

# Honolulu Museum of Art

## Docent Tour Guide

*Science through Art*      1 or 2 hours      Grades K-12

**Final** 2.6.14

### *Enduring Understandings and Questions*

*What is art?*

*What is science? Was a body of knowledge, now considered a way of pursuing knowledge, or a disciplined way to study the natural world.*

*How are science and art related?*

*How do artists and scientists work in the same way?*

*How can art be useful in understanding the world of science?*

*How can science be used to inform the artistic process?*

*How can art be used to inform the scientific process?*

*How do artists and scientists begin in a similar way – asking questions?*

Artist and scientist do the same things. Both use their imaginations to understand or control or explain the world around us. Both science and art are a means of investigation. Both use the scientific process – observation, inquiry, predictions (hypothesis), and conclusions.

Art and science are inextricably linked by their common interest in understanding and exploiting the phenomena of the world. Art and science have long existed and developed collaboratively.

Art requires scientific knowledge and science requires creativity and imagination.

Artists transform information about our world into works of art.

Science forces us to question and wonder about ourselves and environment.  
Art does same thing – causes you to think about your world and self in new way.

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### *Tour Goal(s) based on benchmarks*

**On this tour, we will look at art, understand and explore the scientific process the artist used to create a work of art.**

#### **Students will understand:**

**Both artists and scientists use the scientific process in their work. (observation, inquiry, predictions (hypothesis), and conclusions)**

**Both use their imaginations to understand or control or explain the world around them.**

Creativity is the key scientific discovery and successful art works.

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*Benchmarks*

See each gallery section

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*Required artwork*

See each gallery section

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**BOOKLET**

The kids will get the booklet to take back to the classroom. It is not for the gallery.

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*Routes with 4 rotations: galleries and timing*

Introduction – let them know the goal and discuss the scientific process

#1 Potter's Alchemy (glazes and chemistry)

#2 It'll Last Longer (photographic process)

#3 Fool Spectrum (Light and color mixing)

#4-5 Come Undone (decay and conservation) & What Moves you (Kinetic art)

Lanai – ? Create a plant or animal on the magnetic board

1 hour tour for SAMA + one hour art project

20 minutes in 3 galleries (1; 2&3; 5)

2 hour tour just Science through Art

30 minutes each gallery (1; 2; 3; 4,5)

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Vocabulary

Diffusion

Diffraction

Saturation

Clay

Glaze

Flux

Cones

Ash

Celadon

Crystalline

Camera Obscura

Lens

Photosensitive

Daguerreotype

Optical illusion

Wave length

Frequency

Full spectrum

Kinetic Art

Pulley

Wedge

Lever

Screw

Wheel

Axle

Inclined Plane

Load balancing

**Introduction** – the scientific process Include this with every tour!

What is science?

What is art?

How are they related?

How does a scientists work?

How does an artist work?

What is the scientific process? How do scientists work?

Start with careful observation

Ask Questions about what you see

Create a Hypothesis of what you think would answer your question

Test your Hypothesis

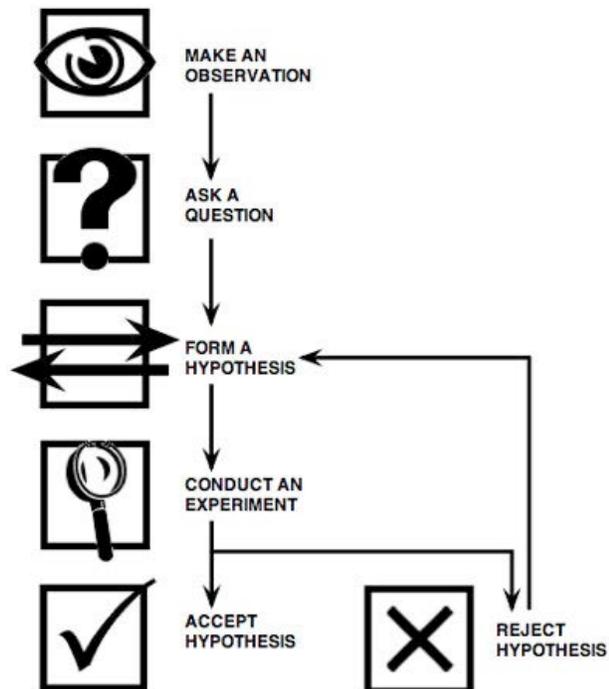
Analyze results and draw conclusions

Share results

How is this the same of different from the work process of the artist?

Tour HYPOTHESIS: ARTISTS AND SCIENTISTS WORK THE SAME WAY

On this tour, we will look at art, understand and explore the scientific process the artist used to create a work of art.



## Rotation 1 Potters Alchemy

### Benchmarks

2	SC.2.6.1	Identify ways to change the physical properties of objects
3	SC.3.6.1	Define energy and explain that the sun produces energy in the form of light and heat
4	SC.4.6.1	Describe how some materials may be combined to form new substances
6	SC.6.6.5	Explain how matter can change physical or chemical forms, but the total amount of matter remains constant
6	SC.6.6.6	Describe and compare the physical and chemical properties of different substances
6	SC.6.6.8	Recognize changes that indicate that a chemical reaction has taken place
2	SC.2.8.1	Identify different Earth materials and classify them by their physical properties
3	SC.3.8.1	Describe different Earth materials (e.g., rocks, minerals, sand, soil) and explain their formation and composition
8	SC.8.8.2	Illustrate the rock cycle and explain how igneous, metamorphic, and sedimentary rocks are formed

### Gallery Goal

Students will understand:

The questions artists ask to create the clay vessels.

The magic of clay and glazes!

The process of making objects with clay and glazes.

The changes in the elements following mixing and heating.

The appearances of glazes change as the formula and proportions change.

### Vocabulary

Heat is molecules moving, a form of energy.

Temperature is how fast all these molecules move.

Clay

Glaze

Flux

Cones

Ash

Celadon

Kiln

### Required artwork

Let the children select pieces (Ash and slat glazed pieces and the copper red and celadon pieces work well)

### Tour Bag for hands-on

Set of cones

Set of 5 objects that are: soft clay, dry, bisque fired,

unfired glazed, fired and glazed  
Minerals

Activity – *What are the questions artists had about making vessels?*

Start by OBSERVATIONS. Let the students walk around and look. Ask them what QUESTIONS the artists had about making these vessels. Listen to them all, don't answer. They need to come up with the possibilities!  
*What were the artists thinking? You may hear things like: What am I trying to make? What is the need? Where do I get the material? How do I know it is useable?*

Activity – if the students question - *What is the process of making clay vessels? What are all these objects? Material?* Discuss where clay comes from.

*What is clay? Why did artists first make things of clay? How did the process begin.* You may give them the scientific description of clay.

*How does an artists make a ceramic pot?*

Making vessels of clay starts with a question and one question leads to another.  
*How can I make this soft clay vessel hard? How can I make it water soluble? How can I make this prettier? How can I make it shiny? How can I make a blue glaze? Etc.*

*What is the scientific process used to transform the clay to stoneware?*

Students will determine the order of making a clay vessel, using objects from the process: soft unclean clay, refined and kneaded clay, leather hard, dry, bisque fired, unfired glazed, fired vessel

Activity – if the students question – *What is used to make glazes?*

*Why does a pot need glazes?*

*What is the process to make the vessel shiny or colorful?*

*What attributes does the glaze need? Water proof, colorful, smooth, not run too much, etc.*

Share formulas for glazes: silica, alumina, flux and colorant  
(Formula in exhibition or in tour bag)

Students will handle the minerals and guess at the color each may make.

Have them consider - what happens if you change the formula – Add more silica? More minerals? More flux? (Answers can be – runnier, thicker, shinier, different color, etc.)

### Booklet

Identify minerals to create a specific color.

Put the process in order.

Questions to answer: *What is clay? What makes up a glaze?*

[AS YOU LEAVE GALLERY 1, COMMENT OF THE VIEW! This is so they will recognize the image inside the camera obscura.](#)

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## Rotation 2 *It'll Last Longer* PHOTOGRAPHY

### Gallery Goal

Students will understand:

- The art of photography is creating art with light.
- There are a variety of cameras used (digital, pones, Polaroid, SLR, etc)
- Artists use light as a media and experiment how it functions to create art.

### Vocabulary

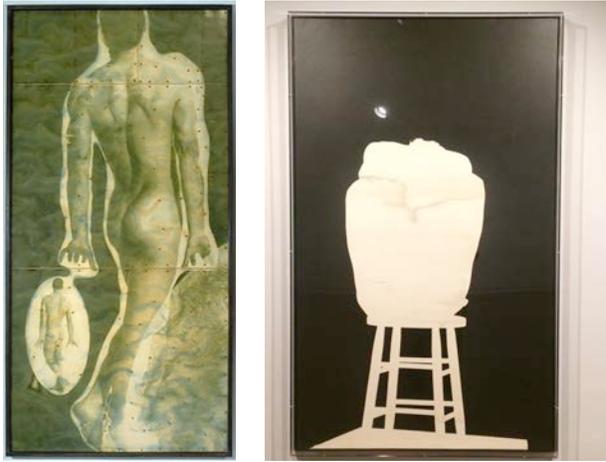
Negatives  
camera obscura  
lense  
light  
refraction  
reflection

### Benchmarks

1-PS4-3.	Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).]	
4-PS3-2.	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.	
3	SC.3.6.3	Explain how light traveling in a straight line changes when it reaches an object
3	SC.3.6.1	Define energy and explain that the sun produces energy in the form of light and heat
5	SC.5.6.1	Identify different forms of energy (e.g., thermal, electrical, nuclear, light, sound) and how they can change and transfer energy from one form to another
5	SC.5.6.3	Compare what happens to light when it is reflected, refracted, and absorbed
7	SC.7.3.1	Explain how energy moves through food webs, including the roles of photosynthesis and cellular respiration.
BS	SC.BS.3.1	Explain the chemical reactions that occur in photosynthesis and cellular respiration that result in cycling of energy.

### Tour Bag for hands-on

Flashlight  
Negative  
Dark room photos  
Ansel Adams on his station wagon full of negatives  
Flashlight, objects to shine through – glass of water, rock, optical lenses, wax paper, plastic, prism, negative, feather, mirror to play with light, lenses, laser pointer  
Image of artist drawing with a camera obscura.  
Image of old traveling camera obscura



Discussion: *What is light?*

Come up with as many different light sources as possible (sun, light bulb, candle, lightning bug, glow stick)

Discuss light as a source of energy and how artists use this energy to create.

*How does an artist use light to create art?*

Activity – Understanding the camera obscura

Enter Camera Obscura with flashlight on in full light. Warn them that it will be dark and stand still and wait for your eyes to adjust. *How did this device come about? How would an artist use this device?* Let them know how artists once used this system to draw exact images of buildings, people, etc.

Let them figure out what this is! Let them find the light hole and then figure out the image.

Discussion

Briefly discuss the difference between a chemical and digital photograph (cell phone vs film cameras) so that they can explore the photographic display in the next section.

Younger kids – a work in progress

Young students create a work of art with light in this dark space using flashlights. Silhouette art? Portraits? Shine light through different things – prism, optic lenses. *What happens to the light as it travels through each object used?*

Objects to experiment with: wax paper, brown paper, plastic milk container, construction paper, cardboard, aluminum foil, plastic wrap, foam meat tray, paper towel, or paper plate to be used to investigate transparent, opaque, and translucent materials, magnifying glass, mirror, bottle of water, negative

Activity – Discover how artists use light for art

Photographs made using light and: algae, paper, water, tin, etc. *Why are they using this process?*

Older kids.

*How do artists use light in new ways?*

Start with the *Man on a stool*. Ask them what is happening? LET THEM determine what the work of art is (a man on a stool) and HOW it was done. If they have already done the

make art, they should be able to figure this out easily. If not, have them notice the shadows on the wall.

Next, explain that they will go and look at a work of art with a partner. Move them around so everyone has something and all works are covered. They are to look carefully and discuss and determine how this work was done with light.

*How is it a unique photograph? What questions did the artists have about how light works? What was the artist experimenting with?*

Have the student report to the group. They can read the label, but they will have to figure out how it was done.

Example: Algae photo! The artist used light, a negative and allowed algae grow where there was light, exposing the photosensitive paper to create art!

Here the artist used photosynthesis to create this work of art.

Man on a stool: Artist used light to cast a shadow of himself onto photographic paper.

**Booklet** – Directions on how to make a pinhole camera  
Picture of camera obscura

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## Rotation 3 Gallery *Color Light and Perception*

### Gallery Goal

**Students will understand:**

That white light is made up of a full spectrum of colors.

Artists experiment with the properties of colors

- 1) complementary colors are placed together create a vibration
- 2) colors shift in our eyes depending on their background
- 3) similar colors next to each other will appear to have soft edges that blurr
- 4) our eye sees afterimages.
- 5) Warm colors come forward, cool colors recede.

The differences between colored light and colored pigments.

### Vocabulary

Light – electromagnetic waves are of different lengths with each color a different length. Mix all colors together = white light. Travels at 186,000 miles per second. Light made up of photons or packets of energy. Light can be reflected, absorbed or transmitted.

Color – we see colors in our eyes since they have light receptors called receptors and cones. Colors are sensations and we all see colors differently.

Pigment colors - waves absorbed. Red and green paint = brown

Light colors – Colors mix as an additive process, with no absorption. (red and green light makes yellow) The more colors you mix, =s white.

Additive colors – RGB – black in the base and light is added to get white. Seen in tv, computers,

Subtractive colors – CMYK secondary colors – reflected light.

Color subtraction – the object absorbs or subtracts certain colors of light and reflects the rest

Refraction – Sunlight bends through water, glass, and fans out at different angles so you see it separated into the full spectrums.

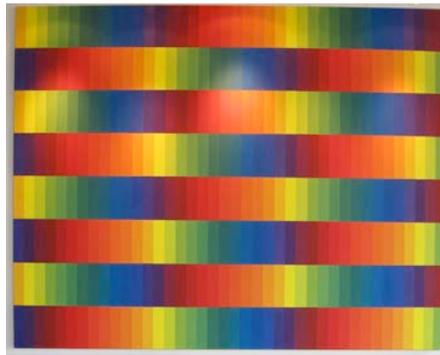
Reflection – Light changes direction when it hits an object, the incoming angle equals the outgoing angle. Reflected light gives objects the color

Wavelength – long wavelength has low energy, short wavelength has high energy.

### Benchmarks

8	SC.8.6.1	Explain the relationship between the color of light and wavelength within the electromagnetic spectrum
8	SC.8.6.3	Identify the characteristics and properties of mechanical and electromagnetic waves

### Required artwork



Tour Bag for hands-on  
Full color spectrum chart  
Color wheel image

Prism

Colors change with background color examples

2+ Color wheels to spin to create colors and to watch colors disappear

White paper with image (to see after image)

Jar of water with pencil inside to show how light can bend.

Start by watching the artwork as the colors change.

*What is happening here?*

*What are these artists doing? What are they using? Light and color.*

*How do artist play with light to create art?*

Discuss light and color

*What is Light?*

Light is energy from the sun or a light bulb. Wavelengths.

Use prism and light to create rainbow.

In 1704, Issac Newton was the first to discover that white light was actually made of many colors.

Show them how light splits into a rainbow through a prism or photograph.

In the last gallery, they learned that light travels I a straight line. Here they see what happens when it bends.

Next, move to the back area where the bag is located where you can explain what is happening in their eyes and show them different activities.

NOTE: the activities WILL NOT WORK in the colored lights. You must have white light to make them work.

Activities - Color wheels to spin Understanding mixing light

Let them LOOK at the color wheels and describe what they have. Ask them what will happen when the wheel spins. Let them come up with an hypothesis. (Answer is that the colors are mixed back into white light)

Cardboard color wheel - spin like a top – colors disappear.

Benham Disk Black and white wheel - spin to see colors appear.

Activities – Light box – understanding mixing color pigments

Mix the colored cells on the light box to see mixing.

Let them guess what happens when you mix the colors. Then test their hypothesis.

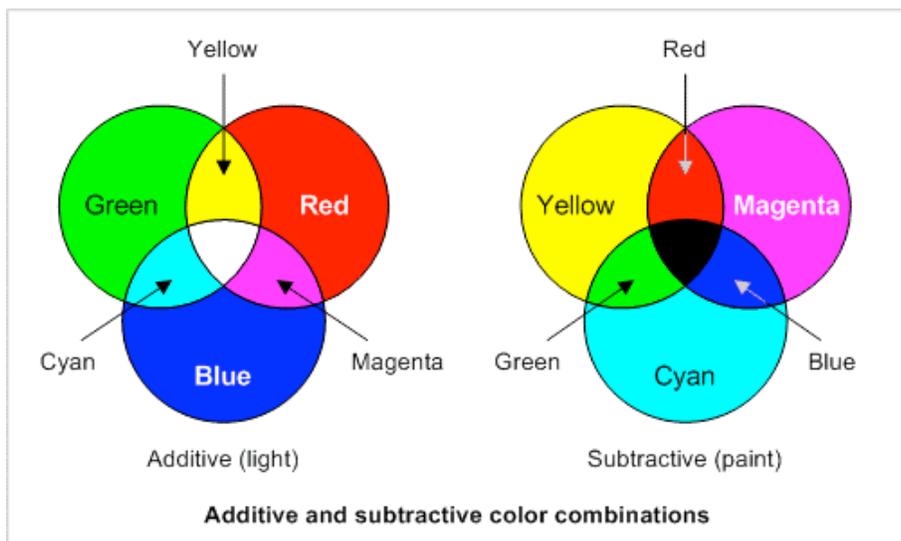
Mixing Pigments – red and yellow make orange

Blue and yellow make green

Red and blue make purple

Mix red, blue and yellow together = BROWN

Mixing lights – yellow and red and blue make WHITE!



Activities – Color is relative

(USE White card with ORANGE SQUARES ON DIFFERENT BACKGROUNDS)

Colors appear to be different based on their context/background.

Orange is more yellow on red, more red on yellow.

Ask them if the colors are the same – pull out the one color.

Colors shift relative to their backgrounds: a green looks more yellow on blue, more blue on yellow.

Activities – Afterimages (USE Anuszhiewicz image on white card)

Stare at art, then look at white paper. *What do you see?*

*Why does this happen?*



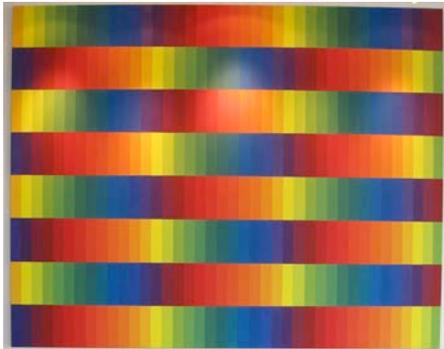
Activities – Colors vibrate

Saturated complementary colors next to each other will have hard edges that vibrate.



Activities – Colors are fuzzy

Colors similar in hue but different saturations appear to be fuzzy.



Activities – Colors recede and advance

Similar colors next to each other will have soft edges that blur.



Booklet - Draw an optical illusion

Look at art work and then look at a white space.

What concepts from science did the artist use to create this work of art?

#### Rotation 4 Gallery Come undone

##### Benchmarks

2	SC.2.4.1	Explain how plants and animals go through life cycles
6	SC.6.6.8	Recognize changes that indicate that a chemical reaction has taken place
Physical Science	SC.PS.6.3	Describe different examples of the concept of entropy
Physical Science	SC.PS.6.11	Describe a variety of chemical reactions
Physical Science	SC.PS.6.9	Describe the factors that affect the rate of chemical reactions

##### Gallery Goal

Students will understand:

How matter changes over time, and that this impacts the creation or preservation of art. Some artists work with these changes. Museum try to stop the changes.

##### Required artwork

Anything but the dying Empress



## Discussion

Discuss the changes of matter and the life cycle.

All matter changes – becomes new molecules – it is a transfer of energy!

We all get recycled ☺

*How do you see changes in yourself? Hair cut, hair growth, etc*

All elements have an impact on art, some artists allow it, others try to prevent it

Earth, fire, water, gas

What has changed in this art? What makes it change?

Art is an experiment of matters planned or unplanned.

Activities – Discover what is happening with each work of art

Let them explore the gallery. Have them approach each work on view as a detective –

*how has it changed since it was made? Are these changes accidental or intentional?*

Discussion – Discover the artist's role in these changes

*How do artists embrace or fight the changes in life?*

*How do artists use the scientific processes (observation, inquiry, etc.) to create art?*

*What scientific knowledge does the artists need to know? Is this knowledge used in preservation or creation of art or both?*

*If you were an artist, you wanted to sell your work (name a material here) and have it last a long time, what do you need to know about the material?*

Discussion – Discover the museum's role in these changes

*What is the role of the museum in changing matter? Should the museum preserve a work of art as it was created or allow it to deteriorate?*

## Booklet

*Identify the changes discovered in these works of art.*

*Check if it was intentional or unintentional.*

*What do you call people whose job it is to preserve art in a museum?*

*What concepts from science did the artist use to create this work of art?*

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## Rotation 5 Gallery # What Moves you

### Gallery Goal

**By exploring kinetic art, students will understand:**

**The science of dynamics and simple machines.**

How energy is transferred between objects and creates motion.  
 Students will create a kinetic work of art. (dominoes and a mobile)

## Vocabulary

*Energy* is a property of an object or a system. It can cause vibration and movement. It can be kinetic, chemical, radiation, etc.

*Force* A force is something that can reform an object or change how it is moving (or not moving).

*Dynamics* is the science of the way objects move when acted upon by forces.

*Inertia* – it will not move unless something is pushing or pulling it

*Momentum* – a moving object goes on moving forever at the same rate unless something forces it to slow down, speed, up or pushes or pulls it off course. No change in motion unless there is a new force applied. How much force is needed depends on the objects mass.

*Density* is not the weight, but the mass of a substance.

## Benchmarks

K	SC.K.7.1	Identify that objects that will fall to the ground unless something is holding them up
1	SC.1.7.1	Describe how the motion of an object can be changed by force (push or pull)
3	SC.3.7.1	Compare how simple machines do work to make life easier
4	SC.4.7.1	Describe that the mass of the Earth exerts a gravitational force on all objects
6	SC.6.6.10	Explain how vibrations in materials set up wavelike disturbances that spread away from the source
6	SC.6.7.1	Describe examples of how forces affect an object's motion
8	SC.8.7.1	Explain that every object has mass and therefore exerts a gravitational force on other objects
Physical Science	SC.PS.7.1	Apply the laws of motion to determine the effects of forces on the linear motion of objects
Physical Science	SC.PS.7.2	Use vectors to explain force and motion
Physical Science	SC.PS.7.3	Explain the relationship among the gravitational force, the mass of the objects, and the distance between objects
4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.		
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.		
K-PS2-1. Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.		
K-PS2-2. a to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.		
SC.6.6.3 Explain how energy can change forms and is conserved		
SC.6.6.4 Describe and give examples of different types of energy waves		
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.		

## Required artwork

Calders *Red Boomerang*

Arthur Ganson's *Another Dream*

UH Students Rube Goldberg Marble machine



Tour Bag for hands-on

6 Simple Machines picture

Dominoes to make a kinetic sculpture

Mobile makings – dowel rods, string, hooks, objects

*What concepts from science did the artists' use to create this work of art?*

## Activities

1 Identify the machines used in art

*What machines do you see in these works of art?*

Bring out the photographs of machines after they have listed types of machines, or before if they need help remembering machines.

*How would changing the parts of the machine change the way the work of art moves? If the wheel were bigger? Smaller?*

2 Discussion – transfer of energy from marble to video

*How can we use a marble to turn on the video?*

Ask the kids to:

1) PRE-determine the path of the marble, the movements of the gears, the motion taken by the art piece.

2) Then let them drop the marble.

3 Make a mobile a la Calder in the gallery

Explore the mobile. Discuss how to make it. *Where do you start when making a mobile?*

*How does it work? What questions did the artist have? Do you start with the top or bottom? Will any weight work?*

4 Make a kinetic work of art

Let the students create a maze of dominos. This will be a complicated collaborative effort. It fulfills benchmarks. Ask how long it will take to fall. Tip them over and see if it works.

## RUBE GOLDBERG MACHINE

The last 5 minutes of the tour, gather all groups on the bridge or at the Rube Goldberg machine. Let them discuss what they think will happen. Then drop the ball.

### Booklet

Design a [Rube Goldberg](#) like machine Incorporate functional elements into the design. Every Rube Goldberg machine uses levers, pulleys, rolling balls, ramps, tubes, and the domino effect to keep things moving.

Think of an everyday object around the house (clock; doorbell; light switch) and design on paper a new and artistic way to carry out that object's function. Be sure to give it some style!

*What concepts from science did the artist use to create this work of art?*

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### Art Project

Solar print of a newly created animal and/ or magnetic animal on the wall.

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### Conclusion

*How are science and art related?*

*Was there evidence in this gallery/exhibition that artists' used the scientific process to create art?*

*Did the artist have to have understanding of science to create his art?*

*Do you agree that artists and scientists think in similar ways?*

*Can they learn from each other?*