TEACHER'S MANUAL GRADES 9–12

MARVELOUS MACHINES

Artmobile

Covering the County • Uncovering the Arts

Traveling throughout Bucks County September 2019–June 2021

Artmobile is a traveling museum dedicated to providing the students and adults of Bucks County access to fine, original works of art and innovative art education programs through its visits to schools and public sites. Artmobile is a vital component of Bucks County Community College which provides significant cultural outreach programs in accordance with its mission.

Since 1976, Artmobile has been committed to fostering an understanding of art, art making, and the value of art in our lives and communities by exhibiting and interpreting works of art.

This manual was developed to help teachers incorporate the Artmobile experience into their curricula by providing background information and classroom activities related to the exhibition. It is intended to serve as a resource both in conjunction with and apart from the exhibition.

For more information about Artmobile and its programs, call 215-968-8435, email artmobile@bucks.edu or visit www.bucks.edu/artmobile.

Marvelous Machines is supported in part by the **National Endowment for the Arts.**

Artmobile receives state arts funding support through a grant from the **Pennsylvania Council on the Arts,** a state agency funded by the Commonwealth of Pennsylvania and the National Endowment for the Arts, a federal agency.

Additional support for Artmobile is provided by BB&T, Covenant Bank, Fred Beans Ford, Fulton Bank, Hatboro Federal Savings, Mid Penn Bank, PNC Bank, SofterWare, Inc., Univest Bank and Trust Co. and Waste Management, Inc.

Front Cover: Brad Litwin, *Greater Strum-U-Lator,* 2019, mixed media

MARVELOUS MACHINES

Contents 9–12

BUCKS 1964 Bucks County Community College

Acknowledgments

I offer my heartfelt thanks to the many people who helped to make Marvelous Machines a success, especially:

- Eileen Streeter for curating this truly marvelous exhibit;
- The artists who graciously loaned their work:

Chris Eckert	Madelaine Shellaby
Arthur Ganson	Elayna Toby Singer
Jeff Kahn	Will Tinsman
Anne Lilly	Jennifer Townley
Bradley N. Litwin	Norman Tuck
Bob Potts	Katie Wynne
John Powers	Dukno Yoon

- Gino White of Bitterroot Design, for producing the hands-on gears and pulleys
- Cynthia Scott, for writing and illustrating the lesson plans;
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- My entire Bucks County Community College family, for their enthusiasm and support—especially Megan Smith and the Marketing, Public Relations & Creative Services team for Artmobile's new wrap.

My deepest gratitude goes to my talented, resourceful and dedicated staff—my dream team:
Cayla Belser, *Artmobile Assistant;*
Jennifer Garey, *Exhibitions Assistant;*
Cassandra Stancil Gunkel, Ph.D., *Artmobile Coordinator;*
Melody Hunt, *Art Handler;* and
Artmobile Educators Michelle Kinney, Rachelle Moes, Pam Soda and Kimberly Troup.

Together, their knowledge and enthusiasm will bring *Marvelous Machines* to life for 35,000 visitors over the course of its two-year tour.

Fran Orlando
Director, Exhibitions and Artmobile
Bucks County Community College

Optimizing your Artmobile Experience

OPPORTUNITIES FOR TEACHERS

Our Artmobile Coordinator provides in-service training at schools prior to Artmobile's visit to help you incorporate the lessons we provide into your curriculum. To schedule in-service training at your school, call 215-968-8435.

Earn Act 48 hours at our Teacher Workshops. See www.bucks.edu/Artmobile/Workshops for a complete listing. Visit often, as we update our professional development opportunities throughout the tour.

PREPARE YOUR STUDENTS

Pre-Visit Classroom Activities included in this manual will provide the background for your students to get the most from their visit to Artmobile.

THE ARTMOBILE EXPERIENCE

Your students will encounter a variety of artworks during their visit to *Marvelous Machines.* Our Artmobile Educator will engage students in discussion and encourage them to make connections between what they see and what they know. By listening and speaking about the artwork, your students will develop the vocabulary and ideas that they will use later in your classroom.

After the presentation, students will have an opportunity to look at the artwork on their own. They will explore the many interactive displays that reinforce the concepts presented by our Educator.

FOLLOW-UP

Post-Visit Classroom Lessons found in this manual will enable your students to synthesize what they have learned in Artmobile with your curriculum. Encourage students to visit the Artmobile website to review the artworks and videos displayed in Artmobile.

EVALUATE

Complete a written evaluation to help us continue to improve and better understand your needs. Download the survey at the bottom of this webpage: www.bucks.edu/ArtmobileVisit

This manual and the online resources for *Marvelous Machines* found at www.bucks.edu/Artmobile provide all you need to incorporate Artmobile into your curriculum with stimulating and effective lessons that directly correlate to the Pennsylvania Department of Education Standards Aligned System.

About the Exhibition

Marvelous Machines offers an exciting chance for K-12 students to explore the fascinating world of physics, structural design, and mechanical engineering. This exhibition presents the six simple machines, then shows them to be powerful building blocks of innovation and artistic expression in kinetic sculpture.

Our partner in the exhibition, the **Mercer Museum** of the Bucks County Historical Society, has loaned historical examples of the six simple machines—Lever, Wheel and Axle, Pulley, Inclined Plane, Wedge, and Screw. Students will explore kinetic sculptures that use these devices in elegant, unexpected, whimsical, and even humorous ways. Some art pieces closely resemble familiar machines, like the balanced points of a hanging mobile, or a chain and sprocket one might find on the gears of a bicycle. Others take more unexpected forms—an instrument that is strummed by winding a gear, or mechanized creatures whose movement depends upon the bending of a human finger, and another by the careful turn of a key. Further still, artists dare to build machines that can express human thoughts and to physically realize preconceived ideas, sometimes with unintentional outcomes.

Clockwise, from left Screw Clamp, Pulley Block, Wagon Jack.
Loan Courtesy of the Mercer Museum of the Bucks County Historical Society.

Marvelous Machines is based on STEAM principles, in which Science, Technology, Engineering, the Arts and Mathematics are utilized as access points for guided inquiry, dialogue and critical thinking. Special attention has been given to artists whose work exemplifies the fascinating place where natural laws, mechanics and human ingenuity meet. Like the tools and devices we produce, the artwork in *Marvelous Machines* is a physical extension of human creativity and problem solving—experimental, curious, and awe-inspiring.

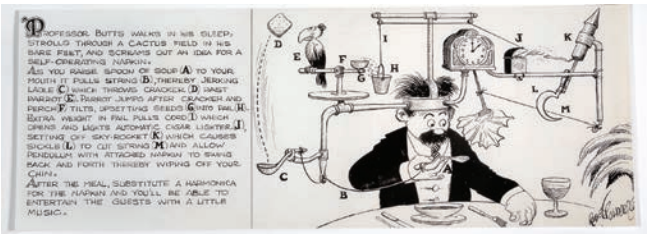
ABOUT THE ARTISTS

Metalsmith, jewelry and costume designer **Dukno Yoon** explores the connection between machines and humans by creating small-scale wearable kinetic sculptures. *Suspended Wings,* a full-finger double ring, uses a fulcrum and lever to transfer the work done by the wearer. As the wearer extends and then closes the adorned finger, the wings on either side of the piece are raised and lowered. Yoon's artwork plays with the idea of machines as a replacement for, or extensions of, the natural world. Yoon states, "A pair of feathered wings flap as the wearer bends the finger with hinged rings. These interactive flapping wings on the tip of the finger evoke an emotional connection from the wearer as if holding a fragile life."

Humming by **Will Tinsman** also draws inspiration from both the natural and mechanical. Created especially for Artmobile, *Humming* is largely comprised of found objects, a notable characteristic of Tinsman's work. In this piece, needle nose pliers form the head of a mechanical hummingbird and utensil handles have become the plumage. At the center of the body are two small metal plates that can be wound with a key, giving life to the hummingbird's wings. The direct connection between turning the key and consequential movement of the plates on a wheel and axle uses familiar machines to manifest an enchanting effect.

The similar mechanical elements between Tinsman's work and that of **Bob Potts'** demonstrate how the style of artists and the materials they choose affect the artwork as much as the engineering they employ. A trained carpenter, Potts makes stick prototypes to explore the necessary geometry of his planned artwork. He then creates one-of-a-kind sculptures out of wood, steel, copper, bronze and aluminum that harness the cyclical rhythms around us. In Potts' electrical-powered *Ascension* (presented on video), the materials have been assembled with extreme precision to mimic the fluid motion of a bird in flight.

Likewise, **Jennifer Townley's** large-scale work, *Lift* (also presented on video), runs on electricity. In it, she explores the tension between chaos and order through a configuration of connected gears and pulleys that move in and out of expected geometric patterns as well as seemingly disordered formations. The central axis of most gears has been removed to allow them to be manipulated by each other, resulting in an irregular motion that resolves itself over time. Townley's kinetic sculpture is peaceful and features slowly changing patterns indicative of her interest in the mathematical and physical interactions of her works.



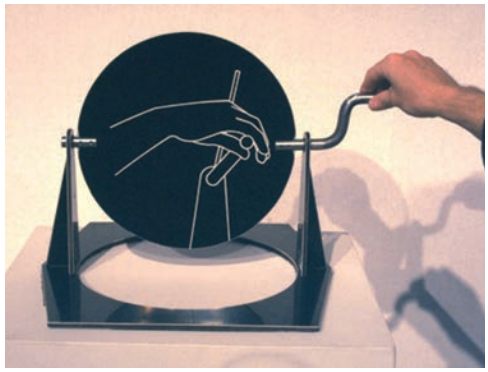
Over-engineering is a common exploration of kinetic art and machines, and was regularly seen in the illustrations of **Rube Goldberg.** His clever machine illustrations are well known throughout the United States as performing a simple task, but in a conspicuously overcomplicated if not absurd fashion. "Often, these machines consist of a series of simple devices that are linked together to produce a domino effect, in which each device triggers the next one, and the original goal is achieved only after many steps." (https://en.wikipedia.org/wiki/Rube_Goldberg_machine). Two reproductions of Goldberg's drawings are featured. *Self-Operating Napkin* is an invention credited to Professor Butts, a recurring character in Goldberg's comics. *Labor-Saving Auto Jack* shows how the everyday man can easily fix his own flat tire, as long as he has an elephant. The two ideas, one complex and one simpler, are both examples of Goldberg's signature style and wit.

Like Goldberg's convoluted contraptions, **Brad Litwin's** sculptural pieces also accomplish simple tasks, while celebrating the process by which the work is achieved. *Greater Strum-U-Lator* gives a clear view of multiple gears of various sizes set into motion by a hand crank. The action ultimately strums guitar strings and, on every fourth crank, shifts the key of the instrument up or down. Unlike many of Goldberg's drawings, *Greater Strum-U-Later* does not begin with one action which sets of a series of chain reactions, but is a continuous effort on the part of the person interacting with the piece. In both cases though the machine is overly complicated; the hand that is turning Litwin's piece could as easily strum the guitar as Goldberg's Professor Butts could wipe his face with a napkin.

My Little Fiddle by **Arthur Ganson** continues to play with this idea of inefficiency or the expectations we may have of machines. Although Ganson has had this idea in mind for several years, *My Little Fiddle* is a kinetic sculpture created especially for *Marvelous Machines.* This piece combines a fairly elaborately motorized feather and a violin. The feather dances against the bottom of the violin, moved around by a gear set within a controlled ring. The violin, capable of creating beautiful music, is soundless as the feather needlessly rotates beneath it. Ganson is a self-taught engineer who creates these whimsical, often interactive, machines in which the viewer's thoughts and feelings are critical to the work's intended completion. His work has been displayed continuously at the MIT Museum since 1995, where Ganson is also one of the originators and co-hosts of the Friday After Thanksgiving (F.A.T.) Chain Reaction challenge, in which teams of amateur inventors of all ages work together to build a massive chain reaction device. "It's great to see really young kids making things," Ganson says. "Talking to them about their process has turned out to be as much fun as watching the chain reaction itself."

Using a machine to reflect back human activity is also inherent in the work of mixed media sculptor and installation artist, **Katie Wynne.** Originally part of a larger installation, *Centipediatrics* offers commentary on the way people, Americans in particular, tend to overuse and overvalue machines in an effort to escape the discomfort, banality, messiness, and ultimately temporary nature of human life. In *Centipediatrics,* a purchased tie rack is embellished and redefined to be larger and more festive. Wynne's additions do not change the movement of the tie rack, but they do remove the function of it, swapping out the machine's work for a constant parade of glittering colors and textures. According to Wynne, "We are throwing a party but what cause we have to celebrate is unclear."

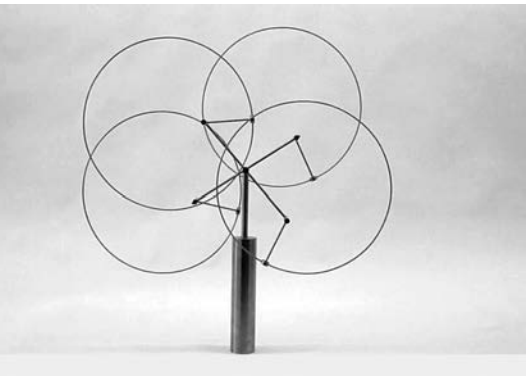
Norman Tuck pushes humor to the ridiculous in his piece *Flipper,* a funny, self-referential work that directs the visitor on how to operate the piece while they actually use it. Made from stainless steel and plastic engraving material, *Flipper* is designed as a simple wheel and axle which visitors can activate. When the handle is down, the image facing the user is of a hand holding the handle down. When the handle is cranked upwards to change the image, the new image shows the handle up higher. The rotating image mimics the actions of the viewer, making a little visual joke.



Elayna Toby Singer's art practice is centered on environmentalism and using everyday objects to convey the vital importance of connecting to the earth, each other, and ourselves. One of her smaller pieces, *Tracks,* is a mobile of recycled toy train tracks and chain-linked beads, which whimsically embodies this universal quest for equilibrium and stability that underpins much of Singer's work. In contrast to some of the other machines displayed in this exhibit, *Tracks* does not require direct human interaction in order to spark its movement. However, only careful and responsive work on the part of its creator facilitates an even distribution of weight and motion with grace.

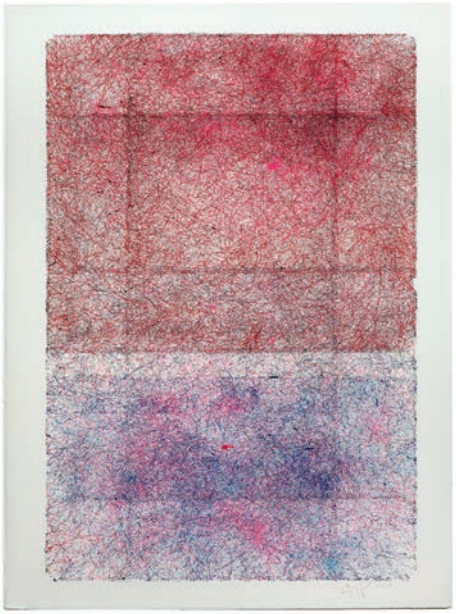
Murder of Crows, by **Madelaine Shellaby** is another piece that does not require direct human interaction to move. Each of the crow silhouettes is attached to a carefully weighted rod (lever) hidden under a metal front panel cut to look like grass. Air currents will cause the crows to move independently of each other. The title refers to the unique term used for a group of crows. As a group of geese is known as a gaggle of geese, a group of crows is called a murder of crows.

Magic Metronome also uses *de facto* principles of physics and geometry, but appears to defy the reality of these laws. **Jeff Kahn** is a sculptor whose current work combines his experience as a jeweler, wood-worker and machinist. His large-scale outdoor sculptures made from steel and aluminum, are powered only by the forces of nature, moving naturally without wires, lights and electronic technology. His work often explores balance and gravity, and Kahn enjoys seeing how the final pieces he creates move in unexpected ways. *Magic Metronome,* a smaller-scale indoor piece, uses lightweight levers to capitalize on even the slightest movement of air to set it in motion. This interplay of pivot and counterbalances presents a clever visual puzzle. Although the work appears to be a standard pendulum, the center of the arm is actually hollow, affecting how the arm swings. When the arm moves it appears to linger in the air longer at the top of each swing, and when it is at rest, it hangs askew.



Sculptor **Anne Lilly** combines the lever and fulcrum with the wheel and axle to challenge the mind with *Conductor/Composer,* displayed in video form in *Marvelous Machines.* Crafted from machined metal, two arms connected to a central rod have an additional arm at either end. These four smaller arms move four metal hoops in opposing directions. The smaller arms jut into the space of these hoops, but they do not actually reach the center. They create a secondary radius for the hoop as it moves around the central rod. Each arm is a lever and the connections between the smaller and larger arms as well as the smaller arms and the four circles are fulcrums. Like much of Lilly's work, *Conductor/Composer* is engineered to encourage the viewer to consider the physical design of the piece as well as one's own reaction to it.

Mechanical engineer and sculptor **Chris Eckert** combines machines with computer technology to reflect deeply personal human thoughts, sometimes his own and sometimes those he finds written by others. *Babel* is an installation piece composed of twenty polychromed metal microelectronic writing machines mounted in a horizontal line high on a wall. Each machine searches the internet for a specific phrase, then uses a ballpoint pen to write the result on long thin rolls of paper in a unique hand-writing and language. The machines dutifully record these global sentiments and continue to share them, rolls of endlessly unspooling thoughts gathering in tangled piles of paper beneath them. *Babel* mirrors genuine human thoughts, anxieties and insecurities that are commonplace throughout the world, all of which were initially—somewhat ironically—expressed via technology.



Another artist and programmer using computers to put pen to paper is **John Douglas Powers,** who is recognized internationally for his kinetic sculptures, installations, animation and video works. *Machine Drawings* appear as geometric forms made up of a myriad of tiny multicolored ink scribbled on large sheets of paper, and are purposely designed to invite viewers to think about how exactly they were made. Powers creates computer code that directs a motorized ball to move in specific patterns within a set area. This ball is contained by a tube with pens on either side, a wheel and self-propelled axle. As the ball moves, it creates a picture he envisioned beforehand. Like the other exhibit artists, Powers employs scientific knowledge combined with a spirit of experimentation and creative expression in his work. He deftly utilizes the simplest and more complex machines to realize his unique artistic vision, of which the process of creation is as much a part of the art as the drawings themselves.

Eileen Streeter, *Guest Curator*
with Rachelle Moes *and* Fran Orlando

9–12 Curriculum Integration & Lesson Plans

All of these activities are designed to be multi-disciplinary, incorporating science, art, math, literature, and technology, among other fields. Our goal is to help teachers incorporate the Artmobile experience seamlessly into their curriculum. Lesson plans were developed in concert with the Standards Aligned System (SAS), developed by the Pennsylvania Department of Education by a Pennsylvania-certified teacher especially for *Marvelous Machines.*

PRE-VISIT: ALL STUDENTS

MUSEUM MANNERS
Take a moment to review proper museum behavior with your students. Leave food, drinks and bags in the classroom. Remind students not to touch the artwork or any of the Plexiglas protecting it. Walk, use quiet voices, and respect the Artmobile Educator.

PRE-VISIT ACTIVITIES
We suggest that all classes at least review the six simple machines before visiting Artmobile. If time allows, add one or more of the Pre-Visit Activities on page 12.

POST-VISIT: CHOOSE ONE OR MORE

POST-VISIT ACTIVITIES
Written by Cynthia Scott, the lesson plans on pages 13–17 are inspired by the artworks your students will see in Artmobile. They include reflections, and can be used as is or easily adapted to suit your particular class.

MARVELOUS MACHINES

Pre-Visit Activities

Choose one or more of the pre-visit activities listed below to prepare your students for their visit to Artmobile.

WHAT ARE THE SIX SIMPLE MACHINES?

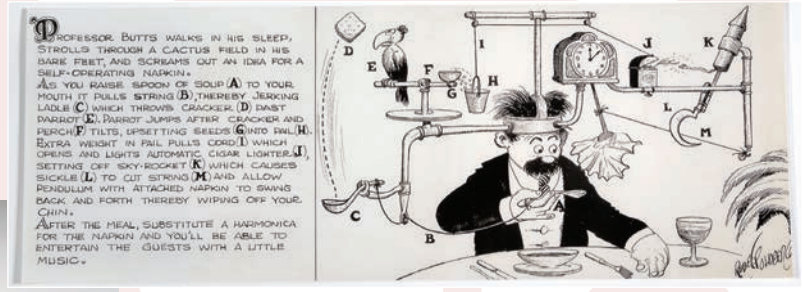
Review six types of simple machines with students. Use the handout on page 21 for vocabulary review. The Mercer Museum has an extensive curriculum on the six simple machines that can be found at www.mercermuseum.org/simplemachines.

ANALYZE COMPLEX MACHINES

Show examples of kinetic sculpture or diagrams of complex machines. Have students identify what simple machines are integrated in them.

CREATE AN IDEA BOARD

Start a "Kinetic Sculpture Board." Ask students to bring in a picture of a favorite kinetic sculpture, identify the simple machines within it and how they operate.



Rube Goldberg, *Professor Butts' Idea for a Self-Operating Napkin,* 1931

Horse Power (Treadmill) Model, Loan Courtesy of the Mercer Museum of the Bucks County Historical Society

Post-Visit Activities

GRADES 9–12

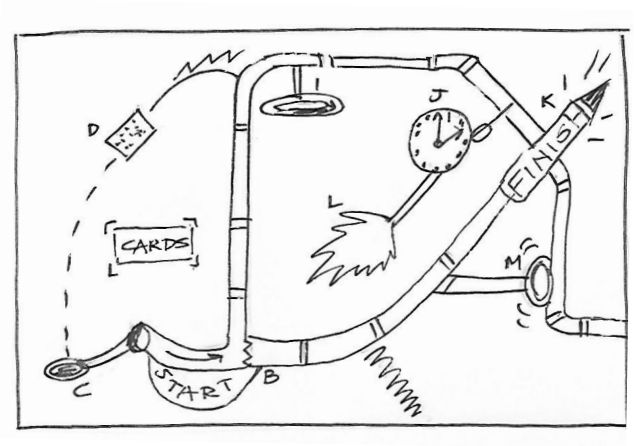
Language Arts, Math, Science, History Art

PA Standards
ELA CC 1.2
Mathematics CC 2.3
Science CC: 3.5
History CC 8.5
Art 9.1 E, 9.2 A, 9.3 C
9.4 D

RUBE GOLDBERG SIMPLE MACHINES BOARD GAME

Objective
Students will collaborate on the creation of a game board using Rube Goldberg-style illustrations, that utilizes all six simple machines and shows how to they make work easier.

Method
After coming up with several game board designs; the group will decide on one idea and illustrate the idea in a cartoon "Rube Goldberg style."



Materials
Drawing paper, pencils, rulers, Crayola Model Magic airdry clay

Background
Using all the simple machines as game pieces, the group will design a game board in which players are asked how each simple machine can be utilized.

Procedure

MAKING THE GAME
Through group collaboration, illustrate the background of a game board like a Rube Goldberg machine.

1. Choose a group of 5–6 students, discuss ideas for a game board design and discuss how the players move from place to place. Choose the best idea.
2. Name the new game, plan out and sketch the whole design using a path of at least 10 blocks, start to finish.
3. Make the game "pick up" cards. Write at least 2 questions on the front of each "pick up" card. Make at least 12 cards with questions that elicit the answers to how the simple machine works and the history of each machine. Write the answers on the back of each card.
4. Using Model Magic clay, design 3-D game pieces to look like the 6 simple machines.

PLAYING THE GAME

1. Decide who goes first by the earliest birthday of the year, then move clockwise.
2. For each correct answer instruct the player to move forward one space, for each wrong answer they move back one space.
3. Players will have to guess the machine that will help them get to the next space toward the finish line. Some game card ideas: Is it Prehistoric? Did the Egyptians use it? Did the Greeks invent it? Is it from Medieval times? Does it make what task easier?

Reflection
Write a story about the game, include what life would be like without the simple machines, add this to the game design.

Think about how the game would be marketed, who would enjoy playing, and what age group is being targeted.

Grades 9–12

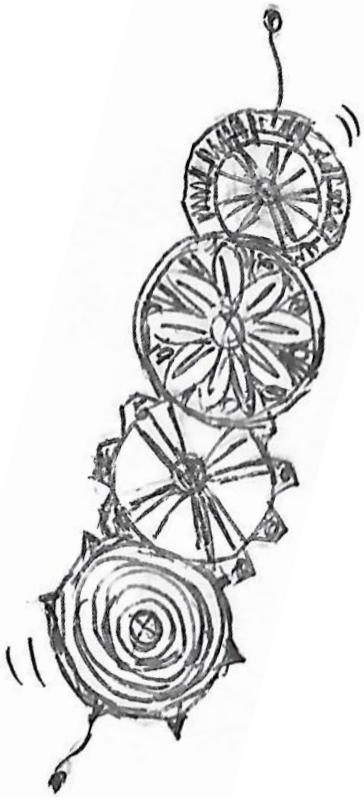
Language Arts, Math, Art

PA Standards
ELA CC: 1.2
Mathematics CC 2.3
Art 9.1 E, 9.2 A, 9.3 C, 9.4 D

MECHANICAL GEAR SCULPTURE

Objective
Students will discover how to create kinetic sculpture using a pully-operated gear design.

Method
Inspired by the work of Artmobile artists Brad Litwin, and Rube Goldberg, the students will design multiple "gears" that spin on spools acting as pulleys when a string is pulled.



Materials
Foam core board, X-Acto knife, empty thread spools, poster board, scissors, string, beads, pointed wooden craft sticks, sticks, Sharpie markers, pencils, drafting compass, white glue

Background
This mechanical artwork moves using a pulley system constructed to make the gears spin all at once. They are are connected to a string which is pulled from both and pulled from one end behind the sculpture to turn. Many artists have joined physical science and engineering with artwork throughout history and have created mechanical sculpture.

Procedure
1. Cut a 32"x 8" length of foam core board using an X-Acto knife.
2. Design 4 different 6" round gears with various size teeth. Use a compass and sharpie markers to color and draw the gears.
3. Make dots on the board to indicate where the center of each gear will be placed.
4. Cut out the gear shapes, glue a wooden spool at the center of the back of each gear. Cut the spools at different heights.
5. Place the pointed end of the wooden sticks into each hole in the spools to act as an axle.
6. Place a bead close to the spool on the sticks and glue loosely so that the gear can move freely, trim the ends of the sticks.
7. Loop the nylon cord around each spool going in the same direction.
8. Make a hole at each end of the backing board and thread the string at both ends through the hole.
9. Pull on the string to rotate the gears.
10. Watch this video link https://www.youtube.com/watch?v=qs88aC0k0yI&feature=youtu.be for more gear design ideas.

Make each gear look like a different type of flower, use metallic markers to make the gears look like metal, draw various op-art designs on each gear.

Brad Litwin, *Greater Strum-U-Lator,* 2019, mixed media

Reflection
Write a paragraph on how your artwork utilizes a simple machine. Making a comparison to the work of Rube Goldberg, describe how the addition of movement added aesthetically to your artwork.

Lesson Adapted from:
https://www.dickblick.com/lesson-plans/art-o-motion-mechanical-sculpture/

KINETIC SILHOUETTE SCULPTURE

Grades 9–12

Language Arts, Math, Science, Art

PA Standards
ELA CC: 1.2
Mathematics CC: 2.3
Science CC: 3.5
Art: 9.1 E, 9.2 A, 9.3 C, 9.4 D

Objective
Students will discover how balance and air currents can cause natural movement in kinetic sculpture.

Method
Inspired by the sculpture, *Murder of Crows* by Artmobile artist Madelaine Shellaby, students will create a kinetic sculpture that demonstrates how levers, the simple machine, can cause movement.

Materials
Small blocks of wood, 6 with holes drilled in the center, oaktag, tempera paint, photo reference for bird, insect or flowers, straight sculpture wire, scissors, wire cutters, white glue, corrugated cardboard, X-Acto knife, ruler, pencil

Background
The silhouetted shapes attached to the top of straight wire are balanced by wooden blocks that act as weights under the sculpture. The shapes move back and forth freely by wind currents.

Procedure
Build a sculpture of multiple silhouetted shapes that have movement.

1. Using a theme of things that move naturally, like birds, flowers or butterflies, draw and cut out 6 shapes using oaktag paper, then trace the 6 and cut a second set Paint the shapes the same solid color.
2. Cut 6—12" pieces of heavy straight sculpture wire and sandwich the wire between the matching shapes, glue.
3. Cut out a platform using corrugated cardboard that measure 16" x 16", measure a 2" strip at the center of the cardboard and score the strip to fold to create a two-sided stand.
4. Cut 6 evenly spaced holes in the 2" center section of the cardboard stand, put the wire posts through each hole with the shapes still mounted on top.
5. Add blocks of wood under the cardboard stand and attach to the wire posts to create balance.
6. Experiment with multiple blocks on one or more of the posts.
7. Watch as the wind currents make the posts with silhouettes move and bob back and forth.

Reflection
Write a paragraph to explain how your sculpture moves, why you chose the theme, and which simple machines were utilized. How does a moving sculpture involve the viewer?

Madelaine Shellaby, *Murder of Crows,* 2019, metal

Grades 9–12

Language Arts, Math, History, Art

PA Standards
ELA CC 1.2
Mathematics: CC 2.3
History: CC 8.5
Art: 9.1 E, 9.2 A, 9.3 C, 9.4 D

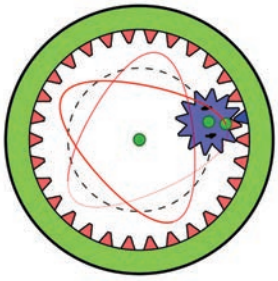
OPTICAL ILLUSION FLIPBOOK DRAWN WITH GEARS

Objective
Students will discover how to use the holes in multiple-sized plastic gears to draw spiral designs. Using repeat patterns, these designs will create movement and optical illusion.

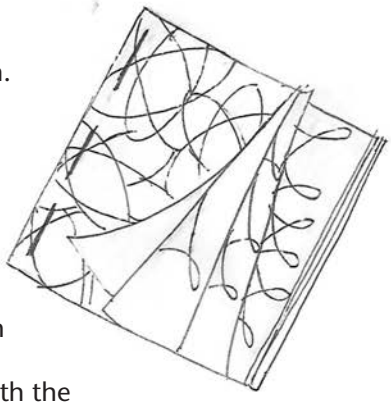
Method
Using the drawing tool game Spirograph, create a flip book consisting of consecutive geometric drawings with a chosen ring and a wheel.

Materials
Spirograph drawing game, colored pencils, thin colored markers, white drawing paper, scissors, stapler, ruler.

Background
The spiral shapes that can be created using the holes in the gears provided in the Spirograph art drawing game were designed to create hundreds of different geometric designs. The position of the holes in the gears allow the user to create a variety of spiral shaped geometric designs. With reflection back to "Non-Objective Art", popular in the 1960's, these designs "trick the eye" and create the optical illusion of movement. Research the work of artists like Bridget Riley and Victor Vasarely who are icons of this art movement.



Procedure
Design a flip book that creates optical illusion.



1. Cut 12 pieces of white paper to measure: 4" x 4", number the pages 1–12, and cut 1 paper 8" x 4", fold in half horizontally and use for the front and back book cover.
2. From the Spirograph game, choose a ring size, i.e. 144/96 and a wheel size i.e. 45, choose #1 on the wheel and #1 on the ring.
3. Place the ring in the center of the page with the #1 hole at the top.
4. With the wheel inside the ring line up with #1 hole on the ring and the number #1 in the wheel.
5. Interlock the teeth of both pieces, position pen vertically in the wheel hole at #1 and hold down the outer ring on the paper, rotate wheel inside the ring to create book pages as follows:
   Page 1, draw 3 rotations with the wheel;
   Page 2, draw 6 rotations;
   Page 3, 9 rotations;
   Continue adding 3 rotations more on each page until
   Page 12, 36 rotations.
6. Using the 8" x 4" paper make a repeat pattern design by tracing around the outside edge of the wheel and ring used on the inside pages to create a front and back cover design.
7. To attach pages together, line up left edges of pages inside the folded cover, staple with 3 staples.

Optional: Using colored pencils, add color to each design on every page in the same position, add color to the cover design.

More kinetic art projects using Spirograph

Design an Op-art Mobile: Draw 12 different Geometric designs using the rings and wheels from the Spirograph game. Glue the designs back to back and attach to 3 dowel sticks with monofilament. Level #1- hang 1 drawing, level# 2, hang 2 drawings, level #3, hang 3 drawings. Watch the mobile move in all directions through air currents.

Op-Art cube: Design a cube that has 6 different geometric designs, one on each side, each drawing made with rings and wheels from a Spirograph game. Hang cube from any corner by making a small hole in the cube and inserting a knot tied in the monofilament. Watch it turn in air currents.

DADA RESEARCH

Objective
Students will research the work of Dada artists throughout history, they will incorporate the work of contemporary Artmobile artists Katie Wynne, Norman Tuck and Arthur Ganson in their research.

Method
Inspired by the work of contemporary artists, the students will write a compare and contrast style research paper.

Materials
Internet research

Background
The ideas of Dada artists are still present today. As seen in Artmobile, it is considered to mock materialism. The students will reflect on the influence Dadaism made on future art movements and contemporary artists work.

Procedure
Write a research paper reflecting on the work of Dada art of the past and Artmobile artists in the present.
1. The work of Dada art is diverse, choose three media to write about.
2. Compare and contrast the differences between artists, discuss the reasoning behind the artwork.
3. Explain the similarities you found between contemporary Dada art and Dada art dating back to the early 1900's.
4. Explain the differences of Dada artists work throughout history and be specific on what the influences were and how they have changed.
5. Site specific examples of Dada artworks and the artists' names.
6. Name the top Dada artists and discuss why they are considered the most influential.

Reflection
Write a few paragraphs after your research.
Answer the following:
Did your research on this topic surprise you?
What was your favorite artwork?
What was your favorite medium? Why?
Would you consider working in this genre?

GRADES 9–12

Language Arts, Art

PA Standards
ELA CC 1.2
Art 9.1 C, 9.2 A, 9.2 J, 9.3 A, 9.4 B, 9.4 D

Arthur Ganson, *My Little Fiddle,* 2019, steel, fiddle, feather

Resources

SIX SIMPLE MACHINES

The Mercer Museum has an extensive curriculum on the six simple machines that can be found at https://www.mercermuseum.org/SimpleMachines.

ThoughtCo (https://www.thoughtco.com/six-kinds-of-simple-machines-2699235) has a variety of excellent resources for teachers including descriptions and examples of the six simple machines, discussion of the physics involved. They also have printables like word search, crossword and activity sheets at https://www.thoughtco.com/simple-machines-printables-1832412.

Idaho Public Television has a terrific website http://idahoptv.org/sciencetrek/topics/simple_machines/facts.cfm that clearly explains each of the six simple machines and how they are used everyday. Click on the Teachers tab http://idahoptv.org/sciencetrek/topics/simple_machines/teachers.cfm for links to videos, quizzes, lesson plans and PowerPoints for lower and upper grades.

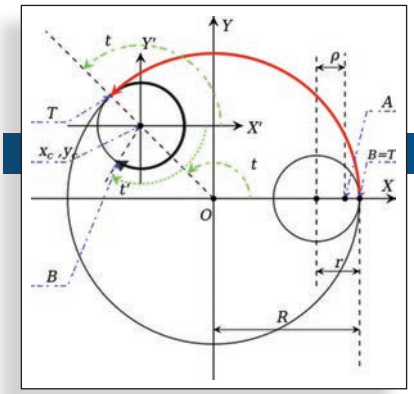
The Museum of Science and Industry in Chicago has several webpages dedicated to simple machines. Find easy pre-visit activities for each of the six simple machines here: https://www.msichicago.org/education/field-trips/learning-labs/simple-machines/activities/.

RUBE GOLDBERG

The official Rube Goldberg website https://www.rubegoldberg.com has lesson plans, videos and complete information about contests.

To learn more about the man, visit http://www.rube-goldberg.com/.

Wilson, Emily. ***"The Story Behind Rube Goldberg's Complicated Contraptions,"*** Smithsonian, Web 1 May 2018. https://www.smithsonianmag.com/history/story-behind-rube-goldbergs-complicated-contraptions-180968928/



SPIROGRAPH MATH

GeoGebra has a detailed diagram with equations for the math whiz. https://www.geogebra.org/m/a5Hd3hZv

Wikipedia has a helpful explanation for the rest of us. https://en.wikipedia.org/wiki/Spirograph

About the Mercer Museum

Mercer Museum
84 South Pine Street
Doylestown, PA 18901

The Mercer Museum is a six-story reinforced concrete castle designed by Henry Mercer and completed in 1916. Today, it is one of Bucks County's premier cultural attractions and a Smithsonian affiliate.

The museum complex features local and national traveling exhibits, as well as a core museum collection of over 50,000 pre-Industrial tools. This permanent collection offers visitors a unique window into pre-Industrial America through sixty different crafts and trades, and is one of the world's most comprehensive portraits of pre-Industrial American material culture. The museum also features a research library that is a center for local history related to Bucks County and the surrounding region, with its roots dating back to the founding of the Bucks County Historical Society in 1880.

The history behind humanity's development and use of tools was at the core of Henry Mercer's original interests, and was central to his collecting and research. The Mercer Museum's collection of everyday objects offers numerous practical examples of the physical and mechanical principles that served as the building blocks of modern technology. A visit to the Mercer Museum reveals essential early American tools on display that demonstrate how simple machines made pre-industrial life easier.

The Mercer Museum education team offers special elementary-level school programs all year long focused on simple machines and their relevance to PA educational standards as well as Common Core standards.

To learn more, please visit www.mercermuseum.org/simplemachines

Photos: Kevin Crawford—VBC—Mercer Museum

Vocabulary Worksheet

INSTRUCTIONS

The vocabulary worksheet on the next page uses the terms and definitions listed in the Mercer Museum Program packet found at www.mercermuseum.org/simplemachines.

TEACHER KEY

Terms

13 Pulley

6 Gravity

10 Load

17 Wheel and Axle

11 Mechanical Advantage

9 Lever

2 Effort

3 Force

12 Mechanism

7 Gear

14 Screw

18 Work

15 Simple Machines

1 Complex (or Compound) Machine

5 Fulcrum

16 Wedge

8 Inclined Plane

4 Friction

SIMPLE MACHINES—VOCABULARY WORKSHEET

Name_____ **Date**_____

Terms

___ Pulley

___ Gravity

___ Load

___ Wheel and Axle

___ Mechanical Advantage

___ Lever

___ Effort

___ Force

___ Mechanism

___ Gear

___ Screw

___ Work

___ Simple Machines

___ Complex (or Compound) Machine

___ Fulcrum

___ Wedge

___ Inclined Plane

___ Friction

Definitions

1. Two or more simple machines combined.

2. The force or energy you put into a machine to make it work.

3. A push or a pull.

4. A force that exists between two surfaces in contact with each other, and that resists motion between these two surfaces.

5. The point on which a lever pivots or turns.

6. A force that causes objects on earth to fall.

7. A wheel with teeth.

8. A simple machine in the form of a ramp—a slanting surface that connects a lower level to a higher level.

9. A simple machine made up of a stiff rod or bar that pivots (or turns) on a support called a fulcrum.

10. The object or material one is attempting to move or lift using a simple or complex machine.

11. The benefit gained by using machines.

12. A device that changes motion, transmits power or force, or controls motion, power or force.

13. A member of the lever family, this simple machine uses a grooved wheel and a rope to move a load.

14. A simple machine composed of an inclined plane wrapped around a pole or cylinder. They hold things together, press or crush things, or move things.

15. Tools or devices that make work easier.

16. A simple machine of the inclined plane family, used to push things apart. It has at least one slanting side ending in a sharp edge.

17. A simple machine of the lever family, composed of a spoked wheel or disk with a rod through the center.

18. The effort needed to move an object multiplied by the distance an object is moved (E x D = W).

Notes

Left to right:
Cassandra Gunkel,
Artmobile Coordinator
Fran Orlando,
Director of Exhibitions and Artmobile
Jennifer Garey,
Exhibitions Associate
Cayla Belser,
Artmobile Assistant
Missing: Melody Hunt,
Art Handler

Our Creative Team

GUEST CURATOR

Eileen Streeter earned her BA in Classics at Mount Holyoke College, and completed her MFA in Museum Exhibition Planning and Design at the University of the Arts in Philadelphia. She worked as an exhibit designer for Artmobile before moving to Washington, DC to work as a Registrar for International Arts & Artists, continuing her passion for bringing art to new audiences around the world. Eileen was excited to work on *Marvelous Machines,* her third project with Artmobile.

CURRICULUM WRITER

Cynthia Scott earned her MA in Education and her BFA from Tyler School of Art. She has been teaching Art to children of all diversities, including those with special needs and from different cultural backgrounds in grade levels K–12. As a working artist, she is currently creating a body of multi-media abstract collages. Cynthia is also an Artist in Residence for Young Audiences of New Jersey.

Bucks County
Community College

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