HIGH MUSEUM OF ART ATLANTA

STEAM Tour: Science, Technology, Engineering, Art, and Math

Docent-Led Tour for Middle School Students: 6th – 8th Grades

STEAM Tour Purpose

Students will use the High's collections as evidence of creative problem solving, learning directly from the objects about how artists create innovative solutions to complex problems.

Essential Questions

These should be used as guiding questions as you lead students through the galleries. The last question should be asked directly to the students.

- *What can we learn from the artistic process to help students become creative problem solvers in the 21st century?*
- *How is an artist similar to a designer, explorer, or scientist?*
- *How do artists use science, technology, engineering, and math?*

Tour Description

The development for this tour is in collaboration with Georgia Tech's Center for Education Integrating Science, Mathematics and Computing (CEISMC). According to John Madea (current President of RISD and a leader in transforming STEM to STEAM), "America is at a critical juncture in defining its economic future. [He] believes that art and design are poised to transform our economy in the 21st century in the same way that science and technology did in the last century, and the STEAM movement is an opportunity for America to sustain its role as innovator of the world." Schools across the United States, specifically in Georgia and the Metro Atlanta area are getting on the STEAM train - identifying its importance in meeting the needs of 21st century learners and thinkers.

In 1836, landscape painter John Constable wrote, "Painting is a science, and should be pursued as an inquiry into the laws of nature. Why, then, may not landscape by considered as a branch of natural philosophy, of which pictures are but experiments?" It's interesting to hear a landscape painter (in our collection!) talk about paintings being similar to experiments. This is the idea that we want students to walk away with. Artists are similar to scientists – they conduct experiments, they analyze their work, they fail, they try again, and they discover new truths.

The STEAM tour will address these needs while highlighting the High's collections as a vital part of the "Art" embedded in STEAM.

Tour Objectives

- To introduce strategies that artists employ in the creative process
- To illustrate that artists are resourceful and creative problem solvers
- To make connections between artists, designers, explorers, and scientists

Tour Organization

Students will be presented with a question: *How is an artist similar to a designer, explorer, or scientist?* They are then presented with different ways artists are challenged and the creative solutions they came up with to address that challenge – was it a lack of resources? Was it creating perspective or certain color pigmentation?

Students will begin to answer the question of how artists are resourceful and creative problem-solvers. The tour is organized by 4 different artistic challenges:

- Materials and Resources
- Light and/or Color
- Design and Structure
- Perspective

Tour Length and Structure

- The STEAM tour experience is 1 hour in length. This includes traveling time to the start of your tour, walking in between stops, and traveling back to the Atrium at the end of your tour.
- Your tour should contain 6 – 8 works of art that focus on two floors in the museum. Within this packet, we list all available works of art based on the different artistic challenges. They are suggestions – it is **not** required to go to all the works of art listed.
- On the day you are giving your tour, consult with the other docents to be sure you do not start in the same spot.

Friendly Reminders!

- Give a warm welcome and remind students of museum etiquette.
- Wait until you are at your first work of art before beginning your introduction!
- Remind students that the chaperone is there to ensure that they have a safe and enjoyable experience in the galleries and they should stay with their group during the entire tour.
- Make relevant transitions in between stops.

TOUR INTRODUCTION

After meeting your group in the Atrium, move to your first stop. Because the Atrium can be loud, begin your introduction of the tour at your first stop. As students explore the works of art, docents should make clear the third Essential Question: *How do artists use science, technology, engineering, and math?*

The suggested text below can be used as a guideline to begin your tour.

Hello! We're so glad that you are here at the museum today. You're going to see some incredible works of art, as well as hear about a few very innovative and resourceful artists. Let's start with what I am holding. Can anyone tell me what this is? [A paint tube] *Yes. Does anyone know the history of the paint tube? Would you believe me if I said that paint used to be carried around in pig bladders? In 1841, over 170 years ago, the best paint storage was a pig's bladder sealed with string. An artist would prick the bladder with a tack to get at the paint.* [Show students the image of the pig's bladder] *But there was no way to completely plug the hole afterward. And bladders didn't travel well, frequently bursting open. Along came an American portrait painter by the name of John Rand who thought of the idea to carry around paint in metal tins with lids. Not only was it easier to travel with, but the paint could be sealed back up and wouldn't dry out. Even when artists used pig bladders to carry around their paints, painting outside was very difficult. Artists rarely did it and when they did, it was a big ordeal. When Mr. Rand invented a new way of making paint mobile, he opened the door for painters to paint outdoors.*

This is an example of how an artist saw a challenge – painting outside without making a mess or having dried-out paint – and created a solution. Today we're going to look at different ways artists create solutions to problems, and we're going to see how artists can be inventors, designers, scientists, and explorers of the world around them.

Artistic Challenge: Materials and Resources

Possible Works of Art:

Madonna and Child with St. James Major and St. Jerome
Il Romanino (Girolamo di Romano)
Oil on panel, ca. 1512
Stent, 2nd Level

Adoration of the Magi
Benvenuto Tisi
Oil on panel, ca. 1534
Stent, 2nd Level

Madonna and Child
Giovanni Bellini
Oil on panel, ca. 1510
Stent, 2nd Level

Temperance and *Prudence*
Vittore Carpaccio
Oil on wood panel, ca. 1525
Stent, 2nd Level

Madonna Adoring the Christ Child
Giovanni Francesco da Rimini
Tempera on panel, ca. 1460
Stent, 2nd Level

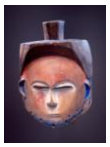
Madonna and Child with Two Angels, St. Francis and St. Louis of Toulouse
Paolo di Giovanni Fei
Tempera and silver gilding on panel, ca. 1375
Stent, 2nd Level

The Nativity
Francesco Di Giorgio
Tempera on panel, ca. 1460 – 1465
Stent, 2nd Level

The Treasure of the Temple at Jerusalem Brought by Nebuchadnezzar to the House of God
Master of Marradi
Tempera on panel, ca. 1490
Stent, 2nd Level

Madonna and Child with Six Saints
Tommaso del Mazza
Tempera on panel, ca. 1390
Stent, 2nd Level

Pair of Twin Figures (ère ìbejì)
Yoruba Artist, Nigeria
Wood, pigment, beads, and cowrie shells, 19th century
Wieland, Lower Level



Helmet Mask
Kwese Artist, Democratic Republic of the Congo
Wood, pigment, 20th century
Wieland, Lower Level, Gallery 405

Hands-on Objects or Materials: laminated photographs of lapis lazuli rock and crushed pigment, map of route from Afghanistan to Italy, photos of materials used to create pigments, images of paint tube, history of paint tube image

Suggested Discussion Questions for Oil on Panel paintings on Stent 2nd Level:

- *What do you see? What colors do you notice?* Give students a few moments to look on their own about what is happening in the painting. After getting a sense of what is going on, guide them to focus on the colors in the painting. The Artful Thinking Routine "Colors, Shapes, Lines" is a good way to start.
- *This painting was created around 1512, almost 500 years ago. Back then, oil paints were not as readily available as they are today. Artists had to create their own paints out of pigments. Pigments have been used for more than 30,000 years to make paint. Pigments can come from both natural (tree bark, stones, plant gum, and sometimes toxic chemicals like arsenic and mercury) and synthetic sources. Oil paint is made by mixing a pigment of a certain color with oil, typically linseed oil.*
- *If we were reading this painting as if we were reading a book, who would be the main character? What makes you say that?* Guide students to the two central characters. *This image is inspired by the religious text* The Bible. *The person in the middle is Mary, the mother of Christ - the baby sitting in her lap. In the 16th century, artists were frequently commissioned to create religious paintings. What colors do you notice that Mary is wearing? The people who commissioned the work required that the color blue be used in the painting, specifically a blue called ultramarine. Ultramarine was symbolic as a "heavenly" and important color. However, it was the most difficult color to obtain in the 1500s. Why do you think that is?* Allow one or two answers from students. *The color blue was difficult to obtain because there are very few naturally occurring materials that are blue. The majority of the blues we see now are synthetic or not natural. The blue in your shirt and jeans are now made out of artificial dyes. These dyes were not available in the 1500s in Italy. The only way artists could create these blues was from a stone called lapis lazuli. It was found in an area that is now Afghanistan.* Show students photos of the lapis lazuli, the crushed lapis lazuli (talk about how artists had to crush up the stones to create pigments), and the map of Afghanistan to Italy. Emphasize the distance between these two countries – almost 4000 miles, which is longer than the distance across the entire United States.
- *What other materials do you think artists used to create pigments?* Allow students time to brainstorm natural occurring materials. Bring out the bag of charcoal. Connect the charcoal to the coal used in BBQ grills. Also, ask students if they have ever had a Strawberry Frappuccino at Starbucks. Before April 2012, Starbucks used cochineal bugs to make the pink color in the Strawberry Frappuccino.

When customers found out, they were upset and Starbucks stopped using the bug. (However, this is a common and FDA-approved practice in many foods we eat.)

- *Artists were creative problem solvers when it came to making pigments and resources for painting.* Show students the photos of materials artists have used to create different pigments.
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Suggested Discussion Questions for Tempera paintings on Stent 2nd Level:

- For paintings that contain "tempera," talk about the egg tempera process.
- *Artists experimented with materials found around them to create art. We've seen some interesting ways that pigments were created. The pigment itself does not create the paint. You need to find a liquid that will bind the pigment together to create paint. On the wall label, you will see the words "tempera." Early paintings (1500s and earlier) usually used dry powdered pigments mixed with a bit of distilled water and something that binds the water to the pigment, such as honey, egg yolk, milk, plant gum, and more. What do these materials have in common? Why do you think they would have used egg? Egg is added in small amounts to get the desired transparency. The more egg, the more transparent. Why do you think that is?*
- *Artists experimented with many different materials before finding the right mixture. They most likely failed many times before obtaining the right balance of water, pigment, and egg. How is this similar to the work of a scientist or an explorer? How did artists use science and math in this process?* Egg tempera is a painting medium (or a material used by an artist to create a work of art) that consists of pigment and egg yolk. Point out that this technique was used for thousands of years before oil painting came around in the 15th century. Egg tempera is not as common today, but it is still used.
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Suggested Discussion Questions for African Works on Lower Level of Wieland:

Extended Wall Label for *Pair of Twin Figures (ère ìbejì):*

"Twins are more common in Yoruba communities than anywhere else in the world. Ère ìbejì figures such as these represent deceased twin children. When a twin dies, a figure is carved to localize the spirit of the deceased. If neglected, its spirit might feel abandoned and invite the soul of the surviving twin to join it in the beyond. The smooth, worn surfaces of these figures show that they have been cared for devotedly. Their elaborate ceremonial coiffures are rubbed with a powdered dye called Rickett's bluing, which was used by the British to whiten laundry during the colonial era. Yoruba artists used the powder as a substitute for indigo."

- *What do you see? What colors do you notice?* Give students a few moments to look on their own about what is happening in these sculptures. After getting a sense of what is going on, guide them to focus on the colors in the painting. The Artful Thinking Routine "Colors, Shapes, Lines" is a good way to start. Also, describe briefly that Yoruba is part of Nigeria in Africa.
- *These are a sculpture of twins. They were created in the 1800s. In Yoruba communities, twins are very common. When one twin dies, a figure is carved to symbolize the deceased. Do you notice the blue on their heads?*
- *What do you think the blue symbolizes? Why would this be important to include?* Allow a few answers. *Let me give you a hint – think of the term "hot-headed." What does that mean? What colors are associated with being "hot-headed"? The opposite of that is "cool-headed." The Yoruba people believed that the blue was associated with being cool-headed and making rational decisions. It is a positive symbol.*
- *The color blue was difficult to obtain because there are very few naturally occurring materials that are blue. The only way artists could create these blues naturally was from a stone called lapis lazuli. It was found in an area that is now Afghanistan. Indigo was VERY difficult to obtain in Nigeria in the 1800s. It is still difficult to obtain and can be very expensive. The pigment used here is called "Rickett's blue" and would have been obtained*

from British colonies. As a substitute for indigo, they discovered that the British used Rickett's bluing as a way to whiten laundry. It is a synthetic material. They could take the blue pigment from this process and use it in art, as seen here.

- *What other materials do you think artists used to create pigments?* Allow students time to brainstorm natural occurring materials. Bring out the bag of charcoal. Connect the charcoal to the coal used in BBQ grills. *Artists were creative problem solvers when it came to making pigments and resources for painting.*
- *Artists had to create their own paints out of pigments. Pigments have been used for more than 30,000 years to create art. Pigments can come from both natural (tree bark, stones, plant gum, and sometimes toxic chemicals like arsenic and mercury) and synthetic sources.*
- Show students the photos of materials artists have used to create different pigments.
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Artistic Challenge: Light and/or Color

11-Scheiben (886-3) (11-Panes)
Gerhard Richter
Hard-coated tempered glass (Antelio silver) standing on wooden beams, 2003
Wieland, Skyway Level, Gallery 414

879-1 Sieben Stehende Scheiben (7-Panes)
Gerhard Richter
Glass and steel, 2002
Wieland, Skyway Level, Gallery 414

Focus: Reflection/Refraction

Hands-On Objects or Materials: A mirror

Suggested Discussion Questions for the Richter works:

- *Gather around this sculpture, standing directly in front. What do you see?* Allow students time to answer. Guide them to saying that they can see themselves. *The design challenge for this artist was being able to create a mirrored surface without actually using a mirror.*
- *How are these 11 panels of glass different than a mirrored surface*? Show the students the mirror for illustration. *A mirror like the one I'm holding reflects all of the light that hits the surface. The light that is reflected shows us an image of ourselves very clearly. Because these 11 panels do not have a mirrored surface and they are transparent, they reflect some of the light against the panels behind it – that is the reason we can see an image of ourselves, but not a clear image like we do in the mirror. These 11 panels reflect some light, but not all of it. The rest of the light is transmitted through the glass – or it passes through to the next panel of glass behind it.*
- *In this sculpture, there is space in between each panel of glass. That means that light is bouncing in between the panels of glass and showing us a reflection of ourselves. Here's another tough question – what if we stacked all of the panels of glass together and allowed no space in between? Would we be able to see ourselves as well then?* Allow time for students to respond. Point out to students that you would not be able to see yourself as clear because all of the light would just be reflected off of the first glass. The glass underneath it would have no effect. *This artist took on the tough challenge of creating a mirrored surface without actually using a mirror.*
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Suggested works of art when discussing reflection/refraction:
NOTE: Any of the cut glass works by the windows in the Stent wing will work when discussing light, glass, and reflection.

Banquet Lamp
T.G. Hawkes and Company
Lead glass with cut decoration and electroplated silver, ca. 1900
Stent, 3rd Level

Untitled
Anish Kapoor
Stainless steel, 2010
Stent, Skyway

- Kapoor deals with how shaped surfaces literally change the shape of reflections ("refraction") as well as reflection. How does your reflection look different in the Kapoor (vs. the Richter) and why? And what about the mysterious auditory effects that occur if speaking in front of the Kapoor? What kind of scientific knowledge did Kapoor employ to create this effect?

Relevant Definitions for Reference for the Artistic Challenge: Light and/or Color Stops

- *Reflection*: one of the actions light can take upon contact with a material, the others being absorption and transmission. Some materials, like metals, do not allow electric fields and reflect all light, not being able to do anything else with it. Mirrors can be created by putting a thin metallic layer over smooth glass.
- *Refraction*: the bending of a light ray when it passes at an angle from one medium into another in which its speed is different

Artistic Challenge: Light and/or Color

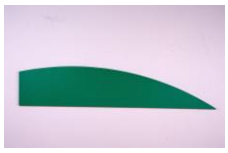
Possible Works of Art:

Port of London, Night
Maximilien Luce
Oil on canvas, 1894
Stent, 2nd Level

Houses of Parliament in the Fog
Claude Monet
Oil on canvas, 1903
Stent, 2nd Level

Blue, Green, Red (EK 950)
Ellsworth Kelly
Painted aluminum, 2005
Wieland, Lobby Level

Red Curve VI
Ellsworth Kelly
Oil on canvas, 1982



Green Curve
Ellsworth Kelly
Oil on canvas, 1999
Wieland, Skyway Level

Hands-On Objects or Materials: Image of optical mixing, if doing pointillism stop

Suggested Discussion Questions:

- *What do you see, what is going on in this painting?* Allow ample time for students to make inferences and read the work of art.
- *How did the artist paint this work?* Guide students to see that the work is not created by large patches of color, but rather by small marks of color. Allow students to "peer" at the work (but not get too close!) and see how the art work is created. Have one student stand 10 feet away and describe the color in the bottom right hand corner. Then, have another student describe the painting in the bottom right hand corner while standing 3 feet away. *What colors can you see up close that you can't see far away?*
- [If looking at *Port of London, Night*] *The artist used a technique called "pointillism" – this is a technique artists use by painting tiny dots of pure color- not mixed - next to each other. The colors in any given area are not the same color. How do you think the artist created this effect?* Allow time for students to respond.
- Show students the color circles diagrams. Show Diagram 1 first. *What color is the ring in the middle?* Point to the ring in the middle. Students will most likely say pink and orange. Then show them Diagram 2. *In Diagram 2, we took away all of the colors except the colors in the middle. The middle rings are*

actually all orange. How is that possible? Did you realize that your eyes "mix" colors? We call this "optical mixing." From far away, we see the colors as one color, but up close, we can see that the colors are separate.

- Explain that color is a phenomenon of light. As light strikes objects, those objects reflect some of that light back to our eyes. Explain that when pointillist painters place two pure or unmixed colors next to each other, our eyes "mix" the color to create a new color.
- Talk a little bit about Impressionist and Post-Impressionist painters (they were interested in depicting light and everyday scenes of life – which was very innovative and radical for this time in art). *Impressionist and post-impressionist painters were very interested in light and color. They created different ways to paint to depict light, such as this painting by Luce (or Monet). They saw a "challenge" – how to creatively depict light in color and paint – and came up with some very innovative solutions.*
- *How did these artists use science to create their work of art? How were these artists like scientists?*
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Curator Notes on *Port of London, Night:*
Maximilien Luce was a follower of Georges Seurat, the artist who developed the style of painting known as Pointillism. In 1892 he traveled with Camille Pissarro to London, where he created several paintings of the River Thames. He favored the Port of London, the area of the industrial docks and warehouses that bordered the river from Greenwich almost to the Tower of London. Painting in 1894 from sketches made during his trip, Luce used the divisionist technique to recreate the night scene of the harbor. Unlike Whistler before him and Monet and Derain after him, Luce illustrated the more humble and less picturesque aspects of the river.

- In what ways does Ellsworth Kelly approach color differently than Monet? Both are similar in their quest for purity (Monet's interest in optical authenticity based on the light conditions *en plein air* and in that particular moment in time and Kelly's painstaking quest for discovering the perfect hue of red, green, blue, etc.)-- but how is looking at Kelly's Blue, Green, Red different from looking at a Monet? Monet's colors blend with distance (as our eye/brain mixes them) but Kelly's colors are clearly separate entities-- the shaped canvases even more so. What happens at that line where blue/green meet (soothing colors) vs. green/red (clashing, tension, visual abrasion)? Kelly faced challenges and thought like a scientist as well, but in different ways- how so?

Artistic Challenge: Light and/or Color

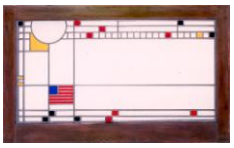
Focus: Properties of Glass; Reflection/Absorption of Light; Color

Possible Works of Art:

Untitled (Architecture)
John La Farge
Glass, lead, and glaze, ca. 1903 - 1904
Stent, 3rd Level, Gallery 305

"Ruba Rombic" Vase
Reuben Haley
Blown and molded glass, Introduced 1928, made ca. 1930
Stent, Skyway Level, Gallery 401

Lantern (on table)
Greene & Greene Architects, designers; Peter Hall Manufacturing Company, maker; Emile Lange, glassmaker
Leaded glass, mahogany, and ebony, ca. 1907



Window
Frank Lloyd Wright
Oak, colored glass, and leading, 1912
Stent, Skyway, Gallery 401

Favrile Vase
Louis Comfort Tiffany
Blown glass, ca. 1892-1900
Stent, 3rd Level, Gallery 309

Sicilian Vase
Mount Washington Glass Company
Lead glass containing volcanic lava with inlaid enamel glass decoration, 1878-1880
Stent, 3rd Level, Gallery 303

NOTES ON WORKS: The suggested discussion questions below are geared towards the John La Farge stained glass window. However, talking about stained glass, how it was made, and how light filters through glass can be applied to the other works listed above.

Suggested Discussion Questions:

- *What is going on in this work of art? What colors do you notice? What shapes, what lines? Who do you think the woman is? What do you see that makes you say that?* Allow time for students to explore the window.
- *Have you ever seen a stained glass window before? Where? Does anyone have an idea of how this window was created? Do you think it was painted? Does anyone know how stained glass is made? Does anyone know how glass is made?* Talk to students briefly about how glass and stained glass is created.

The main ingredient in glass is sand. Other compounds are added to make the sand easier to melt and to work with. The different ingredients added at this stage can make the glass more resilient against heat, more transparent, or tinted different colors.

The mixture must be heated to 3000 degrees Fahrenheit in order to melt into liquid glass! Then the glass is shaped. Since the first century B.C.E. the main way to do this was glass blowing.

Glass is colored by adding metallic salts during the manufacturing process. Another process is that the glass is painted on and then baked in a kiln to lock in the colors.

- *The designer of this stained glass window is John La Farge. La Farge created this piece over 100 years ago. He was very interested in glass and did numerous experiments with it. He was interested in how to create visual scenes without paint and through glass only. He patented opalescent glass (stained glass with a milky/cloudy effect – think of the word "opal"). He was known for the technique of "plating" – which is layering glass pieces on top of each other to create depth and shading, as seen in paintings. He saw a challenge – how can an artist create the effects of painting without using paint? – and spent his life working on solutions to this challenge.*
- Another approach to this work of art is through the lens of color theory. This window is backlit to emphasize how light filters through color to create a visual effect. Talk to students about how objects obtain color by doing certain things with light:
    - Reflect or scatter light (as in a mirror)
    - Transmit light
    - Absorb light

  An object that absorbs all light in the visible spectrum is black. Some objects scatter some frequencies and absorb others. A red object will scatter red and absorb everything else. Stained glass transmits some frequencies and absorbs others, giving it a tint of certain color.
- *How did this designer use science in his designs? How is John La Farge similar to an explorer or a scientist?*
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Relevant Definitions for Reference for the Artistic Challenge: Light and/or Color Stops

- *Reflection*: one of the actions light can take upon contact with a material, the others being absorption and transmission. Some materials, like metals, do not allow electric fields and reflect all light, not being able to do anything else with it. Mirrors can be created by putting a thin metallic layer over smooth glass.
- *Absorption*: Light is absorbed by a material, thus never letting it get back to viewer's eye. Materials that absorb all light appear to be black.
- *Transmission*: Light passes through a material completely. Materials that perfectly transmit are called "transparent" and materials that do not transmit at all are "opaque."
- *Light*: Electromagnetic radiation in the visible frequency range
- *Color*: Different frequencies of light

Artistic Challenge: Design and Structure

Possible Works of Art:

Crochet Chair (prototype)
Marcel Wanders
Crocheted fiber and epoxy resin, 2006
Stent, Skyway Level, Gallery 410

Blo-Void I
Ron Arad
Mirror-polished aluminum alloy and anodized woven-aluminum mesh, 2006
Stent, Skyway Level, Gallery 410

Bone Armchair
Joris Laarman
Cast marble resin and ground bone china, 2008

Easy Edges
Frank O. Gehry
Corrugated cardboard, fiberboard, ca.1970
Stent, Skyway Level, Gallery 404

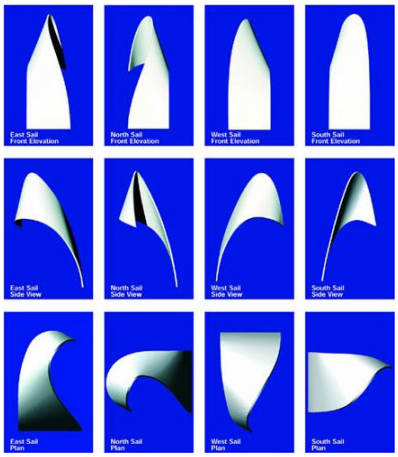
Suggested Discussion Questions for any of the furniture works:

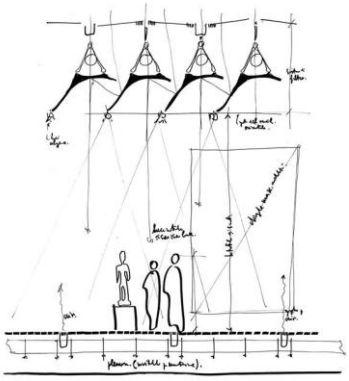
- *Let's look at this piece of furniture. First off – what is it?* Allow for answers. *Yes, a chair. They don't look like your typical chair, but how do you know they are?* Talk about how the basic design of a chair – a place to sit, a place to rest your back – is seen in these chairs, but they're unlike any chair we see everyday. *Why do you think the artist decided to design the chair in this way? What do you think he or she was influenced by?*
- *Now, without looking at the label, what is the material that is used? How do you think it was created?* Allow for answers. Describe the process of how many designers create designs on a computer and then have a machine manufacture the work.
- *Do you think these chairs can hold weight? Why or why not?* [All four chairs listed above can hold the weight of a person] *Artists sometimes use materials or designs that look unstable, but are in fact very sturdy. Why do you think they do this? What "challenge" do you see that the artist might have had? How did he or she solve this challenge?* [For the *Crochet Chair*, *Bone Armchair*, or *Easy Edges*, talk about how the artist might have been challenged by the idea of creating a sturdy piece of furniture out of a seemingly not-sturdy material (fiber, bone china, cardboard)].
- [If looking at *Bone Armchair] Technology and 3-D printers are being used more and more in art. What similarities do you see in this chair and in nature? The form of the pieces in* Bone Chair *was partially created using computer software – the same software that carmakers use to refine car parts to increase strength and efficient use of material. The software mimics the way that growing bones are able to generate additional material where it is needed, but also to remove material where it is not needed, by making the bone thinner or hollow. How did this designer use science, technology, and engineering in his design?*
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

You're the Designer! Design Challenge

For this stop, the purpose is to get students to work collaboratively (touching on the 21st century skill of collaboration), and also to focus on the architecture of the Renzo Piano building. The goal is to get students to think of the building as a work of art itself and to think about Renzo Piano as an architect, scientist, explorer, and artist.

Hands-On Objects or Materials: *You're the Designer!* worksheet, pencils, laminated images and sketches of the Renzo Piano skylights
Allotted time for collaborative activity: >15 minutes





Notes on this Stop:

- This stop can be done anywhere there is a quiet spot in the museum (similar to the *I See Literacy* drawing activity). However, to complete this stop, there must be a visit to the Wieland Skyway Level to view the Renzo Piano skylights.
- The design activity and follow-up discussion of the activity should last no more than 15 minutes. As noted above, the design activity can happen anywhere there is space for your group.
- Divide the students into small groups (for example, if you have a group of 10, break them into 2 groups of 3 students and 1 group of 4 students).
- Pass out one *You're the Designer!* worksheet and one pencil per small group of students. Allow students to spread out a little and work on the floor.
- Describe the activity to the students. One student will be the note taker and/or drawer of the group. Have the students self-select this person (ask for the chaperone's assistance if needed). Read the challenge and instructions at the top of the worksheet:

  THE CHALLENGE
  You are a team of designers. Your challenge is to design skylights for a museum that allows natural lighting. However, sunlight **cannot** hit the artwork directly because sunlight damages and fades artwork. How will your skylights be designed? How will you let ample natural light in, but not allow for any direct sunlight to hit the artwork?

Docent Tips:
Once students have created their design, find a quiet spot on the Wieland Skyway Level.

Although there is ample space on this level, it would still be a good idea to touch base with the other docents on this tour to make sure you coordinate your stops before the tour starts.

INSTRUCTIONS

Pick one person in your group to draw and write. Everyone must brainstorm and work towards a solution to the design challenge. You are all designers.

- Allow students to work for no more than 5 – 10 minutes. If students are stuck, throw out a few examples to get them started – is there a giant sunroof on the top of the building that opens and closes depending on the angle of the sun? [Note: this was an actual idea that was thrown out when the architects were brainstorming!]
- Allow groups time to share their brainstorming ideas.
- Take your group to the Wieland Skyway level to show them Renzo Piano's skylights.

Suggested Discussion Questions:

- *Designers and artists are frequently asked to create something within certain parameters or rules. Sometimes it's the materials they use or the size of the work. They have to be creative and innovative to meet the needs of the person buying the work or for the people who will be using the work.*
- Direct students' attention to the light in the Wieland Skyway galleries. *Where is the majority of the light coming from?* Using your discretion, ask the students to lie on the ground and to look up. Tell students about Renzo Piano and how the High and Woodruff Arts Center commissioned him to create an expansion of the collection and administrative buildings. *In 2005, three new buildings were built, all designed by Renzo Piano, an Italian architect, who is interested in lightweight materials and structures. The outside of this building has aluminum panels. Aluminum is a very lightweight but sturdy material in construction.*
- *A signature of the buildings is the skylights you see above us. There are 800 of them in this building and 200 in the Anne Cox Chambers wing that is attached to this building. We call these "light scoops" because of the shape. Piano calls them "vele" which translates to "sails" in English. They allow indirect north-facing sunlight to enter the building. Piano designed them so no sunlight directly hits the artwork. What do you notice about the light scoops? How would these galleries change if there were no skylights and we used only artificial lighting? How are your designs different than Piano's?*
- Have students sit or stand up and show them the photos and sketches of Piano's light scoops. Talk about the idea of "northern light" and how the light scoops are at a angle so they let in indirect sunlight.
- Piano called these "1,000 sunflowers." *Piano was faced with a technological challenge and came up with a very elegant solution. Many ideas were generated and discarded in the process of creating the skylights. How do you think Piano used technology and engineering in his designs? How is Piano a creative problem solver?*

Artistic Challenge: Design and Structure

Architecture of Richard Meier building
Built in 1983

NOTES:
This can be part of a "stop-by" when moving in between stops, if in the Stent Family Wing. It would make more sense to do this "stop-by" after the Design Challenge, so as not to confuse students.

Suggested Discussion Questions:

- *What do you notice about the building we are in?* Guide students to think about the lights and windows. *Richard Meier is the architect of this building. Light played a great part in his decisions on how to design the architecture of the museum. Look around – can you spot patterns for how the windows are arranged? Why do you think the architect chose to design the building in this way?* Direct students to the idea that, as an architect, Richard Meier had to go through the creative problem solving process of creating a large space that had ample natural light.
- [If near the Atrium and the ramp] *One of the main aspects of the architecture of this space is the ramp ascending back and forth in the four-story atrium. This ramp is along what's called a "quadrant" curve. It is called a quadrant curve because it subtends or forms a 90-degree angle. In other words, it covers the quarter of a circle. How do you think Richard Meier used math and engineering in the design of his building?*

Artistic Challenge: Perspective

NOTES ON PERSPECTIVE AND WHY IT MATTERS:
Perspective is a way of portraying three dimensions on a flat, two-dimensional surface by suggesting depth or distance. Why do artists care about perspective?

The principles of *camera obscura* (an optical device that filters light through an aperture and projects an image on a surface) were in use for thousands of years before humans were able to burn the image onto a surface. Photography became more widely used in the early to mid 1800s. Before photography was accessible (and even way before photography was a well-known medium), artists wanted to document the world around them in a realistic way. Adding perspective to a work of art (painting, drawing, sculpture) helped document the world they lived in and experienced. Perspective helps tell the story that the artist is trying to tell.

So, even after photography became widely accessible, why did modern artists and why do contemporary artists emphasize perspective in their artwork, such as Lichtenstein's *House III?*

There are many theories and thoughts on this question. In the mid-twentieth century, artists were (and still are) interested in optical illusions (sometimes called "Op art") to perhaps "show-off" tricks that the artists can do, but also to help the viewer see the world in a different way. Art can emphasize and bring attention to things that sometimes we take for granted in the world. *House III* is a fun "trick" for viewers, but it also shows us an elegant way to look at perspective.

Possible Works of Art:

A Bit of the Roman Aqueduct
George Inness
Oil on canvas, 1852
Stent, 2nd Level, Gallery 210

Temperance
Vittore Carpaccio
Oil on wood panel, ca. 1525
Stent, 2nd Level, Gallery 201

Luccombe Chine, Isle of Wight
Jasper Francis Cropsey
Oil on canvas, 1861
Stent, 2nd Level, Gallery 208

Abraham's Sacrifice of Isaac
Il Baciccio (Giovanni Battista Gaulli)
Oil on canvas, ca. 1700
Stent, 2nd Level, Gallery 201

Ruins at Narni, Italy
Jasper Francis Cropsey
Oil on canvas, 1875
Stent, 3rd Level, Gallery 310

Shipwrecked Off Labrador
William Bradford
Oil on canvas, 1867
Stent, 3rd Level, Gallery 301

House III
Roy Lichtenstein
Painted and fabricated aluminum, 1997
(fabricated 2002)
Located outdoors!

Supreme Hardware
Richard Estes
Oil and acrylic on canvas, 1974
Stent, Skyway Level

Yard Sale
Mattie Lou O'Kelley
Oil on canvas, 1979
Stent, Skyway Level

Suggested Discussion Questions (for any of the works listed above):

- *What is going on? What do you see?* Allow ample time for students to explore the work of art and to begin to interpret what is happening.
- Point students into the direction that the work of art is in a landscape and cityscape (even *House III* is in a landscape – the house is placed directly in the landscape of the lawns of the High Museum!). *How does the artist show us that this setting is in a landscape or cityscape? What do we see that tells us that?*
- *The artist was faced with a challenge: "How do I create a landscape or cityscape that shows depth? How can I allow my viewers to know there is depth?"* Introduce the concept of perspective. *Has anyone heard of perspective before? Yes? Can anyone define it for me?* Pull from students' definitions to create a definition for this group. *Perspective is a very cool way that artists can show us three-dimensions on a flat or two-dimensional surface.*
- [If looking at a pre-1900 landscape] *Today, we can pull out our phones and take a photo. This was not always the case. Did you know the wide use of photography only began about 150 years ago? AND, it wasn't in households and REALLY widely used until about 50 or 60 years ago? Artists wanted to document the world around them. Perspective is one way for them to document the world around them in a realistic way. This artist in particular used* ***atmospheric perspective****. Atmospheric perspective is the effect the atmosphere has on objects seen from a distance. Notice how these mountains are blue? Typically, objects that are seen from far away appear blue, whereas objects closer to us are sharper and clearer. When the distance between the viewer and the objects increase, the contrast decreases. This means that the colors of the objects (in this case, the mountains) become less saturated and appear to be blue.* [If you want to go deeper, look in the "Relevant definitions" section for more information on atmospheric perspective and the use of light and color to explain why objects in the distance appear blue]
- [If looking at a modern or contemporary painting, drawing, or sculpture] *Although cameras are readily available (and have been for some time), some artists still like to experiment with perspective to create a certain story in their artwork. Why do you think they did this?* Talk to students about how artists use optical

illusions to allow viewers to look at an everyday scene, such as a cityscape or a house, in a different and unique way.

- *How does Estes achieve his particular photorealism*? Unlike many photorealist painters, Richard Estes uses neither a grid system nor a projector to transfer photographic images to canvas. Rather, he refers to multiple photographs of his subject as source materials. He sketches the entire scene with acrylic paint and builds upon it with oil paint, adding and sharpening details and polishing reflective surfaces. As in Supreme Hardware, the absence of narrative in Estes's work challenges the viewer to confront the visual cacophony of urban life. His technique de-emphasizes the artist's individual touch and stresses the impersonal and anonymous character of the big city.
- *How did this artist use science and math to create the work of art? How is this artist similar to a scientist?* Direct students to the idea that artists look directly to science and math to create the illusion of depth. They experimented with light and color, just as scientists experiment.
- *What was the artistic challenge that this artist faced? How did the artist solve the challenge?*

Relevant Definitions:

- Perspective: a way of portraying three dimensions on a flat, two-dimensional surface by suggesting depth or distance
- Atmospheric or aerial perspective [taken from the *Encyclopedia Britannica]:* Method of creating the illusion of depth, or recession, in a painting or drawing by adapting color to simulate the changes effected by the atmosphere on the colors of things seen at a distance

  More information on atmospheric perspective from the *Encyclopedia Britannica:*

  Although the use of aerial perspective has been known since antiquity, Leonardo da Vinci first used the term aerial perspective in his *Treatise on Painting*, in which he wrote: "Colors become weaker in proportion to their distance from the person who is looking at them." It was later discovered that the presence in the atmosphere of moisture and of tiny particles of dust and similar material causes a scattering of light as it passes through them, the degree of scattering being dependent on the wavelength, which corresponds to the color, of the light. Because light of short wavelength—blue light—is scattered most, the colors of all distant dark objects tend toward blue; for example, distant mountains have a bluish cast. Light of long wavelength—red light—is scattered least; thus, distant bright objects appear redder because some of the blue is scattered and lost from the light by which they are seen.

Conclusion of Tour

Conclude your tour in front of your last stop. Reinforce the objectives of the tour:

- *Think back to the different challenges we talked about today. What strategies or methods do artists use while they created art that helped solve a problem?* Go over the different artwork you together today and highlight how different artists used light, color, perspective, different materials and supplies, and design to solve various challenges.
- *Can you think of ways that artists are resourceful and creative problem solvers?* If helpful, show them John Rand's invention again. *What about when you broke into your small groups? How were you resourceful and creative problem solvers?*
- *How did artists use science, math, technology, and engineering in the work that we saw today? In what ways are artists similar to scientists, explorers, inventors?*

As you review these concepts, remind them of comments that were made and works of art that were seen during the tour. Praise them for their good thinking and encourage them to keep it up!