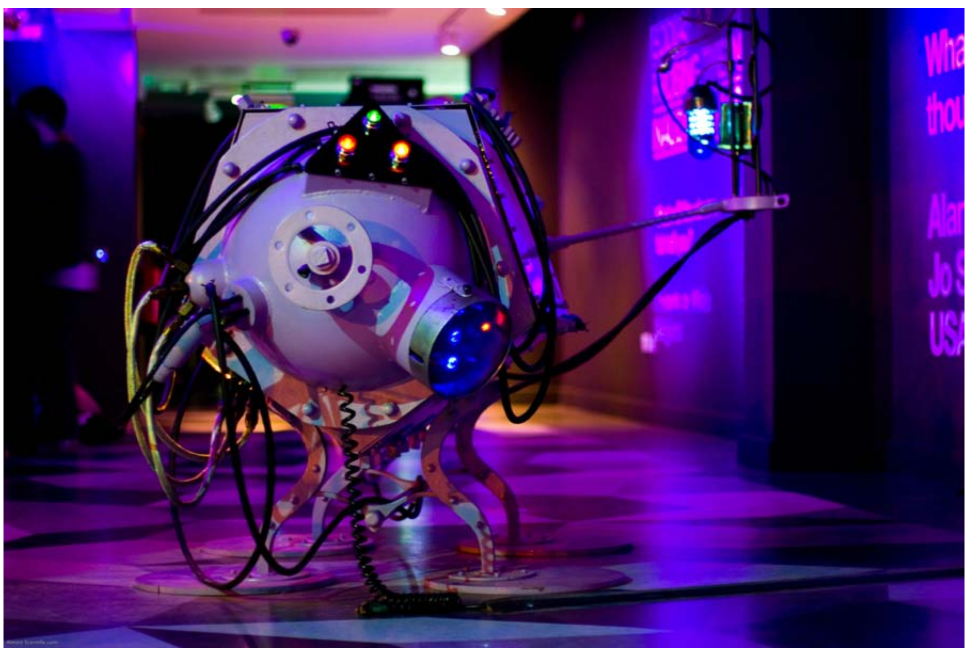
Sonoma County Museum

MAD SCIENCE: *Explorations in Kinetic and Robotic Sculpture*

October 31, 2010 – February 6, 2011



Educator Guide

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EXHIBITION OVERVIEW

Mad Science: Explorations in Kinetic and Robotic Sculpture brings together a group of Bay Area artists who share an interest in science and art. The connections between these subjects have historic roots dating back at least to the 1960s, with kinetic art and conceptual art becoming prominent in these years. Equally important is the political, social, and military context in which these artists grew up: they are part of an era defined by the Cold War, the Internet, "Smart Bombs" and other powerful, technologically driven, new-world experiences that have become deeply entrenched in our popular culture.

In many ways, the spiritual and artistic leader of this group is Mark Pauline, who started Survival Research Laboratories (SRL) in 1978, and has staged over 45 mechanized presentations in the United States and Europe. Making robotic machines that are at once purposeless and dangerous, SRL has forged a creative path that is bolder than anything that preceded it. The best known precedent of sculpture that moves and destroys things is artist Jean Tinguely's 1960 self-destroying sculpture event at MOMA (*Homage to New York*). Other artists, like Alexander Calder and Arthur Ganson, pioneered kinetic sculpture in the 1960s as well, deeply exploring form and movement in their work, as well as possibilities for humor and whimsy.

In this exhibit, artists Reuben Margolin and Andrew Sofie explore the intricacy of structure and motion, involving the viewer as a participant in sculptural transformation (both physical and virtual). Nemo Gould and Michael Cooper, by contrast, play upon humor and fantasy, creating humanoids and dream cars that can exist only in the laboratory or in fiction. Both Margolin and Ned Kahn are deeply inspired by the scientific and mathematical patterns found in nature. We also see some interest in fictional- or pseudo-science in the creations of Alan Rorie, who tinkers with physics and electricity in his projects. Visions of Rube Goldberg are not far from many of the projects in this exhibition.

With the *Mad Science* exhibit, Sonoma County Museum hopes to challenge and entertain, inspire and engage. Above all, with this exhibit the museum aims to provide a selective representation of the highly creative artist/scientists working in the Bay Area today.

EDUCATIONAL OBJECTIVES

Mad Science offers many opportunities for student learning.

As an art exhibit, the show offers curricular tie-ins for the Visual Arts, including the following **California State Content Standards**:

1.0 Artistic Perception
2.0 Creative Expression
3.0 Historical and Cultural Context
4.0 Aesthetic Valuing
5.0 Connections, Relationships, Applications

In addition, teachers may find the following themes useful in finding curriculum overlaps for the exhibit, and planning their visit:

ART THEMES:

Kinetic art --- What does it mean to turn an artwork into something that moves? The viewer gets more involved, involved in a new way / an element of time is introduced (it takes longer to look at the work) / the work might occupy space in a different way.

Found object art / assemblage ---- Some of these artists use found objects (i.e., recycled, everyday materials) to make their sculptures (Nemo Gould robots / Reuben Margolin's *The Pentagonal Wave*). Students can discuss recycling, re-use, and art materials.

Making the useful useless --- Many kinetic artists have been interested in turning the purposes and uses of machines on their head: making useless, absurd machines rather than machines that help us. Mark Pauline's work is a good example – it can be considered mechanical, but the purpose of his pieces is to produce useless machines with advanced military and industrial technology. Older students: what critique does a useless machine offer of the modern, technologized world?

Pseudo-Science --- Also along the lines of making the useful useless, some of these artists play around with 'pseudo-science' rather than real science. Alan Rorie has a PhD in neurobiology, but his artworks are a mix of real scientific principles and fantastical versions of pseudo-science.

SCIENCE THEMES:

Nature (Environmental Sciences) --- Several of these artworks are inspired by nature and how nature works. Margolin's work, for instance, uses mechanics and mathematics (the sine wave) to mimic wave patterns found in nature – from water to the way a caterpillar moves.

Kahn's work is also nature-inspired: he is interested in fluid dynamics, like waves, and also the geosciences and geology.

Engineering --- All the artists in this exhibit are necessarily both artists and engineers. In the exhibit, we see examples of engineering in all the robotic works, as well as the car-inspired works by Michael Cooper, and all the machines driven by a motor.

Computers ---- In this exhibit, artist Andrew Sophie programs computers to make artworks. This branch of science can also be related to engineering and robotics—such as the area called Artificial Intelligence, concerned with creating intelligent systems that solve computational problems, and can communicate like humans and animals do. Pioneer in the field, Alan Turing, proposed the ultimate question regarding these themes: "Can computers think?"

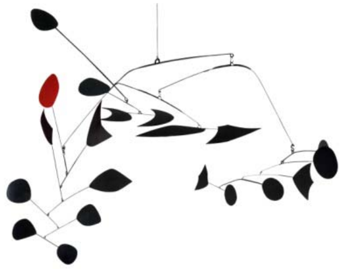
Biology ---- Several of the artists in the exhibit use biology as inspiration. Alan Rorie, trained as a neurobiologist before turning to art, uses biology in his piece *The Neuron Chamber.* Neurons are the basic building blocks of the nervous system. They help transmit information throughout the body. Mark Pauline, in *The Spine Robot*, picks up on the fact that many robotic movements are based on human anatomy. Pauline takes the spine as his model here, which appeals to him because it is *less* useful as a model than the arm for robot-making.

KINETIC ART

Artists have been incorporating movement into art for over a century. At its inception during the birth of the machine age in the early 1900s, kinetic art was influenced by developments in technology, the incorporation of new materials into art-making, and a fascination with machines and their effects on the modern world – both positive and negative.

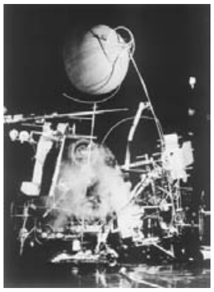
In Europe, pioneers of kinetic art included artists such as Lazlo Maholy-Nagy and Naum Gabo. An instructor at Germany's Bauhaus school of art, Maholy-Nagy wired his moving sculptures with electric lights and was interested in their optical effects. The Russian Gabo's *Standing Wave* sculpture motorized a thin strip of metal to flex continuously. For Gabo, this had revolutionary implications. As he put it in 1920, "In order to interpret the reality of life, art must be based upon two fundamental elements: space and time. Kinetic elements must be used to express time's true nature." Artists of the Italian Futurist movement also saw kinetic art as radically new, dreaming of (but not building) an art of moving gases. Artists in the Dada and Surrealist movements, on the other hand, created kinetic works that emphasized the ridiculous, de-humanizing, and even dangerous nature of machines. In the United States, mobiles were pursued as an art form by Alexander Calder from about 1930 on. Created from floating bits of colored metal and wire, and made in sizes from the small to the massive, Calder's kinetic works emphasized the playful and whimsical side of movement in art.

In 1919, Russian artist Naum Gabo made one of the first kinetic sculptures. *Standing Wave* utilized a motor to continuously flex a thin strip of metal.



American artist Alexander Calder pioneered kinetic art in this country in the 1930s. Made of metal and wire, his mobiles emphasize the meditative, and also the whimsical aspects of movement. Pictured, a large Calder mobile from the 1960s, titled *Rouge Triumphant*.

Kinetic art became a major phenomenon by the 1960s. Swiss sculptor Jean Tinguely had a large impact during this period, making absurdist, functionless machines from scrap metal and other found objects. His *Homage to New York* is a particularly iconic work. Built for a performance at the New York MOMA in 1960, the huge piece was designed to self-destruct as it ran. The work was set in motion but, bursting into flames after only 27 minutes, it failed to self-destruct under its own terms and had to be extinguished by museum guards.



Jean Tinguely's self-destructing machine from 1960, *Homage to New York*. Tinguely focused on making dysfunctional, purposeless machines, and highlighting the chaotic side of the machine aesthetic.

Other artists of this period have focused on the optical and sensory effects that kinetic art produces, as well as kinetic processes found in nature. Still others, such as Rebecca Horn and Arthur Ganson, have carried forward with kinetic art that emphasizes existential themes, both dark and humorous.

Contemporary artists continue to work with a rich variety of interpretations of the kinetic. As the works in this exhibit attest, art based in movement yields a wide field of possibilities for both artists and viewers.

Contemporary artist Arthur Ganson explores existential themes in his machine art, often unveiling the absurd or the humorous. In *Machine with Concrete*, the final gear will make one revolution in roughly 2.3 trillion years.

FROM ARTIST TO MAD SCIENTIST

Curiosity, earnest research to learn the hidden laws of nature, gladness akin to rapture, as they were unfolded to me, are among the earliest sensations I can remember.

- *Frankenstein*, 1818

The words of the literary character Victor Frankenstein could have come from either an artist or a scientist. There is something about the connection between science and art that speaks to our sense of the ultimate potential of humankind, a powerful and perfect connection between intellect and creativity. However, the modern age has also inspired a darker vision of that pure connection.

The artist-scientist is a figure deeply imbedded in the human psyche, at least according to Jungian psychology. Jung's archetypal figure of the artist-scientist is both a dreamer and an inventor, uniquely capable of both creating and discovering. He is not, however, noted for wisdom. Rather, he is a source of change, often singularly focused on the task at hand and obsessed to the point of distraction. Real-world examples of this archetype might include Su Song (the Song dynasty Chinese astronomer, engineer, diplomat and poet), Archimedes, Leonardo Da Vinci, or Benjamin Franklin. Though not all artist-scientists in historical fact, these figures have become representative of that archetypal figure in the popular imagination.

The artist-scientist is one small-step, one dark twist, away from another character - the Mad Scientist. The angst that accompanied the rapid technological changes of the Industrial Revolution helped transform the artist-scientist in the cultural imagination into a character with a sinister edge, someone whose efforts to understand nature were warped into an obsession. In 1818, Mary Shelley wrote of just such an obsessed figure when she created Victor Frankenstein for her famous novel *Frankenstein or the Modern Prometheus*. Shelley's novel was a product of her time, a warning against the potential dangers of human progress and technological advancement in the midst of the Industrial Revolution. As her classic character states, "supremely frightful would be the effect of any human endeavor to mock the stupendous mechanism of the Creator of the world."

For more than two centuries, the Mad Scientist has remained a popular denizen of the world of literature and film. From Shelley's *Frankenstein*, to Jules Verne's many early science fiction novels, to Robert Louis Stevenson's *Dr. Jekyll and Mr. Hyde*, to movies such as *Metropolis* (1927), *Forbidden Planet* (1956), and *Blade Runner* (1982), the Mad Scientist has made innumerable appearances, articulating and elaborating on humanity's fears over the direction of science, technology, and societal progress.

Contemporary artists today are far less sinister than the archetypal Mad Scientist (in most cases anyway), but they retain some of the attributes of the character in their penchant for pushing boundaries in joining science and art. More and more, technology and science have become a part of contemporary art-making, but the artists in this exhibit pursue these themes on a level beyond just digital components, computers, and other new media. The unbridled energy and sometimes dangerous creativity of the Mad Scientist can be seen channeled into something new in many of the artistic projects on show at the museum.

MAD SCIENTIST READING LIST

Recommended for high school and college students: novels that revolve around the character of the 'mad scientist.'

- Mary Shelley, *Frankenstein* (1818)
- Jules Verne, *Journey to the Center of the Earth* (1864)
- Jules Verne, *From the Earth to the Moon* (1865)
- Robert Louis Stevenson, *The Strange Case of Dr. Jekyll and Mr. Hyde* (1886)
- H.G. Wells, *The Time Machine* (1895)
- H.G. Wells, *The Island of Dr. Moreau* (1896)

ARTIST BIOGRAPHIES

MARK PAULINE

Mark Pauline started Survival Research Laboratories (SRL) in 1978, has staged over 45 mechanized presentations in the United States and Europe. Pauline makes robotic machines that are at once purposeless and dangerous.

Pauline says, "My general vision of Survival Research Labs is one of an oasis, where considerations of practicality are replaced by a sublime sense of violent mechanized purposelessness. The Spine Robot project [on display in the exhibition] is an attempt to more fully exploit the impracticality and menace of the long neglected technology of spine mechanics towards those ends."

REUBEN MARGOLIN

Reuben Margolin was raised in Berkeley, California. A love of math and physics propelled him to Harvard, where he changed paths and got a degree in English. He then went on to study traditional painting in Italy and Russia.

In 1999 he became obsessed with the movement of a little green caterpillar, and set out to make wave-like sculptures. He began making a series of large-scale undulating installations that attempt to combine the logic of mathematics with the sensuousness of nature.

Margolin says, "We are surrounded by waves, in water, in wind, in the contours of a flame. Despite having studied them for over ten years, they continue to inspire me with their fluidity, their complexity, and their endless variation. A sine wave is a mathematical movement. By adding together different wavelengths and frequencies, waves of increasing complexity can be made."

NEMO GOULD

East Bay sculptor Nemo Gould makes kinetic robots. Made of found objects, Gould's work focuses on the reassignment of meaning and purpose to salvaged materials. He takes his inspiration from popular culture, science fiction, and making light of at-times dull adult experiences.

Gould says, "I am a compulsive collector of things who has found a creative excuse for his tendencies. All of my work is made from found materials that I gather all over the San Francisco Bay area. For me, the myriad of creative possibilities that found objects offer far outweigh the freedom of, say, a blank canvas. My work attempts to reconcile the innocent wonder of youth with the dull complexity of the adult experience. As we age and learn more of the answers to life's mysteries, I think we lose part of what keeps us alive. It is my ambition to make things that can produce a childlike response from a jaded adult - it's a matter of life and death!"

ANDREW SOFIE

Andrew Sofie's work is informed by a formal training in sculpture and a lifelong interest in digital technology. At Sonoma State University, where he received a BFA with an emphasis in sculpture, Sofie spent most of his time studying bronze-casting and woodworking. In his last few years at SSU he shifted his focus to digital art.

Sofie's 'day job' is working as a software engineer on mobile platforms. As an artist he works on projects that explore the interaction between humans and digital technologies. He is especially interested in new mobile technologies (cell phones, iPads, etc.), and their viral spread in the world.

ALAN RORIE

With a PhD in neuroscience from Stanford University, Alan Rorie has turned to art-making to explore the intersections between art and science, generating works that are at once scientifically grounded and aesthetically imaginative or even fantastical.

Rorie says, "I am an artist, a scientist, a designer and an educator - I am Almost Scientific. Using digital and physical tools, I explore the intersections and boundaries between art, science, and education. I communicate scientific phenomena aesthetically and employ scientific methods to generate art. I'm interested in the relationship between the abstract and the concrete, and the consequences of moving phenomena between these two worlds."

NED KAHN

Ned Kahn graduated from college with an environmental studies degree. From 1982 to 1996 he designed educational exhibits at the Exploratorium in San Francisco. He apprenticed there to Frank Oppenheimer, the center's founder and brother of atomic physicist J. Robert Oppenheimer. Kahn, who flourished in this setting, began developing his ideas independently in the late 1980s.

"Part of my philosophy," Kahn says, "is that in our culture, with its increased interest in computers and television and media … people have fewer and fewer opportunities to nurture their ability to observe and look closely. So my underlying goal is to create objects or places designed to encourage and nurture observation."

MICHAEL COOPER

Michael Cooper was born in Richmond, California and grew up in Lodi, California. He attended art school at UC Berkeley, where he completed his MFA in Sculpture in 1969. Cooper retired from Foothill-DeAnza College, Cupertino, California in 2004 after teaching as an Instructor of Art for thirty-four yeas.

Cooper's artworks often look like fantastical cars or other wheeled vehicles, and are influenced by his interest in kinetic sculpture and various forms of racing. He currently lives in Sebastopol, where he works daily in his studio adjacent to his home. He typically works in wood and metal, or a combination of both.

VOCABULARY LIST

Assemblage: A technique used in sculpture and the other fine arts in which the artist organizes a group of unrelated or discarded objects into a unified composition.

Found object art: Art that is created from real-world objects taken from everyday life, which are not normally considered art because they have a non-art function. Found art must have the artist's input, and there is usually some degree of modification to the object.

Kinetic: Moveable; related to motion and the energy associated with it. In science, kinetic energy is the energy possessed by a system or object as a result of its motion.

Mad scientist: A stereotypical character in popular fiction or science fiction. The mad scientist is sometimes a villain or antagonistic, sometimes benign or neutral. Whether this character is eccentric or silly, they are often using fictional technology to further their own schemes or agenda.

Sine wave: A waveform of a single constant frequency and amplitude that continues for all time. This wave pattern occurs often in nature, including ocean waves, sound waves, and light waves.

Activity I:
COLLAGE – Make Your Own 'Mad Science' Invention

Grade Level: K-12 (adaptable)

CA Curriculum content: Visual Arts, Language Arts
Time Required: 30-50 minutes

Materials:
- Collage elements – supply old magazines, etc. or have students bring in old magazines or newspapers to glue together for their robot/machine invention
- Paper, pens, pencils, scissors, glue sticks, tape

INSTRUCTIONS:
Have students design their own 'mad science' invention – the parameters of what their artistic invention can be are open: useable machine, madcap invention, etc. Students can sketch out a generic shape or background idea for their invention on their piece of paper before beginning their collage. Appendages and/or decorative elements will be pasted or taped on to the paper after they are cut from old magazines or newspapers.

Additional I: To add an element of **Language Arts**, have students give their piece a title and purpose. The lesson can be further expanded by instructing students to write a detailed description of what their invention does and how it operates.

Additional II: To add an **activity for the museum visit**: Ask your class to bring their collages with them, and have them relate their projects to the pieces on display at the museum. Which work is their invention closest to, and why? Older students can consider which categories of the physical or biological sciences the two works share.

Activity II: Classroom *or* Museum Project
COMPARING TWO ROBOTS

Grade Level: 3-12 (adaptable)

CA Curriculum content: Visual Arts, Language Arts
Time Required: 30-50 minutes

Materials:

- ***About the Artists*** and ***Activity Sheet*** handouts in this educator guide (following pages)
- Optional: Pictures of famous robots – C3PO, R2D2, Transformers, etc.

INTRODUCTION:
This activity will help students recognize the various ways robots are meant to personify humans, and will help students understand their purposes. Robots always mimic humans in some way, but precisely how varies greatly. A robot might look, perform, or think like a human – or some combination thereof.

In the *Mad Science* exhibit, students will find examples of robots that are very anthropomorphic (i.e., they look a lot like humans), but also robot 'creatures,' and robots that are very abstract looking.

INSTRUCTIONS:
1. Generate a class list of robot characteristics: Have students describe elements of robots they have seen on television or in movies. Providing images of "famous" robots is also a possibility (C3PO, R2D2, Transformers, etc.).

2. Using the ***About the Artists*** worksheet, show students images of two sculptures in the *Mad Science* exhibit: Nemo Gould's *PoBot* and Mark Pauline's *Spine Robot*. Read to them or have them read the details about each piece. Discuss the following:

- Both sculptures are based on the human body. How so? How are they the same, and how are they different?
- What is the purpose of Gould's sculpture? Fun, playful, humorous? Toy? Art?
- What about Pauline's work? Does it seem different in mood from Gould's robot? (Does it seem dangerous or destructive?)
    - Older students: Read them this statement by Mark Pauline -- *"The typical robot arm is derived from the form of the human arm, and is generally intended to perform some useful work. Spine robots have proven themselves quite useless. I sensed an opportunity in that history, and theorized that spine robots might be put to good use if the goals were reversed to favor the inherent chaos of this class of manipulators."* Discuss: Why does Pauline like the

idea of a useless robot? Does the work symbolize the danger of machines becoming too humanlike? Might it draw attention to the absurdity of a functional robot?

3. After discussing both Gould and Pauline's robots, try to add more characteristics to the list.

4. Generate one more list—ask students to imagine that they are inventors, scientists, or artists designing a robot with human characteristics. What qualities do they want their robot to have?

5. Pass out the ***Activity Sheet*** and give students 20-30 minutes to work on it.

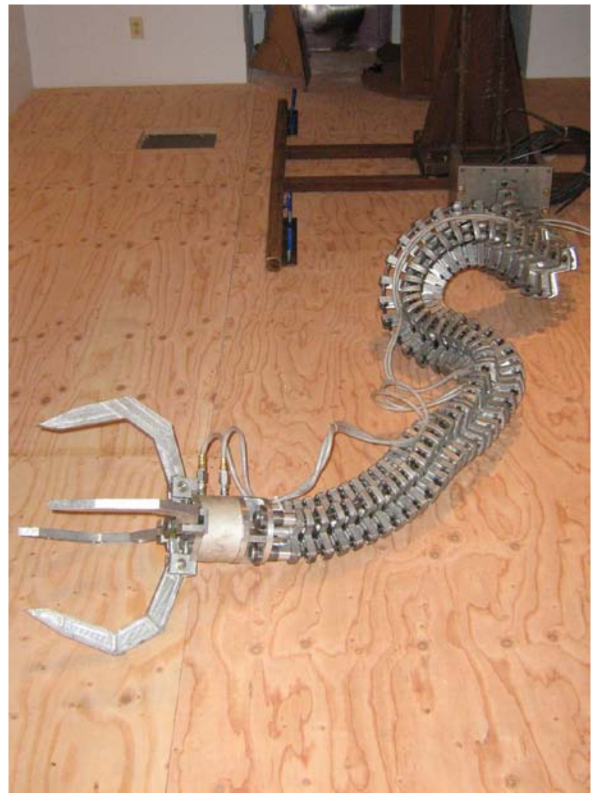
6. Finish the project with a discussion and a mock gallery show. Have students place their designs on their desks and encourage them to walk around the classroom exploring one another's ideas. Discuss the purpose of the activity and relate the "gallery walk" to the experience of a museum tour.

ABOUT THE ARTISTS

Nemo Gould and Mark Pauline

Nemo Gould's sculptures are made out of "found objects" - recycled materials, or what some might call "junk." Not only are Gould's pieces fascinating and entertaining, they are also meant to make you think about the environment and the re-use of salvaged materials. He turns waste (or garbage!) into interesting and thought-provoking creatures. Many of his sculptures are also full of humor.

Gould's *PoBot* (2010) combines the following materials: Pneumatic nail gun, drink pitcher, table leg, folding chair parts, oak barrel, desk chair stand, candlesticks, leather belt, equipment case, salad forks, boat motor parts, voltage meter, parking meter coin slot, indicator lights, fence cap, vacuum attachments, springs, motor.



Mark Pauline takes useful, real-world robots as models for his art, but then makes them useless or crazy in some way. For instance, robots used in car factories mimic the joints of the human arm. Pauline decided to make a robot based on the spine instead of the arm. He takes a practical idea and makes it purposeless, creating large-scale robotic pieces that are used in performances and can be moved by museum visitors.

Mark Pauline's *The Spine Robot* (2010) combines the following materials: Aluminum, titanium, steel, Delrin, nylon, Dyneema rope.

THE HUMAN SIDE OF ROBOTS **Name: ________________________**

Classroom or Museum ***Activity Sheet***

Design a robot! What human traits will your robot have? What is your robot's purpose or duties? Will it be your assistant (to help with homework or do your chores?), or a toy to play with? Useful or useless? How will your robot behave? Describe and draw below.

1. What is the robot's role in your life? Helpful or not? Friend or foe?

____

2. List its special talents or duties: ____

____

____

Robot's name: ____

Activity III:
VORTEX - Whirling Water creates a Tornado in a Bottle

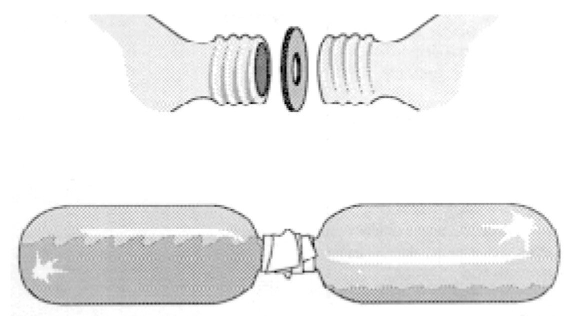
Grade Level: 2-10 (adaptable)

CA Curriculum content: Science, Visual Arts
Time Required: 30-50 minutes

(Adapted from ***://www.exploratorium.edu/snacks/vortex/index.html****)*

Materials:
- Two 2-liter soda bottles
- A washer/connector**,** a washer with a 3/8-inch (9.5 mm) hole available at hardware stores and electrical tape
- Optional: A small dropper bottle of food coloring and/or bits of paper

INTRODUCTION:
Water forms a spiraling, funnel-shaped vortex as it drains from a 2-liter soda bottle. A simple connector device allows the water to drain into a second bottle. The whole assembly can then be inverted and the process repeated.



- Vortices occur in nature in many forms: Tornadoes, whirlpools, weather systems, galaxies, etc.
- In the *Mad Science* exhibit, students can find three artworks that deal with fluid dynamics:
    - Ned Kahn, *Orb*
    - Ned Kahn, *Seismic Sea*
    - Ned Kahn, *Magma Chambers*

INSTRUCTIONS:

ASSEMBLY (15 minutes or less)
Fill one of the soda bottles about two-thirds full of water. For effect, you can add a little food coloring or paper bits to the water. Tape the bottles together with the washer between them.

TO DO AND NOTICE (15 minutes or more)
Place the two bottles on a table with the filled bottle on top. Watch the water slowly drip down

into the lower bottle as air simultaneously bubbles up into the top bottle. The flow of water may come to a complete stop.

With the filled bottle on top, rapidly rotate the bottles in a circle a few times. Place the assembly on a table. Observe the formation of a funnel-shaped *vortex* as the bottle drains. Note the shape of the vortex. Also, notice the flow of the water as it empties into the lower bottle.

WHAT IS HAPPENING
When the water is not rotating, *surface tension* creates a skin like layer of water across the small hole in the center of the connector.

If the top bottle is full, the water can push out a bulge in this surface to form a bulbous drop, which then drips into the lower bottle. As water drops into the lower bottle, the pressure in the lower bottle builds until air bubbles are forced into the upper bottle. The pressure that the water exerts on the surface in the connector decreases as the water level in the upper bottle drops. When the water level and pressure drop low enough, the water surface can hold back the water and stop the flow completely.

If you spin the bottles around a few times, the water in the upper bottle starts rotating. As the water drains into the lower bottle, a vortex forms. The water is pulled down and forced toward the drain hole in the center by gravity. If we ignore the small friction forces, the *angular momentum* of the water stays the same as it moves inward. This means that the speed of the water around the center increases as it approaches the center of the bottle. (This is the same reason that the speed of rotating ice skaters increases when they pull in their arms.)

To make water move in a circle, forces called *centripetal forces* must act on the water. These "center pulling" forces are provided by a combination of air pressure, water pressure, and gravity.

You can tell where the centripetal forces are greater by looking at the slope of the water. Where the water is steeper, such as at the bottom of the vortex, the centripetal force on the water is greater. Water moving with higher speeds and in smaller radius curves requires larger forces. The water at the bottom of the vortex is doing just this, and so the wall of the vortex is steepest at the bottom. (Think about racecars: Racetracks have steeper banks on high-speed, sharp corners to hold the cars in their circular paths around the track.)

The hole in the vortex allows air from the lower bottle to flow easily into the upper bottle. This enables the upper bottle to drain smoothly and completely.

Activity IV:
KINETIC ART PROJECT – Wind Power

Grade Level: 5-12 (adaptable)

CA Curriculum content: Science, Visual Arts
Time Required: 50-120 minutes

(Adapted from ***://pbskids.org/designsquad/projects/kinetic_sculpture.html****. Visit the website to download the detailed Project Guide PDF in English and Spanish. Additional projects and videos related to kinetic art made from recycled materials are available at* ***pbskids.org.****)*

Materials:

- Electric fan (you only need one)
- Strips of colored paper or fabric
- Ruler
- Pens or markers
- Cardboard
- Metal washers (various sizes)
- Markers
- Ping—Pong balls
- Poster putty
- Paper cups (various sizes)
- Scissors
- Wooden skewers
- String
- Tape (duct or masking)

INSTRUCTIONS:
Working in groups or individually, students will aim to make a sculpture that is at least six inches tall and has at least two parts that move in the wind. That's what makes it kinetic—it moves. But watch out, wind can also knock it over. So, make sure the tower is sturdy enough to stand up in the wind.

BRAINSTORM AND DESIGN:
Have students read – or introduce to them – the 'Kinetic Art' section, with illustrations, in this educator guide. Let students know that models are important: being inspired by other people's work and combining the parts you like in new ways is a great way to come up with a unique creation of your own. Next, have students look at the materials and think about how they can meet the challenge.

BUILD:
Have students assemble their sculptures, either in groups or individually.

TEST:
Set the sculptures in front of the fan. Discuss: Do the parts move as you expected? Did the wind knock your sculpture over? Make it more stable by giving it a wide, heavy base. Where the weight is located also effects how it stands. If too much weight is toward the top, it may tip over. If most of the weight is at the bottom, it stays up better.

REDESIGN:
What adjustments will help your sculpture's parts move in the wind? Does it need additional support to keep it from falling over? How can you make it more stable? Once everything's working the way you want, how about:

- Adding another moving part?
- Making your sculpture taller?
- Changing it to work in either more or less wind?